

Papahānaumokuākea Marine National Monument
RESEARCH Permit Application

NOTE: *This Permit Application (and associated Instructions) are to propose activities to be conducted in the Papahānaumokuākea Marine National Monument. The Co-Trustees are required to determine that issuing the requested permit is compatible with the findings of Presidential Proclamation 8031. Within this Application, provide all information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Papahānaumokuākea Marine National Monument (Monument).*

ADDITIONAL IMPORTANT INFORMATION:

- Any or all of the information within this application may be posted to the Monument website informing the public on projects proposed to occur in the Monument.
- In addition to the permit application, the Applicant must either download the Monument Compliance Information Sheet from the Monument website OR request a hard copy from the Monument Permit Coordinator (contact information below). The Monument Compliance Information Sheet must be submitted to the Monument Permit Coordinator after initial application consultation.
- Issuance of a Monument permit is dependent upon the completion and review of the application and Compliance Information Sheet.

INCOMPLETE APPLICATIONS WILL NOT BE CONSIDERED

Send Permit Applications to:
NOAA/Inouye Regional Center
NOS/ONMS/PMNM/Attn: Permit Coordinator
1845 Wasp Blvd, Building 176
Honolulu, HI 96818
nwhipermit@noaa.gov
PHONE: (808) 725-5800 FAX: (808) 455-3093

SUBMITTAL VIA ELECTRONIC MAIL IS PREFERRED BUT NOT REQUIRED. FOR ADDITIONAL SUBMITTAL INSTRUCTIONS, SEE THE LAST PAGE.

Papahānaumokuākea Marine National Monument Permit Application Cover Sheet

This Permit Application Cover Sheet is intended to provide summary information and status to the public on permit applications for activities proposed to be conducted in the Papahānaumokuākea Marine National Monument. While a permit application has been received, it has not been fully reviewed nor approved by the Monument Management Board to date. The Monument permit process also ensures that all environmental reviews are conducted prior to the issuance of a Monument permit.

Summary Information

Applicant Name: Haunani Hi‘ilani Kane

Affiliation: Assistant Professor in the School of Earth Sciences at the University of Hawai‘i at Mānoa

Permit Category: Research

Proposed Activity Dates: TBD - aiming for within 2023 (Summer or Fall)

Proposed Method of Entry (Vessel/Plane): TBD - Potential access methods include by means of vessels hosted by USFWS. We are currently unsure of whether or not the vessel will be separately permitted.

Proposed Locations: French Frigate Shoals

Estimated number of individuals (including Applicant) to be covered under this permit:

14

Estimated number of days in the Monument: TBD - a minimum number of 3-4 days estimated to complete field work

Description of proposed activities: (complete these sentences):

a.) The proposed activity would...

Assess the impacts and recovery upon islands and the shallow marine environment at French Frigate Shoals (FFS) due to recent hurricane events and accelerated sea-level rise. Our survey techniques will use a non-invasive method to collect high resolution aerial imagery to document change in island morphology and subsequent recovery following Hurricane Walaka. Our island and nearshore sediment data collection method will enable shifts in dominant sediment types and sources from the nearshore reef to be identified. This will enable estimates for future sediment production and replenishment to islands following environmental stressors. The proposed activities will improve the understanding of the potential loss and timescales for recovery of critical habitat following extreme storm events. The proposed activities will also improve understanding of how future sea level rise will impact essential habitats for priority species (e.g. sea turtles, monk seals, and various seabirds).

b.) To accomplish this activity we would

1.) Use an unmanned aerial system (UAS) (DJI Drone Phantom 4 Pro) to collect high quality aerial imagery paired with conducting Real Time Kinematic Global Positioning System (RTK-GPS) surveys at three different islands within FFS. RTK-GPS data will be corrected to a local short-term tide gauge 2.) Collect sediment samples (total: 200, $\frac{3}{4}$ cup volume) from the shallow marine environment (80, $\frac{3}{4}$ cup volume), and modern beach face (100, $\frac{3}{4}$ cup volume) at three islands within FFS.

Predictive modeling of island habitat response to hurricane events and accelerated sea-level rise requires the acquisition of high-resolution topographic (land) and bathymetric (shallow seafloor) elevation data. The applicant will derive digital elevation maps (DEMs) and 3D digital reconstructions of each island produced from UAS imagery + RTK-GPS data and Structure-from-Motion software. RTK-GPS control points will also be collected at the time of the UAS survey to ensure that each DEM is adequately georeferenced. A vertical datum will be derived from RTK-GPS control points and a local short-term tide gauge that will be installed for the duration of field work at each island and removed before they depart. The DEM will be used to assess past changes in island habitat documented in historical imagery and their predictive model will simulate island response to climate change impacts.

