To All Interested Government Agencies and Public Groups:

Under the National Environmental Policy Act (NEPA), an environmental review has been performed on the following action.

TITLE:	**Programmatic Environmental Assessment for the Funding, Procurement, and Operation of NOAA Small Uncrewed Aircraft Systems (UAS)**
LOCATION:	United States, Arctic, and Oceanic Domains of Operation at Altitudes up to 100,000 ft MSL
SUMMARY:	The Uncrewed Systems Research Transition Office (UxSRTO) in the Office of Oceanic and Atmospheric Research (OAR) of the National Oceanic and Atmospheric Administration (NOAA) is often directly or indirectly involved in the funding, procurement, and operation of small Uncrewed Aircraft Systems during the course of its normal office functions. This PEA evaluates the potential impacts on the environment from the types of small UAS platforms and operations commonly supported by the UxSRTO across NOAA, in any environment for which NOAA has a mission and potential need for UAS resources to help meet related mission objectives.
DECISION MAKER:	Bryan Cole, Director NOAA Uncrewed Systems Research Transition Office Office of Oceanic and Atmospheric Research 1305 East West Highway, SSMC3 Silver Spring, MD 20910 Tel: 301-734-1126

The environmental review process led us to conclude that this action will not have a significant effect on the human environment. Therefore, an environmental impact statement will not be prepared. A copy of the finding of no significant impact (FONSI) including the supporting environmental assessment (EA) is enclosed for your information.

Although NOAA is not soliciting comments on this completed EA/FONSI, we will consider any comments submitted that would assist us in preparing future NEPA documents. Please submit any written comments to the decision maker named above.

Sincerely,

COLE.BRYAN.JEFFREY.1543877359 Digitally signed by COLE.BRYAN.JEFFREY.1543877359 Date: 2023.06.16 12:15:22 -04'00'

Bryan Cole, Director,
NOAA UxSRTO

Enclosure

Programmatic Environmental Assessment for NOAA Small UAS

Title: Programmatic Environmental Assessment (PEA) for the Funding, Procurement, and Operation of NOAA Small Uncrewed Aircraft Systems (UAS)

Location: United States, Arctic, and Oceanic Domains of Operation at Altitudes up to 100,000 ft MSL

Summary: The Uncrewed Systems Research Transition Office (UxSRTO) in the Office of Oceanic and Atmospheric Research (OAR) of the National Oceanic and Atmospheric Administration (NOAA) is often directly or indirectly involved in the funding, procurement, and operation of small Uncrewed Aircraft Systems during the course of its normal office functions. The UxSRTO, and its predecessor, the NOAA UAS Program Office in OAR, were formally established to provide guidance and expertise for NOAA's efforts in the testing and development of UAS and to help expand UAS research, development, and transitions to operations and commercialization. This PEA evaluates the potential impacts on the environment from the types of small UAS platforms and operations commonly supported by the UxSRTO across NOAA, in any environment for which NOAA has a mission and potential need for UAS resources to help meet related mission objectives.

Decision Maker: Bryan Cole, Director
NOAA Uncrewed Systems Research Transition Office
Office of Oceanic and Atmospheric Research
1305 East West Highway, SSMC3
Silver Spring, MD 20910
Tel: 301-734-1126

Acronyms and Abbreviations

AGL	Above Ground Level
BVLOS	beyond visual line of sight
CZMA	Coastal Zone Management Act
CEQ	Council on Environmental Quality
CRADA	Cooperative Research and Development Agreement
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EO	Executive Order
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FWCA	Fish and Wildlife Coordination Act
FONSI	Finding of No Significant Impact
HALE	high-altitude, long endurance
ICAO	International Civil Aviation Organization
ITAR	International Traffic in Arms Regulations
LALE	low altitude, long endurance
LASE	low altitude, short endurance
LIDAR	Light Detection and Ranging
MALE	medium-altitude, long endurance
MPA	Marine Protection Areas
MBTA	Migratory Bird Treaty Act
MMPA	Marine Mammal Protection Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
NAO	NOAA Administrative Order
NASA	National Aeronautics and Space Administration
NWS	National Weather Service
NEPA	National Environmental Policy Act
NGSP	Next Generation Strategic Plan
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NMSA	National Marine Sanctuaries Act
NOAA	National Oceanic and Atmospheric Administration
OAR	Office of Oceanic and Atmospheric Research
OMAO	Office of Marine and Aviation Operations

PEA	Programmatic Environmental Assessment
PEIS	Programmatic Environmental Impact Statement
R&D	Research and Development
ROD	Record of Decision
SAR	Synthetic Aperture Radar
SBIR	Small Business and Innovative Research
SIR	Supplemental Information Report
SHPO	State Historic Preservation Officer
THPO	Tribal Historic Preservation Officer
TPO	Technology Partnerships Office
TI	Tribal Implications
UAS	Uncrewed Aircraft System
UASPO	Uncrewed Aircraft Systems Program Office
USFWS	United States Fish and Wildlife Service
UxSRTO	Uncrewed Systems Research Transition Office
VTOL	Vertical Take-Off and Landing UAS

List of Tables and Figures

1. Introduction

Originally enacted in 1970, NEPA (42 U.S.C. § 4321 *et seq*.) establishes a national policy to promote the protection of the environment. In tandem with the corresponding implementing regulations adopted by the Council on Environmental Quality (CEQ; 40 CFR § 1500-1508), NEPA mandates that federal agencies, in this case the National Oceanic and Atmospheric Administration (NOAA), consider the environmental effects of any activity which may be fully or partially funded, regulated, conducted, or approved, prior to the commencement of any such activities. Per Executive Order (EO) 12114 (1979, "Environmental Effects Abroad of Major Federal Actions"), this not only applies to all actions that occur within the domain and management authority of the U.S., but also to activities that occur and may affect resources outside of the U.S.

NOAA Administrative Order (NAO) 216-6A (NOAA, 2016) and its accompanying Companion Manual (NOAA, 2017), establish NOAA's policy and procedures for compliance with NEPA; the CEQ regulations; EO 12114 ; EO 11988 (1977), "Floodplain Management"; EO 13690 (2015), "Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input"; and EO 11990 (1977), "Protection of Wetlands". As it pertains to the funding, procurement, and operation of many types of small UAS within NOAA, this document is prepared in compliance with the requirements and procedures of NEPA, the CEQ regulations, NAO 216-6A policy, and the NAO-216-6A Companion Manual.

This document is being prepared using the 1978 CEQ NEPA Regulations. NEPA reviews initiated prior to the effective date of the 2020 CEQ regulations may be conducted using the 1978 version of the regulations. The effective date of the 2020 CEQ NEPA Regulations was September 14, 2020. This review began on March 01, 2018, and the agency has decided to proceed under the 1978 regulations.

1.1 Scope

This document comprises a PEA prepared by the NOAA UxSRTO, operating within the NOAA OAR Line Office. The PEA considers several common types of small UAS platforms and payloads that may be procured and operated within NOAA, including an overview of the types of environments in which these operations would take place. With this information, the potential for these activities to impact each of the corresponding environments is explored and discussed.

As the analysis performed and presented here is based from a programmatic level, it evaluates the affected environments and potential environmental consequences from a broad perspective (i.e., multiple types of small UAS platforms used to supplement, enhance, or replace a variety of existing methods of data collection). Therefore, this PEA will generally cover possible impacts associated with the funding, procurement, and operation of various small UAS platform types, which would be used for several anticipated agency activities in fulfillment of NOAA's research and operational mission requirements.

During its tenure, the NOAA UxSRTO, along with its "UAS Program Office" (UASPO) predecessor, has been involved in facilitating the research, development, and operations of a variety of different UAS platforms and payloads (Figure 1). While this work sometimes includes the use of medium- and high-altitude UAS (MALE and HALE, respectively), such large platforms fall outside of the scope of this PEA. Rather, this analysis will focus primarily on activities related to the funding, procurement, or operation (up to 100,000 ft MSL) of low altitude, short endurance (LASE); low altitude, long endurance (LALE); vertical take off and landing (VTOL); and hybrid VTOL/fixed-wing variants of small UAS platforms. Other similar platforms, such as balloon-borne UAS gliders, are also included in this PEA scope. For purposes of this assessment and its future applicability, the use of the term "small UAS" follows suit with the Federal Aviation Administration's (FAA) definition of "small unmanned aircraft" (14 CFR § 107.3), which weigh "less than 55 pounds on takeoff, including everything that is on board or otherwise attached to the aircraft". NOAA activities involving other, larger types of UAS do not reside within the scope of this analysis. Additional information regarding the types of small UAS covered within this analysis, as well as a description of the environments in which they would be operated, are provided in subsequent sections of this document.

Following a period for internal NOAA review and comment, a draft of this PEA was made available for public review and comment. A notice of availability was published in the *Federal Register* (88 FR 9872; February 15, 2023). No comments were received.

Figure 1. Non-exhaustive list of UAS platform types that NOAA has worked with during previous projects. The scope of this PEA is constrained to small UAS platforms, typically encompassing LASE, LALE, VTOL, and "hybrid" VTOL/fixed-wing (not displayed below) variants. Similar platforms, such as small, balloon-borne UAS gliders are also encompassed within the scope of this PEA.

1.2 Background of the UASPO, UxSRTO, and Engagement across NOAA

NOAA's official involvement with testing and developing UAS began as early as 2004, following the call to action by NOAA Administrator Vice Admiral Lautenbacher:

> "We must move new but proven observing systems into an operational environment and redirect associated resources and research toward exploring new technologies, such as unmanned aerial vehicles, to meet future requirements" (NOAA, 2004).

As a result, extended collaborations with the National Aeronautics and Space Administration (NASA), along with academic and industry partners, led to a series of UAS tests for various applications relevant to NOAA's mission, "Science, Service, and Stewardship". The outcome of these tests inspired a report to Congress, along with NOAA Administrator Vice Admiral Lautenbacher's testimony (U.S. Congress, 2006) before the United States Senate. This was the impetus that led to the initial funding for the "NOAA UAS Project" in FY2008, followed by the official establishment of the NOAA UASPO in FY2009.

The NOAA UASPO in OAR was initially tasked with facilitating UAS research and development to fill data gaps and aid in preparing our nation for changing environmental conditions, while improving our understanding of the related underlying processes to prevent the loss of human life, improve management of natural resources, and strengthen the economy. To accomplish these and later mandated objectives, the UASPO focused efforts to work with the end user community to identify and develop the use of UAS as observation platforms capable of fulfilling many of the agency's long term goals identified in Section 1.3.1 of the NOAA Next Generation Strategic Plan (NGSP; NOAA Office of Program Planning and Integration, 2010). While many of NOAA's unique requirements for observing strategies sometimes require that a UAS application be designed for a specific use in a specific operational environment, it is common that a given observing strategy can meet the differing needs of multiple NOAA Line Offices in a variety of operational environments. Since FY2020, when the UxSRTO was created to replace and carry forward the work of the UASPO, it has continued to work in collaboration with multiple NOAA offices, other federal agencies, and stakeholders to support research, development, and transition of operational UAS activities across all Line Offices and their collaborative partners. These partnerships have been and continue to be instrumental in achieving positive results.

Collaboration with governmental, academic, and industry partners has resulted in years of testing and development of UAS for various applications. As such, the UxSRTO engages with entities across these realms to expand UAS research, development, and transitions to operations and commercialization. Through these events, the office works to increase NOAA's understanding of these technologies and their impacts on the environment. Generally, these systems have a lower environmental impact than traditional observing strategies, and environmental and wildlife monitoring missions involve less human interaction / interference when using uncrewed systems, as compared to many existing ground-based and crewed aircraft operations.

1.3 Purpose and Need for Action

The UxSRTO's proposed Federal action is to support the funding, procurement, and/or subsequent operation of small UAS capabilities for NOAA missions to satisfy observational needs and data requirements. The following sections explain in greater detail the action being considered and specify the underlying purpose and need to which it is addressing.

1.3.1 *Purpose of Action*

The purpose of the proposed action is to enable the research, development, transition, and sustainment of effective, affordable UAS capabilities in NOAA to satisfy existing observational needs and data requirements. The goal is to augment NOAA's existing collection of critical observations from aircraft, balloons, satellites, ships, and surface-based sensors to better support NOAA's mission of science, service, and stewardship. To meet that goal, this action would improve NOAA's ability to target and integrate UAS technologies and methods that can provide quantifiable progress toward the achievement of the four long-term goals outlined in NOAA's NGSP. They include: 1) Climate adaptation and mitigation, which focuses on society's anticipation and response to climate and its effects; 2) A Weather-Ready nation where society is prepared for and responds to weather-related events; 3) Healthy oceans to sustain healthy and productive ecosystems for marine life forms; and 4) Resilient coastal communities and economies that are environmentally and economically sustainable (NOAA Office of Program Planning and Integration, 2010).

1.3.2 *Need for Action*

The need for the proposed action arises from the specific objectives listed in the NGSP (NOAA Office of Program Planning and Integration, 2010), which outlines NOAA's mission to "provide research-to-application capabilities that can recognize and apply significant new understanding to questions, develop research products and methods, and apply emerging science and technology to user needs." Having been described as America's "environmental intelligence agency" (Sullivan, 2016), NOAA has a critical need for observations, and UAS can provide data that are needed to help improve weather forecasts; promote resilient communities; yield situational awareness information about Arctic, coastal, and oceanic wildlife and vegetation; calibrate satellite sensors; effectively manage resources; and aid in many other diverse requirements in fulfillment of NOAA's primary objectives. UAS can supplement or, in some cases, replace current methods (e.g., ground-based data collection, crewed aircraft systems, etc.) to gather data in support of core missions. In many scenarios, they provide a less invasive, quieter, more efficient solution than other data collection methods. UAS also represent a technological advancement over other traditional observation platforms (e.g., large vessels and aircraft) often used to achieve the same objectives, but they are capable of doing so in a manner that minimizes impacts to the environment and, in some cases, to target species. Thus, UAS capabilities can obtain valuable data in support of NOAA missions via means that are otherwise too dangerous, too costly, or not as efficient as other existing observation strategies.

