3.2-A Correspondence

NATIONAL SCIENCE FOUNDATION
4201 Wilson Boulevard
Arlington, Virginia 22230

OFFICE OF THE
GENERAL COUNSEL

5 July 2016

Ms. Nydia Préstamo Torres
Deputy State Historic Preservation Officer
State Historic Preservation Office
Caurtel Ballaga, 3rd Floor
Norcagaray
San Juan, Puerto Rico 00901

RE: Section 106 Consultation for the Proposed Changes to Arecibo Observatory Operations, Arecibo, Puerto Rico

Dear Ms. Torres:

The National Science Foundation (NSF) Directorate for Mathematical and Physical Sciences (MPS), Division of Astronomical Sciences (AST) has identified the need to divest several facilities from its portfolio to retain the balance of capabilities needed to deliver the best performance on the key science of the present decade and beyond. The Arecibo Observatory in Puerto Rico is one of the facilities identified for potential divestment. The decision regarding the potential changes to Arecibo Observatory operations is considered a federal undertaking; accordingly, by this letter, NSF is formally initiating Section 106 consultation under the National Historic Preservation Act (NHPA). While engaging in Section 106 consultation under the NHPA, NSF will be simultaneously conducting an Environmental Impact Statement (EIS) process under the National Environmental Policy Act (NEPA) to identify potential environmental impacts associated with the proposed changes to operations.

Project Location and Background

The Arecibo Observatory, which includes the world's largest single-dish radio telescope, is a national center for research in radio astronomy, planetary radar, and aeronomy (including optical facilities). The Observatory is located in west-central Puerto Rico on federal land and occupies 118 acres. The construction of Arecibo was funded in the early 1960s by the Department of Defense Advanced Research Projects Agency to perform radar back-scatter studies of the ionosphere. In 1969, the facility was transferred from the Department of Defense to NSF and was made a national research center, with operations by Cornell University. In 1971, the facility became known as the National Astronomy and Ionosphere Center.

A key component of the Arecibo Observatory research facility is a 305-meter diameter, fixed, spherical reflector. The telescope has undergone two major upgrades: in 1974, the reflector was resurfaced and a high frequency planetary radar transmitter was installed; and in 1997, major new equipment installations included new ground screen shields that block ground radiation, a Gregorian dome with sub-reflectors and new electronics, and a new radar transmitter. These

improvements greatly increased the capability of the telescope. Arecibo Observatory infrastructure includes instrumentation for radio and radar astronomy and ionosphere physics, office and laboratory buildings, a heavily used visitor and education facility, and lodging facilities for visiting scientists.

In September 2011, Cornell University's cooperative agreement with NSF expired, and following a competition, a new cooperative agreement was awarded to SRI International, with sub-awards to Universities Space Research Association (USRA) and the Universidad Metropolitana (UMET). The cooperative agreement has a term of 5 years, ending in September 2016; both parties are currently discussing extending this through March 31, 2018.

In 2008, the Arecibo Observatory was listed in the National Register of Historic Places (NRHP) as the National Astronomy and Ionosphere Center historic district. It was determined to be significant under NRHP Criteria A (associated with events that have made a significant contribution to the broad patterns of our history) and C (embodies the distinctive characteristics of a type, period, or method of construction or represents the work of a master). A total of 13 buildings and structures were included in the 2008 NRHP nomination. Through correspondence with Berenice Sueiro at the Puerto Rico SHPO office, it was confirmed that five of those buildings are considered non-contributing, including:

- Building #3, Visiting Scientist Quarters and Cafeteria
- Building #4, Recreation Area
- Building #8, West Hill Visiting Scientist Quarters Bachelor Units
- Building #9, West Hill Visiting Scientist Quarters Family Units
- Building #10, North Visiting Scientist Quarters Units

Therefore, there are eight buildings and one structure that are considered to contribute to the NRHP-listed historic district:

- 305-Meter Radio Telescope and Support Towers;
- Building #1, Operations Building
- Building #2, Administration Building
- Building #5, Visitor Center
- Building #6, Learning Center
- Building #7, Photometry Shack and Optical Lab
- Buildings #11 and #12, Warehouse and Business/Purchasing
- Building #13, Maintenance Building

No other buildings or structures on the 118-acre property are listed in or considered eligible for the NRHP.

In 2015, after discovering that Arecibo Observatory was inaccurately listed on the NRHP as being owned by Cornell University, NSF contacted the National Park Service and requested that Arecibo Observatory be delisted and then re-listed with NSF as the owner. That request was granted and Arecibo was both removed and then re-listed on December 22, 2015, reflecting the corrected ownership information.

Project Description

NSF's AST is the federal steward for ground-based astronomy in the United States, funding research with awards to individual investigators and small research groups, and via cooperative agreements for operation of large telescope facilities. These national and international telescope facilities provide world-leading, one-of-a-kind observational capabilities on a competitive basis to thousands of astronomers per year. These facilities also enable scientific advances by making archived data products available to researchers. Along with funding telescope facilities and research awards, AST supports the development of advanced technologies and instrumentation and manages the allocation and assignment of specific frequencies in the radio spectrum for scientific use by the entire NSF community. The need for NSF to reduce its participation in Arecibo Observatory has been established through a number of reviews and surveys conducted by the science community. At present, Arecibo Observatory serves a variety of scientific user communities in astronomy, aeronomy, and planetary science, and is funded for all three activities as well as an active education and public outreach program. The science community evaluations, however, indicated that the science capability of Arecibo Observatory presents a lower priority than other science capabilities that NSF funds. In a funding-constrained environment, NSF needs to maintain a balanced research portfolio with the largest science return for the taxpayer dollar. Therefore, the purpose of the proposed action is for NSF to evaluate changes in operations and to substantially reduce its contribution to the funding of Arecibo Observatory. The proposed alternatives are designed to address this purpose and need.

Between 2014 and 2016, a Divestment Options Study for the Arecibo Observatory was prepared by CH2M under contract with NSF. The purpose of the study was to provide NSF with an overall condition assessment of structures and to evaluate divestment options for the facilities at Arecibo. Appendix A of the study included the Facilities Descriptions and Condition Assessments for each facility at Arecibo, as well as photographs. For reference, a hard copy of Appendix A was provided to your office on June 6, 2016. Because of this previous submittal, no additional current photographs are included with this letter.

Preliminary alternatives (four proposed action alternatives and a no action alternative) were developed based on the feasibility study and the response from the scientific community. Those preliminary alternatives were then developed into preliminary proposed alternatives that were presented to the public for comment during the public scoping period (as described below). The preliminary proposed alternatives are described below:

- **No Action Alternative – Continued NSF Investment for Science-focused Operations:** Under the No Action Alternative, NSF would not divest Arecibo Observatory and NSF would continue funding to operate it. Operations would be contingent on funding appropriations.

- **Alternative 1 – Collaboration with Interested Parties for Continued Science-focused Operations:** Alternative 1 would include continued science-focused operations by a collaboration of interested parties. Existing buildings that would no longer be of use would either be deconstructed or mothballed.

- **Alternative 2 – Collaboration with Interested Parties for Transition to Education-focused Operations:** Alternative 2 would transition the site to education-focused operations. The visitor center, learning center, and 12-meter telescope would remain operational. The 350-meter telescope would be made inoperable, but retained for

visual/historical interest. It would be secured and regularly maintained to prevent structural degradation. Existing buildings that would no longer be of use would either be deconstructed or mothballed.

• **Alternative 3 – Mothballing Facilities:** Alternative 3 would involve preservation of essential buildings, telescopes, and other equipment with periodic maintenance to keep them in working order. This would allow the facility to be reopened at a future date. Structures and facilities that would no longer be of use would be reconstructed. Gates and fencing would be evaluated to determine if upgrades are needed to provide appropriate security/access around portions of the site that would require protection.

• **Alternative 4 – Deconstruction and Site Restoration:** Alternative 4 would include deconstruction of most of the structures at Arecibo Observatory. The large concrete towers, anchors, and rim wall would not be deconstructed, but would remain in a manner that would not present a safety hazard to others. The remainder of the above-grade structures, including gates and fencing, would be removed and deconstructed. Below-grade foundations would be stabilized and filled.

These preliminary proposed alternatives may be further refined during the early phases of the compliance review and will be informed by the public process.

Public Involvement

Public scoping on the preliminary proposed alternatives and issues of concern was initiated on May 24, 2016 with publication of a Notice of Intent in the *Federal Register*. Public meetings were conducted on June 7, 2016 in San Juan and Arecibo, Puerto Rico. During the scoping meetings on June 7, 2016, NSF requested contact information for those individuals and organizations interested in participating as Section 106 consulting parties. NSF contacted those individuals and organizations to provide further details about the Section 106 consultation process and to confirm their consulting party status for this proposed action. Five individuals and organizations confirmed their participation as consulting parties:

- Tony Van Eyken (Arecibo Observatory)
- Dr. Brett Isham (Interamerican University-Bayamon)
- Xavier Siemens (NANOGRAV)
- Dr. Nicholas White (USRA)
- Qihou Zhou (Miami University)
- Luisa Zambrano-Marin (Arecibo Observatory)

NSF anticipates holding further NEPA public meetings during the Fall of 2016, following the release of the Draft EIS. Section 106 consultation needs will be addressed during the Draft EIS meetings, or during separate consulting party meetings following the Draft EIS meetings. Follow-up meetings with consulting parties will occur as needed to complete Section 106 consultation requirements.

Initiation of Section 106 Consultation

As part of the Section 106 process for the proposed changes to Arecibo Observatory operations, CH2M will conduct a site visit to Arecibo Observatory on July 19 and 20, 2016. The purpose of this survey is to verify the current conditions of existing known historic properties located at

Arecibo Observatory. A Secretary of the Interior-qualified architectural historian will conduct a reconnaissance-level field survey to update cultural resources information for the project site. The survey will include a general site assessment and informal interviews with the NSF staff and partners to obtain information regarding alterations to those buildings that contribute to the historic district. CH2M's investigations will only include the nine known properties that contribute to the NRHP-listed historic district to verify that no significant alterations have occurred to the buildings and structures since the district was listed in 2008. The nine resources that contribute to the NRHP-listed historic district were listed earlier in this letter. NSF would like to invite your office to participate in the field investigations on July 19 and 20, 2016, if you are interested and available. If your office is interested in attending the cultural resources field investigations at Arecibo, please contact Ms. Elizabeth Pentecost by phone at 703-292-4907, by email at epenteco@nsf.gov or by US Postal Service to NSF, Division of Astronomical Sciences, Suite 1045, 4201 Wilson Blvd., Arlington, Virginia 22230 as soon as possible so we can coordinate the visit.

As described earlier, Arecibo Observatory is a federally-owned property that is listed in the NRHP; therefore, the proposed action has the potential to affect NRHP-listed historic properties. In compliance with 36 C.F.R. 800.3(c), NSF is initiating consultation with your office on the proposed changes to Arecibo Observatory operations and transmitting the required Section 106 Delivery Control Form (attached as Enclosure 1). If you have any questions, please do not hesitate to contact me by phone at 703-292-4592 or by email at cblanco@nsf.gov. We look forward to further consultation on this proposed action.

Sincerely,

Caroline M. Blanco

Caroline M. Blanco
Federal Preservation Officer
Assistant General Counsel
Office of the General Counsel

Cc: Berenice R. Sueiro Vázquez, Gerente de Conservación Histórica, Puerto Rico SHPO
E. Pentecost, NSF
K. Zender, Ch2M

Enclosures:

1. Section 106 Delivery Control Form
2. Maps: USGS Topo and Site Plan

ESTADO LIBRE ASOCIADO DE PUERTO RICO
Oficina Estatal de Conservación Histórica
State Historic Preservation Office

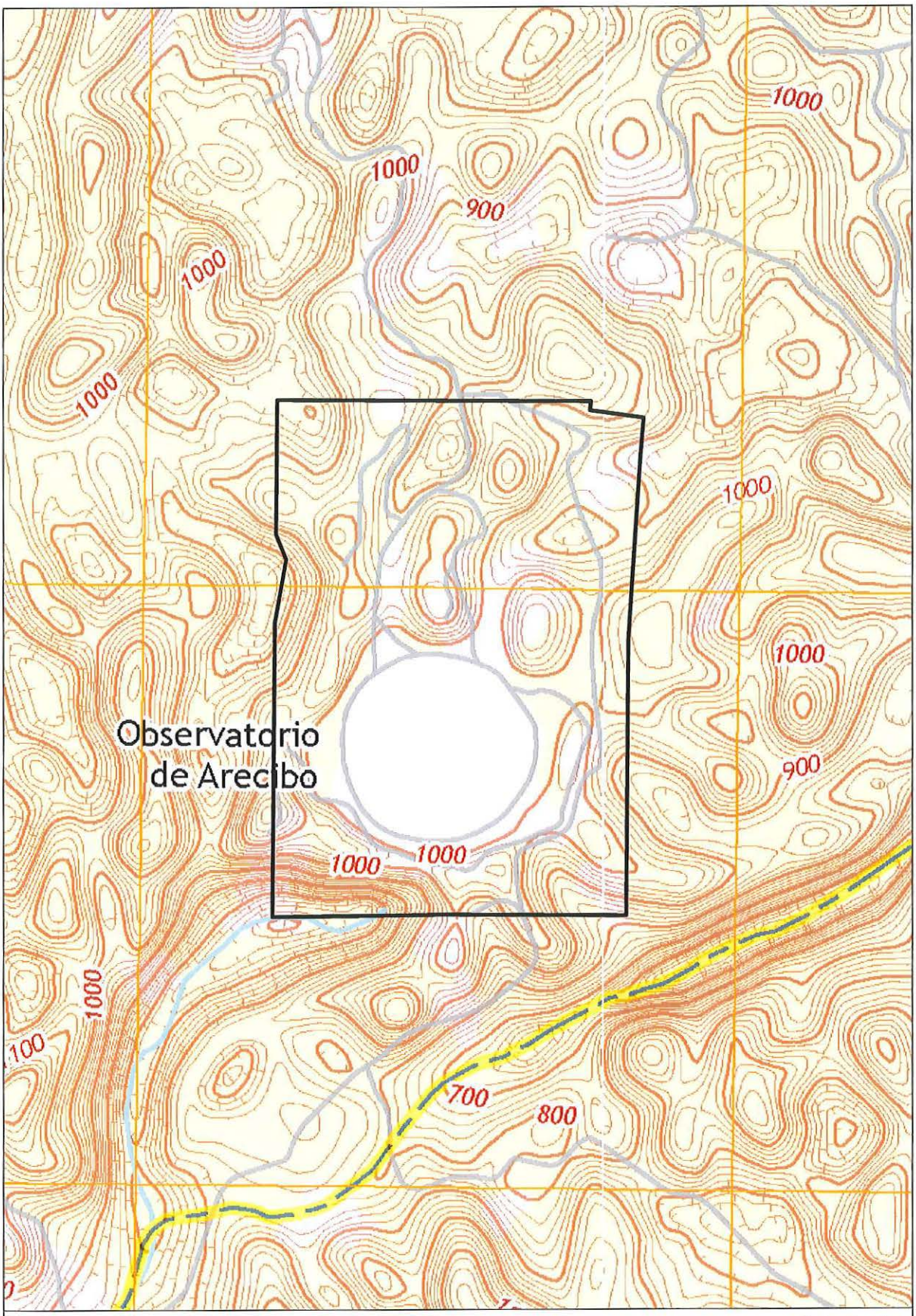
Formulario para el control de entrega.
Proyectos de sección 106

(Delivery control form 106 Section)

SHPO OECH
OFICINA ESTATAL DE CONSERVACIÓN HISTÓRICA
OFICINA DEL GOBERNADOR
STATE HISTORIC PRESERVATION OFFICE
OFFICE OF THE GOVERNOR

Sección A. Información a ser llenada por el proponente* **(Section A. Information to be filled by proponent)**			
Nombre del Proyecto/ Project's name			Número de referencia federal/ Reference federal number
Proposed Changes to Arecibo Observatory Operations			Not Applicable
Municipio/ Municipality	Barrio/ Ward	Nombre del Proponente/ Proponent's name	
Arecibo	Esperanza	National Science Foundation	
Agencia Federal/ Federal Agency		Total de fondos federales solicitados/ Total of federal funds to be requested	Total de acres/ Total amount of acres
National Science Foundation		Not Applicable	118 acres
Nombre de la persona que entrega/ Name of person who delivers		Firma/Signature	
Caroline M. Blanco National Science Foundation		Caroline M. Blanco	
Sección B. Información a ser llenada por la OECH al momento de la entrega del proyecto **(Section B. Information to be filled by SHPO upon delivery)**			
Fecha de entrega en la OECH/ SHPO delivery date		Nombre y firma de la persona que recibe/ Name and signature of person who received	

* **Para poder cumplir su labor ministerial la OECH requiere que la Sección A de este formulario sea completada en su totalidad. Por tal razón, no se aceptarán proyectos que incumplan este requerimiento.**
(To carry out our duties, the SHPO requires that Section A of this form be totally filled-out. For this reason, we will not accept an incomplete form.)



Property Boundary and Historic District Boundary

N
W E
S

1 inch = 500 feet

Project Location
Arecibo Observatory
Puerto Rico

USGS Topographic Quads Bayaney NE (2013) and
Utuado NW (2013)

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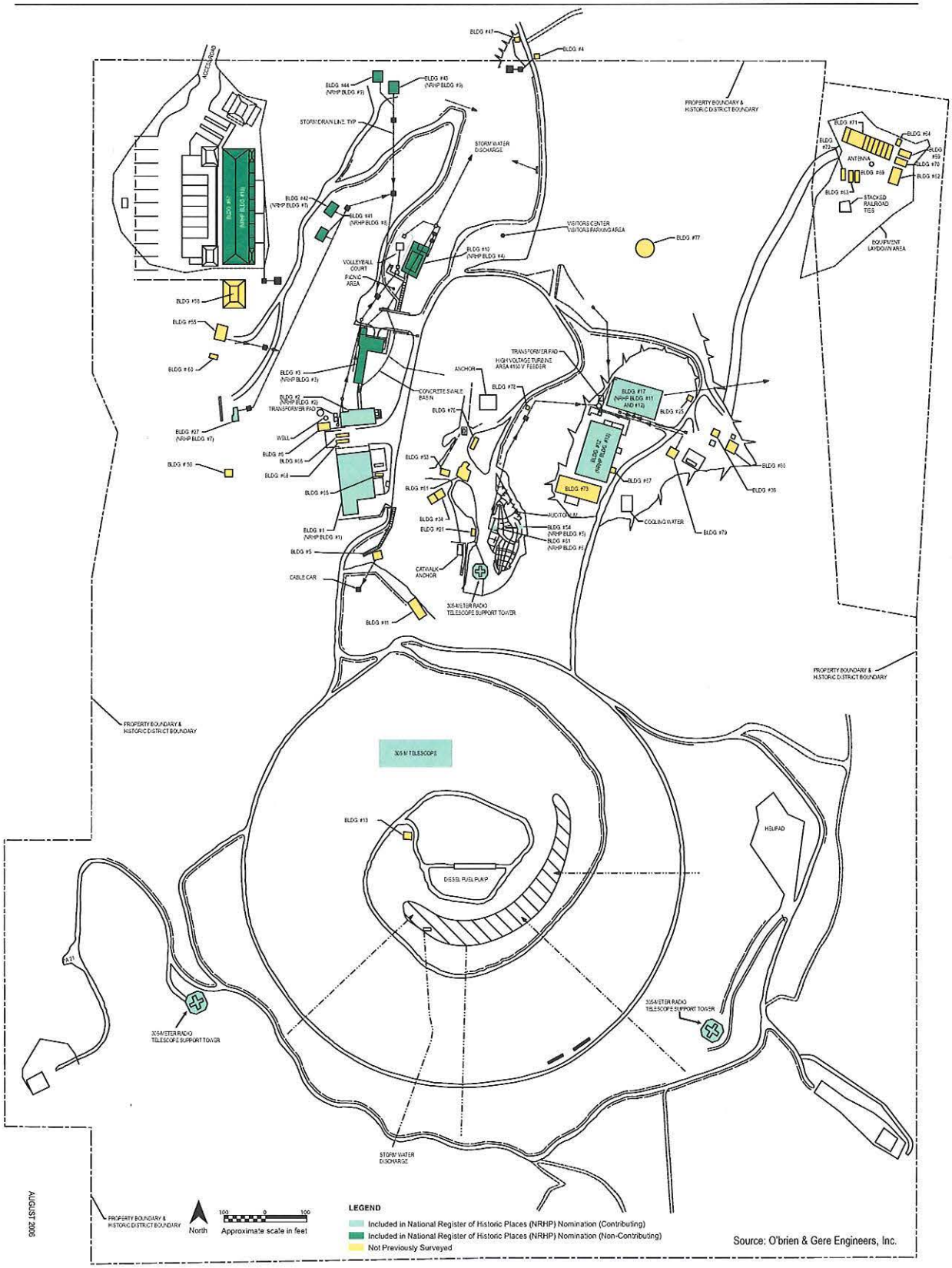

AUGUST 2006

BUILDING NO. DESCRIPTION

1. OPERATIONS BUILDING (Constructed 1963)
2. ADMINISTRATION BUILDING (Constructed 1963)
3. VISITING SCIENTIST QUARTERS AND CAFETERIA (Constructed 1963)
4. ENTRANCE GUARD HOUSE (Constructed 1963)
5. CABLE CAR HOUSE (Constructed 1963)
6. PUMP HOUSE/WATER TREATMENT BLDG. (Constructed 1963)
10. SWIMMING POOL/RESTROOMS (Constructed Mid 1960's)
11. LEWIS BUILDING–RIGGING LOFT (Constructed Mid 1960's)
12. MAINTENANCE SHOPS (Constructed 1967)
13. BOWL SHACK (Constructed 1960's)
17. WAREHOUSE (Constructed 1967)
21. ANTENNA TESTING RANGE (Construction date ?)
25. PAINT STORAGE BUILDING (Constructed 1967)
27. OPTICAL LABS (Constructed 1985/1997)
34. HIGH VOLTAGE POWER SUPPLY BLDG. (Constructed 1973)
35. CUMMINGS GENERATOR CONTROL BLDG. (Constructed 2000's)
41. WEST HILL V.S.Q. BACHELOR UNIT NO. 1 (Constructed date ?)
42. WEST HILL V.S.Q. BACHELOR UNIT NO. 2 (Constructed date ?)
43. WEST HILL V.S.Q. FAMILY UNIT NO. 1 (Constructed date ?)
44. WEST HILL V.S.Q. FAMILY UNIT NO. 2 (Constructed date ?)
47. MAIN GATE RESTROOM (Constructed 1963)
50. INTERFERENCE MONITORING SHACK (Constructed date ?)
51. GREASE PIT (Constructed date unknown)
53. EMERGENCY GENERATOR BLDG. (Constructed date ?)
54. VISITOR CENTER BLDG. (Constructed 1997)
55. LIDAR LABORATORY BLDG. (Constructed 1996)
57. NORTH V.S.Q. BLDG. (Constructed 2002)
58. NORTH V.S.Q. UTILITY BLDG.
59. VISITOR CENTER TRAILER (Constructed date ?)
60. ANT. RECE. TESTING BLDG. (Constructed late 1990's)
61. LEARNING CENTER (Constructed 2001)
62. HFF STORAGE TRAILER (Constructed date ?)
63. IONOSONDE TRAILER (Constructed date ?)
64. ELECTRONIC TRAILER (Constructed date ?)
65. SHIELDED TRAILER (Constructed 1983)
66. ATMOSPHERIC SCIENCE TRAILER (Constructed date ?)
67. CRYOGENICS LAB TRAILER (Constructed 1967)
68. SCIENTIFIC OFFICES TRAILER (Constructed date ?)
69. ELECTRONIC TRAILER (WAVEGUIDE) (Constructed date ?)
70. COMPUTER TRAILER (Constructed date ?)
71. ELECTRONICS CABLE TRAILER (Constructed date ?)
72. ELECTRONIC TRAILER (CRYOGENICS) (Constructed date ?)
73. HF TRANSMITTER BUILDING (Constructed 2000's)
76. INSPIRATION FOR SCIENCE TRAILER (Constructed 2000's)
77. PHASE REFERENCE ANTENNA (12M) (Constructed 2010)
78. COFFEE HUT (Constructed 2000's)
79. ENGINEERING OFFICE BUILDING (Constructed 2000's)
80. CUMMINGS DIESEL GENERATOR BUILDING (Constructed 2000's)

Site Map
Arecibo Observatory
(National Astronomy and Ionosphere Center)
Arecibo, Puerto Rico

ch2m:

Nolan-Wheatley, Marynell/NYC

From: Pentecost, Elizabeth A. <epenteco@nsf.gov>
Sent: Tuesday, July 12, 2016 3:29 PM
To: Berenice Sueiro
Cc: Blanco, Caroline M; Pentecost, Elizabeth A.
Subject: Re: Initiation of Section 106 Consultation for Proposed Changes to Arecibo Observatory Operations [EXTERNAL]
Attachments: image001.jpg; image002.jpg

Dear Ms. Suerio,

I contacted Ch2M and they have provided me with a tentative timeline for their visit to Arecibo on July 19 and July 20. There is no formal agenda for the visit at this time. The Ch2M team plans to arrive soon after the site opens (at 7 am per information from Mr. Jaime Gago at Arecibo) to orient themselves and meet their contacts onsite. Mr. Gago mentioned to Ch2M that there will be no access to and around the platform from 7 am to 10 am on Tuesday the 19th. Ch2M is planning to do the bulk of the reconnaissance architectural survey on that day, and will work around any site access limitations that morning. After 10 am on the 19th, Ch2M will have access to any buildings on site. Work will likely wrap up around 3:30, when the facility closes. During the survey, Ch2M will visit each historic building and verify existing conditions. Ch2M will do any follow-up survey work on Wednesday the 20th.

I hope this will help you in determining whether someone from your office will attend the field investigations.

Sincerely,

Elizabeth Pentecost

National Science Foundation
Division of Astronomical Sciences
Room 1045
4201 Wilson Boulevard
Arlington, VA 22230
Tel: 703-292-4907
Fax: 703-292-9034

From: Berenice Sueiro <bsueiro@prshpo.pr.gov>
Date: Tuesday, July 12, 2016 at 12:05 PM
To: "Pentecost, Elizabeth A." <epenteco@nsf.gov>
Cc: Caroline Blanco <cblanco@nsf.gov>, Kira Zender <kira.zender@ch2m.com>, Nydia Prestamo <nprestamo@prshpo.pr.gov>, Juan Llanes <jllanes@prshpo.pr.gov>
Subject: RE: Initiation of Section 106 Consultation for Proposed Changes to Arecibo Observatory Operations

ESTADO LIBRE ASOCIADO DE
PUERTO RICO
Oficina Estatal de Conservación Histórica
State Historic Preservation Office

Dear Ms. Pentecost:

Greetings,

We will like to know if you have an agenda for those two days . If available please submit. I will be out of the office. Mr. Juan Llanes, Historic Preservation Specialist, will evaluate scope of agenda. He will confirm attendance or not.

Best regards,

Berenice R Sueiro Vázquez
Gerente Conservación Histórica/Historic Preservation Manager
tel. 787-721-3737 ext. 2002
fax. 787-721-3773

SHPO
OFICINA ESTATAL DE CONSERVACIÓN HISTÓRICA
OFICINA DEL GOBERNADOR
STATE HISTORIC PRESERVATION OFFICE
OFFICE OF THE GOVERNOR
OECH

From: Pentecost, Elizabeth A. [mailto:epenteco@nsf.gov]
Sent: Monday, July 11, 2016 1:30 PM
To: Berenice Sueiro
Cc: Blanco, Caroline M; Kira Zender
Subject: Initiation of Section 106 Consultation for Proposed Changes to Arecibo Observatory Operations

Dear Ms. Sueiro,

I am working with Caroline Blanco and Kristen Hamilton on the Arecibo Observatory environmental compliance issues and wanted to follow-up on the email Caroline sent you on July 5 concerning initiation of Section 106 consultation for the proposed changes to Arecibo Observatory operations. In the email, NSF extended an invitation to your office to attend the cultural resources field investigations at Arecibo on July 19 and 20.

We are inquiring now as to whether or not your office is interested in attending the field investigations so that we can coordinate the visit with the CH2M team. We would greatly appreciate it if you or a member of your staff could let me know by Thursday, July 14 whether or not you would be available to attend the field investigations.

We look forward to further consultation with the State Historic Preservation Office on this proposed action.

Sincerely,

Elizabeth Pentecost

National Science Foundation

Division of Astronomical Sciences
Room 1045
4201 Wilson Boulevard
Arlington, VA 22230
Tel: 703-292-4907
Fax: 703-292-9034

3.5-A Arecibo Environmental Baseline Study

F I NA L

Environmental Baseline Study

Arecibo Observatory
Arecibo, Puerto Rico

Prepared for

National Science Foundation

December 2015

ch2m

Executive Summary

This Environmental Baseline Study (EBS) has been prepared to document the current environmental conditions on the approximately 120-acre contiguous parcel (herein referred to as the subject property) located near Arecibo, Puerto Rico. The National Science Foundation requested this EBS to determine the environmental condition prior to any future divestment activities. This EBS report has been prepared in accordance with the ASTM International (ASTM) provisional standards practice for *Environmental Site Assessments: Phase I Environmental Site Assessment Process* (ASTM, 2013).

This EBS report is based on information obtained through a records search, visual site inspections, physical site inspections, and interviews. The records search included a review of available records, including environmental restoration reports, previous surveys, building drawings, and inspection reports. Visual surveys of the subject property and interviews with current employees were conducted. The EBS assessment also included an evaluation of environmental conditions at offsite properties that could pose environmental concerns or affect the subject property. For adjacent properties, visual surveys consisted of observations made from public roads or views from property boundaries.

No recognized environmental conditions (RECs) were found on the subject property.

No historical recognized environmental conditions were found on the subject property.

The following *de minimis* conditions were identified on the subject property:

- Staining on warehouse concrete floor next to motor oil storage.
- Staining in the parking areas likely do to oil drips from vehicles were observed.

The following are other conditions on the subject property that are not considered RECs, but are worth disclosing:

- Asbestos-containing material was found in Buildings #1, #2, #3, #4, #6, and #17.
- Lead-based paint was found in Buildings #1, #2, #3, #4, #5, #7, #10, #11, #12, #17, #27, #47, #58, #61 and the gate area.
- The polychlorinated biphenyl content of the pole-mounted transformers on the property is unknown as the transformers are not labeled Non- polychlorinated biphenyl and documentation was not readily available for review.
- A 55-gallon capacity oil-water separator is associated with the tank farm containment area. Stormwater that collects within the containment area is pumped to the oil-water separator and then discharges to the ground surface. Inspection/maintenance records of the oil-water separator were not available for review. With the oil-water separator being 50 years old, a possibility exists that it may have failed and impacted surrounding soils.
- The septic and leachfield system serving the maintenance area has the potential for concern. No maintenance records were available and the system has served facilities where hazardous and petroleum products have been stored and used for over 50 years. No visual evidence of contamination was observed during the site reconnaissance.

To assess the potential for adjacent properties to affect the subject property, a records search and database search of RECs within 1 mile of the subject property was performed for this EBS assessment (see Attachment C). No other neighboring properties appear to have the potential to environmentally affect the properties.

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Contents

Attachments

Tables

Figures

Acronyms and Abbreviations

DOT	department of transportation
NOV	Notice of Violation
pCi/L	picocurie per liter
ACM	asbestos-containing material
AST	aboveground storage tank
ASTM	ASTM International
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CESQG	Conditionally Exempt Small Quantity Generator
EBS	Environmental Baseline Study
EDR	Environmental Data Resources, Inc.
FINDS	Facility Index System/Facility Registry System
HREC	Historical Recognized Environmental Condition
ICIS	Integrated Compliance Information System
LBP	lead-based paint
LUST	leaking underground storage tank
msl	mean sea level
NPL	National Priorities List
NSF	National Science Foundation
PCB	polychlorinated biphenyl
PR EQB	Puerto Rico Environmental Qualitiy Board
REC	recognized environmental condition
RTE	rare, threatened, or endangered
TSCA	Toxic Substances Control Act
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
VSI	visual site inspection

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SECTION 1

Introduction

The National Science Foundation (NSF) issued a Statement of Work for the Divestment Options Studies for the NSF-funded Telescopes and Observatories Project Task Order on July 29, 2014 and a scope revision on August 5, 2014 under Blanket Purchase Agreement NSFDACS14B1186. This document describes the Environmental Baseline Study (EBS) assessment portion of the task order for the approximately 120-acre property of the Arecibo Observatory, hereinafter referred to as the subject property, located near Arecibo, Puerto Rico. Figure 1-1 depicts the location of the subject property.

This EBS report is organized as follows:

- Section 1 presents the purpose and scope of the EBS.
- Section 2 describes the site and the current uses.
- Section 3 provides historical uses of the property.
- Section 4 presents the environmental setting information and findings on the property.
- Section 5 presents results of the adjacent property assessment for the EBS.
- Section 6 presents information provided from interviews.
- Section 7 provides findings and conclusions.
- Section 8 provides the certification page.
- Section 9 provides the references consulted in preparing this document.

The appendices to this document include the following:

- Attachment A contains photographs taken during the October 6-9, 2014 site visit.
- Attachment B contains the Environmental Data Resources, Inc. (EDR) reports for the subject properties and adjacent properties.
- Attachment C contains copies of historical aerial photographs and historical topographic maps for the subject property.

This EBS report has been prepared in accordance with the ASTM International (ASTM) provisional standards practice for *Environmental Site Assessments: Phase I Environmental Site Assessment Process* (ASTM, 2013).

1.1 Purpose of Environmental Condition of Subject Property Report

The purpose of this EBS report is to document the environmental condition of the subject property prior to any divestment activities or changes in operational strategy.

The purpose of the EBS assessment is to identify, to the extent feasible, the presence or likely presence of any hazardous substances or petroleum products on the subject property under conditions that indicate an existing release, a past release, or a material threat of release of any hazardous substances or petroleum products into structures on the subject property. This does not include *de minimis* conditions that do not present a threat to human health or the environment, and that generally would not be the subject of an enforcement action if brought to the attention of appropriate government agencies.

This EBS report is intended to help NSF conduct the following tasks:

- Develop sufficient information to identify what actions are necessary to protect human health and the environment prior to a real property transaction.
- Aid in establishing lease or deed restrictions.
- Support notice, when required under Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) § 120(h)(3), of the type, quantity, and timeframe of any storage, release, or disposal of hazardous materials or petroleum products and their wastes on the properties.
- Define potential liabilities associated with real property transactions.
- Evaluate possible effects on property valuation caused by contamination or other identified concerns.

1.1.1 Content of Environmental Baseline Survey Report

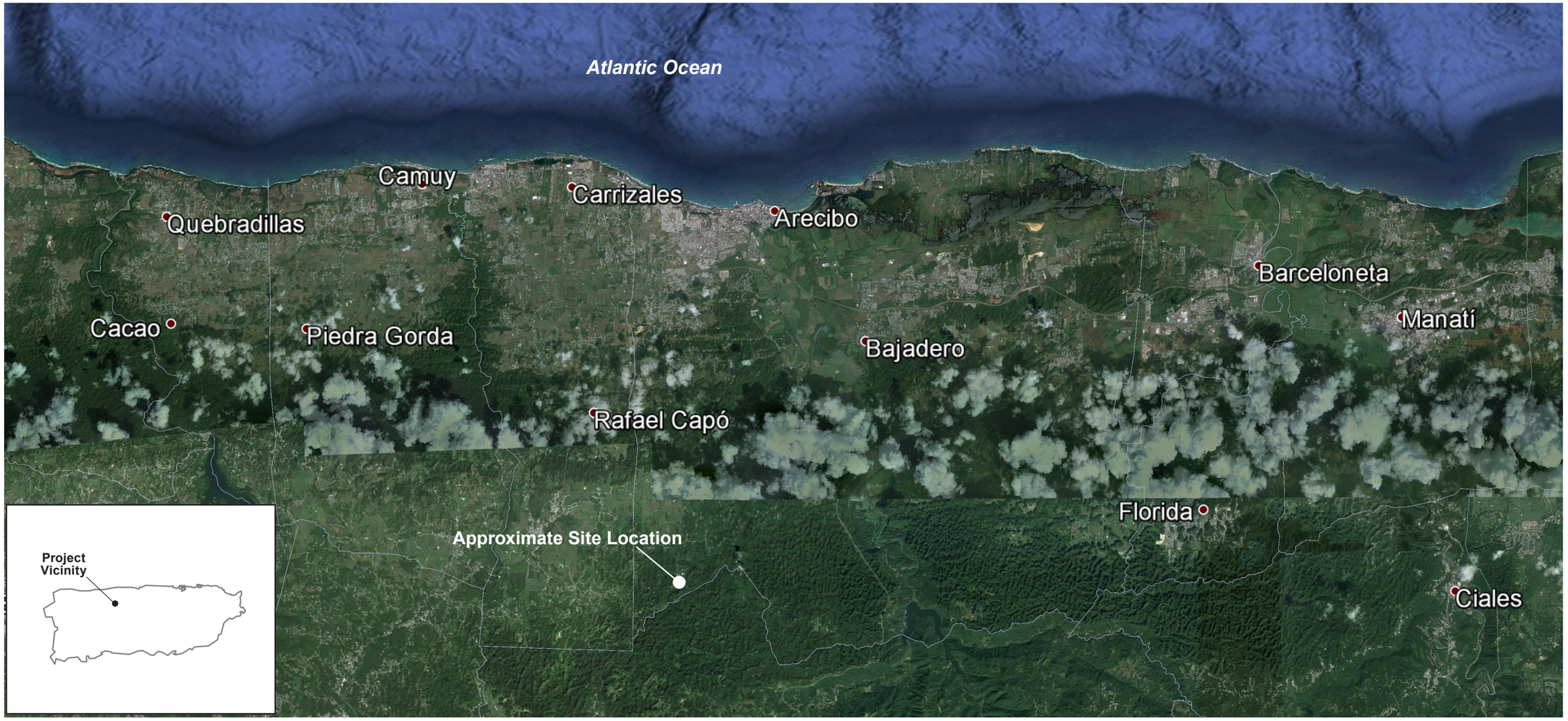
The information contained in this EBS report was obtained through a records search, visual site inspections (VSIs), physical site inspections (sensory observations), and interviews. The records search included an analysis of historical aerial photographs (Attachment C) and a review of available regulatory agency records.

VSIs were performed in accordance with ASTM E1527-13 *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process* (ASTM, 2013). The inspection consisted of a visual examination of the subject properties.

The EBS assessment also included an assessment of environmental conditions on properties within the ASTM standard radius search distance of the subject properties that could pose an environmental concern. As part of this assessment, reasonably ascertainable environmental databases were identified. Search radii were used to identify sites located in the general area of the subject properties. Adjacent properties were visually surveyed from accessible public areas as part of the EBS activities.

This EBS report specifically addresses the approximately 120-acre subject property, which is located near Arecibo, Puerto Rico. The general location and the subject property are illustrated in Figures 1-1 and 1-2.

Database and windshield surveys were conducted for several properties adjacent to the subject property. In addition, a records search was performed for properties within 1 mile of the subject property. The records and surrounding property evaluations are described in Sections 3 and 4, respectively.



Aerial photo source: Google ©2014, modified by CH2M HILL

North

0 5

Approximate scale in miles

FIGURE 1-1
Project Location Map
Arecibo Observatory
Arecibo, Puerto Rico

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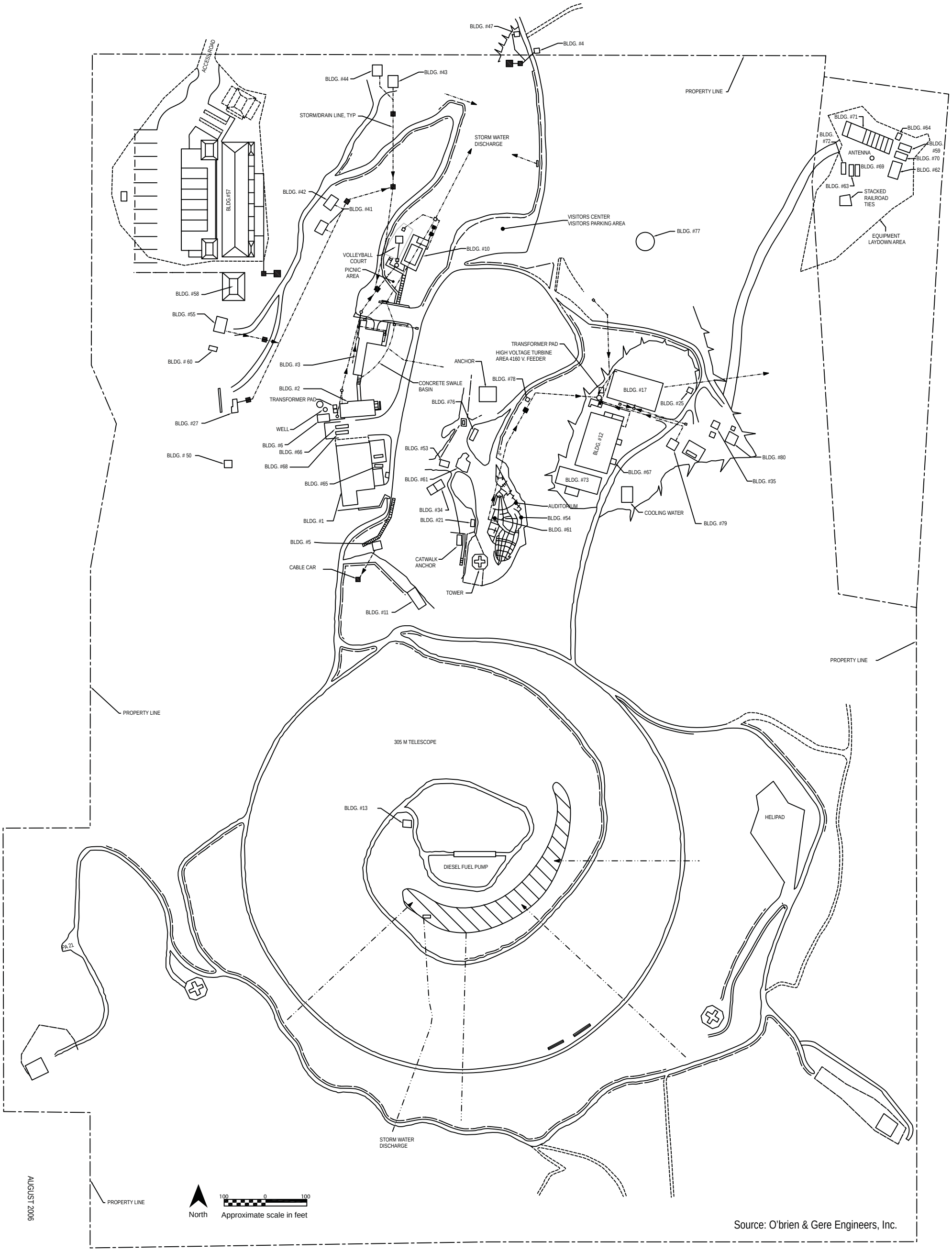

BUILDING NO. DESCRIPTION

1. OPERATIONS BUILDING
2. ADMINISTRATION BUILDING
3. VISITING SCIENTIST QUARTERS AND CAFETERIA
4. ENTRANCE GUARD HOUSE
5. CABLE CAR HOUSE
6. PUMP HOUSE/WATER TREATMENT BLDG.
10. SWIMMING POOL/RESTROOMS
11. LEWIS BUILDING–RIGGING LOFT
12. MAINTENANCE SHOPS
13. BOWL SHACK
17. WAREHOUSE
21. ANTENNA TESTING RANGE
25. PAINT STORAGE BUILDING
27. OPTICAL LABS
34. HIGH VOLTAGE POWER SUPPLY BLDG.
35. CUMMINGS GENERATOR CONTROL BLDG.
41. WEST HILL V.S.Q. BACHELOR UNIT NO. 1
42. WEST HILL V.S.Q. BACHELOR UNIT NO. 2
43. WEST HILL V.S.Q. FAMILY UNIT NO. 1
44. WEST HILL V.S.Q. FAMILY UNIT NO. 2
47. MAIN GATE RESTROOM
50. INTERFERENCE MONITORING SHACK
51. GREASE PIT
53. EMERGENCY GENERATOR BLDG.
54. VISITOR CENTER BLDG.
55. LIDAR LABORATORY BLDG.
57. NORTH V.S.Q. BLDG.
58. NORTH V.S.Q. UTILITY BLDG.
59. VISITOR CENTER TRAILER
60. ANT. RECE. TESTING BLDG.
61. LEARNING CENTER
62. HFF STORAGE TRAILER
63. IONOSONDE TRAILER
64. ELECTRONIC TRAILER
65. SHIELDED TRAILER
66. ATMOSPHERIC SCIENCE TRAILER
67. CRYOGENICS LAB TRAILER
68. SCIENTIFIC OFFICES TRAILER
69. ELECTRONIC TRAILER (WAVEGUIDE)
70. COMPUTER TRAILER
71. ELECTRONICS CABLE TRAILER
72. ELECTRONIC TRAILER (CRYOGENICS)
73. HF TRANSMITTER BUILDING
76. INSPIRATION FOR SCIENCE TRAILER
77. PHASE REFERENCE ANTENNA (12M)
78. COFFEE HUT
79. ENGINEERING OFFICE BUILDING
80. CUMMINGS DIESEL GENERATOR BUILDING

FIGURE 1-2
Subject Property
Arecibo Observatory
Arecibo, Puerto Rico

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1.2 Survey Methodology

1.2.1 Site Reconnaissance

VSIs were conducted October 20 through October 22, 2014. The VSIs included an escorted walk-through of accessible areas of buildings, facilities, and open areas. One of the primary objectives of the VSIs was to note visual evidence of contamination or potential sources of contamination, including leaks, spills, and any other evidence of past or current releases. Each of the existing buildings were visually inspected; however the interiors of occupied residential quarters, and several locked storage container buildings were not visually inspected.

1.2.2 Records Search and Review

The onsite records search was performed October 20 through October 22, 2014 and was facilitated by Wilson Arias. Mr. Arias provided environmental documentation and facilitated the visual inspection.

1.2.3 Interviews

Interviews were conducted October 20 through October 22, 2014 with the site personnel who were knowledgeable of the environmental issues with the subject property. Section 6 lists those interviewed.

1.2.4 Review of Special Resources

None.

1.3 Significant Assumptions

None.

1.4 Limitations, Exceptions, and Data Gaps

1.4.1 Limitations

The interior of some residential housing was not surveyed. The property line where there were no access roads was not viewed. Dense vegetation limited line of sight in some areas. No test pits were installed to inspect subsurface soil conditions. No sampling or analysis of any media was conducted during this survey.

This report has been prepared in compliance with ASTM E1527-13. In preparing this report, CH2M HILL has relied on certain information provided by federal, state, and local officials and other parties referenced herein, and on information contained in the files of governmental agencies that was reasonably ascertainable at the time of this assessment. Although there may have been some degree of overlap in the information provided by these various sources, an independent verification of the accuracy or completeness of all information reviewed or received during the course of this site assessment was not conducted.

1.4.2 Exceptions

There are no identified exceptions.

1.4.3 Data Gaps

According to § 3.2.20 of ASTM E1527-13, a data gap is a lack of or inability to obtain information required by the ASTM standard despite good faith efforts to gather the data. Data gaps may result from incompleteness in any of the activities required by the ASTM standard. A data gap is considered significant only if it affects the ability to identify recognized environmental conditions (RECs). Data gaps that were identified are listed in Table 1-1.

Table 1-1. Data Gaps
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

Data Gap	Explanation	Significance of Gap
Site History	Site history not available in 5-year intervals.	Low – Standard historical sources of information include aerial photographs, historical topographic maps, city directory abstracts, and Sanborn Fire Insurance Maps. Additional maps would not likely provide additional relevant information.
Interiors of Residential buildings and mobile storage containers	The interior of some residential housing and several mobile storage containers were not surveyed due to inaccessibility	Low – Historic use of the facilities for residential purposes is unlikely to have had a significant environmental impact on the subject property. Based on interviews the storage containers did not contain hazardous materials and no impacts to the surrounding environment were observed.

SECTION 2

Site Description

This section describes the methodology used to assess the EBS. The process included a records search, VSIs, physical site inspections, and interviews.

2.1 Location and Legal Description

The subject property is located at Carr 625, Km. 3.2, Barrio Esperanza, Arecibo, Puerto Rico. The subject property is approximately 120 acres located approximately 60 miles west of San Juan, and 10 miles south of the City of Arecibo. Subject property deeds were not available for review.

2.2 Current Use of the Subject Property

The subject property is currently used for radio astronomy observations, research, and support activities including, administrative, maintenance, and housing.

The Arecibo Telescope (Photographs 1 and 2) operates continuously and the facility employs approximately 150 employees. The visitor center (Photograph 3) receives approximately 100,000 visitors per year and is open Wednesday through Sunday of each week.

The subject property is divided into four main areas: the reflector area, the research and administrative area, the maintenance area, and the housing area.

The reflector area is located at the south half of the subject property. It includes the reflector dish, platform, the platform crew building (Lewis Building) and the cable car house (Photograph 4-7).

The research and administrative area is located at the central part of the property. It includes the main control and research building (Building #1), administrative building (Building #2), engineering offices (Buildings #66 and 68), and learning center and auditorium (Photographs 8-11).

The maintenance area is located at the northeast part of the property. It includes maintenance shops, warehouses, storage yards, the maintenance office, the paint storage building, the generator building, and fuel tanks (Photographs 12-17). The northwest corner of the property is used for additional storage and staging areas which consist mainly of mobile storage units (Photographs 18-19).

The housing area is located at the northwest and includes housing for visiting scientists and guests, cafeteria, swimming pool, and recreation area (Photographs 20-24). Just south of this area is the LIDAR building and optical lab (Photographs 25-26).

2.3 Description of Structures, Roads, and Other Improvements

A total of 50 buildings are located on the subject property. Further descriptions of the buildings are presented in the Divestment Options Study Report.

There is one gate to the subject property located at the northern boundary (Photograph 27). A road winds to the various areas of the subject property as shown on Figure 2-2.

2.4 Site Utilities

The water service, sanitary sewer system, and electricity utility providers and the general stormwater flow for the subject property are discussed in this section.

2.4.1 Water Service

An onsite drinking water well (USGS40001045257) provides water to the facilities on the subject property (Photograph 28-29). Depth to groundwater is approximately 350 feet below ground surface (EDR, 2014a).

2.4.2 Wastewater

Six septic systems throughout the facility handle discharges from toilets and sinks throughout the subject property. The cafeteria also discharges to a septic system, but discharge first goes through a grease trap (Photograph 30). The septic tanks are permitted by Puerto Rico Environmental Quality Board (PR EQB) and are in compliance. The septic systems are listed in Table 2-1.

Table 2-1. Septic Systems
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

Septic System	Location	Septic Tank IDs
SS-1	Guard House	ST1
SS-2	Northwest Area	ST2A
		ST2B
		ST2C
		ST2D
		ST2E
SS-3	Cable Car Building	ST3
SS-4	Maintenance Area	ST4A
		ST4B
		ST4C
		ST4D
SS-5	North Visitors Quarters	ST5
SS-7	Pool Area	ST7

According to interviews, the septic systems have underground injection control permits registered with PR EQB.

A 55-gallon capacity oil-water separator is associated with the tank farm containment area. Stormwater that collects within the containment area is pumped to the oil-water separator and then discharges to the ground surface. Inspection/maintenance records of the oil-water separator were not available for review.

2.4.3 Stormwater

Stormwater runoff in the subject property generally flows down slopes and natural swales, and discharges in to several natural sinkholes. Stormwater in the maintenance area flows through several drop-inlets and gravity drains to an outfall to the east of area. Stormwater in the reflector area collects in a pond at the bottom in a natural sinkhole below the reflector (Photograph 31). Water is pumped from the pond and discharged approximately 400 feet southwest of the sinkhole to an intermittent stream.

2.4.4 Electric

Electric service is provided by Puerto Rico Electric Power Authority.

2.5 Current Use of the Adjoining Property

The adjoining property to the north, south, east, and west are mainly undeveloped land with a few rural residences.

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SECTION 3

Site History

The subject property was first developed in 1960 by the U.S. Department of Defense. The Arecibo Ionosphere Observatory was formally opened on November 1, 1963. NSF acquired the property from the U.S. Department of Defense on October 1, 1969. Arecibo Ionosphere Observatory officially changed to National Astronomy and Ionosphere Center on September 1, 1971. The Observatory houses a 305-meter diameter reflector with a 900-ton platform suspended 450 feet above the reflector. The entire structure (reflector and platform) is suspended by a cable system attached to three reinforced concrete towers. Guy cables tied to anchors support the towers (Photograph 32).

The reflector and platform were upgraded in 1974 and then again in 1997. Currently the platform is being painted.

3.1 Previous Environmental Baseline Surveys

An EBS was completed January 2008 by Engineering, Compliance & Construction, Inc. The EBS did not specifically identify RECs. However, the following findings were of note:

- Asbestos-containing material (ACM) was found in Buildings #1, #2, #3, #4, #6, and #17.
- Lead-based paint (LBP) was found in Buildings #1, #2, #3, #4, #5, #7, #10, #11, #12, #17, #27, #47, #58, #61, the gate area, and the concrete guard along the road to the maintenance area.
- An unpermitted solid waste landfill was on the property known as the “semi-junk” pile. (This has been since investigated. See Section 4.2.4).
- Six unpermitted septic systems are on the property. (These have since been permitted. See Section 2.4.2).
- The polychlorinated biphenyl (PCB) content of the pole-mounted transformers on the property are unknown since the transformers are not labeled “Non-PCB” or “PCB-free”.
- No petroleum, lubricant, or oil releases were observed except small staining in the parking areas.
- Two active underground storage tanks (USTs) failed the recent cathodic protection tests. A third inactive UST was not properly closed and remains buried. (All USTs have been removed. See Section 4.2.3).

3.2 Historical Use Information of the Subject Property

3.2.1 Aerial Photographs

Year	Subject Property	Adjacent and Surrounding Properties
1968	The reflector, the support buildings in the northeast, and the maintenance area building are visible. Roads through the observatory are visible	Several structures are visible to the north of the subject property; the surrounding area is natural mountainous terrain.
1972	Similar to the 1968 photograph.	Similar to the 1968 photograph.

Year	Subject Property	Adjacent and Surrounding Properties
1977	The photo is not clear. No apparent differences from the 1972 photograph.	The photo is not clear. No apparent differences from the 1972 photograph.
1993	Several buildings appear on the west side of the subject property and at the maintenance area.	Two additional structures are visible north of the subject property.

3.2.2 Topographic Maps

Year	Subject Property	Adjacent and Surrounding Properties
1946	One structure is visible on the east boundary of the subject property.	A few scattered structures are visible in the area surrounding the subject property.
1947	Similar to the 1946 map.	Similar to the 1946 map.
1952	Another structure appears where the current reflector is located.	Similar to the 1947 map.
1957	Similar to the 1952 map.	Similar to the 1952 map.
1970	The reflector and building for the observatory appear on the map	Similar to the 1957 map.
1982	Similar to the 1970 map.	Similar to the 1970 map.

3.3 Environmental Records

CH2M HILL contracted with EDR of Milford, Connecticut, to review available regulatory agency databases for listings of the subject property. The complete list of databases are presented in Section 5. Table 3-1 presents the listings for the subject property.

Table 3-1. EDR Database Listings
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

Site Name	Database(s)	Site Address	Location Relative to Site
Arecibo Observatory	UST	Arecibo, PR 00612	Target property
Arecibo Observatory	RCRA-CESQG	Arecibo, PR 00612	Target property
Arecibo Observatory	FINDS/ICIS	Arecibo, PR 00612	Target property
Arecibo Observatory	FINDS/RCRAInfo	Arecibo, PR 00612	Target property

CESQG	Conditionally Exempt Small Quantity Generator
FINDS	Facility Index System/Facility Registry System
ICIS	Integrated Compliance Information System
RCRA	Resource Conservation and Recovery Act

The USTs listed in the database have been closed as described in Section 4.2.3. No RECs were identified from the search.

SECTION 4

Findings: Subject Property

4.1 Environmental Setting

The subject property is located at the south end of Route PR-625, Arecibo, Puerto Rico 00612 in Arecibo County. It is located at the following coordinates: Latitude 18° 20’ 53.88’’N and Longitude 66° 45’ 8.64’’W. The approximate elevation of the property is 996 feet above mean sea level (msl). The subject property is approximately 120 acres in size.

4.1.1 Climate

According to the National Oceanic and Atmospheric Administration, the average monthly high temperature ranges from 64 degrees Fahrenheit in February to 91 degrees Fahrenheit in September. The annual average precipitation is about 51 inches (Western Regional Climate Center, 2014).

4.1.2 Land Use

The land surrounding Arecibo is rural countryside near the northwest coast of Puerto Rico. Both residents and tourists visit the subject property. The subject property layout is shown on Figure 1-2.

4.1.3 Regional Physiography and Topography

The subject property is located in Northern Coastal Plains. Rivers flow northward to the Atlantic Ocean through forest lands. The belt of closed forest is interrupted by the canyons and valleys of several rivers. The forest lands have little surface drainage, but a prevalence of underground drainage. These lands constitute the karst belt of the northern limestone (U.S. Department of Agriculture, 2001).

Karsification in Puerto Rico’s climate and rock types causes slopes to become nearly vertical, creating a steep topography. The general topography gradient across the subject property is from the north to the south. The approximate elevation of the property is 996 feet above msl, but varies widely over short distances.

4.1.4 Geology

The subject property is located within a sinkhole. Sinkholes are typical in karst landscapes, which are produced by the solution process, where limestone bedrock dissolves by chemical reaction. Limestone formations range in age from Cretaceous to the Quaternary Periods (USDA, 2001). The Lares Formation extends to approximately 800 feet msl with the Cibao Formation below the Lares.

Cone karst is formed by conical hills in the Lares Limestone. The hills are grouped linearly with intervening sinks. Its formation is attributed to solution along joints in the limestone, or to the notion that the cones are residuals after the collapse of caverns of underground rivers. The best developed cone karst in Puerto Rico occurs near the subject property where many of the cones are sharp, pointed, nearly circular or oval, 650 to 980 feet in diameter at the base, and rise 160 to 250 feet from the bottom of adjacent depressions (U.S. Department of Agriculture, 2001).

4.1.5 Soils and Groundwater

According to the U.S. Department of Agriculture Soil Conservation Service, the subject property is underlain by a soil type called Soller, which is clayey and has a high water table. Soller soils are characterized as silt-clay to 12 inches, weathered bedrock from 12 to 26 inches, and unweathered bedrock from 26 to 30 inches. Depth to the water table is greater than 6 feet.