These models will be compared to 3D models of island environments collected in 2018 by the Climate Resilience Collaborative team at the University of Hawai'i at Mānoa led by Dr. Chip Fletcher (includes Dr. Kane listed on this permit). Comparing 2018 & 2023 3D island models and sediment composition will enable sediment budgets for each island to be quantified by both sediment source, and sediment volume. Ultimately we will obtain detailed data on the impacts of extreme storm events, and the capacity of atoll islands to naturally recover from environmental stressors. This research will allow us to decipher important characteristics of reduced resiliency affecting islands and critical island habitats across PMNM.

c.) This activity would help the Monument by ...

Providing detailed analyses of island habitat and sediment composition that is useful for determining the severity and prevalence of recent hurricane events (i.e. Hurricane Walaka) and accelerated sea-level rise across FFS. By resurveying sites visited in 2018 (Gin and East Island) we will provide visual representations of island recovery and loss. The 3D island reconstructions will provide useful data for assessing island elevation, and island sedimentary budgets. Both are useful metrics for predicting future time scales of vulnerability to storms and sea level rise. Furthermore analyses of island sediments will reveal the dependency of islands upon the adjacent nearshore reef for sediment replenishment following environmental stressors. Our research would provide managers insight into how sea-level rise and perturbations to the island's shape and nearshore bathymetry at FFS will affect the convergence or divergence of wave-drive sand transport, causing the islands to accrete or erode, respectively in the Monument.

Other information or background:

Obtaining a better understanding of the fate of reef islands is vital for understanding the future of critical habitats at FFS and also for depicting what impacts we may foresee for cultural, natural, and historic resources of the PMNM as a whole. Our island surveying methods have proved useful for determining the impacts of past and future sea level rise and storms. Combining a geologic sedimentary approach with cutting edge 3D reconstruction techniques will produce excellent data products that will enhance our understanding of the bio-geological parameters that govern reef-island resiliency and vulnerability to climate related stressors. This research will ultimately provide useful information for managers such as the spatial and temporal dynamics of island evolution and recovery, keystone island sediment species that disproportionately contribute to island composition, and the ability to identify and map the source of keystone species upon adjacent reefs.

Section A - Applicant Information

1. Applicant

Name (last, first, middle initial): Kane, Haunani, H

Title: Assistant Professor in the School of Earth Sciences at the University of Hawai'i at Mānoa

1a. Intended field Principal Investigator (See instructions for more information):

Dr. Haunani H. Kane

2. Mailing address (street/P.O. box, city, state, country, zip):

[REDACTED]

[REDACTED]

[REDACTED]

For students, major professor's name, telephone and email address: N/A

3. Affiliation (institution/agency/organization directly related to the proposed project):

School of Earth Sciences at the University of Hawai'i at Mānoa and the Multiscale Environmental Graphical Analysis (MEGA) Lab.

4. Additional persons to be covered by permit. List all personnel roles and names (if known at time of application) here (e.g. John Doe, Research Diver; Jane Doe, Field Technician):

1. Kainalu Steward, Arizona State University Graduate Researcher & Drone operator
2. Brianna Ninomoto, University of Hawai'i at Hilo Graduate Researcher & Survey technician
3. Haunani Kane, Geologist & surveyor
4. TBD, geologist & survey technician
5. TBD, sediment sampler & survey technician
6. TBD, USFWS personnel
7. TBD, USFWS personnel
8. TBD, USFWS personnel
9. TBD, Boat crew
10. TBD, Boat crew
12. TBD, NOAA personnel
13. TBD, NOAA personnel
14. TBD, NOAA personnel

Section B: Project Information

5a. Project location(s):