1.4 Concept of a PEA

The CEQ regulations direct federal agencies to use a "programmatic" approach to developing environmental assessments (EA) and environmental impact statements (EIS), when relevant, to reduce paperwork by eliminating repetitive discussions of the same issues, and to focus subsequent reviews on the actual issues ripe for decision while excluding from consideration issues already decided or not yet ripe at each level of environmental review. (40 CFR § 1500.4, 1501.11, 1502.4)

This PEA reviews common elements or aspects of small UAS operations and associated best practices for environmental mitigation. The timing and location of future agency actions using small UAS will depend on specific mission needs or project objectives, including those that have not been identified yet. Therefore, this PEA evaluates potential impacts of small UAS on the environment, generally. Section 1.5 provides a framework for using this PEA in reviewing environmental impacts of future project- and site-specific activities when those decisions are ripe for consideration by agency decision makers.

Per NOAA's procedures, as outlined in Section 6 of the Companion Manual for NAO 216-6A:

> "Programmatic reviews are broad or high-level NEPA reviews that assess the environmental impacts of proposed policies, plans, programs, or projects for which subsequent actions will be implemented either based on the programmatic EA (PEA) or programmatic EIS (PEIS), or based on subsequent NEPA reviews tiered to the programmatic review (e.g., a site- or project-specific document)."
>
> "Effective programmatic NEPA analyses should present document reviewers with NOAA's anticipated timing and sequence of decisions, which decisions are supported by the programmatic NEPA document and which decisions are deferred for some later time, and the time-frame or triggers for a tiered NEPA review."

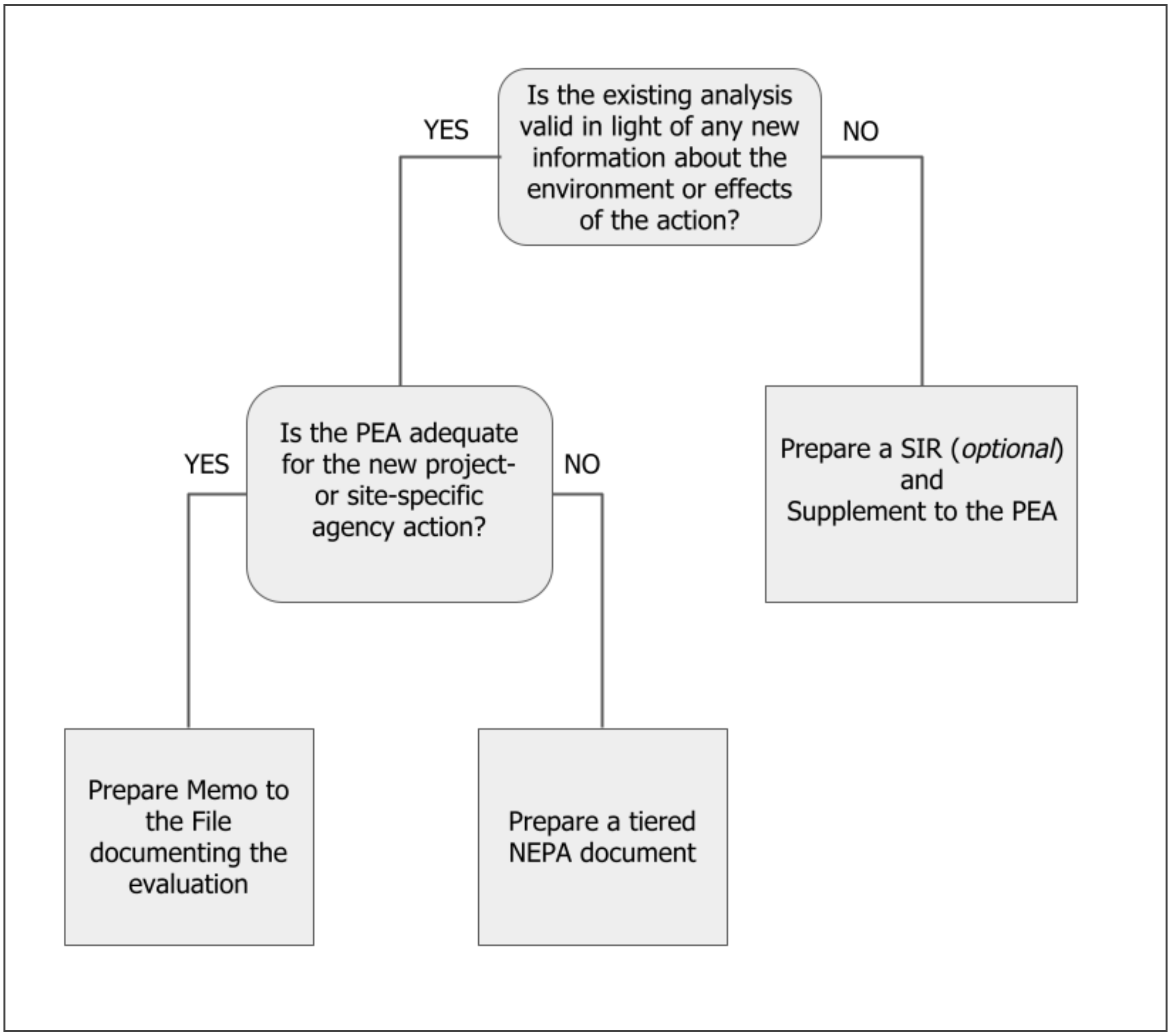
> "Programmatic reviews should be considered, in particular when a decision maker is (1) initiating or revising a national or regional rulemaking, policy, plan, or program; (2) adopting a plan for managing a range of resources; or (3) making decisions on common elements or aspects of a series or suite of closely related projects."
>
> "After completing a PEA or PEIS, decision makers may rely on those documents to prepare subsequent tiered EAs or EISs that address more specific considerations, while benefiting from the programmatic review by summarizing and incorporating by reference parts of those broader reviews. When tiering from a programmatic review, the decision maker must consider whether the depth of analysis needed for a tiered decision requires adding to, or building on, the analysis provided in the programmatic NEPA review."

1.5 How to Use this PEA

To use this PEA to inform future project- or site-specific agency actions, agency decision makers will need to prepare additional documentation, such as one of the following: a memo to the record, an EA/EIS tiered from this PEA, a Supplemental Information Report (SIR), or a supplement to this PEA. The decision tree in Figure 2 illustrates the options discussed in the following subsections.

Decision makers may also need to engage in consultations and request permits or licenses or other authorizations specific to implementation of their action, to be in compliance with laws for the protection of the environment or operation of UAS. See Section 6 for references to other potentally applicable laws and regulations.

Figure 2. Decision Tree for using this PEA



1.5.1 *Evaluating the Adequacy of this PEA for a New Agency Action*

Consistent with NOAA's procedures, as outlined in Section 5.A of the Companion Manual for NAO 216-6A, agency decision makers must consider the following to determine whether the analysis in this PEA adequately covers a new action or decision under consideration:

a) Is the new proposed action a feature of, or essentially similar to, the prior proposed action alternative analyzed in this PEA?

b) Is the project within the same analysis area, or if the project location is different, are the geographic and resource conditions sufficiently similar to those analyzed in this PEA?

c) If there are differences, can the decision maker explain why those differences are not substantial?

d) Is the range of alternatives analyzed in this PEA appropriate with respect to the new proposed action, given the environmental concerns, interests, and resource values relevant to the proposed action?

e) Is the existing analysis valid, in light of any new information or circumstances (see Section 1.5.3 about "Supplementing this PEA")?

f) Are the direct, indirect, and cumulative effects that would result from implementation of the new proposed action similar (both quantitatively and qualitatively) to those analyzed in this PEA?

In documenting their review of these questions, decision makers should provide thorough answers and make specific citations to this PEA. If the answers to all of these questions are "yes", additional NEPA analyses may not be necessary. However, the decision maker should document their consideration of these questions in a memo to the record to demonstrate that this PEA sufficiently covers their action.

In addition to reviewing these questions, decision makers must evaluate whether the public involvement and interagency review associated with the PEA is adequate for their proposed action. The decision maker must evaluate whether their specific action has already been discussed during the public engagement process for this PEA, and thus whether the public has received sufficient notice and opportunity to comment regarding their action.

1.5.2 *Tiering from this PEA*

If an agency decision maker determines that this PEA does not adequately cover their federal action, per the considerations outlined in Section 1.5.1, they may incorporate material from this PEA into a new NEPA document by reference to reduce the length of their document, so long as doing so does not impede agency and public review of the proposed action.

The CEQ regulations pertaining to NEPA implementation direct agencies to tier their EISs and EAs when it would eliminate repetitive discussions of the same issues, focus on the actual issues ripe for decision, and exclude from consideration issues already decided or not yet ripe at each level of environmental review (40 CFR § 1501.11(a)).

As stated in Section 5.B of the Companion Manual for NAO 216-6A:

> "Tiering is a form of incorporation by reference that uses existing analysis of general matters from broader or programmatic NEPA documents in subsequent narrower NEPA

> documents. Tiering allows the decision maker to narrow the scope of the subsequent analysis and focus on issues that are ripe for decision-making. Tiering is appropriate when the analysis for the proposed action will be a more site-specific or project-specific refinement or extension of the existing, broader NEPA document, so long as the existing NEPA document remains timely."

When preparing an EA or EIS tiered from this PEA for a project- or site-specific agency action that is within the scope of the program, the tiered NEPA document should summarize and incorporate by reference the relevant issues discussed in this PEA and state where this PEA is available. The tiered document shall concentrate on the issues specific to the subsequent action (40 CFR § 1501.11(b)).

1.5.3 *Supplementing this PEA*

The CEQ regulations pertaining to NEPA implementation direct federal agencies to prepare supplements to either draft or final EISs if a major Federal action remains to occur, and: (i) the agency makes substantial changes to the proposed action that are relevant to environmental concerns; or (ii) there are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts (40 CFR § 1502.9(d)). Agency decision makers may also choose to prepare supplements when the agency determines that the purposes of NEPA will be furthered by doing so. We apply these same criteria to a decision about whether to supplement this PEA.

In determining whether supplementation is necessary, decision makers may prepare a SIR. As defined in Section 5.C of the NAO 216-6A Companion Manual, a SIR is a concise document that describes the decision maker's evaluation of new information, changed circumstances, or proposed changes to an action and assists the decision maker in determining and documenting whether a supplemental NEPA document is necessary. If a tiered or supplemental EA or EIS is not warranted, the information that would ordinarily be contained in a SIR may be combined with a memo to the record evaluating the adequacy of this PEA for the new agency action, per the considerations outlined in Section 1.5.1.

A SIR is a decision tool rather than a final NEPA document and, as a stand-alone document, cannot repair deficiencies in the original environmental analysis or documentation, nor can it change a decision to implement an action made pursuant to appropriate NEPA procedures. Thus, if a decision maker finds, as the result of a SIR or other evaluation of the adequacy of this PEA for a project- or site-specific action, that such deficiencies exist, those deficiencies should be corrected via a supplement to this PEA, either as an EA or EIS.

The supplemental EA/EIS must reference the original analyses in this PEA. The decision maker must complete the supplemental analysis with a new Finding of No Significant Impact (FONSI) or Record of Decision (ROD), as applicable.

2. Alternatives Considered

The following section provides a detailed description of the Proposed Action and No Action alternatives.

2.1 Alternative #1: "No Action" Alternative

The null, or "No Action", alternative is the one in which no action is taken. In this alternative, NOAA's UxSRTO would not facilitate the funding, procurement, or operation of small UAS as observation platforms within NOAA. Facilitation of research, development, and transition of matured UAS capabilities into sustained operations would be diminished, which would impede NOAA's ability to explore and implement safer, more cost-effective, or more efficient methods to accomplish NGSP goals with UAS.

While the use of UAS presents new, alternative observing strategies that could be used to more efficiently collect critical data or even expand observation collection into realms where data collection is not currently possible, many traditional data collection methods do exist and are currently employed by NOAA, albeit in a relatively limited capacity. Because such traditional methods exist, the "No Action" alternative may also be considered a "Status Quo" alternative. In this case, implementation of either the "No Action" or "Status Quo" alternative would result in a cessation of the UxSRTO's ability to support innovative research, development, and operational transition of new UAS capabilities for NOAA applications. This would effectively limit the agency by forcing it to consider fewer observation collection strategies and pursue critical data collection more so via existing methods, which may be less safe, less cost-effective, or less efficient.

With a large list of benefits from using UAS to accomplish agency missions, proven through focused NOAA R&D that began around 2008, implementing the "No Action" alternative would result in a comparatively degraded use of observation collection methods. UAS are emerging as powerful tools in wildlife ecology and can provide novel remote-sensing data at fine spatial and temporal scales (Anderson and Gatson, 2013). Applications of UAS technology are diverse and growing, ranging from collecting atmospheric measurements (Koch et al., 2018), to mapping sea ice and enhancing marine domain awareness (Jacobs et al., 2015), to providing data on marine mammal behavior and body condition. For example, traditional, ground-based methods to conduct Steller sea lion population counts require significantly more time and resources, compared to surveys conducted via aerial imaging from UAS (Sweeney et al., 2015), which also results in less harassment (Marine Mammal Commission, 2016). Similarly, in the meteorological and atmospheric science communities, there is broad consensus that small UAS can provide critical, timely measurements in locations that simply cannot be obtained via any other feasible means (McFarquhar et al., 2020; Cione et al., 2020; Dyer, Moorhead, and Hathcock, 2020).

