**NATIONAL SCIENCE FOUNDATION**

**AMENDED RECORD OF DECISION**

## I. INTRODUCTION

Arecibo Observatory is a National Science Foundation (NSF)-owned scientific research and education facility. For many years, Arecibo Observatory enabled research in three scientific disciplines: space and atmospheric sciences, radio astronomy, and solar system radar studies. An education and public outreach program has also been a significant component of the Arecibo Observatory scientific program.

A key feature of Arecibo Observatory's research facility was a 305-meter-diameter, fixed, spherical reflector[1]. The infrastructure at the Arecibo Observatory site (AO site) included instrumentation for radio and radar astronomy and ionospheric physics, office and laboratory buildings, a visitor and education facility, and lodging facilities for visiting scientists. On December 1, 2020, the 305-m telescope platform (305-m telescope) collapsed when cables supporting it failed. Emergency clean-up operations were conducted and the site was ultimately stabilized.

In June of 2021, NSF brought individuals from a variety of disciplines together at the Arecibo Observatory Options Workshop (Workshop) to explore potential pathways for the future of the AO site. Multiple competing ideas based on the science or application were considered – whether astronomy, planetary science, atmospheric and geospace sciences, or monitoring of potentially hazardous near-Earth objects (PHOs). One area where there was overwhelming consensus was the outstanding educational and STEM outreach legacy of Arecibo Observatory. In 2022, NSF determined that, since the 305-meter telescope is no longer operational, and consistent with what was learned during the 2021 workshop, it would be appropriate to consider a new model that would enable both science education-focused operations and selected merit reviewed scientific research to continue at the AO site (Proposed Action), even as the 305-meter telescope[2] is no longer operational.

NSF is committed to fostering vibrant scientific and engineering ecosystems throughout the country and remains focused on exploring how the AO site can be a catalyst for inspiring STEM talent and innovation in Puerto Rico for decades to come. The Proposed Action is consistent with this commitment as it would support, within a constrained budgetary environment, education-focused activities and potential meritorious scientific research at the AO site. As a result, in reaching its decision, NSF considered many aspects of the Proposed Action, including the impacts of the collapse of the 305-m telescope on the remainder of the AO site, the strong legacy of educational programs at the AO site, budgetary constraints, the viability of a collaborator to carry out the Proposed Action at the AO site, and the environmental consequences of the Proposed Action and their associated mitigation measures. After conducting a thorough review and consideration of these factors and the entire administrative record, NSF concludes that the

[1] The 305-meter telescope has also been referred to as the "William E. Gordon Telescope," the "305-meter-diameter radio telescope," or the "Arecibo Radio Telescope."

Proposed Action represents an opportunity to continue operations at this important and historically significant scientific facility that provides useful and innovative STEM educational activities and selected scientific research. Based on the reasoning set forth more fully below, NSF hereby selects the Proposed Action as the path forward for the AO site.

## II. BACKGROUND

### A. Collapse of the 305-Meter Telescope

A series of cable failures over several months in the second half of 2020 eventually led to the collapse of the 305-m telescope on December 1, 2020. Events relating to the 305-m telescope that are pertinent to this agency decision include the following (see https://www.nsf.gov/news/special_reports/arecibo/ for additional details):

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| August 10, 2020: | A 305-meter telescope cable failed; in response, the current managing organization, the University of Central Florida (UCF), engaged Thornton Tomasetti to be the Engineer of Record for the necessary repairs to stabilize the structure. |
| November 6, 2020: | A second cable failed. |
| November 19, 2020: | NSF adopted Thornton Tomasetti's recommendation to decommission the 305-m telescope. |
| December 1, 2020: | The 305-m telescope collapsed on its own when additional cables failed; Thornton Tomasetti was retained to perform a forensic investigation of the cable failures and telescope collapse, as well as to conduct emergency clean-up activities, with UCF and NSF; NSF provided initial notifications to the Puerto Rico State Historic Preservation Officer (PR SHPO), the Advisory Council on Historic Preservation (ACHP), the National Park Service (NPS), and environmental agencies regarding the collapse. |
| January 27, 2021: | NSF provided the PR SHPO with a written update on unanticipated effects at the AO site and notification of a screening process (including coordination with the Smithsonian Institution) for items of potential historical importance in the debris. |
| March 10, 2021: | NSF issued a Dear Colleague Letter: Intent to support a Workshop to Explore Novel Ideas for Future Scientific, Educational, and Cultural Activities with the Arecibo Observatory (NSF 21-055). |
| April-June 2021: | NSF hosted the Workshop. |
| November 17, 2021: | An "Update on Arecibo Observatory Cleanup" was posted to the above-referenced website, describing the completed emergency cleanup activities. |
| December 7, 2021: | NSF, Jacobs Engineering, and Thornton Tomasetti provided an update (via a virtual meeting) to the PR SHPO, the ACHP, and interested parties to describe the completion of the emergency cleanup and stabilization activities. |

Ultimately, 14,000 damaged panels out of the 39,000 total panels (approximately 35%) were removed and 225 feet of the concrete rim wall was repaired. A hurricane-proof temporary roof

was placed on the damaged Learning Center and permanent repairs in alignment with the original design were implemented. Minor repairs to the Science and Visitor Center were completed. The Cable Car House had sustained damage, but the contributing portion of this structure was retained with minor repairs and stabilization. The three towers, each of which lost the top portion during the collapse, were stabilized and appropriate repairs were made (scaffolding was erected, cracked and loose concrete was removed, structural testing was performed, and the tops of the towers were leveled and sealed to protect them from water intrusion). (View the Update on Arecibo Observatory Emergency Cleanup (found at the above referenced website) for additional details and photographs.)