Ocean Based

- | | | | |
|---|-------------------------------------|--|--|
| <input type="checkbox"/> Nihoa Island | <input type="checkbox"/> Land-based | <input type="checkbox"/> Shallow water | <input type="checkbox"/> Deep water |
| <input type="checkbox"/> Necker Island (Mokumanamana) | <input type="checkbox"/> Land-based | <input type="checkbox"/> Shallow water | <input type="checkbox"/> Deep water |
| <input type="checkbox"/> French Frigate Shoals | <input type="checkbox"/> Land-based | <input type="checkbox"/> Shallow water | <input type="checkbox"/> Deep water |
| <input type="checkbox"/> Gardner Pinnacles | <input type="checkbox"/> Land-based | <input type="checkbox"/> Shallow water | <input type="checkbox"/> Deep water <input type="checkbox"/> |
| Maro Reef | | | |
| <input type="checkbox"/> Laysan Island | <input type="checkbox"/> Land-based | <input type="checkbox"/> Shallow water | <input type="checkbox"/> Deep water |
| <input type="checkbox"/> Lisianski Island, Neva Shoal | <input type="checkbox"/> Land-based | <input type="checkbox"/> Shallow water | <input type="checkbox"/> Deep water |
| <input type="checkbox"/> Pearl and Hermes Atoll | <input type="checkbox"/> Land-based | <input type="checkbox"/> Shallow water | <input type="checkbox"/> Deep water |
| <input type="checkbox"/> Midway Atoll | <input type="checkbox"/> Land-based | <input type="checkbox"/> Shallow water | <input type="checkbox"/> Deep water |
| <input type="checkbox"/> Kure Atoll | <input type="checkbox"/> Land-based | <input type="checkbox"/> Shallow water | <input type="checkbox"/> Deep water |
| <input type="checkbox"/> Monument Expansion Area | | | |
| <input type="checkbox"/> Other | | | |

NOTE: Shallow water is defined by water less than 100 meters in depth.

Remaining ashore on any island or atoll (with the exception of Sand Island, at Midway Atoll and field camp staff on other islands/atolls) between sunset and sunrise.

NOTE: There is a fee schedule for people visiting Midway Atoll National Wildlife Refuge via vessel and aircraft.

Location Description:

French Frigate Shoals (East Island, Gin Island and Tern Island).

At East island, Gin island, and Tern Island we propose to collect imagery of the island and surrounding shallow nearshore environment using an unmanned aerial system.

At East island, Gin island, and Tern Island we propose to survey, and collect sediment samples (3/4 cup) from the beach face, and the nearshore environment. At Tern Island we propose to excavate two shallow trenches and collect sediment samples.

We will follow best management practices for moving between islands, boat operations and unmanned aerial systems. All survey and sample locations will be conducted at sites determined by Dr. Kane, under the guidance of PMNM resource monitors that accompany this project. The exact loactions are still to be decided.

5b. Check all applicable regulated activities proposed to be conducted in the Monument:

Removing, moving, taking, harvesting, possessing, injuring, disturbing, or damaging any living or nonliving Monument resource

- Drilling into, dredging, or otherwise altering the submerged lands other than by anchoring a vessel; or constructing, placing, or abandoning any structure, material, or other matter on the submerged lands
- Anchoring a vessel
- Deserting a vessel aground, at anchor, or adrift
- Discharging or depositing any material or matter into the Monument
- Touching coral, living or dead
- Possessing fishing gear except when stowed and not available for immediate use during passage without interruption through the Monument
- Attracting any living Monument resource
- Sustenance fishing (Federal waters only, outside of Special Preservation Areas, Ecological Reserves and Special Management Areas)
- Subsistence fishing (State waters only)
- Swimming, snorkeling, or closed or open circuit SCUBA diving within any Special Preservation Area or Midway Atoll Special Management Area

6. Purpose/Need/Scope *State purpose of proposed activities:*

The purpose of our proposed activities is to collect imagery and sediment samples to assess the impacts of recent hurricane events and accelerated sea-level rise upon islands and the nearshore environment. This work is needed in order to monitor and track changes in island erosion and accretion, and future island sediment availability. Our activities will improve understandings of potential loss and recovery of essential habitats for priority species. This information will provide guidance for PMNM managers tasked with developing responsive management plans.

Atoll reef islands within the PMNM, provide critical nesting habitat for 96% of the population of the threatened Hawaiian green sea turtle (*Chelonia mydas*), one-third of the population of endangered Hawaiian monk seal (*Monachus schauinslandi*), and the largest colony of tropical seabirds in the world (Baker et al., 2006; Reynolds, et al., 2012). These critical species require stable island habitats that are becoming increasingly threatened by sea level rise (Anderson et al., 2018; Romine et al., 2013) and more frequent tropical cyclone activity (Murakami et al., 2013). In 2018, FFS received international attention after East Island was removed in its entirety following a direct hit from Walaka, a category three tropical cyclone. Since 2018 reefs and islands have both accreted and eroded by bio-geological processes that are still not fully understood.