The northern limestone contains two productive aquifers. The upper aquifer within the Aymamon and Aguada Limestones and alluvial deposits occur along the coast. The lower aquifer occurs within various members of the Cibao Formation and the Lares Limestone. The regional groundwater flow direction is to the north coastline. Locally, groundwater flow direction is impacted by topography, hydrogeology, soil characteristics, and nearby waterbodies. The nearest named surface water body is the Tanama River located approximately 2,500 feet southwest of the subject property. Storm water drains to various sinkholes on and around the subject property.

The subject property is not located in the 100-year or 500-year flood zones, as defined by the Federal Emergency Management Agency (FEMA).

According to EDR, two groundwater wells are listed as being located within 1-mile of the subject property. One well is registered to the USGS Puerto Rico Water Science Center and is located on the subject property. The well hole depth is 900 feet, cased to 600 feet. The depth to water in the well is approximately 350 feet below ground surface. The second well is located ½ to 1-mile north-northwest. This well is also registered to U.S. Geological Survey (USGS) Puerto Rico Water Science Center and is approximately 951 feet deep. No public water supply wells were identified in the EDR report.

4.1.6 Surface Water and Wetlands

A wetland and waterbody delineation and jurisdictional determination of Waters of the U.S. were not included in this effort. A desktop analysis was completed using USGS quadrangle maps (USGS; Bayaney, Puerto Rico), available aerial photography, and site visit observations to identify potential wetlands and waterbodies.

An unnamed intermittent stream is located approximately 400 feet southwest of the Arecibo site that appears to connect to the Tanama River located approximately 2,500 feet to the southwest of the Arecibo site based on review of USGS quadrangle maps and the U.S. Fish and Wildlife Service (USFWS) Wetlands Mapper (USFWS, 2014). No other intermittent or perennial waterbodies were identified at the subject property during site visit observations or on the USGS quadrangle maps or USFWS Wetlands Mapper.

Potential wetland areas are located in the vicinity of the subject property based the presence of localized standing water and saturated areas observed during previous site visits. The only mapped potential wetland areas in the vicinity of the subject property are riverine wetlands associated with adjacent waterbodies (USFWS, 2014).

4.1.7 Threatened and Endangered Species

Habitat assessments and species-specific surveys to determine the presence or absence of rare, threatened, or endangered (RTE) species were not included in this effort. Publicly available sources of information regarding federally-listed RTE species that may be found on or in the vicinity of the subject property were evaluated as part of a desktop review. The USFWS Endangered Species List (Puerto Rico/Virgin Islands) was the primary source of information used for the desktop analysis. The Puerto Rico Department of Natural and Environmental Resources has designated areas throughout Puerto Rico as critical habitat for several flora and fauna species. No officially protected areas are located within the

subject property. The protected area nearest to the subject property is the Río Abaja State Forest, located approximately 1.5 miles east of the subject property.

Twenty-three RTE species are listed by the USFWS as potentially occurring in Arecibo, Puerto Rico. A general habitat description and desktop evaluation of the potential utilization of the Arecibo site by RTE species are summarized for each of the 23 species in **Table 4-1**. Two plant species (*Cornutia obovata* and *Tectaria estremerana*) are identified by the USFWS as potentially occurring near the subject property. Surveys for RTE species or detailed habitat assessments were not included in this effort to determine if these species or the RTE species located in the Río Abaja State Forest are present or are likely to use the subject property. Impacts to RTE species are unknown but are not anticipated because activities would be generally limited to previously disturbed areas within the subject property.

Table 4-1. Rare, Threatened, and Endangered Species Summary (Arecibo, Puerto Rico)
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

Group	Name	Federal Status	Habitat Description / Location	Desktop Analysis
Bird	*Accipiter striatus venator* (Puerto Rican Sharpshinned Hawk)	Endangered	Río Abajo State Forest	Potential; Proximity of subject property to area
Bird	*Amazona vittatta* (Puerto Rican Parrot)	Endangered	Río Abajo State Forest	Potential; Proximity of subject property to area
Plant	*Auerodendron pauciflorum* (No Common Name)	Endangered	Río Abajo State Forest	Potential; Proximity of subject property to area
Bird	*Buteo platypterus brunnescens* (Puerto Rican Broadwinged Hawk)	Endangered	Río Abajo State Forest	Potential; Proximity of subject property to area
Plant	*Calyptronoma rivalis* (No Common Name)	Threatened	Río Abajo State Forest	Potential; Proximity of subject property to area
Reptile	*Chelonia mydas* (Green Sea Turtle)	Threatened	Coastal Zones	No Potential; No coastal areas at subject property
Plant	*Cordia bellonis* (No Common Name)	Endangered	Río Abajo State Forest	Potential; Proximity of subject property to area
Plant	*Cornutia obovata* (No Common Name)	Endangered	Río Abajo State Forest, Near Arecibo Observatory	Likely Potential; Proximity of subject property to area
Plant	*Daphnopsis hellerana* (No Common Name)	Endangered	Northern Limestone (Karst) Hills	Potential; Karst areas are present at subject property
Reptile	*Dermochelys coriacea* (Leatherback Sea Turtle)	Endangered	Coastal Zones	No Potential; No coastal areas at subject property
Reptile	*Epicrates inornatus* (Puerto Rican Boa)	Endangered	Forested Volcanic and Limestone (Karst) Hills	Potential; Karst areas are present at Arecibo site
Reptile	*Eretmochelys imbricata* (Hawksbill Sea Turtle)	Endangered	Coastal Zones	No Potential; No coastal areas at subject property
Plant	*Goetzea elegans* (Beautiful Goetzea)	Endangered	Cambalache State Forest	Unlikely; Identified area is not proximate to subject property
Plant	*Myrcia paganii* (No Common Name)	Endangered	Biafara Arrozal	Unlikely; Identified area is not proximate to subject property

Table 4-1. Rare, Threatened, and Endangered Species Summary (Arecibo, Puerto Rico)
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

Group	Name	Federal Status	Habitat Description / Location	Desktop Analysis
Plant	*Ottoschulzia rhodoxylon* (No Common Name)	Threatened	Cambalache State Forest, Sabana Hoyos	Unlikely; Identified area is not proximate to subject property
Bird	*Pelecanus occidentalis* (Brown Pelican)	Delisted due to Recovery	Coastal Zones, Inland Waterbodies, No Nesting	No Potential; No coastal areas at subject property
Amphibian	*Peltophryne lemur* (Puerto Rican Crested Toad)	Threatened	Northern Karst Regions	Potential; Karst areas are present at subject property
Plant	*Pleodendron macranthum* (No Common Name)	Endangered	Río Abajo State Forest	Potential; Proximity of subject property to area
Plant	*Schoepfia arenaria* (No Common Name)	Threatened	Río Abajo State Forest	Potential; Proximity of subject property to area
Plant	*Solanum drymophilum* (No Common Name)	Endangered	Río Abajo State Forest	Potential; Proximity of subject property to area
Bird	*Sterna dougallii* (Roseate Tern)	Threatened	Coastal Areas and Offshore Cays, Nesting	No Potential; No coastal areas at subject property
Plant	*Tectaria estremerana* (No Common Name)	Endangered	Río Abajo State Forest, Near Arecibo Observatory	Likely Potential; Proximity of subject property to area
Mammal	*Trichechus manatus* (Antillean Manatee)	Endangered	Coastal Zones	No Potential; No coastal areas at subject property

Sources:

USFWS Endangered Species List (Puerto Rico/Virgin Islands) (http://www.fws.gov/caribbean/es/documents/2012-Species-MapUpdate-2012.pdf)

NatureServe (http://explorer.natureserve.org/index.htm)

4.2 Environmental Factors

The following sections discuss environmental factors that may affect the subject property.

4.2.1 Hazardous Material/Petroleum Product Management

The majority of hazardous materials and petroleum products are stored in areas near the warehouse building. Smaller quantities of products were stored at buildings where they intend to be used. Hazardous material/petroleum product inventory lists were not available. However, the following materials were observed:

- Building #1: Machine shop flammable locker with isopropanol and epoxy coating (Photograph 33); Electronics lab flammable locker with isopropanol and spray paint (Photograph 34).
- Generator Building: 2 55-gallon drums of oil (Photograph 35).
- Building #17: small quantities of motor oil (Photograph 36).
- Six sheds behind building #17 (Photograph 37) contain the following:

  - CS-1: New lead-acid batteries (Photograph 38)
  - CS-2: Chlorine (Photograph 39)
  - CS-3 (corrosive storage): 26 2.5-liter hydrochloric acid containers, 1 gallon of ammonia absorber, and 9 1-gallon containers of ammonium (29 percent).
  - CS-4: 14 gallons of Amine CD, 20 gallons of Roundup, snail and slug pellets, brush killer, and 75 pounds of Pramito SPS. (Photograph 40)
  - CS-5: 5 bags of fertilizer.
  - CS-6: 15 bags of black beauty abrasive.
- Building #25 is used for storage for paint and oil. It contains numerous 1-gallon and 5-gallon cans of paint, motor oil, antifreeze, petroleum distillates, (Photographs 41)
- Next to Building #25 is a diked area with container for oil dispensing. It includes 5 55-gallon drums of lubricant oil and 9 5-gallon containers of motor oil. (Photograph 42)
- The caged shed next to the vehicle lift building (grease pit) contains 3 overpacked 55-gallon drums of used oil (Photograph 43).
- Inside the machine shop: cans of paint, motor oils, and lubricants. (Photograph 44-45)
- Building #27 (Optics Lab): 1 5-gallon container of methanol. (Photograph 46)
- Paint and primer containers are stored in an outside closet of the utility building next to the north visiting scientist quarters building (Photograph 47).
- On the platform above the reflector, 2 5-gallon buckets of gear oil and 120 pounds of grease (Photograph 48).

Carbon-14 (C-14) is stored on site and used for experiments. On June 23, 2014, Mr. Todd J. Jackson of the United States Nuclear Regulatory Commission inspected the C-14. The C-14 was secured with no leaks. (Dade Moeller, 2014)

Fuel oil is also stored in aboveground storage tanks (ASTs) and USTs, as listed in Section 4.2.2 and 4.2.3, respectively.

No significant spills of hazardous materials or petroleum products were observed; however, the following staining was observed:

- Stain on warehouse concrete floor next to motor oil storage (Photograph 49).
- Stains at parking spaces at cafeteria (Photograph 50)

Generated waste stored in the waste accumulation area is located outside Building #17, and includes 55-gallon drums containing contaminated diesel, paint, grease, oily rags, aerosol cans, oil filters, and used oil (Photograph 51).

4.2.2 Aboveground Storage Tanks

There are five ASTs on the subject property and are described on Table 4-2.

Table 4-2. ASTs Located on the Subject Property
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

AST Location	Capacity	Contents	Photograph
Generator Building	1,000-gallon daily tank	Diesel	52
Maintenance area tank dike	12,000 gallons	Diesel	53

Table 4-2. ASTs Located on the Subject Property
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

AST Location	Capacity	Contents	Photograph
Maintenance area tank dike	2,000 gallons	Gasoline	53
North of Building #53	2,000 gallons	Diesel	54
Below reflector	300 gallons	Diesel	Not available

The day tank is a metal double-walled tank on a concrete slab. The 300-gallon tank below the reflector was temporarily removed from service to be painted. The concrete slab did not show any staining and there was no stressed vegetation around the slab. No leaks or staining were observed. The other tanks are in concrete dikes and no leaks or stains were observed.

4.2.3 Underground Storage Tanks

No USTs are on the subject property. Three gasoline USTs previously existed on the property. A 4,000-gallon tank and a 2,000-gallon tank were installed near the maintenance building in 1983. A 3,000-gallon tank was installed near the former pina colada stand in 1963. This UST was abandoned in place; however, the tank was not properly closed according to PR EQB. In 2011, all three USTs were removed and confirmation samples were taken and no contamination was detected above PR EQB criteria. (O'Brien & Gere, 2011)

4.2.4 Environmental Investigations

The following environmental investigations were performed at the subject property:

- An investigation was conducted in December 2007 at a former debris pile located northeast of the reflector dish in an area known as the semi-junk yard. The debris was removed and four surface soils were collected and analyzed for mercury, cadmium, chromium, lead, diesel range organics, oil range organics, gasoline range organics, PCBs, semi-volatile organics, and volatile organics. The results for all samples showed that the analytes were below U.S. Environmental Protection Agency (USEPA) Region III risk-based concentrations. (Pace Analytical, Inc., 2007)
- Soil samples were collected and analyzed as part of the oil-water separator and dry well closure at the former vehicle wash rack in Building #51. The soil was analyzed for volatile organic compounds, total petroleum hydrocarbons, metals, and cyanide. Only arsenic was above USEPA Region III risk-based concentrations and was likely representative of background concentrations (O'Brien & Gere, 2004).The PR EQB approved the closure report on December 12, 2005.
- Soil samples were collected and analyzed as part of a dry well closure associated with the tank farm secondary containment system. The soil was analyzed for volatile organic compounds, total petroleum hydrocarbons, metals, and cyanide. Only arsenic was above USEPA Region III risk-based concentrations and was likely representative of background concentrations (O'Brien & Gere, 2007). The closure report was approved by PR EQB in March 2007.

4.3 Disclosure Factors

Disclosure factors are not regulated under CERCLA and, if properly managed, do not have an environmental impact on the property and do not affect the property categorization. However, their presence may result in an environmental concern if a release to the environment has occurred. Each of the disclosure factors are discussed in the following sections.

4.3.1 Asbestos-containing Materials

Renovation and demolition of buildings with ACMs have the potential for releasing asbestos fiber into the air. Asbestos fibers could be released because of disturbance or damage to various building materials, such as pipe lagging, ceilings, floor tile, sheetrock, waterlines, and gasket material.

ACM surveys were performed in 2005 at Buildings #1, #2, and #3. Another survey was performed in 2007 for Buildings #4, #6, and #17. Table 4-3 summarized the ACM survey results.

Table 4-3. Confirmed ACM
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

Building	ACM
Building #1	12”x12” brown speckles floor tile; 9”x9” floor tile
Building #2	9”x9” floor tile; reflective sheet on interior lighting in stairwell
Building #3	Silver Roof Coating
Building #4	Roof mastic
Building #6	Tank expansion joint
Building #17	Gray window caulk; 12”x12” blue floor tile: expansion joint

No records of ACM abatement were obtained.

4.3.2 Lead-based Paint

Lead is a heavy, ductile metal commonly found in association with organic compounds, oxides, salts, and metallic lead. Human exposure to lead has been classified as an adverse health risk by agencies such as the Occupational Safety and Health Administration and USEPA. Sources of exposure to lead include paint, dust, and soil.

Exposure to LBP primarily presents a health concern to children, and its use was generally discontinued in 1978. The routine application of LBP in the past, and the associated peeling or degradation of paint over time, have created the potential for localized lead contamination in soils around buildings that were constructed before or during 1978.

A LBP survey was conducted in 2007. Table 4-4 lists the areas with detectable levels of lead.

Table 4-4. 2007 LBP Survey Results
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

Building	LBP Description
Building #1	Interior white paint
Building #2	Exterior white paint
Building #3	Exterior paint; interior paint in laundry room
Building #4	Exterior paint
Building #5	Exterior white paint
Building #7	Interior paint, stair railing, guard rails and posts, gray hand rails
Building #10	Exterior paint, roof finish
Building #11	Exterior paint, guard rail
Building #12	Exterior paint
Building #17	White and green paint

Table 4-4. 2007 LBP Survey Results
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

Building	LBP Description
Building #27	Red primer, white and green paint
Building #47	Paint in restroom
Building #58	Paint on flashing
Building #61	White paint, rail and stair paint
Gate	Parking striping, rails
Concrete guard along the road to the maintenance area.	Paint on concrete guard.

No records of LBP removal were obtained. Significant peeling paint was not observed during the site reconnaissance.

Tests have shown that LBP still exists on areas of the platform. Currently the platform above the reflector is being painted as part of an on-going project to remove paint and primer and repaint with non-LBP (O'Brien & Gere, 2006).

4.3.3 Polychlorinated Biphenyls

Electrical transformers, capacitors, switches, light ballasts, and machinery with hydraulic systems are potential sources of PCB-containing oil. No PCB survey reports were available for review.

The transformers and switches outside Building #1 contain non-PCB dielectric fluid (Photograph 55). The transformers and capacitors inside the Transformer Room are labeled non-PCB.

The transformers at the high voltage power supply building are labeled non-PBC (Photograph 56).

Pole-mounted transformers were located throughout the subject property and are owned by Puerto Rico Electric Company. These transformers were not labeled to indicate the presence or absence of PCBs. They appeared to be in good condition, and no leak, soil staining, or stressed vegetation was observed around the poles.

Light ballasts in the buildings were not checked to determine if they contain PCBs. However, fluorescent bulbs were generally not used due to the interference they cause with the telescope.

4.3.4 Radon

Radon testing has not been performed recently at the subject property. In 1993, USGS collected 13 indoor air samples in the subject property and analyzed them for radon. The mean radon value was 0.3 picocurie per liter with the maximum value of 0.9 picocurie per liter. (USGS, 1995). Radon is not anticipated to be a potential environmental concern at the subject property.

4.3.5 Medical/Biohazardous Waste

From the records search and interviews, no medical or biohazardous waste was found to be stored on the subject property.

4.3.6 Munitions and Explosives of Concern

From the records search and interviews, no munitions and explosive of concern are on the subject property.

SECTION 5

Findings: Adjacent Properties

5.1 Land Use

Arecibo is located in a rural area of northwest Puerto Rico. The main industries for Puerto Rico are agriculture and tourism. The land use adjacent to Arecibo is low density, rural residential/agricultural, and undeveloped land.

5.2 Surveyed Properties

CH2M HILL contracted with EDR of Milford, Connecticut to review available regulatory agency databases for sites within the various ASTM-prescribed radii of the property. The specific radii are identified according to source in the complete database search, provided in Attachment B. Additional sources of information include:

- GoogleEarth™

The following databases were searched and provided in the EDR report to identify generators and transporters of hazardous wastes; hazardous waste treatment, storage, and disposal facilities; and sites where releases of hazardous materials have been reported:

5.2.1 Federal Databases

- USEPA National Priorities List (NPL) of uncontrolled or abandoned hazardous waste sites identified for priority remedial action (last updated 09/29/14)
- USEPA Proposed NPL site list (last updated 09/29/14)
- USEPA Delisted NPL site list (last updated 09/29/14)
- USEPA Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) list of sites that either are proposed for or are on the NPL and sites that are in the screening and assessment phase for possible inclusion on the NPL (last updated 10/25/13)
- Federal Facility site listing of NPL and Base Realignment and Closure (BRAC) sites found in CERCLIS database (last updated 07/21/14)
- CERCLIS No Further Remedial Action Planned sites where, following an initial investigation, no contamination was found, contamination was removed quickly, or the contamination was not serious enough to require federal Superfund action or NPL consideration (last updated 10/25/13)
- EPA database of Resource Conservation and Recovery Act (RCRA) facilities that are undergoing corrective action (CORRACTS) because there has been a release of hazardous waste or constituents into the environment from a RCRA facility (last updated 06/10/14)
- RCRA Treatment, storage, and disposal facilities (RCRA-TSDF) (last updated 06/10/2014)
- EPA RCRA large-quantity, small-quantity, and conditionally exempt small-quantity generators (last updated 06/10/2014)
- U.S. Engineering Controls: Federal engineering control registry (last updated 09/18/2014)

- U.S. Institutional Controls: Federal institutional control registry (last updated 09/18/2014)
- Land Use Control Information System (LUCIS) records pertaining to former Navy Base Realignment and Closure sites (last updated 08/29/2014)
- Federal Emergency Response Notification System (ERNS) list of reported accidental releases of oil and hazardous substances (last updated 9/29/14)
- FEMA underground storage tank (UST) locations (last updated 01/01/10)
- U.S. Brownfields (last updated 09/22/14)
- Open Dump Inventory (ODI) (last updated 06/30/1985)
- U.S. Clandestine Drug Labs (US CDL) Drug Enforcement Administration (last updated 07/25/14)
- LIENS2 is the CERCLA Lien Information database (last updated 02/18/14)
- EPA database of Superfund Consent Decrees (last updated 12/31/13)
- Records of Decision that document permanent remedies at an NPL site (last updated 11/25/13)
- EPA Toxic Substances Control Act (TSCA) database, which identifies manufacturers and importers of chemical substances (last updated 12/31/2006)
- EPA Office of Prevention, Pesticides and Toxic Substances Federal Insecticide, Fungicide, & Rodenticide Act (FIFRA)/TSCA Tracking System (FTTS), which tracks administrative cases and pesticide enforcement actions and compliance activities related to FIFRA, TSCA, and the EPCRA (last updated 04/09/2009)
- U.S. Mines Master Index File Department of Labor (last updated 08/05/2014)
- Section 7 Tracking Systems reports types and amounts of pesticides, active ingredients, and devices produced (last updated 12/31/2009)
- National Clandestine Laboratory Registry (US HIST CDL) for either clandestine drug laboratories or dump sites (last updated 07/25/2014)
- U.S. Department of Transportation (DOT) Hazardous Materials Information Reporting System (HMIRS), which contains hazardous material spill incidents reported to DOT (last updated 09/30/14)
- USEPA database of RCRA facilities that currently do not generate hazardous waste (RCRA-NonGen) (last updated 06/10/14)
- USEPA Records of Decision (ROD) database (last updated 11/25/13)
- U.S. Department of Transportation (DOT) Office of Pipeline Safety (OPS) Incident and Accident Data (last updated 07/31/12)
- U.S. Department of Defense Sites (DOD) (last updated 12/31/2005)
- U.S. Army Corps of Engineers Former Used Defense Sites (FUDS) (last updated 06/06/2014)
- USEPA database of Superfund Consent Decrees (CONSENT) (last updated 12/31/13)
- Uranium Mill Tailings Sites (UMTRA) locations (last updated 09/14/2010)
- Emergency Planning and Community Right-to-Know Act (EPCRA) inventory of toxic chemical emissions (Toxic Release Inventory System [TRIS]) (last updated 12/31/2011)
- Integrated Compliance Information System (ICIS) national enforcement and compliance program for the National Pollutant Discharge Elimination System (NPDES) (last updated 07/31/2014)

- USEPA PCB Activity Data Systems (PADS), which identifies transporters, commercial stores, and/or brokers, and disposers of PCBs who are required to notify EPA (last updated 07/01/14)
- USEPA Material Licensing Tracking System (MLTS) maintained by the Nuclear Regulatory Commission maintains list of sites that possess or use radioactive materials (last updated 07/22/13)
- Radiation Information Database (RADINFO) facilities regulated by EPA for radiation and radioactivity (last updated 10/07/14)
- EPA Facility Index System (FINDS) that contains information and "pointers" to other sources that contain more detail, including permit compliance system (PCS), Aerometric Information Retrieval System (AIRS), Enforcement Docket (DOCKET), Federal Underground Injection Control (FURS), Criminal Docket (C-DOCKET), Federal Facilities Information System (FFIS), state environmental laws and statutes (STATE), and polychlorinated biphenyl (PCB) activity data system (PADS) (last updated 08/16/14)
- RCRA Administrative Action Tracking System (RAATS) contains records based on enforcement actions (last updated 04/17/1995)
- USEPA Risk Management Plans (RMP) chemical accident prevention at facilities using extremely hazardous substances (last updated 08/01/2014)
- USEPA Biennial Reporting System (BRS) database, which collects detailed data regarding large-quantity generators and treatment, storage, and disposal facilities (last updated 12/31/2011)
- USEPA 2020 Corrective Action List (COR ACTION) a RCRA cleanup baseline includes facilities expected to need corrective action (last updated 11/11/2011)
- USEPA Lead Smelter Sites a listing of former lead smelter locations (last updated 06/04/14)
- USEPA Potentially Responsible Parties (PRP) a listing of verified potential responsible parties (last updated 10/25/13)
- USEPA Financial Assurance Information (US FIN ASSUR) facilities that treat, store, or dispose of hazardous waste are required to provide proof that they will have sufficient funds to pay for the cleanup, closure, and post-closure care (last updated 09/04/14)
- Steam-Electric Plan Operation Data (COAL ASH DOE) listing of power plants that store ash in surface ponds (last updated 12/31/2005)
- US AIRS (AFS) Aerometric Information Retrieval System Facility Subsystem contains compliance data on air pollution sources (last updated 10/16/2014)
- US AIRS MINOR Air Facility Systems Data is a listing of minor source facilities (last updated 10/16/2014)
- Coal combustion residues surface impoundments (COAL ASH EPA) list (last updated 07/01/2014)
- PCB Transformer Database (PCB TRANSFORMER) registration database (last updated 02/01/2011)
- USEPA Watch List on enforcement matters (last updated 08/30/2013)

5.2.2 Puerto Rico and Tribal Databases

- Indian Reservation Locations (INDIAN RESERV) (last updated 12/31/2005)
- Federally and Indian administrated lands (FEDLAND) (last updated 12/31/2005)
- Indian Report on the Status of Open Dumps on Indian Land (INDIAN ODI) (last updated 12/31/1998)

- Leaking Underground Storage Tank (LUST) database contains an inventory of reported LUST incidents (last updated 12/01/2010)
- UST database contains data regarding registered USTs (last updated 01/01/2008)
- State Coalition for remediation of drycleaners (SCRD DRYCLEANERS) (last updated 03/07/2011)

5.2.3 Additional Environmental Site Information

The subject property was listed in UST, RCRA-CESQG, FINDS-ICS, and FINDS-RCRAInfo databases in the EDR report as shown in Table 3-1. No other properties were identified by EDR within 1 mile from the subject property boundary. Searches ranged from the location of the subject property to 1 mile from the subject property location. The EDR report did not identify any orphan properties (unknown locations).

SECTION 6

Interviews

Interviews were conducted October 20 through October 22, 2014, with the personnel listed in Table 6-1.

Table 6-1. Personnel Interviewed during the Site Visit
Environmental Baseline Study, Arecibo Observatory, Puerto Rico

Personnel	Title or Department	Information or Services Provided
Mr. Jaime Gago	Engineer, Arecibo Observatory	Provided facility maps. Escorted the field team for a portion of the site reconnaissance.
Mr. Robert Kerr	Facility Manager, Arecibo Observatory	Provided background information.

Information gathered from the interviews are presented within the other sections of this report.

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SECTION 7

Findings and Conclusions

This section consolidates the findings presented in Sections 4 and 5 in accordance with ASTM E1527-13, *Standard Practice for Environmental Site Assessments: Phase I Environmental Site Assessment Process.*

The findings of this EBS report were based on reasonably available environmental information; interviews with site, state, and local personnel; a review of previous environmental studies; and federal and state database and file information related to the storage, release, treatment, or disposal of hazardous substances or petroleum products. Results were also based on visual observations of the subject property and adjacent properties.

7.1 Recognized Environmental Conditions

RECs are defined as the presence or likely presence of a hazardous substance or petroleum product on the property under conditions that indicate an existing release, a past release, or material threat of a release of hazardous substances or petroleum products into the structures of the property or into the ground, groundwater, or surface water of the property. The term includes hazardous substances or petroleum products even under conditions in compliance with applicable laws. The term is not intended to include *de minimis* conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be subject to enforcement action if brought to the attention of the appropriate government agencies. No RECs were found on the subject property.

7.2 Historical Recognized Environmental Conditions

A Historical Recognized Environmental Condition (HREC) is one that in the past would have been considered a REC but which is not currently considered a REC. If a past release of a hazardous substance or petroleum product has occurred in connection with the subject property and has been remediated, with such remediation accepted by a responsible regulatory agency, that condition is considered an HREC. No HRECs were found on the subject property.

7.3 *De Minimis* Conditions

De minimis conditions are conditions that generally do not present a material risk of harm to public health or the environment and that generally would not be subject to an enforcement action if brought to the attention of the appropriate government agencies. Conditions determined to be *de minimis* are not RECs. The following *de minimis* conditions were identified on the subject property:

- Stain on warehouse concrete floor next to motor oil storage.
- Staining at the parking area which are likely small vehicle oil leaks.

7.4 Other Conditions of Note

The following are other conditions on the subject property that are not considered RECs, but are worth disclosing:

- ACM was found in Buildings #1, #2, #3, #4, #6, and #17.

- LBP was found in Buildings #1, #2, #3, #4, #5, #7, #10, #11, #12, #17, #27, #47, #58, #61 and the gate area.
- The PCB content of the pole-mounted transformers on the subject property are unknown as the transformers are not labeled Non-PCB and documentation was not readily available for review.
- A 55-gallon capacity oil-water separator is associated with the tank farm containment area. Stormwater that collects within the containment area is pumped to the oil-water separator and then discharges to the ground surface. Inspection/maintenance records of the oil-water separator were not available for review. With the oil-water separator being 50 years old, a possibility exist that it may have failed and impacted surrounding soils.
- The septic and leachfield system serving the maintenance area has the potential for concern. No maintenance records were available and the system has served facilities where hazardous and petroleum products have been stored and used for over 50 years. No visual evidence of contamination was observed during the site reconnaissance.

SECTION 8

Certification for the Arecibo EBS

CH2M HILL has performed an EBS for the approximately 120-acre subject property located near Arecibo, Puerto Rico. We reviewed all of the appropriate records that were made available and conducted site inspections of the facility. The information in this EBS report is based on records made available and, to the best of CH2M HILL's knowledge, is correct and current as of October 2014.

We declare that, to the best of our professional knowledge and belief, we meet the definition of environmental professional as defined in §312.10 of 40 *Code of Federal Regulations* Part 312, and we have the specific qualifications based on education, training, and experience to assess a property of the nature, history, and setting of the subject properties. We have developed and performed all of the appropriate inquiries in conformance with the standards and practices set forth in 40 *Code of Federal Regulations* Part 312.

_____ _____

Michael Brose
Environmental Scientist
CH2M HILL

Date

_____ _____

David Stieb
Senior Technical Reviewer
CH2M HILL

Date

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SECTION 9

References

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Attachment A
Site Reconnaissance Photographs

Photo 1: The Arecibo Telescope facing south.

Photo 2: Platform of the Arecibo Telescope from below the reflector dish facing up.

Photo 3: Visitors Center facing southeast.

Photo 4: Platform crew office (Lewis Building) facing south.

Photo 5: Cable Car House facing east.

Photo 6: Reflector dish facing south.

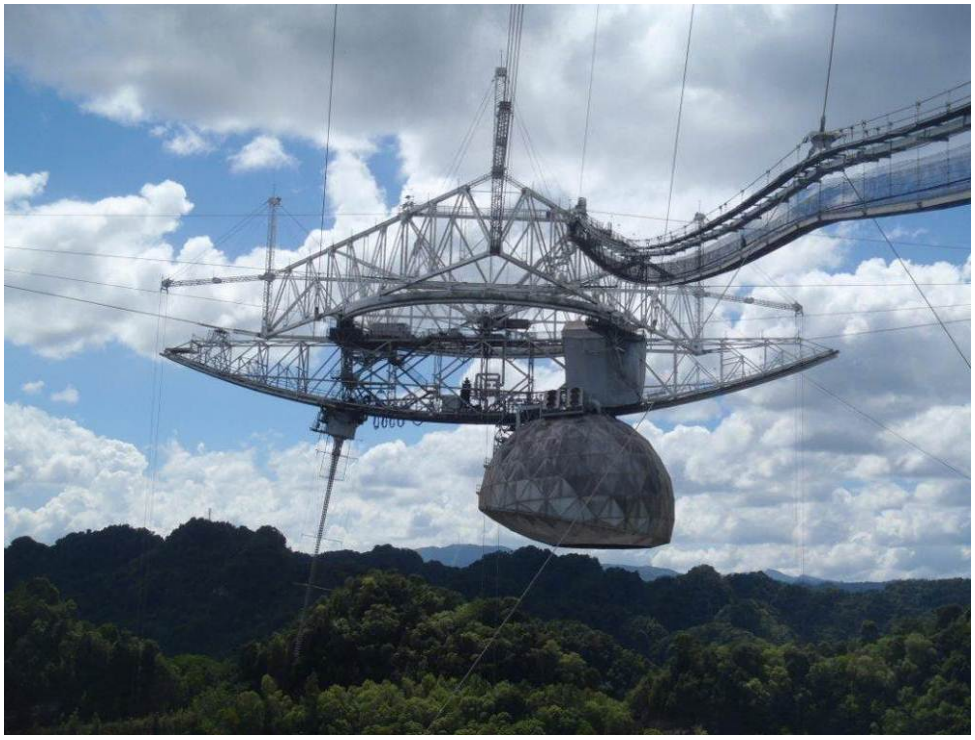


Photo 7: Platform of the Arecibo Telescope facing south.

Photo 8: Building #1 facing west.

Photo 9: Building #2 facing west.

Photo 10: Engineering office trailers (Buildings #66 and #68) facing west.

Photo11: Visitors Center facing south.

Photo 12: Maintenance Shop (Building #12) facing east.

Photo 13: Warehouse (Building #17) facing northeast.

Photo 14: Maintenance office facing north.

Photo 15: Generator Building

Photo 16: Fuel tanks facing south.

Photo 17: Paint storage building.

Photo18: Mobile storage containers facing northwest.

Photo 19: Storage Building #52 facing southwest

Photo 20: Building #3, Visiting Scientist Quarters and cafeteria facing east.

Photo 21: Swimming pool and basketball courts facing north.

Photo 22: Building #43, visiting scientist family unit facing east.

Photo 23: Visiting scientist bachelor unit facing east.

Photo 24: North Visiting Scientist Building facing southeast.

Photo 25: LIDAR Building facing northwest.

Photo 26: Optics lab facing east.

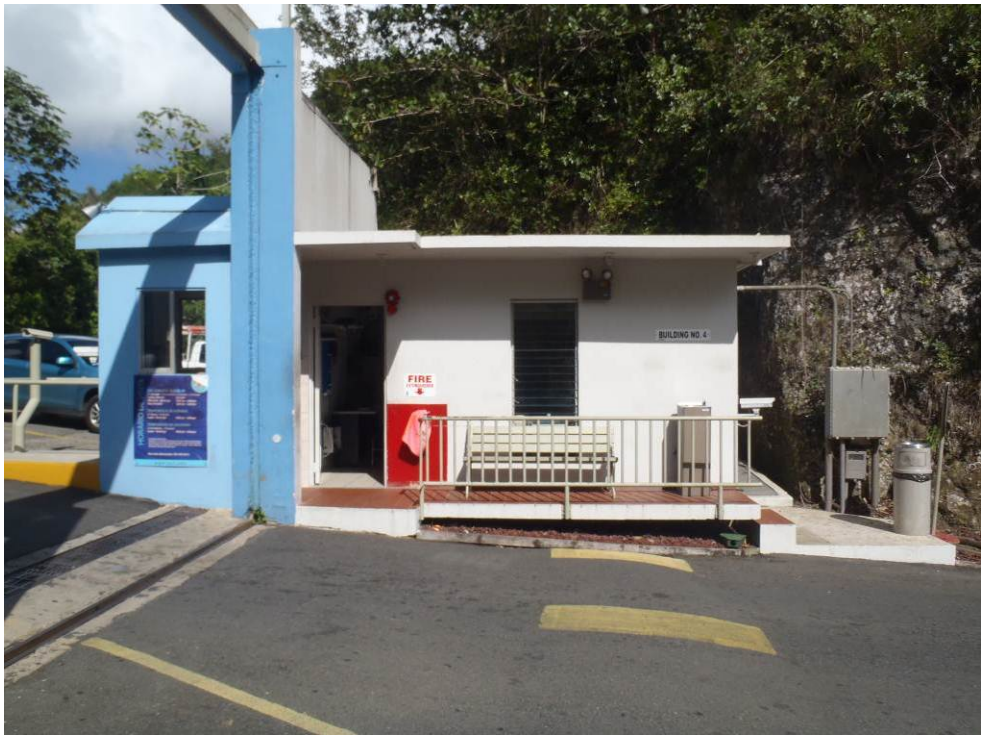


Photo 27: Guard house facing east.

Photo 28: Water well facing west.

Photo 29: Water treatment building facing west.

Photo 30: Grease trap next to the cafeteria facing west

Photo 31: Pond beneath reflector dish facing north.

Photo 32: Tower and guy wires facing north.

Photo 33: Flammable locker at the machine shop inside Building #1.

Photo 34: Flammable locker at the electronics lab in Building #1.

Photo 35: Drums of oil inside Generator Building.

Photo 36: Inside warehouse building.

Photo 37: Storage sheds outside warehouse building facing north.

Photo 38: Battery storage in shed CS-1.

Photo 39: Chlorine storage in shed CS-2

Photo 40: Herbicides in shed CS-4

Photo 41: Inside paint storage building (Building #25).

Photo 42: Oil storage next to warehouse facing west.

Photo 43: Grease rack and used oil storage facing west.

Photo 44: Paint inside maintenance shop.

Photo 45: Inside maintenance shop.

Photo 46: Methanol container inside Optic Lab.

Photo 47: Paint inside utility building next to the north visiting scientist quarters.

Photo 48: Gear oil and grease on platform.

Photo 49: Stain on concrete floor inside warehouse.

Photo 50: Stain on parking space at cafeteria facing southwest.

Photo 51: Used oil storage area next to Warehouse.

Photo 52: 1,000-gallon day tank for generator at Building #80.

Photo 53: 2,000-gallon gasoline aboveground storage tank and 12,000-gallon diesel aboveground storage tank facing south.

Photo 54: 2,000-gallon diesel tank for emergency generator facing west.

Photo 55: Transformer outside Building #1.

Photo 56: High voltage power supply building facing south.

Attachment B
Environmental Data Resources, Inc., Radius Map Reports with Geocheck

Arecibo Observatory
Arecibo
Arecibo, PR 00612

Inquiry Number: 4135296.2s
November 24, 2014

EDR Summary Radius Map Report

EDR® Environmental Data Resources Inc

6 Armstrong Road, 4th floor
Shelton, CT 06484
Toll Free: 800.352.0050
www.edrnet.com

TABLE OF CONTENTS

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

EXECUTIVE SUMMARY

A search of available environmental records was conducted by Environmental Data Resources, Inc (EDR). The report was designed to assist parties seeking to meet the search requirements of EPA's Standards and Practices for All Appropriate Inquiries (40 CFR Part 312), the ASTM Standard Practice for Environmental Site Assessments (E 1527-13) or custom requirements developed for the evaluation of environmental risk associated with a parcel of real estate.

TARGET PROPERTY INFORMATION

ADDRESS

ARECIBO
ARECIBO County, PR 00612

COORDINATES

Latitude (North):	18.3483000 - 18˚ 20' 53.88''
Longitude (West):	66.7524000 - 66˚ 45' 8.64''
Universal Tranverse Mercator:	Zone 19
UTM X (Meters):	737518.0
UTM Y (Meters):	2030065.8
Elevation:	996 ft. above sea level

USGS TOPOGRAPHIC MAP ASSOCIATED WITH TARGET PROPERTY

Target Property:	N/A
Source:	USGS 7.5 min quad index

MAPPED SITES SUMMARY

Target Property Address:
ARECIBO
, PR 00612

Click on Map ID to see full detail.

MAP ID	SITE NAME	ADDRESS	DATABASE ACRONYMS	RELATIVE ELEVATION	DIST (ft.) DIRECTION
A1	ARECIBO OBSERVATORY	ROUTE 625, KM. 3.1 E	UST		TP
A2	OBSERVATORIO DE AREC	CARR 625 KM 3.3	RCRA-CESQG		TP
A3	ARECIBO OBSERVATORY	RT 625 KM. 3.1	FINDS		TP
A4	OBSERVATORIO DE AREC	CARR 625 KM 3.3	FINDS		TP

EXECUTIVE SUMMARY

TARGET PROPERTY SEARCH RESULTS

The target property was identified in the following records. For more information on this property see page 7 of the attached EDR Radius Map report:

Site	Database(s)	EPA ID
ARECIBO OBSERVATORY ROUTE 625, KM. 3.1 E ARECIBO, PR 00612	UST	N/A
OBSERVATORIO DE AREC CARR 625 KM 3.3 ARECIBO, PR 00612	RCRA-CESQG	PRR000015057
ARECIBO OBSERVATORY RT 625 KM. 3.1 ARECIBO, PR 00612	FINDS	N/A
OBSERVATORIO DE AREC CARR 625 KM 3.3 ARECIBO, PR 00612	FINDS	N/A

SURROUNDING SITES: SEARCH RESULTS

Surrounding sites were not identified.

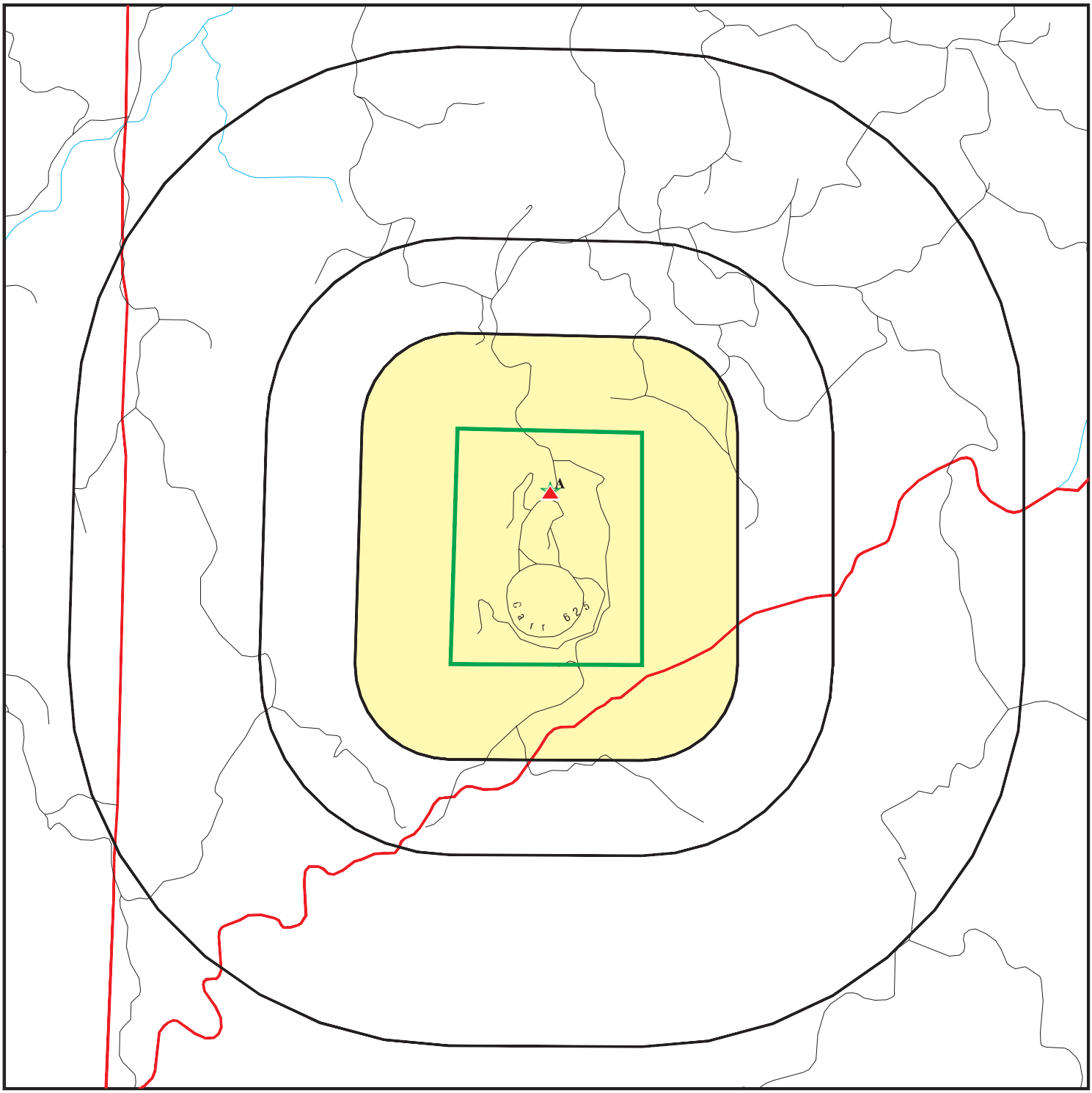
Unmappable (orphan) sites are not considered in the foregoing analysis.

Count: 0 records.

ORPHAN SUMMARY

City	EDR ID	Site Name	Site Address	Zip	Database(s)
		NO SITES FOUND			

OVERVIEW MAP - 4135296.2S



Target Property
Sites at elevations higher than or equal to the target property
Sites at elevations lower than the target property
Manufactured Gas Plants
National Priority List Sites
Dept. Defense Sites

0 1/4 1/2 1 Miles

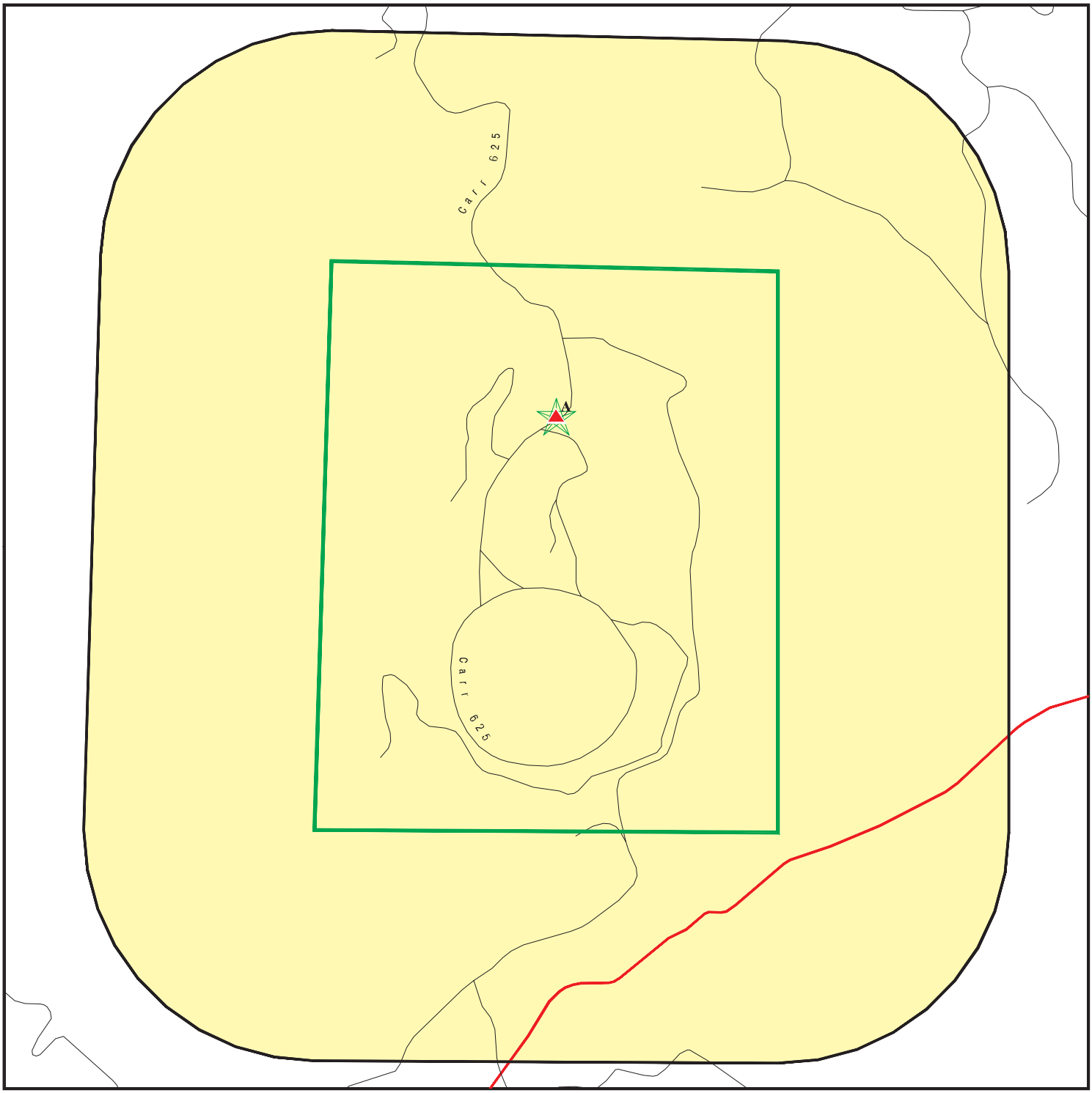
Indian Reservations BIA
County Boundary
100-year flood zone
500-year flood zone

N

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME: Arecibo Observatory ADDRESS: Arecibo Arecibo PR 00612 LAT/LONG: 18.3483 / 66.7524	CLIENT: CH2M Hill, Inc. CONTACT: Mike Brose INQUIRY #: 4135296.2s DATE: November 24, 2014 6:02 pm

DETAIL MAP - 4135296.2S



Target Property

Sites at elevations higher than or equal to the target property

Sites at elevations lower than the target property

Manufactured Gas Plants

Sensitive Receptors

National Priority List Sites

Dept. Defense Sites

Indian Reservations BIA

County Boundary

100-year flood zone

500-year flood zone

0 1/8 1/4 1/2 Miles

N

This report includes Interactive Map Layers to display and/or hide map information. The legend includes only those icons for the default map view.

SITE NAME:	Arecibo Observatory	CLIENT:	CH2M Hill, Inc.
ADDRESS:	Arecibo Arecibo PR 00612	CONTACT:	Mike Brose
LAT/LONG:	18.3483 / 66.7524	INQUIRY #:	4135296.2s
		DATE:	November 24, 2014 6:02 pm

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
STANDARD ENVIRONMENTAL RECORDS								
Federal NPL site list								
NPL	1.000		0	0	0	0	NR	0
Proposed NPL	1.000		0	0	0	0	NR	0
NPL LIENS	TP		NR	NR	NR	NR	NR	0
Federal Delisted NPL site list								
Delisted NPL	1.000		0	0	0	0	NR	0
Federal CERCLIS list								
CERCLIS	0.500		0	0	0	NR	NR	0
FEDERAL FACILITY	0.500		0	0	0	NR	NR	0
Federal CERCLIS NFRAP site List								
CERC-NFRAP	0.500		0	0	0	NR	NR	0
Federal RCRA CORRACTS facilities list								
CORRACTS	1.000		0	0	0	0	NR	0
Federal RCRA non-CORRACTS TSD facilities list								
RCRA-TSDF	0.500		0	0	0	NR	NR	0
Federal RCRA generators list								
RCRA-LQG	0.250		0	0	NR	NR	NR	0
RCRA-SQG	0.250		0	0	NR	NR	NR	0
RCRA-CESQG	0.250	1	0	0	NR	NR	NR	1
Federal institutional controls / engineering controls registries								
US ENG CONTROLS	0.500		0	0	0	NR	NR	0
US INST CONTROL	0.500		0	0	0	NR	NR	0
LUCIS	0.500		0	0	0	NR	NR	0
Federal ERNS list								
ERNS	TP		NR	NR	NR	NR	NR	0
State- and tribal - equivalent CERCLIS								
SHWS	N/A		N/A	N/A	N/A	N/A	N/A	N/A
State and tribal leaking storage tank lists								
LUST	0.500		0	0	0	NR	NR	0
INDIAN LUST	0.500		0	0	0	NR	NR	0
State and tribal registered storage tank lists								
UST	0.250	1	0	0	NR	NR	NR	1
INDIAN UST	0.250		0	0	NR	NR	NR	0
FEMA UST	0.250		0	0	NR	NR	NR	0
State and tribal voluntary cleanup sites								
INDIAN VCP	0.500		0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
ADDITIONAL ENVIRONMENTAL RECORDS								
Local Brownfield lists								
US BROWNFIELDS	0.500		0	0	0	NR	NR	0
Local Lists of Landfill / Solid Waste Disposal Sites								
ODI	0.500		0	0	0	NR	NR	0
DEBRIS REGION 9	0.500		0	0	0	NR	NR	0
INDIAN ODI	0.500		0	0	0	NR	NR	0
Local Lists of Hazardous waste / Contaminated Sites								
US CDL	TP		NR	NR	NR	NR	NR	0
US HIST CDL	TP		NR	NR	NR	NR	NR	0
Local Land Records								
LIENS 2	TP		NR	NR	NR	NR	NR	0
Records of Emergency Release Reports								
HMIRS	TP		NR	NR	NR	NR	NR	0
Other Ascertainable Records								
RCRA NonGen / NLR	0.250		0	0	NR	NR	NR	0
DOT OPS	TP		NR	NR	NR	NR	NR	0
DOD	1.000		0	0	0	0	NR	0
FUDS	1.000		0	0	0	0	NR	0
CONSENT	1.000		0	0	0	0	NR	0
ROD	1.000		0	0	0	0	NR	0
UMTRA	0.500		0	0	0	NR	NR	0
US MINES	0.250		0	0	NR	NR	NR	0
TRIS	TP		NR	NR	NR	NR	NR	0
TSCA	TP		NR	NR	NR	NR	NR	0
FTTS	TP		NR	NR	NR	NR	NR	0
HIST FTTS	TP		NR	NR	NR	NR	NR	0
SSTS	TP		NR	NR	NR	NR	NR	0
ICIS	TP		NR	NR	NR	NR	NR	0
PADS	TP		NR	NR	NR	NR	NR	0
MLTS	TP		NR	NR	NR	NR	NR	0
RADINFO	TP		NR	NR	NR	NR	NR	0
FINDS	TP	2	NR	NR	NR	NR	NR	2
RAATS	TP		NR	NR	NR	NR	NR	0
RMP	TP		NR	NR	NR	NR	NR	0
INDIAN RESERV	1.000		0	0	0	0	NR	0
SCRD DRYCLEANERS	0.500		0	0	0	NR	NR	0
PCB TRANSFORMER	TP		NR	NR	NR	NR	NR	0
US FIN ASSUR	TP		NR	NR	NR	NR	NR	0
EPA WATCH LIST	TP		NR	NR	NR	NR	NR	0
COAL ASH EPA	0.500		0	0	0	NR	NR	0

MAP FINDINGS SUMMARY

Database	Search Distance (Miles)	Target Property	< 1/8	1/8 - 1/4	1/4 - 1/2	1/2 - 1	> 1	Total Plotted
US AIRS	TP		NR	NR	NR	NR	NR	0
COAL ASH DOE	TP		NR	NR	NR	NR	NR	0
LEAD SMELTERS	TP		NR	NR	NR	NR	NR	0
PRP	TP		NR	NR	NR	NR	NR	0
2020 COR ACTION	0.250		0	0	NR	NR	NR	0
EDR HIGH RISK HISTORICAL RECORDS								
EDR Exclusive Records								
EDR MGP	1.000		0	0	0	0	NR	0
EDR RECOVERED GOVERNMENT ARCHIVES								
Exclusive Recovered Govt. Archives								
RGA LUST	TP		NR	NR	NR	NR	NR	0

NOTES:

TP = Target Property

NR = Not Requested at this Search Distance

Sites may be listed in more than one database

N/A = This State does not maintain a SHWS list. See the Federal CERCLIS list.

A1
Target Property
Actual: 996 ft.

ARECIBO OBSERVATORY
ROUTE 625, KM. 3.1 ESPERANZA WARD
ARECIBO, PR 00612

UST **1000573516**
N/A

Click here for full text details

UST
Facility Id: 2-860049

A2
Target Property
Actual: 996 ft.

OBSERVATORIO DE ARECIBO
CARR 625 KM 3.3
ARECIBO, PR 00612

RCRA-CESQG **1005444722**
PRR000015057

Click here for full text details

RCRA-CESQG
EPA Id: PRR000015057

A3
Target Property
Actual: 996 ft.

ARECIBO OBSERVATORY
RT 625 KM. 3.1
ARECIBO, PR 00612

FINDS **1010053277**
N/A

Click here for full text details

A4
Target Property
Actual: 996 ft.