### B. Proposed Path Forward

As mentioned above, in June of 2021, NSF held the Workshop to engage individuals interested in exploring novel ideas for future scientific, educational, and cultural activities at the AO site. The Workshop focused on finding actionable and innovative ways to support, broaden, and strengthen the radio science community across Puerto Rico and to create or enhance opportunities for scientific, educational, and cultural activities, as well as public outreach, at the AO site. Participation in this Workshop was open to all who submitted their ideas via an application form, and participants at universities, colleges, and non-academic organizations (such as museums) in Puerto Rico were particularly encouraged to contribute. The broad theme of the Workshop provided a multifaceted approach supporting any or all of the following: next generation science in astronomy, atmospheric and geospace sciences, planetary radar or related fields; inclusive educational and cultural programs; and robust radio science programs, including engineering and instrumentation. Participants were encouraged to think about the intersection of these themes and to explore ideas that would bring people from these various fields together to support and learn from one another. On the final day of the Workshop, eight teams gave presentations describing the projects they had been developing over the course of the month. All presentations acknowledged the significant impact of the educational programs and outreach efforts led by the Arecibo Observatory over several decades.

After considering the impact of the collapse of the 305-m telescope on the AO site and the outcomes of the Workshop, NSF determined that it would be reasonable to pursue a transition to education-focused operations with selected scientific research at the AO site (the Proposed Action). To determine the viability of the Proposed Action, NSF, in October of 2022, solicited proposals for the establishment of the Arecibo Center for STEM Education and Research (ACSER) at the AO site. The solicitation (NSF #23-505) sought proposals that would transition the existing AO site to the new ACSER, shifting the disciplinary focus from (primarily) the astronomical sciences to science, technology, engineering, and mathematics (STEM) education and, more broadly, research. The ACSER, as proposed, would have a significant role in modeling and advancing equitable and inclusive STEM education and research, especially in Puerto Rico and for individuals and communities underrepresented in STEM. Funded at $5 million dollars over five years, the ACSER would be poised to serve as a catalyst for increased and inclusive engagement in a broad range of STEM disciplines, cutting-edge research, and workforce development initiatives by students, teachers, researchers, local communities, and the public within and outside of Puerto Rico. In February 2023, NSF received several viable ACSER proposals, which were reviewed and considered under the agency's merit review criteria and process. Accordingly, NSF considered the Proposed Action to be viable.

## III. ENVIRONMENTAL COMPLIANCE

Prior to the issuance of its 2017 Record of Decision concerning the future of the AO site (see Attachment A), NSF conducted a comprehensive environmental review of a range of Action Alternatives to address potential funding changes at the AO site. The environmental review included preparation of an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act, 43 U.S.C. §§ 4321, *et seq.* (NEPA), its implementing regulations at 40 C.F.R. Parts 1500-1508, and NSF's supplemental NEPA regulations at 45 C.F.R. Part 640; preparation of a Programmatic Agreement under Section 106 (54 U.S.C. § 306108) of the National Historic Preservation Act of 1966, as amended (54 U.S.C. §§ 300101 *et seq*.) (NHPA) and the NHPA's implementing regulations, "Protection of Historic Properties" at 36 C.F.R. Part 800; and Section 7 of the Endangered Species Act, 16 U.S.C. §§ 1531, *et seq.* (ESA). As set forth more fully below, NSF reviewed its 2017 environmental review to determine if it was applicable to the Proposed Action, and, if so, whether it needed to be updated.

NSF ultimately concluded that the Proposed Action generally fits within the description and analysis of Action Alternative 2– *Collaboration with Interested Parties for Transition to Education-focused Operations with Reduced NSF Funding* in the 2017 EIS, although the Proposed Action is anticipated to result in fewer environmental impacts since it does not contemplate the transfer of the AO site out of federal ownership. Moreover, NSF determined that there was no significant new information that would require supplementation of the 2017 EIS. Thus, NSF's 2017 NEPA analysis applies to the Proposed Action. Regarding NSF's Section 106 compliance, after considering the 2017 Programmatic Agreement, NSF determined that a new Programmatic Agreement would need to be prepared for the Proposed Action. Finally, NSF determined that its 2017 finding under Section 7 of the ESA needed to be updated to further consider the Proposed Action's potential impacts on the endangered Puerto Rico parrot. NSF's additional environmental compliance activities beyond the 2017 environmental review are set forth below.

### A. NEPA Compliance

#### 1. The 2017 EIS Process

On August 4, 2017, NSF published a Notice of Availability in the Federal Register of its Final Environmental Impact Statement (FEIS), which analyzed the anticipated environmental impacts associated with potential funding changes for the Arecibo Observatory in Arecibo, Puerto Rico. 82 Fed. Reg. 36456 (August 4, 2017). In the FEIS, NSF considered the following Action Alternatives: Alternative 1 – *Collaboration with Interested Parties for Continued Science-focused Operations with Reduced NSF Funding;* Alternative 2 – *Collaboration with Interested Parties for Transition to Education-focused Operations with Reduced NSF Funding;* Alternative 3 – *Mothballing Facilities;* Alternative 4 – *Partial Demolition and Site Restoration;* and Alternative 5 – *Complete Demolition and Site Restoration.* NSF also analyzed a No-Action Alternative. The environmental resources evaluated in the FEIS included biological resources, cultural resources, geology and soils, groundwater, hazardous materials, solid waste, health and safety, noise, socioeconomics, traffic and transportation, and visual resources. (For a full description of the anticipated environmental impacts and an analysis of those impacts associated with each Action Alternative and the No-Action Alternative, see the FEIS, which is fully incorporated herein by reference.)

On November 15, 2017, NSF executed a Record of Decision (ROD), which memorialized its decision to select and implement NSF's Preferred Alternative, Action Alternative 1– *Collaboration with Interested Parties for Continued Science-focused Operations with Reduced NSF Funding* (see Attachment A). This concluded the agency's 2017 decision-making process with respect to the general path forward for the facility's operations in a budget-constrained environment. The ROD also provided the basis for a 2018 decision regarding a new collaborator, UCF, to serve as the AO site operator from April 1, 2018 to the present.

### 2. NEPA Review following the Collapse of the 305-m Telescope

In December of 2020, following the collapse of the 305-m telescope, the main scientific instrument at the AO site, it was clear that continued implementation of Action Alternative 1 was no longer feasible. As explained above, after considering the results of the Workshop and following a determination of viability of a collaborator to carry out a transition to education-focused operations at the AO site, NSF determined that it would be reasonable to pursue consideration of the Proposed Action through a flexible model that included education-focused operations and selected scientific research at the AO site. NSF then reviewed the comprehensive environmental analysis it completed in 2017, to determine its applicability and whether additional NEPA review would be required.