Our activities bridge this gap in knowledge by employing non-invasive interdisciplinary approaches to address management and conservation questions during a time when impacts related to environmental change are accelerating. We propose to do the following: 1.) Collect RTK-GPS data and aerial imagery using an unmanned aerial system (UAS) at three islands within FFS. 2.) Collect sediment samples (total: 200, $\frac{3}{4}$ cup volume) from the shallow marine environment (80, $\frac{3}{4}$ cup volume), and modern beach face (100, $\frac{3}{4}$ cup volume) at three islands within FFS. In addition at Tern Island two shallow trenches will be sampled (not to exceed a total of 20 samples, $\frac{3}{4}$ cup volume) to compare pre and post-Walaka derived sediments.

The research activities of this project build upon a 2018 and 2021 data collection effort focused on assessing the impacts of sea level rise upon FFS. Pre (July 2018) and post (2023) Walaka UAS derived datasets will be compared to quantify island-specific volumes of sediment gains and losses. Furthermore pre and post-Walaka sediment analyses will elucidate shifts in island sediment composition and identification of island sediment sources from the nearshore reef. The resulting data of the activities proposed in this study will be critically valuable to better understandings of the timescales and spatial extent of island vulnerability and the potential for natural recovery following environmental stressors. The application and relevance of the products produced by the proposed activities extend beyond FFS and are applicable both across PMNM and to other low-lying island ecosystems such as the Maldives (Indian Ocean), Tuvalu, Kiribati and the Marshall Islands (Pacific).

References

Baker, J. D., Littnan, C. L. & Johnston, D. W., 2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. *Endanger. Species Res.* 2, 21–30.

Reynolds, M., Berkowitz, P., Courlot, K. N. & Krause, C. M., 2012. Predicting Sea-Level Rise Vulnerability of Terrestrial Habitat and Wildlife of the Northwestern Hawaiian Islands.

Anderson, T. R. et al., 2018. Modeling multiple sea level rise stresses reveals up to twice the land at risk compared to strictly passive flooding methods. *Sci. Rep.* 8.

Romine, B. M., Fletcher, C. H., Barbee, M. M., Anderson, T. R. & Frazer, L. N., 2013. Are beach erosion rates and sea-level rise related in Hawaii? *Glob. Planet. Change* 108, 149–157.

Murakami, H., Wang, B., Li, T. & Kitoh, A., 2013. Projected increase in tropical cyclones near Hawaii. *Nat. Clim. Chang.* 3, 749–754.

*Considering the purpose of the proposed activities, do you intend to film / photograph federally protected species beyond the protocols provided in PMNM Best Management Practices (<https://www.papahanaumokuakea.gov/permit/bestmanagement.html>)? Yes No

If so, please list the species you specifically intend to target.

We do not plan to specifically target protected species. However, we will be using a drone to collect imagery of the islands, and nearshore environment, thus our images may ultimately capture endangered species.

For a list of terrestrial species protected under the Endangered Species Act visit:

<http://www.fws.gov/endangered/>

For a list of marine species protected under the Endangered Species Act visit:

<http://www.nmfs.noaa.gov/pr/species/esa/>

For information about species protected under the Marine Mammal Protection Act visit:

<http://www.nmfs.noaa.gov/pr/laws/mmpa/>

7. Answer the Findings below by providing information that you believe will assist the Co-Trustees in determining how your proposed activities are compatible with the conservation and management of the natural, historic, and cultural resources of the Monument:

The Findings are as follows:

a. How can the activity be conducted with adequate safeguards for the cultural, natural and historic resources and ecological integrity of the Monument?

The activities proposed will be conducted with adequate safeguards for the resources and ecological integrity of the Monument. We acknowledge that there are concerns with disturbing sediment from the islands and nearshore. We welcome discussion with PMNM staff including cultural experts to ensure that our research is conducted in a manner that is respectful of the place, and its cultural, natural, and historical resources. All survey and sample locations will be conducted at sites determined by the Dr. Kane, under the guidance of PMNM resource monitors that accompany this project. For sediment sample collection at Tern Island we will consult USFWS contaminants biologists. Collection equipment will be inspected and disinfected between sampling different areas to mitigate for the spread of aquatic invasive species, coral disease or other pathogens or parasitic organisms. Best efforts will be made to ensure that the collection of samples is conducted in such a manner as the process does not result in any additional harm to surrounding marine or terrestrial organisms.