As the technology and regulatory frameworks improve, research applications are diversifying rapidly, and studies incorporating UAS technology are likely to proliferate in the future. For a number of applications, UAS may increasingly replace crewed fixed-wing aircraft and helicopters, which represent popular traditional tools for collecting atmospheric observations, as well as surveying animals and plants for research, conservation, and management purposes. While effective for covering large areas, crewed aircraft are also expensive, disturb wildlife, and are the leading cause of work-related deaths among biologists (Sasse, 2003; Wiegmann and Taneja, 2003; Watts et al., 2010). "Recent technological advances in UAS, combined with increasingly sophisticated remote-sensing equipment, are facilitating research and operational missions that may be safer, more cost-effective, and less invasive than traditional methods (Anderson and Gaston, 2013)." Although other observation platforms and methods often do exist, a decision to rely solely on traditional methods is a decision to withhold many benefits that could aid NOAA in better meeting many of its goals for the benefit of the public it serves.

2.2 Alternative #2: Proposed Action Alternative

The Proposed Action Alternative pertains to the funding, procurement, and/or subsequent operation of small UAS within a variety of environments to address NOAA's critical need for observations, as referenced in Section 1.3.2.

The Proposed Action Alternative encompasses facilitation of NOAA's UAS research, development, and routine operations to collect critical observations supporting missions involving high impact weather-, marine-, and polar-monitoring, along with a variety of other related UAS application developments. Each of these thematic focus areas has its own unique set of requirements that present scientific and technological challenges for efficient and cost effective integration into a holistic Earth system. The anticipated result of choosing the Proposed Action Alternative is a range of new capabilities at NOAA's disposal for broad application across all Line Offices and in nearly any airspace environment in which the agency has a footprint.

With the opportunities afforded under the Proposed Action Alternative to develop and implement innovative, efficient methodologies with UAS, relevant stakeholders from all NOAA Line Offices would be able to follow applicable NOAA policies and procedures to procure and operate UAS for the purpose of collecting critical observations in support of their stated missions. In some instances, this activity could be supported via internal agency funding. In other situations, such support could be readily achieved through collaborative inter-agency partnerships, as well as through coordination and agreements with partners from other local, state, and federal agencies, industry, and academia. In any case, all UAS procurement and/or operational missions would be vetted by the appropriate agency entities for scientific merit and adherence to relevant policies (e.g., local office, Line Office, Office of Marine and Aviation Operations (OMAO), etc.), and the responsibility to ensure NEPA compliance would reside with the office or group seeking to fund, procure, and/or operate UAS for their purposes.

2.2.1 *Facilitation Through Internal Agency Partnerships and Funding*

In the case of internal agency partnerships and funding to facilitate NOAA UAS activities, some of this activity may involve support in the form of funding via competitive, independently reviewed grants, and the resulting projects could be executed by grantees affiliated with any of NOAA's Line Office branches (NOAA Corporate Finance and Administrative Services Offices, n.d.). Additionally, funding could also be provided to NOAA Cooperative Institutes[1] equipped with the proper facilities and staff deemed appropriate by the funding office to advance the research and development goals of the agency (NOAA OAR, n.d.).

In these scenarios, the funding recipients would be responsible for obtaining safe, legal access to the airspace for any UAS operations they are coordinating. This process would often involve direct coordination with NOAA's Uncrewed Systems Operations Center in OMAO, as needed. As part of this coordination, the Uncrewed Systems Operations Center would review planned operations for safety and adherence to aircraft operation policies and regulations of NOAA and the FAA. With the exception of operations pertaining to grants and "data buys", described below, all NOAA-funded UAS missions would be subject to such review. This would also be true for all other types of official NOAA UAS operations, which may be characterized by any of the following: operation of any NOAA-owned UAS, UAS piloted by NOAA Federal employees, UAS operations based from NOAA vessels or other NOAA facilities, or any contracted UAS operation in which there is a significant degree of oversight and direction provided by NOAA Federal employees.

Referenced above, there is another scenario known as a "data buy", in which a particular type of data is sought within an identified area of interest via a paid-for, outsourced UAS operation.

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[1] NOAA Cooperative Institutes are non-federal, academic and non-profit research institutions that demonstrate the highest levels of performance in conducting research that supports NOAA's mission goals and Strategic Plan. As of this writing, NOAA supports 19 Cooperative Institutes consisting of 80 universities and research institutions across 34 states and the District of Columbia

Unlike official NOAA UAS operations, described above, in the data buy approach, the required degree of oversight for the operation by NOAA personnel would be minimal or non-existent (NOAA UxS Operations Center, 2022). More specifically, the only input that a NOAA entity would provide is a request for the type of data required and the general area and timeframe from which it is needed. Otherwise, there would be no operational control by NOAA in this simplified data acquisition approach, and any operational risks and liabilities would reside with the outsourced operating organization.

2.2.2 *Facilitation Through External Collaboration*

The Proposed Action may also involve partnerships with other entities at the federal, state, and local levels, academia, and industry. This might include, but not be limited to, efforts coordinated through Small Business and Innovative Research (SBIR) and Cooperative Research and Development Agreements (CRADA) with non-federal, industry partners. Efforts related to SBIRs and CRADAs would be initiated with oversight originating from NOAA's Technology Partnerships Office (TPO). This type of collaboration would enhance progression of R&D during the early science and technology investigation phase, as well as during the more mature development and operational transition efforts that follow. Ultimately, this would benefit NOAA by enabling it to more rapidly develop and integrate applicable UAS observation strategies into routine NOAA operations, as addressed above in the "Purpose" and "Need" for action sections of this document.

2.2.3 *Relevant Conditions of UAS Implementation Actions by Responsible NOAA Offices*

As directed by relevant NOAA policies, all applicable federal, state, local, and tribal laws, permits, regulations, and policies must be followed by responsible NOAA offices leading up to and during UAS operations. This could be monitored through technical reviews and regularly recurring reports, as determined by the corresponding NOAA office overseeing the activities. If an error or violation is discovered, the associated responsible NOAA party must report to the appropriate coordinating organization (e.g., the permitting organization) and the NOAA UxS Operations Center, and follow any directed actions required to address the issue. For some activities that are related to projects or missions with fixed timelines, it may not be practical for prospective NOAA UAS operations teams to have secured all necessary permits by the time grant proposals or operational mission plans are due for review. In these situations, proposed project activities would be reviewed to determine the risk of violating such environmental laws, and an analysis of impacts would need to conclude that the responsible NOAA entity would be able to operate in compliance. If it is determined that the responsible party has not complied, or is not capable of complying, then grounds are presented for rescinding support and/or approval to operate UAS for those applications.

2.2.4 *General Description of UAS Platforms and Payloads*

As mentioned previously, the scope of this PEA only covers the use of “small UAS” (i.e., all up weight of less than 55 lbs), following the FAA’s definition. With few exceptions, these would typically be characterized as either fixed-wing (e.g., LASE and LALE), VTOL, hybrid VTOL/fixed-wing platforms, or similar small UAS platforms closely resembling the profile of those listed here.

2.2.4.1 Fixed-wing Platforms

Typically, small LASE UAS platforms are only capable of carrying payloads weighing up to approximately 2 lbs and operating for no more than 2 hours at a time; whereas, some small LALE UAS platforms can carry payloads weighing up to around 15 lbs and may operate for up to 24 hours or longer. Both of these types of UAS are generally characterized as small fixed-wing platforms, ideal for operating along horizontal transects, and require some degree of open horizontal surface space for launch and recovery (i.e., landing). Most fixed-wing UAS have integrated autopilot capabilities and altimeters, allowing the UAS to fly between predetermined waypoints at specific altitudes (Hardin and Jensen, 2011). While capable of flying safely at lower altitudes, these platforms can often operate efficiently at higher altitudes and at faster speeds than VTOL systems; however, moderately slower speeds are usually necessary to ensure collection of accurate measurements or to reduce data distortion for aerial imaging missions. Fixed-wing UAS can range several kilometers from the launch site and, thus, work well in remote locations (Koski et al., 2009). Pairing this capability with the ability to legally operate beyond visual line of sight (BVLOS) will often require additional permission from the FAA, but efforts are currently underway to make such operations more commonplace (FAA, 2012).

2.2.4.2 VTOL Platforms

Alternatively, small VTOL UAS are characterized by single or multi-rotor engines that are capable of performing vertical launch and recovery operations from a constricted surface area (Eriksson and Ringman, 2013). Spinning rotors, affixed to the top or extended from arms, serve as the propulsion mechanisms. The number of rotors varies and generally ranges from four (quadcopter) to eight (octocopter). While not ideal for long endurance operations, resulting in relatively short radial ranges, VTOLs are capable of hovering and/or collecting data from within a tight, vertical column. As an example for NOAA Fisheries applications, this allows for aerial photography and videography that can be used for counting species for population assessments (Koski et al., 2009; Hodgson et al., 2013), conducting photogrammetric studies to determine wildlife body condition (Durban et al., 2015; Goebel et al., 2015), and collecting biological samples such as breath exhalate to monitor health status of whales (Acevedo-Whitehouse et al., 2010). For atmospheric observations, VTOLs operated in straight vertical ascent and descent patterns can enable the rapid, accurate, and repeatable collection of seldom obtained meteorological variables (Koch et al., 2018; McFarquhar et al., 2020).

2.2.4.3 Hybrid Fixed-wing / VTOL Platforms

A relatively new type of small UAS platform technology is emerging that capitalizes on many of the above stated benefits of both fixed-wing and VTOL platforms, while mitigating some of the limitations of each. These "hybrid" types of UAS possess the ability to take off and land within a smaller footprint, like a VTOL, but are then able to transition into fixed-wing style horizontal flight operations. This enables greater efficiency and conserves power to allow for longer duration and longer range operations.

2.2.4.4 Propulsion Systems

When considering which UAS platforms might be useful for various NOAA missions, the associated propulsion systems must also be taken into account. With the exception of glider platforms, which do not possess any sort of propulsion system, UAS engines generally run on either electricity or some type of fossil fuel. Because of the reduced size and weight associated with many of the above-mentioned capabilities, most of the small UAS platforms that NOAA stakeholders would work with are run solely on battery power. In particular, rechargeable Lithium-ion types have become the battery of choice for many UAS designs, owing to their relatively high energy density. Additionally, a significant amount of research and development within the industry has recently gone into producing electric engine UAS that utilize solar power to recharge on-board batteries, extending operational endurance, though that technology has been mostly relegated to larger platforms. Regarding gasoline-powered small UAS, their ability to yield longer endurance operations would make them ideal candidates for projects and missions that need such capabilities to meet certain observational requirements. The engines of small, gasoline-powered LALE UAS, such as the Boeing Insitu "ScanEagle", for example, are highly efficient and typically consume only about 330 mL per hour. When the need for long-range or sustained observations exists, capabilities like this could allow for continuous operation at upwards of 24 hours to meet the NOAA mission requirements (Hodgson et al., 2013). However, for short-duration requirements, many NOAA missions would likely benefit from other, electric-propulsion options.

2.2.4.5 Payloads

The payloads or "sensor packages" that would be utilized for NOAA operations can be characterized as either "in situ" or "remote". In situ sensors are designed to be directly inserted into the medium for which they are measuring a given property. For example, most miniaturized atmospheric sensors (e.g., thermometer) can be described as a type of in situ sensor, and using them requires that the UAS onto which they are integrated be flown directly in the air space environment for which direct observations are needed (e.g., temperature). Remote payload sensors, on the other hand, are used to sense electromagnetic radiation within predetermined spectrums of wavelength originating from a distant source, such as visible light reflecting from the land surface or other objects. These sensors are classified as either “passive” or “active”. Passive remote sensors do not emit any type of electromagnetic radiation; they only sense it after it has been emitted or reflected from another source. Active remote sensors both emit and receive electromagnetic radiation. Light Detection and Ranging (LIDAR) and Synthetic Aperture Radar (SAR) represent two good examples of active remote sensors, as they emit small amounts of electromagnetic radiation, then sense how much of it is reflected back to the sensor from various targets of observation. As with the choice of UAS platform, the selection of any corresponding sensor packages would be based on observational requirements developed to address a defined need and accomplish a particular mission goal. Regardless of any payloads selected, none of the ones used for NOAA missions would be expected to significantly contribute to any environmental impacts.

2.2.4.6 Launch and Recovery

Depending upon the mission objectives and the type of UAS platform that may be considered for an operation (i.e., fixed-wing, VTOL, etc.), there would also be consideration about the temporary base locations from which UAS would be launched or recovered, along with the different corresponding methods for accomplishing this component of the operation. In most scenarios, platforms would be launched from the same general location that they would be recovered at the conclusion of a single operation. For most NOAA applications, these UAS launch and recovery base locations would exist either on land or on a nautical vessel. As previously discussed, such sites would not need to be very large for most small VTOL UAS operations, due to their ability to execute vertical take-off and landing maneuvers from a relatively confined space.