NSF first considered whether the "Purpose and Need" identified in the 2017 EIS was applicable to the Proposed Action. In 2017, the "Purpose" of the proposed agency action was to substantially reduce NSF's contribution to the funding of Arecibo Observatory. The "Need" for the agency action was based on evaluations by the scientific community indicating that the scientific capability of Arecibo Observatory is lower in priority than other scientific capabilities funded by NSF and the importance of NSF maintaining a balanced research portfolio with the largest science return for the taxpayer dollar, especially in a funding-constrained environment. This situation is still true today, even more so given the 2020 collapse of the 305-m telescope. Therefore, the Purpose and the Need as defined in 2017 are applicable to the Proposed Action.

NSF next reviewed the 2017 EIS to determine if Action Alternative 2 – *Collaboration with Interested Parties for Transition to Education-focused Operations with Reduced NSF Funding* needed to be updated to apply to the Proposed Action. As described in the 2017 EIS, Action Alternative 2 would involve collaborating with outside entities to operate and maintain the AO site as an education-focused operation. An official collaboration would be created to keep the science center open for students and visitors. New collaborators could include Commonwealth agencies, educational institutions, industrial or commercial ventures, or private individuals. This aspect of the description is consistent with what is contemplated under the Proposed Action. Under Action Alternative 2, NSF could either transfer or retain the property, however, under the Proposed Action, NSF has no intention to transfer the property out of federal ownership.

Under both the 2017 Action Alternative 2 and the Proposed Action, the visitor center, learning center, and 12-meter telescope would remain operational, although under the Proposed Action, the 12-meter telescope would be safely stowed unless a successful proposal to use it is awarded. In the 2017 EIS, Action Alternative 2 calls for the 305-m telescope to be made inoperable but retained for visual/historical interest. Under the Proposed Action, the 305-m telescope is already inoperable, and it is being retained for visual/historical interest unless, under the 2023 Programmatic Agreement recently finalized under Section 106 of the NHPA (see Attachment B), a different option is proposed and considered by NSF. In that case, NSF would, as appropriate,

supplement its environmental review.

In the 2017 EIS, Action Alternative 2 noted that buildings/structures not needed to meet the anticipated operations-related goals would be safe-abandoned[2] or demolished and the majority of residential housing and recreational facilities would not be retained.[3] (See Table 2.3-1 in the FEIS for a list of building/structure disposition as analyzed in the FEIS.) Under the Proposed Action, however, there is no current plan to safe-abandon any buildings/structures or demolish the majority of residential housing or recreational facilities (although those activities could be authorized under the Proposed Action, provided that all applicable mitigation measures, the terms of the new Programmatic Agreement, and the requirements established by the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the ESA are followed).

Under both Action Alternative 2 and the Proposed Action, equipment, tools, machinery, furniture, and ancillary items with salvage value that are no longer needed for a proposed education-based facility to operate would be disposed of in accordance with federal law. Existing utilities would be maintained, and there would be site restoration to establish landscaping where buildings/structures were previously located. Likewise, under both Action Alternative 2 and the Proposed Action, landscaped areas would be maintained during operations, and educational activities would continue, even while any demolition activities take place.

In sum, while the description of Action Alternative 2 in the 2017 EIS slightly differs from that of the Proposed Action in that it would allow for the transfer of the property out of federal ownership, the descriptions of the two are essentially the same. Further, there is no significant new information that has come to light indicating that the anticipated environmental impacts associated with Action Alternative 2 in the 2017 EIS now warrants supplemental NEPA review. Therefore, the analysis of environmental impacts associated with Alternative 2 in the 2017 EIS can be applied to the Proposed Action. A summary of the impacts described in the 2017 EIS for

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[2] Safe-Abandonment: To remove a building or facility from service without demolishing it. This includes removing furnishings, disconnecting utilities, and isolating the building/structure from public access by fencing or other means to reduce fall and tripping hazards and preclude vandalism. The building/structure is also made secure from environmental damage due to wind, rain, humidity, and temperature extremes. Pest and insect damage must also be taken into account and biodegradable items must be removed to the maximum extent practicable. Under safe abandonment, there is no intention that buildings/structures would be brought back to operational status.

[3] The anticipated activities to implement demolition activities associated with Alternative 2 include the following:

- Conduct hazardous materials assessment for asbestos-containing material (ACM), lead-based paint (LBP), and other conditions of concern for structures to be demolished. Remediate as necessary.
- Demolish or safe-abandon buildings, structures, and infrastructure that are no longer needed. Concrete buildings would be removed using hammerhoes, jackhammers, and other heavy equipment.
- Segregate, load, and transport waste materials to appropriate offsite landfills and recycling centers.
- Establish soil in areas where buildings/structures were removed from bedrock. Landscape areas of bare soil.

The demolition period for Action Alternative 2 would be expected to take 12 weeks; depending on the availability of funds, activities may be spread out over multiple fiscal years. All demolition work would be conducted within developed areas of the AO site, so there would be no need to construct new access routes to haul debris away and no widening or other improvements to existing roads would occur.

Action Alternative 2, with notes indicating where the anticipated impacts for the Proposed Action may differ, is set forth below.

### 3. Summary of Environmental Impacts

**Biological Resources:** In the 2017 EIS, the impacts anticipated from demolition activities on biological resources under Action Alternative 2 would include direct, minor, adverse, and short-term impacts on common vegetation and wildlife and direct, negligible, adverse short-term impacts on migratory birds and the endangered Puerto Rican boa. There would be indirect, negligible, adverse, and short-term impacts on offsite wetlands and protected plant species. Likewise, under the Proposed Action, the anticipated impacts would be the same. There would be no impacts on biological resources during operations under either Action Alternative 2 or the Proposed Action.

**Cultural Resources:** As described in the 2017 EIS, demolition and operations activities under Action Alternative 2 would result in major, adverse, and long-term impacts on known historic properties that would be considered an adverse effect on historic properties under Section 106 of the NHPA. Major, adverse, and long-term impacts on known historic properties would also result if, under this Alternative, the AO site were transferred to a non-federal entity. This would occur because Section 106 of the NHPA would not apply to activities carried out by a non-federal entity. There would be no impacts on archaeological resources expected during either demolition or operations activities.