As a means to ensure that our research aligns with PMNM we will follow best management practices for moving between islands, boat operations and unmanned aerial systems. We will be operating a drone to collect high-resolution imagery of FFS islands. In July 2018 Dr. Chip Fletcher's team successfully collected drone imagery and constructed 3D, Digital Evolution Models (DEMs) of East Island, and Gin Island. This baseline data will be compared to 2023 3D DEMs to quantify changes in the volume of sediment loss and gain following Hurricane Walaka. Dr. Kane and Kainalu are both DOT/FAA certified remote pilots and have experience piloting UAS in the main Hawaiian islands and aim to work with PMNM resource monitors to assure that we make every effort to follow established drone protocols and best management practices. We will also seek guidance from the PMNM before any UAS derived data is made publicly available.

Our research group will pay respect and conduct culturally appropriate protocols at each island visited as well as throughout the research to continue to connect to place and stay grounded as a group. We will have group discussions centered around huli 'ia, a tool developed by the non-profit organization Nā Maka Onaona, to document environmental observations experienced through all of our senses while in Papahānaumokuākea. Researchers will participate in discussions contributing their observations sharing noticeable dominant characteristics of Iani (sky), honua (earth), and kai (ocean) as a way to characterize that time (season) and space (Papahānaumokuākea). This broader holistic view will support our research team in intimately understanding moods and characteristics of Papahānaumokuākea and through this documentation process, supports the development of best practices enabling communities to adjust and adapt their activities to assist in mālama 'āina (care for the land). In addition as a part of our cultural plan, we will provide data and information to assist the Cultural Working Group's effort to develop Hawaiian names and descriptions for new processes and spaces that may be encountered in the island and in the shallow nearshore environment. Finally, in an effort to create intergenerational capacity building, native Hawaiian students and early scholars will be

included in the research team, and be mentored in all aspects from research development, fieldwork, and post-cruise data analysis.

b. How will the activity be conducted in a manner compatible with the management direction of this proclamation, considering the extent to which the conduct of the activity may diminish or enhance Monument cultural, natural and historic resources, qualities, and ecological integrity, any indirect, secondary, or cumulative effects of the activity, and the duration of such effects?

Our research activities will temporarily disturb island sediment at two shallow trenches at Tern Island. However, the lessons learned from our research has the potential for researchers and managers to better plan for the very existence of low lying islands throughout PMNM as hurricane impacts become more prevalent and sea-level continues to rise into the future.

c. Is there a practicable alternative to conducting the activity within the Monument? If not, explain why your activities must be conducted in the Monument.

There is no practicable alternative to conducting activities in the Monument. We are addressing questions that are directly relevant to the very existence of critical habitat within the Monument in a future of increased impacts related to more prevalent and intense hurricanes and elevated sea level. Hence the study must be carried out within the Monument. We are limiting our study site to three islands at FFS. Lessons learned from FFS are applicable to low lying sandy islands throughout the PMNM. An important implication of this work is relevant to endangered species management plans. As sandy habitat in PMNM becomes unstable as a result of increased storminess and sea level rise the main Hawaiian Islands may be considered as future replacement habitat. Therefore, it is the specific location of PMNM that is necessary for this research.

d. How does the end value of the activity outweigh its adverse impacts on Monument cultural, natural and historic resources, qualities, and ecological integrity?

The management value of data produced by our research activities outweighs the impacts upon Monument resources. FFS has already experienced island lost at Disappearing Island, Trig Island, and most recently East Island following Hurricane Walaka in 2018. Devastating impacts on reefs at FFS have also been documented. Furthermore, a preliminary study by the USGS predicts that under 2 m of sea level rise, five of the nine islands at FFS will be completely submerged assuming a passive inundation model. Here we propose to improve upon previous studies by characterizing Hurricane Walaka impacts and recovery of the critical island and nearshore habitats. This project will contribute to the formulation of monitoring and management action for reefs and island habitats at French Frigate Shoals. Our project will increase conservation and management capacity for mitigating the impacts of hurricane damage and sea level rise thus contributing to the decision-making ability for stewardship of PMNM. Research products produced at FFS are applicable across the PMNM. In addition, we will do our best to ensure that our methods have minimal impact on

monument resources. Finally, we will work with PMNM staff to return samples in a culturally appropriate manner.

e. Explain how the duration of the activity is no longer than necessary to achieve its stated purpose.