As for fixed-wing platforms, depending upon their size, weight, and other related characteristics, these would either be launched by hand or via the use of a small, portable slingshot or catapult system. Much like their larger crewed counterparts, these types of UAS require larger open areas to take off horizontally and gain altitude without hindrance from nearby obstructions. Upon the completion of their operation, many small fixed-wing platforms would perform what is known as a “skid” landing maneuver across a suitable, flat surface. Although not as common, other small fixed-wing UAS recovery maneuvers might involve a “deep stall” landing, in which the platform slowly descends in altitude as it laterally approaches the intended surface recovery area, then quickly pitches upward to decrease horizontal momentum, and falls a short distance onto the intended recovery target (sometimes with the assistance of a deployed parachute). Even more rare, but sometimes used for boat-based operations, small fixed-wing UAS could be captured in mid-flight by steering the UAS directly into a net or portable retracting system. Most LASE UAS are small and light enough to launch by hand (Figure 3) and gently land via either of the former two methods; however, some of the larger platforms in the small LALE UAS category require the assistance of a catapult and retracting system for operational launch and recovery procedures (Figure 4).

Figure 3. Hand-launch of the "Puma AE" UAS from NOAA's R/V *Shearwater*

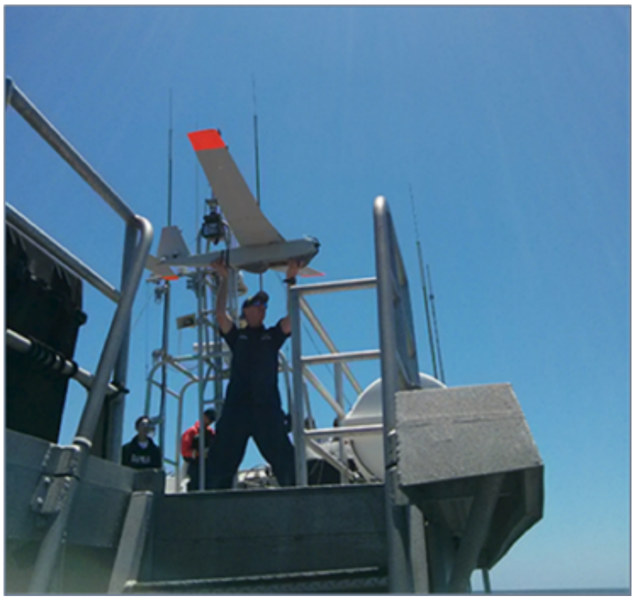


Figure 4. The Boeing Insitu "ScanEagle" UAS is a LALE platform that requires a portable, catapult-assisted launch system (left) for take-off and a retractor system known as "Skyhook" (right) for landing

3. Affected Environment

This section describes the environmental resources that are present in the action area. Due to the agency's diverse set of missions, NOAA's footprint and corresponding need for data spans across a large portion of the global domain. For any given location within that domain, the geographic scope of the action area includes the "airspace" ranging from just above the surface, extending upward to an altitude of approximately 400 ft AGL for a majority of applications, but may also include airspace up to as high as 100,000 ft MSL for a few others. Depending upon the specific observational requirements of a given mission, data collection needs may exist virtually anywhere within this range of airspace, overlying the coasts and land surfaces of the Continental U.S., Alaska, or Hawaii; above the Arctic/polar regions; or anywhere above the oceans where NOAA has a need for observations.

Such operations may occur day or night, during any time of the year. The large majority of environments affected would be confined to the volume of airspace in which UAS platforms are operated. The only exceptions to this would be the isolated points located at the surface that may be utilized for launch and recovery of the platforms (refer to Section 2.2.4.6).

3.1 Physical Environment

The Action Area may include airspace over a variety of terrestrial and aquatic environments, some of which may contain areas designated as unique or protected under various federal or state laws, including National Marine Sanctuaries, National Wildlife Refuges, National Monuments, and National or State Parks. During operations, the UAS would not interact or come into contact with physical structures or components of the physical environment including soils, sediments, bodies of water, ice cover, or the built environment. The only exception to this would be limited to any direct contact with the surface that might occur during certain types of launch and recovery activities. In those scenarios, while project-specific locations would be assessed for the presence of unique or protected areas ahead of time, there are no mechanisms by which such UAS operations may alter the physical characteristics of such environments.

Any of the environments discussed above may need to be accessed in order to develop and implement UAS applications for obtaining a variety of critical data needed to meet NOAA's observational requirements. While the geographic locations of potential NOAA UAS operations might vary to address the broad spectrum of needs within NOAA's vast realm of responsibility, many of the projects would utilize similar types of UAS platforms and sensors, and all of the project domains would fall within one of the generally defined environmental categories listed above. When using this PEA, agency decision makers must identify the specific physical resources within their project's action area and determine whether the general analysis here adequately covers their action, per the considerations outlined in Section 1.5, regarding the use of this PEA.

3.1.1 *Focus Area 1: Atmospheric Observations and Mapping for Extreme Events*

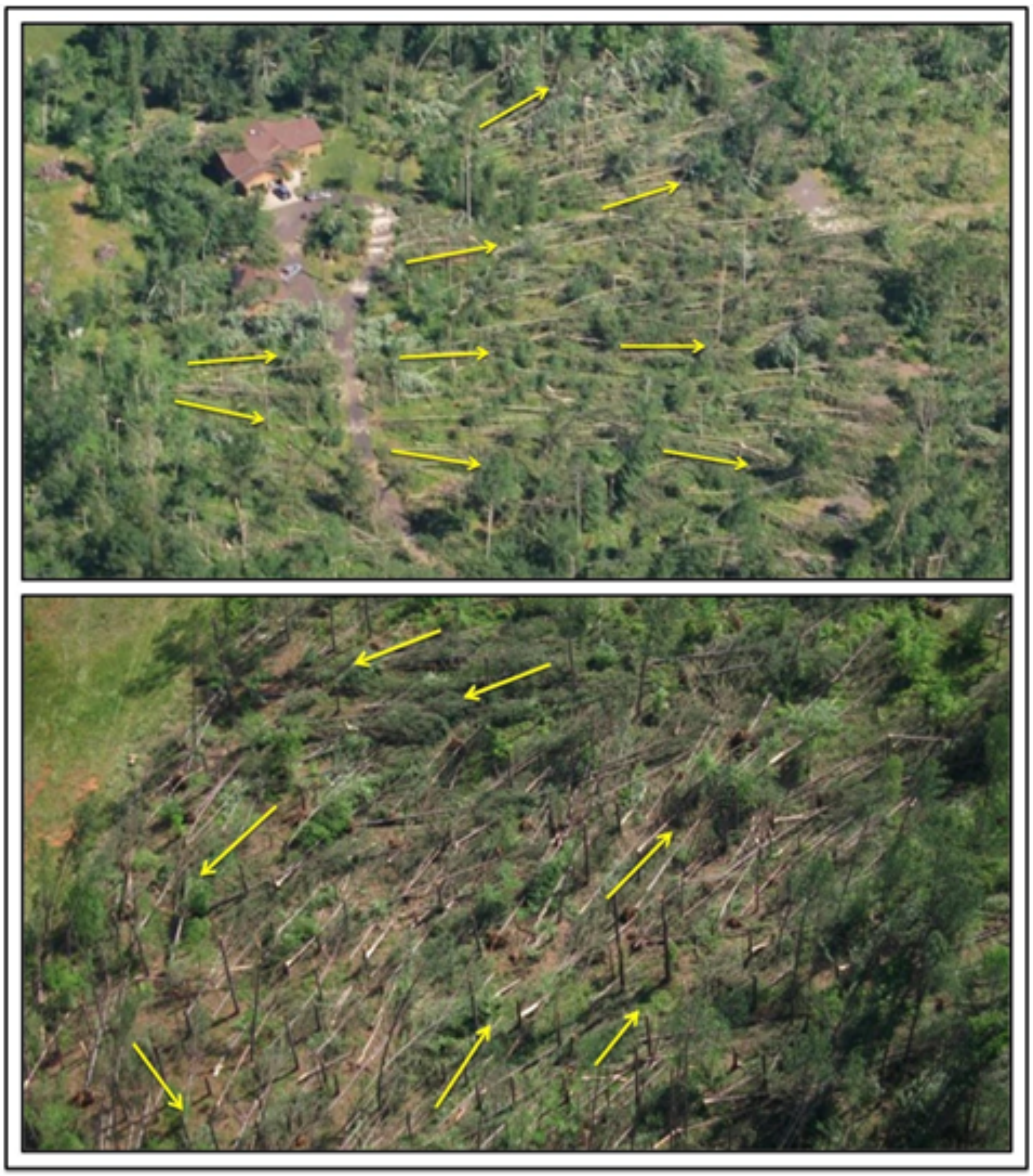
As one of its many focus areas, NOAA is interested in evaluating and implementing a broad range of research and operational data collection methods with small UAS to help improve forecasts, public preparedness, and our understanding of high impact weather and other extreme events within NOAA's purview. The goal would be to use UAS to complement existing observing assets, especially where UAS could enable collection of cost-effective and otherwise difficult-to-obtain data in support of NOAA research and operational applications.

Previous research has shown that the use of small UAS platforms shows great promise for making atmospheric measurements—for both meteorological and air quality applications—within and just above the atmospheric boundary layer. This layer may extend up to as high as 3 km AGL over some land surfaces, but generally resides within lower altitudes over most other land surfaces and over the oceanic and Arctic domains. Alternatively, other missions within the scope of this PEA would require atmospheric measurements at higher altitudes, up 100,000 ft MSL. While such capabilities would allow for the study and prediction of severe storms, it could also provide useful atmospheric measurements on other (non-severe weather) days and even enable the collection of aerial imagery to map post-storm damage for assessment. Similarly, small UAS could be used for localized and broad-area observations of flood conditions and terrains in support of the National Weather Service (NWS) River Forecast Centers, as well as for surface mapping related to other extreme events (e.g., fire weather mapping, landslides, etc.).

To accomplish these data collection objectives, a combination of small UAS would be utilized, integrated with a variety of sensor payloads. As an example, VTOL UAS platforms mounted with in situ sensors could be flown up and down in long vertical columns to directly obtain atmospheric profile measurements, such as pressure, temperature, humidity, wind speed/direction, air quality, and other relevant observations. Small fixed-wing and hybrid UAS platforms could carry the same types of in situ sensors and be utilized to fly long horizontal transects at various fixed altitudes or in spiraling ascent / descent patterns for collection of atmospheric measurements in vertical corridors.

Remote sensors would also be considered for integration onto multiple types of small UAS platforms to measure the properties of distant targets, such as land surface temperature or soil moisture. Combined with in situ observations, remotely sensed measurements can provide a wealth of valuable information to enhance situational awareness of operational end users, improve numerical weather prediction models, and advance findings for basic research. Additionally, high resolution cameras could be used to provide streaming video or still pictures that can be viewed directly or processed to produce image products of ongoing hazards (e.g., flooding), post-hazard damage (e.g., storm damage; Figure 5), or of terrain and other land cover characteristics that may provide information to aid in improving future forecasts and our understanding of extreme event phenomena.

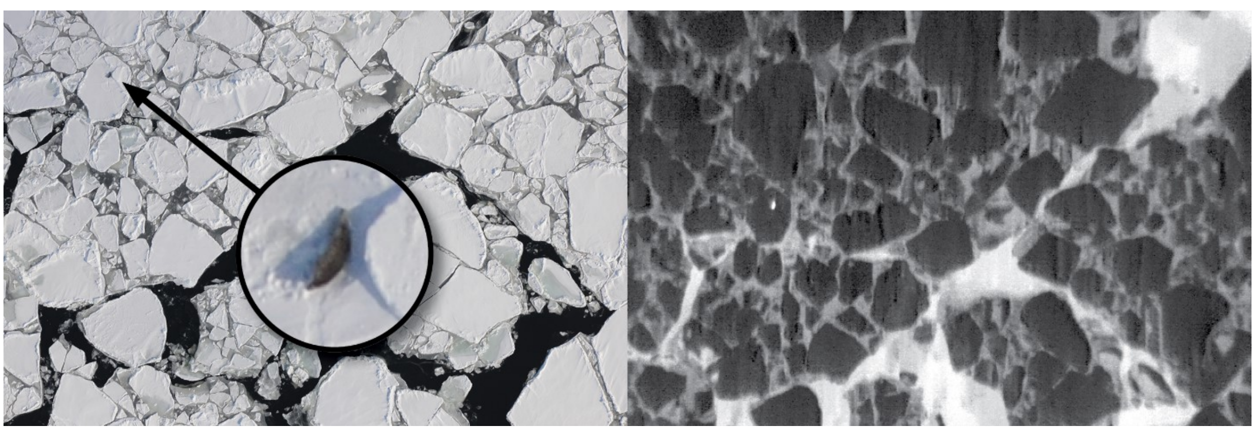
Figure 5. An aerial perspective can aid NWS damage surveyors in distinguishing straight-line wind damage (top) from tornado damage (bottom) by looking for fanned-out (top) or convergent (bottom) tree-fall patterns. Images provided, courtesy of NWS forecast offices in Duluth, Minnesota, and Huntsville, Alabama, respectively.



3.1.2 *Focus Area 2: Polar Monitoring*

The Arctic and Antarctic, or "polar" regions, represent another pair of NOAA priority domains for collecting environmental observations, but because they reside in such remote and often hazardous regions, it can be difficult to collect data from those locations. Near the inception of the program, the original NOAA UASPO supported technology demonstrations of small UAS in polar regions with partners in other federal agencies, such as the U.S. Coast Guard, and in private industry. Because of those successful collaborations, the agency endeavored to consider similar efforts in the future to evaluate the performance, communication, and ability of various small UAS to complement or replace existing observation strategies for wildlife (Figure 6), sea ice mapping, disaster rapid response, and maritime domain awareness in polar environments during ship-based operations. Other focal areas could include mapping and monitoring of sea ice loss and atmospheric distribution of anthropogenic aerosols, such as black carbon, to study climate-cryospheric interactions. Similar agency interests also include the use of UAS for meteorological atmospheric observations in this domain, and for identifying locations and other characteristics of sea ice, glaciers, snow, and icebergs.