The Programmatic Agreement finalized in 2023 for the Proposed Action (see Attachment B), however, requires that a new Section 106 consultation would need to be completed if NSF were to propose demolition of the remains of the 305-m telescope in the future or if NSF were to transfer the AO site out of federal ownership. Thus, this requirement offers some level of protection for both the AO site and the 305-m telescope and, accordingly, reduces the level of adverse impacts on historic resources associated with the Proposed Action.

**Geology and Soils:** Under the 2017 EIS, demolition impacts from Action Alternative 2 on geological features and soils would include negligible adverse, and short-term impacts on topography and soils and minor, adverse, and long-term impacts on karst features. These impacts would be similar under the Proposed Action, although no demolition activities are currently contemplated. There would be no impacts under either the 2017 EIS or the Proposed Action on geological features or soils during operations.

**Groundwater:** Demolition activities for Action Alternative 2 would result in minor, adverse, and short-term groundwater impacts from runoff and negligible, adverse, and long-term impacts on underlying groundwater. These impacts are anticipated to be the same under the Proposed Action, although no demolition activities are currently contemplated. There would be no impacts on groundwater during operations under either Action Alternative 2 or the Proposed Action.

**Hazardous Materials:** A minor to moderate, long-term beneficial impact on the level of site contamination would be expected during demolition under Action Alternative 2, depending on the level of contamination that must be addressed. A minor, adverse, and short-term impact would result from increased use of hazardous materials during demolition. Under the Proposed Action, the impacts would be anticipated to be the same, although no demolition activities are currently contemplated. Under both the Proposed Action and Action Alternative 2, a minor,

long-term benefit would be anticipated to occur from the reduced use of hazardous materials during operations.

**Solid Waste:** Minor, adverse, and short-term solid waste impacts would occur during demolition activities under Action Alternative 2 due to disposal of the debris from demolished structures that could not be reused or recycled. The same impacts would be anticipated under the Proposed Action, although no demolition activities are currently contemplated. There would be no solid waste impacts for either Action Alternative 2 or the Proposed Action during operations.

**Health and Safety:** Negligible, adverse, and short-term impacts on public safety and protection of children during demolition under Action Alternative 2 would be expected. Also under Action Alternative 2, minor, adverse, and short-term impacts on occupational health during demolition may occur. Under the Proposed Action, the impacts are anticipated to be the same, although no demolition activities are currently contemplated. Negligible, adverse, and long-term impacts on public safety could occur during operations under either Action Alternative 2 and the Proposed Action, primarily resulting from the possible reduced capability to observe PHOs.

**Noise:** Negligible, adverse, and short-term noise impacts from construction equipment and increased traffic would be expected during demolition under Action Alternative 2. The anticipated impacts would be the same under the Proposed Action, although no demolition activities are currently contemplated. There would be no noise impacts during operations under either Action Alternative 2 and the Proposed Action.

**Socioeconomics**: Demolition activities under Action Alternative 2 would result in negligible, adverse, and short-term impacts on housing, and minor, adverse, and short-term impacts on education and tourism in the Municipality of Arecibo. The same impacts would be anticipated under the Proposed Action, although no demolition activities are currently contemplated. There would be negligible, short-term benefits on employment, income, and the economy under Action Alternative 2. It is anticipated that the impacts would be the same under the Proposed Action. For both Action Alternative 2 and the Proposed Action, impacts during operations would include negligible, adverse impacts on population, housing, the economy, employment and income. Moderate, adverse, and long-term socioeconomic impacts under both Action Alternative 2 and the Proposed Action would result from fewer regional education activities and STEM opportunities, however, minor, beneficial, long-term impacts on education would be expected from new STEM programs.

**Traffic and Transportation:** Minor, adverse, and short-term impacts on traffic and transportation would be expected during demolition under Action Alternative 2. There would be a minor, adverse, and long-term impact from road damage during demolition activities under Action Alternative 2. The same level of impacts would be anticipated under the Proposed Action, although no demolition activities are currently contemplated. No traffic impacts would be expected under either Action Alternative 2 or the Proposed Action during operations.

**Visual Resources:** Impacts on visual resources during demolition would be moderate, adverse, and long-term under Action Alternative 2. The same level of impacts would be anticipated under the Proposed Action, although no demolition activities are currently contemplated. Minor, adverse, long-term impacts would be expected from operations under both Action Alternative 2 and the Proposed Action.

**Cumulative Impacts:** No adverse cumulative impacts to resources would occur under either Action Alternative 2 or the Proposed Action.

Finally, there is no known significant new information that has come to light since the 2017 analysis was conducted. While the collapse of the 305-m telescope did occur since 2017, the area is stabilized and no additional environmental impacts from the Proposed Action would be anticipated as a result. Therefore, no supplementation of the 2017 EIS is warranted.

### 4. Environmentally Preferable Alternative

NEPA also requires NSF to determine the Environmentally Preferable Alternative. The determination of the Environmentally Preferable Alternative is based on the analysis of environmental impacts presented in Section 4 of the FEIS and summarized above in this Amended Record of Decision. It is also based on the net differences in impacts among the various feasible Alternatives, after all mitigation and monitoring measures are applied. As mentioned earlier, Action Alternative 1 is no longer feasible following the collapse of the 305-m telescope and, thus, cannot be considered further. Similarly, the No-Action Alternative, which would otherwise have the least potential for adverse environmental impacts, does not meet the Purpose and Need of the Proposed Action and, therefore, cannot be considered further.

After eliminating Action Alternative 1 and the No Action Alternative from further consideration, Action Alternative 2 would be the Environmentally Preferred Alternative compared to the other Action Alternatives analyzed in the FEIS. Given that the Proposed Action is, essentially, Action Alternative 2 with reduced adverse impacts, the Proposed Action is the Environmentally Preferred Alternative. Specifically, the net impacts associated with Action Alternative 2 would include no major adverse impacts, other than major adverse and long-term impacts on cultural resources resulting from the potential demolition of any historic resources deemed necessary by a future collaborator(s) and from the potential transfer of the facility to a non-federal entity (in which the protections of the NHPA would be lost). However, the Programmatic Agreement finalized in 2023 for the Proposed Action requires that a new Section 106 consultation would need to be completed if NSF proposed to demolish the remains of the 305-m telescope or transfer the AO site out of federal ownership, thus reducing the adverse impacts on historic resources suffered from those potential actions under Action Alternative 2. Accordingly, NSF has determined that the Proposed Action is the Environmentally Preferable Action Alternative.