The actual fieldwork component of this research involves the minimum time required to obtain the desired data necessary to assess the impacts and recovery of critical habitat following Hurricane Walaka. We anticipate spending approximately a day at each island to collect sediment and survey data

f. Provide information demonstrating that you are qualified to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.

Haunani H. Kane (Assistant Professor in the School of Earth Sciences at the University of Hawai'i at Mānoa). Dr. Kane is a coastal geologist who studies the impacts of sea level rise and storms upon atoll reef islands like those at French Frigate Shoals. Dr. Kane was a part of the team that collected the baseline data, Pre Walaka data in July of 2018. Dr. Kane returned in 2019 with the FWS and NOAA to assist with debris removal following Hurricane Walaka and field camp set up at Tern Island. Most recently in the summer of 2021, Dr. Kane was the lead scientist on a research voyage to FFS and Nihoa. Led by Dr. Kane, this cruise was the first time that an entire crew of Native Hawaiian scientists conducted research in PMNM under a research permit. Haunani's previous research modeled future impacts of coastal erosion and sea level rise upon cultural assets (Journal of Coastal Research, 2012), and Hawaiian wetlands (Climatic Change, 2015; Regional Environmental Change, 2015). Haunani has investigated the impacts of sea level rise upon islands within Sāmoa (Quaternary Research, 2017; The Holocene, 2015), and the Republic of the Marshall Islands (Earth's Futures, 2020). Haunani has worked with the USGS to collect sediment data that contributed to a 700-year paleotsunami record for Hawai'i (Sedimentology, 2019). Haunani has published 8 peer-reviewed manuscripts and presented her research to the PMNM Board (January 2020), the NOAA monk seal and turtle science teams, FWS (2022-2023) and numerous local and international conferences. Haunani also has experience advising graduate students, is a member of the Native Hawaiian Cultural Working Group, and is a research representative for the PMNM Research Advisory Council. More information on Haunani's research can be found at haunanikane.com

Kainalu Steward (Arizona State University Graduate Researcher & Drone Operator): Kainalu recently graduated with his M.S in Tropical Conservation Biology and Environmental Science at the University of Hawai'i at Hilo working under the advisement of Dr. Kane. Kainalu conducted a shoreline change analysis project to understand the recovery process of FFS from Hurricane Walaka and identify seasonal rates of island erosion and accretion. Kainalu is currently a PhD student at Arizona State University in the School of Geographical Sciences and Urban Planning working closely with Dr. Kane to continue mapping shoreline change at FFS. Kainalu is a FAA

certified drone pilot (certification #4574280) and has experience conducting surveys at different sites across Hawai'i island. Kainalu was a participant on the 2021 research voyage led by Dr. Kane to FFS and Nīhoa, and is well versed in best management practices and cultural protocol for collecting sediments and survey data. Kainalu has also been on two other deep sea exploration vessels to PMNM as a intern with the Ocean Exploration Trust in 2021 and 2022.

Brianna Ninomoto (University of Hawai'i at Hilo Graduate Researcher & Survey technician): Brianna is currently a M.S student in the Tropical Conservation Biology and Environmental Science program at the University of Hawai'i at Hilo. Since starting the program in the Fall of 2022, Brianna has worked closely with Dr. Kane and Kainalu on conducting UAS and RTK-GPS surveys at sites across Hawai'i Island. Brianna has experience post processing this type of mapping data and creating 3D digital reconstructions and DEMs of coastal ecosystems. Brianna will assist in the surveying fieldwork and collection of sediment samples.

g. Provide information demonstrating that you have adequate financial resources available to conduct and complete the activity and mitigate any potential impacts resulting from its conduct.

We currently have funding from the University of Hawaii to support the activities outlined in this permit. We are also seeking additional funding through grants to support data analysis and student support.

h. Explain how your methods and procedures are appropriate to achieve the proposed activity's goals in relation to their impacts to Monument cultural, natural and historic resources, qualities, and ecological integrity.