OBSERVATORIO DE ARECIBO
CARR 625 KM 3.3
ARECIBO, PR 00612

FINDS **1016302521**
N/A

Click here for full text details

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

St	Acronym	Full Name	Government Agency	Gov Date	Arvl. Date	Active Date
PR	LUST	Leaking Underground Storage Tanks	Environmental Quality Board	12/01/2010	02/03/2011	03/08/2011
PR	RGA LUST	Recovered Government Archive Leaking Underground Storage Tan	Environmental Quality Board		07/01/2013	01/04/2014
PR	SHWS	This state does not maintain a SHWS list. See the Federal CE	Environmental Quality Board			
PR	UST	Underground Storage Tank Facilities	Environmental Quality Board	01/01/2008	03/26/2008	04/23/2008
US	2020 COR ACTION	2020 Corrective Action Program List	Environmental Protection Agency	11/11/2011	05/18/2012	05/25/2012
US	BRS	Biennial Reporting System	EPA/NTIS	12/31/2011	02/26/2013	04/19/2013
US	CERCLIS	Comprehensive Environmental Response, Compensation, and Liab	EPA	10/25/2013	11/11/2013	02/13/2014
US	CERCLIS-NFRAP	CERCLIS No Further Remedial Action Planned	EPA	10/25/2013	11/11/2013	02/13/2014
US	COAL ASH DOE	Sleam-Electric Plan Operation Data	Department of Energy	12/31/2005	08/07/2009	10/22/2009
US	COAL ASH EPA	Coal Combustion Residues Surface Impoundments List	Environmental Protection Agency	07/01/2014	09/10/2014	10/20/2014
US	CONSENT	Superfund (CERCLA) Consent Decrees	Department of Justice, Consent Decree Library	12/31/2013	01/24/2014	02/24/2014
US	CORRACTS	Corrective Action Report	EPA	06/10/2014	07/02/2014	09/18/2014
US	DEBRIS REGION 9	Torres Martinez Reservation Illegal Dump Site Locations	EPA, Region 9	01/12/2009	05/07/2009	09/21/2009
US	DELISTED NPL	National Priority List Deletions	EPA	09/29/2014	10/08/2014	11/17/2014
US	DOD	Department of Defense Sites	USGS	12/31/2005	11/10/2006	01/11/2007
US	DOT OPS	Incident and Accident Data	Department of Transporation, Office of Pipeli	07/31/2012	08/07/2012	09/18/2012
US	EDR MGP	EDR Proprietary Manufactured Gas Plants	EDR, Inc.			
US	EPA WATCH LIST	EPA WATCH LIST	Environmental Protection Agency	08/30/2013	03/21/2014	06/17/2014
US	ERNS	Emergency Response Notification System	National Response Center, United States Coast	09/29/2014	09/30/2014	11/06/2014
US	FEDERAL FACILITY	Federal Facility Site Information listing	Environmental Protection Agency	07/21/2014	10/07/2014	10/20/2014
US	FEDLAND	Federal and Indian Lands	U.S. Geological Survey	12/31/2005	02/06/2006	01/11/2007
US	FEMA UST	Underground Storage Tank Listing	FEMA	01/01/2010	02/16/2010	04/12/2010
US	FINDS	Facility Index System/Facility Registry System	EPA	08/16/2014	09/10/2014	10/20/2014
US	FTTS	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fu	EPA/Office of Prevention, Pesticides and Toxi	04/09/2009	04/16/2009	05/11/2009
US	FTTS INSP	FIFRA/ TSCA Tracking System - FIFRA (Federal Insecticide, Fu	EPA	04/09/2009	04/16/2009	05/11/2009
US	FUDS	Formerly Used Defense Sites	U.S. Army Corps of Engineers	06/06/2014	09/10/2014	09/18/2014
US	HIST FTTS	FIFRA/TSCA Tracking System Administrative Case Listing	Environmental Protection Agency	10/19/2006	03/01/2007	04/10/2007
US	HIST FTTS INSP	FIFRA/TSCA Tracking System Inspection & Enforcement Case Lis	Environmental Protection Agency	10/19/2006	03/01/2007	04/10/2007
US	HMIRS	Hazardous Materials Information Reporting System	U.S. Department of Transportation	09/30/2014	10/01/2014	11/06/2014
US	ICIS	Integrated Compliance Information System	Environmental Protection Agency	07/31/2014	10/29/2014	11/06/2014
US	INDIAN LUST R1	Leaking Underground Storage Tanks on Indian Land	EPA Region 1	02/01/2013	05/01/2013	11/01/2013
US	INDIAN LUST R10	Leaking Underground Storage Tanks on Indian Land	EPA Region 10	05/20/2014	06/10/2014	08/22/2014
US	INDIAN LUST R4	Leaking Underground Storage Tanks on Indian Land	EPA Region 4	07/30/2014	08/12/2014	08/22/2014
US	INDIAN LUST R5	Leaking Underground Storage Tanks on Indian Land	EPA, Region 5	11/03/2014	11/05/2014	11/17/2014
US	INDIAN LUST R6	Leaking Underground Storage Tanks on Indian Land	EPA Region 6	10/06/2014	10/29/2014	11/17/2014
US	INDIAN LUST R7	Leaking Underground Storage Tanks on Indian Land	EPA Region 7	05/22/2014	08/22/2014	09/18/2014
US	INDIAN LUST R8	Leaking Underground Storage Tanks on Indian Land	EPA Region 8	11/04/2014	11/07/2014	11/17/2014
US	INDIAN LUST R9	Leaking Underground Storage Tanks on Indian Land	Environmental Protection Agency	03/01/2013	03/01/2013	04/12/2013
US	INDIAN ODI	Report on the Status of Open Dumps on Indian Lands	Environmental Protection Agency	12/31/1998	12/03/2007	01/24/2008
US	INDIAN RESERV	Indian Reservations	USGS	12/31/2005	12/08/2006	01/11/2007
US	INDIAN UST R1	Underground Storage Tanks on Indian Land	EPA, Region 1	02/01/2013	05/01/2013	01/27/2014
US	INDIAN UST R10	Underground Storage Tanks on Indian Land	EPA Region 10	05/20/2014	06/10/2014	08/15/2014
US	INDIAN UST R4	Underground Storage Tanks on Indian Land	EPA Region 4	07/30/2014	08/12/2014	08/22/2014
US	INDIAN UST R5	Underground Storage Tanks on Indian Land	EPA Region 5	11/03/2014	11/05/2014	11/17/2014
US	INDIAN UST R6	Underground Storage Tanks on Indian Land	EPA Region 6	10/06/2014	10/29/2014	11/06/2014
US	INDIAN UST R7	Underground Storage Tanks on Indian Land	EPA Region 7	08/20/2014	08/22/2014	09/18/2014
US	INDIAN UST R8	Underground Storage Tanks on Indian Land	EPA Region 8	11/04/2014	11/07/2014	11/17/2014

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

St	Acronym	Full Name	Government Agency	Gov Date	Arvl. Date	Active Date
US	INDIAN UST R9	Underground Storage Tanks on Indian Land	EPA Region 9	08/14/2014	08/15/2014	08/22/2014
US	INDIAN VCP R1	Voluntary Cleanup Priority Listing	EPA, Region 1	09/29/2014	10/01/2014	11/06/2014
US	INDIAN VCP R7	Voluntary Cleanup Priority Lisitng	EPA, Region 7	03/20/2008	04/22/2008	05/19/2008
US	LEAD SMELTER 1	Lead Smelter Sites	Environmental Protection Agency	06/04/2014	06/12/2014	07/28/2014
US	LEAD SMELTER 2	Lead Smelter Sites	American Journal of Public Health	04/05/2001	10/27/2010	12/02/2010
US	LIENS 2	CERCLA Lien Information	Environmental Protection Agency	02/18/2014	03/18/2014	04/24/2014
US	LUCIS	Land Use Control Information System	Department of the Navy	08/29/2014	10/09/2014	10/20/2014
US	MLTS	Material Licensing Tracking System	Nuclear Regulatory Commission	07/22/2013	08/02/2013	11/01/2013
US	NPL	National Priority List	EPA	09/29/2014	10/08/2014	11/17/2014
US	NPL LIENS	Federal Superfund Liens	EPA	10/15/1991	02/02/1994	03/30/1994
US	ODI	Open Dump Inventory	Environmental Protection Agency	06/30/1985	08/09/2004	09/17/2004
US	PADS	PCB Activity Database System	EPA	07/01/2014	10/15/2014	11/17/2014
US	PCB TRANSFORMER	PCB Transformer Registration Database	Environmental Protection Agency	02/01/2011	10/19/2011	01/10/2012
US	PRP	Potentially Responsible Parties	EPA	10/25/2013	10/17/2014	10/20/2014
US	Proposed NPL	Proposed National Priority List Sites	EPA	09/29/2014	10/08/2014	11/17/2014
US	RAATS	RCRA Administrative Action Tracking System	EPA	04/17/1995	07/03/1995	08/07/1995
US	RADINFO	Radiation Information Database	Environmental Protection Agency	10/07/2014	10/08/2014	10/20/2014
US	RCRA NonGen / NLR	RCRA - Non Generators	Environmental Protection Agency	06/10/2014	07/02/2014	09/18/2014
US	RCRA-CESQG	RCRA - Conditionally Exempt Small Quantity Generators	Environmental Protection Agency	06/10/2014	07/02/2014	09/18/2014
US	RCRA-LQG	RCRA - Large Quantity Generators	Environmental Protection Agency	06/10/2014	07/02/2014	09/18/2014
US	RCRA-SQG	RCRA - Small Quantity Generators	Environmental Protection Agency	06/10/2014	07/02/2014	09/18/2014
US	RCRA-TSDF	RCRA - Treatment, Storage and Disposal	Environmental Protection Agency	06/10/2014	07/02/2014	09/18/2014
US	RMP	Risk Management Plans	Environmental Protection Agency	08/01/2014	08/12/2014	11/06/2014
US	ROD	Records Of Decision	EPA	11/25/2013	12/12/2013	02/24/2014
US	SCRD DRYCLEANERS	State Coalition for Remediation of Drycleaners Listing	Environmental Protection Agency	03/07/2011	03/09/2011	05/02/2011
US	SSTS	Section 7 Tracking Systems	EPA	12/31/2009	12/10/2010	02/25/2011
US	TRIS	Toxic Chemical Release Inventory System	EPA	12/31/2011	07/31/2013	09/13/2013
US	TSCA	Toxic Substances Control Act	EPA	12/31/2006	09/29/2010	12/02/2010
US	UMTRA	Uranium Mill Tailings Sites	Department of Energy	09/14/2010	10/07/2011	03/01/2012
US	US AIRS (AFS)	Aerometric Information Retrieval System Facility Subsystem (	EPA	10/16/2014	10/31/2014	11/17/2014
US	US AIRS MINOR	Air Facility System Data	EPA	10/16/2014	10/31/2014	11/17/2014
US	US BROWNFIELDS	A Listing of Brownfields Sites	Environmental Protection Agency	09/22/2014	09/23/2014	10/20/2014
US	US CDL	Clandestine Drug Labs	Drug Enforcement Administration	07/25/2014	09/09/2014	10/20/2014
US	US ENG CONTROLS	Engineering Controls Sites List	Environmental Protection Agency	09/18/2014	09/19/2014	10/20/2014
US	US FIN ASSUR	Financial Assurance Information	Environmental Protection Agency	09/04/2014	09/04/2014	10/20/2014
US	US HIST CDL	National Clandestine Laboratory Register	Drug Enforcement Administration	07/25/2014	09/09/2014	10/20/2014
US	US INST CONTROL	Sites with Institutional Controls	Environmental Protection Agency	09/18/2014	09/19/2014	10/20/2014
US	US MINES	Mines Master Index File	Department of Labor, Mine Safety and Health A	08/05/2014	09/04/2014	11/17/2014

GOVERNMENT RECORDS SEARCHED / DATA CURRENCY TRACKING

St	Acronym	Full Name	Government Agency	Gov Date	Arvl. Date	Active Date
NJ	NJ MANIFEST	Manifest Information	Department of Environmental Protection	12/31/2011	07/19/2012	08/28/2012
RI	RI MANIFEST	Manifest information	Department of Environmental Management	12/31/2013	07/15/2014	08/13/2014
US	Oil/Gas Pipelines	GeoData Digital Line Graphs from 1:100,000-Scale Maps	USGS			
US	AHA Hospitals	Sensitive Receptor: AHA Hospitals	American Hospital Association, Inc.			
US	Medical Centers	Sensitive Receptor: Medical Centers	Centers for Medicare & Medicaid Services			
US	Nursing Homes	Sensitive Receptor: Nursing Homes	National Institutes of Health			
US	Public Schools	Sensitive Receptor: Public Schools	National Center for Education Statistics			
US	Private Schools	Sensitive Receptor: Private Schools	National Center for Education Statistics			
US	Flood Zones	100-year and 500-year flood zones	Emergency Management Agency (FEMA)			
US	NWI	National Wetlands Inventory	U.S. Fish and Wildlife Service			
US	USGS 7.5' Topographic Map	Scanned Digital USGS 7.5' Topographic Map (DRG)	USGS			

STREET AND ADDRESS INFORMATION

GEOCHECK ®- PHYSICAL SETTING SOURCE ADDENDUM

TARGET PROPERTY ADDRESS

ARECIBO OBSERVATORY
ARECIBO
ARECIBO, PR 00612

TARGET PROPERTY COORDINATES

Latitude (North):	18.3483 - 18˚ 20’ 53.88”
Longitude (West):	66.7524 - 66˚ 45’ 8.64”
Universal Tranverse Mercator:	Zone 19
UTM X (Meters):	737518.0
UTM Y (Meters):	2030065.8
Elevation:	996 ft. above sea level

USGS TOPOGRAPHIC MAP

Target Property:	N/A
Source:	USGS 7.5 min quad index

EDR’s GeoCheck Physical Setting Source Addendum is provided to assist the environmental professional in forming an opinion about the impact of potential contaminant migration.

Assessment of the impact of contaminant migration generally has two principal investigative components:

1. Groundwater flow direction, and
2. Groundwater flow velocity.

Groundwater flow direction may be impacted by surface topography, hydrology, hydrogeology, characteristics of the soil, and nearby wells. Groundwater flow velocity is generally impacted by the nature of the geologic strata.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW DIRECTION INFORMATION

Groundwater flow direction for a particular site is best determined by a qualified environmental professional using site-specific well data. If such data is not reasonably ascertainable, it may be necessary to rely on other sources of information, such as surface topographic information, hydrologic information, hydrogeologic data collected on nearby properties, and regional groundwater flow information (from deep aquifers).

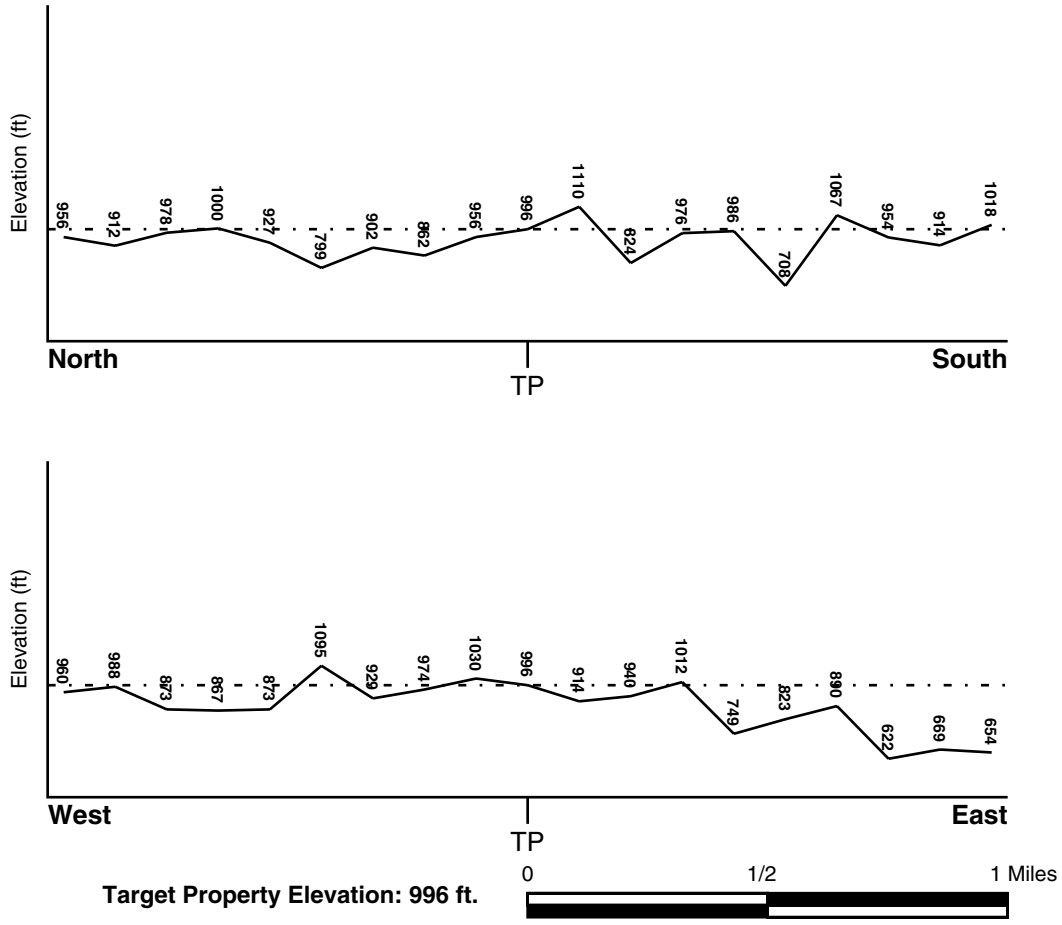
TOPOGRAPHIC INFORMATION

Surface topography may be indicative of the direction of surficial groundwater flow. This information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

TARGET PROPERTY TOPOGRAPHY

General Topographic Gradient: General South

SURROUNDING TOPOGRAPHY: ELEVATION PROFILES



Source: Topography has been determined from the USGS 7.5' Digital Elevation Model and should be evaluated on a relative (not an absolute) basis. Relative elevation information between sites of close proximity should be field verified.

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

HYDROLOGIC INFORMATION

Surface water can act as a hydrologic barrier to groundwater flow. Such hydrologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

Refer to the Physical Setting Source Map following this summary for hydrologic information (major waterways and bodies of water).

FEMA FLOOD ZONE

Target Property County	FEMA Flood Electronic Data
ARECIBO, PR	YES - refer to the Overview Map and Detail Map

Flood Plain Panel at Target Property:	7200000085A - FEMA Q3 Flood data
Additional Panels in search area:	7200000090B - FEMA Q3 Flood data

NATIONAL WETLAND INVENTORY

NWI Quad at Target Property	NWI Electronic Data Coverage
NOT AVAILABLE	YES - refer to the Overview Map and Detail Map

HYDROGEOLOGIC INFORMATION

Hydrogeologic information obtained by installation of wells on a specific site can often be an indicator of groundwater flow direction in the immediate area. Such hydrogeologic information can be used to assist the environmental professional in forming an opinion about the impact of nearby contaminated properties or, should contamination exist on the target property, what downgradient sites might be impacted.

AQUIFLOW®

Search Radius: 1.000 Mile.

EDR has developed the AQUIFLOW Information System to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted by environmental professionals to regulatory authorities at select sites and has extracted the date of the report, groundwater flow direction as determined hydrogeologically, and the depth to water table.

MAP ID	LOCATION FROM TP	GENERAL DIRECTION GROUNDWATER FLOW
Not Reported		

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

GROUNDWATER FLOW VELOCITY INFORMATION

Groundwater flow velocity information for a particular site is best determined by a qualified environmental professional using site specific geologic and soil strata data. If such data are not reasonably ascertainable, it may be necessary to rely on other sources of information, including geologic age identification, rock stratigraphic unit and soil characteristics data collected on nearby properties and regional soil information. In general, contaminant plumes move more quickly through sandy-gravelly types of soils than silty-clayey types of soils.

GEOLOGIC INFORMATION IN GENERAL AREA OF TARGET PROPERTY

Geologic information can be used by the environmental professional in forming an opinion about the relative speed at which contaminant migration may be occurring.

ROCK STRATIGRAPHIC UNIT

Era:	-
System:	-
Series:	-
Code:	N/A *(decoded above as Era, System & Series)*

GEOLOGIC AGE IDENTIFICATION

Category: -

Geologic Age and Rock Stratigraphic Unit Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - a digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

DOMINANT SOIL COMPOSITION IN GENERAL AREA OF TARGET PROPERTY

The U.S. Department of Agriculture's (USDA) Soil Conservation Service (SCS) leads the National Cooperative Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps. The following information is based on Soil Conservation Service STATSGO data.

Soil Component Name:	SOLLER
Soil Surface Texture:	clay
Hydrologic Group:	Class D - Very slow infiltration rates. Soils are clayey, have a high water table, or are shallow to an impervious layer.
Soil Drainage Class:	Well drained. Soils have intermediate water holding capacity. Depth to water table is more than 6 feet.

Hydric Status: Soil does not meet the requirements for a hydric soil.

Corrosion Potential - Uncoated Steel:	HIGH
Depth to Bedrock Min:	> 20 inches
Depth to Bedrock Max:	> 34 inches

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

Soil Layer Information							
	Boundary			Classification			
Layer	Upper	Lower	Soil Texture Class	AASHTO Group	Unified Soil	Permeability Rate (in/hr)	Soil Reaction (pH)
1	0 inches	5 inches	clay	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit 50% or more), Fat Clay.	Max: 2.00 Min: 0.60	Max: 8.40 Min: 7.90
2	5 inches	12 inches	clay	Silt-Clay Materials (more than 35 pct. passing No. 200), Clayey Soils.	FINE-GRAINED SOILS, Silts and Clays (liquid limit 50% or more), Fat Clay.	Max: 2.00 Min: 0.60	Max: 8.40 Min: 7.90
3	12 inches	26 inches	weathered bedrock	Not reported	Not reported	Max: 0.20 Min: 0.06	Max: 0.00 Min: 0.00
4	26 inches	30 inches	unweathered bedrock	Not reported	Not reported	Max: 0.06 Min: 0.01	Max: 0.00 Min: 0.00

OTHER SOIL TYPES IN AREA

Based on Soil Conservation Service STATSGO data, the following additional subordinant soil types may appear within the general area of target property.

Soil Surface Textures: gravelly - clay loam
cobbly - clay

Surficial Soil Types: gravelly - clay loam
cobbly - clay

Shallow Soil Types: No Other Soil Types

Deeper Soil Types: No Other Soil Types

LOCAL / REGIONAL WATER AGENCY RECORDS

EDR Local/Regional Water Agency records provide water well information to assist the environmental professional in assessing sources that may impact ground water flow direction, and in forming an opinion about the impact of contaminant migration on nearby drinking water wells.

WELL SEARCH DISTANCE INFORMATION

DATABASE	SEARCH DISTANCE (miles)
Federal USGS	1.000
Federal FRDS PWS	Nearest PWS within 1 mile

GEOCHECK® - PHYSICAL SETTING SOURCE SUMMARY

FEDERAL USGS WELL INFORMATION

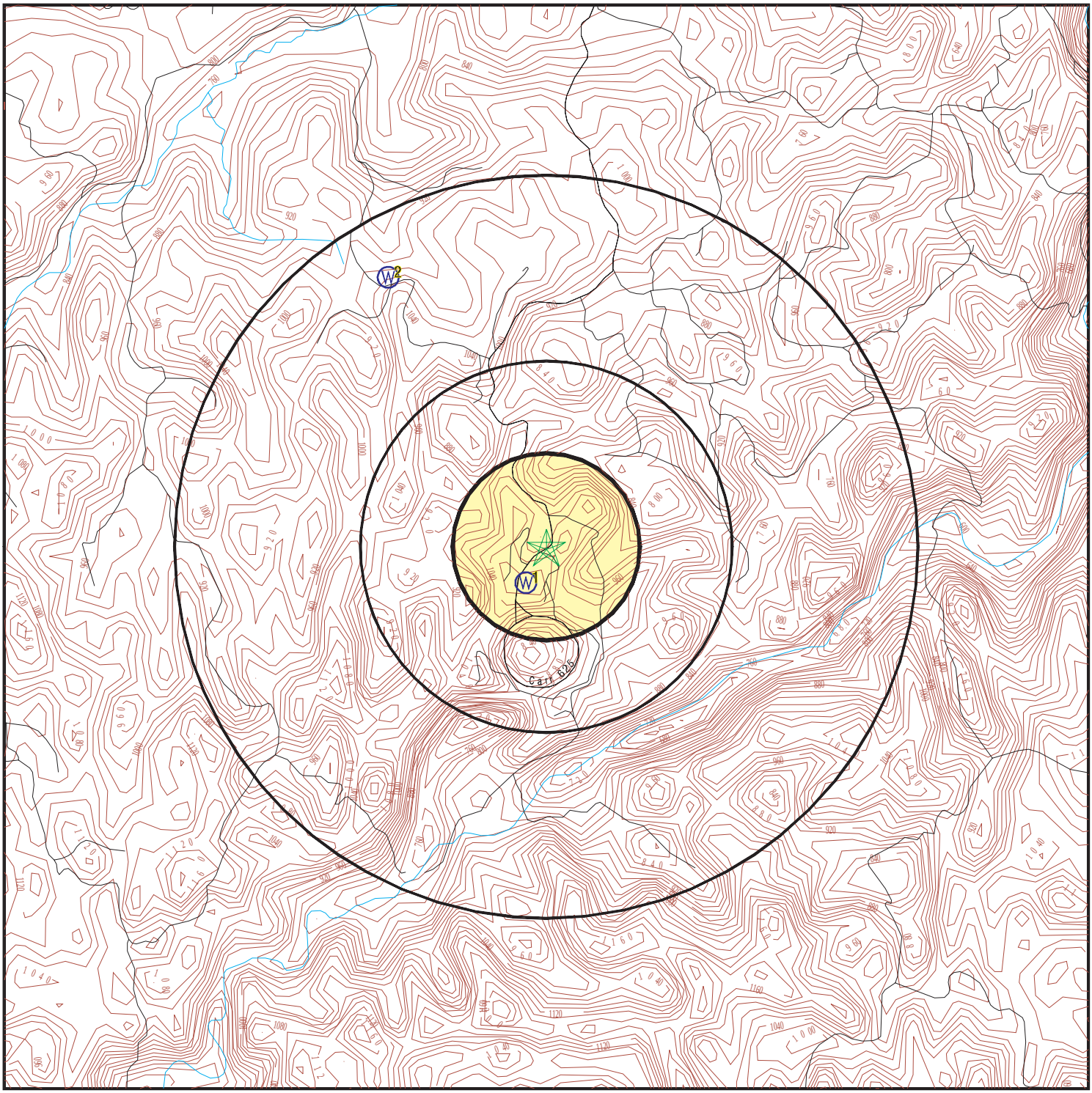
MAP ID	WELL ID	LOCATION FROM TP
1	USGS40001045257	0 - 1/8 Mile SSW
2	USGS40001045321	1/2 - 1 Mile NNW

FEDERAL FRDS PUBLIC WATER SUPPLY SYSTEM INFORMATION

MAP ID	WELL ID	LOCATION FROM TP
No PWS System Found		

Note: PWS System location is not always the same as well location.

PHYSICAL SETTING SOURCE MAP - 4135296.2s



0 1/4 1/2 1 Miles

N

- County Boundary
- Major Roads
- Contour Lines
- Earthquake epicenter, Richter 5 or greater
- Water Wells
- Public Water Supply Wells
- Cluster of Multiple Icons
- Groundwater Flow Direction
- GI Indeterminate Groundwater Flow at Location
- GV Groundwater Flow Varies at Location

SITE NAME:	Arecibo Observatory	CLIENT:	CH2M Hill, Inc.
ADDRESS:	Arecibo Arecibo PR 00612	CONTACT:	Mike Brose
		INQUIRY #:	4135296.2s
LAT/LONG:	18.3483 / 66.7524	DATE:	November 24, 2014 6:02 pm

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS

Map ID Direction Distance Elevation		Database	EDR ID Number
1 **SSW** **0 - 1/8 Mile** **Higher**	**Click here for full text details**	**FED USGS**	**USGS40001045257**
2 **NNW** **1/2 - 1 Mile** **Lower**	**Click here for full text details**	**FED USGS**	**USGS40001045321**

GEOCHECK® - PHYSICAL SETTING SOURCE MAP FINDINGS
RADON

AREA RADON INFORMATION

Not Reported

PHYSICAL SETTING SOURCE RECORDS SEARCHED

TOPOGRAPHIC INFORMATION

USGS 7.5' Digital Elevation Model (DEM)
Source: United States Geologic Survey
EDR acquired the USGS 7.5' Digital Elevation Model in 2002 and updated it in 2006. The 7.5 minute DEM corresponds to the USGS 1:24,000- and 1:25,000-scale topographic quadrangle maps. The DEM provides elevation data with consistent elevation units and projection.

Scanned Digital USGS 7.5' Topographic Map (DRG)
Source: United States Geologic Survey
A digital raster graphic (DRG) is a scanned image of a U.S. Geological Survey topographic map. The map images are made by scanning published paper maps on high-resolution scanners. The raster image is georeferenced and fit to the Universal Transverse Mercator (UTM) projection.

HYDROLOGIC INFORMATION

Flood Zone Data: This data, available in select counties across the country, was obtained by EDR in 2003 & 2011 from the Federal Emergency Management Agency (FEMA). Data depicts 100-year and 500-year flood zones as defined by FEMA.

NWI: National Wetlands Inventory. This data, available in select counties across the country, was obtained by EDR in 2002, 2005 and 2010 from the U.S. Fish and Wildlife Service.

HYDROGEOLOGIC INFORMATION

AQUIFLOW^{R} Information System
Source: EDR proprietary database of groundwater flow information
EDR has developed the AQUIFLOW Information System (AIS) to provide data on the general direction of groundwater flow at specific points. EDR has reviewed reports submitted to regulatory authorities at select sites and has extracted the date of the report, hydrogeologically determined groundwater flow direction and depth to water table information.

GEOLOGIC INFORMATION

Geologic Age and Rock Stratigraphic Unit
Source: P.G. Schruben, R.E. Arndt and W.J. Bawiec, Geology of the Conterminous U.S. at 1:2,500,000 Scale - A digital representation of the 1974 P.B. King and H.M. Beikman Map, USGS Digital Data Series DDS - 11 (1994).

STATSGO: State Soil Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services
The U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) leads the national Conservation Soil Survey (NCSS) and is responsible for collecting, storing, maintaining and distributing soil survey information for privately owned lands in the United States. A soil map in a soil survey is a representation of soil patterns in a landscape. Soil maps for STATSGO are compiled by generalizing more detailed (SSURGO) soil survey maps.

SSURGO: Soil Survey Geographic Database
Source: Department of Agriculture, Natural Resources Conservation Services (NRCS)
Telephone: 800-672-5559
SSURGO is the most detailed level of mapping done by the Natural Resources Conservation Services, mapping scales generally range from 1:12,000 to 1:63,360. Field mapping methods using national standards are used to construct the soil maps in the Soil Survey Geographic (SSURGO) database. SSURGO digitizing duplicates the original soil survey maps. This level of mapping is designed for use by landowners, townships and county natural resource planning and management.

PHYSICAL SETTING SOURCE RECORDS SEARCHED

LOCAL / REGIONAL WATER AGENCY RECORDS

FEDERAL WATER WELLS

PWS: Public Water Systems
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Public Water System data from the Federal Reporting Data System. A PWS is any water system which provides water to at least 25 people for at least 60 days annually. PWSs provide water from wells, rivers and other sources.

PWS ENF: Public Water Systems Violation and Enforcement Data
Source: EPA/Office of Drinking Water
Telephone: 202-564-3750
Violation and Enforcement data for Public Water Systems from the Safe Drinking Water Information System (SDWIS) after August 1995. Prior to August 1995, the data came from the Federal Reporting Data System (FRDS).

USGS Water Wells: USGS National Water Inventory System (NWIS)
This database contains descriptive information on sites where the USGS collects or has collected data on surface water and/or groundwater. The groundwater data includes information on wells, springs, and other sources of groundwater.

OTHER STATE DATABASE INFORMATION

RADON

Area Radon Information
Source: USGS
Telephone: 703-356-4020
The National Radon Database has been developed by the U.S. Environmental Protection Agency (USEPA) and is a compilation of the EPA/State Residential Radon Survey and the National Residential Radon Survey. The study covers the years 1986 - 1992. Where necessary data has been supplemented by information collected at private sources such as universities and research institutions.

EPA Radon Zones
Source: EPA
Telephone: 703-356-4020
Sections 307 & 309 of IRAA directed EPA to list and identify areas of U.S. with the potential for elevated indoor radon levels.

OTHER

Airport Landing Facilities: Private and public use landing facilities
Source: Federal Aviation Administration, 800-457-6656

Epicenters: World earthquake epicenters, Richter 5 or greater
Source: Department of Commerce, National Oceanic and Atmospheric Administration

Earthquake Fault Lines: The fault lines displayed on EDR's Topographic map are digitized quaternary faultlines, prepared in 1975 by the United State Geological Survey

STREET AND ADDRESS INFORMATION

Attachment C
Aerial Photographs and Topographic Maps

Arecibo Observatory
PR-625
Arecibo, PR 00612

Inquiry Number: 4107925.9
October 17, 2014

The EDR Aerial Photo Decade Package

6 Armstrong Road, 4th Floor
Shelton, Connecticut 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Aerial Photo Decade Package

Environmental Data Resources, Inc. (EDR) Aerial Photo Decade Package is a screening tool designed to assist environmental professionals in evaluating potential liability on a target property resulting from past activities. EDR's professional researchers provide digitally reproduced historical aerial photographs, and when available, provide one photo per decade.

When delivered electronically by EDR, the aerial photo images included with this report are for ONE TIME USE ONLY. Further reproduction of these aerial photo images is prohibited without permission from EDR. For more information contact your EDR Account Executive.

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Date EDR Searched Historical Sources:

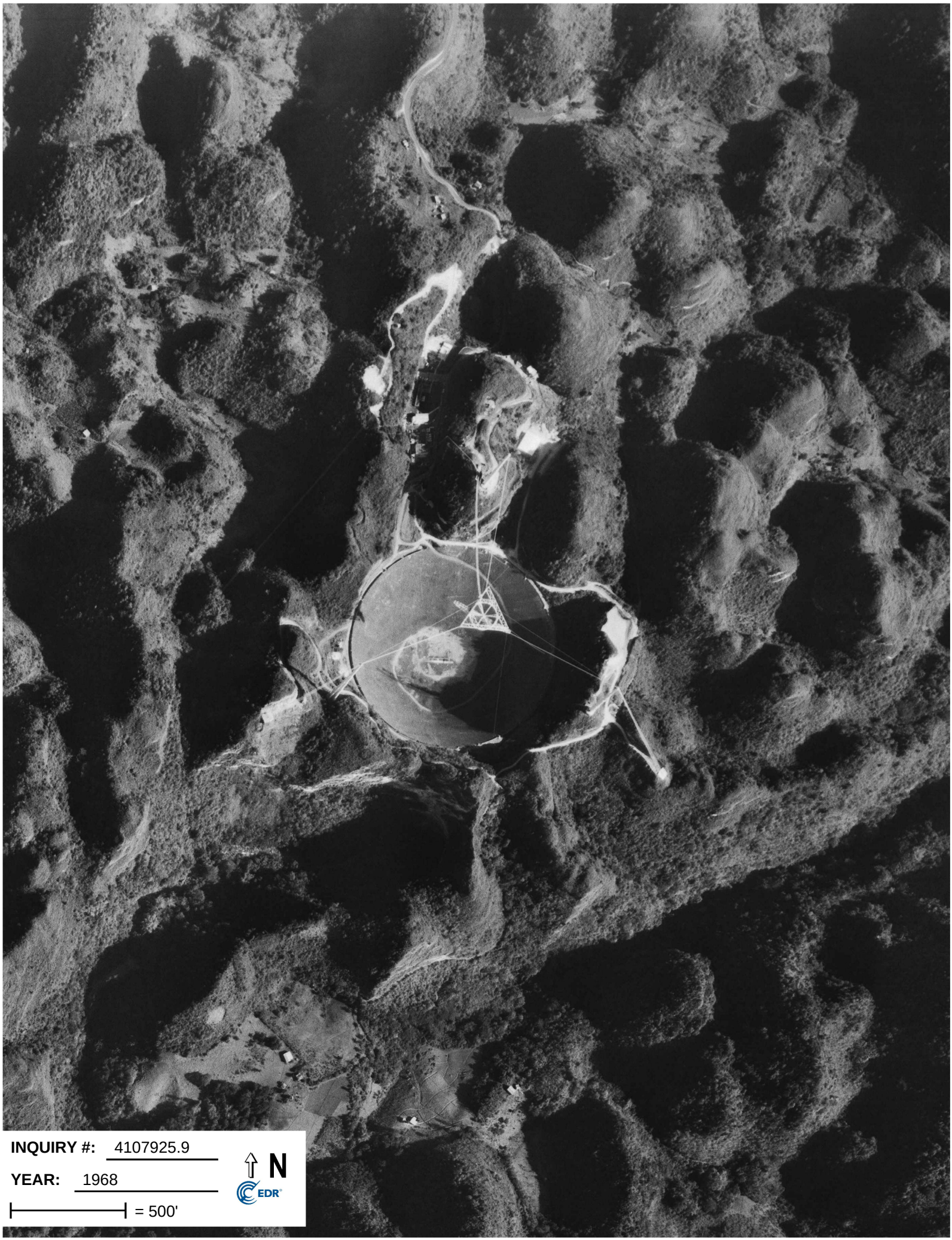
Aerial Photography October 17, 2014

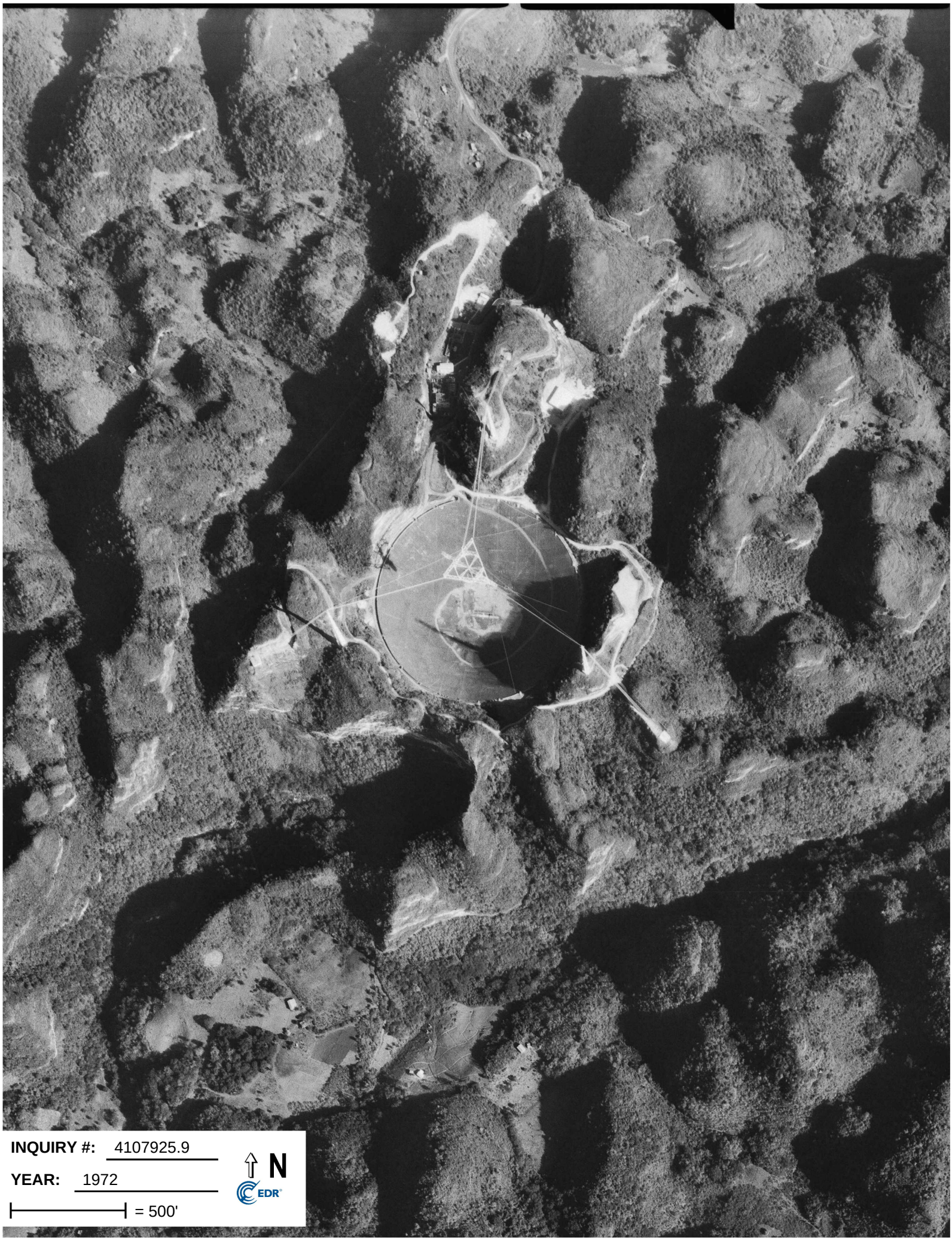
Target Property:

PR-625

Arecibo, PR 00612

Year	***Scale***	***Details***	***Source***
1968	Aerial Photograph. Scale: 1"=500'	Flight Date: March 05, 1968	EDR
1972	Aerial Photograph. Scale: 1"=500'	Flight Date: March 05, 1972	EDR
1977	Aerial Photograph. Scale: 1"=500'	Flight Date: March 20, 1977	EDR
1993	Aerial Photograph. Scale: 1"=500'	DOQQ - acquisition dates: October 11, 1993	USGS/DOQQ


INQUIRY #: 4107925.9
YEAR: 1968
= 500'
N
EDR



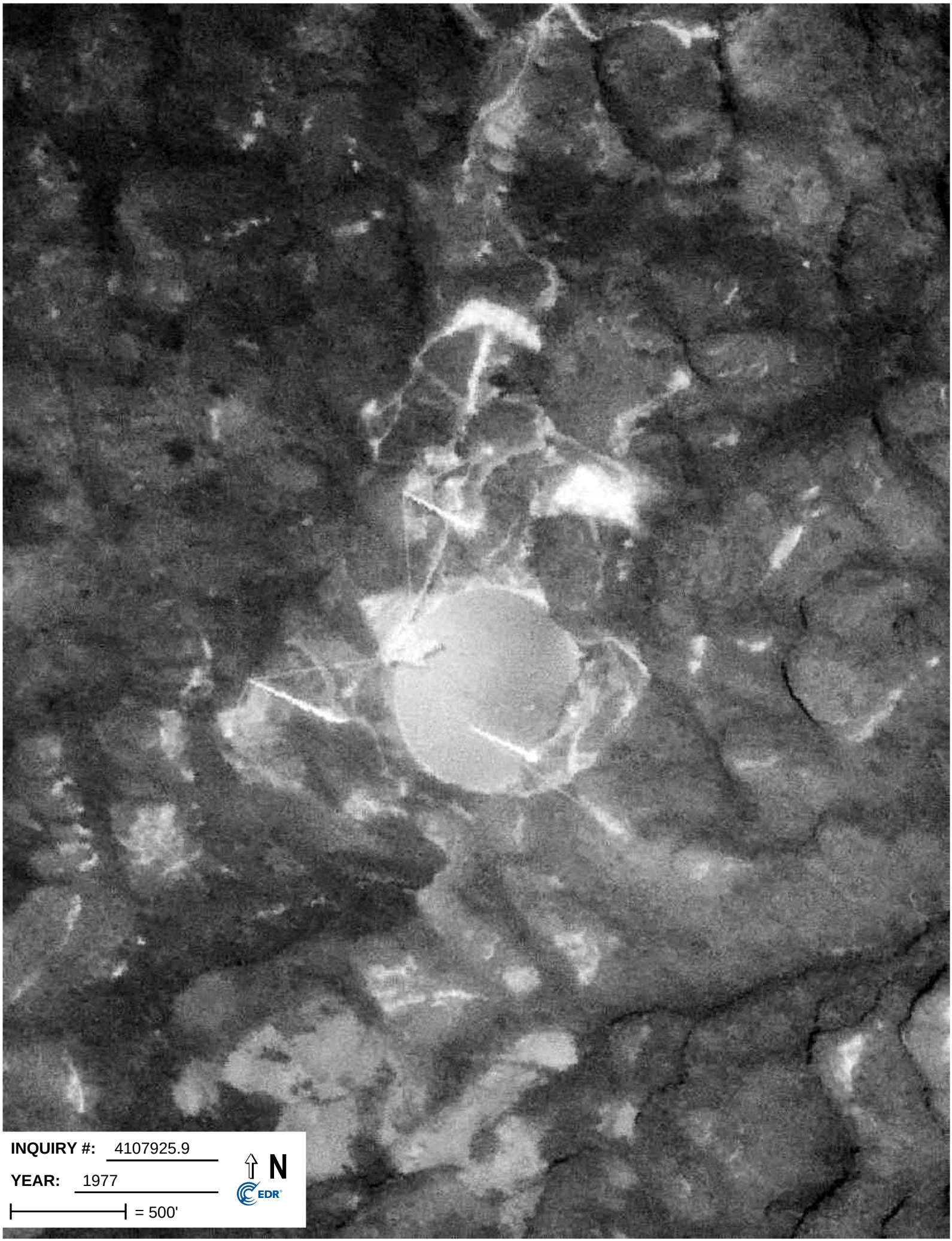
INQUIRY #: 4107925.9

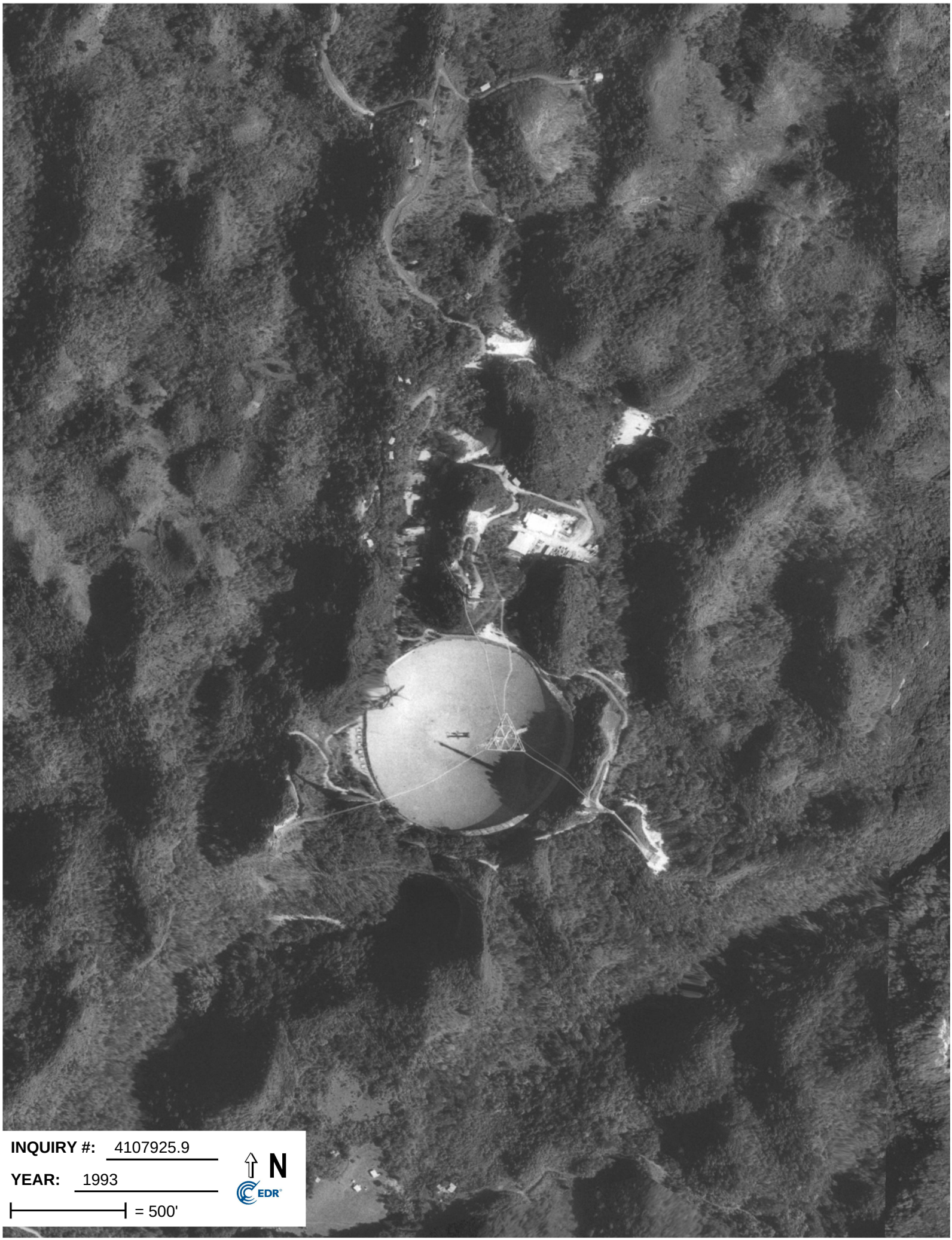
YEAR: 1972

= 500'

N

EDR


INQUIRY #: 4107925.9
YEAR: 1977
= 500'
N
EDR


INQUIRY #: 4107925.9
YEAR: 1993
= 500'
N
EDR

Arecibo Observatory
PR-625
Arecibo, PR 00612

Inquiry Number: 4107925.4
October 16, 2014

EDR Historical Topographic Map Report

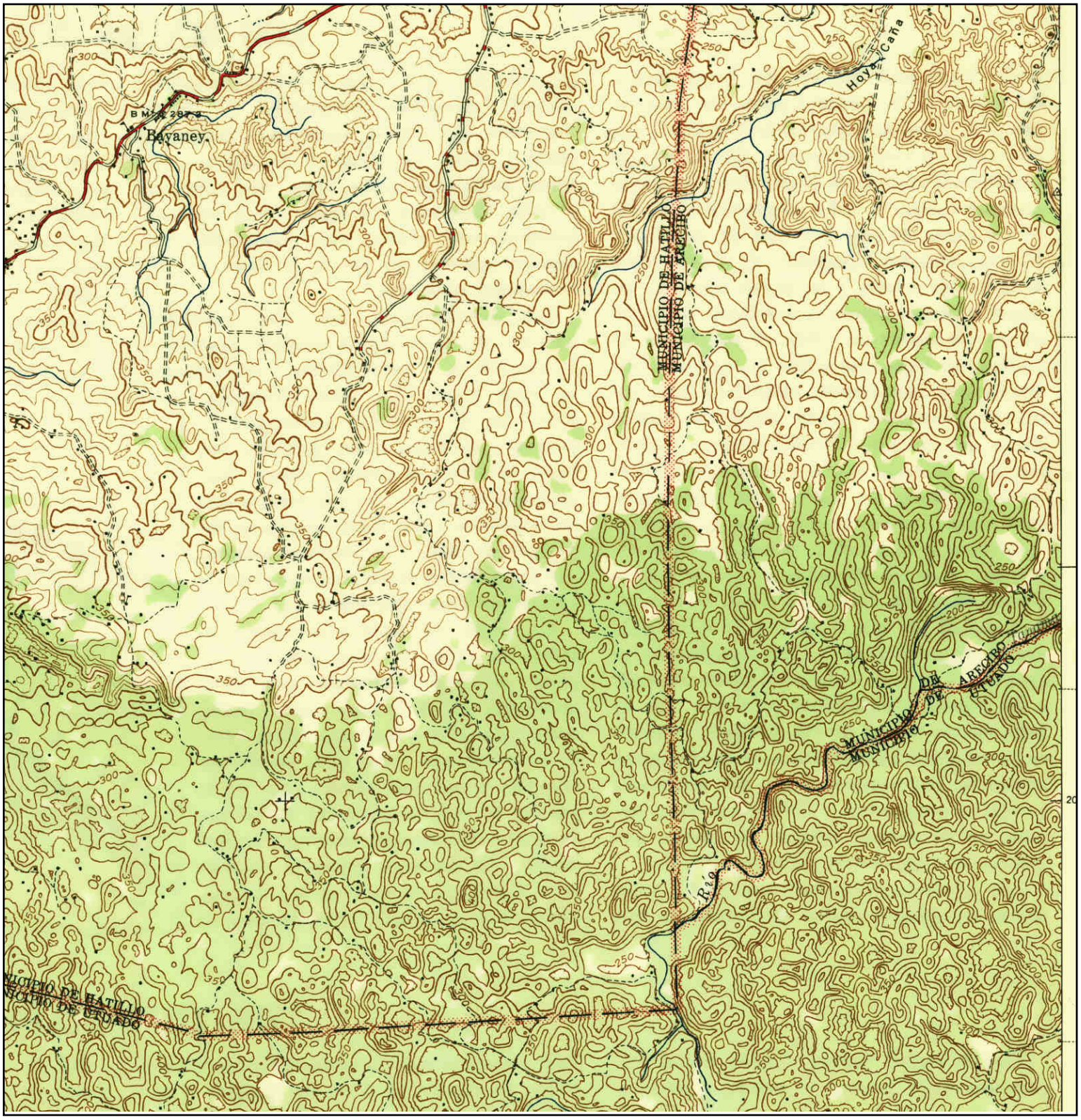
6 Armstrong Road, 4th Floor
Shelton, Connecticut 06484
Toll Free: 800.352.0050
www.edrnet.com

EDR Historical Topographic Map Report

Environmental Data Resources, Inc.s (EDR) Historical Topographic Map Report is designed to assist professionals in evaluating potential liability on a target property resulting from past activities. EDRs Historical Topographic Map Report includes a search of a collection of public and private color historical topographic maps, dating back to the early 1900s.

Thank you for your business.
Please contact EDR at 1-800-352-0050
with any questions or comments.