Figure 6. Example of a "spotted seal" detected in the Arctic domain, using an airborne, visible / thermal infrared camera. The seal's warm body is seen as a bright spot on the cold sea ice in the thermal image on the right and classified to species using the high resolution color image on the left (Credit: Erin Moreland; NOAA National Marine Mammal Laboratory).



Depending on the data needs, small VTOL UAS platforms could fulfill certain requirements for many polar monitoring missions, but small fixed-wing and hybrid UAS platforms would also be used as common observation platform resources. Most operations would typically be conducted within the lowest few hundred feet AGL to accomplish mission objectives. Operations would primarily be based from either land or boat, and the platforms would carry either in situ or remote sensing payloads. For many of these applications, in situ payloads would be used for obtaining direct meteorological or air quality observations (e.g., aerosol concentration). More often, however, polar monitoring UAS capabilities would utilize remote sensing payloads that provide visible or infrared imagery, which are useful for maritime domain awareness. Previous research has shown that these capabilities, along with multispectral imagers, have proven useful for identifying wildlife populations and attributes (e.g., seals, polar bears, etc.), as well as for responding to simulated oil spill disasters. While most of the remote sensing payloads being considered are passive, there has also been an emerging interest for integrating active remote sensors onto UAS, such as SAR, which are safe for the environment and safe for personnel and wildlife over which these platform/sensor combinations would be operated. When used effectively, UAS-mounted SAR instruments have the ability to aid in mapping characteristics of snow and sea ice. As with any of the focus areas, a variety of UAS platform and sensor combinations would be required to adequately address all of the known observational needs within these polar environments.

3.1.3 *Focus Area 3: Marine Monitoring*

Marine science and monitoring applications, for both coastal and oceanic observations, encompasses one of the largest potential focus areas for which NOAA has interest in using UAS as a tool for collection of critical data (Figure 6). More specifically, NOAA is charged with the monitoring and protection of resources in and outside of certain areas designated for the protection of specific wildlife, vegetation, and corresponding habitats. As with UAS, “crewed” systems (e.g., traditional marine vessels and piloted aircraft) have long been integral to the monitoring and management of marine protected species. Surveys and data gathering tools using any of these observation platforms can yield important information regarding habitat conditions, population size and demographics, as well as health and fitness for both terrestrial and marine species (Mann et al., 2000; Fearnbach et al., 2011; Sweeney et al., 2015; Vermuelen et al., 2013). However, with the rapid advancements in new technology and the simultaneous need for minimally invasive research methods, scientists are relying more upon UAS as safer, more cost-effective observation platforms for conducting wildlife and ecological surveys (Smith et al., 2016; Johnston et al., 2017). These smaller, quieter platforms are being considered as a more environmentally friendly alternative to previously existing, traditional types of operations within areas such as the National Estuarine Research Reserve System, National Marine Sanctuaries, and other similarly designated locations.

Much like the polar monitoring work, and depending upon the specific requirements of various marine monitoring applications, either VTOL or fixed-wing types of platforms could be employed, which would typically be operated within the lowest few hundred feet AGL. While various types of in situ payloads could be used for missions in this focus area, most observations would likely be obtained via passive, or sometimes active, remote sensors. This could be particularly useful for monitoring wildlife from a safe distance without causing disruption, as well as for producing detailed, accurate, two-dimensional maps and three-dimensional models of coastlines and other relevant features. As with any NOAA UAS operation, the selection of appropriate platforms and payload sensors would be dictated by the actual mission requirements.

3.2 Biological Environment

Because of the broad domain in which NOAA has a need to collect observations with UAS in fulfillment of its many missions, there are some scenarios in which it can be expected that these operations may affect the natural biological resources associated within these physical environments. As one of the primary focus areas and uses of UAS within NOAA is the monitoring and assessment of vegetation and wildlife, these are the resources that are the most likely to be encountered within the action area. This is particularly the case when the observational requirements necessitate the need for UAS operations above land- and marine-mammals, fish, amphibians, and birds, as well as various types of vegetative species. As such, these operations would at times deliberately take place within the vicinity of species covered under the Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA), or Migratory Bird Treaty Act (MBTA), and would require consultations or permitting in advance, as appropriate.

The species and habitats within the action area would vary by project. For operations at altitudes above 1,000 ft AGL, no harassment, disturbance, or other impacts on biological resources is likely. For operations at substantially lower altitudes, particularly those directed at surveying or sampling wildlife, some disturbance of wildlife is possible. The nature and extent of the disturbance would depend on the operational altitude and the species' response to visual or auditory stimuli associated with the presence of the UAS. For example, wildlife that are acclimated to human activities in an area may be less likely to be adversely affected by close approach of UAS than wildlife that are sensitized to disturbance in general or in particular during sensitive life-history stages, such as breeding season.

This section is not a comprehensive listing or description of the species and habitats that could be affected by future project- or site-specific actions. Environmental consequences in Section 4 of this PEA are evaluated by operational activity, as applied to broad or generalized categories of biological resources. When using this PEA, agency decision makers must identify the specific resources within their project's action area and determine whether the general analysis, presented here, adequately covers their action, per the considerations outlined in Section 1.5, regarding the use of this PEA.

3.3 Social and Economic Environment

The below text provides information pertaining to the limited interaction that would be expected to take place between the proposed NOAA UAS actions and potentially impacted social and economic environments. The funding, procurement, and operation of small UAS described within the scope of this assessment are anticipated to result in minimally invasive data collection techniques, primarily relegated to the airspace and environments described in Section 3.1, and would likely pose only negligible[2] impacts to any biological resources (Section 3.2). As a corollary, effects on social and economic environments related to impacts on corresponding physical and biological environments are also anticipated to be negligible or non-existent.

3.3.1 *UAS Operators and Support Personnel*

The social and economic effects of using small UAS for relevant NOAA applications are primarily limited to effects on the people involved in the operations, as well as any industry personnel that support the missions, such as charter vessel operators, and suppliers of equipment needed to accomplish the operations. However, affiliated personnel who would participate in these activities represent a small fraction of the overall community of UAS operators. By comparison, UAS are popular with the general public (i.e., hobbyists), who comprise the majority of consumers of this commercial product. UAS are also used much more frequently in other, unrelated industry applications (e.g., crop assessment, construction management, etc.). If there are anticipated impacts from any of these activities, then the small subset contributed by the proposed NOAA UAS action would be comparatively negligible. Therefore, there are no anticipated significant social or economic impacts of the Proposed Action Alternative, and those analysis aspects will, therefore, not be considered further.

3.3.2 *Rural, Suburban, and Urban Locations*

Because NOAA UAS activities may occur anywhere within NOAA's domain of responsibility, the proposed action may sometimes facilitate UAS operations that occur above rural, suburban, and, at times, above urban areas, depending upon airspace access authorizations allowed by the FAA and guided by data collection needs. This means that UAS operations could potentially occur over a variety of designated land- or water-use locations, which may be either commercially managed or deemed culturally important. Nevertheless, such activities would only commence, provided that all necessary authorizations are in place, and the operations would be primarily relegated to the overlying airspace for collection of data in a non-invasive manner.

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[2] Negligible is defined in the glossary of the NAO 216-6A Companion Manual as a level of impact that is below minor to the point of being barely detectable and therefore discountable.

4. Environmental Consequences

This section of the PEA presents an evaluation of the potential environmental impacts that could result from implementation of the No Action and Proposed Action alternatives.

4.1 Alternative #1: "No Action" Alternative

There are two general ways in which the effects of the "No Action" alternative could present potential long term cumulative impacts. First, selection of this alternative would result in comparatively negative impacts resulting from the continued employment of traditional observation collection methods to facilitate NOAA missions. Second, the "No Action" alternative would result in a reduced capacity to fulfill data collection needs to meet NOAA objectives. Both of these general impacts will be discussed in greater detail, below.

4.1.1 *Environmental Impacts from Traditional Data Collection Methods*

One of the key benefits of using UAS for environmental data collection is that it provides for new, minimally invasive data collection methods, which has led scientists to begin relying on this technology as a safer, more cost-effective option, compared to traditional methods. Many antiquated data collection approaches must be facilitated via ground-based methods, which pose a greater risk to the natural and biological environments that NOAA scientists are interested in observing and preserving. Sometimes, those methods require large numbers of surface-based vehicles and personnel to transport equipment and employ it to collect critical observations. Other traditional data collection approaches might involve the use of crewed aircraft. While those methods do not necessarily produce direct impacts on the underlying physical environment, they are typically large, loud, and produce a greater concentration of emissions from the engines used to propel the aircraft over or through a targeted domain. These effects could result in greater impacts to the surrounding environment, at least from an indirect standpoint. While it can be justified that the data collected via such proven, long-standing methods does serve NOAA's mission and the greater good, it is difficult to argue that the sole employment of these traditional methods results in less negative impacts to the affected environments when compared to augmentation by newer, less invasive, and less impactful methods facilitated via use of small UAS.

4.1.2 *Reduced Effectiveness of Traditional Data Collection Methods*

Not only do many data collection methods traditionally employed by NOAA result in increased risk of impact to the environment when compared to alternative methods that use UAS, but there are also inherent limitations to their effectiveness for addressing observation needs. Traditional, ground-based methods are hindered by limited perspective, particularly as it relates to observations used for wildlife monitoring and habitat assessment. Traditional, crewed aircraft-based observations are often limited by endurance and concerns for safety to the operations crew and any onboard scientists. Because of the great diversity and versatility of UAS platforms, many are capable of accessing targeted domains more easily while providing a more persistent presence to collect data for a longer period of time. For in situ observations in the atmosphere, UAS operations provide a natural fit for easily accessing the airspace in which such observations are required, which are sometimes needed in remote, hazardous environments. For surface mapping and wildlife monitoring missions, UAS can be integrated with a variety of small remote sensing payloads and, depending on the need, operated for long periods of time to provide an efficient, complete collection of required data in fulfillment of NOAA missions.

While it is not envisioned that UAS would make for the best observation platform in all circumstances, their ability to more effectively meet data collection objectives for several NOAA missions makes them a viable option for consideration. By opting for the "No Action" alternative and omitting the use of more effective technology, NOAA's goals to observe, protect, and preserve the natural environment could be hindered, indirectly resulting in relatively negative impacts when compared to potentially more effective solutions.

4.2 Alternative #2: Proposed Action Alternative

In general, the very purpose for using UAS in place of other observational approaches has to do with their ability to obtain data more efficiently, more cost-effectively, more safely, or, for many NOAA applications, via a more environmentally-friendly approach. While it is not proposed that the facilitation of UAS operations within NOAA may have a beneficial effect on the relevant environments, the possibility should be considered that the use of this capability can reduce negative environmental impacts, when compared to other existing observational approaches.

Related to the proposed NOAA action, there are two primary activities that could have potential environmental impacts on the physical and biological environments. These pertain to impacts resulting at surface locations where launch/recovery operations would take place and impacts resulting from the actual, in-flight operations of small UAS. To a lesser degree, a third consideration involves the use of "active" remote sensing payloads, which is somewhat of an extension and a subset of the in-flight operations activities. With these considerations in mind, the proposed use of UAS in accordance with applicable permits, authorizations, and consultations would not be expected to result in greater than negligible impacts to native vegetation or more than short-term,[3] minor harassment of individual animals of any age, class, or sex.

[3] Defined in the glossary for the NAO 216-6A Companion Manual, "short term" refers to a potential impact of short duration, relative to the proposed activity and the environmental resource. Short-term impacts occur while the activity is underway and do not persist once the activity ends.

In general, the proposed use of UAS for NOAA applications would not be expected to have any effects not known to occur for crewed aerial and vessel platforms used to obtain the same data. Rather, UAS represent a technological improvement over existing methods for surveying and sampling protected species that would likely result in lesser impacts than traditional crewed systems. When operating in accordance with best practices and within the limits of applicable permits and authorizations necessary under laws such as ESA and MMPA, the short-term effects that might result from harassment by UAS would not likely lead to disruption of essential behaviors, such as feeding or mating, to a degree that the individual's likelihood of successful reproduction or survival would be substantially reduced. Lastly, no serious injury or mortality is likely from the types of missions typically supported by the UxSRTO.

4.2.1 *Surface Launch/Recovery Operations*

For most small UAS operations facilitated by the Proposed Action, launch/recovery of UAS to commence/conclude flight operations would have negligible impact on the physical environment. Because small VTOL and hybrid UAS platforms are capable of vertical take-off and landing from a single, small surface area, they require very limited contact with the surface. Similarly, most small fixed-wing UAS (typically of the LASE variety) may be hand-launched with the need for only a couple of forward steps by the operator. Slightly more surface contact area is required to perform skid-landing or deep-stall landing maneuvers of these platforms at the conclusion of a flight; however, the reduced size and weight of these small platforms yield a commensurately minimal degree of impact on the surface. As for the remaining small fixed-wing UAS, residing in the LALE category, launch operations sometimes require portable catapults, and platform recovery may require a specialized retraction device. These launch and recovery systems must be transported and set up for deployment, but they typically take up no more footprint than would a standard sized automobile, in terms of surface area contact. Therefore, LALE launch and recovery activities are also not considered capable of producing significant impacts to the physical environment under normal operations. Other, seldom used methods of recovery might include deep-stall landings or parachute landings. Both of these methods are intended to substantially slow the rate of descent of the UAS platform at the point of landing and reduce the amount of force applied to the surface and the platform itself, effectively negating the potential for any significant impacts to the physical environment.