## B. Compliance with Section 106 of the NHPA

On October 13, 2022, NSF notified the PR SHPO and the ACHP that it had issued a solicitation for proposals that would transition the AO site from one focused primarily on astronomical sciences to a new science, technology, engineering, and mathematics (STEM) education and research center. NSF provided a summary of the goals and functions for the proposed new center and noted that proposals would be due February 28, 2023. NSF further stated that its environmental review, including Section 106 compliance, would occur after it received and reviewed the proposals and identified potential proposals to consider for funding. NSF explained that it would not know until that time whether the Proposed Action was viable. NSF also provided the PR SHPO and the ACHP with a status update in early February of 2023.

Following the February 28th deadline for proposals submitted in response to NSF's solicitation, NSF conducted a preliminary review of proposals and determined that there were multiple

proposals submitted that met the requirements of the solicitation and would move the proposals forward to the merit review phase; therefore, it was appropriate to re-open Section 106 consultation on NSF's proposal to shift operations from science-focused operations to a more flexible approach that would enable both science- and science education-focused operations to continue at the AO site, even as the 305-m telescope is no longer operational. On March 30, 2023, NSF sent a letter to the PR SHPO reinitiating Section 106 consultation, confirming the Area of Potential Effects (APE), the historic properties affected, and NSF's adverse effect finding (noting that the effects would remain the same as those evaluated during the 2017 consultation). In its letter, NSF also requested the PR SHPO's concurrence on these findings, explaining that the Proposed Action generally fits within the definition of Action Alternative 2, which had been evaluated during the 2017 consultation. NSF provided the letter to the ACHP as well as to additional Consulting Parties who eventually, as explained above, referred to themselves as the, "Archaeology Working Group." NSF invited the PR SHPO, the ACHP, and the Archaeology Working Group to attend a consultation meeting on May 3rd, 2023.

The parties to NSF's Section 106 consultation process held several consultation meetings between early May, 2023, and mid-August, 2023. A draft of a new Programmatic Agreement followed by several revised drafts were prepared by NSF and shared with the parties. The new Programmatic Agreement includes many provisions from the 2017 Programmatic Agreement as well as substantive new provisions, such as a stipulation for a group of preservation experts to conduct a 305-meter Telescope Preservation Options Study and make recommendations to NSF regarding the documentation and preservation of the remains of the 305-m telescope. (See Attachment B). Importantly, the new Programmatic Agreement requires that NSF initiate a new Section 106 consultation process if, in the future, it proposes to demolish the remains of the 305-m telescope or transfer the AO site out of federal ownership. Another stipulation requires that NSF provide a written justification and consult with the PR SHPO prior to the proposed demolition of any historic building. The new Programmatic Agreement also includes clarifications with regard to terminology and the description of the undertaking, an extension of the expiration date to 15 years from the date the Programmatic Agreement is fully executed, the requirement that NSF provide an annual meeting to provide status updates, and the inclusion of a new WHEREAS clause specifying that NSF would maintain the 12-meter telescope on the AO site in a safe stowage status such that it could be put into operation if there were a successful merit reviewed proposal and a team with the appropriate level of expertise to use it. (See Attachment B).

At the close of the last Section 106 consultation meeting on August 14, 2023, all comments provided by all parties were resolved. NSF provided a draft Final Programmatic Agreement on August 15, 2023 to the PR SHPO, the ACHP, and the Archaeology Working Group seeking confirmation that all comments had been appropriately addressed in the document so that it could be prepared for signature. On August 17, 2023, the parties agreed that the document was in final form and ready to be signed. The final PA was signed on _____ (see Attachment B), which concluded NSF's Section 106 consultation obligations.

### C. Compliance with Section 7 of the ESA

Although Action Alternative 2 was included in the 2017 informal consultation with the USFWS, NSF was obligated to consider any new information regarding potential impacts to listed species under the Proposed Action and consult with USFWS as appropriate under Section 7 of ESA. NSF consulted USFWS's Information for Planning and Consultation (IPaC) database and

confirmed that the list of species with the potential to exist at the AO site remains the same as it was in 2017, with no critical habitat present. On April 5, 2023, NSF requested an update from USFWS on the Puerto Rican parrot's current range, given the ongoing population recovery efforts for that species. USFWS contacted the Puerto Rico Department of Natural and Environmental Resources (DNER), the lead agency for managing the wild parrot population in the adjacent Rio Abajo State Forest and reported back to NSF that the parrots are likely to occur within a mile of the site, between the Tanama River and the AO site. Further, USFWS stated that, since the wild population has grown, with an increased number of sightings outside of the forest, NSF should consult on this species as a part of Section 7 consultation under ESA for Action Alternative 2.

On June 29, 2023, NSF initiated informal consultation with USFWS under Section 7 of the ESA and requested concurrence on its determinations with regard to potential effects on listed species from AO site operations under NSF's proposed transition from science-focused operations (with the operation of the 305-m telescope) to education-focused operations (without operation of the 305-m telescope) at the AO site. This letter summarized species survey results from 2021, when NSF consulted with USFWS on an emergency basis regarding the avoidance of impacts to listed species during clean-up activities; during these surveys, Puerto Rican boa and Puerto Rican broad winged hawks were confirmed to be present in the area (with no sightings of parrots during the hawk surveys) and no new listed plant identification during a survey near one of the towers. NSF also confirmed that, under Action Alternative 2, boa protocols would continue to be implemented, NSF would maintain the seasonal restrictions on any demolition activities to avoid the Puerto Rican broad-winged hawk nesting season (December-May), and no work would occur in undisturbed or forested areas in and around the site.

In addition, the letter describes that the 2017 Biological Assessment (BA) (which is incorporated herein by reference) adequately addresses potential impacts of the current proposal on federally listed species, highlighting two updates: (1) the increased likelihood of the presence of Puerto Rican parrots in the vicinity of the Arecibo site, and (2) the changed status of the 305-m telescope since the prior consultation, since it is no longer in-tact and will require different vegetation maintenance.