Historical Topographic Map



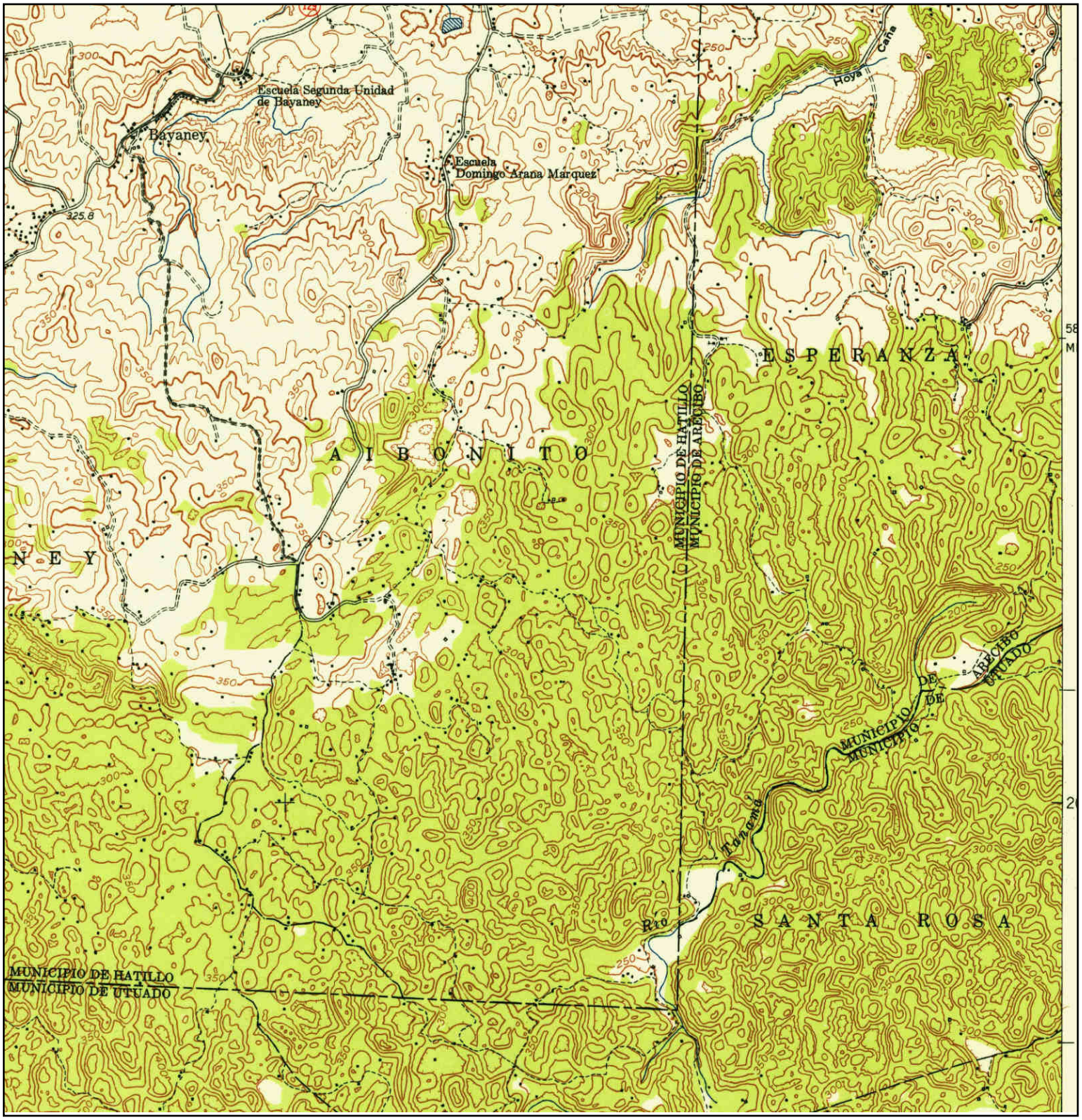
N

TARGET QUAD		SITE NAME:	Arecibo Observatory	CLIENT:	CH2M Hill, Inc.
NAME:	BAYANEY	ADDRESS:	PR-625	CONTACT:	Jean Bossart
MAP YEAR:	1946		Arecibo, PR 00612	INQUIRY#:	4107925.4
		LAT/LONG:	18.3458 / -66.7525	RESEARCH DATE:	10/16/2014
SERIES:	7.5				
SCALE:	1:30000				

Historical Topographic Map

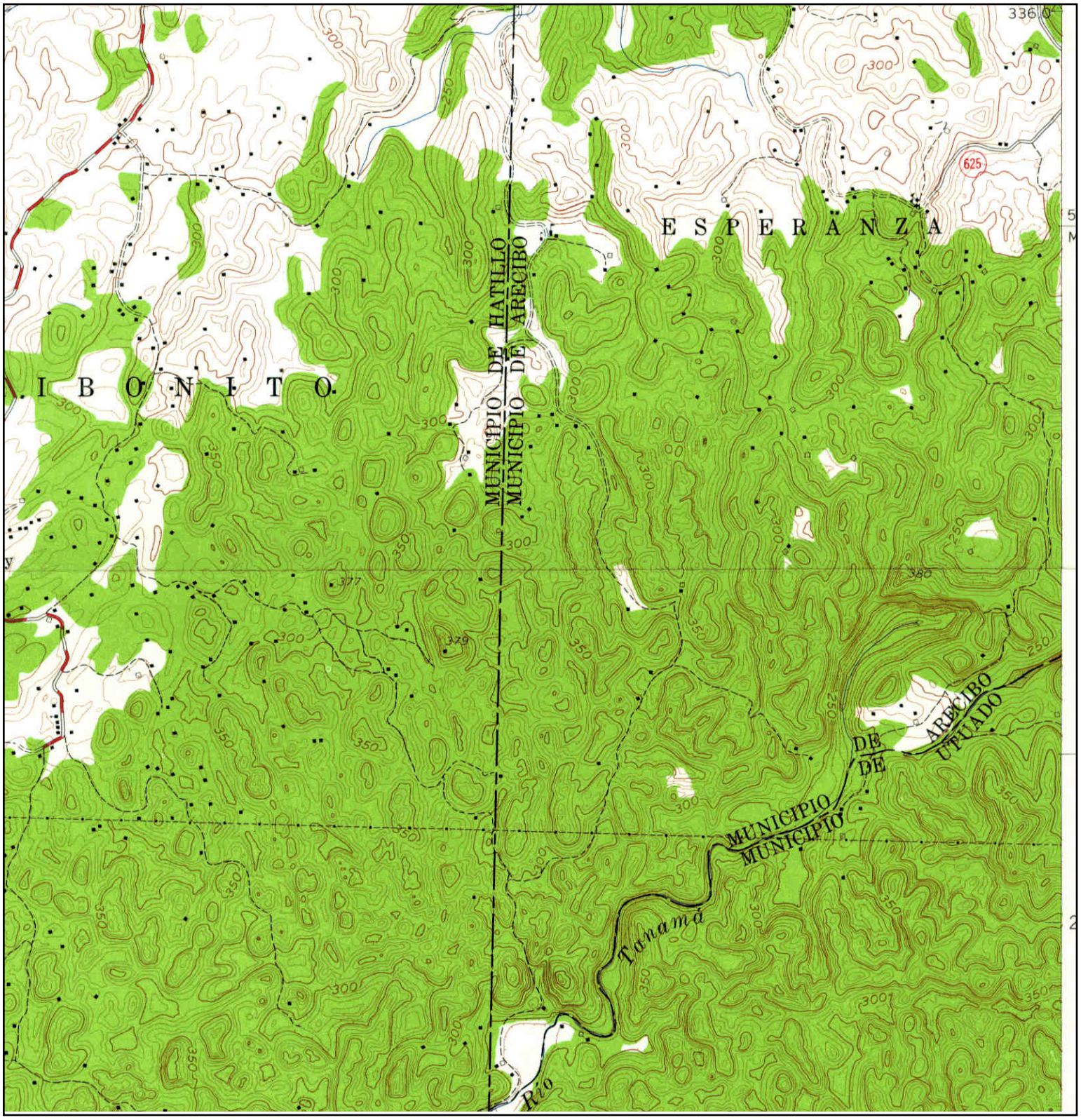
N	TARGET QUAD NAME: BAYANEY NE MAP YEAR: 1947 SERIES: 7.5 SCALE: 1:10000	SITE NAME: Arecibo Observatory ADDRESS: PR-625 Arecibo, PR 00612 LAT/LONG: 18.3458 / -66.7525	CLIENT: CH2M Hill, Inc. CONTACT: Jean Bossart INQUIRY#: 4107925.4 RESEARCH DATE: 10/16/2014

Historical Topographic Map



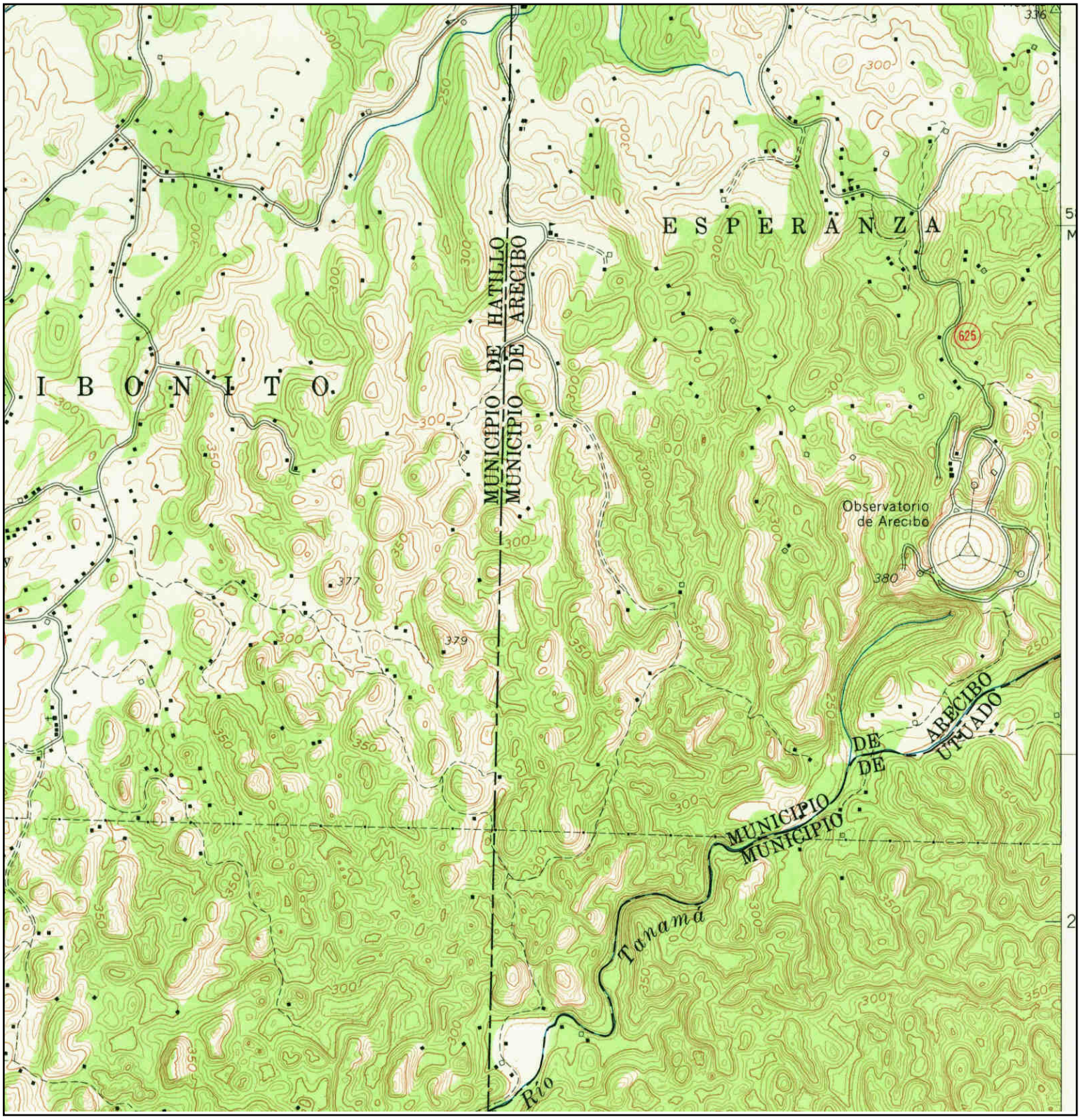
N	TARGET QUAD NAME: BAYANEY MAP YEAR: 1952 SERIES: 7.5 SCALE: 1:30000	SITE NAME: Arecibo Observatory ADDRESS: PR-625 Arecibo, PR 00612 LAT/LONG: 18.3458 / -66.7525	CLIENT: CH2M Hill, Inc. CONTACT: Jean Bossart INQUIRY#: 4107925.4 RESEARCH DATE: 10/16/2014

Historical Topographic Map



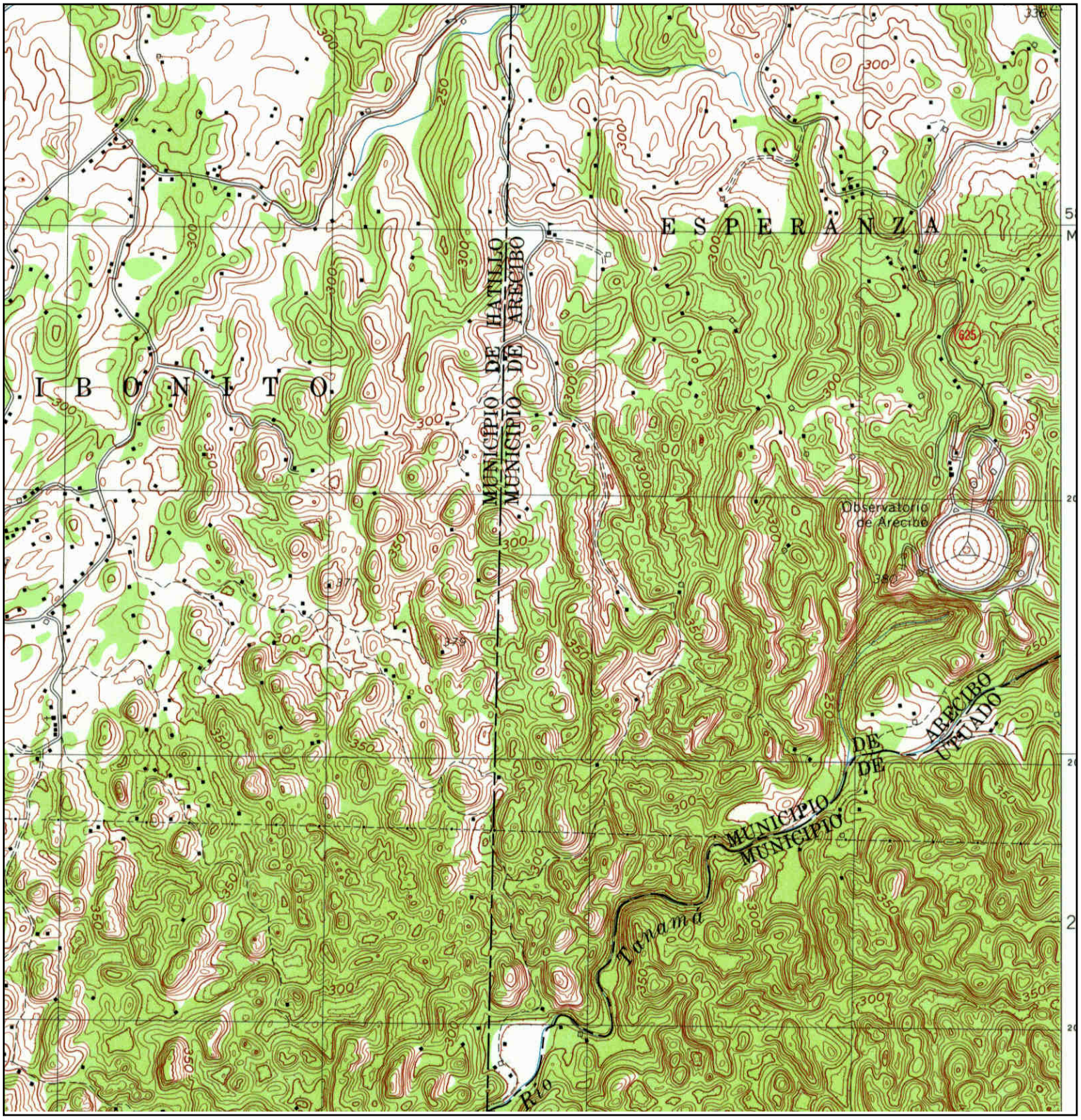
N	TARGET QUAD NAME: BAYANEY MAP YEAR: 1957 SERIES: 7.5 SCALE: 1:20000	SITE NAME: Arecibo Observatory ADDRESS: PR-625 Arecibo, PR 00612 LAT/LONG: 18.3458 / -66.7525	CLIENT: CH2M Hill, Inc. CONTACT: Jean Bossart INQUIRY#: 4107925.4 RESEARCH DATE: 10/16/2014

Historical Topographic Map



N	TARGET QUAD NAME: BAYANEY MAP YEAR: 1970 SERIES: 7.5 SCALE: 1:20000	SITE NAME: Arecibo Observatory ADDRESS: PR-625 Arecibo, PR 00612 LAT/LONG: 18.3458 / -66.7525	CLIENT: CH2M Hill, Inc. CONTACT: Jean Bossart INQUIRY#: 4107925.4 RESEARCH DATE: 10/16/2014

Historical Topographic Map

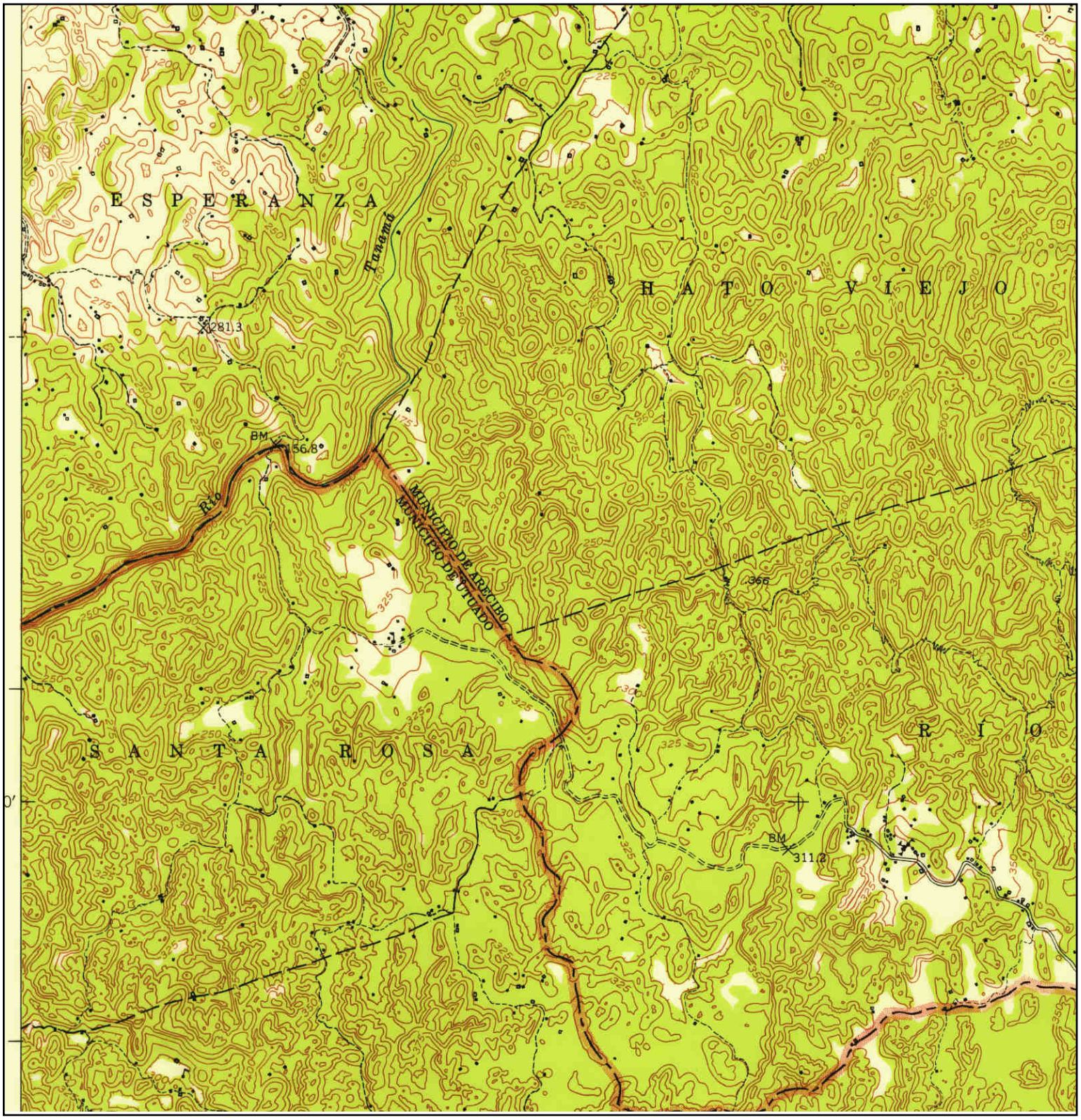


N	TARGET QUAD NAME: BAYANEY MAP YEAR: 1982 PHOTOREVISED FROM :1970 SERIES: 7.5 SCALE: 1:20000	SITE NAME: Arecibo Observatory ADDRESS: PR-625 Arecibo, PR 00612 LAT/LONG: 18.3458 / -66.7525	CLIENT: CH2M Hill, Inc. CONTACT: Jean Bossart INQUIRY#: 4107925.4 RESEARCH DATE: 10/16/2014

Historical Topographic Map

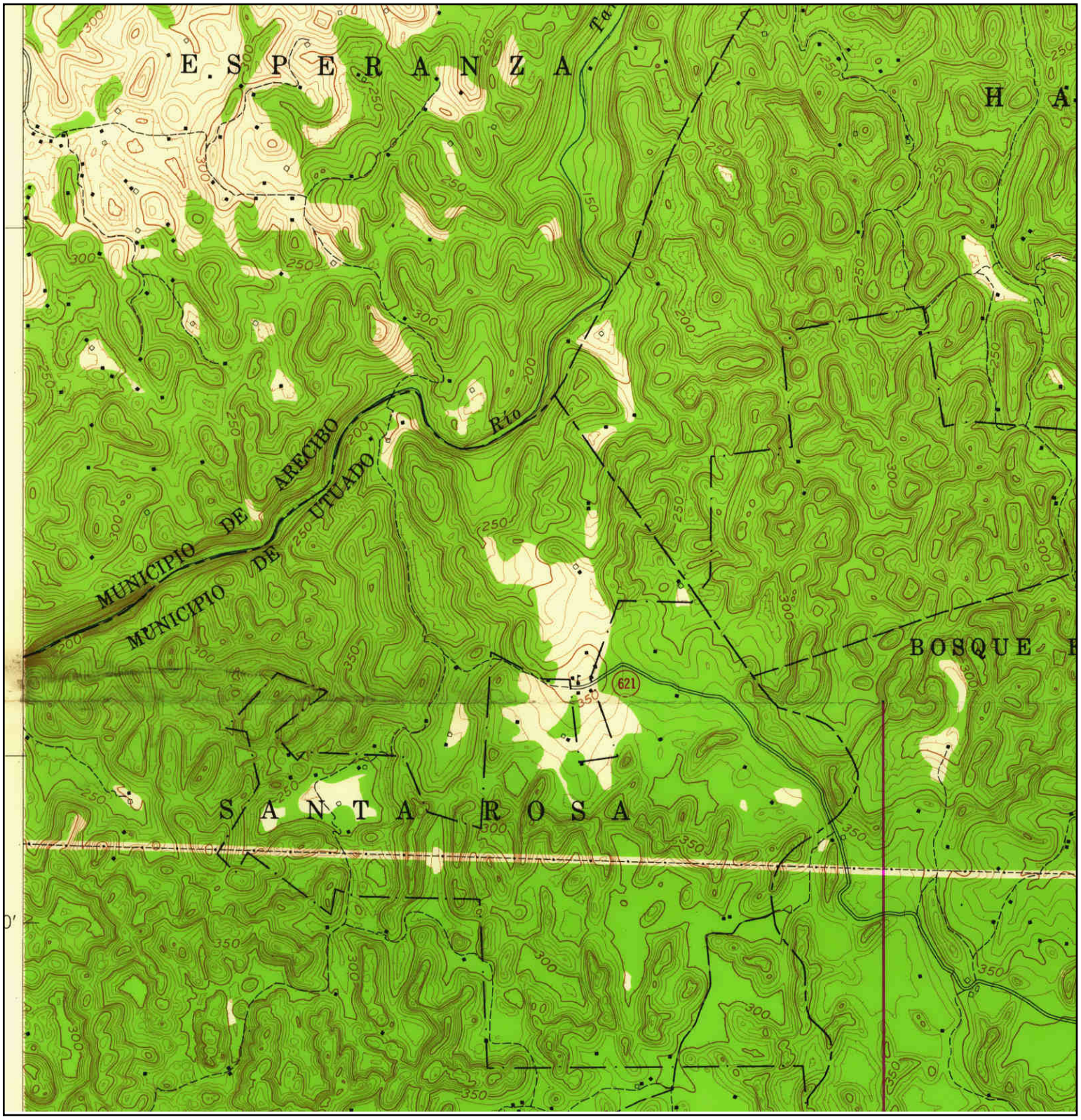
N	ADJOINING QUAD NAME: UTUADO MAP YEAR: 1946 SERIES: 7.5 SCALE: 1:30000	SITE NAME: Arecibo Observatory ADDRESS: PR-625 Arecibo, PR 00612 LAT/LONG: 18.3458 / -66.7525	CLIENT: CH2M Hill, Inc. CONTACT: Jean Bossart INQUIRY#: 4107925.4 RESEARCH DATE: 10/16/2014

Historical Topographic Map



N	ADJOINING QUAD NAME: UTUADO MAP YEAR: 1952 SERIES: 7.5 SCALE: 1:30000	SITE NAME: Arecibo Observatory ADDRESS: PR-625 Arecibo, PR 00612 LAT/LONG: 18.3458 / -66.7525	CLIENT: CH2M Hill, Inc. CONTACT: Jean Bossart INQUIRY#: 4107925.4 RESEARCH DATE: 10/16/2014

Historical Topographic Map

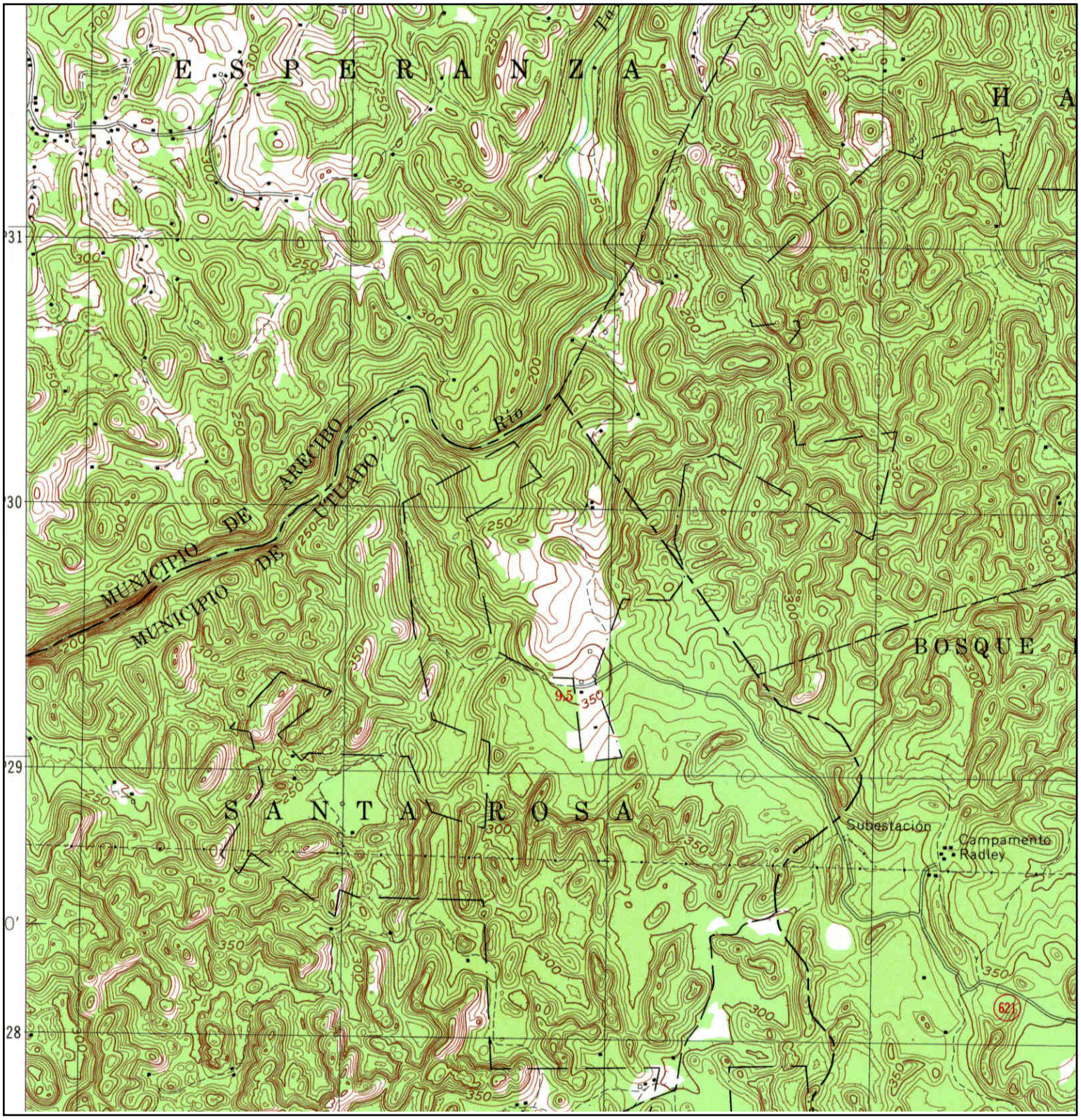


N	ADJOINING QUAD NAME: UTUADO MAP YEAR: 1957 SERIES: 7.5 SCALE: 1:20000	SITE NAME: Arecibo Observatory ADDRESS: PR-625 Arecibo, PR 00612 LAT/LONG: 18.3458 / -66.7525	CLIENT: CH2M Hill, Inc. CONTACT: Jean Bossart INQUIRY#: 4107925.4 RESEARCH DATE: 10/16/2014

Historical Topographic Map

N	ADJOINING QUAD NAME: UTUADO MAP YEAR: 1972 SERIES: 7.5 SCALE: 1:20000	SITE NAME: Arecibo Observatory ADDRESS: PR-625 Arecibo, PR 00612 LAT/LONG: 18.3458 / -66.7525	CLIENT: CH2M Hill, Inc. CONTACT: Jean Bossart INQUIRY#: 4107925.4 RESEARCH DATE: 10/16/2014

Historical Topographic Map



N	ADJOINING QUAD NAME: UTUADO MAP YEAR: 1982 PHOTOREVISED FROM :1972 SERIES: 7.5 SCALE: 1:20000	SITE NAME: Arecibo Observatory ADDRESS: PR-625 Arecibo, PR 00612 LAT/LONG: 18.3458 / -66.7525	CLIENT: CH2M Hill, Inc. CONTACT: Jean Bossart INQUIRY#: 4107925.4 RESEARCH DATE: 10/16/2014

3.9-A Employment and Median Earnings

APPENDIX 3.9-A

Employment and Median Earnings for 2009 and 2014 by Occupation for the Esperanza Barrio, Municipality of Arecibo and Commonwealth of Puerto Rico[a]

	Esperanza Barrio					Arecibo Municipality					Puerto Rico				
	2009 Estimate	2014 Estimate	2014 % Distribution	2009 - 2014 % Change	2014 Median earnings (dollars)	2009 Estimate	2014 Estimate	2014 % Distribution	2009 - 2014 % Change	2014 Median earnings (dollars)	2009 Estimate	2014 Estimate	2014 % Distribution	2009 - 2014 % Change	2014 Median earnings (dollars)
Civilian employed population 16 years and over	290	391		35%	$ 11,973	27111	24369		-10%	$ 18,024	1208908	1,081,146		-11%	$ 17,754
Management, business, science, and arts occupations:	73	44	11%	-40%	$ 23,636	7595	7,245	30%	-5%	$ 26,175	352087	338,802	31%	-4%	$ 29,271
Management, business, and financial occupations:	8	8	18%	0%	-	2534	2,221	31%	-12%	$ 29,334	132489	123,686	37%	-7%	$ 32,448
Management occupations	0	0	0%	-	-	1476	1,210	54%	-18%	$ 31,859	76807	72,923	59%	-5%	$ 35,652
Business and financial operations occupations	8	8	100%	0%	-	1058	1,011	46%	-4%	$ 24,645	55682	50,763	41%	-9%	$ 29,609
Computer, engineering, and science occupations:	65	6	14%	-91%	-	609	677	9%	11%	$ 34,792	36109	33,136	10%	-8%	$ 39,264
Computer and mathematical occupations	0	0	0%	-	-	81	169	25%	109%	$ 24,893	10107	10,888	33%	8%	$ 38,447
Architecture and engineering occupations	8	0	0%	-100%	-	204	255	38%	25%	$ 38,456	16346	13,612	41%	-17%	$ 42,854
Life, physical, and social science occupations	0	6	100%	100%	-	324	253	37%	-22%	$ 36,046	9656	8,636	26%	-11%	$ 36,042
Education, legal, community service, arts, and media occupations:	57	30	68%	-47%	$ 23,409	3088	2,726	38%	-12%	$ 24,766	128266	120,071	35%	-6%	$ 24,826
Community and social services occupations	0	11	37%	100%	-	657	583	21%	-11%	$ 22,793	18219	16,648	14%	-9%	$ 23,839
Legal occupations	0	0	0%	-	-	201	146	5%	-27%	$ 39,219	11830	10,939	9%	-8%	$ 50,763
Education, training, and library occupations	57	19	63%	-67%	-	2056	1,752	64%	-15%	$ 25,660	83519	78,640	65%	-6%	$ 24,367
Arts, design, entertainment, sports, and media occupations	0	0	0%	-	-	174	245	9%	41%	$ 19,375	14698	13,844	12%	-6%	$ 20,932
Healthcare practitioner and technical occupations:	0	0	0%	-	-	1364	1,621	22%	19%	$ 24,847	55223	61,909	18%	12%	$ 27,300
Health diagnosing and treating practitioners and other technical occupations	0	0	-	-	-	1015	1,119	69%	10%	$ 32,951	39127	42,891	69%	10%	$ 32,104
Health technologists and technicians	0	0	-	-	-	349	502	31%	44%	$ 18,160	16096	19,018	31%	18%	$ 19,705
Service occupations:	61	147	38%	141%	$ 10,393	5052	4,721	19%	-7%	$ 14,295	234365	222,320	21%	-5%	$ 13,347
Healthcare support occupations	0	18	12%	100%	-	278	318	7%	14%	$ 15,165	17726	14,257	6%	-20%	$ 14,029
Protective service occupations:	0	33	22%	100%	$ 31,094	1717	1,675	35%	-2%	$ 18,968	60958	58,417	26%	-4%	$ 19,350
Firefighting and prevention, and other protective service workers including supervisors	0	0	0%	-	-	775	997	60%	29%	$ 14,148	32494	33,466	57%	3%	$ 15,100
Law enforcement workers including supervisors	0	33	100%	100%	$ 31,094	942	678	40%	-28%	$ 30,417	28464	24,951	43%	-12%	$ 28,853
Food preparation and serving related occupations	8	41	28%	413%	$ 2,500	1145	1,132	24%	-1%	$ 11,455	58848	56,725	26%	-4%	$ 11,087
Building and grounds cleaning and maintenance occupations	0	55	37%	100%	$ 11,080	1309	1,133	24%	-13%	$ 15,370	66033	62,040	28%	-6%	$ 12,045
Personal care and service occupations	53	0	0%	-100%	-	603	463	10%	-23%	$ 7,460	30800	30,881	14%	0%	$ 9,507
Sales and office occupations:	58	113	29%	95%	$ 8,313	7643	7,117	29%	-7%	$ 16,477	334475	302,378	28%	-10%	$ 16,629
Sales and related occupations	20	93	82%	365%	$ 6,985	3085	3,266	46%	6%	$ 12,394	145400	134,770	45%	-7%	$ 14,209
Office and administrative support occupations	38	20	18%	-47%	$ 16,111	4558	3,851	54%	-16%	$ 18,621	189075	167,608	55%	-11%	$ 18,068
Natural resources, construction, and maintenance occupations:	39	69	18%	77%	$ 15,804	2,961	1,932	8%	-35%	$ 16,599	139724	104,668	10%	-25%	$ 15,385
Farming, fishing, and forestry occupations	14	30	43%	114%	$ 11,974	375	168	9%	-55%	$ 12,298	10650	9,241	9%	-13%	$ 9,089
Construction and extraction occupations	25	39	57%	56%	-	1517	857	44%	-44%	$ 15,156	79717	52,585	50%	-34%	$ 14,645
Installation, maintenance, and repair occupations	0	0	0%	-	-	1069	907	47%	-15%	$ 21,011	49357	42,842	41%	-13%	$ 17,455
Production, transportation, and material moving occupations:	59	18	5%	-69%	-	3860	3,354	14%	-13%	$ 16,602	148257	112,978	10%	-24%	$ 16,227
Production occupations	16	11	61%	-31%	-	2465	2,239	67%	-9%	$ 17,581	84031	62,193	55%	-26%	$ 17,077
Transportation occupations	0	7	39%	100%	-	754	613	18%	-19%	$ 15,826	37782	29,964	27%	-21%	$ 15,986
Material moving occupations	43	0	0%	-100%	-	641	502	15%	-22%	$ 14,488	26444	20,821	18%	-21%	$ 13,408

Sources: USCB, 2009, 2014b.

Note:

[a] In 2014 inflation-adjusted dollars, which are calculated using the average Consumer Price Index for a given calendar year and represent the change “buying power” because of the increases in the prices of all goods and services purchased by consumers.

4.1-A SOP for Puerto Rican Boa

STANDARD OPERATING PROCEDURES (SOP) FOR THE CAPTURE AND RELOCATION OF THE PUERTO RICAN BOA, FORT BUCHANAN, PUERTO RICO

1. References and Related Regulatory Requirements

a. Endangered Species Act (ESA) of 1973
b. National Environmental Policy Act (NEPA)
c. Sikes Act (16 USC 670a-670b, Stat. 1052)
d. Army Regulation (AR) 200-1, Environmental Protection and Enhancement.
e. Policy Memorandum No. 24
f. Endangered Species Management Plan (ESMP)
g. Integrated Natural Resources Management Plan (INRMP)
h. USFWS Species Recovery Plan for the Puerto Rican Boa

2. Purpose. This procedure describes guidelines for the safe capture and relocation of the Puerto Rican boa *(Chilabothrus inornatus)*. The Puerto Rican boa is a federally designated endangered species known to occur on Fort Buchanan.

3. Background. The Puerto Rican boa is endemic to Puerto Rico and is the largest snake that inhabits the island. The color pattern of the Puerto Rican boa is highly variable, ranging from tan to dark brown with irregular diffused markings on the dorsum. Some individuals lack markings and are uniformly dark. Juveniles have a reddish-brown color. The boa tolerates a wide variety of habitat types ranging from wet montane to subtropical dry forest and can be found from virgin forests to areas that exhibit human disturbance, such as roadsides or outbuildings. Boas have been sighted throughout the Installation by residents and staff. Most of the boa sightings have been reported from areas frequented by humans; however, the boa also occurs in the undeveloped areas in the northeastern portion of Fort Buchanan and in forested areas along the southern boundary of the base. Boas are more active at night, although they can be seen basking in the sun during the day. On occasion, boas need to be safely captured and relocated due to construction or the occurrence of nuisance boas found in or near homes or buildings.

It is important to recognize that the Puerto Rican Boa is listed as endangered and is protected by the Endangered Species Act of 1973, as amended. Any person that harasses, injures or kills a Puerto Rican boa is subject to penalties under federal law, up to $100,000, one year in prison or a combination of both.

4. Responsibilities.

a. The Department of Public Works (DPW), Environmental Division will be responsible for establishing an annual training program for all Installation personnel who may be called upon to capture and relocate a Puerto Rican boa. A qualified wildlife biologist/herpetologist will provide the necessary technical guidance and hands-on training to assist Fort Buchanan with establishment of this training program. Pest Control, Fire Department, and Police Patrol are responsible for responding to calls requiring on-base handling and relocations of "nuisance" boas or boas encountered during construction. Personnel from these departments will be required to attend the training session to learn how to safely handle and relocate boas. They will also be responsible for maintaining documentation for each encounter. Sighting Forms will be provided to all personnel who may potentially be handling and relocating boas on Fort Buchanan.

5. **Capture.** If a call for removal of a boa is received during business hours, the DPW Environmental Division will be contacted at 787-707-3508 prior to handling the boa, unless conditions of immediate danger to the boa exist. Handling and capture techniques should prevent or minimize injury to the animal. The following steps describe proper handling techniques for safely capturing and relocating a boa:

    a. Wear gloves made of sturdy, but soft material such as suede or leather to avoid injury to yourself and the snake.

    b. Approach the snake by moving slowly and calmly.

    c. Extend your reach and maintain a safe distance by using a safety tool such as a hook, tongs, or a long-handled broom. These tools allow the person to manipulate the animal from a safe distance. If using tongs, do not grab the boa by the neck, as this will potentially cause pain and injury to the snake. Instead, grasp the snake about 1/3 of the way down from the head. Do not lift the snake fully off the ground for longer than a few seconds.

    d. Place boa in a burlap bag or other suitable cage/container to minimize injury.

    e. Minimize handling of the boa as much as possible to reduce stress.

    f. Keep boa out of the sun in a cool and shady place until a suitable relocation site is determined.

    g. A suitable relocation area that is removed from human activity will be selected by personnel of the DPW Environmental Division or appropriate natural resource agency. Preference must be given to relocation within Fort Buchanan.

    h. A Sighting Form must be completed by the person performing the relocation and release of the boa. A copy of this form should be submitted to DPW Environmental Division.

6. **Safety Practices.** Precautions will be taken to prevent injury to any person. All personnel responsible for handling and relocating boas must attend a training session to learn and practice the correct handling techniques. This training is critical in preventing and minimizing injury to both personnel and boas.

7. **Emergency Procedures**, In case of injury, a fully stocked first aid kit should be kept in the vehicle at all times. As with handling any wild animal, there is risk of injury. The most likely injury with handling a non-venomous snake, such as the Puerto Rican boa, is a bite or scratch. If the handler is injured, proceed with the following instructions for a bite/scratch:

    a. If the bite is serious and requires emergency care, contact Emergency Medical Services (EMS) immediately at (787) 707-5911

    b. If the bite is not serious, follow these first aid steps to clean and protect the wound to prevent further infection:
        i. Use iodine or an antiseptic with sterile gauze to cleanse the wound.
        ii. Flush water into the open wound for several minutes.
        iii. Pat wound with dry sterile gauze and place bandage over wound
        iv. Change bandage as necessary

v. If infection occurs, contact medical professional immediately.

8. **Construction and Development Project.** The U.S. Fish and Wildlife Service has developed recommendations to avoid or minimize impact to boas during construction projects in areas where boas may occur. Pursuing these recommendations, we have modified them to fit the Installation's needs and goals for boa management. These are as follows:

    a. Prior to any earth movement or vegetation clearing, the boundaries of the project area, buffer areas and areas to be protected should be clearly marked in the project plan and in the field.

    b. A pre-construction meeting with DPW Environmental Division will be conducted to inform supervisors and employees about the conservation of protected species, as well as penalties for harassing or harming such species. Staff will be briefed on how to properly identify the boa by the Environmental Conservation Manager

    c. Prior to any use of machinery on areas where boa may occur, all personnel involved in site-clearing must be informed of potential presence of the snake, and the importance of protecting the snake.

    d. Before activities commence each workday during the vegetation clearing phase, the personnel experienced in identifying and searching for boas will survey the areas to be cleared that day. If boas are found within the working area, activities should stop at the area where the boas are found. Immediately call point of contact (POC) Environmental Conservation Manager, at telephone (787) 707-3508 to coordinate management actions. If relocation is deemed necessary, the snake should be relocated by authorized personnel (personnel that have completed the Boa handling training).

    e. Strict measures should be established to minimize boa casualties by motor vehicles or other equipment. Before operating or moving equipment and vehicles in staging areas near potential boa habitats (within 25 meters of potential boa habitat), these should be thoroughly inspected to ensure that no boas are lodged in the standing equipment or vehicles. If boas are found within vehicles or equipment, authorized personnel must be notified immediately for proper handling and relocation. Any relocated boas should be transferred to appropriate habitat close to the project site.

9. **Non-Compliance.** Failure to comply with the above guidance can result in administrative or punitive actions against individual(s) involved.

10. **Point of Contact.** The POC for this action is the Environmental Conservation Manager at telephone (787) 707-3508. Alternate POC is Pest Control Technician at mobile phone (787) 407-6800, or (787)-707-3894

4.6-A Solid Waste Calculations

Ponce landfill - Aida Clas 8-5-16

Friday, August 05, 2016
3:23 PM

Kristine MacKinnon sent an email to Aida Clas - Republic Waste Services, Ponce landfill asking if the Ponce landfill could handle 14,000 metric tons of construction waste.

Ms. Clas called back and said the Ponce landfill is licensed for another 30 years, so they would have the capacity for that quantity of waste.

Ms. Clas said they usually measure the waste by cubic yards, but she has priced a few jobs by the metric ton. Metric tons are only used for heavier materials, cubic yards used for lighter materials. Kristine said she could convert to cubic yards if necessary.

Ms. Clas added that the Salinas landfill can also take special waste

Ms. Clas confirmed that the Ponce landfill will take asbestos and lead-based paint waste

She can send the permit for the Ponce facility. Will need to provide proof that are sending waste to a licensed facility.

She can contract any dump trucks and roll offs that would be needed.

The Ponce landfill can take wastewater. They have a solidification facility. Can receive liquid waste by the ton, in drums or totes. They can provide transportation.

Metals recycling can be done through another firm - Schnitzer (sp?). They are the largest scrap metal recycler in Puerto Rico. They have a facility in Salinas. Phone number is 787-824-6133

Electrical equipment - they have an agreement with an electronics recycler, can help facilitate.

Aida is in charge of all special waste in Puerto Rico for republic services. Can assist with any projects on the island.

Truck Loads Per Alternative

	Full Demolition			Demolition - Partial			Mothball			Education Park			Partnership		
	Alternative 5			Alternative 4			Alternative 3			Alternative 2			Alternative 1		
	truck loads	metric ton	cubic meters	truck loads	metric ton	cubic meters	truck loads	metric ton	cubic meters	truck loads	metric ton	cubic meters	truck loads	metric ton	cubic meters
[1]Demolition Debris	347	6,940	7,287	341	6,820	7,161	31	620	651	128	2,560	2,688	106	2,120	2,226
Asbestos Abatement	13	260	273	13	260	273	0	0	0	9	180	189	7	140	147
LBP	1	20	21	1	20	21	0	0	0	1	20	21	4	80	84
Universal Waste	2	40	42	2	40	42	1	20	21	1	20	21	1	20	21
[2]Electrical Equipment/Goods	5	100	105	5	100	105	1	20	21	4	80	84	2	40	42
[3]Liquid Waste, non-specific	11	220	231	11	220	231	5	100	105	6	120	126	6	120	126
OWS/Septic Liquid Waste	14	280	294	14	280	294	10	200	210	0	0	0	7	140	147
[2]Salvage/Recycle - Non-Ferrous	16	320	336	16	320	336	1	20	21	1	20	21	1	20	21
[2]Salvage/Recycle - Ferrous	340	6,800	7,140	219	4,380	4,599	2	40	42	85	1,700	1,785	15	300	315
[4]Total:	749	14,980	15,729	622	12,440	13,062	51	1020	1071	235	4700	4935	149	2980	3129
[5] Mobilization	18			12			2			4			4		

[6] Truck Route From Arecibo to Disposal/Ponce: start PR-625 to PR-635 to PR-651 to Ave Cludad De La Vega to Pso Los Olmos to PR-10 to PR-654 to Disposal/Ponce... +/- 50 miles.

[1] Combustable Material may qualify for waste to energy - estimated 30% of the loads. All concrete, masonry and pavement materials will be sized/ crushed to 3-in minus and will be utilized during restoration (fill and contouring) or available for off-site beneficial reuse.

[2] Salavage and/or Recycle

[3] Petroleum products recycle. Household waste, paint, etc non-recycle disposal.

[4] Total truck passage is two times the load count

[5] Equipment and materials delivery; no specific off-site point of origination

[6] The haul route is based on CH2M evaluation of the land routes available from the Arecibo site to the general Ponce, PR area (landfill location). NSF Sipulation that CH2M not reveal location, source and/or schedule for the required disposal service; no haul route was provided by the disposal and/or recycling facilities.

Assumptions fo metric ton and cublic meter calcuations:

20 metric tons/load	transportation estimate	
20 metric tons/20 cubic meters	dump truck load estimate	
20 metric tons/30 cublic meters	lightweight materials	roll-off cintainers
assume	90% dump truck	10% roll-offs

4.12-A EJSCREEN Results

EJSCREEN Report (Version 2016)

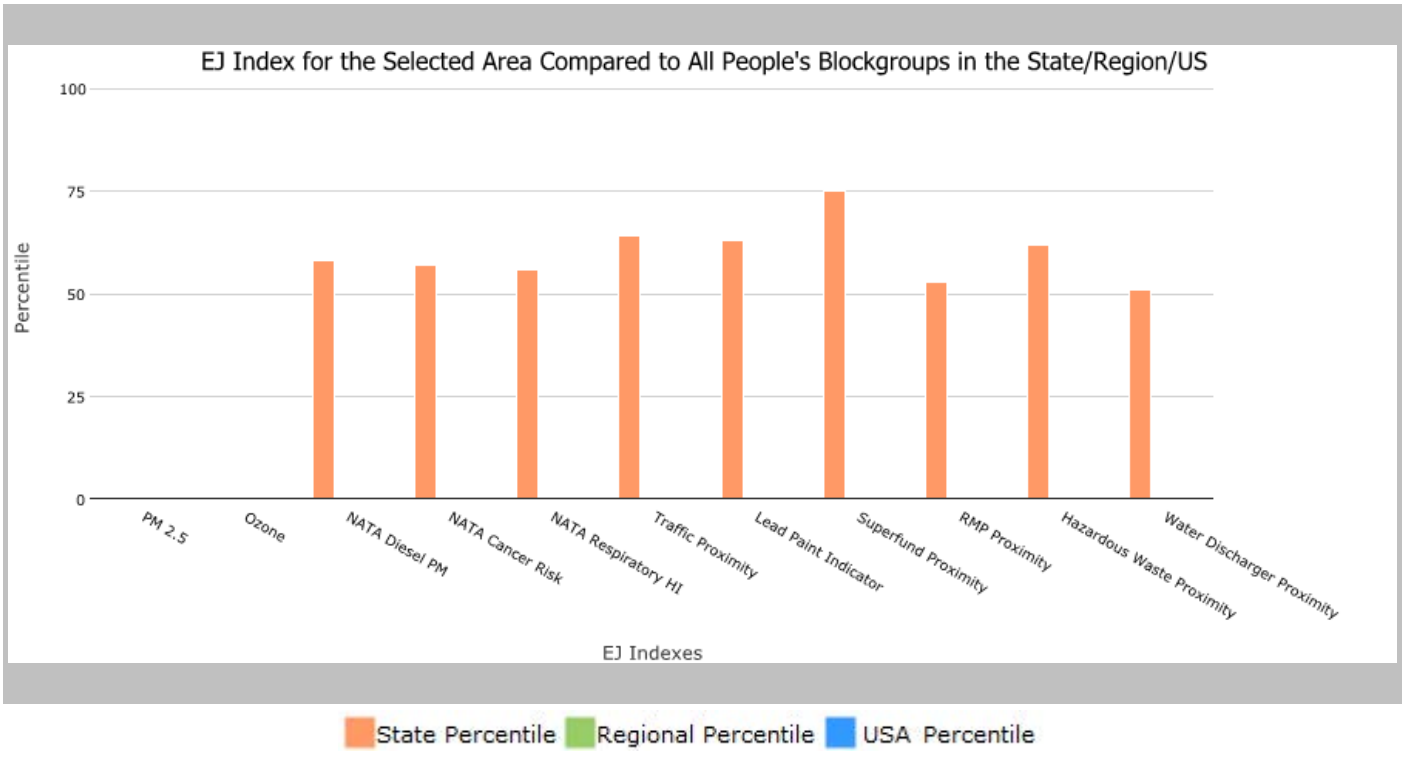
5 mile Ring Centered at 18.344262,-66.752703, PUERTO RICO, EPA Region 2

Approximate Population: 19,577

Input Area (sq. miles): 78.53

Arecibo Observatory

Selected Variables	State Percentile	EPA Region Percentile	USA Percentile
EJ Indexes			
EJ Index for PM2.5	N/A	N/A	N/A
EJ Index for Ozone	N/A	N/A	N/A
EJ Index for NATA* Diesel PM	58	N/A	N/A
EJ Index for NATA* Air Toxics Cancer Risk	57	N/A	N/A
EJ Index for NATA* Respiratory Hazard Index	56	N/A	N/A
EJ Index for Traffic Proximity and Volume	64	N/A	N/A
EJ Index for Lead Paint Indicator	63	N/A	N/A
EJ Index for Proximity to NPL sites	75	N/A	N/A
EJ Index for Proximity to RMP sites	53	N/A	N/A
EJ Index for Proximity to TSDFs	62	N/A	N/A
EJ Index for Proximity to Major Direct Dischargers	51	N/A	N/A



This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

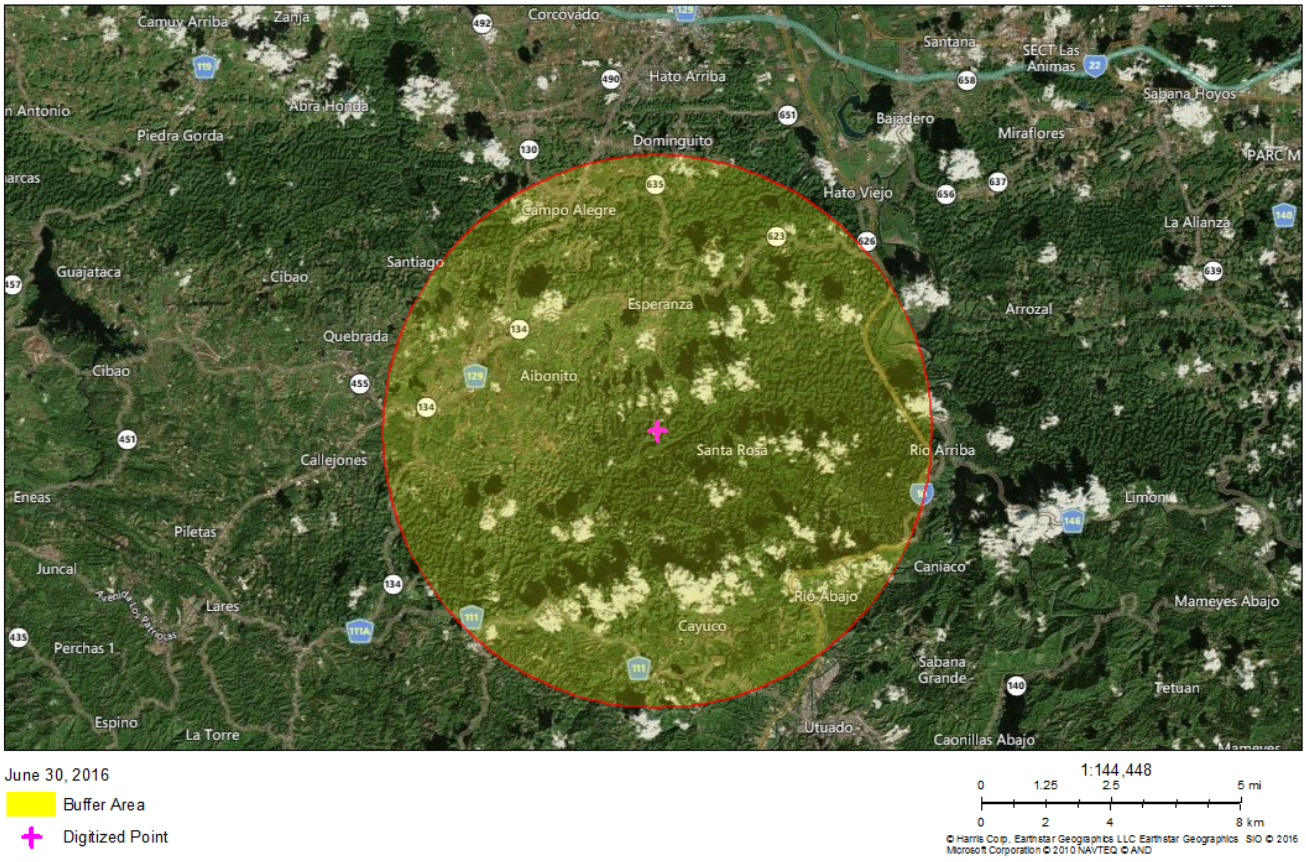
EJSCREEN Report (Version 2016)

5 mile Ring Centered at 18.344262,-66.752703, PUERTO RICO, EPA Region 2

Approximate Population: 19,577

Input Area (sq. miles): 78.53

Arecibo Observatory



Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0
National Pollutant Discharge Elimination System (NPDES)	0

EJSCREEN Report (Version 2016)

5 mile Ring Centered at 18.344262,-66.752703, PUERTO RICO, EPA Region 2

Approximate Population: 19,577

Input Area (sq. miles): 78.53

Arecibo Observatory

Selected Variables	Value	State Avg.	%ile in State	EPA Region Avg.	%ile in EPA Region	USA Avg.	%ile in USA
Environmental Indicators							
Particulate Matter (PM 2.5 in µg/m^3)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ozone (ppb)	N/A	N/A	N/A	N/A	N/A	N/A	N/A
NATA* Diesel PM (µg/m^3)	0.234	0.761	26	N/A	N/A	N/A	N/A
NATA* Cancer Risk (lifetime risk per million)	27	34	21	N/A	N/A	N/A	N/A
NATA* Respiratory Hazard Index	0.69	1.1	28	N/A	N/A	N/A	N/A
Traffic Proximity and Volume (daily traffic count/distance to road)	11	140	29	N/A	N/A	N/A	N/A
Lead Paint Indicator (% Pre-1960 Housing)	0.084	0.15	46	N/A	N/A	N/A	N/A
NPL Proximity (site count/km distance)	0.098	0.15	60	N/A	N/A	N/A	N/A
RMP Proximity (facility count/km distance)	0.13	0.51	22	N/A	N/A	N/A	N/A
TSDF Proximity (facility count/km distance)	0.039	0.053	62	N/A	N/A	N/A	N/A
Water Discharger Proximity (facility count/km distance)	0.12	0.41	15	N/A	N/A	N/A	N/A
Demographic Indicators							
Demographic Index	91%	86%	63	N/A	N/A	N/A	N/A
Minority Population	100%	99%	34	N/A	N/A	N/A	N/A
Low Income Population	82%	73%	62	N/A	N/A	N/A	N/A
Linguistically Isolated Population	82%	70%	78	N/A	N/A	N/A	N/A
Population With Less Than High School Education	39%	28%	79	N/A	N/A	N/A	N/A
Population Under 5 years of age	5%	6%	48	N/A	N/A	N/A	N/A
Population over 64 years of age	17%	16%	62	N/A	N/A	N/A	N/A

* The National-Scale Air Toxics Assessment (NATA) is EPA's ongoing, comprehensive evaluation of air toxics in the United States. EPA developed the NATA to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that NATA provides broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. More information on the NATA analysis can be found at: https://www.epa.gov/national-air-toxics-assessment.

For additional information, see: www.epa.gov/environmentaljustice

5-A Notice of Intent

NATIONAL SCIENCE FOUNDATION

Notice of Intent To Prepare an Environmental Impact Statement and Initiate Section 106 Consultation for Proposed Changes to Arecibo Observatory Operations, Arecibo, Puerto Rico and Notice of Public Scoping Meetings and Comment Period

AGENCY: National Science Foundation.

ACTION: Notice of intent to prepare an Environmental Impact Statement and initiate Section 106 consultation for proposed changes to Arecibo Observatory operations, Arecibo, Puerto Rico and notice of public scoping meetings and comment period.

SUMMARY: In compliance with the National Environmental Policy Act of 1969, as amended, the National Science Foundation (NSF) intends to prepare an Environmental Impact Statement (EIS) to evaluate potential environmental effects of proposed changes to operations at Arecibo Observatory, in Arecibo, Puerto Rico. (See supplementary information below for more detail.) By this notice, NSF is announcing the beginning of the scoping process to solicit public comments and identify issues to be analyzed in the EIS. NSF also intends to initiate consultation under Section 106 of the National Historic Preservation Act to evaluate potential effects to the Arecibo Observatory, which is a historic property listed in the National Register of Historic Places.

DATES: This notice initiates the public scoping process for the EIS and the initiation of public involvement under Section 106 per 36 CFR 800.2(d). Comments on issues may be submitted verbally during scoping meetings scheduled for June 7, 2016 (see details below) or in writing until June 23, 2016. To be eligible for inclusion in the Draft EIS, all comments must be received prior to the close of the scoping period. NSF will provide additional opportunities for public participation upon publication of the Draft EIS.

ADDRESSES: You may submit comments related to this proposal by either of the following methods:

- *Email to: envcomp-AST@nsf.gov,* with subject line ''Arecibo Observatory.''
- *Mail to:* Ms. Elizabeth Pentecost, RE: Arecibo Observatory, National Science Foundation, Suite 1045, 4201 Wilson Blvd., Arlington, VA 22230.

Scoping Meetings: NSF will host two public scoping meetings.

- *Daytime meeting:* June 7, 2016, at 9:30 a.m. to 11:30 a.m., DoubleTree by Hilton San Juan, 105 Avenida De Diego, San Juan, PR, Phone: (787) 721–6500.
- *Evening meeting:* June 7, 2016, 6:00 p.m. to 8:00 p.m., Colegio de Ingenieros y Agrimensores de Puerto Rico/Puerto Rico Professional College of Engineers and Land Surveyors (Arecibo Chapter), Ave. Manuel T. Guillán Urdáz, Conector 129 Carr. 10, Arecibo, Puerto Rico, Phone: (787) 758–2250.

Comments will be transcribed by a court reporter. Spanish language translation will be provided for simultaneous translation of presentations. Please contact NSF at least one week in advance of the meeting if you would like to request special accommodations (*i.e.,* sign language interpretation, etc.).

FOR FURTHER INFORMATION CONTACT: For further information regarding the EIS process or Section 106 consultation, please contact: Ms. Elizabeth Pentecost, National Science Foundation, Division of Astronomical Sciences, Suite 1045, 4201 Wilson Blvd., Arlington, VA 22230; telephone: (703) 292–4907; email: *epenteco@nsf.gov.*

SUPPLEMENTARY INFORMATION: The Arecibo Observatory is an NSF-owned scientific research and education facility located in Puerto Rico. In 2011, NSF awarded a five-year Cooperative Agreement to SRI International (SRI), which together with Universities Space Research Association (USRA) and Universidad Metropolitana (UMET) have formed the Arecibo Management Team to operate and maintain the Arecibo Observatory for the benefit of research communities. Arecibo Observatory enables research in three scientific disciplines: Space and atmospheric sciences, radio astronomy, and solar system radar studies; the last of these is largely funded through a research award to USRA from the National Aeronautics and Space Administration. An education and public outreach program complements the Arecibo Observatory scientific program. A key component of the Arecibo Observatory research facility is a 305-meter diameter, fixed, spherical reflector. Arecibo Observatory infrastructure includes instrumentation for radio and radar astronomy, ionospheric physics, office and laboratory buildings, a heavily utilized visitor and education facility, and lodging facilities for visiting scientists.

Through a series of academic community-based reviews, NSF has identified the need to divest several facilities from its portfolio in order to retain the balance of capabilities needed to deliver the best performance on the key science of the present decade and beyond. In 2012, NSF's Division of Astronomical Sciences' (AST's) portfolio review committee recommended that ''continued AST involvement in Arecibo . . . be re-evaluated later in the decade in light of the science opportunities and budget forecasts at that time.'' In 2016, NSF's Division of Atmospheric and Geospace Sciences' (AGS') portfolio review committee recommended significantly decreasing funding for the Space and Atmospheric Sciences portion of the Arecibo mission. In response to these evolving recommendations, in 2016, NSF completed a feasibility study to inform and define options for the observatory's future disposition that would involve significantly decreasing or eliminating NSF funding of Arecibo. Concurrently, NSF sought viable concepts of operations from the scientific community via a Dear Colleague Letter NSF 16–005 (see *www.nsf.gov/AST*), with responses due by January 15, 2016. Alternatives to be evaluated in the EIS will be refined through continued public input, with preliminary alternatives that include the following:

- Continued NSF investment for science-focused operations (No-Action Alternative)
- Collaboration with interested parties for continued science-focused operations
- Collaboration with interested parties for transition to education-focused operations
- Mothballing of facilities (suspension of operations in a manner such that operations could resume efficiently at some future date)
- Deconstruction and site restoration

The purpose of the public scoping process is to determine relevant issues that will influence the scope of the environmental analysis, including identification of viable alternatives, and guide the process for developing the EIS. At present, NSF has identified the following preliminary resource areas for analysis of potential impacts: Air quality, biological resources, cultural resources, geological resources, solid waste generation, health and safety, socioeconomics, traffic, and groundwater resources. NSF will consult under Section 106 of the National Historic Preservation Act and Section 7 of the Endangered Species Act in coordination with this EIS process, as appropriate. Federal, state, and local agencies, along with other stakeholders that may be interested or affected by NSF's decision on this proposal are invited to participate in the scoping

process and, if eligible, may request to participate as a cooperating agency.

Proposal Information: Information will be posted, throughout the EIS process, at *www.nsf.gov/AST.*

Dated: May 18, 2016.

Suzanne H. Plimpton,

Reports Clearance Officer, National Science Foundation.

[FR Doc. 2016–12036 Filed 5–20–16; 8:45 am]

BILLING CODE 7555–01–P

NUCLEAR REGULATORY COMMISSION

[Docket Nos. 50–445, 50–446, and 72–74; License Nos. NPF–87 and NPF–89; NRC–2016–0020]

In the Matter of Luminant Generation Company LLC; Comanche Peak Nuclear Power Plant, Unit Nos. 1 and 2, and Independent Spent Fuel Storage Installation Facility

AGENCY: Nuclear Regulatory Commission.

ACTION: Direct and indirect transfer of license; order.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) is issuing an order approving the direct transfer of ownership and indirect transfer of control of Facility Operating License (FOL) Nos. NPF–87 and NPF–89 and the general license for the independent spent fuel storage installation facility from the current holder, Luminant Generation Company LLC, to as-yet unnamed companies, herein identified as Comanche Peak LLC, as owner, and Operating Company LLC, as operator. The NRC will issue conforming amendments to the FOLs for administrative purposes to reflect the proposed license transfer. No physical changes to the facility or operational changes were proposed in the application. The Order is effective upon issuance.