For a small subset of NOAA UAS missions, it is possible that the launch and recovery of UAS platforms might result in direct impacts related to a temporary disruption of the surface-based, native vegetation and, as an extension of that, the habitats of resident or migratory species of animals. However, due to the small scale, short-term nature of these operations, related impacts to the affected biological environment are likely to be negligible.

4.2.2 *In-flight Operations*

In terms of potential impacts to the physical environment from small UAS during actual flight operations, such effects would likely be negligible for the types of missions normally supported by the UxSRTO. The only physical environment which might be affected during this portion of the operation is the volume of airspace through which the UAS platform is moving. Since most UAS covered within the scope of this PEA operate with small electric motors, air quality impacts are negligible. As for the others that operate with gasoline engines, they tend to be highly efficient, typically consuming only around 330 mL of fuel per hour (Hodgson, 2013).

Once a UAS platform has been launched for a NOAA mission, its operation would remain within the designated airspace in or over which the targeted observations are required. While in flight, potential effects on the biological environment in general, and more specifically to wildlife, would be minimal and limited to a small number of mission types.

With the exception of experiments designed to intentionally expose wildlife to UAS to observe their responses, impacts of UAS operations on wildlife are the result of unintended incidental or unavoidable exposure. Incidental exposures occur when wildlife are present in the mission space but are not the target of the mission, such as during flights designed to collect atmospheric data. Unavoidable exposures occur when wildlife are the focus of the mission, such as during aerial wildlife census surveys.

Regardless of whether the exposure is intentional or unintentional, wildlife can respond to auditory and visual cues from UAS in negative ways. Both behavioral and physiological responses to UAS have been observed, including vigilance or avoidance behaviors as well as increased heart rate or other indicators of stress response. While data from some observational studies suggest that some species are tolerant of UAS approaches, other studies may suggest the opposite. This seemingly contradictory information does not represent controversy about potential impacts of UAS on wildlife. Rather, it suggests results from UAS wildlife response studies should be assessed within the applicable context, as recommended by Krause et al. (2021).

There are a large number of variables that may affect animal behavior in response to UAS exposure, including attributes of the UAS, such as the type and size, method of operation, and amplitude and frequency of sound produced. The ecological context of exposure may also determine whether or how animals respond to UAS, including species, age, sex, breeding chronology, hearing ability, group size, and behavioral activity. In addition, habitat type may be a factor in the response of wildlife to UAS (Bennitt et al., 2019).

It is reasonable to conclude that the responses of wildlife to UAS are likely to correspond to their responses to non-anthropogenic threats, such as predators or aggressive conspecifics. Species commonly preyed upon by avian predators are likely to respond to overhead approaches at altitudes or flight paths that resemble their predators; species with no avian predators are less likely to respond to similar approaches. For example, the closer that a UAS resembles a potential predator, the more disturbances occurred in seabirds (McEvoy et al., 2016).

In general, the closer the UAS is to animals, the more likely it will provoke a response. The distance at which a response was observed is highly variable among species. For example, a review of the literature revealed minimal, or no, disturbance was documented at altitudes of approximately 150 m for beluga whales (Sleno and Mansfield, 1978), 12 m for blue, gray, humpback, and sperm whales (Acevedo-Whitehouse et al., 2010), and 30 m for killer whales (Durban, 2015). When flown at approximately 23 m AGL, there was no visible disturbance to Northern fur seals (*Callorhinus ursinus*), Weddel seals (*Leptonychotes weddellii)*, and leopard seals (*Hydrurga leptonyx*) (Goebel et al., 2015). However, gray seals (*Halichoerus grypus*), did show responses (heads-up to look at the UAS) at 20 m AGL and movement towards the water at an altitude of 9 m above the haul out (Pomeroy et al., 2015). VTOLs flown lower than 60 m AGL and closer than 100 m horizontal distance from target animals triggered behavioral responses in most herbivore species studied in the Moremi Game Reserve, Botswana (Bennitt et al., 2019). Behavioral responses of chinstrap penguins (*Pygoscelis antarcticus*), Antarctic fur seals (*Arctocephalus gazella*), and leopard seals (*Hydrurga leptonyx*) to flights at higher altitudes were limited, but increased for flights below 30 m (Krause et al., 2021).

Species vary in their hearing ability and those with less sensitive hearing at the sound frequency of the UAS would tend to be less responsive to auditory cues associated with the operation of the system. Because the sound produced by a UAS is attenuated by water, aquatic species are less likely to be affected by noise from UAS than terrestrial species. One of the primary reasons researchers cite a preference for using UAS, in contrast to crewed aircraft, is due to reduced noise impacts on protected species (Smith et al., 2016).

Overall, literature on the effects of UAS on wildlife suggests exposure, whether incidental to missions not directed at wildlife or unavoidable during wildlife-focused missions, is not likely to result in significant adverse consequences for individual animals, populations, or species when appropriate best practices are followed, such as those required by the terms and conditions of research permits. Studies have shown that reactions of wildlife to surveys using UAS are generally short-term, produce low impact, and are not likely to disrupt the migration, breathing, nursing, feeding, breeding, or sheltering behavior of animals (NMFS, 2009). These short-term behavioral responses would not likely lead to mortality, serious injury, or disruption of essential behaviors such as feeding, mating, or nursing, to a degree that the individual's likelihood of successful reproduction or survival would be substantially reduced.

It is important to note that indiscriminate or incautious operation of UAS around wildlife, without application of best practices and compliance with applicable permits and authorizations, can cause disturbance with significant adverse impacts on individuals, populations, or species. However, operation of UAS in such a manner is not within the scope of the Proposed Action, and NOAA decision makers and users of UAS must ensure their UAS activities comply with all applicable laws for protection of the environment, including those specific to wildlife. To be eligible for permits or authorizations under laws such as the MMPA or ESA, UAS-facilitated research directed at protected species as well as UAS activities that may affect them incidentally must be deemed by the applicable permitting or consulting agency to be consistent with the purpose and policy of the law and any specific limits on impacts. This generally means the impacts of the activity would be limited to levels that are not significantly adverse.

This is supported by NOAA's administrative record for establishing categorical exclusions (CEs) that may encompass use of UAS for research activities "to collect aquatic, terrestrial, and atmospheric data in a nondestructive manner" (NOAA CE #E3)[4] and to "remotely survey or observe living resources in the field using non-invasive techniques which have little to no potential to adversely affect the environment or interfere with organisms or habitat" (NOAA CE #E4)[5]. It is also supported by the administrative record for establishing NOAA CEs for issuance of permits under the ESA (NOAA CE #B1) and MMPA (NOAA CE #B2) that allow takes of threatened/endangered species and marine mammals, respectively, resulting from aerial surveys using remotely operated vehicles, and controlled close approach for photography and remote sampling (e.g. biopsy). NOAA has also established CE #B4 for "issuance of incidental harassment authorizations under section 101(a)(5)(A) of the MMPA for the incidental, but not intentional, take by harassment of marine mammals during specified activities and for which no serious injury or mortality is anticipated," which could apply to some UAS activities not directed at marine mammals.

4.2.3 *Active Remote Sensing Payload Impacts*

While most NOAA UAS operations would employ in situ sensor payloads or passive remote sensing payloads, which would result in no impacts to the environment, it is worth addressing the potential impacts from "active" remote sensing payloads that could be used for some of the missions. Generally, there are two standard types of active remote sensing payloads that may be

[4] "Use of mobile platforms (e.g., ships, aircraft, balloons, vehicles) to study biological, chemical, or physical processes" is an example listed for this CE definition.
[5] "Visual observation of marine mammals and sea turtles from stationary or mobile platforms using best management practices" is an example listed for this CE definition.

employed for NOAA missions, as needed: LIDAR and SAR (Hugenholtz et al., 2012; Whitehead and Hugenholtz, 2014). Recent advances in LIDAR development have produced lighter-weight, miniaturized variations (small enough for UAS integration) that utilize focused, pulsed beams with wavelengths that reside outside of the visible spectrum. Because of this spectral characterization, they are considered non-hazardous to humans or other environmental inhabitants (Crocker et al., 2012; Sabatini et al., 2014; Overton, 2015; Corrigan, 2020). Likewise, many beneficial advances have also led to the miniaturization of SAR instruments, which are now being integrated onto small UAS platforms (Koo et al., 2012). These instruments produce microwave pulses of radiation within various frequency bands operating in the 1-12 GHz range (Di Traglia et al., 2017). From an environmental impact standpoint, these smaller UAS-mounted SAR variants are extremely limited in how much power output they can produce (peak transmit power of approximately 50 W) during the active phase of their operation. This, combined with the pulse-mode style of operation and the brevity with which any surface target areas may be radiated during a UAS overflight, would produce, at most, non-significant impacts to the affected biological (World Health Organization, n.d.) or physical environments (Koo et al., 2012).

4.3 Mitigation Measures and Best Practices

CEQ regulations (40 CFR §1508.1(s)) define mitigation measures as:

> (a) avoiding the impact altogether by not taking a certain action or parts of an action
>
> (b) minimizing impacts by limiting the degree or magnitude of the action and its implementation
>
> (c) rectifying the impact by repairing, rehabilitating, or restoring the affected environment
>
> (d) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action
>
> (e) compensating for the impact by replacing or providing substitute resources or environments

With the application of appropriate mitigation measures, or best operating practices, the effects of small UAS on wildlife, in particular, and the environment, in general, can be avoided or minimized to a level that is negligible in most uses. It is not likely that operation of small UAS under the Proposed Action would result in impacts severe enough to require repair, rehabilitation, or restoration of the environment. It is also not likely that small UAS operations under the Proposed Action would result in impacts for which compensation or preservation and maintenance operations are necessary.

This section describes recommended measures and practices for minimizing or avoiding potential adverse effects of small UAS operations. While it is assumed users would adopt these, or similar measures, it is possible that some project- or site-specific operation goals would require different measures. It is incumbent upon the NOAA decision maker to evaluate the need for and effectiveness of mitigation measures when assessing whether this PEA adequately considers potential impacts of their action, including applicable mitigation measures, per the considerations outlined in Section 1.5 regarding the use of this PEA. As the greatest potential for impacts from the Proposed Action Alternative pertains to the biological environment and in particular, wildlife, the discussion on mitigation measures and best practices in this analysis will focus on that aspect.

To limit the spread of invasive species when transporting, launching, and recovering UAS for NOAA missions, the following standard protocols should be followed:

1. Transport UAS platforms, portable ground control stations, and other relevant equipment in closed containers (e.g., Pelican case)
2. At the conclusion of each UAS deployment, wipe down and inspect all equipment
3. Return all UAS platforms, portable ground stations, and other relevant equipment to their designated closed containers prior to departing from the deployment base site and/or transporting the equipment away from that site

Of potentially higher likelihood for impacts, different wildlife populations can respond idiosyncratically to a UAS in close proximity, depending on a variety of factors, including the species, environmental and historical context, as well as the type of UAS platform used and its method of operation. While there does not presently exist sufficient information regarding how these factors might affect wildlife to develop prescriptive policies for UAS use, existing guidelines could be drawn from to ensure the ethical treatment of animals in research. For example, ARRIVE (Animals in Research: Reporting In Vivo Experiments) guidelines detail the minimum information all scientific publications reporting research using laboratory animals should include (Du Sert et al., 2020), which may serve as a good starting point for the UAS context. Considering the growing popularity of UAS as a tool among field biologists, the authors of this analysis advocate for the precautionary principle to manage these risks. Specifically, the following suite of recommendations are provided as the basis for a code of best practice in the use of UAS in the vicinity of animals or for the purpose of animal research (Hodgson and Koh, 2016), which supplement current standards in animal field research and reporting:

1. Adopt the precautionary principle in lieu of evidence. When researchers cannot make informed decisions about minimum wildlife disturbance flight practices for their

environment or study species, they should exercise caution, particularly if endangered species or ecologically sensitive habitats are involved.

2. Utilize the institutional animal ethics process to provide oversight to UAS-derived animal observations and experiments. UAS monitoring operations that involve animals will benefit from ensuring all UAS methods are kept in accordance with approved institutional ethics permits.
3. Adhere to relevant civil aviation rules and adopt equipment maintenance and operator training schedules. UAS operations need to comply with all relevant civil aviation rules which may include restrictions on BVLOS flight operations, above a defined altitude, at night, near people, or in the vicinity of important infrastructure and prohibited areas.
4. Select appropriate UAS platforms and sensor equipment. UAS should be selected to minimize visual and audio stimulus to target and non-target organisms, while remaining capable of satisfying study objectives.
5. Exercise minimum wildlife disturbance flight practices. Particular attention should be given to siting launch and recovery sites away from animals (out of sight if possible) and maintaining a reasonable distance from animals at all times during flight.
6. Cease UAS operations if they are found to be excessively disruptive. Animal responses should be measured during UAS operations (and before and after if possible).