Regarding the Puerto Rican parrot, the 2017 BA describes it as a cavity-nesting, frugivorous species that is rarely seen far from the forest. The current recovery plan for the Puerto Rican parrot[3] states that nesting occurs seasonally in late February or early March, during the driest time of the year when Sierra palms fruit; this fruit is identified as a primary food for parrots during breeding. Fledgling occurs between 8-11 weeks. No activities are proposed that would involve clearing of forest, so parrot nesting and foraging activities would not be affected by operations under Action Alternative 2. Further, NSF noted that should demolition of buildings occur in the future, seasonal restrictions to protect nesting hawks from disturbance would ensure that construction-related noises would not occur during December-May, which is also inclusive of the typical parrot nesting season. Therefore, NSF determined that the proposed operations under Action Alternative 2, including any future demolition activities, would not affect this species.

[3] USFWS 2009. Recovery Plan for the Puerto Rican Parrot (*Amazona vittata*). Atlanta, Georgia. 75 pp.

Regarding the current status of the 305-m telescope, NSF's letter described that the areas around the remaining components of the 305-m telescope dish would continue to be maintained as they have been, to the extent that this can be done safely, at least until a long-term historic preservation plan has been determined. Other areas that the dish no longer covers may be allowed to revegetate, returning to natural conditions, which could potentially create new habitat for listed species. In the future, NSF may consider historic preservation options for the remaining components of the 305-m telescope, subject to the terms of the 2023 Programmatic Agreement prepared under Section 106 of the NHPA. If at that time NSF proposes to conduct any activities that involve clearing of undisturbed areas (including any newly vegetated areas), NSF will conduct a new Section 7 consultation under ESA, as appropriate.

On June 29, 3023, NSF requested concurrence from USFWS on its findings of no effect on *Tectaria estremerana*, the Puerto Rican broad-winged hawk, the Puerto Rican parrot, the Puerto Rican sharp-shinned hawk, beautiful goetzea, chupacallos, erubia, *Myrcia paganii*, *Schoepfia arenaria*, *Cordia bellonis,* palo de nigua, palo de rosa, uvillo, *Daphnopsis hellerana*, and *Thelypteris verecunda* and a finding of may affect but is not likely to adversely affect the Puerto Rican boa. USFWS provided its concurrence with these findings on July 31, 2023. (See Attachment C.)

### D. Mitigation Measures

Although identified as the Environmentally Preferable Action Alternative, the Proposed Action, could result in several adverse impacts on various resources. To reduce those impacts, which largely stem from any demolition activities deemed necessary by a collaborator(s), NSF has committed to implement the following mitigation measures, which track those set forth for Action Alternative 2 in the 2017 EIS:

**Air Quality**

- Contracts for any demolition work will require idle reduction and proper equipment maintenance to reduce emissions during demolition.

**Biological Resources**

- The expected areas of disturbance that were analyzed to determine potential impacts to protected species will be provided to prospective bidders that propose to provide demolition services. If a bidder indicates that additional areas, including additional or widened roads, will be needed to complete work, NSF will delay the award until additional consultations with USFWS, including additional surveys, have been completed.

- Worksites will be clearly marked, and workers will be instructed to stay within the marked areas.

- Staging areas for any onsite work will be placed in disturbed areas whenever possible.

- If offsite soil is needed to backfill an excavated area, the minimum amount of soil needed will be brought onto the site.

- Landscaped areas will be maintained to avoid the propagation of weed species.

- As appropriate, soil used for planting will be augmented with nutrients, organic matter, or bulking agents to provide an appropriate medium for root establishment and subsequent growth of the species selected for planting.

- Re-landscaping will use non-invasive species and will incorporate native vegetation, if feasible.

- If offsite soil is needed to backfill an excavated area, the minimum amount of soil needed will be brought onto the site.

- A site-specific stormwater pollution prevention plan (SWPPP) will be developed to support the National Pollutant Discharge Elimination System stormwater permit.

- Erosion control measures such as riprap, check-dams, and compost filter berms will be used to protect exposed soil and minimize erosion, scouring, and sedimentation. Good housekeeping measures will be practiced during demolition and the disturbed areas will be revegetated. Steep slopes that are disturbed will be protected with biodegradable erosion control measures. Pre-demolition runoff patterns will be restored upon completion of demolition activities.

- Standard operating procedures for the capture and relocation of Puerto Rican boas (FEIS Appendix 4.1-A) will be used during onsite activities and will be implemented as follows:

  - Key onsite personnel will be trained in the identification of boas and the value of boas and boa conservation by qualified personnel.

  - Daily pre-work surveys of equipment and work areas, including buildings/structures and karst features, will be completed by qualified personnel trained in boa identification and location.

  - Any Puerto Rican boas found on equipment or within the day's work area will be relocated to the designated relocation area south of the staging yard on the eastern side of the AO site; this should be done by an individual authorized by the USFWS and trained in handling Puerto Rican boas.

  - If a Puerto Rico boa is observed in the day's work area, work will be stopped until a qualified wildlife biologist trained in handling Puerto Rican boas can relocate the snake to the designated relocation area or the Puerto Rico boa voluntarily vacates the work area.

- While transfer of the AO site out of federal ownership is not anticipated, should NSF propose to transfer it out of federal ownership in the future, NSF will consult with USFWS, as appropriate, to meet Section 7 consultation requirements and to determine whether any mitigation measures are necessary.

- A pre-demolition survey for any active bird nests will be conducted. If any identified active nests are found, they will be protected from disturbance by a 100-foot nesting buffer, which will remain in place until the young have fledged from the nest.

**Cultural Resources**

- Stipulations specified in the new Programmatic Agreement (see Attachment B) will be implemented, subject to available appropriations and funding priorities. These stipulations, which were reached through consultation with the PR SHPO, the ACHP, and the Archaeology Working Group were developed to address potentially adverse effects on historic properties if Alternative 2 were selected and implemented by NSF. Although the Programmatic Agreement specifically references Alternative 2, NSF considers those references to be interchangeable with and equally applicable to the Proposed Action; as such, all of the stipulations in the 2023 Programmatic Agreement shall apply to the Proposed Action. These stipulations also provide the necessary mitigation to address potentially major impacts to cultural resources under NEPA.