Our surveying methods and procedures are designed to be as un-invasive and thorough as possible. We utilize a unique approach to assessing the impacts and recovery of the island and shallow reef environments to decipher the dynamics between sediment production at reefs and sediment delivery to adjacent islands. We have successfully implemented our methodologies in similar studies at 'Upolu Island, Sāmoa, the Republic of the Marshall Islands, and at FFS in July of 2018 and 2021. Our island surveys will enable 3D reconstructions of island and nearshore environments. These methods are non-invasive and provide high-resolution data pertaining to island topography that cannot be acquired from remotely sensed satellite imagery. Sediment sampling will enable island sediment sources and availability from the shallow marine environment to be quantified. Comparisons to data collected in 2018 and 2021 provide baselines for detecting changes in island and reef sediment sources following Hurricane Walaka. Ultimately this work will provide the PMNM with a comprehensive and robust dataset pertaining to the vulnerability and or resiliency of atoll reef islands systems to environmental stressors such as storms and sea level rise. Islands and corals are cultural and ecological resources that provide critical habitat to a multitude of marine and terrestrial species.

i. Has your vessel been outfitted with a mobile transceiver unit approved by OLE and complies with the requirements of Presidential Proclamation 8031?

j. Demonstrate that there are no other factors that would make the issuance of a permit for the activity inappropriate.

There are no other factors that would make the issuance of a permit for our proposed activities inappropriate.

8. Procedures/Methods:

1.) UAS + RTK-GPS island surveys

Topographic or island elevations will be acquired from UAS imagery. We propose to collect high resolution imagery of 3 islands (Gin, East, and Tern Islands) and the surrounding nearshore environment using a UAS equipped with an internal GPS and a camera. Brand new canvas targets that follow quarantine protocols (1 m x 1 m) will be laid out on the island at the time that imagery is collected and later surveyed with an RTK-GPS for ground control. The RTK-GPS includes a fixed base station that will sit on a tripod during the duration of the survey. The rover system is attached to a pole, and the surveyor will transport the rover to each survey site (corners of trenches, GPS control points, and geological features). UAS imagery and GPS control points will be post-processed at the University of Hawai'i. A topographic DEM of each island will be derived from UAS imagery using Structure-from-Motion.

2.) Sediment collection

We propose to collect no more than 200 sediment samples (not to exceed $\frac{3}{4}$ cup volume) from the shallow marine environment (80, $\frac{3}{4}$ cup volume), and modern beach face (100, $\frac{3}{4}$ cup volume). Sampling the shallow seafloor will involve a small team (at least 2 people) deploying a benthic sediment sampler from a small boat operated by the crew. The benthic sediment sampler will be tethered to the boat. If necessary, the team may also enter the nearshore marine environment with snorkel gear to recover sediment. We will follow the protocols from the PMNM Boating and Diving BMP. We will avoid contact with live corals and take great care when navigating around islands so that corals are not impacted by our work.

No more than 100 sediment samples will be collected from the beach face at Gin, East, and Tern island. At Tern Island two shallow trenches will be sampled (not to exceed a total of 20 samples, $\frac{3}{4}$ cup volume) to compare pre and post Walaka derived sediments. We anticipate trenching along the beach side of the runway as this site was noted in 2019 to have Walaka lagoon sediments deposited upon the Pre Walaka soil and subsurface sand layer. Trenches will not exceed 1 m x 1 m x 1 m in size. Trenches will be opened only long enough to be described, sampled (no more than 20 samples total), and photographed. Each trench will be backfilled with preexisting sediment. We don't anticipate any trenches being left unattended or opened overnight. We hope these measures will limit the potential for a listed species (turtle or monk seal) from

entering the trench. Furthermore, we will consult with the resource monitor that accompanies us on our proposed project and the USFWS contaminants biologist to determine the safest place to excavate at Tern island.

Sediment samples will be taken back to the University of Hawai'i for compositional analysis under the microscope, and radiocarbon dating. Upon completion of analyses, samples will be returned to PMNM under the guidance of PMNM staff including the OHA.

NOTE: If land or marine archeological activities are involved, contact the Monument Permit Coordinator at the address on the general application form before proceeding.

9a. Collection of specimens - collecting activities (would apply to any activity): organisms or objects (List of species, if applicable, attach additional sheets if necessary):

We will not collect any living specimens however we do anticipate collecting skeletal reef derived material in the beach and nearshore sediment samples. Anticipated organisms include sand-sized fragments of unidentified coral species, red calcareous algae, green calcareous algae (*Halimeda*), mollusks, and foraminifera (e.g. *Amphistigena*).