For general operations, these measures would be most applicable to the launch and recovery portions of the operation and certain in-flight operations, determined on a case-by-case basis. In addition to the terms of consultations, permits, and authorizations that would be required prior to commencement and execution of an operation, additional mitigation measures may be incorporated into site-specific projects to minimize impacts to the environment. Implementing these “best practices” can help to avoid or minimize potentially adverse impacts of operations, such as:

- conducting surveys with UAS at a constant speed and distance and limiting the number of passes to reduce the potential for harassment of individual animals;
- in the event of launching the UAS from primary research vessels, conducting small boat approaches using crew members with extensive experience in handling small boats around protected species;
- limiting time spent in the vicinity of target animals and the number of attempts made to collect photographs or other data; and

- not approaching animals exhibiting behaviors that indicate a negative reaction to the UAS. If at any time there is a negative reaction (e.g., avoidance or escape maneuvers), as observed from available UAS imagery, that is not intended, efforts to approach the animals should cease.

At the discretion of the responsible authorities or decision makers in NOAA (e.g., Program Manager, NOAA UAS Mission Commander, etc.), a periodic review of operations should be used to monitor the effectiveness of mitigation measures, general best practices, and project-specific requirements for permits and other authorizations, as deemed relevant. If impacts are not found to be consistent with those predicted and analyzed in this PEA, the responsible party should consider modifications to the corresponding UAS missions and related types of operations in order to reduce impacts to the lowest practicable level. If such modifications are not practical and the level of adverse impact exceeds what has been evaluated in this PEA, the responsible party may decide to discontinue such operations or prepare additional NEPA analysis and decision documents prior to further implementation.

5. Cumulative Effects

Cumulative effects are defined as those that result from incremental impacts of a proposed action when added to other past, present, and reasonably foreseeable future actions, regardless of which agency (federal or nonfederal) or person undertakes such actions. Cumulative impacts can result from individually minor, but collectively significant, actions that take place over a period of time.

It is not likely that implementing the Proposed Action Alternative would pose the potential for significant cumulative impacts on its own or in instances when the affiliated activities might be combined with other past or present actions, or with those that might reasonably be foreseen to take place in the future. Individual small UAS activities associated with the Proposed Action Alternative are not likely to have more than negligible impacts, either for individual project-operations, site-specific operations, or collectively.

Furthermore, implementing the Proposed Action Alternative would not establish any precedents for future actions falling outside of the scope of this analysis or for actions that represent a decision in principle about future actions with potentially significant environmental effects. The funding, procurement, or operation of small UAS, as described in the Proposed Action Alternative section, are not likely to result in any irretrievable or irreversible commitment of resources or otherwise contribute to growth-inducing changes, compel future actions with potential impacts, or foreclose options for future actions.

6. Compliance with Applicable Laws

As this analysis and the corresponding proposed action are intended to apply to a broad suite of referenced NOAA UAS activities, on a case by case basis, it will be up to the individual, responsible decision makers overseeing each mission (e.g., Program Manager, NOAA UAS Mission Commander, etc.) to ensure that UAS funding, procurement, operations, and other related activities comply with all relevant authorities. This would primarily be accomplished through coordination of necessary permits and consultation with relevant authorities–with oversight by the applicable NOAA decision maker–prior to any decisions made regarding the funding, procurement, or operation of UAS within the agency.

6.1 International Laws for Flight Operations

UAS flights conducted within foreign countries or territories require the permission of that country's civil aviation authority. Foreign UAS flight operations require NOAA and State Department approval. Additionally, foreign UAS flight operations must meet Federal policies regarding International Traffic in Arms Regulations (ITAR) and export control. In 2011, the International Civil Aviation Organization (ICAO) issued a circular (ICAO 2011) serving as a first look at potential guidelines to standardize UAS use globally. While no mandatory regulation exists at the international scale, the ICAO has developed a toolkit for best practices to follow, which is available at https://www.icao.int/safety/UA/UASToolkit/Pages/default.aspx.

6.2 Federal Environmental Laws and Executive Orders

Given the broad spectrum of geographic realms in which NOAA's many Line Offices operate and in which they have responsibilities to obtain critical observations, there has been and will likely continue to be a future need for the UxSRTO to facilitate UAS operations within any and all of these environments. Adherence to environmental laws and regulations may apply to all, some, or none of the considered activities within the range of NOAA UAS operations taking place at any given time. In any case, it is the responsibility of associated NOAA decision makers (e.g., Program Manager, NOAA UAS Mission Commander, etc.) to ensure that any coordinating personnel planning to approve (e.g., via federal financial assistance) or undertake a NOAA UAS operation understand their duty to identify which of the existing regulations and requirements apply to their specific missions and follow through in taking appropriate measures of compliance prior to the commencement of operations.

Table 6.1 describes federal statutes and EOs pertaining to the protection of the environment that were considered in this analysis and whether or how they may apply to small UAS operations and related activities in NOAA that may be executed within the scope of this PEA. While some laws may not be triggered by UAS operations on their own, they may be applicable to a larger action that includes UAS operations. Other federal or state-level regulations may apply on a mission-specific basis. Complying with these requirements further reduces the likelihood for the proposed action and affiliated operations to negatively impact any associated physical, biological, or social/economic environments.

Table 1. Environmental laws considered. Permits and consultations may be required for specific projects to comply with various laws.

Statute / Executive Order	Application	Compliance
Endangered Species Act (ESA) of 1973, 16 U.S.C. 1531 et seq. Administered jointly by the National Marine Fisheries Service (NMFS) and the United States Fish and Wildlife Service (USFWS). Provides a framework to conserve and protect endangered and threatened species and their habitats both domestically and abroad; prohibits the import, export, or taking of species listed as threatened or endangered.	Actions that may affect: -Species listed as threatened or endangered -Any designated critical habitat	Interagency consultation with NMFS or USFWS pursuant to section 7 to ensure that any action authorized, funded, or carried out is not likely to jeopardize the continued existence of endangered or threatened species or result in the destruction or adverse modification designated critical habitat Permits under Section 10(a)(1)(A) from NMFS or USFWS as needed for the purposeful or direct take of an ESA-listed species for scientific purposes or to enhance the propagation or survival of listed species.

Statute / Executive Order	Application	Compliance
Marine Mammal Protection Act of 1972 (MMPA), 16 U.S.C. 1361 et seq Administered jointly by NMFS and the USFWS. Prohibits the take of marine mammals in U.S. waters and by U.S. citizens on the high seas and the importation of marine mammals and marine mammal products into the U.S.	Actions that may result in the taking (i.e., hunting, harassing, capturing, or killing) of any marine mammals	Permits from NMFS or USFWS for takes resulting from research on marine mammals. Authorizations from NMFS or USFWS for the "incidental," but not intentional, take of small numbers of marine mammals when engaged in a specified activity (other than commercial fishing).
Magnuson-Stevens Fishery Conservation and Management Act of 1976 (MSFCMA), 16 U.S.C. 1801 et seq. Provides for conservation and management of Federal fisheries and requires Federal fishery management plans to describe and identify essential fish habitat for managed fish species, to minimize to the extent practicable adverse effects on such habitat caused by fishing, and to identify	Actions authorized, funded, or undertaken that may adversely affect Essential Fish Habitat (EFH) identified in a fishery management plan	A written assessment of the effects of a proposed Federal action on EFH and, as applicable, consultation with NMFS under Section 305(b)

Statute / Executive Order	Application	Compliance
other actions to encourage the conservation and enhancement of such habitat.		
National Marine Sanctuaries Act (NMSA), 16 U.S.C. 1431 et seq. Authorizes the Secretary of Commerce to designate and protect areas of the marine environment with special national significance due to their conservation, recreational, ecological, historical, scientific, cultural, archeological, educational or esthetic qualities as national marine sanctuaries	Actions that are likely to destroy, cause the loss of, or injure any Sanctuary resource	Consultation under section 304(d) with NOAA's Office of National Marine Sanctuaries. In the case of Stellwagen Bank National Marine Sanctuary, the decision maker must consult on proposed actions that may affect any resource of the Sanctuary. Permits to conduct an activity within a sanctuary that is otherwise prohibited (e.g., operation of aircraft below the minimum altitude in restricted zones of National Marine Sanctuaries).
National Historic Preservation Act of 1966 (NHPA), 54 U.S.C. 300101 et seq. Legislation intended to preserve historic and archaeological sites.	Approving or carrying out a federal, federally assisted, or federally licensed undertaking that may affect any district, building, structure, site, or object that is listed or eligible for listing in the National Register of Historic Places because the property is significant at the national, state, or local level in American history, architecture, archeology, engineering, or culture.	Engage in the NHPA Section 106 review process to consider the effects of the actions on historic properties, including identifying the appropriate State Historic Preservation Officer (SHPO) and Tribal Historic Preservation Officer (THPO) to consult with during the process.

Statute / Executive Order	Application	Compliance
Coastal Zone Management Act of 1972 (CZMA), 16 U.S.C. 1451 et seq. Provides for the management of the nation's coastal resources, including the Great Lakes. Requires that Federal actions that are reasonably likely to affect any land or water use or natural resource of the coastal zone be consistent with enforceable policies of a State's federally-approved coastal management program.	Actions with reasonably foreseeable effects on any land, water use, or natural resource of the coastal zone	Consultation with the lead State agency as identified in a coastal State's Federally approved coastal management program
Migratory Bird Treaty Act (MBTA) of 1918; 16 U.S.C. 703-712 Legislation established to conserve migratory birds; requires the protection of migratory birds and their habitats. Prohibits the take (including killing, capturing, selling, trading, and transport) of protected migratory bird species without prior authorization by the USFWS	Actions that may result in the killing, injuring, take, and other actions that may adversely affect migratory birds and their habitat.	Permits from USFWS for activities related to migratory birds.
Fish and Wildlife Coordination Act (FWCA) of 1934, 16 U.S.C. 661-666(e) Directs the USFWS to investigate and report on	Actions anticipated to result in the control or modification of a natural stream or body of water	Requires federal agencies that construct, license or permit water resource development projects to first consult with the USFWS (and NMFS in some instances) and state fish and

Statute / Executive Order	Application	Compliance
proposed Federal actions that affect any stream or other body of water and to provide recommendations to minimize impacts on fish and wildlife resources.		wildlife agency regarding the impacts on fish and wildlife resources and measures to mitigate these impacts.
Executive Order 13112 of February 1999, Invasive Species Directs executive departments and agencies to take steps to prevent the introduction and spread of invasive species, and to support efforts to eradicate and control invasive species that are established.	Actions that may introduce or affect the status of invasive species.	Take actions to prevent the introduction of invasive species and provide for their control Abstain from authorizing, funding, or carrying out actions that are likely to cause or promote invasive species introduction or spread, unless the agency has determined that the benefits of such actions clearly outweigh the potential harm caused by invasive species and that all feasible and prudent measures to minimize risk of harm will be taken
Executive Order 13175 of November 2000: Consultation and Coordination With Indian Tribal Governments Ensures that all executive departments and agencies consult with Indian Tribes and respect tribal sovereignty as they develop policy on issues that impact Indian communities.	Applies to rules, policies, and guidance with Tribal Implications (TI), including rules with substantial direct compliance costs on Indian tribal governments, and not required by statute, and rules that preempt tribal law.	Ensure meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications

Statute / Executive Order	Application	Compliance
Executive Order 11990 of May 1977: Protection of Wetlands Requires federal agencies to provide leadership and take action to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands.	An action is defined as any federal activity including (1) acquiring, managing, and disposing of Federal lands and facilities, (2) providing Federally undertaken, financed, or assisted construction and improvements, and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.	Consider alternatives to activities (particularly construction) considered within wetland locations and limit potential damage if an activity affecting a wetland cannot be avoided. To the extent permitted by law, avoid undertaking or providing assistance for new construction located in wetlands unless the head of the agency finds: there is no practical alternative to such construction; the proposed action includes all practical measures to minimize harm to wetlands that may result from such use.
Executive Order 13089 of June 1998, Coral Reef Protection Directs agencies to preserve and protect the biodiversity, health, heritage, and social and economic value of U.S. coral reef ecosystems and the marine environment	Actions that may affect US coral reef systems.	Provide for implementation of measures needed to research, monitor, manage, and restore affected ecosystems, including, but not limited to, measures reducing impacts from pollution, sedimentation, and fishing. Such measures should be developed in cooperation with the U.S. Coral Reef Task Force and Fishery Management Councils and in consultation with affected states, territorial, commonwealth, tribal, and local government agencies, non-governmental

Statute / Executive Order	Application	Compliance
		organizations, the scientific community, and commercial interests.
Executive Orders 13178 & 13196: Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve To ensure the comprehensive, strong, and lasting protection of the coral reef ecosystem and related marine resources and species of the Northwestern Hawaiian Islands.	Restricted or prohibited activities include commercial and recreational fishing; exploring for, developing, or producing oil, gas, or minerals; anchoring on any living or dead coral; drilling into, dredging, or otherwise altering the seabed; constructing, placing, or abandoning any structure, material, or other matter on the seabed; discharging or depositing any material or other matter into the Reserve, or discharging or depositing any material or other matter outside the Reserve that subsequently enters the Reserve and injures any resource of the Reserve; and removal, moving, taking, harvesting, or damaging any living or nonliving Reserve resources.	Consultations and permits as necessary for research, monitoring, education, or management activities that further the Management Principles of the Orders.
Executive Order 13158, Marine Protected Areas	Federal agencies are directed to work closely with state, local, and	Consider alternatives to avoid actions resulting in harm to MPAs through federally

Statute / Executive Order	Application	Compliance
To aid in the protection of significant natural and cultural resources within the marine environment for the benefit of present and future generations by strengthening and expanding the system of Marine Protection Areas (MPAs) within the nation	non-governmental partners to create a scientifically based, comprehensive system of MPAs representing diverse U.S. marine ecosystems, and the nation's natural and cultural resources.	conducted, approved, or funded activities.
Executive Orders 11988, Floodplain Management; 13690, Federal Flood Risk Management Standard; and 11990, Protection of Wetlands Direct federal agencies to avoid, to the extent possible, adverse impacts associated with occupying or modifying floodplains and wetlands.	Actions in or affecting floodplains and wetlands that involve acquiring, managing, and disposing of Federal lands and facilities; providing Federally undertaken, financed or assisted construction and improvements; and conducting Federal activities and programs affecting land use such as water and related land use resource planning, regulating, and licensing activities.	Avoid floodplain or wetland development whenever there is a practical alternative. Ensure Federally funded projects—those Federal actions that involve construction, substantial improvement, or repair of substantial damage of structures and facilities—are resilient to both current and future flood risk.
Executive Order 12114 of January 1979, Environmental Effects Abroad of Major Federal Actions Requires Federal agencies undertaking activities/projects abroad to consider the impact	Federal actions outside the U.S., its territories and possessions, U.S. Territorial Seas, or which may affect resources not subject to the management authority of the U.S., including the Antarctic	The decision maker, in consultation with the NOAA NEPA Coordinator and Line/Staff Office NEPA Coordinator, must determine the appropriate level of environmental review.