- An unanticipated discovery plan will be developed prior to any demolition activities under the Proposed Action being carried out to address any archaeological resources that might be discovered during demolition.

**Geology and Soils**

- Construction stormwater controls will be implemented and maintained to prevent scour and soil loss from runoff.

- Before any demolition begins, a geophysical survey will be conducted to inspect designated work areas and note any suspected karst features, including sinkholes, solution cavities, and areas of soil subsidence that could be affected by demolition work. The survey will also evaluate soil stability and the vertical and horizontal projection of sinkholes. These features will be avoided when possible and protected with sandbags, nets, and filter fabric. They will be monitored during the work for changes such as soil subsidence, collapse, water infiltration, and clogging.

- A site-specific SWPPP will be prepared and implemented prior to starting any demolition activities.

- Disturbed areas, if any, will be stabilized and revegetated with native plant species to minimize the potential for erosion after any demolition is completed. Native species will, to the extent possible, be used for any necessary revegetation; if the use of non-native species is necessary, only non-invasive species will be planted.

- Earth-disturbing activities, if any, will be conducted in a manner that minimizes alteration of the existing grade and the hydrology of existing surficial karst features.

- Previously unknown karst features that are identified during any invasive work activities, including blasting and removal of foundations, anchors, and below-grade structures, will be addressed as follows:
  - Work will stop within a 100-foot radius of the feature and the feature will be assessed to identify its potential to impact other karst features such as groundwater conduits, surface water conduits, and caves. The assessment method could include visual assessment, geophysical survey, or other techniques for subsurface characterization of karst features.

- The karst feature will be either isolated or temporarily sealed to minimize impacts during demolition work (e.g., blocked with sandbags, protected with baskets, nets, or filter fabric).

**Groundwater**

- A site-specific SWPPP will be prepared and implemented prior to starting any demolition activities.

- Construction stormwater controls will be implemented and maintained to prevent scour and soil loss from runoff anticipated to result from any demolition activities.

- Disturbed areas, if any, will be stabilized and revegetated to minimize the potential for erosion. Any necessary revegetation will use native species to the extent possible; if non-native species are needed, only non-invasive species will be planted.

- Before any demolition begins, a geophysical survey will be conducted to inspect designated work areas and note any suspected karst features, including sinkholes, solution cavities, and areas of soil subsidence that could be affected by the work. The survey will also evaluate soil stability and the vertical and horizontal projection of sinkholes. These features will be avoided when possible and protected with sandbags, nets, and filter fabric. They will be monitored during the work for changes, such as soil subsidence, collapse, water infiltration, and clogging.

- A spill prevention, control, and countermeasures (SPCC) plan will be developed to address risks to groundwater from potential spills. The SPCC plan will include equipment inspections, equipment refueling, equipment servicing and maintenance, equipment washing, and the use and storage of any hazardous materials, chemicals, fuels, lubricating oils, and other petroleum products.

- Any earth-disturbing activities will be conducted in a manner that minimizes alteration of the existing grade and the hydrology of existing surficial karst features.

- Previously unknown karst features that are identified during any invasive work activities, including blasting and removal of foundations, anchors, and below-grade structures, will be addressed as follows:

  - Work will stop within a 100-foot radius of the feature and the feature will be assessed to identify its potential to impact other karst features such as groundwater conduits, surface water conduits, and caves. The assessment method could include visual assessment, geophysical survey, or other techniques for subsurface characterization of karst features.

  - The karst feature will be either isolated or temporarily sealed to minimize impacts during demolition work (e.g., blocked with sandbags, protected with baskets, nets, or filter fabric).

**Hazardous Materials**

- Complete site characterization and removal or remediation of contamination will be

completed prior to engaging in any demolition activities.

- Hazardous materials and wastes will be used, stored, disposed of, and transported during any demolition activities in compliance with all applicable laws and regulations.

- Demolition contractors will create and implement a spill response plan.

- NSF will require all demolition contractors to create and implement a management plan that includes hazardous materials discovery protocols. The demolition management plan will include, at a minimum, a list of persons to contact in case of a possible encounter with undocumented contamination; provisions for immediate notification of the observation to demolition management; and notification of the regulatory agency with jurisdiction. If previously unknown contamination is found, demolition will halt in the vicinity of the find and the next steps will be decided in consultation with the regulatory agency.

**Solid Waste**

- Whenever possible, any demolition debris (such as soil) will be used onsite.

- Demolition debris, if any, will be diverted from landfills through reuse and recycling to the extent practicable.

**Health and Safety**

- Any demolition contractor will develop and implement a Health and Safety Plan.

- AO site personnel will comply with OSHA safety protocols.

- Fencing and signage will be installed around any demolition sites.

**Noise**

- Demolition areas, if any, will be fenced to keep personnel as far away as possible from heavy equipment.

**Traffic and Transportation**

- Transport of materials and demolition vehicles will occur during off-peak hours when practicable.

- Delivery truck personnel and demolition workers will be notified of all potential height restrictions and overhead obstructions.

- Vehicles used for material transport will be required to comply with local standards for height, width, and length of vehicles, when practicable. If at any time vehicles of excessive size and weight are required on local roads and bridges, NSF will coordinate with the appropriate transportation authority to obtain the necessary permits.

- NSF will coordinate with the appropriate transportation authority to determine the

appropriate mitigation measures to implement in response to road damage.

- Further detailed waste haul routes and concerns will be addressed during the detailed design phase of the Proposed Action, including verification that all bridge crossings on the delivery routes have adequate strength and capacity.

- To minimize the impacts of any demolition on local residents, the demolition contractor will coordinate with local public schools to ensure demolition and haul routes do not adversely affect school bus traffic.