DATES: The Order was issued on May 6, 2016, and is effective for 1 year.

ADDRESSES: Please refer to Docket ID NRC–2016–0020 when contacting the NRC about the availability of information regarding this document. You may obtain publicly-available information related to this document using any of the following methods:

- *Federal Rulemaking Web site:* Go to *http://www.regulations.gov* and search for Docket ID NRC–2016–0020. Address questions about NRC dockets to Carol Gallagher; telephone: 301–415–3463; email: *Carol.Gallagher@nrc.gov.* For technical questions, contact the individual listed in the **FOR FURTHER INFORMATION CONTACT** section of this document.
- *NRC's Agencywide Documents Access and Management System (ADAMS):* You may obtain publicly available documents online in the ADAMS Public Documents collection at *http://www.nrc.gov/reading-rm/adams.html.* To begin the search, select ''*ADAMS Public Documents*'' and then select ''*Begin Web-based ADAMS Search.*'' For problems with ADAMS, please contact the NRC's Public Document Room (PDR) reference staff at 1–800–397–4209, 301–415–4737, or by email to *pdr.resource@nrc.gov.* The ADAMS accession number for each document referenced in this document (if that document is available in ADAMS) is provided the first time that a document is referenced. The Order was issued to the licensee in a letter dated May 6, 2016 (ADAMS Accession No. ML16096A266).
- *NRC's PDR:* You may examine and purchase copies of public documents at the NRC's PDR, Room O1–F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

FOR FURTHER INFORMATION CONTACT: Margaret Watford, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington, DC 20555–0001; telephone: 301–415–1233, email: *Margaret.Watford@nrc.gov.*

SUPPLEMENTARY INFORMATION: The text of the Order is attached.

Dated at Rockville, Maryland, this 16th day of May 2016.

For the Nuclear Regulatory Commission.

Margaret M. Watford,

Project Manager, Plant Licensing Branch IV–1, Division of Operating Reactor Licensing, Office of Nuclear Reactor Regulation.

Attachment—Order Approving Transfer of Licenses and Approving Conforming Amendments

United States of America

Nuclear Regulatory Commission

In the Matter of Luminant Generation Company LLC; Comanche Peak Nuclear Power Plant, Unit Nos. 1 and 2

Dockets Nos. 50–445 and 50–446
License Nos. NPF–87 and NPF–89

Order Approving the Transfer of Licenses and Approving Conforming Amendments

I.

Luminant Generation Company LLC (Luminant Power, the licensee) is the holder of the Facility Operating License (FOL) Nos. NPF–87 and NPF–89 of the Comanche Peak Nuclear Power Plant, Unit Nos. 1 and 2 (CPNPP), and the holder of the general license for the independent spent fuel storage installation (ISFSI) facility. CPNPP is located in Somervell County, Texas.

II.

Pursuant to Section 184 of the Atomic Energy Act of 1954, as amended (the Act), and Title 10 of the *Code of Federal Regulations* (10 CFR), Section 50.80, ''Transfer of licenses,'' Luminant Generation Company LLC (Luminant Power) requested that the U.S. Nuclear Regulatory Commission (NRC) consent to the transfer of the FOL Nos. NPF–87 and NPF–89 for CPNPP, and the general license for the ISFSI facility (Docket No. 72–74) from the current holder, Luminant Power, to as-yet unnamed companies, herein identified as Comanche Peak LLC (CP LLC), as owner, and Operating Company LLC (OpCo LLC), as operator (together these entities are referred to as ''the licensees''). Luminant Power submitted the request by application dated November 12, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML15320A093), as supplemented by letters dated December 9, 2015, and March 14, March 29, April 7, and April 20, 2016 (ADAMS Accession Nos. ML15345A048, ML16076A162, ML16091A121, ML16099A291, and ML16112A396, respectively).

Luminant Power is acting on behalf of itself and the future to-be-formed companies. These future to-be-formed companies include the ultimate parent of CP LLC and OpCo LLC, Reorganized Texas Competitive Electric Holdings Corporation (Reorganized TCEH), and the intermediate parents, Intermediate Holding Company LLC, Asset Company LLC, and Preferred Stock Company Corporation (together with Luminant Power these entities are referred to as the ''Applicants''). Entity names in the licensee's application and supplements are placeholders.

On April 29, 2014, Luminant Power notified the NRC of its filing of a bankruptcy (ADAMS Accession No. ML14120A212). Luminant Power is owned by Energy Future Competitive Holdings Company LLC (EFCH), through its wholly owned subsidiaries. The EFCH is a direct wholly owned subsidiary of Energy Future Holdings Corporation (EFH). The current and intended ownership structure of the facility is depicted in the simplified organizational charts provided in Exhibits A and B of Enclosure 1 in the submittal dated November 12, 2015. As a result of the proposed transactions and consistent with Exhibit B, EFH and EFCH will no longer ultimately own CPNPP. The licenses will be transferred from Luminant Power to CP LLC, responsible for ownership of the facility, and OpCo LLC, responsible for the operation and maintenance of CPNPP. At the emergence from bankruptcy, Reorganized TCEH, the ultimate parent company of CP LLC, will be owned by a numerous and diverse set of independent and unaffiliated stockholders. No single entity is expected to own a majority of, or exercise control over Reorganized TCEH or its Board of Directors. Current Luminant Power nuclear management and technical personnel will be employed by OpCo LLC. Accordingly, there will be no change in management or technical qualification, and OpCo LLC will continue to be technically qualified to operate the facility. No physical changes to the CPNPP and ISFSI facility or operational changes are proposed in the application.

ENVIRONMENTAL IMPACT STATEMENT (EIS)

In compliance with the National Environmental Policy Act of 1969 (NEPA), as amended, the National Science Foundation (NSF) intends to prepare an Environmental Impact Statement (EIS) to evaluate potential environmental effects of proposed changes to operations at Arecibo Observatory, in Arecibo, Puerto Rico. NSF also intends to initiate consultation under Section 106 of the National Historic Preservation Act (NHPA) to evaluate potential effects to the Arecibo Observatory, which is a historic property listed in the National Register of Historic Places.

By this notice, NSF is announcing the beginning of the scoping process to solicit public comments and identify issues to be analyzed in the EIS and the initiation of public involvement under Section 106. Comments on issues may be submitted verbally during scoping meetings scheduled for June 7, 2016 (see details below) or in writing until June 23, 2016. To be eligible for inclusion in the Draft EIS, all comments must be received prior to the close of the scoping period. NSF will provide additional opportunities for public participation upon publication of the Draft EIS.

NSF WILL HOST TWO PUBLIC SCOPING MEETINGS:

Daytime meeting:
June 7, 2016, 9:30 am to 11:30 am
Double Tree by Hilton San Juan
105 Avenida De Diego
San Juan, Puerto Rico
Phone: (787) 721-6500

Evening meeting:
June 7, 2016, 6:00 pm to 8:00 pm
Colegio de Ingenieros y Agrimensores de Puerto Rico/
Puerto Rico Professional College of Engineers and Land Surveyors (Arecibo Chapter)
Ave. Manuel T. Guillán Urdáz
Conector 129 Carr. 10
Arecibo, Puerto Rico
Phone: (787) 758-2250

You may submit comments related to this proposal by either of the following methods:

Email to: envcomp-AST@nsf.gov, with subject line "Arecibo Observatory"
Mail to: Ms. Elizabeth Pentecost, RE: Arecibo Observatory
National Science Foundation, Suite 1045
4201 Wilson Blvd
Arlington, VA 22230

Project information will be posted, throughout the EIS process, at **www.nsf.gov/AST**.

Comments will be transcribed by a court reporter. Translation in English and Spanish will be provided during the meeting. Please contact NSF at least one week in advance of the meeting if you would like to request special accommodations (for example, sign language interpretation).

DECLARACIÓN DE IMPACTO AMBIENTAL (DIA)

En cumplimiento con la Ley de Política Ambiental Nacional del 1969 (NEPA, por sus siglas en ingles), según enmendada, la Fundación Nacional de Ciencias (NSF, por sus siglas en inglés) tiene la intención de preparar una Declaración de Impacto Ambiental (DIA) para evaluar los efectos ambientales potenciales de los cambios propuestos a las operaciones en el Observatorio de Arecibo, en Arecibo, Puerto Rico. La NSF también tiene la intención de iniciar consulta bajo la Sección 106 de la Ley de Preservación Histórica Nacional (NHPA, por sus siglas en inglés) para evaluar los efectos potenciales al Observatorio de Arecibo, que es una propiedad histórica que se encuentra en la lista del Registro Nacional de Lugares Históricos.

Mediante esta notificación, la NSF está anunciando el inicio del proceso de definición de alcance para solicitar comentarios públicos e identificar asuntos a ser analizados en la DIA e iniciar el proceso de participación pública bajo la sección 106. Comentarios referentes a los asuntos pueden ser sometidos verbalmente durante las reuniones de definición de alcance programadas para el día 7 de junio de 2016 (ver detalles abajo) o por escrito hasta el día 23 de junio de 2016. Para ser elegible a ser incluido en el Borrador de la DIA, todos los comentarios deben ser recibidos previo al cierre del período de definición de alcance. La NSF va a proveer oportunidades adicionales para la participación pública una vez se publique el Borrador de la DIA.

LA NSF LLEVARÁ A CABO DOS EVENTOS DE DEFINICIÓN DE ALCANCE:

Reunión diurna:
7 de junio de 2016, 9:30 am a 11:30 am
DoubleTree by Hilton San Juan
105 Avenida De Diego
San Juan, Puerto Rico
Teléfono: (787) 721-6500

Reunión nocturna:
7 de junio de 2016, 6:00 pm to 8:00 pm
Colegio de Ingenieros y Agrimensores de Puerto Rico
Ave. Manuel T. Guillán Urdáz
Conector 129 Carr. 10
Arecibo, Puerto Rico
Teléfono: (787) 758-2250

Puede someter sus comentarios relacionados a esta propuesta por cualquiera de los siguientes métodos:

Correo electrónico a: envcomp-AST@nsf.gov, especifique en la línea del asunto "Arecibo Observatory"
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National Science Foundation, Suite 1045
4201 Wilson Blvd
Arlington, VA 22230

La información del proyecto va a ser publicada, a través del proceso de DIA, en **www.nsf.gov/AST.**

Los comentarios van a ser transcritos por un reportero de la corte. Se va a proveer traducción en inglés y español durante la reunión. Por favor contacte a la NSF con al menos una semana de anticipación a la reunión si usted desea solicitar servicios especiales (como por ejemplo, interpretación de lenguaje de señas).

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FUNDACION NACIONAL DE CIENCIAS
(NSF)

DECLARACION DE IMPACTAO AMBIENTAL (DIA)

En cumplimiento con la Ley de Política Ambiental Nacional del 1969 (NEPA, por sus siglas en inglés), según enmendada, la Fundación Nacional de Ciencias (NFS, por sus siglas en inglés) tiene la intención de preparar un Declaración de Impacto Ambiental (DIA) para evaluar los efectos ambientales potenciales de los cambios propuestos a las operaciones en el Observatorio de Arecibo, en Arecibo Puerto Rico.

AFIDAVIT

Yo, Carmencita Santana Rosado, habiendo prestado el debido juramento declaro:

Que soy Representante del periódico "EL NUEVO DIA" que se publica en Guaynabo, P.R.; que en las ediciones de este periódico correspondientes a los días:

24 DE MAYO DE 2016

se dio publicidad al anuncio expedido por

MS. ELIZABETH PENTECOST, RE: ARECIBO OBSERVATORY

en el caso arriba mencionado y copia del cual se une al presente afidávit para que forme parte del mismo.

Guaynabo, P.R. 24 MAYO 2016 20__.

Afidávit No. 80,583 del Registro.

Jurado y reconocido ante mi por Carmencita Santana Rosado, vecina de San Juan, mayor de edad, soltera, Representante del periódico "EL NUEVO DIA", a quien doy fe de conocer personalmente.

Guaynabo, P.R. 24 MAYO 2016 20__.

NOTARIO

FUNDACION NACIONAL DE CIENCIAS
(NSF)

DECLARACION DE IMPACTAO AMBIENTAL (DIA)

En cumplimiento con la Ley de Política Ambiental Nacional del 1969 (NEPA, por sus siglas en inglés), según enmendada, la Fundación Nacional de Ciencias (NFS, por sus siglas en inglés) tiene la intención de preparar un Declaración de Impacto Ambiental (DIA) para evaluar los efectos ambientales potenciales de los cambios propuestos a las operaciones en el Observatorio de Arecibo, en Arecibo Puerto Rico.

AFIDAVIT

Yo, Carmencita Santana Rosado, habiendo prestado el debido juramento declaro:

Que soy Representante del periódico "EL NORTE" que se publica en Guaynabo, P.R.; que en las ediciones de este periódico correspondientes a los días:

26 DE MAYO DE 2016

se dio publicidad al anuncio expedido por

MS. ELIZABETH PENTECOST, RE: ARECIBO OBSERVATORY

en el caso arriba mencionado y copia del cual se une al presente afidávit para que forme parte del mismo.

Guaynabo, P.R. 26 MAYO 2016 20__.

Afidávit No. 80,736 del Registro.

Jurado y reconocido ante mi por Carmencita Santana Rosado, vecina de San Juan, mayor de edad, soltera, Representante del periódico "EL NORTE", a quien doy fe de conocer personalmente.

Guaynabo, P.R. 26 MAYO 2016 20__.

NOTARIO

5-B Transcripts

ARECIBO OBSERVATORY

PUBLIC SCOPING MEETING

TUESDAY, JUNE 7, 2016

6:11 P.M.

CHAIRED BY:
CAROLINE M. BLANCO, ESQ.
RALPH GAUME, PHD4

Reported By: Derek L. Hoagland
California CSR No. 13445

MS. BLANCO: Good evening, everybody. Welcome. For the first half hour of this meeting, it's an informal opportunity to take a look at the boards. We are going to translate. There are boards in both English and in Spanish. And this is the informational portion of the evening, the informal informational portion of the evening.

And beginning at 6:30, we will have a brief presentation from NSF to explain the process. And at the end of the presentation, we will welcome comments from anybody who wishes to provide oral comments.

And just as a note, due to the number of people who are here, we are going to limit comments to three minutes initially per person, and with remaining time, people can come back and add to those comments if they wish. There are also comment sheets available at the

table if you wish to provide written comments.

And, finally, after the meeting today, you can still submit comments either by email or regular mail up through June 23rd.

So we will see you back at 6:30.

(A recess transpires.)

MS. BLANCO: Folks, just a reminder, we will be starting the brief presentation in about five minutes.

And just a clarification, the timing for public comments tonight, due to the fact that we are having translation services, we will allow four minutes for each comment, and that will include the time for translation as well. And, again, if there is time remaining, we will go back to people who still want to make comments.

Thank you. We will be back in five minutes.

(A recess transpires.)

MS. ALMODOVAR: Good afternoon. Welcome to the Arecibo Observatory public scoping meeting.

We have with us today representatives from the National Science Foundation. I have Dr. Ralph Gaume. He is the program director for Arecibo for the Division of Astronomical Sciences. Ms. Caroline Blanco, assistant general counsel. Karen Pearce, she is from the Office of Legislative and Public Affairs with NSF.

This is a public scoping meeting where we will gather comments from the public regarding preliminary proposal alternatives.

The details regarding today's meeting and the proposed action will be further explained by Dr. Gaume and Ms. Blanco with a brief presentation, which will be translated into Spanish by our translator, Mayra.

And we have with us Derek over here. He will be our court reporter.

For today, we just went through a brief poster session at 6:30. We are now doing the presentation, a short presentation. And then at 7:00 we are going to start taking the public comments.

Please remember to sign in if you haven't done. If you want to provide comments, please mark the check mark to provide oral comments today.

Let's go ahead and get started.

MR. GAUME: Thank you, Caroline.

I would like to welcome everybody here today. A lot of new faces, some of the same faces as earlier today. As Madeline said, my name is Ralph Gaume. I am an astronomer, and I am the program officer for Arecibo Observatory at the National Science Foundation.

So I would like to get maybe the elephant in the room out of the way right away. I am not here today to announce a reduction in funding or the closing of Arecibo Observatory.

So let me provide a little bit of background. And both Caroline and I will talk about the process. So in way of background, the National Science Foundation is the federal steward for ground-based astronomy and space and atmospheric sciences. We provide funding for national and international telescopes and facilities. And besides our facilities that we fund, we fund research grants that allow individuals to conduct specific science investigations.

So in the current fiscal year in which we are in, the National Science Foundation provides $8.2 million to Arecibo Observatory.

There are two groups within the

National Science Foundation that fund Arecibo Observatory: the Division of Astronomical Sciences, which I work in; and the Division of Atmospheric and Geospace Sciences. And the funding which we provide is equally divided between these two groups.

In addition to the National Science Foundation funding, in the current fiscal year, the Planetary Science Division of NASA is providing around $3.7 million funding to Arecibo.

Over the past decade, the National Science Foundation has received multiple advice from external review committees who have told us that we need to reduce or cease support of some of our existing telescopes and facilities. And this is to allow for construction and operation of new telescopes, facilities, and instruments, and also to continue

funding for our research grants that enable scientists to conduct individual science investigations.

Specifically for Arecibo, the 2012 astronomy portfolio review said that the astronomy division should reevaluate its participation in Arecibo and another telescope called SOAR later in the decade in light of the science opportunities and budget forecasts.

Furthermore, the report went on to say that if funding remains tight later in the decade, then the funding that AST contributes to Arecibo and SOAR must be weighed or balanced against the needs of our grants programs.

Very recently, the geospace group at the National Science Foundation conducted a portfolio review which recommended that the geospace group reduce its management and operations support for Arecibo Observatory to $1.1

million by 2020. Of course, this compares to the current support level of 4.1 million annually.

So given these previous community recommendations, combined with our current budget constraints, NSF has a need to reduce funding levels for a number of our astronomical and geospace science telescopes and facilities.

So the purpose of this environmental impact statement that we are preparing is specifically to evaluate the environmental impacts of alternatives which address the need to change operations at Arecibo Observatory.

So let’s look at these alternatives. And they are preliminary alternatives. So the first one is continued NSF investment for science-focused observations -- operations, sorry. So this is basically the no-action alternative, continue on as we are

today.

The second alternative is collaboration with interested parties for continued science-focused operations.

Collaboration with interested parties for transition to education-focused operations.

The fourth is moth-balling of the facility, which is a suspension of operations in such a manner that operations could resume efficiently at some future date.

And the final of the five preliminary alternatives is deconstruction and site restoration.

And now I will turn it over to Caroline -- Ms. Caroline Blanco to talk a little bit more about the process.

MS. BLANCO: Good evening, everybody.

The environmental impact statement process is a process that

is legally required by the National Science Foundation pursuant to the National Environmental Policy Act. We are required to take a look at the environmental impacts of potential alternatives before a decision is made. Importantly, it requires us to have public input into the decision-making process. And some of the information we will be looking at and analyzing are these resource areas and potential impacts on them by each alternative. It is a broad range of resources that we analyze, including such things as air quality, biological resources, cultural resources, et cetera.

As I mentioned, this is a public process, and there will be a couple of public comment periods throughout this process. And comments received by the National Science Foundation will be considered and responded to in the

final environmental impact statement.

This is the first stage, which is called the scoping process, and we are seeking public comments on the proposed preliminary alternatives. Your comments will be very helpful in helping us to refine those alternatives or to learn of any new alternatives you may suggest.

This is part of a 30-day public comment period that will close on June 23rd. As set forth in this handout, which is available at the front desk, there is a timeline for the next major steps in this process. After we receive public comments from the scoping process, we will refine the alternatives and prepare a draft environmental impact statement. And in that draft environmental impact statement we will include an analysis of those potential impacts

from the resource areas we just discussed on each of the alternatives.

Following the issuance of that document, which will be noticed in the Federal Register and in the local newspapers, it will begin -- we will begin a 45-day public comment period. The comments can be received either by email, by regular mail, or during the two public comment -- or public meetings we will hold when -- after it is released during the public comment period.

We anticipate that we will issue the draft environmental impact statement in the late fall of this year, 2016. After we receive the public comments, we will consider them, adjust the draft environmental impact statement accordingly, and prepare a final environmental impact statement. We anticipate issuing

the final environmental impact statement during the spring of 2017.

After the final environmental impact statement is issued, we will have a time period where we will consider the environmental impacts on the alternatives, along with any public comments received after the final environmental impact statement is issued, along with other important factors that are not part of this process, such as the scientific merit, the budget considerations, and other factors, and then we will issue a final decision. And we anticipate at this point that that decision will be issued at some point in the summer of 2017.

The ambiguity in the target dates is largely due to the fact that this is a public process and we cannot at this juncture anticipate what the public comments

will be and how we will respond to them. So those target dates are our best estimates as of today.

There's one other process I would like to mention, and that is also listed on this fact sheet, and it's referred to as Section 106. And it is a process under the National Historic Preservation Act. It is another federal statute that requires us to look at impacts on nationally significant historic properties. And that process requires us to consult with interested parties and the State Historic Preservation Office of Puerto Rico, and to consider potential effects on the historic properties, and work together to find ways to avoid, minimize, or mitigate those effects if they are adverse.

On the sign-up sheet there is a section there, a column that asks if you would like to be a

consulting party. Please check it if you are interested in participating in that process. And we will be handling these processes concurrently to the best extent possible.

And now I believe that was -- we will begin our public comment period at this point. And as I mentioned earlier, we will be limiting comments initially to four minutes, including the translation, and that is simply to accommodate everybody who is here who would like to speak. If there is time remaining, we will come back to anybody who wishes to add to their comments. And, again, if you would still like to submit comments in addition to what you have said this evening, you can do so by email or regular mail by June 23rd.

And it is particularly helpful to us at this stage in the scoping process if you can relate your

comments to the preliminary proposed alternatives or new alternatives.

And Madeline will be timing people and giving 30-second warnings before so that you can wrap up your comments.

Thank you.

MS. ALMODOVAR: So I have the sign-in sheet with me, so those of you who have marked that you are interested in providing oral comments, I am going to go ahead and read your name going down the list, handing you the microphone, and start taking the time. And I will mention when the 30 seconds are coming up.

The first person I have is Patrick Taylor. Please raise your hand because I don’t know who you are.

MR. TAYLOR: Hi. My name is Patrick Taylor. I am the group lead for planetary radar at Arecibo

Observatory.

And I wanted to say that any level of divestment by the NSF of Arecibo, without replacement of that funding from some source, will endanger the NASA-supported work that we do, which is also congressionally mandated, of tracking and characterizing potentially hazardous asteroids.

So it mentions on some of the posters here that environmental impacts may be mitigated to lessen or remove that impact, which is exactly what we are trying to do at Arecibo, is prevent environmental impacts from above. So supporting new initiatives like LSST is commendable for this mission, but it’s work done by Arecibo that prevents us from losing track of these asteroids in the future. So in the future, we need to support one of the proposed alternatives that allows us to continue this

scientific work, because no other telescope in the world can do what we do. Thank you.

MS. ALMODOVAR: Next person, Edgar Rivera-Valentín.

MR. RIVERA: Saludo. I am Edgar Rivera-Valentín. I am a planetary scientist at the Arecibo Observatory. And I am a native from this very city that you are in. My family is from here. You can see the hospital I was born in right across the street. My dad works right over there, right across the street. And my father is right there.

The point is, how I got into science was because of the observatory. So you want to talk about a cultural resource for Puerto Rico according to your EIS. The last two options you have would be a huge loss as a cultural resource for all of Puerto Rico.

I went there when I was seven.

Seeing science that was done in my backyard is what got me to do what I do today. Now I run the Arecibo Observatory Space Academy. Every day I get to see the huge impact we have on these high school students. And it makes me cry because I can see that the observatory is still affecting students from my island.

So I really do hope that when you consider any of the more drastic options, you remember the emotional cost of the cultural resource that would be lost for all the island. Thank you.

MS. ALMODOVAR: Next person is Joan Schmelz.

MS. SCHMELZ: I am Joan Schmelz. I am the deputy director at Arecibo Observatory.

If we are considering socioeconomic impacts, tourism and STEM education are dependent on the telescope. Tourists wouldn’t come to the site to see a hole in the

ground where the telescope used to be. Students couldn't be inspired by a telescope that is not there anymore. The telescope itself cannot be separated from the science that is done there. This science inspires the kids who come to the observatory and the tourists who come to visit.

For example, The Discovery of the First Repeating Fast Radio Burst was published in March in the journal *Nature*. The resolution of the distance controversy for the Pleiades star cluster sets the distance scale for the universe. The anticipation of gravitational waves from supermassive black holes is a discovery that we are all waiting for.

Arecibo science is new, fundamental, and cutting edge. The telescope is what makes these discoveries possible.

Thank you.

MS. ALMODOVAR: The next person is Brett Isham.

MR. ISHAM: I am Brett Isham from the Interamerican university in Bayamón, electrical and computer engineering.

I spoke this morning. I won't repeat those comments. I wanted to say that I agree with Joan that the education option on this, which appears to me to be education only, is unrealistic, that the research done by the telescope is why there is the inspiring education at the telescope. I realize that education has a broader impact at NSF, but perhaps it could be expanded at the observatory, and in that case, maybe partnerships with the Department of Education and maybe even -- because of the many comments by local people, maybe even the Puerto Rico Department of Education could be persuaded to have some participation even

financially.

I think there are other opportunities, some simple, some more involved. For example, the seminars -- the many seminars at the observatory could be made available on the Internet for anyone in Puerto Rico or anywhere to participate in.

I think some collaboration -- some enhanced collaboration within the local campuses could expand internships for students and participation in those -- supervising those internships by the faculty.

Aerospace in Puerto Rico is growing. Perhaps aerospace and electronics companies would be willing to chip in for education-related costs.

And I just wanted to mention also that it extends beyond Puerto Rico, as you heard this morning, but I have a student here from

Sweden who is visiting here for three months, and we are working on projects with Arecibo.

Thank you.

MS. BLANCO: Thank you.

MS. ALMODOVAR: The next person is Benjamin Sharky.

MR. SHARKY: Hello. I am speaking as an undergraduate physics student who has been fortunate enough to work as a summer intern this year and last year. My experience working at Arecibo has been deeply inspiring to me because I have had the chance to learn about a variety of disciplines and have received meaningful mentorship in both astronomy and planetary science. I have learned how to move forward practically to approach a research career while being continually inspired every day by the welcoming community environment that the staff have created and the exciting

unique science that has been mentioned previously that I would not have had access to at my university alone.

I know from talking with my fellow interns that my experience is not unique. The cultural impact on inspiring and directing students lives across the country and directing their careers cannot be overstated.

Thank you.

MS. ALMODOVAR: Thank you. Next person, Scott Ransom.

MR. RANSOM: So hello. I am Scott Ransom. I am an astronomer and a professor, and my research is critically based on the Arecibo telescope.

So I am here representing two groups. One of them is called NANOGrav, which is looking to detect gravitational waves. And the other group is the Arecibo Science Advocacy Partnership, known

as ASAP.

And I have two points to make, one of them based on what would happen if we lost scientific capability and the other if we lost educational capabilities with Arecibo.

So the first point is the scientific one -- go ahead. So the senior review and portfolio review which has kind of led us to this crossroads are very important things that NSF needs to do on a recurring basis, especially in a time of flat or even declining budgets. But something -- a very important thing to remember is that the scientific context for those reports has changed.

This year, one of the greatest scientific discoveries of the last century happened, the direct detection of gravitational waves. Arecibo is a crucial component of NANOGrav, will open up the next

window of gravitational waves in the coming years.

And one important point about this is NANOGrav is now supported by NSF physics via Physics Frontier Center. So, hopefully, one of the solutions with how we can potentially help fund Arecibo in the future, physics at NSF will be part of that.

My last point is about the educational opportunities. We have heard of the fantastic opportunities here in Puerto Rico, but in the U.S. as a whole, Hispanics are dramatically underrepresented in STEM.

Hopefully I can finish this up after another round of comments.

MS. BLANCO: Thank you. If there is time left over, we will come back to you.

MS. ALMODOVAR: Robert Minchin.

THE DEPONENT: Good evening. I am Robert Minchin. I am the group

lead for radio astronomy at Arecibo Observatory and I also run the summer internship program that givens research opportunities to undergraduates and teachers.

I want to make a point that over the last five years, we have had 24 Hispanic students or teachers on this internship program. This may not sound like a huge number, but with what Scott was saying at the end of his comment, if we are graduating 24 bachelor's in physics every year, we would be in the top ten universities in the U.S. producing Hispanics physics graduates. Over three-quarters of the Hispanics that come are Puerto Rican. And we have recently had the (unintelligible) internship program renewed for a further five years. And one of our goals of this expanded period is specifically to target not just Hispanics, but

Hispanic woman who are doubly affected by both being women and Hispanics.

So this is the program that we would be running here, but it relies crucially on this observatory being active in research because it is not possible to give someone research experience if you are not doing research. So we want to deliver it. We need to do this. The community of science in the U.S. needs programs like this reaching out to minorities, reaching out to woman. And this is -- this expansion of the community was identified by the (unintelligible) survey as something that we needed absolutely in astronomy, and the same is true for the other fields that work at Arecibo.

But the first two options obviously will allow us to continue it. The third option, moving

toward education focused, that would allow us to continue this if it expanded education but did not bring down the research element, because if we went to education focus and lost research, I think we would be a worse education facility than we are now.

MS. BLANCO: Thank you. We will come back to you if there is time.

MS. ALMODOVAR: Next person is Ms. Sandra -- no? Okay.

Vivian Claudio. No?

Okay. Christopher Salter.

MR. SALTER: I must say, I am a little saddened by the fact that there are not more people from Arecibo at the meeting when this is supposed to be a public scoping meeting. I wonder how much the NSF actually did to publicize this meeting within Arecibo and the surrounding communities. Certainly most of my neighbors and people

I've spoken to within the town knew nothing of the occurrence of this meeting.

I have been a radio astronomer for over 50 years, 23 years of that at Arecibo, and during that time almost every year I have had students, undergraduates who have moved on, most of them entering a research career in astronomy, many in radio astronomy, and many of them have moved to senior positions, either senior staff at American universities or Puerto Rican universities. One is even a senior scientist at the ALMA telescope, which is one of the new facilities that Ralph was mentioning earlier.

And I would just like to emphasize the importance of our work teaching science teachers. For many years, we ran teachers workshops, and we also had at least one or two teachers join us every

summer who joined us in our research work.

Just this morning, I was teaching to our undergraduates who are here this summer and our teachers who are here, and for me, it's a wonderful experience. I hope it was as good for them. But what I think many of us feel, we wish to put something back into this place that has become our home and we have got to love.

MS. BLANCO: Dr. Salter, I wonder if I could just address your question about the outreach that NSF did for this meeting.

In addition to the Federal Register notice that was published, NSF also arranged to have published in the San Juan newspaper and the Arecibo newspaper announcing the meeting.

MS. ALMODOVAR: And the newspapers were *El Nuevo Día* and *El Norte*.

MS. BLANCO: In addition, there also were announcements on the NSF's Division of Astronomy and Geo -- AGS.

And just a reminder to everybody that updates on the process will be posted when they occur on the NSF AST Web site that is listed at the bottom of the fact page. Thank you.

MS. ALMODOVAR: The next person, Andrew Seymour.

MR. SEYMOUR: Hello. My name is Andrew Seymour. I am a post doc at the Arecibo Observatory.

I can expand on the science, I can expand on the impact that a person would have from an area related to a telescope since I was from around the DPT, but I feel that the purpose of this meeting is to look at the true environmental impact.

Underneath the dish a diverse biosystem has been able to flourish

for over 50 years. I think if we were to return to nature, you could not do so without destroying nature itself. These plants will only survive in full shade. Destroying the dish would kill these plants and expose the soil.

Coming from a state with mountaintop removal, I have seen firsthand how detrimental this can be. Because the dish lies directly above a sink hole as well, such runoff would run directly into the groundwater.

My suggestion to the committee is to do a full geo, bio, and water runoff study before any other options in continuation is considered.

Thank you.

MS. BLANCO: Thank you.

MS. ALMODOVAR: We have one more person, Luisa Zambrano.

All right. That’s all the people I have on the list. Is

there anybody that hasn't spoken yet that would like to?

MS. GHOSH: Hello. I am Tapasi Ghosh. I also work at the observatory in astronomy. I am going to talk about again on the socioeconomic side, mostly aspect of us being here as a function.

Sociocultural is important because -- because observatory is here, we have a lot of scientists here, and along with them come their families, their spouses. Often they are highly educated.

And I have two examples. One of them is right here. Our friend (unintelligible) --

THE REPORTER: I am sorry.

MS. GHOSH: Whose wives of two of our colleagues Barry del Backo (phonetic) and (unintelligible), they started two schools. They basically built up the two schools from local schools, from a general level to a very high standard. And

out of these schools, there were three Presidential Scholars, if you can imagine, from Arecibo. Three students with Presidential Scholars. And I will argue if Arecibo were to vanish, similar situations would be somewhat harder to come by.

Thank you.

MS. BLANCO: Thank you.

MS. ALMODOVAR: Anyone else that hasn't spoken that would like to?

MS. BLANCO: Would anybody who ran out of time like to speak? Have you spoken yet and you wanted to? We have one person who has not yet spoken, and then I think we should have time to have additional comments.

MR. QUINTERO: (Speaking in Spanish) Hi. My name Luis Quintero. I am head of the electronics department at the Arecibo Observatory.

I can talk on behalf of the electronics department, but I believe that the same thing happens in other departments of the observatory. We contract to retain products and services in Puerto Rico and in the United States, and we also use messenger and transport services in Puerto Rico to be able to receive these products and services. As an example of that, we are customers of the Puerto Rico Telephone Company for our Internet and phone services. And we also try to seek local representatives for product distribution, and we try to do it locally because that's money that stays in Puerto Rico. And in terms of messenger services, we use the USPS and FedEx. And in terms of local transport, we have also sought local transport companies to do the shipments.

So in that case with fund cuts to the Arecibo Observatory would

also entail cuts in the movement of the economy -- of the local economy of Puerto Rico in Arecibo.

MS. BLANCO: Thank you.

MR. RANSOM: So Scott Ransom again. Just to finish about my last topic about the educational impacts of Arecibo.

So Arecibo can be incredibly inspirational to Hispanic students outside of Puerto Rico as well as within. And a great example of this is a program called the Arecibo Remote Command Center at the University of Texas.

That program uses the Arecibo telescope. The students can use it, do research on it and learn about astronomy, and it’s turned into a pipeline for producing Hispanic students in STEM.

This type of activity would not be possible if Arecibo were not actively doing research in the future.

Thank you.

MS. BLANCO: Thank you.

Is there anybody else who either hasn't spoken or already has spoken who would like to? Yes.

MS. ZAMBRANO: Hi. My name is Luisa Zambrano, and I work at Arecibo Observatory as the coordinator of the Space Academy.

In the last four years, the Space Academy has been able to serve to over 150 Puerto Rican students. They are -- all the ones of age to enroll in college are doing so. All the ones of age to be in college, they are currently enrolled in college. So we have 100 percent college retention -- college seeking results. And you heard from some of those students this morning.

What is more interesting about this is that throughout the four years, we have been able to maintain almost even male to female

ratio, which is very unusual for science, especially among Hispanics.

Some of the students from the Space Academy have gone direct to school in universities such as MIT, Stanford, University of Maryland and, of course, University of Puerto Rico, Mayagüez campus.

But I won't take much more of your time right now. We have decided that we will share with you our reports for the last eight semesters of AOSA so they can be included in your evaluation and your study, as they are from the impact it has in socioeconomic side.

Thank you.

MS. BLANCO: Thank you.

Are there any more people that would like to speak? Okay. And it is okay if you have already spoken. Yes.

MR. CRUZ: So my name is

Christian Cruz. I am the space (unintelligible) of space and atmospheric sciences at Arecibo.

THE REPORTER: I am the? I am sorry, you need to hold the mic very close to your mouth. Your title?

I apologize. I need to hear you, sir.

MR. CRUZ: I am the (unintelligible) of space and atmospheric sciences at Arecibo.

MS. BLANCO: I think it might help if you hold the mic close to your mouth.

MR. CRUZ: I am from Brazil. I came here to work at Arecibo eight years ago. For two times I run our summer school program.

And I believe that this program is 38 years old right now or 39 maybe. The last statistic I saw, we had about 370 students. Among them, more than 200 become doctors. Yeah. This is the statistics from

how multiplicative are this place.

The second part of my argument here is we are more than 50 years old place, so we have more than 50 years of data. Very few places in the world have this amount of data for such a long time. But this environment using our data, for example, three years ago, we detected a long transiting (unintelligible) using this data set. Three years ago we detect a long term of trends over Arecibo. Neutral waves. What it means there? It means that we are seeing a huge effect to the upper atmosphere. Or, in other words, the greenhouse effect. And very few places in the world you can detect that because we have this long-term data set. If you broke this chain, we are going to have problems detecting that.

MS. BLANCO: Thank you.

Is there anybody who would like

to speak? Please remember, you have until June 23rd to submit comments. Comments can be submitted either by email or regular mail. And please watch for any updates on the NSF AST Web site that is listed at the bottom of the fact sheet.

And the next step will be preparation of the draft environmental impact statement. And that, again, will be followed by a 45-day public comment period. And that we anticipate will take place in the late fall. And there will be two more public meetings, one in San Juan, and one here in Arecibo.

And thank you very much for coming tonight. We very much appreciate your comments. Thank you.

(The proceeding concluded at 7:51 p.m.)

REPORTER'S CERTIFICATE

I, DEREK L. HOAGLAND, Certified Shorthand Reporter #13445, State of California, do hereby certify that the foregoing is a true and correct transcript of the proceedings had in the within-entitled and numbered cause on the date hereinbefore set forth; and I do further certify that the foregoing transcript has been prepared under my direction.

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DEREK L. HOAGLAND

ARECIBO OBSERVATORY

PUBLIC SCOPING MEETING

TUESDAY, JUNE 7, 2016

10:04 A.M.

CHAIRED BY:
CAROLINE M. BLANCO, ESQ.
RALPH GAUME, PHD4

Reported By: Derek L. Hoagland
California CSR No. 13445

MS. ALMODOVAR: Good morning, everybody.

MR. GAUME: Good morning.

MS. ALMODOVAR: Can you all hear me well?

Welcome to the Arecibo Observatory public scoping meeting. We have with us today representatives from the National Science Foundation. We have Dr. Ralph Gaume, Caroline Blanco, and we have Karen Pearce.

MS. PEARCE: Hello.

MS. ALMODOVAR: This is a public scoping meeting where we will gather comments from the public regarding preliminary and proposed alternatives.

The details regarding today's meeting and the proposed action will be further explained by Dr. Gaume and Ms. Blanco during a brief presentation, which will be translated into Spanish by Mayra on your right -- on your left. Sorry.

Well, today you had an opportunity to look at the posters and have some initial questions. We will have a short presentation, and then around 10:30, we will go ahead and start the public comment period. And some of you have already signed up for public comments. If you haven't done so, you can do so, or when the people that have already signed up are -- have completed their comments, then you may raise your hand, and I will open the microphone.

(Speaking in Spanish.)

MS. ALMODOVAR: Let's go ahead and get started.

MR. GAUME: Thank you. So I am very happy that everybody is here today. Thank you all very much for coming. My name is Ralph Gaume, and I am the principal program officer for the National Science Foundation for Arecibo.

There has been a lot of

information out there in the press that I have seen and read about Arecibo Observatory and about what we are doing here today. Some of the information is actually correct. We are here today to try and clarify why -- what we're doing and why we are doing it and to answer your questions and to give you an opportunity to provide your input into the process. And, fundamentally, we are not here today to announce the closing of Arecibo or the reduction of any funding whatsoever.

So the National Science Foundation is the federal steward for ground-based astronomy and space and atmospheric sciences. So NSF provides the funding for national and international telescopes and facilities and provides funding for research grants that allow individuals and groups to conduct specific science

investigation.

So with regards to Arecibo, in this current fiscal year, the NSF provides $8.2 million to Arecibo Observatory.

I am an astronomer, and the astronomy group at the National Science Foundation provides half of that funding. There is another group at the National Science Foundation, the Division of Atmospheric and Geospace Sciences, which provides the other half of the National Science Foundation funding for Arecibo.

Also, in this fiscal year, the Planetary Science Division of NASA provides another $3.7 million in funding to the Arecibo Observatory.

So over the past decade, many of you are aware that the National Science Foundation has received advice from external review committees, and this advice has stated that the National Science

Foundation needs to reduce or cease support of some existing telescopes and facilities, the purpose being to provide construction funding and operation funding for new telescopes that the community has asked us to build and also, very importantly, to have the funding to provide money for research grants that enable individual science investigations.

So with regards to Arecibo Observatory, the 2012 portfolio review report said that the astronomy group should reevaluate its participation in Arecibo and another telescope called SOAR later in this decade in light of the science opportunities and budget forecasts at that time. They also recommended that if funding remains tight later in the decade, that the scientific need for continued funding for Arecibo and SOAR must be weighed against the needs of our

grants programs.

The space and atmospheric group at the National Science Foundation conducted a portfolio review this year, and that report stated that they should reduce the management and operation support for Arecibo to $1.1 million by 2020. As I mentioned before, that compares to the current funding level of 4.1 million which the space and atmospheric group is currently providing.

So the only thing that has been recognized thus far is that given the previous community recommendations from the science community, the National Science Foundation has a need to reduce funding levels for a number of our astronomical and geospace science telescopes and facilities.

So the purpose of why we are here today to do these scoping meetings for the environmental

impact study, the purpose is to evaluate the environmental impacts of the proposed alternatives, preliminary alternatives, which will address the National Science Foundation's need to change operations at Arecibo Observatory.

So what are these alternatives? There are five alternatives in the preliminary list that we are studying:

The first alternative is continued NSF investment for science-focused observations, which is basically a continuation of what we're doing now.

Second is collaboration with interested parties for continued science-focused observations.

Third, collaboration with interested parties for transition to education-focused operations.

Fourth is moth-balling of the facility, which is basically a suspension of operations in a

manner such that the facility and operations can resume at some point in the future.

And, fifth, deconstruction and site restoration.

Let me turn it over to Ms. Caroline Blanco.

MS. BLANCO: Thank you, Dr. Gaume. Good morning. My name is Caroline Blanco. I am the assistant general counsel at National Science Foundation, and I oversee environmental matters.

So today's scoping meeting, as Dr. Gaume expressed, is to introduce you to the proposed preliminary alternatives that NSF has identified and to request public input on those proposed preliminary alternatives.

As is said in the handouts and on the boards outside, NSF is requesting public comments through June 23rd of this month. The public comments can be received

either today during this meeting or by email or by regular U.S. mail.

We are requesting again that these comments go to these preliminary proposed alternatives so that we have refined which alternatives we will analyze in the environmental impact study process.

And once we receive the comments, we will prepare a draft environmental impact statement, and that document will include an analysis of impacts that are anticipated on the preliminary proposed alternatives. And the resources that will be analyzed include all of these here, including air quality, biological resources, cultural resources, et cetera.

I would like to emphasize that this is a public process and that no decision has been made. The ultimate decision will not take place for over a year from now and

will take into consideration information on the environmental impacts that will be considered through NSF's environmental impact statement process, including other very important considerations, such as science, budget, and other considerations. But this is process is -- involves the environmental impacts of proposed alternatives.

And the next step will be, as I mentioned, the preparation of a draft environmental impact statement that we anticipate will be issued in the late fall of this year.

Once issued, that will begin a 45-day public comment period. And during that public comment period, we will return here for two more public meetings, one in San Juan and one in Arecibo. And, again, during those public meetings, the public will have an opportunity to

submit oral comments. And, also, at that time during the 45-day public comment period, just as is the case here, people can submit comments either through email or regular mail.

And after we receive those comments, NSF will consider them, and we will adjust the draft environmental impact statement accordingly and produce a final environmental impact statement.

And then the final environmental impact statement we anticipate will be issued in the late spring of 2017.

After the final environmental impact statement is issued, NSF will take into consideration the environmental impacts in the final environmental impact statement and then also consider the scientific merits, budget constraints, and other factors before issuing a final decision. And that will

probably take place at some point in the summer of 2017.

The time frames are rough estimates at this point because this is a public process and it will depend on what type of comments we receive from the public. We also have a Web site on the AST division Web -- that is on the handouts, the Web addresses at the bottom of this handout. And I would encourage you to periodically check that Web site to keep informed on the process.

Thank you very much. We will now take public comments.

MS. ALMODOVAR: (Speaking in Spanish.) I have here the list of people that have signed up to ask questions if people are not sure. I am going to read your names, so bear in mind that Mayra is translating here.

First person is Hilda Colón. Second person Carla Colón. No?

Okay.

Brett Isham.

MR. ISHAM: Right here. I have a few -- I am from Interamerican University in Bayamón. I am a little bit confused about what you're asking here because of the -- I guess it doesn't include discussion of the alternatives or just the environmental impact of each alternative, which I have -- and the socioeconomic impacts include things like education and research impacts on, for example, Interamerican University?

MS. BLANCO: At this stage, this is a very preliminary stage in the process. At this stage, the scoping process is designed to identify preliminary proposed alternatives and to receive public input on those alternatives themselves. It is not the stage where we are looking at environmental impacts yet. That

stage will occur at the draft environmental impact statement process.

MR. ISHAM: Okay. So I would like to echo the comment of Dr. Gaume. I think that some of the information in the portfolio review is correct. And I don't -- I just wonder if the information in various reviews is fact checked -- you don't have to answer that right now -- because I hear a lot of comments that some of it is not correct.

It was also my impression -- which I don't know if everyone would agree with me, but it was my personal impression that the mandate of the new management of Arecibo that took over at the last competition, their mandate was to seek -- already implement the second on your list, not continue operations as they had been, but to seek new collaborators. Sorry.

And I think also that -- so, anyway, my impression was that the second alternative was intended to be the current state of Arecibo.

And the third alternative to move toward education, I believe that Arecibo Observatory, and I am sure there could be more done, but I believe that it is already one of the NSF facilities in terms of the national facilities that has some of the most extensive education programs. For example, 20,000 students from Puerto Rico every year visit the observatory and the education center, which is a pretty nice science museum. And there are or have been quite a few programs for students -- high school students and high school teachers to improve science education in Puerto Rico.

I guess a couple other things I wanted to point out.

MS. BLANCO: Excuse me. I just

wanted to be sure other people have an opportunity.

MR. ISHAM: Yes.

MS. BLANCO: Perhaps if you could hold your comments the remainder of --

MR. ISHAM: That’s fine.

MS. BLANCO: -- and see for other people. If we have time remaining, we would welcome additional comments.

MR. ISHAM: Okay. That’s fine.

MS. BLANCO: And if there is no time, you can, of course, still submit comments by email or by mail.

MR. ISHAM: All right.

MS. BLANCO: Thank you.

MS. ALMODOVAR: Next is Xavier Siemens.

MR. SIEMENS: I can actually translate myself. It might be a little bit more quick. There may be some jargon that will be a little bit easier.

Okay. So my name is Xavier Siemens, and I come from Milwaukee, where I am a faculty member at the University of Wisconsin.

I am here to talk about, I guess, in that list of things sort of cultural impacts or sort of human environmental issues. I am here on behalf of the North American Nanohertz Observatory for Gravitational Waves, NANOGrav, a collaboration that involves over 100 students and scientists from 15 institutions in the U.S. and Canada.

I am also the chair of the NANOGrav collaboration and the director of the National Science Foundation’s NANOGrav Physics Frontiers Center.

Using Arecibo, our collaboration is doing gravitational wave astronomy. We are leading the search for low-frequency gravitational waves

produced by the mergers of supermassive black holes that live at the centers of galaxies.

These low-frequency gravitational waves have periods 11 orders of magnitude longer than those discovered by LIGO and announced earlier this year. By continuously monitoring millisecond pulsars with Arecibo and the Green Bank Telescope in West Virginia, we are building an observatory much like LIGO but that will open a new window onto a completely different part of the gravitational wave spectrum.

We are now at a time when we have reached unprecedented sensitivities and expect to make a detection soon. Arecibo is the most sensitive radio telescope in the world and a lack of access to this instrument would cripple our observatory, we would lose a factor of 2 in sensitivity, seriously

damaging U.S. leadership in this field.

Given the unprecedented sensitivity of NANOGrav, which is the result of our access to the best facilities in the world, Arecibo being the most sensitive, and LIGO's recent gravitational wave discovery announcement, which was appropriately announced with much fanfare by both LIGO folks and NSF, and has already received several major scientific prizes, we were surprised to hear about NSF's decision to conduct this review.

To be clear, what we are putting in peril are three things: The research and careers of our more than 100 scientists and students of NANOGrav, our U.S. leadership in this field, and a new scientific discovery as profound as the one announced by LIGO earlier this year.

MS. BLANCO: Thank you.

MS. ALMODOVAR: Next person is Qihou Zhou.

MR. ZHOU: My name is Qihou Zhou. Q-i-h-o-u, Z-h-o-u, if that helps.

I come from Miami University. I am professor of the electrical and computer engineering departments. But I am here mainly on behalf of ASAP, Arecibo Science Advocacy Partnership, which consists of up to 150 members. By training, I am an atmospheric scientist.

Another representative from ASAP, Scott Ransom, is going to speak tonight.

So I am going to speak mainly on two aspects. The first one is impact of the Arecibo facility for the study of climate change and space environment.

Arecibo Observatory is perhaps -- I would say definitely the only facility that can probe

from the ground level to the deepest part of space. And is certainly true that Arecibo Observatory is the only facility in the world that can study the atmosphere continuously from the ground level to several thousand kilometers. This unmatched capability makes it a primary instrument in studying our spatial environment, including climate change. One indicator of climate change lies in the upper atmosphere temperatures from 100 kilometers to 600 kilometers. As the surface temperature rises, the upper atmosphere cools. We know that ground temperature has significant local variations. The upper atmosphere temperature is more homogenous. Clearly, the longer the data set is available, the easier it is to discern any long-term change. Continuous operation of Arecibo is important

to understand climate change and our spatial environment.

The second aspect that I want to speak about is impact of Arecibo on STEM education. It is well known that Arecibo hosts many, many high school students on a yearly basis. The Arecibo Observatory also inspires many undergraduate students engaged in STEM studies.

THE INTERPRETER: In? I'm sorry.

MR. ZHOU: STEM, Science, technology, engineering and math.

As an example, Miami University has an annual faculty-led winter study-away workshop using the Arecibo Observatory. Students come to the observatory to take and analyze the data and to experience the local culture. In 2015 and 2016, there were 14 and 19 students, respectively, participating in the Miami-Arecibo workshops. Additionally, there are

another 5 to 8 Miami students working on capstone and research projects using the Arecibo data every year.

Well, actually, I have a long quote from a student about how he is inspired by his experience here, but I think for the sake of time, I am just going to submit this written statement.

MS. BLANCO: Yes. Thank you. We have at least three more speakers who have indicated they would like to speak. And if -- again, if you would like to speak at the end of that, again, you are more than welcome to if we have time. We have this room until 11:30. Thank you.

MS. ALMODOVAR: The next person is José Molina.

MR. MOLINA: Hi. I am from the National Space Society.

Well, I want to point out here that we have Luisa Zambrana. She

is the founder and director of the Space Academy. And we have a couple of students back there which are -- that have been inspired, you know, by the facility, by the science there. So it is really important that we keep the education aspect in line.

Furthermore, I would like to add for the alternatives and resources areas, I don't see the commercialization or a partial or full commercialization of the Arecibo facility, so I suggest to study the possible public partnership.

And, yeah, that's all I have. Thank you.

MS. BLANCO: Thank you.

MS. ALMODOVAR: The next person is Luisa Fernando-Zambrana.

MS. FERNANDO: Good afternoon. Good morning. My name is Luisa Fernando-Zambrana. I am here as a member of the National Space

Society. And I also work at the Arecibo Observatory; although, my statements do not reflect those of the Arecibo Observatory, U.S. SRI, S-R-I, or the Metropolitan University or any of its partners. I am here as a citizen and as a scientist.

I wonder how will this new plan will ensure that the future of the Arecibo Observatory is not determined by a private interest, but, also -- but, indeed, for the benefit of the science and for the benefit of Puerto Rico.

We don’t need to remind everybody that Arecibo was the first telescope to discover an exoplanet or how many students have walked through its hallways or produced a dissertation thesis relating to its science.

Now it is my turn. I am writing my dissertation thesis using the single dish largest radio

telescope in the world. And for this, I have a vision where other scientists will be able to follow my road, as have those students from the Space Academy.

I only want to invite the NSF office assigned with this task to take a detailed view on what has happened with its previous attempts to have the observatory continue producing science. Partnerships indeed have flourished and developed amazing science. But, however, it has created reemergence of profits within the observatory, which has led to a decrease in the best use of the funds. So let's take as an example what we have done already, learn from it, and try to get everybody's input to keep Arecibo open. Thank you.

MS. ALMODOVAR: Amanda? Next person is Amanda Marín Morales.

MS. MARÍN: Amanda Marín Morales.

Good morning to all. I have collaborated for 17 years with the public schools of Puerto Rico, and I know firsthand the impact that the Arecibo Observatory has in our high school students and their education, and I believe that it does not fit in my mindset to close the Arecibo Observatory.

In my vision, it does fit the possibility of future students pursuing their careers in sciences, and since maybe in our high schools, they do not provide enough information or tools for students to elaborate in sciences, it is wonderful to see how these students flourish in the Arecibo Observatory, because the Arecibo Observatory is not only for the students in Puerto Rico, it is also for the Caribbean, for Latin America, for all of them.

What we need is to develop more scientists, more scientists of the

stature of Luisa and the scientists that we have here. Scientists is what we need the most.

MS. ALMODOVAR: Thank you. Next person, Wilbert Ruperto.

MR. RUPERTO: Good morning, ladies and gentlemen. My name is Wilbert Andres Roberto Hernández, and I am 16 years old. I am an Arecibo Observatory Space Academy spring 2015 semester alumni, and I currently work at this institution as a teacher's assistant. This is a precollege research program for high school students in Puerto Rico. My participation in this program began in January 2015, and my life has not been the same since then.

Let me tell you a bit of backstory about myself. Ever since I was a small child, I dreamt of becoming an astronaut. And as I grew older, I grew fond of science and space through school classes

and some other medias for information, such as the Internet. However, I was missing a very important part in my journey to become an astronaut, and it was hands-on research experience and understanding of the scientific method.

AOSA, the Arecibo Observatory Space Academy, represented the opportunity to gain that knowledge and experience and also help me decide on what I would study in college.

Once I was accepted in the academy, I noticed how I began evolving as both an individual and a team member through the acquirements of new skills such as scientific research planning and execution and data analysis and the refinement of many others, such as public speaking and interaction using English as a second language and teamwork. In addition, I

developed a higher sense of respect and responsibility towards myself, my peers, and science as a branch of study.

As I continued in the program, I also got to meet many people, including scientists and fellow space geeks, whom all contributed in some way or another to my increasing affection towards the Arecibo Observatory.

I consider every Saturday spent at AO, Arecibo Observatory, as a privilege and an honor that inspired me even more to pursue my path to the stars.

Even though after I finished my research and presented it and obtained my graduation diploma from this academy, I felt that I wasn’t done. I felt I wanted to do more and went and applied once again to this academy and to which I was later reaccepted as a teacher’s assistant. Since then, I have

grown and met even more amazing people while working in this position. I can even say that I have found a second family and a second home at Arecibo.

Today, I can say that every moment spent at AO has impacted my life in a great manner, a true life-changing experience, and I am eternally grateful to everyone who helped make it so.

With the closing of the observatory, I would be losing my second home and one of my favorite places in the world. But what worries me the most is the fact that closing the observatory will be also closing a door to many hopeful teenagers that see the facility and the space academy as an alternative and an additional learning system and even a definitive path to reaching their professional goals. I want the observatory to keep inspiring

people, like us, the AOSA alumni, to study a career in any of the STEM branches and together build a better future where human advancement is greater.

I call upon you, distinguished members of the NSF and other agencies and institutions, to take into consideration the impact the Arecibo Observatory has on the Puerto Rican youth and population in overall. Thanks.

MS. ALMODOVAR: Miguel Sarriera.

MR. SARRIERA: Good morning. My name is Miguel Sarriera. I am a resident of the town of Quebradillas in the northern coast of Puerto Rico, and I frequently use and enjoy the scenery on the surrounding natural areas to the Arecibo Observatory.

In the year 1960, specifically on June 14th, The Government of Puerto Rico enacted Law No. 88.

That law was designed to promote and protect the establishment and operations of the Arecibo radio observatory.

To do that, it included several prohibitions about activities within a radius of four miles to the Arecibo Observatory. Those prohibitions included the construction and operation of transmission and distribution -- high voltage transmission and distribution lines, AM, FM and TV transmitters, and the operation of a wide array of electric appliances and systems.

As a result of those prohibitions, development within this radius has been extremely limited. As an indirect consequence of those prohibitions, we have an exuberant and incredibly beautiful natural area and a very important example of the ecology of the northern Kársticas region in

Puerto Rico. We are talking here about a total of 32,172 acres.

This is a scoping meeting for the development or the -- yes, development of an environmental impact statement. My request to the NSF is that this document should include a section studying the environmental impact of other alternatives that represent a cessation of the operation of the observatory in relation to these prohibitions. Because if there is no observatory, these prohibitions are irrelevant, and the indirect environmental benefits that they currently represent will be no longer available and that will have an environmental impact. And that will be my request.

MS. BLANCO: Thank you.

MS. ALMODOVAR: We have one more person signed up. Carla Colón.

MS. COLÓN: Good morning. I am

small. Well, I have seen that between all of you grown people and a lot of big titles and all of that, I am just a little girl. But just like you, the Arecibo Observatory Space Academy inspired me and gave me love to science.

My speech will be like really short. But I just want to say that -- encourage you just to not change our hopes. You know, the educational system of Puerto Rico, it doesn't give that much emphasis to science. The observatory gives us hope. It gives us hope and gives us desire for more. So, please, keep it just -- keep an open mind for us.

MS. BLANCO: Thank you.

MS. ALMODOVAR: So we have already gone through everyone who wrote themselves down, and she has asked me for a chance, and you will have another chance. Okay.

MS. MARTORELL: (Speaking in

Spanish) Good morning. My name is Deborah Martorell. I am a meteorologist and science reporter for WAPA TV. I worked in WAPA TV for 22 years, and I have had a journalism career for 30 years.

I am here dealing with the coverage of the hearing. I do not usually intervene or give my input in settings like this, especially because of the coverage, but I have an obligation as a citizen and as a witness of the Arecibo telescope to give my opinion.

For years I have been in charge of the work that the Arecibo Observatory does in terms of the meteorology and also in the educational aspect. It is a very special place for Puerto Rico, not only for its historical value, but also for its scientific value that it has for the people. I am also witness to its scientific value and also to a day like today, meteor of

an asteroid that is passing by at a 100,000 miles right now that is being observed at the Arecibo Observatory.