Statute / Executive Order	Application	Compliance
of major actions on the environment.		
Executive Order 12898 of February 1994, Federal Actions to Address Environmental Justice in Minority and Low-Income Populations Directs federal agencies to identify and address the disproportionately high and adverse human health or environmental effects of their actions on minority and low-income populations, to the greatest extent practicable and permitted by law.	Actions that may result in disproportionately high and adverse effects on minority and low-income communities, including communities that rely on subsistence hunting or fishing activities.	Identify and address any disproportionately high and adverse human or environmental effects of programs, policies, and activities on minority populations and low income populations

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8. List of Agencies, Organizations, and Persons Consulted

An internal working draft of the PEA was distributed within NOAA for review and comment via the UxS Executive Oversight Board, as well as through the NOAA NEPA Coordinator and the NOAA Line Office NEPA or Environmental Compliance Coordinators.

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Programmatic Environmental Assessment for the Funding, Procurement, and Operation of NOAA Small Uncrewed Aircraft Systems (UAS)

FINDING OF NO SIGNIFICANT IMPACT

I. Purpose of Finding of No Significant Impact (FONSI):

The National Environmental Policy Act (NEPA) requires the preparation of an Environmental Impact Statement (EIS) for any proposal for a major federal action significantly affecting the quality of the human environment. 42 U.S.C. § 4332(C). The Council on Environmental Quality (CEQ) Regulations direct agencies to prepare a Finding of No Significant Impact (FONSI) when an action not otherwise excluded will not have a significant impact on the human environment. 40 CFR §§ 1500.4(b), 1500.5(b), & 1501.6. To evaluate whether a significant impact on the human environment is likely, the CEQ regulations direct agencies to analyze the potentially affected environment and the degree of the effects of the proposed action. 40 CFR § 1501.3(b). In doing so, agencies should consider the geographic extent of the affected area (i.e., national, regional or local), the resources located in the affected area (40 CFR § 1501.3(b)(1)), and whether the project is considered minor or small-scale (NAO 216-6A CM, Appendix A-2). In considering the degree of effect on these resources, agencies should examine, as appropriate, short- and long-term effects, beneficial and adverse effects, and effects on public health and safety, as well as effects that would violate laws for the protection of the environment (40 CFR § 1501.3(b)(2)(i)-(iv); NAO 216-6A CM Appendix A-2 - A-3), and the magnitude of the effect (e.g., negligible, minor, moderate, major). CEQ identifies specific criteria for consideration. 40 CFR § 1501.3(b)(2)(i)-(iv). Each criterion is discussed below with respect to the proposed action and considered individually as well as in combination with the others.

In preparing this FONSI, we reviewed the **Programmatic Environmental Assessment (EA) for the Funding, Procurement, and Operation of NOAA Small Uncrewed Aircraft Systems (UAS)**, which evaluates the affected area, the scale and geographic extent of the proposed action, and the degree of effects on those resources (including the duration of impact, and whether the impacts were adverse and/or beneficial and their magnitude). The EA is hereby incorporated by reference. 40 CFR § 1501.6(b).

II. Approach to Analysis:

The analysis in the EA is at a programmatic level, and it evaluates the potential environmental consequences from a broad perspective (i.e., multiple types of small UAS platforms used to supplement, enhance, or replace a variety of existing methods of data collection). The Proposed Action alternative considers several common types of small UAS platforms and payloads that may be procured and operated within NOAA, in fulfillment of NOAA's research and operational mission requirements, across a range of environments. The potential for these activities to impact each of the corresponding environments is considered in generalized terms. The EA specifies procedures for confirming that the impacts of site-specific actions considered pursuant to the proposed action are consistent with predictions for the proposed action. The EA also considers the impacts of implementing a No Action alternative in which NOAA would not facilitate the funding, procurement, or operation of small UAS as observation platforms within NOAA.

The proposed action is not considered to meaningfully contribute to a significant impact based on the scale of operations and type of effects. Components of the action pertaining to funding and procurement of small uncrewed aircraft systems (UAS) are, by nature, administrative activities that produce no significant environmental impacts. Subsequent operation of UAS within the scope defined in the referenced EA, used to address a variety of NOAA missions, have been found to result in negligible impacts, at most. For the analysis in the EA, negligible was defined according to the glossary of NOAA's NAO 216-6A Companion Manual as a level of impact that is below minor to the point of being barely detectable and therefore discountable.

The proposed action will not meaningfully contribute to significant impacts to specific resources. Although the scope of the analysis is broad, covering several applications within NOAA's extensive mission space, the proposed action has been found in all applicable scenarios to yield no more than negligible impacts to any specific resource.

The proposed action is not connected to other actions that have caused or may cause effects to the resources in the affected area, and there is then no potential for the effects of the proposed action to add to the effects of other projects, such that the effects taken together could be significant.

III. Geographic Extent and Scale of the Proposed Action:

Components of the proposed action cover multiple administrative activities, including the funding and procurement of UAS, intended for subsequent NOAA applications. Such administrative activities are constrained to office type environments. Pursuant to this, the proposed action also includes use of UAS for a variety of NOAA applications, which can be applied across a broad geographic extent, ranging across the United States, Arctic, and oceanic domains with operations at altitudes up to 100,000 ft MSL. The EA describes the spectrum of domains for which NOAA UAS operations would take place. While the geographic scope of the action area is large, the scale of operations within that area is small.

IV. Degree of Effect:

A. *The potential for the proposed action to threaten a violation of Federal, state, or local law or requirements imposed for environmental protection.*

   This proposed action will not threaten a violation of any Federal, state, or local law, or requirement imposed for the protection of the environment. The proposed action is designed to be consistent with Federal law (see EA Section 6: Compliance with Applicable Laws). NOAA UAS operations within certain domains may require permits or approvals from Federal, state, or local authorities. Obtaining such permissions is a requirement of implementing operations under the proposed action.

B. *The degree to which the proposed action is expected to affect public health or safety.*

   This proposed action will not have a measurable impact on public health or safety. Operation of sUAS, as described, including implementation of best practices, would not pose more than a negligible impact to any biological or physical resources. Any effects on social and economic environments, including public health and human safety, related to impacts on corresponding physical and biological environments are also anticipated to be negligible or non-existent.

C. *The degree to which the proposed actions is expected to affect a sensitive biological resource, including: Federal threatened or endangered species and critical habitat; stocks of marine mammals as defined in the Marine Mammal Protection Act (MMPA); essential fish habitat identified under the Magnuson–Stevens Fishery Conservation and Management Act; bird species protected under the Migratory Bird Treaty Act (MBTA); national marine sanctuaries or monuments; vulnerable marine or coastal ecosystems, including, but not limited to, shallow or deep coral ecosystems; and biodiversity or ecosystem functioning (e.g., benthic productivity, predator-prey relationships, etc.).*

Some locations of operations may overlap with species and habitats protected under the Endangered Species Act (ESA), MMPA, or MBTA. Operations could at times take place within the boundaries or vicinity of sanctuaries, monuments, marine or coastal ecosystems, and designated essential fish habitat. However, impacts on these resources are expected to be negligible given best practices. In general, operation of sUAS has no more than short-term minor impacts on the physical environment. Disturbance of wildlife from operations as described in the proposed action is expected to be negligible and have no impact on ecosystem function or biodiversity. For the analysis in the EA, "short-term" was defined according to the glossary of NOAA's NAO 216-6A Companion Manual and refers to a potential impact of short duration, relative to the proposed activity and the environmental resource; short-term impacts occur while the activity is underway and do not persist once the activity ends.

D. *The degree to which the proposed action is reasonably expected to affect a cultural resource: properties listed or eligible for listing on the National Register of Historic Places; archeological resources (including underwater resources); and resources important to traditional cultural and religious tribal practice.*

No measurable impacts are expected to occur in any of the listed locations. The most relevant components of the proposed action pertaining to this issue would involve the launch and recovery of UAS from designated surface locations. The analysis in the EA shows that, for any environment, this activity would provide only negligible impacts, at most. The EA further recognizes that, for some situations, it may be required for permissions to be granted ahead of time in order to gain access to certain locations for the purpose of conducting small UAS operations. Once airborne, there are no expected impacts from any of the scoped UAS operations for any such locations.

E. *The degree to which the proposed action has the potential to have a disproportionately high and adverse effect on the health or the environment of minority or low-income communities, compared to the impacts on other communities (EO 12898).*

The proposed action would not result in measurable impacts on the environment in general, and no impacts would fall disproportionately on the health or the environment of minority or low-income communities. One of the primary purposes of the proposed action is to enable the collection of data to aid NOAA in many of its missions. There is no evidence and no substantive dispute indicating that the likelihood of seeking such information, from UAS or other known observation platforms, is more prominent in any of the outlined locations, compared with other locations.

F. *The degree to which the proposed action is likely to result in effects that contribute to the introduction, continued existence, or spread of noxious weeds or nonnative invasive species known to occur in the area or actions that may promote the introduction, growth, or expansion of the range of the species.*

The proposed action involving operation of UAS platforms is not known or likely to contribute to the introduction, continued existence, or spread of noxious weeds or nonnative invasive species given best practices for ensuring equipment is not a vector. While airborne, these aircraft do not make contact with substrates or otherwise provide a mechanism for transport of noxious weeds or invasive species. Furthermore, prior to launch and following recovery of the aircraft, proper protocols dictate that all exposed hardware components be cleaned and stored within designated transportation containers.

G. *The potential for the proposed action to cause an effect to any other physical or biological resources where the impact is considered substantial in magnitude (e.g., irreversible loss of coastal resources, such as marshland or seagrass) or over which there is substantial uncertainty or scientific disagreement.*

The proposed action is not expected to cause a substantial effect to any other physical or biological resource, nor is there substantial uncertainty or scientific disagreement on the impacts of the proposed action. The administrative activities in the proposed action are not reasonably likely to affect any component of the environment. For the components of the proposed action involving operation of UAS platforms, the likely impacts from these activities are well-known based on prior use and monitoring of the same or similar systems, and those impacts have been shown to be no more than negligible when operating within the scope defined by the proposed action including abiding by all referenced policies and and protocols.

V. Other Actions Including Connected Actions:

The proposed action to fund, procure, or operate UAS in support of NOAA missions will not result in effects that add to effects of other related actions in such a way as to synergistically compound effects that might result in significant impacts. Furthermore, it does not establish a precedent and is not connected to any future actions with potentially significant effects on the environment. Because each component of the proposed action is overseen via multiple levels of authority within NOAA, based on established policies and protocols that have been into place to examine each new activity prior to proceeding with approvals, such actions may be deemed related but are not connected in any way that might automatically trigger other actions that may require environmental impact statements, cannot or will not proceed unless other actions are taken previously or simultaneously, or represent interdependent parts of a larger action that depend on the larger action for justification.

VI. Mitigation and Monitoring:

The proposed action was developed to be consistent with the manner in which NOAA currently proceeds with decisions to fund, procure, or operate UAS in support of its many missions. The current approach involves careful attention to the latest agency policies and close adherence to mandated protocols. Because the range of applicable UAS operations fitting within the scope of the proposed action involve activities within a variety of environments, varying types of mitigation procedures may apply; however, those are either established via the referenced policies and procedures already determined within the agency or by the list of best practices referenced within the EA for certain types of operations. These measures are in place to ensure safety of operations as well as to help protect environments in which UAS are operated. Deviation from required procedures can be reported to the appropriate agency authorities and result in the cessation of related activities, pending an investigation, and possibly followed by additional punitive actions.

DETERMINATION

The CEQ NEPA regulations, 40 CFR § 1501.6, direct an agency to prepare a FONSI when the agency, based on the EA for the proposed action, determines not to prepare an EIS because the action will not have significant effects. In view of the information presented in this document and the analysis contained in the supporting EA prepared for Funding, Procurement, and Operation of NOAA Small UAS, it is hereby determined that the proposed action to fund, procure, and operate NOAA small UAS within the defined scope will not significantly impact the quality of the human environment. The Programmatic Environmental Assessment for the Funding, Procurement, and Operation of NOAA Small UAS is hereby incorporated by reference. In addition, all beneficial and adverse impacts of the proposed action as well as mitigation measures have been evaluated to reach the conclusion of no significant impacts. Accordingly, preparation of an EIS for this action is not necessary.

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May 16, 2023
Date