## IV. DECISION

NSF has determined that, in light of the collapse of the 305-m telescope, a change in operations at the AO site is warranted. NSF recognizes the significant scientific and educational legacy of the AO site and is focused on exploring how the site can be a catalyst for inspiring STEM talent and innovation in Puerto Rico for decades to come. Therefore, NSF pursued a path forward to address ways in which the strong educational legacy of the AO site could be supported, coupled with a full understanding of the environmental consequences that would likely result from implementation of the Proposed Action, as well as the Action Alternatives and No-Action Alternative analyzed during the 2017 environmental review.

As set forth above, NSF reconsidered the environmental consequences of the Action and No-Action Alternatives analyzed in the 2017 and the anticipated environmental impacts associated with the Proposed Action. NSF concluded that, as a result of the collapse of the 305-m telescope, Action Alternative 1 and the No-Action Alternative from the 2017 EIS were no longer feasible. NSF also determined that Action Alternative 2 and the Proposed Action would support the Purpose and Need and were viable Action Alternatives. Because the Proposed Action does not include demolition of the 305-m telescope nor the transfer of the property out of federal ownership, it would result in fewer adverse impacts than Action Alternative 2 (even though both Action Alternatives involve the transition to education-focused operations and are otherwise generally the same). Therefore, NSF identified the Proposed Action as both the Preferred Alternative and the Environmentally Preferable Alternative.

In addition, as discussed above, NSF re-opened its Section 106 consultation process and its Endangered Species Act compliance. As explained earlier, NSF's Section 106 consultation process resulted in the development of a new Programmatic Agreement with the PR SHPO, the ACHP, and the Archaeology Working Group (see Attachment B). The consultation under Section 7 of the ESA resulted in the USFWS concurring with NSF's findings of no effect on *Tectaria estremerana*, the Puerto Rican broad-winged hawk, the Puerto Rican parrot, the Puerto Rican sharp-shinned hawk, beautiful goetzea, chupacallos, erubia, *Myrcia paganii*, *Schoepfia arenaria*, *Cordia bellonis*, palo de nigua, palo de rosa, uvillo, *Daphnopsis hellerana*, and *Thelypteris verecunda* and a finding of may affect but is not likely to adversely affect the Puerto Rican boa (see Attachment C).

After considering the results of the environmental review, the viability of the proposals received in response to NSF's solicitation to establish a STEM education and research center (which would capitalize on the robust educational foundation established at the AO site), and the additional factors below, the Proposed Action was identified as the Action Alternative to

recommend for the path forward for the AO site. The additional factors include the following:

- Arecibo Observatory serves as an inspiration for many, leading to increased interest in and pursuit of education in STEM disciplines.

- An important outcome of the June 2021 Workshop was an overwhelming consensus on the outstanding educational and STEM outreach legacy of the Arecibo Observatory.

- Implementation of a proposed ACSER would allow important science-based educational programs to be conducted at the AO site; these programs were identified by the public as being of very high value to the people of Puerto Rico.

- The AO site is an important cultural icon to the people of Puerto Rico and is listed on the National Register of Historic Places for its scientific and engineering merit.

**Alternatives Not Selected**

As stated earlier, Action Alternative 1 is no longer feasible in light of the collapse of the 305-m telescope, and the No-Action Alternative fails to meet the Purpose and Need. Therefore, neither were selected under the recent analysis.

Action Alternative 3 analyzed in the 2017 EIS was not selected because, while the general environmental impacts and costs associated with implementation of Action Alternative 3 would be comparable to both Action Alternative 2 and the Proposed Alternative, the impacts to cultural resources would be greater than those under either Action Alternative 2 or the Proposed Alternative. This is because Action Alternative 3 would remove the scientific and educational opportunities supportable under Action Alternative 2 and the Proposed Action, and those opportunities are very important to both the scientists and the people of Puerto Rico.

Action Alternative 4 was not selected because the environmental impacts, public concerns, and costs associated with implementation of it would be greater than those for either Action Alternative 2 or the Proposed Action. Also, under Action Alternative 4 no operations would continue at the AO site.

Action Alternative 5 was not selected for multiple reasons. The environmental impacts associated with demolition of the towers and cable anchors would be greater than any of the other Action Alternatives. The cost to implement Action Alternative 5 would be much greater than any other considered Action Alternative. In addition, Action Alternative 5 would result in demolition of the remainder of the iconic 305-meter radio telescope dish, which is one of the main reasons why the AO site is historically significant and listed on the National Register of Historic Places. Also, Action Alternative 5 would not allow for the continuation of scientific research or educational programs, both of which are very important to the scientists and the people of Puerto Rico

**Conclusion**

NSF has considered the impacts of the collapse of the 305-m telescope at the AO site, the strong legacy of educational programs at the AO site, budgetary constraints, the viability of a collaborator, and the environmental consequences of the Proposed Action and their associated

mitigation measures. After thorough consideration of the entire administrative record, we conclude that the Proposed Action, Transition to Education-focused Operations, represents an opportunity to provide important and innovative STEM educational activities at the site of the historically significant Arecibo Observatory. Accordingly, we hereby approve the selection of the Proposed Action as the path forward for the future of the AO site.

By: The National Science Foundation

Smith, Robert C. Digitally signed by Smith, Robert C. Date: 2023.09.22 11:57:38 -04'00' Date _____

Robert C. Smith, Ph.D., Division Director (Interim),
Division of Astronomical Sciences

JOLENE K JESSE Digitally signed by JOLENE K JESSE Date: 2023.09.22 12:04:23 -04'00' Date _____

Jolene K. Jesse, Ph.D., Acting Division Director
Division of Research on Learning in Formal and Informal Settings

ANNE M JOHANSEN Digitally signed by ANNE M JOHANSEN Date: 2023.09.22 11:52:35 -04'00' Date _____

Anne M. Johansen, Division Director
Division of Atmospheric and Geospace Sciences (GEO/AGS)

# ATTACHMENT A

2017 Record of Decision by the National Science Foundation Regarding Changes to Arecibo Observatory Operations in the Vicinity of Arecibo, Puerto Rico

# ATTACHMENT B

2023 Programmatic Agreement Among the National Science Foundation, the Advisory Council on Historic Preservation, and the Puerto Rico State Historic Preservation Officer Regarding Potential Changes to Arecibo Observatory Operations in the Vicinity of Arecibo, Puerto Rico

# ATTACHMENT C
## Updated Consultation under Section 7 of Endangered Species Act