It is very important for us to save the Arecibo Observatory. Puerto Rico is going through a very serious economic situation which is directly affecting the educational part. I have been a witness to how there is no money to even tend to children of special education. I have been a witness to how the Arecibo Observatory has been -- is an important place in promoting that study of sciences and education as in the space academy.

I do hope you take this in consideration when you deal with the alternatives for the Arecibo Observatory, because it is a very valuable piece of education and science for Puerto Rico.

Thank you.

MS. BLANCO: Thank you.

MS. LÓPEZ: Good morning. My name is Adriana López. I am 14 years old. And I was an alumni of the fall class of 2015. And I can say that Arecibo Observatory Space Academy has had certainly a great effect and has had a great impact on my life.

Always in my life I have been fascinated with space, and it has led me to join several camps, but none of them affected me like AOSA. This academy provided me with skills not even my own academic institution did. I learned and experienced how to truly work in team, keep track of my work, and even organize my own journal.

This has even led for my own study method to be formed. And for example, while I was in school, I was rather bored, but once I joined AOSA, I was full of things, and I had to organize myself. One of the requirements was to even create

your own research project, and that was extremely hard. So I can certainly say that the impact and the amount of things I just learned because of AOSA is monumental and can greatly affect any teenager that truly puts their mind to it.

So with this I end that I am considering becoming a teacher's assistant next semester if the Arecibo Observatory is still open.

Thank you very much.

MS. BLANCO: Thank you.

MS. ALMODOVAR: We have one more comment.

MS. COLÓN: Thank you very much. My name is Hilda Colón, and I wanted just to add two or three aspects to what has already been said.

One of them is that I received a request from the Ángel Ramos Foundation president because he wants to let you all know that the foundation is very interested in

participating in this and that they will be submitting a written opinion with a written document by June -- earlier than June 23rd. Just for the record.

On the other hand, I cannot tell you how impressed I am with the participation of the students and everybody here. And I also want to add that the experience with the undergraduates as well as graduate students at the Arecibo Observatory is just as impacting as what you have just recently heard.

Now, we are also looking at another factor as a faculty member in Puerto Rico, and that’s the special education area. And that’s another area in which we intend to participate very soon in an organized way using the science of the Arecibo Observatory as the means.

So at this point I think I am going to stop because you know the

rest of the story of what I was going to say. Thank you very much for your attention.

MS. BLANCO: Thank you. Is there anybody left who would still -- would like to speak who hasn't had a chance to do so?

We will ask people who haven't yet spoken first and then we will go back to anyone still left.

MR. LUGO: So I am Ramon Lugo from the University of Central Florida.

So two questions. You don't really describe the review process with respect to externals like Congress and the Office of Science and Technology policy.

And then, finally, also, are you having a group of external consultants review your contractor's work? In NASA, when we do environmental impact statements, we always bring in external stakeholders and experts

to review the contractor's work before the final decision is made. So are you doing that as well?

MS. BLANCO: The first question you asked with regard to external reviews by other agencies and Congress, that is not part of the environmental impact statement process under the National Environmental Policy Act. However, there are other federal agencies, Congress. This is an open process.

MR. LUGO: Right.

MS. BLANCO: We noticed this process in the Federal Register. So, therefore, any federal agency or congress or any member of the public who wishes to comment may do so.

The second question you asked was with regard to contractor oversight. NSF is fortunate to have the contracting services of CH2M Hill to help support NSF in this process. However, NSF is

ultimately responsible for this process and conducts very careful oversight. And NSF is here today, and we will be here again when the draft environmental impact statement comment period commences, and we are taking the lead role throughout this process. Thank you.

Other people who haven't yet spoken?

Okay. Then I would like to offer the opportunity to continue speaking if you wish.

MR. ISHAM: Brett Isham from Interamerican University, electrical and computer engineering.

I just wanted to mention some of our projects that we have that are related to Arecibo Observatory.

On the Aguadilla campus of Interamerican University, we are in the process of constructing a high-frequency array of radio

antennas. We also have a -- we are a lead institution on a Puerto Rico CubeSat project which also has a high-frequency radio instrument on board. Both of these projects have direct ties to Arecibo Observatory because they will be used in joint observations of the atmosphere and with the high-frequency atmospheric modification facility at Arecibo. And one of the primary motivations, also, of both projects is undergraduate student participation.

I also wanted to mention because some -- there are other institutions whose representatives are not here that have projects related to Arecibo. University of Colorado has an HF radar in Cayey. So that is -- also contributes to joint observations with Arecibo and will with our Interamerican project as well.

Cornell University has

30-megahertz radio on St. Croix which is used jointly with Arecibo.

Johns Hopkins has radio receivers on Culebra, which I have been collaborating with this week with Arecibo high-frequency ED (phonetic) campaign observations.

And Oberlin College is a collaborator on the NANOGrav project, and they have -- I know Dan Steinberg there, who is professor of astronomy and physics, and has many students working on Arecibo data.

More generally, I wanted to mention briefly a couple of impressions I had. When Arecibo started operating in the early 1960s, there were a series of papers about new observations within the incoherent scattered radar. It has struck me profoundly recently that the latest observations with Arecibo are

comparable in their novelty and new capabilities with the -- in the area of incoherent scatter, for example, the new receiving systems allow observations of plasma lines out to 1,000 kilometers. In contrast, past observations in the ’60s were just very limited in their range.

And so that’s just one example. There is other -- gyro lines now can be routinely observed. And these full -- observations to the full atmosphere of the incoherent scatter spectrum can be observed 24 hours a day, which is a new capability only in the past couple of years.

Since you were answering questions, I was just curious if NSF does fact check those reports such as the Ford-Colley review and other reports.

MS. BLANCO: That is something that is outside of the

environmental review process. I personally couldn't answer that question for you. I can say that those processes are very well vetted, though.

MR. ISHAM: Thank you.

MR. ZHOU: Can I still ask a clarifying question? I would like to know whether the EIS is going to drive the decision on the alternatives or should the alternatives drive on the EIS.

MS. BLANCO: The alternatives -- I will answer this briefly because we are out of time. The alternatives -- this stage addresses -- let me start again.

This stage only addresses the alternatives, and that is the basis for the process, because after this point, we will refine the alternatives and then look at the environmental impacts of those alternatives. So this is the stage where if there is public input on

different alternatives or refinement of these preliminary alternatives, this is the time to voice that -- those comments.

MR. ZHOU: So there will be five different EIS depending on the five alternatives?

MS. BLANCO: These are at this point conceptual alternatives. They haven't been refined yet because this public process is still open. And when the public comment period closes on June 23rd, we will take another look to see if refinement is appropriate.

So thank you, everybody, very much for participating, and I do encourage you, if you have more comments, to please submit them by email or by U.S. mail by June 23rd, which is the deadline for receiving public comment on the record.

And please make sure, if you haven't already, to pick up the handout, which has information on

how to keep up with this process and gives a description of the basic timeline and also the proposed action and alternatives.

And one important thing I do want to mention, on this handout, it refers to Section 106, and Section 106 is part of the National Historic Preservation Act, and it is a process where we work with people who are interested, called consulting parties, and with the State Historic Preservation Office in Puerto Rico to look at potential effects, adverse or otherwise, to the proposed alternatives. And if there are adverse effects, we work with the consulting parties on ways to avoid, minimize or mitigate those effects.

So if you are interested in becoming a consulting party, please make sure that you check that box on the sign-in sheet. And if you find that you did put your name on

the sign-in sheet but you are not getting information through this process, it may be that we couldn’t read the information on it, so please contact us.

Thank you very much.

(The proceeding adjourned at 11:37 a.m.)

REPORTER'S CERTIFICATE

I, DEREK L. HOAGLAND, Certified Shorthand Reporter #13445, State of California, do hereby certify that the foregoing is a true and correct transcript of the proceedings had in the within-entitled and numbered cause on the date hereinbefore set forth; and I do further certify that the foregoing transcript has been prepared under my direction.

_____
DEREK L. HOAGLAND

5-C Scoping Materials

National Science Foundation

Environmental Impact Statement and Section 106 Consultation for Proposed Changes to Arecibo Observatory Operations

Arecibo, Puerto Rico

Overview:

The National Environmental Policy Act requires federal agencies to conduct an environmental review to assess the potential environmental impacts of federal actions that could significantly affect the environment.

Section 106 of the National Historic Preservation Act requires federal agencies to consult with interested parties and the State Historic Preservation Officer regarding potential effects of their proposed actions on significant historic properties, such as the Arecibo Observatory.

The purpose of the public scoping process is to determine relevant issues that will influence the scope of the environmental analysis, including identification of viable alternatives. Additional opportunities for public participation will be available throughout the process.

Project Timeline Schedule for Public Involvement:

- **Scoping Comment Period:** May 24-June 23, 2016
- **Draft EIS target release:** Late Fall 2016
  - *45-Day Comment Period on Draft EIS*
  - *Public meetings on Draft EIS*
- **Final EIS target release:** Spring 2017
- **Record of Decision target release:** Summer 2017

Submit Comments:

You may submit comments by either of the following methods:

Email to: envcomp-AST@nsf.gov, with subject line "Arecibo Observatory"

Mail to: Ms. Elizabeth Pentecost,
RE: Arecibo Observatory
National Science Foundation,
Suite 1045 4201 Wilson Blvd
Arlington, VA 22230

Project information will be posted, throughout the EIS process, at www.nsf.gov/AST.

ENOS2016ITSATL_NSF_ARECIBO_BOARD.1

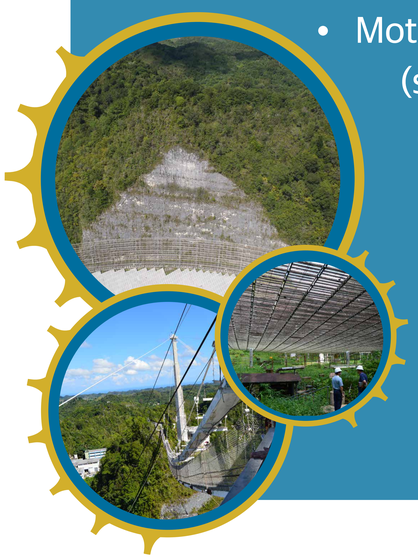
National Science Foundation

Environmental Impact Statement and Section 106 Consultation for Proposed Changes to Arecibo Observatory Operations

Arecibo, Puerto Rico

Alternatives to be evaluated in the EIS will be refined through continued public input. Preliminary alternatives include the following:

- Continued NSF investment for science-focused operations (No-Action Alternative)
- Collaboration with interested parties for continued science-focused operations
- Collaboration with interested parties for transition to education-focused operations
- Mothballing of facilities (suspension of operations in a manner such that operations could resume efficiently at some future date)
- Deconstruction and site restoration



Potential Resources to be considered:

An impact is a change or consequence that results from a proposed activity; it can be positive, negative or both. It may be mitigated to lessen or remove the impact. At present, NSF has preliminarily identified the following resource areas for analysis of potential impacts:

air quality

geological resources

biological resources

solid waste generation

health and safety

socioeconomics

traffic

cultural resources

groundwater resources

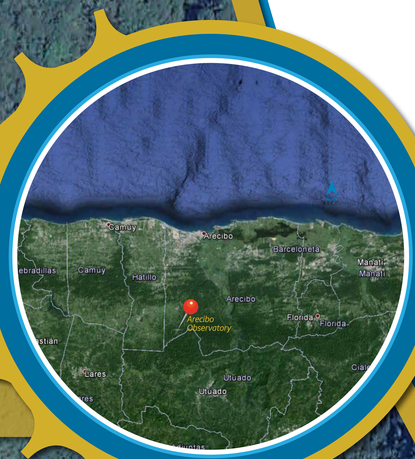
Section 106 Process for the Arecibo Observatory:

In coordination with the EIS, NSF will consult with the State Historic Preservation Officer and other consulting parties on potential effects to historic properties located within the Area of Potential Effects (APE).

- NSF proposes that the APE encompass the full Arecibo Observatory property.
- Arecibo Observatory (as the "National Astronomy and Ionosphere Center") is listed in National Register of Historic Places as a historic district that is significant in the areas of science, engineering, and education.
- Consultation would be focused on identifying potential effects and any measures to avoid, minimize, and/or mitigate adverse effects; in the case of adverse effects, a Memorandum of Agreement may be used to formalize such measures.

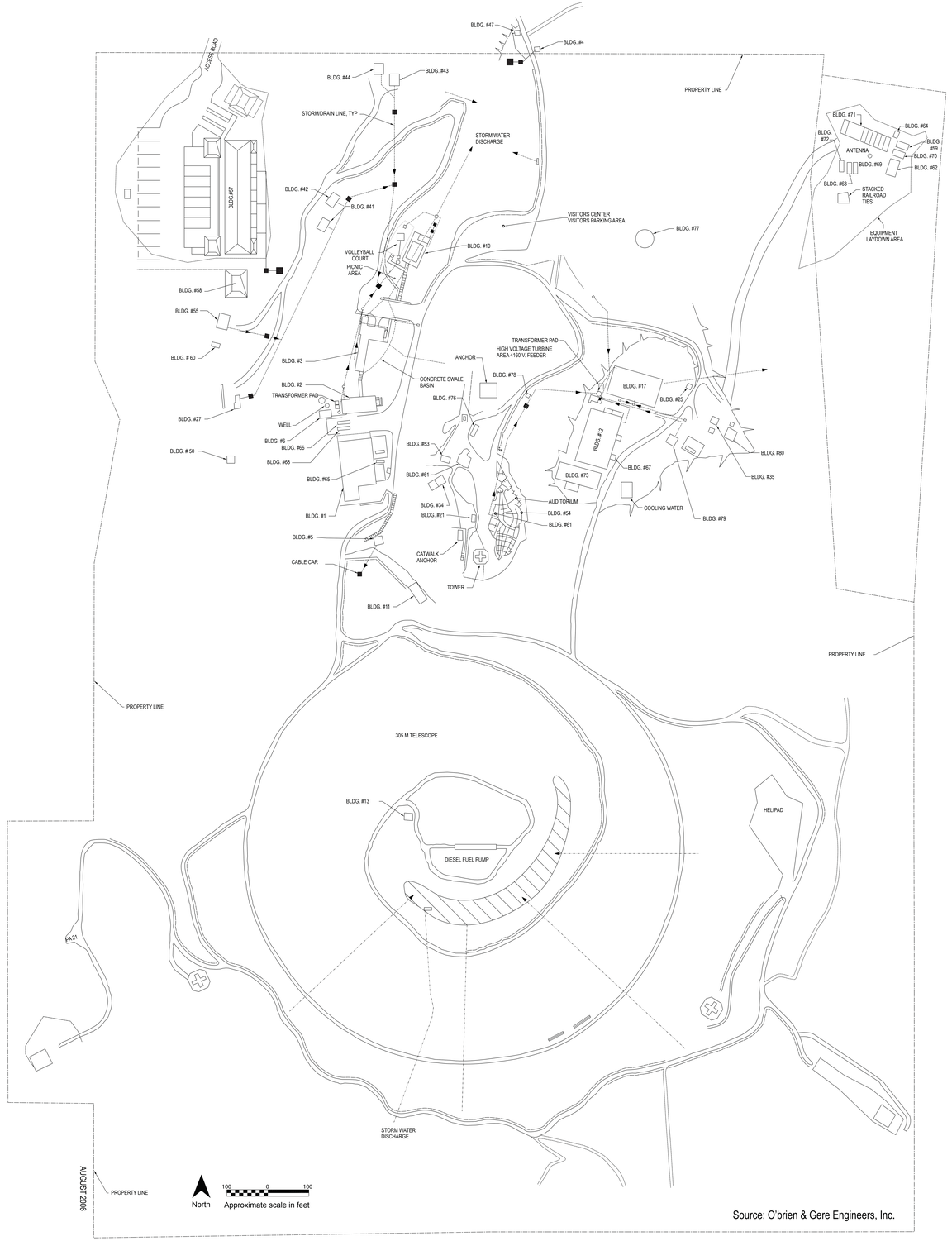
Environmental Impact Statement and Section 106 Consultation for Proposed Changes to Arecibo Observatory Operations

Site Plan



Arecibo, Puerto Rico

Arecibo is a municipality on the northern coast of Puerto Rico, on the shores of the Atlantic Ocean, located north of Utuado and Ciales; east of Hatillo; and west of Barceloneta and Florida. It is about 50 miles west of San Juan, the capital city.



Source: O'brien & Gere Engineers, Inc.

BUILDING NO. DESCRIPTION

1. OPERATIONS BUILDING
2. ADMINISTRATION BUILDING
3. VISITING SCIENTIST QUARTERS AND CAFETERIA
4. ENTRANCE GUARD HOUSE
5. CABLE CAR HOUSE
6. PUMP HOUSE/WATER TREATMENT BLDG.
10. SWIMMING POOL/RESTROOMS
11. LEWIS BUILDING–RIGGING LOFT
12. MAINTENANCE SHOPS
13. BOWL SHACK
17. WAREHOUSE
21. ANTENNA TESTING RANGE
25. PAINT STORAGE BUILDING
27. OPTICAL LABS
34. HIGH VOLTAGE POWER SUPPLY BLDG.
35. CUMMINGS GENERATOR CONTROL BLDG.
41. WEST HILL V.S.Q. BACHELOR UNIT NO. 1
42. WEST HILL V.S.Q. BACHELOR UNIT NO. 2
43. WEST HILL V.S.Q. FAMILY UNIT NO. 1
44. WEST HILL V.S.Q. FAMILY UNIT NO. 2
47. MAIN GATE RESTROOM
50. INTERFERENCE MONITORING SHACK
51. GREASE PIT
53. EMERGENCY GENERATOR BLDG.
54. VISITOR CENTER BLDG.
55. LIDAR LABORATORY BLDG.
57. NORTH V.S.Q. BLDG.
58. NORTH V.S.Q. UTILITY BLDG.
59. VISITOR CENTER TRAILER
60. ANT. RECE. TESTING BLDG.
61. LEARNING CENTER
62. HFF STORAGE TRAILER
63. IONOSONDE TRAILER
64. ELECTRONIC TRAILER
65. SHIELDED TRAILER
66. ATMOSPHERIC SCIENCE TRAILER
67. CRYOGENICS LAB TRAILER
68. SCIENTIFIC OFFICES TRAILER
69. ELECTRONIC TRAILER (WAVEGUIDE)
70. COMPUTER TRAILER
71. ELECTRONICS CABLE TRAILER
72. ELECTRONIC TRAILER (CRYOGENICS)
73. HF TRANSMITTER BUILDING
76. INSPIRATION FOR SCIENCE TRAILER
77. PHASE REFERENCE ANTENNA (12M)
78. COFFEE HUT
79. ENGINEERING OFFICE BUILDING
80. CUMMINGS DIESEL GENERATOR BUILDING

Scoping Meeting/
Reunión de Definición de Alcance

Daytime: Doubletree by Hilton, San Juan, 9:30-11:30 AM
Evening: College of Engineers and Land Surveyors, Arecibo, 6:00-8:00 PM

Arecibo Observatory Environmental Impact Statement (EIS) Scoping Meeting: *Overview*

- Introduction of team members
- Presentación de los miembros del equipo

- Background information
- Información de trasfondo

- The proposed preliminary alternatives and resource areas to be studied
- Las alternativas preliminares propuestas y las áreas de recurso a ser estudiadas

- The EIS process
- El proceso de la Declaración de Impacto Ambiental (DIA)

- Public Comments
- Comentarios del Público

06/07/2016 Arecibo EIS Scoping Meetings 2

Background/ Trasfondo
(1)

- The National Science Foundation (NSF) is the federal steward for ground based astronomy and space and atmospheric science.
- La Fundación Nacional de la Ciencia (NSF, por sus siglas en inglés) es la representante federal para la astronomía y la ciencia del espacio y atmosférica con base en tierra.

- NSF provides funding for national and international telescopes and facilities and provides funding for research grants that allow individuals and groups to conduct specific science investigations.
- NSF provee fondos para los telescopios y las instalaciones nacionales e internacionales y provee fondos para becas de investigación que permiten que individuos y grupos realicen investigaciones científicas específicas.

Background/ Trasfondo
(2)

- In fiscal year (FY) 2016, NSF is providing $8.2M to Arecibo Observatory.
- En el año fiscal (FY, por sus siglas en inglés) 2016, la NSF está proveyendo $8.2 millones al Observatorio de Arecibo.

- NSF funding for Arecibo Observatory is equally divided between the NSF Division of Astronomical Sciences (AST) and the NSF Division of Atmospheric and Geospace Sciences (AGS).
- Los fondos que otorga NSF para el Observatorio de Arecibo se dividen en partes iguales entre la División de Ciencias Astronómicas de NSF (AST, por sus siglas en inglés), y la División de las Ciencias Atmosféricas y Geoespaciales de NSF (AGS, por sus siglas en inglés)

- In FY 2016 the Planetary Science Division of NASA is providing $3.7M funding to Arecibo Observatory.
- En FY 2016, la División de Ciencia Planetaria de la NASA está proveyendo $3.7 millones en fondos para el Observatorio de Arecibo.

Background/ Trasfondo
(3)

- Over the past decade NSF has received advice from external review committees stating that NSF will need to reduce or cease support of some existing telescopes and facilities to allow for (1) construction and operation of new telescopes, facilities, and instruments, (2) continued funding for research grants that enable individual science investigations.

- A través de la década pasada la NSF ha recibido consejo de parte de comités de revisión externos que indican que el NSF va a necesitar reducir o cesar el apoyo a algunos telescopios e instalaciones existentes para permitir (1) la construcción y operación de nuevos telescopios, instalaciones e instrumentos, (2) continuar proveyendo fondos para becas de investigación que permiten investigaciones científicas individuales.

Background/ Trasfondo
(4)

- With regards to the Arecibo Observatory:
  - The 2012 report: *Advancing Astronomy in the Coming Decade: Opportunities and Challenges* stated:

    "AST should reevaluate its participation in Arecibo and SOAR later in the decade in light of the science opportunities and budget forecasts at that time. If funding remains tight later in the decade, then the scientific need for continued AST funding for Arecibo and SOAR must be weighed against the needs in the grants programs."
- Con respecto al Observatorio de Arecibo:
  - El informe de 2012 titulado: *"Advancing Astronomy in the Coming Decade: Opportunities and Challenges"*, indicó:

    "El AST debe reevaluar su participación en Arecibo y SOAR más tarde en la década a la luz de las oportunidades de ciencia y las proyecciones de presupuesto en ese momento. Si el presupuesto sigue ajustado mas tarde en la década, entonces la necesidad científica para la otorgación de fondos de parte del AST a Arecibo y SOAR deben ser evaluados contra las necesidades de los programas de propuestas."

Background/ Trasfondo
(4) (Continued)

- With regards to the Arecibo Observatory (Continued):
  - The 2016 report: *Investments in Critical Capabilities for Geospace Science 2016 to 2025* stated:

    "The GS should reduce its M&O [Management and Operations] support for the Arecibo Observatory (AO) to $1.1M by 2020, i.e., to a proportional pro rata level approximately commensurate with its fractional NSF GS proposal pressure and usage for frontier research." (This compares to a current support level of $4.1 million annually from AGS.)
  - El informe de 2016 titulado: Investments in Critical Capabilities for Geospace Science 2016 to 2025, indicó:

    "El GS debe reducir su apoyo al Manejo y Operaciones (M&O, por sus siglas en inglés) del Observatorio de Arecibo (AO, por sus siglas en inglés) a $1.1 millones para el año 2020, i.e., a un nivel de razón proporcional aproximadamente conmensurado con la fracción de presión de propuestas de GS de NSF y su uso para investigación de desarrollo innovador." (Esto se compara con un nivel de apoyo actual de $4.1 millones de AGS.)

Background/ Trasfondo
(5)

- Given previous community recommendations combined with current budget constraints, NSF has a need to reduce funding levels for a number of its astronomical and geospace science telescopes and facilities.

- Dadas las previas recomendaciones de la comunidad en combinación con las actuales limitaciones de presupuesto, la NSF tiene una necesidad de reducir los niveles de fondos para una cantidad de sus telescopios e instalaciones astronómicas y geoespaciales.

Background/ Trasfondo

(6)

- The purpose of the Arecibo Observatory EIS is to evaluate the environmental impacts of the alternatives addressing the need to change operations at Arecibo Observatory.
- El propósito de la DIA para el Observatorio de Arecibo es evaluar los impactos ambientales de las alternativas que atienden la necesidad del cambio a las operaciones en el Observatorio de Arecibo.

EIS: Alternatives and Resource Areas/ DIA: Alternativas y Áreas de Recursos

(1)

Preliminary Alternatives for Study

- Continued NSF investment for science-focused operations (No-Action Alternative)
- Collaboration with interested parties for continued science-focused operations
- Collaboration with interested parties for transition to education-focused operations
- Mothballing of facilities (suspension of operations in a manner such that operations could resume efficiently at some future date)
- Deconstruction and site restoration

Alternativas Preliminares para Estudio

- Inversión continua de parte de la Fundación Nacional de Ciencias (NSF, por sus siglas en inglés) para operaciones enfocadas en ciencia (Alternativa De No Acción)
- Colaboración con grupos o entidades interesados en continuar las operaciones enfocadas en la ciencia
- Colaboración con grupos o entidades interesados para una transición de las operaciones a unas con enfoque a la educación
- Suspensión de actividad en las facilidades (suspensión de las operaciones de una manera que las operaciones se puedan continuar eficientemente en una fecha futura)
- Deconstrucción y restauración del sitio

EIS: Alternatives and Resource Areas/ DIA: Alternativas y Áreas de Recursos (2)

Preliminary List of Resources to be analyzed during the EIS

- Air quality, biological resources, cultural resources, geological resources, solid waste generation, health and safety, socioeconomics, traffic, groundwater resources.

Lista Preliminar de Recursos a ser analizados durante la DIA

- Calidad de aire, recursos biológicos, recursos culturales, recursos geológicos, generación de desperdicios sólidos, salud y seguridad, socio economía, tránsito vehicular, recursos de aguas subterráneas.

EIS: Alternatives and Resource Areas/ DIA: Alternativas y Áreas de Recursos (3)

- The EIS is a public process, and comments received during the public comment periods will be considered by NSF as part of its decision-making process.
- La DIA es un proceso público, y los comentarios recibidos durante los períodos de comentario público serán considerados por la NSF como parte de su proceso de toma de decisiones.
- No decisions have been made!
- ¡No se han tomado decisiones!

5-D Comment Matrix

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
1	Michael K	Shepard	Bloomsburg University of PA	Using the S-band radar at Arecibo Observatory, we observed 16 Psyche, the largest M-class (metallic) asteroid in the main belt and a potential spacecraft target. We obtained 18 radar imaging and 6 continuous wave runs in November and December 2015, and combined these with 16 Arecibo observations in 2005 and 6 recent adaptive-optics (AO) images [Conrad et al. 2016] to generate a three-dimensional shape model of Psyche. We find Psyche to be roughly ellipsoidal with dimensions 279 x 232 x 189 km. Our radar measurements are consistent with a metal (iron-nickel) object and 40% bulk porosity. Our radar images show at least two large crater-like depressions. The Arecibo images were absolutely essential for the generation of the shape model. The results and the shape model are currently being used by JPL scientists as they submit their Phase 2 Discovery Mission proposal, “Psyche: Journey to a Metal World.” Authors Michael K. Shepard, Bloomsburg University, 400 E. Second St., Bloomsburg, PA 17815, USA James Richardson, Patrick A. Taylor, Linda A. Rodrigues-Ford, Arecibo Observatory, USRA Arecibo, PR 00612, USA and 18 additional coauthors.	Against Closure	Email	5/26/2016	
2	Tracy	Becker	Southwest Research Institute	Please find details below regarding the Becker et al., 2015 publication in Icarus using radar observations made at the Arecibo Observatory (attached or doi:10.1016/j.icarus.2014.10.048) : Title: Physical modeling of triple near-Earth Asteroid (153591) 2001 SN263 from radar and optical light curve observations Author list: Tracy M. Becker, Ellen S. Howell, Michael C. Nolan, Christopher Magri, Petr Pravec, Patrick A. Taylor, Julian Oey, David Higgins, Jozef Világi, Leonard Kornoš, Adrián Galád, Štefan Gajdoš, Ninel M. Gaftonyuk, Yurij N. Krugly, Igor E. Molotov, Michael D. Hicks, Albino Carbognani, Brian D. Warner, Frederic Vachier, Franck Marchis, Joseph T. Pollock Abstract: On February 12, 2008, radar observations conducted at the Arecibo Observatory revealed that Asteroid (153591) 2001 SN263 had two small satellites, making it the first-known triple near-Earth asteroid (NEA) system. In this work, we used the delay-Doppler images observed at Arecibo, supplemented by visible light curve data obtained from 8 observatories across the globe, to produce 3-D shape models of the three components of the asteroid 2001 SN263. The models place limits on the size, density, rotation period and the pole direction of the three bodies in the asteroid system. These physical properties help to constrain formation mechanisms and the evolution of binary and ternary systems. Radar observations, like those from Arecibo, are required for observing and reproducing the high-resolution structure of asteroids, short of sending a spacecraft. The resulting shape models provide strong constraints on the asteroids’ density and internal structure, essential characteristics for understanding the near-Earth asteroid population. On a personal note, I began this research as an REU student at the Arecibo Observatory in 2008. The experience inspired me to pursue research in planetary science and I was awarded my doctorate in the field in May of this year.	Against Closure	Email	5/27/2016	Becker_2001SN263.pdf
3	Yuri Y.	Kovalev		RadioAstron Observations of the Quasar 3C273: A Challenge to the Brightness Temperature Limit Kovalev, Y. Y.; Kardashev, N. S.; Kellermann, K. I.; Lobanov, A. P.; Johnson, M. D.; Gurvits, L. I.; Voitsik, P. A.; Zensus, J. A.; Anderson, J. M.; Bach, U.; Jauncey, D. L.; Ghigo, F.; Ghosh, T.; Kraus, A.; Kovalev, Yu. A.; Lisakov, M. M.; Petrov, L. Yu.; Romney, J. D.; Salter, C. J.; Sokolovsky, K. V. Inverse Compton cooling limits the brightness temperature of the radiating plasma to a maximum of 10^11.5 K. Relativistic boosting can increase its observed value, but apparent brightness temperatures much in excess of 10^13 K are inaccessible using ground-based very long baseline interferometry (VLBI) at any wavelength. We present observations of the quasar 3C 273, made with the space VLBI mission RadioAstron on baselines up to 171,000 km, which directly reveal the presence of angular structure as small as 26 muas (2.7 light months) and brightness temperature in excess of 1013 K. These measurements challenge our understanding of the non-thermal continuum emission in the vicinity of supermassive black holes and require a much higher Doppler factor than what is determined from jet apparent kinematics. http://adsabs.harvard.edu/abs/2016ApJ...820L...9K	Against Closure	Email	5/28/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
4	Yuri Y.	Kovalev		Extreme Brightness Temperatures and Refractive Substructure in 3C273 with RadioAstron Johnson, Michael D.; Kovalev, Yuri Y.; Gwinn, Carl R.; Gurvits, Leonid I.; Narayan, Ramesh; Macquart, Jean-Pierre; Jauncey, David L.; Voitsik, Peter A.; Anderson, James M.; Sokolovsky, Kirill V.; Lisakov, Mikhail M. Earth-space interferometry with RadioAstron provides the highest direct angular resolution ever achieved in astronomy at any wavelength. RadioAstron detections of the classic quasar 3C 273 on interferometric baselines up to 171,000 km suggest brightness temperatures exceeding expected limits from the "inverse-Compton catastrophe" by two orders of magnitude. We show that at 18 cm, these estimates most likely arise from refractive substructure introduced by scattering in the interstellar medium. We use the scattering properties to estimate an intrinsic brightness temperature of 7e12 K, which is consistent with expected theoretical limits, but which is ~15 times lower than estimates that neglect substructure. At 6.2 cm, the substructure influences the measured values appreciably but gives an estimated brightness temperature that is comparable to models that do not account for the substructure. At 1.35 cm, the substructure does not affect the extremely high inferred brightness temperatures, in excess of 10^13 K. We also demonstrate that for a source having a Gaussian surface brightness profile, a single long-baseline estimate of refractive substructure determines an absolute minimum brightness temperature, if the scattering properties along a given line of sight are known, and that this minimum accurately approximates the apparent brightness temperature over a wide range of total flux densities. http://adsabs.harvard.edu/abs/2016ApJ...820L..10J	Against Closure	Email	5/28/2016	
5	Eric	Dahlstorm	International Space Consultants	Thank you for the opportunity to comment on the beginning of the NSF effort on the Environmental Impact Statement (EIS) related to the Arecibo observatory. Although I have not had an opportunity to use the Arecibo observatory, I was trained in radio astronomy before I became a space science and space engineering consultant. I appreciate the severe budget constraints faced by the NSF that have forced a review of the future support of the Arecibo observatory. Currently, the value of the observatory is judged solely by its contribution to the division of astronomical sciences. But I feel the observatory has much more value beyond the astronomical sciences. Here are three other areas where Arecibo makes significant contributions: 1. Arecibo continues to contribute to the search for extraterrestrial intelligence (SETI). This is a highly uncertain effort of course, but the potential value to humanity of a successful detection is immense. 2. Arecibo has also, in the past, been used to test technologies for power beaming from space. The design of space based solar power systems has continued, and the value of Arecibo for this application could be significant. 3. And finally, Arecibo plays an important role in using interplanetary radar to map near-Earth asteroids. The more than 600 asteroids mapped by this technique play an important role in our understanding of how to deal with a potentially threatening asteroid. If any asteroid were discovered to be on a trajectory to impact Earth, Arecibo would immediately be called upon to provide accurate radar mapping. While Arecibo may be judged to contribute insufficiently strictly in astronomical sciences, the telescope may play vital roles in - the development of future energy for humanity; perhaps discovering ETI, the greatest discovery of all time; and it may help protect the very existence of human civilization. If Arecibo did not exist, we would have many reasons to build it. I hope that we can find a way that these other contributions of Arecibo may support the operating budget to maintain the observatory. However, I understand that you are simply asking for comments on the EIS process at this time.	Against Closure	Email	5/30/2016	
6	Eric	Dahlstorm	International Space Consultants	My comment on the EIS process follows: Two of the alternatives - “Mothballing of facilities”, and “Deconstruction and site restoration” - would seem to be the alternatives with significant environmental impacts. I suggest that these alternatives also include an estimate of the environmental impact of *restoring* the observatory to operation. In other words, if an environmental impact is identified for removing hardware from the site, the study should also include (as a separate entry) an estimate of the environmental impact for *returning* the equipment to the site. If, for example, we discover an asteroid on a potentially threatening trajectory, we would immediately send the trucks back up to the observatory to restore Arecibo to full function. Any estimate of the environmental impact of decommissioning should account for the potential need to reactivate the observatory.	Resource Considerations	Email	5/30/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
7	Sarah	Scholes		My name is Sarah Scoles, and I'm a science writer doing a story for Scientific American about the upcoming June 7 meeting at Arecibo Observatory, to begin the environmental impact scoping process. I'd like to get your perspective on this meeting and the whole scoping and decision-making process. I'm at the American Astronomical Society's Solar Physics meeting right now, so a phone meeting might be difficult (as it might be for you, too, since this is short notice), but I'm hoping you can give a comment by email for the article, which I am turning in on Thursday. I'm just wondering • how a potential closing of Arecibo would affect American astronomy, for better, worse, or neutral.	Decision Process	Email	5/31/2016	
8	Sarah	Scholes		My name is Sarah Scoles, and I'm a science writer doing a story for Scientific American about the upcoming June 7 meeting at Arecibo Observatory, to begin the environmental impact scoping process. I'd like to get your perspective on this meeting and the whole scoping and decision-making process. I'm at the American Astronomical Society's Solar Physics meeting right now, so a phone meeting might be difficult (as it might be for you, too, since this is short notice), but I'm hoping you can give a comment by email for the article, which I am turning in on Thursday. I'm just wondering • where in the decision-making process the NSF is (in terms of whether to mothball, change to educational focus, etc.), as well as in the scoping process • and how much response you have received so far to the request for comment.	General	Email	5/31/2016	
9	Frankie	Lucena		I would like to express my opinion regarding the hearing for changes and the environmental impact of the Arecibo Observatory. First I would like to express the importance the observatory is to not only the citizens of Puerto Rico but also to the tourist who come here to visit us from all over the world. I had some friends from the Czech Republic come to Puerto Rico this past January and they were very eager to visit the observatory. Unfortunately it was closed for renovation so they never got to see it but they will return next year and hopefully it will be open. Our economy could use all the help we can get and tourist do want to visit the observatory so please consider this in your decision. I would also like to add that the observatory plays host to many scientist and researchers and when they visit the observatory they too help in contributing to our economy by spending money during their stay here. Professor John Mathews from Penn State University is one of those scientists that uses the observatory for his research and comes here quite often. Their research and discoveries will attract more visitors in the future. Maybe it was their research that lead to Hollywood coming here to film Contact and also a segment of a James Bond movie. The Arecibo Observatory has been seen in many Documentaries and TV specials over the years and this helps generate interest abroad which will lead to tourists wanting to visit there. Please consider all of this while making your decision.	Against Closure	Email	6/2/2016	
10	Frank T.	Djuth	Geospace Research, Inc.	The proposed changes to Arecibo Observatory will be highly detrimental to the education of underprivileged children on the Island of Puerto Rico. The current activities of Arecibo Observatory include more than just scientific research. Approximately 20,000 K-12 students travel to the Arecibo Observatory Visitor Center each year, most of which come from low-income families. The Visitor Center resembles a miniature air and space museum and is inspiring to say the least. Students need such exposure so that they see what higher education brings and how it offers a path to an exciting and productive career. Also Arecibo upgrades the teaching capabilities of high school teachers through STEM learning and conducts a Saturday School Space Academy for local high school students. This essentially gives the students advanced placement. No other observatory worldwide does more to advance the socioeconomic development of the underprivileged. I am convinced that very few people understand what it means for a child to be a member of a poor family when it comes to education. The family tends to have a very limited educational background, and the child is provided little support or encouragement to excel in school. The educational problem that will arise from the proposed Arecibo Observatory changes will be much deeper than even the unemployment disaster of laying off more than one hundred local Puerto Rican residents who work at the Observatory. In the current Puerto Rican economy quality jobs are almost impossible to find.	Against Closure	Email	6/3/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
11	Frank T.	Djuth	Geospace Research, Inc.	The proposed changes to Arecibo Observatory will be highly detrimental to the education of underprivileged children on the Island of Puerto Rico. Academy for local high school students. This essentially gives the students advanced placement. No other observatory worldwide does more to advance the socioeconomic development of the underprivileged. I am convinced that very few people understand what it means for a child to be a member of a poor family when it comes to education. The family tends to have a very limited educational background, and the child is provided little support or encouragement to excel in school. The educational problem that will arise from the proposed Arecibo Observatory changes will be much deeper than even the unemployment disaster of laying off more than one hundred local Puerto Rican residents who work at the Observatory. In the current Puerto Rican economy quality jobs are almost impossible to find.	Against Closure	Email	6/3/2016	
12	Olivia	Keenan		Title: The Arecibo Galaxy Environment Survey X: The Structure of Halo Gas Around M33 Authors: Miss Olivia C. Keenan, Prof. Jon I. Davies, Dr Rhys Taylor and Dr Robert F. Minchin Abstract: Understanding the distribution of gas in and around galaxies is vital for our interpretation of galaxy formation and evolution. As part of the Arecibo Galaxy Environment Survey (AGES) we have observed the neutral hydrogen (HI) gas in and around the nearby Local Group galaxy M33 to a greater depth than previous observations. As part of this project we investigated the absence of optically detected dwarf galaxies in its neighbourhood, which is contrary to predictions of galaxy formation models. We observed 22 discrete clouds, 11 of which were previously undetected and none of which have optically detected counterparts. We find one particularly interesting hydrogen cloud, which has many similar characteristics to hydrogen distributed in the disk of a galaxy. This cloud, if it is at the distance of M33, has a HI mass of around 10^7 Msun and a diameter of 18 kpc, making it larger in size than M33 itself. Paper reference: http://arxiv.org/abs/1511.02710	Against Closure	Email	6/3/2016	
13	Michael	Smith	The University of Kent	The Centre for Astrophysics & Planetary Science at the University of Kent in England collaborates with many research institutes in the United States. Amongst these, the Arecibo Observatory has been very important with two of our doctoral students gaining excellent data and hands-on experience in the last year. It is clear that Arecibo is a great asset for astronomy, both now and in the next twenty years ahead for sure. We must find a way to maintain it and sustain the science output. It has potential to make many significant discoveries in an era where radio astronomy will become increasingly important.	Against Closure	Email	6/4/2016	
14	lyles	joseph		I have some serious concerns regarding the potential of shutting down the Observatory. 1. Lost Data 2 . The information provided from this satellite exceeds all cost. We still even today can't fully grasp the potentially of this data. It's the only one like it and nothings else comes even close in comparison . 3. The cost to shut down out weighs the cost of improving operations. This would cost at least 150 million dollars just to demolish with the potentially of a much higher cost with long term environmental side effects / Cost. 4 Effects of the local economy which is already struggling. Point blank theres always a way and reason. You just have to search for it and quit letting idiots mislead you along the way.	Against Closure	Email	6/6/2016	
15	Robert	McEachen		this is an irreplaceable asset that must be maintained. it is a COST EFFECTIVE investment in our scientific world leadrship	Against Closure	Website	6/6/2016	
16	Harry S.	Pickering	Southern Cross Astronomical Society	I speak in opposition of any proposal to close the National Science Foundation Arecibo Radio Telescope. On a personal note, this scientific instrument helped spark my interest in astronomy when I was a young man in the 1960's. I was fortunate enough to be able to travel and visit the facility and its museum several years ago, a life long dream of mine. In my personal opinion, the 12 million dollar annual budget, if I am correct, in the scope of our Nations astronomical and space science budget is miniscule. The benefits and payoff this telescope has yielded towards the understanding of our universe have been immense and well worth the investment. This radio telescope is instrumental in our Nation's security, as it relates to tracking and studying potential catastrophic asteroids that could cross Earth's orbit. Shutting down this telescope will also set back our Nations research into the study of Pulsars and other space projects. No other Nation in the World can match this radio telescope, in terms of its capabilities, or advancements, or its value. These proposals could not come at a worse time. Our government needs to do what it can to stimulate Puerto Rico's collapsing economy, not contribute to further unemployment and inflation. Not to mention closing the Space Academy at Arecibo, further diminshing the hopes of our youth who aspire to study space science. Thank you for providing me this opportunity for input into the Environmental Impact Study.	Against Closure	Email	6/6/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
17	Glenn	Whiteside		For the Arecibo Observatory operations I would like the NSF to support the following options with the following priorities or a combination of all 3. Mothballing or deconstructing the facilities should not be viable options for this great Nobel-prize winning facility that has made so many wonderful discoveries over the years. 1. Continued NSF investment for science-focused operations (No-Action Alternative) 2. Collaboration with interested parties for continued science-focused operations 3. Collaboration with interested parties for transition to education-focused operations	Against Closure	Website	6/6/2016	
18	Glenn	Whiteside		For the Arecibo Observatory operations I would like the NSF to support the following options with the following priorities or a combination of all 3. Mothballing or deconstructing the facilities should not be viable options for this great Nobel-prize winning facility that has made so many wonderful discoveries over the years. 1. Continued NSF investment for science-focused operations (No-Action Alternative) 2. Collaboration with interested parties for continued science-focused operations 3. Collaboration with interested parties for transition to education-focused operations	Alternative Consideration	Email	6/6/2016	
19	Lydmarie Rivera	Antonetti		Hola,mi nombre Es Lydmarie Rivera Antonetti ,tengo 16 años de edad y soy cadete del AOSA SP16 class del observatorio de Arecibo.Antes de yo entrar a la academia yo no podia hablar muy bien al frente de un publico.Yo tenia miedo de poder expresarme a las personas y nunca creia en mi,pero desde que yo entre al programa,mi vida entera ha sido impactada.He podido hacer cosas que la gente no podia imaginar que yo fuera capaz de hacer,mi confianza en mi ha subido y ahora me interesa la ciencia mas que nunca.A mi dolio mucho saber sobre el peligro que se encuentra el observatorio y yo y mis compañeros hemos decidido luchar hasta el final para que observatorio de Arecibo no cierre.Cosas como esas son las que inspiran los estudiantes a que tengan un amor y una pasion por las ciencias.Yo he sido testigo del efecto positivo que el observatorio de Arecibo ha tenido no solo en los estudiantes de Puerto Rico sino tambien en la poblacion puertorriqueña como tal.Yo hare lo que sea por que el observatorio de Arecibo siga funcionando,por que mi sueño mas grande es poder ver el impacto bien grande que el Observatorio ha tenido con todos nosotros,mas que quiero poder saber seguira impactando las vidas de muchos estudiantes y que su amor por la ciencia y el espacio vaya creciendo.A mi me da una pena saber que el gobierno de Puerto Rico no motiva mucho las ciencias a las escuelas Y de verdad no quisiera que cambiaran y eso y que implanten mas proyectos como estos aqui. Ps:Hay mucho talento en nuestra isla,por favor motiven a los estudiantes a querer aprender y implementen cosas como estas para que su conocimiento se expanda	Against Closure	Email	6/7/2016	
20	Yeshary	Aviles		Apoyo que se mantenga en operación nuestro radiotelescopio	Against Closure	Email	6/7/2016	
21	German	Crespo		Please don't close our Arecibo Radar, it is a heritage to our students and scientific community.	Against Closure	Email	6/7/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
22	Katie	Eckert	UNC	My name is Katie Eckert and I'm a graduate student at UNC. Below the signature, I have provided two abstracts from recent papers I have published using Arecibo data. The abstracts and titles have been simplified from their original forms to remove jargon and I have included links to the actual articles as well. Please let me know if you need any other information. 1. Title: Calibration of a New Gas Mass Estimator with the RESOLVE Survey Authors: Kathleen D. Eckert, Sheila J. Kannappan, David V. Stark, Amanda J. Moffett, Mark A. Norris, Elaine M. Snyder, and Erik A. Hoversten Abstract: We use the REsolved Spectroscopy of a Local VolumE (RESOLVE) survey, a census of stellar, gas, and dynamical mass, to calibrate and test new galaxy gas mass estimators. Our estimators rely on the tight relationship between gas-to-stellar mass ratio and color to predict galaxy gas masses. The new calibrations can be used on the entire galaxy population - from massive galaxies that have small gas reservoirs to small galaxies that are dominated by their gas component. To accomplish this feat we have relied on the Arecibo telescope for sensitive observations of galaxies with the smallest gas reservoirs, key for estimating gas masses for the entire galaxy population. Our tests show that, while the most other calibrations systematically under or overestimate gas masses, our new calibrations perform well and can be used for larger surveys that lack complete gas information. NASA ADS link to the published paper: http://adsabs.harvard.edu/abs/2015ApJ...810..166E 2. Title: RESOLVE and ECO: The Shape of the Galaxy Stellar+Gas Mass Function Authors: Kathleen D. Eckert, Sheila J. Kannappan, David V. Stark, Amanda J. Moffett, Andreas A. Berlind, and Mark A. Norris Abstract: In this work, we present the galaxy mass function, the frequency distribution of galaxies as a function of their mass, for two complete galaxy data sets that probe down to low-mass, gas-rich galaxies. These data sets are the REsolved Spectroscopy of a Local VolumE (RESOLVE) survey and the 40x larger Environmental COntext (ECO) catalog. While previous studies of the galaxy mass function have focused on the mass function using the galaxy mass in stars (stellar mass function), here we construct the mass function using the galaxy mass in stars+gas (stellar+gas mass function). Our gas masses include both new measurements from the Arecibo telescope and estimates using our color-based gas mass estimator whose calibration required Arecibo data. While the stellar mass function flattens at lower galaxy masses, the stellar+gas mass function rises steeply towards low galaxy masses as gas-dominated galaxies become the majority of the population. Thus, including the gas component, whether through direct measurements or estimates, is important for studies of galaxy mass and the galaxy population. NASA ADS link to arXiv version, accepted for publication in ApJ: http://adsabs.harvard.edu/abs/2016arXiv160403957E	Against Closure	Email	6/7/2016	
23	Luz	Fontanez		We hope that the Radar in Arecibo continue open to the públic, the students and to científic community.	Against Closure	Email	6/7/2016	
24	Lilliam	Garcia-Barbon		NO QUEREMOS QUE CIERRE EL RADAR DE ARECIBO PR	Against Closure	Email	6/7/2016	
25	Min-Chang	Lee		This is Prof. Min-Chang Lee sending to you an ~200 word abstract together with a review paper by Lee et al. presented at the Arecibo Observatory 50th Anniversary Symposium in 2013, reporting our 20+ years' experiments at Arecibo Observatory. The Observatory has been proving a unique place for our study of space weather effects caused by whistler wave interactions with ionospheric plasmas and inner radiation belts above Arecibo. These experiments have supported a large number of MIT and BU graduate and undergraduate students for thesis research. We would greatly appreciate NSF's continuing support to the world class facility and research at Arecibo Observatory.	Against Closure	Email	6/7/2016	2016-NSF-A0 rev(Lee).pdf, AO-50th-Anniversary-Symposium-Paper (updated - June-2016).pdf
26	Bin	Lui	The SIGGMA Team	We are a team that has been working on a astronomical survey project with the Arecibo telescope since 2010. Under excellent operation and maintenance from the Arecibo observatory, the telescope is always with its great capabilities, which keeps our project running smoothly and productively. Following is the details of the project. Title of the project: Survey of Ionized Gas in the Galaxy, made with the Arecibo telescope (SIGGMA). List of Authors: Bin Liu, Travis McIntyre, Yervant Terzian, Robert Minchin, Loren Anderson, Edward Churchwell, M. Lebron, and D. Anish Rosh Abstract: A Survey of Ionized Gas in the Galaxy, made with the Arecibo telescope (SIGGMA), uses the Arecibo L-band Feed Array (ALFA) to fully sample the Galactic plane observable with the telescope in radio recombination lines (RRLs). Processed data sets are being produced in the form of data cubes, archived and made public. The survey data will permit a wide range of science, including studies of: (1) H ii regions, planetary nebulae, and novae; (2) the Galactic temperature; (3) the large scale structure of the Milky Way; (4) carbon recombination line emitting regions; and, possibly, (5) the diffuse interstellar medium. With 3.4 arcmin resolution and a super high sensitivity of the telescope, SIGGMA will produce the most sensitive fully sampled RRL survey to date. Attachement: The first paper of the SIGGMA project.	Against Closure	Email	6/7/2016	siggma.2013.aj.146.80.pdf
27	Lourdes E.	Martinez		Saludos, es muy importante mantener esta joya científica para el beneficio de los experimentos e investigaciones internacionales. Apoyo que hagan lo posible por mantenerlo funcionando.	Against Closure	Email	6/7/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
28	Richard Soto	Matos		Please don't close this radar, we are very sad with the possibility of closing notice. For more than 50 years has been a tool of investigation.	Against Closure	Email	6/7/2016	
29	Gery	Mejias	Realty Consultants	Hello: I am sending you my email in support to the Arecibo observatory radar. If it is not obsolete them why closing it. This is a great scientific facilty and very impressive	Against Closure	Email	6/7/2016	
30	Adriana Lorenzo	Meléndez		Apoyo en que se mantenga en operación el Observatorio de Arecibo.	Against Closure	Email	6/7/2016	
31	Andrea Lorenzo	Meléndez		APOYO A QUE SE MANTENGA EN OPERACIÓN NUESTRO RADIOTELESCOPIO DE ARECIBO!!!! 🦾	Against Closure	Email	6/7/2016	
32	Sara	Merced		I write in this way, to benefit the radiotelesscopio of Arecibo, Puerto Rico. I understand that forms a very important part in astronomical studies in the scientific comunity. It is not only important in the investigation, if not a laboratory study and preparation for future scientists in astronomy. Thank you	Against Closure	Email	6/7/2016	
33	Guillermo	Mundo		An icon for astronomy students and an opportunity of superior education.	Against Closure	Email	6/7/2016	
34	Jan	Peña		Apoyo que se mantenga en operación nuestro radiotelescopio	Against Closure	Email	6/7/2016	
35	Hillis	Pratt		Keep the observatory open.	Against Closure	Email	6/7/2016	
36	Rolando	Quiñones		Saludos, Fui profesor del Departamento de Educación, como educador entiendo que sería un error cerrar el radar. Hay que hacer lo que sea para que este monumento no lo cierren.	Against Closure	Email	6/7/2016	
37	Alejandro	Rivera		I write this e-mail giving my full support for the Arecibo radar, the times that I been it was a great experience and also and great adventure	Against Closure	Email	6/7/2016	
38	Lourdes	Rivera		APOYO QUE SE MANTENGA EN OPERACIÓN NUESTRO RADIOTELESCOPIO EN ARECIBO PUERTO RICO	Against Closure	Email	6/7/2016	
39	Faustino R.	Rodriguez		No,no por favor, no pueden cerrar ese telescopio radar, es muy importante para nuestro pais y el Mundo entero, Grasias	Against Closure	Website	6/7/2016	
40	Felix	Rom		Hello as well hear on the news of WAPA America that the Arecibo Observatory possibly close, I had the opportunity to share with my family and was an unforgettable experience and as the end of the same is possible when it is a very important tool for science and then if you close that we were ?. I support 100% the Arecibo Radio Telescope hope not close and if necessary will make a Facebook group No closure Telescope. Thank you!	Against Closure	Email	6/7/2016	
41	Ivette Ruiz	Ruiz	Maestra de Paternidad y Maternidad Responsable Programa de Educación a la Familia y el Consumidor (Economía Doméstica)	En mis años universitarios tuve la oportunidad de visitar éste gran lugar al igual que mi sobrino. Mis humildes ideas: 1. Telemaratón Anual de por vida, que cada ser humano done un dólar o la cantidad que desee. 2. Que el Departamento de Educación de PR ponga como ley o requisito dr graduación la visita de estudiantes y profesores de las disciplinas de ciencias (todas), y las matemáticas. Que ccobren la entrada. Que éstas visitas formen parte de los requisitos de graduación. 3. Que las Ferias Científicas, las preliminares y finales se lleve a cabo el evento desde ese lugar. 4. Que los que trabajan o colaboran en el Observatorio de Arecibo preparen un periódico, revista que la vendan, también que vendan anuncios (comercios) es decir que los comercios, compañías paguen por anunciarse en el periódico, revista del Observatorio. 5.Que el Observatorio de Arecibo hagan una Cumbre en PR, invitando al mundo entero para que conozcan las riquezas de éste lugar. A su vez que preparen especie de internados (temas bien planificados, de interés) para que personas...estudiantes se hospeden en PR, y a través del Observatorio sus facilidades sigan, mejoren sus investigaciones. Que la Compañía de Turismo, el Observatorio hagan Alianza con las diversas líneas aéreas para que en cada asiento esté una promoción del Observatorio para que sea visitado. 6. Que sea compulsorio para los estudiantes de 4.00 puntos de promedio en Física, Biología u otras ciencias, matemáticas; participen de unos campamentos,, o fines de semanas pagados por el DE, Empresas o sus Padres. 7. Preparar un calendario para 2017 12 fotos del Observatorio, venderlo a $10.00. Yo lo compraría. Informar Breve Historia....no ponerla completa porque no van...que deje un interés a la persona que debe visitarlo para que complete (conocer) toda la historia drl lugar. 8. Preparar un sello del Observatorio para los automóbiles y venderlo a $1.00. 9. Que para el año escolar 2016-2017, el Calendario Escolar pongan una foto del Observatorio. 10. Que los estudiantes desde 6xto grado comiencen a visitar el lugar. 11. Que siempre se tome un Registro de Visitantes.	Alternative Consideration	Email	6/7/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
42	David V.	Stark	Kavli Institute for the Physics and Mathematics of Universe (IPMU) University of Tokyo	Below, you will find a short abstract describing a recent project using the Arecibo telescope. The Arecibo observatory was instrumental for this study given its unmatched sensitivity. I would like this project summary to be considered for inclusion in the Draft EIS on the Arecibo observatory. The paper describing these results is currently submitted to the Astrophysical Journal and is undergoing peer review. However, this work has been presented at a number of conferences, including the American Astronomical Society meeting last January (http://adsabs.harvard.edu/abs/2016AAS...22731105S). Please let me know if you would like any further details. Title: The RESOLVE Survey Gas Census and Environmental Influences on Galaxy Gas Content Authors: David V. Stark, Sheila J. Kannappan, Kathleen D. Eckert, Jonathan Florez, Kirsten R. Hall, Linda C. Watson, Erik A. Hoversten, Joseph N. Burchett, David T. Guynn, Ashley D. Baker, Amanda J. Moffett, Andreas A. Berlind, Mark A. Norris, Martha P. Haynes, Riccardo Giovanelli, Adam K. Leroy, D. J. Pisano, Lisa H. Wei, Roberto E. Gonzalez, Victor F. Calderon We present the gas mass inventory for the RESOLVE (REsolved Spectroscopy Of a Local VolumE) galaxy survey. We have obtained estimates of gas mass (or very strong upper limits) for nearly all ~1500 galaxies inside our survey volume, a feat which would not have been possible without the unmatched sensitivity of the Arecibo radio telescope. With this powerful data set, we investigate the influence of environment on galaxy evolution by analyzing the dependence of gas-to-stellar mass ratio on both galaxy group size as well as location within the large-scale structure of the universe. We find that satellite galaxies in Milky-Way sized groups are systematically gas deficient suggesting that mechanisms which have been proposed to drive gas deficiency in large galaxy clusters may be active in significantly smaller groups. Additionally, the mean gas content of galaxies varies significantly in different regions of large-scale structure, even when variations in other galaxy properties (e.g., mass) are accounted for. This finding supports a number of proposed mechanisms through which galaxy gas content is affected by environment on significantly larger scales.	Against Closure	Email	6/7/2016	
43	Zoraida	Torrado		No al cierre del radal Arecibo	Against Closure	Email	6/7/2016	
44	**Olga**	**Vazquez**		I support one of the best observatory and sensitive of the world.	Against Closure	Email	6/7/2016	
45				Buenas.hace mucha falta este recursos para los estudiantes.universitarios...si lw sacan mucho provecho. ..gracias...	Against Closure	Text	6/7/2016	
46	Sael			As a student and a experienced scholar, I think you should not close this observatory.It is a very important place for science and astronomy. It can contribute to the work already done by us. It can help us decipher the unsolved mysteries of space. I hope you take this message into consideration when you are choosing descision and I hope you have magnificent day.	Against Closure	Email	6/7/2016	
47				Apoyo en su totalidad q este Radar se mantenga abierto,hay agenda abierta para estudios científicos en donde se encuentran miles de personas en espera de esos estudios.Hay estudiantes q estudian y contribuyen en las ciencias.Envien fondos pata q se mantenga abierto.Ustedes mismo saben lo importante que es para todos.	Against Closure	Email	6/7/2016	
48	Iris			Por este medio quiero dejarle saber que el cerrar el Observatorio de Arecibo en PR sería viajar al pasado. El observatorio de Arecibo es el más sensitivo del mundo. Como es posible que decida cerrarlo? Por favor!!! Es el mejor y el único del mundo entero. Nooo!! No nos retiren su apoyo. Mi país y yo lo apoyamos.	Against Closure	Email	6/7/2016	
49	Yvette	Aviles		My name is Yvette Irizarry Arecibo Aviles and I do not agree that the Arecibo Observatory , located in the Esperanza neighborhood is closed. It is extremely important that this continue operations as it is frequented by students, engineers, air staff. In this radio telescope, the largest in the world, research is done from the simplest to the most complex. Arecibo is proud to have these facilities open to the public . In addition , it would bring negative consequences , because in that place working parents who are heads of families who have sustenance to their homes.	Against Closure	Email	6/8/2016	
50	Melvin	Bleck		Imposible que lo cierren . Es el telescopio mas sensible del mundo. Y todo el mundo lo usa principalmente Estados Unidos.	Against Closure	Email	6/8/2016	
51	Herbert	Carlson		Approximately 20,000 K-12 students are attracted to the Arecibo Observatory every year, most from low income families. AO also upgrades the teaching capabilities of High School teachers through STEM learning plus has conducted a Saturday Space Academy for local High School students. This socioeconomic development of the under-privileged is not merely the right thing to do, it is investment in the long term growth of one of Puerto Rico's strongest natural resources, its natural brain power waiting to be unleashed on raising more fully to its potential. Loosing this would be a terrible waste of human resource and lost potential economic gain just waiting to be tapped by the Puerto Rican economy.	Against Closure	Email	6/8/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
52	Jose Luis	Escobar		I support here Puerto Rico radar stays in operations since it is very useful for scientists , teachers and students hope that they do not reduce the funds . It would be a shame that we lost a resource as important as it is the radar at Arecibo in Puerto Rico.	Against Closure	Email	6/8/2016	
53	Mario	Espinosa		Pelease dont close this magnífic research tool. Its our probe into The Universe	Against Closure	Email	6/8/2016	
54	Maria	Feliciano		Apoyo al Radiotelescopio de Arecibo. No deseo que lo cierren. Gracias.	Against Closure	Email	6/8/2016	
55	Lawrence	Glasheen	Adirondack Skywatchers	Arecibo Observatory operations are still a vital part of man's exploration of the universe.Many universities are using the Observatory for scientific research. I feel the Observatory should be maintained and utilized fully now and in the future.	Against Closure	Website	6/8/2016	
56	Lawrence	Glasheen		Arecibo Observatory operations are still a vital part of man's exploration of the universe.Many universities are using the Observatory for scientific research. I feel the Observatory should be maintained and utilized fully now and in the future.	Against Closure	Website	6/8/2016	
57	Elizabeth	Kaufman	USA Citizen and resident of Puerto Rico	I am in favor to Continue the NSF investment and funding on the Arecibo Observatory. First for all, due to all the historic discoveries made at this Observatory. Without the previous funding none would have been made. It serves a social purpose and service by attracting many students, scientists, and general public interested in Science. How could anyone discontinued funding to the most sensitive radar in the WORLD!!! It also helps in the economy of Puerto Rico by being a touristic point of interest to thousands of tourists that comes to the Island. Notwithstanding, that it has been used in several Hollywood Movies, injecting money to our economy.	Against Closure	Website	6/8/2016	
58	María de los Ángeles Caballero	López		Please don't close the radar in Arecibo!	Against Closure	Email	6/8/2016	
59	Lourdes	Matos		My comment is in reference of the meetings you are conducting to reduce Observatory Telescope funds and eventually closeness of this facilities, the observatory is a respectable part of this Island, throughout years hundreds and thousands visited this fascinating facilities to feel the connection we have and the responsibility to search threads across the vast universe. As a resident I felt an almost romantically relation with the facility and is always for me and my family a regenerist experience visiting it. Please reconsider the shortenest of these fund to the this important tool of exploration and what the importance means for all of our residents. Hope my letter help in this.	Against Closure	Email	6/8/2016	
60	J	Mendez		Please do not close the Arecibo Radiotelescope. This is an important tool for the whole world.Is the most sensitive of all.	Against Closure	Email	6/8/2016	
61	Olga	Mercado		Please reconsider the closure of this magnificent center of learning...	Against Closure	Email	6/8/2016	
62	Silvia	Morales		In union of many others I want to raise my voice for the Arecibo Observatory, which is so important not only for Puerto Rico, but for the rest of the world. And should remain operating, open and available for students, teachers, investigators, NASA. Let's provide all the necessary support so thus radar remains operating here.	Against Closure	Email	6/8/2016	
63	Jomary Rosa	Ortiz		As a resident of PR and, most of all, Arecibo, I found it very heartbreaking when I heard there were even just plans to close the observatory. I have been going to this place for ever: in different tours all through elementary, middle and highschool. I really enjoy this place, the view is amazing, there is information provided in every single corner of the radius of this place, overall I have always had the time of my life going to it. But, apart from my own joy and interest in going, this observatory has had a great part in the scientific (or practical) aspect of astronomy. It is, after all, the world's largest radio and radar telescope. It has helped in many things such as astronomy, planetary studies and amospheric sciences, which in my opinion is ENOUGH to cut that "closing" idea for good. Arecibo has discovered binary pulsars, found the first extrasolar planets and elucidated the Three Dimensional structure of the visible universe. This is the most capable telescope for worldwide precise discoveries. So, after all that hard work put into this place, to remodel, to have it stand as one of the greatest, why do you want to close it down? Is it because there's "no money for maintenance"? Please let this one pass and forgive my rude remark, but that is very unfair and just plainly dumb. There have been cuts made to the observatory's budget since a long while back. If there's SO MUCH money for politics, how come there can't be any for IMPORTANT INVESTIGATIONS THAT HELP OUR SCIENTISTS ACHIEVE GREATER THINGS? I understand there are many things that go into this desicion, but I just need to get my voice heard by someone, so they understand the pride we have in this observatory, so they understand how much it has done. Sincerely, Jomary Rosa Ortiz; 18 year old, Biology student, filled with pride of what our people have discovered and done over the years and hoping that at least someone understands my views on this subject.	Against Closure	Email	6/8/2016	
64	Erik	Rivera		En apoyo a que el Radar de Arecibo permanezca abierto y reciba los fondo necesarios para sus operaciones. Gracias	Against Closure	Email	6/8/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
65	Raquel	Rodriguez		Por favor no lo cierren!!!!!😱 😱 😱 Nuestro radiotelescopio; que además de haber salido en varias películas y series.... Es mucho más q es eso!!!!! Grax a él ustedes bien saben q se han realizados varios descubrimientos. Sabrá Dios q otros grandes descubrimientos estamos por recibir de este magnífico artefacto. Por esto y mucho más no podemos permitir que los cierren. Ustedes hablan del verano del 2017 por algo de unos fondos q tal vez le quiten... Pero si ustedes hacen eso nos arrancarían un pedacito de nuestra historia, de nuestro orgullo. Es un recurso valioso para nosotros los maestros. Y sufriríamos mucho por la acción. Espero q lo consideren 10 veces antes de q tomen una decisión. Además de eso es un lugar turístico indispensable donde yo llevo a mis amistades cuando vienen de visita a PR y soy del sur (Coamo). Por favor considérenlo muuuuuuchas veces....	Against Closure	Email	6/8/2016	
66	Sara	Santiago		Hello. My name is Lara and I live in San Juan...I saw some local news yesterday about the Arecibo Observatory..which is an icon, it generates jobs, kids, locals and from the state can do research...and tourists come here all the time. Puerto Rico is inmersed in a 72 billion debt that had accumulated during decades..and the Arecibo Obervatory is a hem, a hem of pride, it creates direct and indirect jobs, tourists come, it get's international coverage and it helps the economy. I am a science teacher...and I consider the Arecibo Observatory en emblem, a cultural pride, it helps the economy and you really do not give that much money to it...you should never even consider this again. We are in a big big economic crisis..and for the community: you should not even consider this..it is like spitting on us...it is just too important. Gracias again for getting it out of the list!!	Against Closure	Email	6/8/2016	
67	Maria	Santiago		Sería muy triste el cierre del observatorio de Arecibo. Puerto Rico va d mal en peor... NO al cierre. ☹PR	Against Closure	Email	6/8/2016	
68	Rosa			Please continue to support Arecibo Observatory. It is unique in the world, the best...	Against Closure	Email	6/8/2016	
69				Saludos. Como Maestra de Ciencias en la Escuela Elemental, apoyo que siga en funcionamiento el Radiotelescopio de Arecibo. Soy puertorriqueña y como otros hemos sido partícipes de los grandes descubrimientos y las aportaciones que el Radar ha hecho a la comunidad científica mundial. Demás está decir que el visitarlo y participar de las actividades ha motivado a muchos de nuestros niños y jóvenes a interesarse en carreras relacionadas a la astronomía y otras ciencias relacionadas.	Against Closure	Email	6/8/2016	
70				APOYO QUE CONTINUE ABIERTO EL OBSERVATORIO DE ARECIBO DE PUERTO RICO. LA APORTACION CIENTIFICA Y,ASTROLOGICA NOS PERMITE NUEVOS E IMPORTANTES DESCUBRIMIENTOS QUE SOLO ATRAVES DE ESTE OBSERVATORIO SE PUEDE LOGRAR. ADEMAS DE SU IMPORTANCIA AL SER UTILIZADO POR MUCHOS CIENTIFICOS Y ASTROLOGOS PARA SUS EXPERIMENTOS Y OBSERVACIONES Y CENTRO DE DESARROLLO Y ESTUDIO PARA ESTUDIANTES LOS CUALES SOLO CUENTAN CON ESTE OBSERVATORIO COMO CENTRO DE ESTUDIO, GRACIAS.	Against Closure	Email	6/8/2016	
71	Josean			Please notice that by closing the Arecibo observatory it will stop high school students to do astronomy research, it will hurt tourism, and children becoming less interested in this matter. Please help us. Thank you.	Against Closure	Email	6/8/2016	
72	Elvin	Figueroa		please, save the Arecibo, Puerto Rico observatory	Against Closure	Website	6/9/2016	
73	Carlos	Ramirez		I made a petition for you that the Arecibo's Observatory do not close. It is very important to the island of Puerto Rico and to the world. It is important in the study of astronomy.	Against Closure	Email	6/9/2016	
74	Yamilet			I have a petition for not closing Arecibo's Observatory. It is very important to the island of Puerto Rico and to the world. It is the world's largest telescope that has many research in astronomy and science. With it there has been many discoveries and experiments that would not exist without it. In the island is important a place of tourism and films that invest money to the economy that is fragile in this days. It is important to maintain this facility open for the good of Puerto Rico and the world. Thank you.	Against Closure	Email	6/9/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
75	Kalpana	Arun		I came to Arecibo in 1988, newly married to the Head of the Computer Department, Arun Venkataraman, who had accepted a job offer from the world's largest single dish telescope in 1986 after completing his PhD from UCSD. I was 23 years old, had a degree in English literature from India and little idea of how I was going to make myself useful in a distant tropical island. However, within the span of a month I was fully occupied as a volunteer at the local Catholic school, Colegio Nuestra Senora del Carmen, where I was welcomed as an observatory wife who could enrich the school community with my cultural diversity. Another observatory wife, was the head of the English department at the school. She had taken over that position from yet another observatory spouse. I worked at the school for over twenty five years. A few other wives of observatory scientists joined in for short periods of time. My boss and I stayed long enough at the school to create an English language program on level with States side schools, to offer courses in advanced US history and history of Art, to secure the school's accreditation by the Middle States Association of Schools and Colleges and to persuade students to broaden their horizons by applying to universities outside Puerto Rico. The favorable reputation of the school's English program, encouraged employees at the observatory to enroll their children there. The presence of these observatory kids whose families had ambitious academic expectations further stimulated the performance of the local students. We soon saw students from the school being accepted in Harvard, Princeton, MIT, Cambridge University, and Stanford as well as several other prestigious schools. The school's performance in math olympiads, science fair competitions and other island wide competitions improved. Those students who reaped the benefits of the school's English and history programs will readily acknowledge that their lives and their career paths were infinitely enriched by the fortuitous presence of the Arecibo Observatory in the neighbourhood. The proud parents of these students do undoubtedly regard the observatory as instrumental in their children's extraordinary achievements. I am equally confident that if the observatory had flourished without the constant threat of funding cuts from the NSF, more families of employees at this world renowned centre would have had an even more enriching impact on the lives of the local families. As a high school English teacher, I have had the opportunity to interact with local students and to listen to their point of view regarding Puerto Rico's status as a commonwealth. In the years that the pharmaceutical companies in Barceloneta were shut down, a number of parents in the school community lost their jobs. The ensuing economic instability provoked resentment and a reawakening of the awareness that these companies as well as the naval bases established by the USA on the island were painful reminders of Puerto Rico's colonial status. The island's favorable location, the availability of cheap labor, the tempting tax exemptions, are listed in high school history books as the reasons for the establishment of the pharmaceutical companies and the naval bases. However, the history of the Arecibo observatory has been spared the taint of such colonial motives. It is a proud badge of distinction that the USA has bestowed on its last colony. It is the "world's largest"; it is the place where a Nobel prize was won; a scientist after a brief stint at barrio Esperanza was featured on postage stamps in a far away country. My students kept track of any news about "El Radar" and expressed pride over the geographic proximity of such great happenings. Any measure that cripples the scientific research done at the observatory would see the corruption of this proud confidence with a sceptical questioning of motives. It would be an undeserved disappointment to the world class scientists who have whole heartedly undertaken to adapt to a new country and culture for the sake of their scientific pursuits. It would create yet another unsavory taste of the way the USA does business in its last colony stripping it of its pride and integrity. I do not believe that adopting any of the Preliminary alternatives leading to the suspension of scientific research at the observatory would result in anything but a detrimental socioeconomic and cultural impact on an island whose future is already fraught with economic uncertainty.	Against Closure	Email	6/10/2016	
76	Boris	Blagojevic		My name is Boris Blagojevic,I'm born December 13.1986.in Arandjelovac in Shumadia in Serbia,I'm 29 years old and I'm an Orthodox Christian.I'm fully and completely supporting Arecibo Opservatory.I really love and like to work with them and for them I love and completely and really seriousely most seriousely enjoy to helping them and supporting them.And I won't permit you to shut them down.I won't let you do it.I love SETI@Home.I would love and it would makes me happy if I can live long enough to meet and hanging out and spending all my ree spare time with other species animals,peoples from other worlds,planets,galaxsyies,universes and even from alternate parallele realaties world.Maybe there I get a new friends,even a grlfriend who will be my future wife and first who will have my name Blagojevic.I would n't mind at all to maried a grill from other planet,galaxyies and universe.And I would love to be there and for thouse people from other planets,galaxyies and universe outside our home planet Earth and our home galaxy Milkyway.MOST SERIOUSELY.I'm from Shumadia in Serbia I'm serbian citisen.MOST SERIOUSELY!!!And I would love most honestly to meet ascept and helping and protecting their families too and to supporting them to learn their customs and etc.And to work and live with them!!!Let's apsoluthely perfectly clear one thing.Everywhere there is a good and bad people everywhere,innocents,criminals politicans,wars and etc.Somewhere far in the galaxy I'm sure that there is a inteligent life like us.WE are looking for them and I'm sure that they are looking for us too.And We all in the galaxy and in the entire universe don't know for each other existence we are all looking for the ame thing,same answers,same needs and so one.So please don't be suprised that if we someday find them and they find us that you realise that we are more or less the same or atleast we are the similar.Similar everyday normal life problems and so one.If we faind them someday and if I see that thouse people friom outside the our planet and our galaxy and universe are in any kind of the trouble I will be the first who will helping them,saving them,defending them and supporting them only if they are species of good,honest,fair,justice and the people who will do only the good and noble actions and deeds.Only what is right and good.The good deeds.	Against Closure	Website	6/10/2016	
77	Marc	Lewis		The nearly constant stream of astronomical data distributed from the Arecibo Radio Telescope is of very high importance to the scientific community and should not be stopped. In addition to the importance of the data, the fact that the Observatory is in the National Register of Historic Places must surely come under consideration.	Against Closure	Email	6/10/2016	