Common name:

Scientific name:

& size of specimens:

Not to exceed 200 samples, each approximately $\frac{3}{4}$ cup in size.

Collection location:

Gin, East, and Tern Island.

Whole Organism Partial Organism

9b. What will be done with the specimens after the project has ended?

Specimens will be returned to PMNM staff under the guidance of PMNM. The Office of Hawaiian Affairs will be consulted for cultural guidance.

9c. Will the organisms be kept alive after collection? Yes No

No live organisms will be sampled.

• General site/location for collections:

Gin, East, Tern Island

- Is it an open or closed system? Open Closed

N/A

- Is there an outfall? Yes No

N/A

- Will these organisms be housed with other organisms? If so, what are the other organisms?

N/A

- Will organisms be released?

N/A

10. If applicable, how will the collected samples or specimens be transported out of the Monument?

Sediment and fossil reef samples will be stored in sample bags and transported out of the monument on the chartered vessel.

11. Describe collaborative activities to share samples, reduce duplicative sampling, or duplicative research:

All results, imagery, and products will be made publicly available, and provided to PMNM.

12a. List all specialized gear and materials to be used in this activity:

Shovel

Elevation survey equipment (total station, tripod, survey rod, survey ribbon, survey prism, canvas targets, brunton compass, RTK GPS base station and rover, etc.)

Tide gauge (water level sensor that records temperature, water elevation and salinity) DJI Phantom 4 Pro drone (lithium batteries, iPad)

Miscellaneous tools (handheld GPS, notebooks, walkie talkies, cameras, measuring tape, etc)

Snorkeling gear (mask, fins)

Sample bags and vial

12b. List all Hazardous Materials you propose to take to and use within the Monument:

Lithium batteries for the drone & GPS

13. Describe any fixed installations and instrumentation proposed to be set in the Monument:

N/A

14. Provide a time line for sample analysis, data analysis, write-up and publication of information:

Sample analysis, data analysis, and write-up/publication of information will be completed within 24 months of the proposed research cruise.

15. List all Applicants' publications directly related to the proposed project:

- *Kane, HH, Fletcher, CH. Rethinking reef island stability in relation to future sea level rise. Earth's Future. In Review.
- *Kane, HH, Fletcher, CH, Cochrane, EE, Mitrovica, JX, Habel, S, Barbee, M. 2017. Coastal plain stratigraphy records tectonic, environmental, and human habitability changes related to sea-level drawdown, 'Upolu, Samoa. Quaternary Research 87: 246-257.
- *Kane, HH, Fletcher, CH, Frazer, LN, Anderson, T, Barbee, M. 2015. Modeling sea level rise vulnerability of coastal environments using ranked management concerns. Climatic Change 131: 349-361.
- *Kane, HH, Fletcher, CH, Frazer, N, Barbee, M. 2015. Critical elevation levels for flooding due to sea-level rise. Regional Environmental Change. Regional Environmental Change 15: 1679-1687.
- *Kane, HH, Fletcher, CH, Romine, BM, Anderson, TR, Frazer, NL, Barbee, MM. 2012. Vulnerability Assessment of Hawai'i's Cultural Assets Attributable to Erosion Using Shoreline Trend Analysis Techniques. Journal of Coastal Research 28: 533-539.

With knowledge of the penalties for false or incomplete statements, as provided by 18 U.S.C. 1001, and for perjury, as provided by 18 U.S.C. 1621, I hereby certify to the best of my abilities under penalty of perjury of that the information I have provided on this application form is true and correct. I agree that the Co-Trustees may post this application in its entirety on the Internet. I understand that the Co-Trustees will consider deleting all information that I have identified as “confidential” prior to posting the application.



Signature

Date

**SEND ONE SIGNED APPLICATION VIA MAIL TO THE MONUMENT OFFICE
BELOW:**

NOAA/Inouye Regional Center
NOS/ONMS/PMNM/Attn: Permit Coordinator
1845 Wasp Blvd, Building 176
Honolulu, HI 96818
FAX: (808) 455-3093

DID YOU INCLUDE THESE?

- Applicant CV/Resume/Biography
- Intended field Principal Investigator CV/Resume/Biography
- Electronic and Hard Copy of Application with Signature
- Statement of information you wish to be kept confidential
- Material Safety Data Sheets for Hazardous Materials