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78	Judy	Yates		Please, may we please have your support for the SETI Project, it is so very important for all of us here now and in our future explorations of contact of existence of life outside planet Earth, the SETI program is in dire need of your support President Obama even as I send this to you. Your help would be immensely appreciated by people from all over our planet Earth so very much. Any help, letter, etc... that could help keep the SETI program forth going would be so greatly appreciated.	Against Closure	Website	6/10/2016	
79	Sonia	Maldonado		Este mensaje es para apoyar al Observatorio de Arecibo, Puerto Rico. Debe continuar operando. Es el más SENSITIVO a Nivel MUNDIAL.	Against Closure	Email	6/11/2016	
80	Rachel	Grout		Closing the Arecibo facility comes down to economic responsibility. We are nearing $20 Trillion in national deficit. Keeping an aged and dilapidated facility open does not make any sense. NASA has plenty of facilities that are able to monitor distant stars and so do other organizations. Puerto Rico is in economic distress. Those making a decision on the facility need to weigh in on the economy. I lived in Puerto Rico for 5 years and I have seen the facility. Please make a smart choice, this isn't about a handful of people, this is about accountability and what makes sense economically.	Support Closure	Email	6/12/2016	
81	Daliana	Rodriguez		This email is to express my support to the Arecibo Conservatory. The Observatory, as a research center, attracts some of the best scientists in the world and has a beneficial socioeconomic and cultural impact on its immediate neighborhood. The NSF would be hurting the community by withdrawing funding for research. Though I currently reside in Chicago, I was born and raised there, and benefited from the socioeconomic and cultural benefits that it brought to the neighborhood. A small example of this benefit was learning english (literature and grammar) from one of the best teachers in high school. She was the wife of a scientist in the Observatory. They were not from Puerto Rico but had moved to the area to work in the Observatory. Additionally, schools bring students to the Observatory to learn. It encourages the community to think far beyond their geography limits.	Against Closure	Email	6/12/2016	
82	Peter G	Tomasi III		I was recently reading the postings about the NSF trying to shut down Arecibo and I have to tell you I am appalled by your actions and the the actions of the National Science Foundation. I spouse I should not be shocked for if you really were a scientist you would see the benefits to keeping a facility like Arecibo(the largest most unique radio telescope of its kind) open. I suppose your part of the new farm it out to India and Chine mentally. I mean why bother to encourage american children to learn STEM if there will not be any place in the USA for them to work. THE NSF needs to tell out idiot Congress and President that money needs to spend on the NSF to help secure a promising future in the sciences. The fact that you even proposed this makes me sick to my stomach and makes me ask what sort of scientist / American you really are.	Against Closure	Email	6/12/2016	
83	Thad	Carlson		Please don't close down that big telescope. Thank you.	Against Closure	Email	6/13/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
84	Doug	Currie		Although I don't live in Puerto Rico or United States but in Canada I have been inspired by the Arecibo radio telescope all my life. I was born in 1960 and continue to be quite fascinated by astronomy and space exploration including the leading part played by the United States through NASA and astronomical facilities such as optical and radio telescopes I think that would be funded by the NSF. I heard that the recent clear discovery of gravitational waves by the US LIGO facility could give some new potential for use and discovery of the Arecibo telescope that is capable of detecting gravitational waves and is still clearly the most sensitive radio telescope in the United States if not in the world and is seems a missed opportunity to start a process of closing Arecibo down or limiting its use at this time if it could more likely soon make a major contribution in this area among others. With more discoveries including closer to us of exoplanets including some potentially habitable ones I am sure Arecibo could continue to have a productive and inspiring role in learning more about them including their magnetic fields among other things if you allow it to continue to operate. After a second major meteorite impact in Russia in Cherylbinsk after the Tunguska one in 1908 I think wouldn't it be good to keep funding the role of Arecibo to continue to detect and monitor near-Earth asteroids to better inform us and help us avoid or at least minimize any future problems with small asteroid or large meteors that could be on a collision course with Earth? I don't know if Arecibo has been specifically involved in these areas but I know it is in radio wavelengths that many molecules in space have been detected and that we can see better to places like the center of the Milky Way galaxy and tell more about these things from radio wavelengths. If Arecibo can detect these parts of the radio spectrum I am sure it would still be one of the most powerful and useful facilities in American territory and can find many more informative and important examples and information. Arecibo is also a very well known symbol of, especially leading American scientific ability, and is certainly illustrated in a number of my astronomy books including recent ones on astronomy including looking for life or habitable places in the universe and it would be a shame to have it only a symbol of past ability. This would especially be true if it is at the same time and the new comparable size and ability FAST radio telescope in China is opening. It is too bad that there isn't a larger budget for NSF that would make it easier for your department to continue funding Arecibo. I also follow Abel Mendez at University of Puerto Rico on Twitter and his excellent web site the Habitable Planet Laboratory and I am sure his leading work in extrasolar planets benefits from the continuing operation of the Arecibo radio telescope. Of course his last name indicates he is Hispanic and I have also heard that generally Hispanics in the United States are under-represented in science and technology professional positions and I think in university placements but that Arecibo and tours there for local Puerto Rican students has been a deciding factor in encouraging a significant number to study and get careers in astronomy or other science areas. Therefore for these and other reasons I encourage you and other people in the National Science Foundation to continue to find funding or allow some other mix of funding that would keep Arecibo open and operating for the forseeable future so people on Earth, especially in American and its territories, can continue to learn more about our universe, protect our Earth and perhaps learn more about other habitable environments beyond Earth and their possible inhabitants.	Against Closure	Email	6/13/2016	
85	Dr. Mark	Jackson	Founder and CEO, Fiat Physica	I am a physicist who recently founded Fiat Physica, a crowdfunding platform devoted to the advancement of physics, astronomy and space exploration. Introducing an untapped channel for fundraising and engagement between scientists and individuals who support their work, campaigns on Fiat Physica bring awareness to these fields and important projects, and pave the way for future technology. For a summary of the many campaigns currently on our site, please visit https://www.fiatphysica.com/campaigns. I have been following the recent issue of NSF's proposed budget cuts of the Arecibo Observatory, and would like to suggest that the funds be raised on the Fiat Physica platform. This would not only allow the observatory to gain its much needed financial support, it would also gain visibility to the public for the incredible science happening there. I have already interacted with several of you in person about this new way to raise funds from the public, but wanted to send a single email summarizing this to all involved in this issue (based on Nadia Drake's recent National Geographic article and live-tweeting of the public discussion earlier this week). Rather than a single crowdfunding campaign, Arecibo could launch several campaigns corresponding to separate projects. I've created a partner page at https://www.fiatphysica.com/partners/arecibo-observatory to collect all such campaigns in one location, and you may begin setting up crowdfunding campaigns immediately by visiting https://www.fiatphysica.com/campaigns/new. For an example of a Partner which has run several successful campaigns on our platform, please visit https://www.fiatphysica.com/partners/astronomers-without-borders There is also great opportunity for foundations and corporations to become involved. Our associated non-profit is the Science Partnership Fund, allowing us to collect tax-deductible donations on behalf of any crowdfunding campaign or scientific event, making it substantially easier for foundations and corporations to make charitable donations to scientific projects. We have already had great success for our first project, NASA SpaceApps NYC, in which we raised about $40,000 from 13 sponsors including SpaceX, Microsoft, IBM, Amazon, and Wolfram (who personally appeared): http://www.sciencepartnershipfund.org/space/space-apps-nyc/. Since you are already partnering with the Breakthrough initiative, they might be interested in further donations or matching the gifts made by the public. Alternatively, the NSF may be interested in a similar program, allowing them to support the Observatory for less budget outlay. Our platform also features a blog to provide context for campaigns, and we may be able to tailor articles to your campaigns. I believe that Fiat Physica and the Science Partnership Fund could greatly help the Arecibo Observatory in raising funds, as well as engaging with the public. I have attached brochures about both organizations and would be glad to answer any further questions you may have. Please feel free to forward this to anyone else who you think may be interested.	Alternative Consideration	Email	6/13/2016	FP brochure.pdf, SPF-brochure.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
86	Sir Thomas W.	Kilburn	Hitcher's Guide to the Universe	keep it open. it will be needed for future research. don't send it down the path of the space shuttles.	Against Closure	Website	6/13/2016	
87	Patrick	ODell		Please do not defund this project or shuffle it to its virtual demise. We need to look beyond this planet to find not only the objects coming our way that threaten our world with extinction, but to continue to seek for intelligent life that might lay elsewhere in our galaxy or universe. When Congress will pass pork legislation to fund other insignificant projects like studies of flies in Africa, then we seriously need to look at the scientific importance of saving our planet from an extinction level event!	Against Closure	Website	6/13/2016	
88	Stephen	O'Rourke		My name is Stephen O'Rourke and I am writing to argue strongly against the potential deconstruction or mothballing of the Arecibo Observatory. The reasons are numerous and I will offer just a few of them here: 1. The search for potentially threatening near-Earth objects, 2. The ability to uniquely contribute to important new gravitational waves research, 3. It's contribution to atmospheric science and studies of climate, 4. The ability to inspire STEM research and interests in the population, 5. It's status as a landmark and tourism draw for Puerto Rico, and 6. Preservation of the karst landscape. I encourage you to find the real answer to the problem. It's not to cut this program but rather get the NSF budget increased to the point where we don't have to choose which science projects win and which ones lose. Please feel free to contact me for any additional questions.	Against Closure	Email	6/13/2016	
89	Dr. Joshua	Peek	Assistant Astronomer, Space Telescope Science Institute, Baltimore, MD, 21218	I write to strongly urge that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for sciencefocused operations (No-Action Alternative)." I have conducted astronomical research using the Arecibo Observatory since 2003, and the 10,000 hours of data collected for the GALFA-HI survey formed the backbone of my thesis. In this letter I will focus on three issues that may not have been directly brought to your attention previously, which make rather clear how critical Arecibo's continued existence is for the scientific community. While these don't relate to the natural environment, they are critical to the educational and scientific environment. Single dish instruments are natural world class teaching facilities. While facilities like ALMA will make great discoveries, it is nearly impossible for the next generation as astronomers to learn how to build new instruments and techniques with these machines. While interferometers are less sensitive, they are also far more complex, which makes using them in a hands-on way impossible for students. It is perfectly feasible for a student to deploy their own detector or correlator on Arecibo and do world-class research, as we did with GALFA-HI. Such a thing is completely impossible with world class interferometers. And while "teaching" dishes may exist, it is not possible to do world-class work without the sensitivity afforded by large dishes in the present environment. Arecibo is still the perfect tool for students to amplify their creativity and brilliance, and will train the next generation of radio astronomers. Arecibo is a crucial tool for public engagement. While radio astronomy can seem abstruse and strange, we know it is critical for our understanding of the universe. Our colleagues in optical astronomy have lovely Hubble images to show the public, but we often must rely on simulations or mockups to show why a particular pulsar or spectrum is important. Arecibo, with it's physical vastness, engages the public directly in a way that cannot be overstated. No one has stood at the visitor's center and not be overwhelmed by its awesomeness. In addition I, along with my GALFA-HI colleagues, have produced a visually compelling map of the Galaxy in Galactic hydrogen, will will serve to engage the public with radio astronomy and Arecibo for a long time to come. The future of strong gravity and the first instant of the universe lies with Arecibo. Arecibo's contribution to the history of strong gravity is well known — B1913+16, which earned Taylor and Hulse a Nobel Prize, was and is the first key to the confirmation of gravitational waves, long before LIGO. In addition, you are likely hearing much about the importance of the pulsar timing array as a critical tool in understanding gravitational waves and their origins. I am writing to you about a third way Arecibo can contribute to the study of strong gravity. The announcement of the detection of inflationary B-modes in the CMB was scuttled by the acknowledgment of strong polarized foregrounds from Galactic dust. Arecibo is poised to make a huge contribution to this field by measuring the structure of this polarized, dusty ISM using HI signatures. I refer you to the recent work by Arecibo REU graduate and current NSF Graduate Fellow Susan Clark on the topic, made possible by Arecibo observations with the ALFA instrument. In this way Arecibo is critical to the past, present, and future study of strong gravity.	Against Closure	Email	6/13/2016	Arecibo_Jpeek.pdf
90	Brendalee			No cierren el Radio telescopio de Arecibo	Against Closure	Email	6/13/2016	Do not close the Arecibo Radio Telescope

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
91	William	Axsom		It would not be wise remove funding from Arecibo Observatory as thousands of Americans donate time to read results for free. Really it is a world wide free effort through Seti. Where else does our government get FREE effort for reading anything, especially science data? As a Country let us not defund important projects but rather support them.	Against Closure	Website	6/14/2016	
92	Carlos	Catalano	AOSA SP16 Graduate	I am a graduate of Spring 2016 class from the Arecibo Observatory Space Academy, held in such facilities. We learnt so much about space, physics, chemistry, engineering, maths, geology, biology, and, of course, about the Arecibo Observatory (AO) itself. This has been a unique experience in my life, since I was taught things I would never imagine I would like, and now, thanks to that, my future is to study Mechanical Engineering at the University of Puerto Rico at Mayaguez. The AO supports this amazing Academy, meant for us students to learn much about the space, since it needs us to explore it! We had talks and presentations from famous scientists from around the globe too: South Africa, Finland, Colombia, USA, Britain and many more! All of them came, since the dish is the BIGGEST is the world. It was such a shame that the biggest is on the headlines, not because of a new discovery (from the many it had have), but because it's about to shut down due to funds. I was baffled when I knew about it! How could it be that such a landmark of Puerto Rico is being threatened to close? What does this means to the scientific community, not only from the Island, but from the rest of the States and the World? In some of those speeches I said earlier, scientists were relaying their life as a profession, and how they were settling where the largest observatory was, since they needed the most keen technologies and infrastructure to study the ever-growing Universe. Now, they'll have to retrocede to former biggest-Observatories since the largest one is being closed down. Or even worse, leaving the country, USA, since the next one will be in China. However, no Observatory will beat AO's capacity of viewing the sky, since every each one of them is unique, and by shutting it down, the World will be loosing a unique Observatory (just like the GB in West Virginia). This science cradle means a lot for the local communities in PR, since it's one of the most advanced scientific center in the whole Island, it makes us proud, it's amazing to say "we have the largest Observatory in Earth". And you'll just be ripping it out from us. So, please, I pledge you, consider better the options, and don't shut down a center of education, discovery and professionalism to PR, USA, and the Globe itself.	Against Closure	Email	6/14/2016	
93	Susan	Clark	NSF Graduate Fellow Columbia University	Title: Neutral Hydrogen Structures Trace Dust Polarization Angle: Implications for Cosmic Microwave Background Foregrounds Authors: Susan E. Clark, J. Colin Hill, Joshua E.G. Peek, Mary E. Putman, Brian L. Babler Paper Reference: Physical Review Letters 115, 241302. Published 2015. ADS link: http://adsabs.harvard.edu/abs/2015PhRvL.115x1302C. Abstract: In the first trillionth of a trillionth of a billionth of a second after the Big Bang, the Universe is thought to have experienced a growth spurt – a period of rapid expansion known as inflation. Cosmological observations provide strong circumstantial evidence for inflation, but no direct detection thus far. The predicted "smoking gun" evidence for inflation is primordial B-mode polarization. These “B-modes” are a polarization pattern imprinted in the cosmic microwave background (CMB), the pervasive leftover radiation from the Universe’s formation. Unfortunately, despite enormous experimental effort, the B-mode signal has yet to be detected because it is obscured by polarized dust in our galaxy. Galactic dust grains emit polarized light because they are aligned with the interstellar magnetic field, creating a signal that must be carefully measured and subtracted from CMB data in order to uncover the inflationary B-mode signal. This dust is a component of the interstellar medium – all the diffuse material between the stars in the Milky Way. The interstellar medium is also full of gas, much of which is neutral hydrogen. In this paper, we present the discovery that slender linear filaments of neutral hydrogen gas in the Milky Way, revealed by high-resolution Arecibo survey data, are extremely well aligned with the dust polarization. This means that structures in the gas are strongly aligned with the ambient magnetic field. We use a machine vision algorithm to measure the orientation of the Arecibo filaments. The shape of neutral hydrogen provides an entirely new way to constrain the dust polarization foreground obscuring the inflationary B-mode signal. Our work will allow astrophysicists to more precisely measure the foreground dust signal, improving our ability to uncover the signature of inflation. This work would not have been possible without Arecibo. The sensitive, high dynamic range Galactic Arecibo L-Band Feed Array (GALFA-HI Survey) revealed the slender, magnetically aligned neutral hydrogen structures.	Against Closure	Email	6/14/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
94	John	Mathews	Professor of Electrical Engineering FRAS, Fellow IEEE JDMathews@psu.edu (814) 777-5875	This letter is in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory (AO). I find that AO is a scientifically and culturally unique institution that has amazing potential for a future positive impact in both arenas. The scientific contributions stemming from AO have been outstanding and the scientific future remains bright indeed. The cultural contributions to Puerto Rico and the world are incalculable and must remain so. I outline of few of these: • AO primary and secondary contributions to STEM education are huge due to the visitor center but also via the large number of AO "graduates" who have entered careers in education both in Puerto Rico and worldwide. AO has always been an education-focused institution. • Over the life of AO many students and scientists have lived in Puerto Rico for various extended periods. Several have spent their entire careers at AO—one of the original scientists from the early 60's still lives in Ramey. Their children were born in Puerto Rico (as was my daughter), went to school in Puerto Rico, and left the island as Puerto Ricans to attend, for example, Stanford, Cornell, Harvard, and Cambridge Universities. These AO families have made a major socio-economic impact on Puerto Rico. • AO is culturally unique in that it brings together many fields of endeavor and many cultural "ideas" that encourage global thinking—a mix of both cultural and scientific tools and concepts. It has and will continue to attract visitors and users in many fields from around the world. Longer-term users of AO capabilities have come from EU countries, Japan, India, Brazil, Australia, etc. As AO has always provided a de facto institution of higher education in Puerto Rico.	Against Closure	Email	6/14/2016	JDMathews_AOEIS comments.pdf
95	John	Mathews	Professor of Electrical Engineering FRAS, Fellow IEEE JDMathews@psu.edu (814) 777-5875	I suggest making AO the central component of a degree granting graduate and post-graduate research and education institution that would be unique to Puerto Rico and to Latin and South America. This proposed institution has been discussed elsewhere as the Puerto Rican Institute for Advanced Studies (PRIAS). PRIAS would greatly leverage the already firm cultural impact that AO has made across many communities and further enable many more decades of multi-disciplinary science and engineering at AO. I recommend that a mix of NSF and partner funding support this future.	Alternative Consideration	Email	6/14/2016	JDMathews_AOEIS comments.pdf
96	Greg	Roelofs		Arecibo's instrument suite and frequency range mean it won't even be matched in many respects for a decade or more; it's still making dramatic and surprising discoveries even about our own backyard (e.g., the M33 galaxy next door). At $12 million a year it's _cheap_ compared to almost any other astronomical science mission you could name: for the price of Opportunity on Mars, you could fund it for another half-century(!), and virtually all manned missions are vastly more expensive than even that. This is a national treasure in more ways than one. Let's treat it like one.	Against Closure	Website	6/14/2016	
97	Kerry	Lyons		How can this be shut down?? So many people, so much time, has been used toward the search for extraterrestrial life, finding ways to combat ebola, aids, the zika virus... this is a meaningful amount of research!!!! How can you shut this down??	Against Closure	Website	6/15/2016	
98	Carlos S.	de Jesús		This radio telescope is an icon of Puerto Rico. There's people from around the world which comes daily to visit it because is the biggest in the world at the moment; something difference. It is an excelent resource and an inspiration for future sciences students.	Against Closure	Email	6/16/2016	
99	Carlos S.	de Jesús		We just need more marketing and promotional material to promote the visit of the people around the world to be sustainable.	Alternative Consideration	Email	6/16/2016	
100	John	Gosselin		Please DO NOT initiate changes which would downscale, or eliminate, the current Arecibo Observatory Operations schedule.	Against Closure	Website	6/16/2016	

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101	Phil	Kronberg	Lifetime Prof. Emeritus, Dept. of Physics, University of Toronto philkronberg@gmail.com 505-310-8077	Among the five options listed for the AO's future in the recent Federal Register notice, I highly recommend the first two: – Continued NSF investment for science-focused operations, and simultaneously pursuing collaboration with other interested parties. If this is done, the widespread benefits to education and culture will automatically follow. This World-unique Arecibo Observatory, with its impressive multi-million dollar upgrades, has yet to achieve the appropriate return in science and education on the money invested. Why?— Because, like any entity of physical plant, adequate ongoing support is needed to produce a commensurate yield on the invested money. This support needs to be designed-in, and steered over time. Men and women of the Congress appreciate that an major capital investment using taxpayers' money requires careful and strategic planning, along with needed budget support, and enlightened and expert management. The investment made in the AO upgrades now makes the AO capable of spanning the entire radio spectrum up to ca. 15 GHz (2cm wavelength). The underlying mechanical structure upgrades permit the AO to exploit a host of computer software, electronic, radar, and feed-antenna refinements. These can also greatly expand the power of the AO. One example, already demonstrated, is to promote Earth-Earth and Earth-space long baseline radio interferometry. In another context it has been demonstrated how the non-real time combination of the AO 305m aperture with a precision-imaging, multi-element interferometer (at the NRC Canada DRAO) can enhance the angular resolution of the Arecibo telescope – in this case from a 305m- to the equivalent to a □ 1000m-diameter single dish (see e.g. Kronberg, Kothes, Salter, and Perillat, Astrophys.J. v659, 267, 2007). The author of this letter has served on, or chaired many senior US committees and panels on radio astronomy and plasma astrophysics (NSF, AUI and NRAO, AO, NASA and APS), and including all major NSF-supported radio astronomy facilities.	Against Closure	Email	6/16/2016	Arecibo Continuation_Support.pdf
102	Nathan	Leaflight		Whilst the Arecibo Radio Telescope has much relevance as a historical object - and is worthy of preservation as such - its real importance lies in its utility. It may be old, but in numerous regards it is unsurpassed. Similar new facilities are coming on line, it is true. However, they do not render Arecibo redundant. The telescope's unique ability to broadcast helps us to detect dangerous asteroids which may cross Earth's orbit. All astronomers agree that there is no question that such an event will happen again. Forewarning is therefore indispensable to our planet's defense. Not only does Arecibo have unique capabilities which the other telescopes will not duplicate, but it will be part of a greater network. Vital research requires a massive instrument, which can only be provided by multiple dishes making linked observations. Remove one, and our ability to do research will diminish.	Against Closure	Email	6/16/2016	
103	Nathan	Leaflight		I realize that NSF is having terrible budgetary issues, and maintenance of the Arecibo facility is costly. However, the dismantling of the telescope dish, and subsequent restoration of the site, would be crushingly expensive. May I recommend that some other agency take over administration of the Arecibo dish? This will both free up substantial monies for other NSF programs, and keep an important research tool alive.	Alternative Consideration	Email	6/16/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
104	Joan	Schmelz		Environmental Baseline Study of Arecibo Observatory that CH2M Hill Re this paragraph: "Surveys for RTE species or detailed habitat assessments were not included in this effort to determine if these species or the RTE species located in the Río Abaja State Forest are present or are likely to use the subject property. Impacts to RTE species are unknown but are not anticipated because activities would be generally limited to previously disturbed areas within the subject property." This paragraph misses an essential point. The critically endangered species, the Puerto Rican Parrot (Amazona vittata), was reintroduced in the Río Abajo forest in 2006 as part of an aggressive conservation program to save the species from extinction. It had previously gone extinct in the region due to habitat loss in the 1920s, and survived only in the El Yunque National Forest. This reintroduction was done well after the last observatory upgrade, which took place from 1993-97. It is thus impossible to conclude that the Puerto Rican Parrot population would not be impacted because the areas have been disturbed previously. Information on the Puerto Rican Parrot from Bird Life International http://www.birdlife.org/datazone/speciesfactsheet.php?id=1666 The Puerto Rican Parrot (Amazona vittata) is a critically endangered species. Once abundant, there has been a drastic decline, which reduced the population to an all-time low of 13 birds in 1975. It has been confined to the El Yunque National Forest since the 1960s. Conservation action has prevented the parrot's extinction, although recovery has been slow and the population remains tiny. In 1989, Hurricane Hugo cut the wild population from 47 to about 23. By the beginning of 1992, there were a minimum of 22-23 parrots in the wild and 58 in captivity. In 2000, the parrot numbered 40 wild birds, plus 10 recently re-introduced birds and 100 in captivity. In 2001, thieves broke into an aviary and stole a number of captive adults. In 2004, the wild population was 30-35 individuals. In 2006, 20 birds were released in the Rio Abajo State Forest marking the beginning of a second population in the wild. 26 additional birds were released in December 2007 and 19 more were released in December 2008, with the first two successful nests recorded in the wild at Rio Abajo in 2008. In 2013 there were 64-84 wild birds and 16 chicks at Rio Abajo and 15-20 wild birds at El Yunque, and the first known natural nest in 42 years was recorded in Rio Abajo. At least three captive bred birds that were released in the Rio Abajo Forest were found to be flocking with approximately 150 Orange-winged Amazons (Amazona amazonica) away from the original release site. In May 2014, two young birds were discovered in a natural nesting hole outside the boundary of a national park.	Resource Considerations	Email	6/16/2016	
105	David A.	Smith	CNRS Senior Staff Scientist	The future of our technology-based society depends crucially on instilling scientific culture in today's youth and in the general public. Arecibo is a universally recognized icon of Science. I give public science lectures to a broad variety of audiences, including school children, teachers, people interested in Science and, importantly, people who think that Science doesn't concern them. I give these talks in France, Italy, Greece as well as (more occasionally) in the United States. I nearly always include a photograph of Arecibo – people know it, and it grabs their attention. Like Hubble or the Space Station, people associate Arecibo with "good" Science, as distinct from more controversial fields. Thus, Arecibo is a "spark" that we use to ignite people's interest in the underlying basis of engineering and technology. As an American living abroad, I also clearly see that Arecibo projects a tremendously positive image of the United States. Amongst the reasons that people around the world love us is our ability to create and perpetuate dream-inspiring inventions. Last, but definitely not least, Arecibo is a science-tool unmatched by any other. To lose it would be a horrible loss for science and thus for society. The rate of scientific breakthroughs is accelerating continually – we live in one of the most exciting periods for Knowledge since the dawn of history. One of the causes is the increasing number of fantastic scientific instruments in all fields. But a major cause is the synergy of the different instruments and fields. The sum of our technological, scientific wealth is much greater than the sum of its individual parts. Arecibo on its own is great. Arecibo as a tool meshed into a network of all the other scientific tools is much greater. America's strength and greatness comes from our ability to transform dreams into practical devices and knowledge. America's wealth is a result of continued investment in dreams that may not be obviously useful in the short term. To perpetuate a strong America that continues to be loved by the family of nations, I strongly encourage you to continue to support Arecibo generously.	Against Closure	Email	6/16/2016	AreciboSupport-signed.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
106	Donald F.	DuBois	Los Alamos National Laboratory Fellow (retired)	In 2015 the Arecibo Observatory (AO) resumed experiments involving the transmission of high power, high frequency (HF), electromagnetic waves, into the ionosphere. Arecibo is the premier facility for studying the plasma turbulence induced by these HF waves because of its powerful and very sensitive 430 Mhz incoherent scatter radar. I am writing to emphasize the importance of continuing this unique capability as an interdisciplinary research tool that can produce detailed understanding of nonlinear physics also vital to laser-plasma interactions in the large national inertial fusion programs. Past HF heating experiments*, utilizing the ultra-sensitive 430MHz radar, in the smooth, well-characterized, ionosphere over Arecibo, have produced the most detailed, reproducible, and quantitatively predictable, data concerning the induced turbulence, available from any venue. Such detail is not available in current laser-plasma experiments where much of the same physics operates on vastly smaller space and time scales. Continuation of this line of research at the Arecibo Observatory promises to increase physical understanding essential to both fields. In both the laser regime and the HF heating regime the driving beams trigger certain “parametric instabilities” that drive the plasma into a nonlinear turbulent state. The computer simulation modeling successful in the HF heating regime, scales to the laser driven regime with simple, physically obvious, changes. An important physical effect, in both regimes, is the acceleration of electrons to suprathermal energies by the plasma turbulence. These so called “hot electrons” can pre-heat the imploding core, hindering ignition, in inertial compression laser fusion applications. Kinetic hot electron modeling methods developed for the laser regime are readily applicable to the HF-ionosphere regime. A controlled, well-characterized, source of suprathermal electrons produced by HF heating would significantly improve aeronomy studies of collisional effects outside the heated volume, including studies of electron transport, energy loss, and energy balance in the upper ionosphere. The very sensitive 430Mhz radar at the AO is unique in its ability to measure the velocity distribution of hot electrons streaming out of the HF-heated layer of the ionosphere. Hot electrons have been observed in many laser experiments. Laser experiments, such a those at the Omega laser at the University of Rochester and the multibillion dollar National Ignition Facility at Livermore are severely restricted, compared to the HF heating capabilities, in the range of diagnostics possible for these nonlinear processes. The lasers produce the plasma and also drive the instabilities that, in turn, drive the nonlinear processes. Disentangling the plasma production - in very complex geometries- and the nonlinear excitation requires many uncontrolled assumptions. In the HF heating experiments, in the so-called low duty cycle regime, the ionospheric plasma is smooth and can be completely characterized and is unaffected by the HF beam. The theory can then be applied to this known initial state without uncontrolled assumptions needed in the laser case. But most importantly, the unique combination of the HF heating capability and the extremely sensitive 430 Mhz radar at the AO can measure the properties of the enhanced turbulent fluctuations and hot electrons in far more physical detail than any diagnostics available in the laser regime. *F.T. Djuth and D.F. DuBois, Earth, Moon and Planets, DOI 10.1007/s11038-015-9458-x	Against Closure	Email	6/17/2016	
107	Dr. BJ	Howerton	Northwest Regional Office Environmental Services Mgr. 911 N.E. 11th Avenue Portland, OR 97232-4169 Telephone: (503) 231-6749 Fax: (503) 231-2275	• Is there a budget for continued operations? • Is technology out of date? If so, at what cost to make technology current? • What is the quality of science received from project? • Is project cost effective to operate? • Has project achieved its goal or mission? • Has a Lessons Learned report been generated from Project operation? • Does Project still provide acceptable solutions? • Should new procedures/processes be developed for future operation? • Are there any new research possibilities for project? • Educational value as Science Technology, Engineering, and Math (STEM) tool? • What is impact to environment as built and operated, i.e., will operation increase environmental impacts? • Any opportunities for operational improvement? • Questions concerning: Mothballing of facilities (suspension of operations in a manner such that operations could resume efficiently at some future date). • What is annual cost to mothball facilities? • Does operational value outweigh mothballing costs? • Deconstruction and site restoration. • Cost of deconstruction and site restoration vs benefit to public of operation?	Decision Process	Email	6/17/2016	
108	Dr. BJ	Howerton	Northwest Regional Office Environmental Services Mgr. 911 N.E. 11th Avenue Portland, OR 97232-4169 Telephone: (503) 231-6749 Fax: (503) 231-2275	• Have project needs been meet? •Have all deliverables been met? • What earned value management (EVM) data is available to review? • Where is the project information developed archived? Is it available to the public? • Are there future requirements for project information?	General	Email	6/17/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
109	Wes	Patterson		Title: Bistatic Radar Observations of the Moon using Mini-RF on LRO and the Arecibo Observatory Authors: G.W. Patterson1, A.M. Stickle1, F.S. Turner1, J.R. Jensen1, D.B.J. Bussey1, P. Spudis2, R.C. Espiritu1, R.C. Schulze1, D.A. Yocky3, D.E. Wahl3, M. Zimmerman1, J.T.S. Cahill1, M. Nolan4, L. Carter5, C.D. Neish6, R.K. Raney1, B. J. Thomson7, R. Kirk8, T. W. Thompson9, B.L. Tise3, I.A. Erteza3, C.V. Jakowatz3 Author institutions: 1The Johns Hopkins University Applied Physics Laboratory, 11100 Johns Hopkins Rd., Laurel, MD 20723, USA, 2Lunar and Planetary Institute, 3600 Bay Area Boulevard, Houston, TX 77058, USA, 3Sandia National Laboratories, Albuquerque, NM 87815 USA, 4Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, USA, 5NASA Goddard Space Flight Center, Greenbelt, MD 20771, USA, 6University of Western Ontario, 1151 Richmond Street, London, ON, N6A 5B7, Canada,7 Center for Remote Sensing, Boston University, 725 Commonwealth Ave., Boston, MA 02215, USA, 8 Astrogeology Science Center, U.S. Geological Survey, Flagstaff, AZ 86001, USA, 9Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109, USA Abstract: Mini-RF/Arecibo Observatory observations of the Moon show an opposition surge for portions of the floor of Cabeus that are not in permanent shadow. The unique nature of the response may indicate the presence of near-surface deposits of water ice. Link to manuscript: http://dx.doi.org/10.1016/j.icarus.2016.05.017	Against Closure	Email	6/17/2016	
110	Bryan	Strom		Please do not shut down Arecibo. The telescope has a historical and cultural value as well as a future value for scientific discovery.	Against Closure	Email	6/17/2016	
111	Dr. Joeri	van Leeuwen	ERC Laureate, Associate Professor ASTRON, University of Amsterdam	I write this letter to strongly urge the NSF to choose "Continued NSF investment for science-focused operations (No-Action Alternative)", in the Arecibo EIS. I do this in my role of as a global astronomical outreach leader, as exemplified by e.g. my 2016 De Graaff astronomy outreach prize. Astronomy is a uniquely visual means of drawing our wider society in to science. Outreach on the sky is an especially effective way of explaining the place of Earth in the Universe. Results obtained with Arecibo continue to power this outreach. Our 2015 discovery, with a team of US and ex-US astronomers which I led while at UC Berkeley, of a pulsar disappearing in bent space-time is just oneexample. It allowed us to explain some of the wonders of the Universe we live in, for an extremely broad audience. This research made the front pages (!) of e.g. Yahoo.es, El Diario de Santiago, El Siglo de Torreón, CNET.es and RT in Spanish, and CNN, the Wall Street Journal, the Huffington Post in English. Much popularization of this work came from the beautiful, yet scientifically correct, animations which tallied over 200,000 youtube views within days, and were trending on space.com -- outlets that uniquely captivate a wide, eager, and young audience. Arecibo thus puts Puerto Rico in the vanguard of scientific exploration and its dissemination to current and future tax payers: in the Spanish speaking world, on the US main land, and even globally. I urge you to treasure that unique capability, and include this important visibility and education factor in your EIS.	Against Closure	Email	6/17/2016	EIS_Response_20160617.pdf
112	David	Bloxham		please keep the radio telescope known as ARECIBO operational. I believe that the SETI program is important to the advancement of humankind.	Against Closure	Website	6/18/2016	
113	Daniel	Kellett	Miami University 2016 Electrical Engineering Major Physics Minor College of Engineering and Computing IEEE Student Branch Vice President	I write to urge that NSF choose alternative 1 of its Notice of Intent to Prepare an EIS . . . , namely Continued NSF investment for science-focused operations (No-Action Alternative). During my junior year of college, I had the privilege to not only work with data collected by the observatory, but also spend 4 days there, getting to see the facilities and an explanation of the function of each part of the observatory. I look back on this as a very enriching experience and believe that Arecibo Observatory still has much to offer, both in terms of unique research use and in terms of educational value for students.	Against Closure	Email	6/18/2016	
114	David	Porter		Please do not remove support for Arecibo.	Against Closure	Website	6/18/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
115	Emily	Altiere	University of British Columbia	I am writing in response to the notice of intent to produce an Environmental Impact Statement regarding the future of the Arecibo Observatory. As an undergraduate student Bryn Mawr College, I undertook research using the Arecibo Observatory for studies of pulsar astrophysics as part of a summer research internship at Bryn Mawr. During my research program, I visited and made observations with the telescope. Through this project I learned skills in computer coding and algorithm development, in addition to astrophysics itself. This project was the first stepping stone in my development as a researcher and provided me with inspiration and excitement to continue my journey at my present position as a graduate student in physics. I hope that the Observatory can remain in operation with a science-focused research program, and that it can continue to provide such valuable experiences for future students.	Against Closure	Email	6/19/2016	
116	Sarah	Henderson	Physics & German A.B., Mathematics minor Lafayette College Class of 2016	I am writing in response to the notice of intent to produce an Environmental Impact Statement regarding the future of the Arecibo Observatory. As an undergraduate student at Lafayette College, I undertook research using the Arecibo Observatory for studies of pulsar astrophysics as part of a summer research internship and senior thesis at Lafayette. During my research program, I made observations with the telescope. Through this project, I learned skills in computer coding and algorithm development, in addition to astrophysics itself. This experience was a significant part of my development as a researcher and was an important step leading to my current position at Google and future astrophysics graduate student this fall. By having this opportunity to utilize Arecibo data, I developed as a scientist, and my passion for astrophysics was really solidified. I am truly thankful that I was able to work alongside top-notch scientists and observe pulsars directly thanks to the Arecibo Observatory. It would be a shame if the observatory had to be closed; I can only hope that the NSF recognizes how valuable of a resource Arecibo is for professors, students, and the public alike. I hope that the Observatory can remain in operation with a science-focused research program and that it can continue to provide such valuable experiences for future students.	Against Closure	Email	6/19/2016	
117	Patricia A.	Henning	Interim Associate Vice President for Research Professor of Physics and Astronomy University of New Mexico	I would like to note the following comment in the Draft EIS: Surveying the Zone of Avoidance with the Arecibo L-band Feed Array P.A. Henning (University of New Mexico), W. van Driel (Paris Obs.), Monica Sanchez (UNM), R. Minchin (NAIC), E. Momjian (NRAO), J.L. Rosenberg (GMU), S. Schneider & Z. Butcher (UMass), L. Staveley-Smith & E. Viaz (UWA), C. Springob (ICRAR), B. Koribalski (CSIRO) Abstract: Galaxies are hard to see behind our own Milky Way. There is a "Zone of Avoidance" for optical astronomy there, but radio waves from neutral hydrogen gas in optically-obscured galaxies are easily detected by the Arecibo radio telescope. With the unparalleled sensitivity of Arecibo, and its state of the art receiver system, we have found about 500 galaxies, and we're on track to uncover ~1500 more. This discovery will shed light on motions of galaxies in the nearby Universe, and how galaxies flow at larger distances through space, pulled by important gravitational sources, some of which are hidden behind the Milky Way. Our survey is able to make a three-dimensional map of the distribution of hidden galaxies, and will be unsurpassed for years to come. We have published several refereed papers: Henning et al. 2010 Astronomical Journal, 139, 2130 McIntyre et al. 2011, Astrophysical Journal Letters, 739, 26 McIntyre et al. 2015, Astronomical Journal, 150, 28 Ph.D. thesis: McIntyre 2015 Ph.D. Thesis, University of New Mexico Further, we have published numerous conference proceedings and American Astronomical Society abstracts (BAAS): Henning et al. 2006, BAAS, 38, 133, Henning et al. 2008, in The Evolution of Galaxies Through the Neutral Hydrogen Window, AIPS Conf. Proc. 1035, 246 Lamm, R. et al. 2007, BAAS, 39, #132.22 McIntyre et al. 2011, BAAS, 43, #409.08 McIntyre et al. 2011, BAAS, 43, #246.18 McIntyre, T.P., Minchin, R., & Henning, P. 2012 AAS meeting 219, #410.03 Springob et al. 2006, AAS Meeting 209, #95.04, BAAS, 38, 1034 Springob et al. 2008, in Dark Galaxies and Lost Baryons, Proceedings of the International Astronomical Union, IAU Symposium, Vol 244, 383 Truebenbach, A. et al. 2012, AAS Meeting 219, #252.18 These Arecibo data have figured in public outreach. Henning has given five public lectures featuring the survey in the United States and Australia. Further, note over the course of this project, 11 students have been involved, 7 of whom are women.	Against Closure	Email	6/19/2016	

Comment Number	First Name	Last Name	Affiliation	Comment	Category	Comment Source	Date Comment Received	Attachments
118	Anthony	Post	Rensselaer Polytechnic Institute	I am writing in response to the notice of intent to produce an Environmental Impact Statement regarding the future of the Arecibo Observatory. As an undergraduate student at Lafayette College, I undertook research using the Arecibo Observatory for studies of pulsar astrophysics as part of a summer research internship and senior thesis. During my summer research program, I visited and made observations with the telescope. For my senior thesis, a large part of the data I used was gathered from Arecibo. Through both of these projects I learned skills in computer coding and algorithm development, in addition to astrophysics itself. This experience was a significant part of my development as a researcher, and was an important step leading to my present position as a graduate student in physics. I hope that the Observatory can remain in operation with a science-focused research program, and that it can continue to provide such valuable experiences for future students.	Against Closure	Email	6/19/2016	
119	Dr. Julio	Urbina	Associate Professor (814)-863-5326 E-mail: jvu1@psu.edu Communications and Space Sciences Lab Department of Electrical Engineering The Pennsylvania State University	I can only envision high impact citation impact that is typically greater when research groups collaborate, as indicated in the article Collaborations: The fourth age of research by Jonathan Adams, Nature 497, 557–560 (30 May 2013), doi:10.1038/497557a. The science applications of AO with the new HF-radar are unique and include meteor aeronomy and physics applications as well as radio science investigations. In these applications major issues include exploring the recently discovery—using Arecibo V/UHF observations—that the vast majority of meteoroids visible as radar meteors fragment rather than simply ablating. This process is likely a source of considerable aeronomically important nanometer “dust” in the 80-130+ km meteor zone. Other important science areas include studies of mid-latitude spread-F, sporadic-E instabilities, quasi- periodic echo (QPE) structures, low-altitude quasi-periodic echo (LQPE) structures, and detection of the D-region ionization enhancements associated with lightning-related elves using the radar in wave-interaction and/or partial-reflection modes. These types of research can only be conducted at AO. I grew up in a very poor suburb of Lima, Peru, but was fortunate enough to study and complete my undergraduate education in Peru. I was also fortunate to have great mentors in Peru, whom guided and encouraged me to go an extra mile and pushed me to pursue an advanced degree in the United States. I did my Ph.D thesis at AO and I can attest of the impact that AO has had in my career and it continues to be a source of inspiration to underrepresented students. Undoubtedly AO has strong broader impact in reaching out to minority students and engaging them in pursuing a career in STEM fields. AO has also been a steady source of engineers and scientists. Many of my graduate students did their research at AO and are working at SpaceX, Jet Propulsion Lab, DoD, and several national laboratories. College of Engineering The Pennsylvania State University 121 Electrical Engineering East University Park, PA 16802-2705 (814) 865-2212 (814) 865-7065 (FAX)	Against Closure	Email	6/19/2016	Urbina-Letter-NSF-EIS.pdf
120	Dr. Julio	Urbina	Associate Professor (814)-863-5326 E-mail: jvu1@psu.edu Communications and Space Sciences Lab Department of Electrical Engineering The Pennsylvania State University	I write this letter in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory (AO). I strongly request NSF to choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." AO is a unique institution that has incredible potential to continue: making scientific discovery, training future scientists and engineers, cultivating international collaboration, and perhaps transform higher education if AO becomes a degree granting graduate and post-graduate that would be truly remarkable to Puerto Rico and Latin America. The proposed higher education approach has been discussed elsewhere as the Puerto Rican Institute for Advanced Studies (PRIAS). With this avenue, there is an amazing opportunity to make stronger links between the United Stated and South America, a component that is missing; despite the fact that South America is not too far from the mainland.	Alternative Consideration	Email	6/19/2016	Urbina-Letter-NSF-EIS.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
121	Garrett	Wiens-Kind		I don't know if you know this, but there is an amazing opportunity to crowdfund Arecibo. In every millennial's mind there a fondness for the Nintendo 64 title GoldenEye, a video game based on the Bond movie of the same name. What's interesting is that GoldenEye became even more popular than the movie and is considered a classic game up there with Super Mario Brothers. Why would anyone who's played GoldenEye care about Arecibo? The millennials know it by a different name, "Skyhook." This is what the facility is called in the film, and also the name of the level in the video game. All you have to do is name the campaign. "Save The GoldenEye Skyhook" and then make a slight nod to the fact that the facility was used in the bond movie and the game. Of course talk about all the great science and the benefits for Arecibo regionally. The internet will go nuts. I promise. You'll get on all of the millennial tech blogs. If you get the rewards right, you could easily raise 12 million dollars. Do you know how badly I want a "I saved the Skyhook" t-shirt? Badly. Actually scratch that, the t-shirt I really want is "Make Skyhook Great Again." Think about that on a t-shirt and awesome that would be! Look the Smithsonian raised substantial funds for their museum. "https://www.kickstarter.com/projects/smithsonian/reboot-the-suit-bring-back-neil-armstrongs-spacesu" They did it! You never know if you don't try.	Alternative Consideration	Email	6/19/2016	
122	Fronefield	Crawford	Associate Professor of Astronomy Faculty Don of Weis College House Department of Physics and Astronomy Franklin and Marshall College P.O. Box 3003 Lancaster, PA 17604-3003 USA email: fcrawfor@fandm.edu office: (717) 358-4499 fax: (717) 358-4474	I am writing in support of the continued operation of the Arecibo Observatory for astronomy. A number of undergraduate students that I have supervised and I have used Arecibo for various pulsar-related projects in recent years. One of these projects is a search for new pulsars in another spiral galaxy, the Triangulum Galaxy. To date, no pulsars have been discovered outside of our Galaxy with the exception of pulsars located in dwarf satellite galaxies, the Magellanic Clouds. Arecibo is the only telescope capable of possibly detecting such pulsars owing to its exquisite sensitivity (this is since it has such a big collecting area). In addition, new instrumentation recently commissioned at the telescope (the so-called PUPPI backend) has vastly increased the bandwidth available for low frequency observations. This combination makes our search for pulsars in the Triangulum Galaxy the most sensitive ever undertaken. I note that the new instrumentation is a key piece of this project: it is a mistake to think that Arecibo is outdated just because the dish is old. With new technology being developed, such as PUPPI, the telescope remains at the forefront of pulsar astronomy.	Against Closure	Email	6/20/2016	M33_letter_to_AST_for_Arecibo.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
123	Jonathan S.	Friedman		I am a long-time (24 years) employee of and scientist at the Arecibo Observatory, where I currently hold a ½-time position while serving as the Director of the Puerto Rico Photonics Institute (PRPI) at the Universidad Metropolitana. I write with respect to the Environmental Impact Statement under preparation for the Arecibo Observatory, in consideration of a range of prospective futures for the astronomy, planetary science, and space and atmospheric science institute. Although not all I have to say is directly relevant to the EIS, I believe the EIS cannot be separated from the need for a positive, pro-active approach by the NSF in assuring a secure and certain future for Arecibo, open and productive. I am conscious of the pressures NSF faces, given flat budgets and the urgent need to advance science in response to the scientific community and national interest. I am also conscious that responsible stewardship of facilities you operate should include plans for decommissioning. I do not object to the NSF taking steps to address its life-cycle responsibilities for Arecibo just as it should do with all of its facilities. My objection comes from the perception of, after nine years of implied threats to the existence of the Arecibo telescope without taking a pro-active approach towards alternatives, when it finally appears the first steps were taken with the Dear Colleague letter, the NSF proceeds on a path that implies closure. What do I mean? In my view, rather than piecewise taking your legally required steps along with other actions designed towards defining Arecibo's future, a more positive and progressive approach is called for. This would start by laying out a series of steps that the NSF will take. Then, meetings such as the EIS public comment meetings held in San Juan and Arecibo on June 6 would be seen as steps in such a process. By not having a published and publicized process, NSF has inadvertently created a situation where the public image is negative: termination. As to the future of Arecibo: Under the new management structure, Arecibo is for the first time closely integrated into the Puerto Rican community, both publicly and in its institutes of higher education. Under this paradigm, I was able to connect Arecibo research and development to its Puerto Rico partner university by founding the Puerto Rico Photonics Institute (PRPI). PRPI is only one of a number of initiatives underway to enhance Arecibo's science by much more profound involvement from Puerto Rican universities and researchers. With the recent evolution of Arecibo, I see option 2 as the only viable future for Arecibo. Continued funding under the current model is clearly not sustainable by the NSF and only leaves the Arecibo staff facing the constant pressure of its uncertainty, and thus unable to plan for the future, thus dooming Arecibo to decline. Option 3 is also not viable, nor is option 4, and mostly for the same reason. Whether to mothball it with the idea of opening in an undefined future or maintaining minimal operational levels for the purpose of education and tourism requires a budget of many millions each year. I recall that a study completed in the final years under Cornell administration estimated that this cost would exceed $6M, just to keep the telescope safe. Even if the number is less, it is not unsubstantial, and it unlikely that there would be close to sufficient income under Option 3, or available funding for Option 4. Option 5 is also not viable, as the cost of deconstructing the telescope, even minimal deconstruction, must be too much to consider. My suggestion is simple: The NSF will have a major interest in Arecibo science, as long as there is science to do there. As the current major stakeholder, NSF should host a conference and invite the responders to the Dear Colleague Letter along with other	Decision Process	Email	6/20/2016	Letter to the NSF-EIS 10 June 2016.pdf
124	Patryk	Giza	Electrical Engineering Miami University	I write to urge that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." During my time as an undergraduate at Miami University, I had a chance to work and collect data with the staff at Arecibo National Observatory. During my time at the Observatory, I learned about the ionosphere as well as different topics in astrophysics, plasma physics as well as radio telescopy. With the data I collected and a group of my peers, we analyzed the data and ended up getting our first scientific publication ever! This was a major event in my life, and I'm definite it helped within my job search. In short, the work I was able to conduct and the subsequent paper published allowed to be a successful electrical engineer, so I urge the committee to allow Arecibo to operate with the NSF.	Against Closure	Email	6/20/2016	
125	Dr. Yun	Gong	Postdoctoral fellow Electrical & Computer Engineering Department 260D Garland Hall Miami University Oxford, Ohio 45056	I write to urge that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . , namely "Continued NSF investment for science-focused operations (No-Action Alternative)." The Arecibo incoherent scatter radar (ISR) is the most powerful instruments in observing the ionosphere in the world since its operation in 1963. Thanks to this powerful radio wave detector, I have done many interesting works in studying the fascinating ionosphere and obtained my PhD degree. I have been to the Arecibo Observatory. Natural Karst terrain, large limestone sinkholes, cat-walk, and the dome caught my eyes. Folks in the facility are very nice. This amazing place should not be shut down. I believe that for many researchers and college students, the Arecibo Observatory is irreplaceable. Great works cannot be done without the Arecibo Observatory!	Against Closure	Email	6/20/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
126	Kristina	Kaldon		I was fortunate enough to be selected for the summer 2014 Arecibo Observatory REU (Research Experience for Undergraduates) program. It was a life changing experience in which I really discovered what it meant to be a scientist. The employees and scientists at Arecibo Observatory are the most welcoming, intelligent, and passionate people I have ever met. They moved their lives to rural Puerto Rico for this telescope and the scientific advancements it promises. My current position at MIT Lincoln Laboratory is due largely to the work I did at Arecibo Observatory. I have never felt so tangibly close to the cosmos and future of astronomy and planetary science. It truly saddens me to think the future funding of Arecibo Observatory is even up for question. My dream career, ever since my first day at the observatory, is to end up working there. My experience, and the experiences of the others in the program, has led us all to more passionately and aggressively follow our hearts and reach for what we once thought was unreachable, especially in a scientific and educational sense. After working with concrete data and hardware, we take things seriously now knowing first-hand there is a future for all science. To think that future students, scientists, and the general public will not be able to visit and see the great things that come from this telescope is a national disgrace. The structure of classes and the way we learn at most universities is broken. Undergraduates need to gain hands-on experience and see how things work. We learn how to analyze but not where data come from or how it is collected or processed. At Arecibo Observatory, I learned how data are collected, how radars work, how signals are generated and received, how environmental aspects play a factor, why fast Fourier transforms matter, how one has to process signals, the equipment and manpower needed to process the signals and run the hardware, the preciseness of measurements and clocks, the cooling mechanisms needed for the machinery to work, how images are produced, how to code programs, how to break signals into different data streams, and so much more. Before my time at Arecibo Observatory, I only saw data in the form someone else had uploaded it, had one way to process it, and analyzed what I saw. After working at Arecibo Observatory, I see the beauty in how everything comes together to work; I realize how science is so much greater when you learn the engineering and hands-on aspects of data collection and when you can first-hand see how much work goes into collecting data. It means a lot to learn it in person; there are images in my head of the observatory that I will never forget. When I learn from doing, I remember so much more vividly than in a classroom. The fact the USA owns this masterpiece of science and could possibly let it go to waste is a silly idea that needs to be forgotten. This place is everything STEM in America needs to be and how to make our students the best. I have personally benefitted, watched other students benefit, watched Puerto Rican citizens smile and revel at the size of the dish at the visitors center, read blog posts of visiting scientists and how much they loved their time at the observatory, and personally boasted every chance I got. I have not spoken with one person who would say bad things about this observatory and the scientists and faculty that work there. As a committee chair for the Hispanic Latino Network at work (a position I received as a non-Hispanic because of my general love of Puerto Rico due to my time there), I find Arecibo Observatory a great asset for Hispanic minority expansion in STEM. Puerto Ricans can come to the visitor center and see first-hand how groundbreaking science is happening in their backyards. This tangibility, along with the space academy program and REU, allows them to develop a passion for science and astronomy. This is so important because we see a lack of interest in STEM among minorities. I hope you all realize the severe impact this would have on continental US students, Puerto Rican students, scientists around the world, personal lives, and how we are viewed by the scientific community. Research needs to mean more. We need more people exposed to it and we need to take a stand and find permanent methods of funding for this amazing observatory that I am proud to have called home. I strongly advocate for option one, where the observatory stays running the way it is and science-focused operations continue as before. This is the best option and allows all to benefit. In terms of future funding, issues may come up frequently again and I would not enjoy having to express how ridiculous it is that funding is an issue every year so I understand how this option might not be viable.	Against Closure	Email/mail	6/20/2016	Aoletter-finalKaldon.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
127	Kristina	Kaldon		Option two is possibly realistic but should target Federally Funded Research and Development Centers (FFRDCs). I suggest checking with FFRDCs such as MIT Lincoln Laboratory as a potential source of funding. Line funding is used for internal research and development, which often involves outside collaborations. FFRDCs normally have funding like this available for science expansion programs, to which Arecibo Observatory sounds like a perfect candidate. Also, from a national security standpoint, I cannot see how we would even consider letting China have the capabilities of Arecibo Observatory while we decommission ours. The third option, transitioning to education-focused operations over research operations, is a horrible idea. The entirety of the observatory's status and educational value lies in the research. To cease research, everything I've already mentioned goes to hell: the experiences of students would be terrible and the experiences for scientists would be nonexistent. The fourth option, temporary suspension of operations, is a clear cop out. When can we foresee the scientific community getting so much extra funding that the observatory would be up and running again in a non-set time period? There would still be significant maintenance costs and if you chose to not maintain the dish, it would be useless in a few months. I don't see this as a feasible option at all: high costs with no return. Option five, is the most sickening but hopefully the least likely. Deconstruction would be expensive and stupid. Think of all the amazing things that have been discovered using this dish. Think of the life, both plants and animals, that has grown and lived here and how that destruction would affect the environment and ecosystem. Think of all the raw and organic side effects, all the science and education the observatory offers, the diversity, the wildlife, and the coquís! The observatory has brought so much knowledge, happiness, diversity, and biology over the years. We need to find a viable option to keep it running with the science and education it now offers. Please do not change my old home for the worse; I want to remain as proud as I am today. Please feel free to contact me for any more information or clarification. I have specific people I can also refer to if need be.	Alternative Consideration	Email/mail	6/20/2016	Aoletter-finalKaldon.pdf
128	Amy	Lovell	Professor of Astronomy Agnes Scott Department of Physics & Astronomy alovell@agnesscott.edu 404-471-6265	I am writing in response to the invitation for public comments on environmental impacts of the Arecibo Observatory, and regret that I cannot be present at either of the public scoping meetings. I am offering comments related to the impacts of Arecibo Observatory on cultural resources, health and safety, and socioeconomics. As a national facility located in the US territory of Puerto Rico, the Arecibo Observatory is a major cultural resource on the island. The facility attracts large numbers of tourists, both from the island and from the rest of the world, forming part of Puerto Rican cultural identity and a strong point of pride. Even more importantly, the Arecibo Observatory is a very important part of STEM education on the island: thousands of school children visit the facility to learn about the scientific and engineering accomplishments made there and become inspired about their own futures. Hispanic STEM professionals are still vastly underrepresented: in spite of being 20% of the college-age population, only 5-9% of physical sciences, mathematics, and engineering degrees (https://www.aps.org/programs/education/statistics/hispanicmajors.cfm) are awarded to Hispanic college graduates. The Arecibo Observatory educational programs get children interested, and the student research programs (summer and Saturday) have a huge impact in recruiting and retaining talented Latino/as into the STEM workforce. This is a cultural as well as socioeconomic impact that extends way beyond the island itself. Finally, it is probably a larger, bigger-picture safety impact than is often considered in the Environmental Impact Statement, but the Arecibo Planetary Radar plays a pivotal role in the investigation and characterization of potentially hazardous asteroids (PHAs). This highly sensitive capability is not matched anywhere else in the world, and without this radar, we will be significantly less able to assess asteroid impact hazards, which affects the health and safety of the entire planet. I urge you to consider these factors as you prepare the EIS for Arecibo Observatory: in addition to being a unique scientific facility which has served as an international model for interdisciplinary scientific and technical accomplishment, it has important cultural, safety, and socioeconomic importance in PR and across the Earth.	Against Closure	Email	6/20/2016	AreciboEISComments.pdf
129	Sergio Colon	Medina		Por decadas el Radar de Arecibo a sido el oido del planeta para escuchar el Universo , seria una trajedia para la Ciencia si dejase de funcionar	Against Closure	Email	6/20/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
130	Marjan	Tibbe	Office Manager Liesbet Elpenhof Secretary Radio Observatory Division and Astronomy Group ASTRON Oude Hoogeveensedijk 4 7991 PD Dwingeloo The Netherlands www.astron.nl Tel: +31 (0)521 - 595776 (Marjan) Tel: +31 (0)521 - 595790 (Liesbet) Fax: +31 (0)521 - 595101 e-mail: secretaryobservatory@astron.nl and secretaryastronomy@astron.nl	As chairman of the Consortium board of Directors of the European VLBI Network (EVN), t write to express our deep concern about the continued availability of Arecibo Observatory for the astronomical community in general, and for Very Long Baseline Interferometry (VLBI) observing as an associated member of the EVN in pafticular. Radio Astronomy is an important tool in basic scientific research to provide answers to fundamental questions in the minds of many members of the general public: where did the world around us come from, what does it consist of, how did it form? Exposure to astronomy, perhaps more than any other science, is able to capture the imagination of youngsters and draw them into an education in science or engineering. Radio Astronomy requires highly sensitive telescopes to receive and study the very faint natural emissions from celestial bodies and physical processes occurring in the remote Universe. Time and again, sophisticated techniques, instruments, and (increasingly) software algorithms and ICT or Big Data applications first designed for Radio Astronomy find their way to societal applications not dreamt of originally. The collecting area of the Arecibo Observatory 1000 ft dish is nearly ten times larger than that of any other radio telescope in the world. 1 expect that other concerned members of the astronomical community will address how, in and of itself, the resultant exquisite sensitivity to faint radio waves brings fantastic scientific oppoftunities. Here, 1 wish to emphasize the important and irreplaceable role of Arecibo Observatory in VLBI networks, and in the EVN in particular. The EVN offers ultra-high resolution imaging of faint celestial objects. The greater the distances between the pafticipating telescopes, the flner the details of the resultant celestial images. The EVN is a partnership between prominent independently operated radio observatories on several continents. The EVN Consortium Board of Directors is continuously focused on expanding the capabilities of the network, in order to offer cutting-edge capabilities for high-impact science projects. The EVN is accessible indiscriminately by astronomers world-wide, based on rigorous peer-review of observing proposals; many regular users of the EVN are based in the USA. Arecibo specifically extends across the Atlantic the EVN network of large-diameter telescopes in Europe and Asia (perhaps superfluously: Arecibo's position in the EVN cannot be suppianted by the Chinese EAST telescope, now under construction, which should have a similar effective collecting area at zenith, but is located nearly on the opposite side of the globe). Since the VLBI technique spreads out the already faint radiation from celestial objects into progressively more "pixels", t is crucial to achieve the greatest possible sensitivity on the longest distances in order to see the finest details. Arecibo's great collecting area, extending the longitude range of the EVN array of telescopes, is therefore vital to the most demanding high-resolution high-sensitivity studies. Just a few of the most prominent application areas inciude pulsar astrometry (beacons which for example allow timing and measuring the geometry of the Galaxy with profound importance for the study and interpretation of gravitational waves), cosmic maser kinematics (shedding light on the formation and evolution mechanisms of stars and planets), and deep studies of distant starbursting and active galaxies (which harbor highly energetic supermassive black holes in their nuclei). Arecibo's share just a few years ago in the resolution of the "Plelades distance controversy" was an important landmark in the establishment of consistent yardsticks to measure the cosmos, and an excellent illustration of the vital role of this extremely large telescope in fundamental VLBI studies. Please allow me to conclude, therefore, by expressing my fervent hope, as chairman of the EVN, and also as a concerned researcher in astronomy personally, that the means will continue to be found that will allow Arecibo to retain its prominent position in radio astronomy, and in pafticular to remain with us as an irreplaceable partner in the EVN.	Against Closure	Email	6/20/2016	Arecibo Obervatory 200616.pdf
131	Huib Jan	van Langevelde	Director of the Joint Institute for VLBI ERIC (JIVE) Professor Galactic Radio Astronomy at Leiden University	On behalf of the scientists and technical staff, as well as the international partners who collaborate in JIVE, I write you to express our concerns on the future of the Arecibo Observatory. The Arecibo Radio Telescope plays an indispensible role in Very Long Baseline Interferometry (VLBI) studies as the world's single-most sensitive radio astronomy instrument. Over the past four decades it has provided unique capabilities for a broad range of cutting-edge studies in fundamental and applied disciplines. The users of the JIVE research facility remain very keen to use the Arecibo telescope in their high-resolution observations, for example of interstellar masers, Fast Radio Burst or future gravitational wave events. The recent addition of a 12-m parabolic dish to the suit of instruments of the Arecibo Observatory opens up new perspectives of even more efficient advanced phase-referencing VLBI experiments. Moreover, the imminent commissioning of the large Arecibo-like radio telescope FAST in China probably makes Arecibo's VLBI role even more important: we are looking forward to have both super-sensitive elements in the VLBI array for "relay" observations with unsurpassed sensitivity. We are convinced that with the progress of analogue and digital electronics, the Arecibo telescope will continue to be the prime science tool for most sensitive radio astronomy investigations at least until the Square Kilometre Array (SKA) becomes operational (in mid 2020s) and very likely beyond that. Denying the Arecibo telescope to progress further will have detrimental effect on the development of world radio astronomy, and science in the region specifically. We hope for many more years of exciting collaboration with the Arecibo Observatory staff.	Against Closure	Email	6/20/2016	supportAO.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
132	Yong	Zheng	Columbia	The Accretion of Star Formation Fuel onto a Nearby Spiral Galaxy Y. Zheng, J. E. G. Peek, J. K. Werk, M.E. Putman It remains puzzling how a galaxy can sustain star formation over the age of the universe. The search for the accretion of star formation fuel onto a galaxy has continued in order to construct a clearer picture of galaxy evolution and our project is the first to clearly detect gas accretion toward the disk of the nearby Triangulum Galaxy (M33). We accomplish this by analyzing neutral hydrogen spectra from the Arecibo Galaxy Environment Survey and the Galactic Arecibo L-band Feed Array survey, together with ultraviolet spectra from the Hubble Space Telescope. With the Arecibo spectra as the reference point, we are able to show that there exists a disk-wide ionized gas inflow which can be kinematically modeled as an accreting layer above the galaxy's disk. The data from Arecibo Observatory also provide a critical measurement of the neutral hydrogen content in the accreting layer; based on which we quantify the metal enrichment of the accreting gas. This directly hints that the detected gas inflow is material that has been recycled through previous generations of stars and may be gas that was once inside M33. Our M33 project is among the first to clearly reveal the existence of an ionized gas inflow onto the disk of a galaxy beyond the Milky Way.	Against Closure	Email	6/20/2016	
133	Dr. Marina	Brozovic		I write to strongly urge that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." As a scientific user of Arecibo Observatory for almost 10 years, I can attest to its unique role in the planetary sciences. Arecibo is the world's most powerful planetary radar and it is 20 times more sensitive than the next best instrument – Goldstone Solar System Radar in Mojave Desert, California. Only Arecibo can obtain ranging measurements of the Galilean satellites of Jupiter (Io, Europa, Ganymede, and Callisto) that are 50 times more precise than the best optical measurements. These precise measurements of the satellites' line-of-sight positions are needed to detect orbital changes due to tidal dissipation within Jupiter or the satellites themselves. Tidal dissipation is one of the few constraints available on Jovian interior models. The tidal responses of the satellites are of particular interest since this is directly related to heat dissipation that causes volcanism on Io and can keep sub-surface oceans from freezing on Europa. We started this observing program in the winters of 2015 and 2016, and we hope to continue in 2022 when Jupiter comes back into the declination window of Arecibo for another 6 years. The long data arc is essential for this study. We used Arecibo to obtain the very first radar images of the satellite Io that is famous for its volcanic activity. The radar images obtained in February of 2015 displayed some tantalizing evidence that the volcanic activity could be detected by this technique. If this gets confirmed in the future Arecibo data, this will be incredibly exciting news for many planetary astronomers. The combination of optical and radar data could provide completely new insights into the solar system volcanism. Arecibo is the only observatory in the world that has a radar capability to conduct this type of research. I could cite several other examples of the role that Arecibo alone can play in my other research (near-Earth asteroids), and many others can and will do so. The telescope is the state-of-the art and one-of-a-kind. Thus, I urge NSF to continue to fund Arecibo. Thank you for reading this letter.	Against Closure	Email	6/21/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
134	Dr. Helen M.	Burt	Executive Assistant to Dr. Helen Burt, Vice President Research & International pro tem Office of the Vice President Research & International The University of British Columbia Old Administration Building 111 – 6328 Memorial Road | Vancouver, BC Canada V6T 1Z2 Phone 604 822 0233 | Fax 604 822 6295 fred.woo@ubc.ca | research.ubc.ca	I am writing to encourage renewed support for the Arecibo Observatory from the National Science Foundation. This telescope is essential to the research program of Dr. Ingrid Stairs, who is a Full Professor at UBC and a Senior Fellow of the Canadian Institute for Advanced Research's Program in Cosmology and Gravity. In her 14 years at UBC, Prof. Stairs has mentored 10 trainees on the use of Arecibo data, seeding the next generation of Canadian and international radio astronomers. Prof. Stairs studies the radio-emitting neutron stars known as pulsars, and has been awarded hundreds of hours of Arecibo time to search for new pulsars and to test the predictions of Einstein's theory of General Relativity. In particular, she is a founding member of the North American Nanohertz Observatory for Gravitational Waves (NANOGrav), which monitors the fastest-spinning pulsars with the aim of making a direct detection of gravitational waves. I understand from Prof. Stairs that NANOGrav will be sensitive to gravitational waves from pairs of supermassive black holes in distant galaxies, making it a perfect complement to the Laser Interferometric Gravitational Wave Observatory (UGO) experiment which has recently enthralled us all with the identifications of black-hole binaries of tens of solar masses. This is indeed an exciting new field of astronomy, and I am pleased that UBC has an opportunity to play a leading role. I understand that the NSF is preparing an environmental impact statement to aid in deciding the future of Arecibo. Since Arecibo is the most sensitive radio telescope in the world, its loss would be a severe blow to Prof. Stairs'research program and to the NANOGrav collaboration, delaying the anticipated time of detection of gravitational waves and limiting the collaboration's ability to conduct follow-up astrophysical studies. I understand from Prof. Stairs that, while there are potentially suitable alternative telescopes on the horizon, the FAST telescope in China has open questions with regard to its accessibility to worldwide scientists, while the planned Square Kilometre Array in South Africa is years from completion. I therefore urge you to maintain support for the Arecibo Observatory until a telescope with similar sensitivity is available for use by the NANOGrav collaboration. This will ensure a bright future for a research program that has the potential to join UGO in providing an expanded view of black holes in our universe. I appreciate the investment that the National Science Foundation has made in supporting leading astronomers around the world, such as Dr. Stairs.	Against Closure	Email	6/21/2016	Arecibo Obervatory Support Letter.pdf
135	John M.	Cannon	Associate Professor and Chair Department of Physics & Astronomy Macalester College 1600 Grand Avenue Saint Paul, MN 55105 (651) 696-6798 jcannon@macalester.edu	I write to strongly urge that the National Science Foundation chooses alternative #1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." As a scientific user of Arecibo Observatory for over 10 years, I can attest to its continuing importance for studies of galaxies. Its enormous collecting area (the largest in the world) has been and continues to be crucial in studies of faint objects, such as low-mass galaxies. Most importantly, although the facility is over fifty years old, it has undergone two major upgrades, each of which created an essentially new, far more powerful telescope. Consequently it remains in the prime of its scientific life, still able to make important and impactful scientific discoveries. While many radio astronomers (including myself) use multiple-dish interferometers for high angular resolution observations, there remains an important need for large single dish telescopes such as Arecibo. As the ALFALFA blind HI survey (Giovanelli et al. 2005, AJ, 130, 2598) demonstrates, Arecibo has an unique capability to catalog the faintest HI sources at a variety of distances. My own research program at Macalester College leverages this capability in a fundamental way. The faint galaxies discovered by Arecibo are subsequently observed with interferometric instruments to determine physical characteristics such as rotational velocity, neutral gas surface densities, etc. It is important to stress that these types of galaxies can only be discovered by Arecibo; the Sloan Digital Sky Survey and interferometric observations do not provide the same discovery potential. As a demonstration of the power of the synthesis between Arecibo and other observatories, consider that ALFALFA observations conducted with Arecibo have now discovered two of the five most metal-poor galaxies known in the local universe: Leo P (Skillman et al. 2013, AJ, 146, 3) and Leoncino (Hirschauer et al. 2016, ApJ, 822, 108). Given the decades-long quest to discover more of these sources via optical searches, this is especially meaningful. As the best analogues of the metal-poor first galaxies, these local systems offer optimal environments in which to test fundamental parameters of the big bang cosmological model (e.g., the primordial Helium abundance). I can cite more than a dozen peer-reviewed scholarly manuscripts that stem from ALFALFA observations that involve Macalester College undergraduate students. Arecibo plays a critical role in the professional and scientific development of these students. The telescope thus remains a unique, powerful, flexible, and pedagogically central instrument for the 21st century.	Against Closure	Email	6/21/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
136	H. Thankful	Cromartie	PhD Candidate The University of Virginia Dept. of Astronomy	In light of the Environmental Impact Statement being prepared for the Arecibo Observatory (AO), I am writing in adamant support of the no-action alternative; that is, to keep the observatory running normally. During the summer of 2013, I conducted research at AO as an NSF Research Experience for Undergraduates (REU) student. My time in Puerto Rico was pivotal for me both scientifically and personally. As an undergraduate student at the University of North Carolina at Chapel Hill, I had abandoned my passion for journalism to pursue physics and astronomy. Though I had fallen in love with astrophysics, I was exceedingly unsure of my ability to continue in the discipline. I applied for the REU program at Arecibo simultaneously hoping to get a taste of academic science using world-class facilities and wanting to explore whether I felt truly passionate about astrophysics as a career. I left Arecibo in August feeling absolutely transformed — confident in my scientific abilities and sure of my desire to apply to graduate school in astrophysics and continue seriously in the discipline. As a summer student, I used the Arecibo telescope to search for new Millisecond Pulsars (MSPs) in unidentified gamma-ray sources cataloged by the Fermi telescope. I learned how to observe using AO, and how to reduce and analyze data. As a result of my REU research, I discovered a total of 11 new MSPs. The results of my AO discoveries are detailed in a paper, Cromartie et al. 2016 (http://arxiv.org/abs/1601.05343). My time in Puerto Rico was more than scientifically transformative, however. Living at the observatory and interacting with its scientists, engineers, and support staff on a daily basis made me understand what an incredible and vibrant community exists in order to keep the telescope in operation. The group of REU students of which I was part was a diverse group of men and women from both Puerto Rico and mainland US institutions. We all conducted research that excited and inspired us; I know that many of the students in my program have continued in astronomy and atmospheric sciences, and I suspect that our experience at AO is significantly responsible for this. Living with the other students on-site, traveling around the beautiful island as a group and tackling scientific problems together was an experience that I could not imagine having anywhere else. Puerto Rico, and AO especially, is a truly magical place. The REU program was a catalyst for lasting friendships and scientific collaborations (for me, this included meeting my current PhD advisor). AO is an investment the value of which must not be underestimated. Clearly, the telescope is still among the best in the world, especially for pulsar science. With the recent detection of gravitational waves by the LIGO collaboration, a new window into the Universe has been opened. As a graduate student at the University of Virginia, I am working as a member of the North American Nanohertz Observatory for Gravitational Waves (NANOGrav), which absolutely needs AO to stay open in order to continue conducting state-of-the-art research observing MSPs in the effort to detect gravitational waves. AO still has many productive years of science left in its life, and it would be an absolute shame to reduce the capabilities of its world-class facilities. Not only is AO ahotspot for scientific discovery, but it is a beacon for underserved students and those for whom scientific achievement was not accessible. I implore you to consider the children who are awe-inspired by visiting the telescope and museum, the high-schoolers who are given the unique opportunity to use a world-class telescope, and the college students who are given the chance to conduct real, publishable science and who are inspired to pursue a career in STEM fields because of their time at AO. The telescope is a place of multicultural exchange and scientific innovation that is unique among US-run facilities. The closure of AO would be a huge loss to American science, and especially to the thousands of underrepresented students who may never have access to another scientific facility so inspiring as Arecibo.	Against Closure	Email	6/21/2016	Cromarti_Arecibo.pdf

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137	Carl	Heiles	Professor of the Graduate School VOICE PHONE: 510 280 8099 Campbell Hall Astronomy Department University of California Berkeley, CA 94720-3411 FAX: 510 642 3411	I write this letter in response to the Federal Register Notice of an EIS concerning proposed changes to operations at Arecibo Observatory, in particular regarding the alternatives listed therein. I strongly request NSF to choose a combination of alternatives 1 ("Continued NSF investment for science-focused operations"), 2 ("Collaboration with interested parties for continued science-focused operations"), and 3 ("Collaboration with interested parties for transition to education-focused operations"). AO is a unique institution that already makes great contributions in these three areas and has tremendous potential to do even better—if only it were imaginatively and properly organized, managed, and funded. The Arecibo Observatory is a premier facility that serves public education and STEM activities; a worldwide icon representing "can-do" science and big-project engineering that stimulates intense worldwide fascination; and a high-level, forefront research instrument. As such, it ideally serves NSF's dual missions of research and education. Ever since AST/NSF formed the Senior Review Committee more than a decade ago, it has focussed exclusively on the research aspect. This is myopic vision at its worst, because Arecibo's research areas involve forefront mature science, which is not so "exciting" as the fashionable newest game in town, whatever it happens to be this year. Concentrating on the current short-term excitement at the expense of long-term detailed understanding makes it easy for NSF to bring Arecibo down—literally. NSF has steered grad students away from topics in which Arecibo excels; has tightened Arecibo's budget to eliminate its ability to maintain its widespread technological leadership; and selected the obviously unpromising triumvirate managing organization—SRI, USRA, and UMet—whose combination of incompetence, disinterest, marginal or unwilling technical ability, poor intercommunication, and—let's face it—budget-sapping maximization of internal overhead transfer has been very unhelpful. All this has turned Arecibo's focus from forefront technological innovation to just limping along, which makes it an easy target for NSF's axe. If you want to talk about environmental impact, here's what the impact will be when AST/NSF finally realizes its dream of ripping down the telescope and turning it back into rainforest and agricultural land: (1) Elimination of a major worldwide stimulant of young people's interest in pursuing science and engineering education and careers; (2) Elimination of a major source of public education, particularly in the Caribbean basin; (3) Elimination of a major piece of scientific infrastructure that enables inquiry-based unique research in several areas. I'm sure that NSF high-level bureaucrats will be rewarded and self-satisfied for their achievement of eliminating "old, outdated" facilities—while the world watches and counts yet another example of the United States' decline from its past worldwide leadership in science, technology, and related education. As a research facility, Arecibo serves three scientific areas: radio astronomy, planetary and near-earth-object radar, and aeronomy (both radar and lidar). My own research area is radio astronomy in aspects ranging from the study of Mira variable stars to the Galactic interstellar medium. In these topics I have worked closely with dozens of graduate students, postdocs, and career scientists in both the academic and the broader research world. This includes people from the US, Europe, Australia, China, South America, and India. As Arecibo users, they get turned-on by not only the technical excellence, but also the grandeur of what is probably the most widely-recognized iconic scientific facility in the world.	Against Closure	Email	6/21/2016	envltr_21jun2016.pdf

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138	Fredrick	Jenet	The ARCC Network Executive Team: Fronefield Crawford, Franklin and Marshall College Timothy Dolch, Hillsdale College Robert Ferdman, University of East Anglia (UK) Alma Guerrero-Miller, University of Texas-Rio Grande Valley Fredrick Jenet, ARCCNET Chair, University of Texas-Rio Grande Valley Volker Quetschke, University of Texas-Rio Grande Valley Xavier Siemens, University of Wisconsin-Milwaukee Tristan Smith, Swarthmore College Kevin Stovall, University of New Mexico Leslie Wade, Kenyon College Madeline Wade, Kenyon College	We are writing this letter in support of the continued operation of the Arecibo Observatory, an instrument that continues to impact the scientific community not only by delivering world class scientific results, but also by its unique ability to inspire students, especially underrepresented minority students, to pursue careers in STEM fields. The Arecibo Remote Command Center (ARCC) program, developed in South Texas at what is now known as the University of Texas Rio Grande Valley, is a highly successful integrated research/education environment that, at its heart, utilizes the unique nature of the Arecibo Radio Telescope to attract, train, and retain students in physics, computer science, engineering, and related fields (see paper attached from the proceedings of AO's 50th anniversary). The model was so successful that it has now expanded to several other colleges and universities throughout the United States. This collaboration, known as the ARCC Network, now includes the University of Wisconsin--Milwaukee, Franklin & Marshall College, Hillsdale College, Swarthmore College, and Kenyon College. Over the last eight years, 14 ARCC students have gone into PhD programs. This includes 7 underrepresented minority students in the last five years. In that same time, hundreds of high school and undergraduate students have been able to use the telescope to search for exotic stars known as radio pulsars. More than 60 new pulsars have been found to date by ARCC students. Now, we are ramping up efforts for ARCC students to be involved not only in the pulsar search efforts, but in the follow-up timing efforts as well. The existence of the Arecibo Observatory made it possible for the ARCC program to be created and impact the lives of so many people. Given the observatory's unique capabilities together with its "lets do it now!" management style that fosters creativity, no other observatory would be able play the same role.	Against Closure	Email	6/21/2016	ARCCPaper_v2.pdf

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139	David	Nice	Associate Professor Physics Department, Lafayette College niced@lafayette.edu +1-610-330-5204 http://sites.lafayette.edu/niced	I wish to strongly encourage you to pursue with all vigor any option which maintains the continued scientific operation of the Arecibo Observatory. The scientific capabilities of the telescope are unmatched by any other observatory in the world. Although the basic telescope structure is several decades old, the surface, optics, receiver systems, and data acquisition systems have all undergone upgrades, and it is only since 2012 that the full receiver bandwidth of the telescope has been usable for core science operations – in other words, this can realistically be thought of as a telescope that is only 4 years old! (Technically this refers to the combination of Gregorian optics, L-wide receiver, and ”PUPPI” data acquisition instrument, which roughly tripled the sensitivity of the telescope for many pulsar observations.) This ongoing development seems not to have been understood or appreciated by past telescope review committees. Further upgrades are planned to keep the receiving equipment at the cutting edge. The telescope holds a very promising future formany areas of studies, including highprecision millisecond pulsar timing. Work at Arecibo in this field has already yielded the first indirect evidence of gravitational waves (1993 Nobel Prize in Physics to Russell Hulse and Joseph Taylor), the first discovery of planets outside our solar system (Alex Wolszczan), and many other exciting discoveries. We have every expectation that pulsar studies at Arecibo will directly detect gravitational waves within the next few years. This discovery will be highly complementary to the recent direct detection of gravitational waves by the Laser Interferometer Gravitational Observatory (LIGO); the pulsar work done at Arecibo probes an entirely different part of the gravitational wave spectrum – waves with periods of years, instead of periods of milliseconds as at LIGO. Arecibo Observatory is uniquely powerful in its ability to measure and characterize near-Earth asteroids using its radar system. The environmental impact of such asteroids on Earth could be truly catastrophic, and continued work in this area is absolutely crucial. The educational mission of the Observatory is critical for several reasons. As the most prominent scientific research facility on the island, it contributes greatly to the education of Puerto Rican students, a large fraction of whom visit the telescope. The socioeconomic impact of the telescope on Puerto Rican students cannot be overestimated. The Observatory is an exciting and inspiring place for physics and astronomy students at all levels – from high school through postdoctoral scholars – to visit. Unlike most observatories, observers get real ”hands on” experience observing at Arecibo, rather than having observations made by professional telescope operators. Further, because of the nature of the data products collected at the observatory, many such students receive extensive education in computer programming, algorithm development, data analysis methods, and electronics, which they simply would not get were it not for this facility. This is a critical socioeconomic impact, affecting dozens or even hundreds of students a year. The Observatory also plays a prominent tourism role in Puerto Rico, a source of further socioeconomic impact. Radio telescopes are being developed elsewhere around the globe—most notably in China and South Africa—which may eventually meet or surpass the Arecibo telescope’s capability. However, it will be many years before any of these telescopes are in full operation and proven to be capable competition to the Arecibo telescope. Further, all are likely to have severely restricted access for astronomers from the United States (no ”open skies” policies), and surely none will match the educational impact of the Arecibo telescope. For all these reasons, I urge that the scientific operation of the Arecibo Observatory not be curtailed.	Against Closure	Email	6/21/2016	aercibo_eis.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
140	José Humberto Andrade	Sobral	PhD Cornell University, 1973	I am writing this letter as a former user and presently a scientific collaborator to the Arecibo Observatory-AO and also as a member of the " Arecibo Science Advocacy Partnership-ASAP". I visited the Arecibo Observatory-AO, for the first time, for a stay of approximately one month in June 1970 as a PhD student of the department of Electrical Engineering-EE of Cornell University, under the academic orientation of EE Professor D. T. Farley. My major PhD field of study was "Electrophysics", as it was called at that time, and my major research activity focused on the study of the ionosphere/thermosphere dynamics. Then I came back again to the AO, still as a Cornell PhD student, to the Arecibo Observatory for a longer stay, namely, from mid-1971 to February 1973, to carry out the ionospheric experiments necessary to my thesis. At that time in the early 1970 decade I was lucky enough to be a contemporary at the AO of some of the present ASAP and ASAP/Board members. In a later time, I performed a series of ionospheric experiments at the Arecibo Observatory in 1986, with a Grant from the National Science Foundation and local support from the AO and the Puerto Rico University/ Colegio Universitario de Humacao. This experimental campaign rendered to my former Puerto Rican junior research assistant Sixto Gonzalez, then an undergraduate student at the Colegio Universitario de Humacao –CUH, located at Humacao city, Puerto Rico inland, the first place prize in the United States/NSF sponsored MARC (Minority Access for Research Carreers) science contest for undergraduate students in field of study in Physics. At that time I was a Professor at the Physics Department of the CUH and also I got a prize of US$ 2,500 from the University of Puerto Rico – UPR in recognition of that student orientation and research carried out at the AO. A few years later Sixto became a scientist at the AO and the local Director. In addition, in the present time, two other staff scientists at the AO that have been my graduate students. Perhaps I should mention also that I have been kindly invited by AO staff members to the ceremonies of celebration of the 40th and 50th anniversary of the AO. I was present at both events. Therefore, my scientific involvement with the AO has been clear in the last 46 years. At present, I have plans to continue doing research at the AO in a collaborative scientific effort in the field of study of Space Weather focusing on the ionosphere-thermosphere-magnetosphere system with the collaboration of the Brazilian Institute for Space Research – INPE and possibly with other Peruvian or Argentinean Aeronomic observatories. Such effort will comprise AO Senior Researchers and both Latin American and US students, including the Puerto Rican university Universidad Metropolitana de Puerto Rico. I may mention that in the last few decades, I visited the AO very frequently and in the last decade I visited at least once a year for scientific/academic purposes.	Against Closure	Email	6/21/2016	
141	David J.	Thompson	Fermi Large Area Telescope Multiwavelength Coordinator	Since its launch in 2008, the Fermi Gamma-ray Space Telescope has actively pursued multiwavelength studies with a wide variety of telescopes, because we learn so much more about the Universe by looking at cosmic objects in a variety of ways. Surprisingly, gamma rays, the most energetic form of light, and radio waves, the least energetic form, are frequently produced in the same extreme astrophysical environments The combination of radio and gamma-ray observations reveal where and how powerful energy releases take place throughout the Universe. As a specific example, the unique capabilities of the Arecibo Radio Observatory have been crucial in our cooperative studies of pulsars, the rapidly rotating neutron stars representing endpoints of stellar evolution. The overwhelming majority of gamma-ray "stars" in the Milky Way are pulsars – understanding the high-energy nature of our home galaxy is hopeless if we do not first master the pulsars. Unidentified Fermi gamma-ray sources have become prime targets for radio pulsar searches, revealing many new black widow/redback pulsars, a 'missing link' in the evolution of millisecond pulsars. We have also found a new pulsar with radio, gamma-ray, and optical emission, and millisecond pulsars stable enough to be valuable additions to pulsar timing array searches for nanoHertz gravitational waves. Many of these discoveries were only possible with the extreme sensitivity of Arecibo. The Fermi observatory will continue operations for several more years, making use of the improved performance introduced last year, but it does have a finite lifetime. We look forward to continuing the ongoing cooperative projects with Arecibo, convinced that important scientific discoveries involving the synergy between Fermi and Arecibo will be made. Retaining the scientific capabilities of Arecibo is clearly essential to this process.	Against Closure	Email	6/21/2016	AreciboLetter_final.pdf

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142	Dr. Mark	Walker	Director Manly Astrophysics 3 / 22 Cliff St, Manly 2095, Australia www.manlyastrophysics.org	As a scientific user of the Arecibo Observatory I ask that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS ...", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." Much of my own research is outside the field of radio astronomy, but I have been an occasional user of Arecibo, and the other nationally-funded U.S. radio telescopes (VLA, VLBA, GBT). In each instance where radio data are important to one of my own projects, the scientific needs dictate the appropriate telescope to use, and in several instances that is Arecibo: it is in some respects simply the best telescope in the world. My understanding is that the EIS is not concerned with science per se. However, I think you cannot ignore the socio-economic consequences of the various possible alternative futures for the observatory, and there the scientific vitality of the observatory is crucial - any sort of downgrade would be detrimental. Although I haven't visited Arecibo Observatory myself, from the Australian counterparts (Parkes and Narrabri) I'm familiar with the impact that a world-class radio observatory has on its surroundings. Locally it imbues the community with a sense of pride, and provides pathways to employment at the state-of-the-art in various science and engineering disciplines. In the society more broadly it inspires people - it is a focus of technological achievement for the host community, who feel, in a way, that the telescope is theirs. If you were to downgrade the observatory in some way, then my guess is that the effect on the local community would be quite serious. No longer could there be pride in their world-class "temple of science", and there is a danger that they would be led to the idea that science and technology is not what they're good at. I do hope that NSF can maintain Arecibo as a world-class research facility.	Against Closure	Email	6/21/2016	
143	Douglas	Arenberg	University of Michigan	Please do NOT allow this important scientific and National Security (asteroids anyone) resource to fall victim to misguided and ill-informed attempts at "saving" money.	Against Closure	Website	6/22/2016	
144	Daniel	Balch		I am writing to urge the NSF to choose alternative 1 of its "Notice of Intent (NOI) to Prepare an Environmental Impact Statement and Initiate Section 106 Consultation for Proposed Changes to Arecibo Observatory Operations, Arecibo, Puerto Rico and Notice of Public Scoping Meetings and Comment Period," namely "Continued NSF investment for science-focused operations (No-Action Alternative)." I visited Arecibo Observatory this past January as part of a study abroad program led by Dr. Qihou Zhou, when I was an engineering undergraduate at Miami University of Ohio. During my time at Arecibo, I was very impressed by the facility and various types of research taking place there. With my classmates and Dr. Zhou, I toured the dish itself, the control room, the learning center, and a few other locations. I had the opportunity to hear a scientist and former coworker of Dr. Zhou deliver a 20-25 minute talk on how the radio telescope and radar are used, along with some technical details on how signals are processed and data is analyzed at the control room. I also attended a few lectures on how incoherent scatter radar works and its use for studying the ionosphere, with some specific information pertaining to Arecibo. Lastly, I participated in a project to analyze data that was collected at Arecibo while we were there. Based on the technical details I learned about Arecibo and the research taking place there, I am convinced that Arecibo Observatory is among the most valuable assets in the world for radio astronomy and the study of the ionosphere, and firmly support alternative 1 to continue funding for science-focused operations and avoid any fundamental changes to the nature of operations at Arecibo Observatory.	Against Closure	Email	6/22/2016	
145	Keith	Boehler	ARCC	I am a Physics student who of works with professors in Astrophysics. To me this observatory is more than a source of inspiration and material for dreams; it gives me a way to put my skills to the test while in school. It would be as if taking a class about riding a bicycle purely out of a textbook, but never actually riding one until I graduate. Many of my peers who do research with Arecibo will not remain in academia in order to pursue careers in industry. The skills we will learn are more than a ribbon to distinguish ourselves; they will be the material for the prestige of the nation. With this I ask that Arecibo be given another chance.	Against Closure	Website	6/22/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
146	Casey	Brinkman-Traverse		I write this letter in anticipation of the NSF's upcoming Environmental Impact Survey regarding Arecibo Observatory. The Observatory is beloved by radio astronomers and science enthusiasts alike, but its importance stretches beyond science and intersects with social and economic plights, and the safety of our species. I urge the committee to consider all of these factors when determining the value and impact of this great Observatory. The United States government has been abusing and taking advantage of Puerto Rico to the extent where the Island cannot afford necessities like electricity in hospitals. To close Arecibo's doors would deny Puerto Rico of the revenue generated from those traveling to the Observatory, and the relative fame that the observatory brings. More importantly than this, it would deprive the Island of a world-class educational resource. Arecibo provides an opportunity for more Latino/a people to receive STEM education: education that could allow them to rise above impoverished conditions and begin to help their island. Without Arecibo Observatory, one of the last great resources will be taken away from Puerto Rico at a time when they need it most. The destruction of Arecibo will have many environmental impacts, some more obvious than others. Beyond the immediate impacts on the local forests and wildlife, the Observatory plays a large role in atmospheric science and asteroid monitoring. Atmospheric science is vital to the health of our planet, and will only become more critical in the coming years and decades as our climate continues to change. Additionally, asteroid monitoring has the potential to save our planet from a disastrous ending. The Island of Puerto Rico and the world as a whole would be much safer with Arecibo Observatory. I understand that the NSF lacks the means to fund every valuable project and that compromise must be made somewhere, but the decision to defund Arecibo would be shortsighted. It may save the NSF money today, but this gain is far overshadowed by the lasting devastation that it will have on the astronomy community, the people of Puerto Rico, and the island itself. The Observatory is not in a position to be temporarily defunded, and picked back up once we have the money to do so. I implore the NSF to invest in the future of radio astronomy and atmospheric science, so that the next generation of scientists can continue Arecibo's legacy. I promise, as a young astrophysicist, that the possibilities afforded by keeping Arecibo open and funded will be well worth it. Scientific progress represents the best of humanity: the pure curiosity to know the world from which we developed, and then the desire to use that knowledge to help fellow humans, animals, and the planet. If we as a nation and a planet wish to continue pushing toward a future bright with possibilities, toward the future scientists and humanitarians alike have envisioned, we need to invest in the scientific equipment to get us there.	Against Closure	Email	6/22/2016	
147	Carlos	Dorta-Quinones	Senior Engineer, Cavium Networks Cambridge, MA cid2@cornell.edu 787-356-6192	I am writing to urge the NSF to maintain the current arrangement for the Arecibo Observatory in Puerto Rico. As a native of Arecibo, the observatory was instrumental in my learning experience as a child. Not only did it peak my interest in science but it also introduced me to a vibrant international community that inspired me to pursue higher education in the United States. In particular, one of my high school teachers who was affiliated with the observatory encouraged me to apply to MIT, an opportunity I never would have been aware of otherwise. The advice I received from that mentor changed the course of my life. I went on to obtain a bachelor's degree from MIT followed by a doctoral degree from Cornell University. Having an institution like the observatory is especially critical during the challenging economic crisis that Puerto Rico is currently facing. Brain drain is rampant on the island, and the observatory offers an opportunity to keep and attract new talent that can make an important contribution to the scientific community. The observatory has made a significant difference in the lives of many Puerto Ricans such as myself, and it is a point of great pride for the island. It would be tragic to lose this valuable asset, and I strongly encourage the NSF to maintain the existing arrangement to continue the legacy that the observatory has established. Thank you for your consideration.	Against Closure	Email	6/22/2016	
148	Dale C.	Ferguson	Lead for Spacecraft Charging Science and Technology Air Force Research Laboratory Kirtland Air Force Base, New Mexico 87117	In my opinion, the US Air Force has a strong need to know the ionospheric environment, for GPS propagation and other purposes (over the horizon radar for example), and should be kept in mind when divestment of Arecibo is being considered. As far as the local environment is concerned, Air Force regulations will enforce its protection.	Against Closure	Emaiil	6/22/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
149	Manuel J.	Fernos		I am writing to strongly underscore the importance of the Arecibo Observatory to Puerto Rico and in particular to Inter American University of Puerto Rico. Arecibo Observatory is a strong contributor to the STEM education in Puerto Rico. Each year 20,000 school children visit the Observatory. The Arecibo Observatory Visitor Center introduces students to a broad range of science and engineering topics, far beyond what they are exposed to in school, and motivates many to consider continuing on to higher education, including education in Inter American University's science and engineering programs. In addition, the Arecibo Observatory Space Academy offers a summer camp and programs in pre-college research for students, and teacher training workshops for high school teachers. These programs are highly inspirationa l to participant s, and contribute significantly to the participation of Puerto Ricans in STEM fields. No other national laboratory or observatory does more for underprivileged students. More broadly we support the increased integration of Observatory activities into our island economy and educational system. We support the development of new initiatives such as sharing of seminars and lectures between Arecibo Observatory and Inter American and other local universities via live webinars; expanded co llaborative student and faculty internship programs; and cooperation between Inter American University, Arecibo Observatory, and island electronics and aerospace industries, the latter which has recently been experiencing exponential growth. Within the Inter American Schoo l of Engineering we have two major projects leveraging atmospheric science research at the Observatory. Inter american University's Bayamon campus is the lead institution Aon the Puerto Rico CubeSat project, whose major sponsors are the Puerto Rico Industrial Development Corporation (PRIDCO) and Puerto Rico Space Grant. The Puerto Rico CubeSat will carry an ion density instrument from NASA Marshall Space Flight Center, and a high-frequency radio instrument from Malardalen University in Sweden. These instruments are intended to collaborate with and complement the capabilities of the Arecibo Observatory 430-MHz atmospheric radar and the new Arecibo Observatory high-frequency radio transmitter. In addition, Inter American University is in the midst of a project to install a high-frequency radio array on the Inter American Aguadilla campus in northwest Puerto Rico. This array will produce the first images ever made of the radio emissions from the ionosphere which are stimulated during the types of experiments made possible by the new Arecibo high-frequency transmitter. The array will also produce the first wide-field bistatic radar images of the ionosphere over Arecibo Observatory, complementing the capabilities of the atmospheric radar and of other Observatory instruments including optical image rs and the Observatory laser radar (lidar). Through their collaborative use of multiple detectors, the Puerto Rico CubeSat and the Inter American radio array implement a multimessenger approach to atmospheric research, echoing the multimessenger approach to astronomical research which you highlighted on May 6 as one of nine big ideas for NSF. Both projects promise to contribute to breakthroughs in our understanding of processes related to space weather and its effects on space-based communications and navigation and human space travel. And, very importantly, both projects emphasize student participation in related research and development. The unmatched sensitivity of the Arecibo Observatory atmospheric radar allows breakthrough research not possible at other observatories. One of our engineering faculty, Professor Brett Isham, has told me how the most recent upgrades to the radar electronics allow stunning observations of ionospheric ion and electron waves over their entire frequency ranges, throughout the day and night, and over a previously unimagined 1000 kilometers in altitude. According to Professor Isham, these recent observations echo the excitement of the initial groundbreaking measurements made by the Arecibo radar after its inauguration in 1963. These new capabilities promise to lead to new as-yetuncontemplated discoveries. I ask you to support continued operation of the Arecibo Observatory as a critical contributor to education and research in Puerto Rico. Inter American University, as always, stands ready to collaborate and participate.	Against Closure	Email	6/22/2016	201606211545.pdf
150	Mary	Fillmore		I understand that you are considering the possibility of “mothballing” or even dismantling the renowned Arecibo Observatory in Puerto Rico. As someone who has visited the Observatory several times, I wonder how much you have considered the importance of the cultural resource it represents – to the people of Puerto Rico in particular, to US citizens more broadly, and to the world. Astronomy is not confined to any one nationality. It is a global endeavor. The U.S. has been a leader in all kinds of astronomy virtually from colonial times. Why would we consider shutting down (“temporarily” or permanently) the world’s largest and most sensitive radio telescope, which scientists around the world use as an essential part of their work? I question whether you have really inventoried the range of invaluable discoveries to which Arecibo has been critical, much less its potential for the future. These are cultural resources not only to us in the US, but to all of humanity. If the US wishes to maintain our status as a world leader in science, why would we consider giving up a major resource which is significant worldwide? Even if the Observatory were not of cultural value just on the basis of its past and future contributions to science, it is a landmark which every Puerto Rican I have ever spoken with recognizes and speaks of with pride. Every time I have been at the Observatory, school groups have been going through. Even a Puerto Rican taxi cab driver in New York has heard of it. On that island which is so beleaguered by financial problems at this time, having a world class Observatory to which Puerto Ricans can point with pride is of inestimable value. I hope you will put the same energy and ingenuity that built the Observatory into maintaining its cultural and scientific value for the future.	Against Closure	Email	6/22/2016	

Comment Number	First Name	Last Name	Affiliation	Comment	Category	Comment Source	Date Comment Received	Attachments
151	Dr. Nectaria A. B.	Gizani	Ph.D Radioastronomy, Jodrell Bank Observatory, Univ. of Manchester Assistant Professor Coordinator & Tutor of MSc Modules Hellenic Open University, School of Science & Technology, Parodos Aristotelous 18, Building 'E' Office No 103 26335 Patra Greece tel: +30-2610-367521 mobile: +30-6972709435 Physics Labs: +30-2610-367537 fax no: +30-2610-367528 email: ngizani@eap.gr web: http://ngizani.weebly.com/index.html and http://www.eap.gr/view.php?artid=1292	I am very sad to hear that Arecibo yet again, like other major old radio telescopes (e.g. Lovell, UK) has to prove how much it contributes to present science. I hope that whom ever takes financial decisions and is not a scientist really listens to what the scientific community has to say about Arecibo. We have observed Hercules A with EVN + Arecibo recently (2014, project EG072) at 6 and 18 cm for 12 hours, in order to detect the weak core of the powerful radio galaxy, and register the jet position for a reliable spectral index image. The central engine of this radio galaxy is very weak and previous EVN observations confirmed that, although the phase reference technique did not work back in 2002. So this time, we have re-observed the AGN with an improved EVN, but also using Arecibo to take advantage of its great sensitivity as we needed our observations to have high sensitivity. The paper of these observations should be published by the end of this year. Please keep Arecibo up and running	Against Closure	Email	6/22/2016	
152	Timothy H.	Hankins	Emeritus Professor of Physics, New Mexico Tech	I write this letter is in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory (AO). I strongly advocate that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." In 1970 I was one of the first external users of the Arecibo Observatory soon after its support was transferred to the National Science Foundation. I have continued to use the Observatory throughout my career and far into my formal retirement. I have served on its scientific staff twice and once as the Site Director. Throughout my career I have had the opportunity to use all of the other major radio telescopes in the world. These observations have been successful, but none so productive as my work at the Arecibo Telescope. I attribute this success to the welcome attitude for trying new techniques there. Other installations have their specialties, but they lack the flexibility and supportive attitude that I have always enjoyed at the Arecibo Observatory. My point here is that the loss of the Arecibo Telescope would mean a loss of a vital capability in science — the versatility and adaptability of the largest and most sensitive radio telescope in the world. There are many other arguments to support the continued funding of the Arecibo Observatory — educational, economic, cultural, environmental, etc. — which I leave to others to make. The Arecibo Telescope now works better than it ever has, it is the most sensitive, and supports the most diverse arenas of science. I strongly urge the National Science Foundation to support the Observatory at a level at which it can thrive, rather than starve.	Against Closure	Email	6/22/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
153	Martha P.	Haynes	Goldwin Smith Professor of Astronomy 530 Space Sciences Building Cornell University Ithaca, NY 14853 USA	I write in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at the Arecibo Observatory (AO) in Puerto Rico. I strongly support Alternative #1 given in NSF's "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." I am both a scientific user of the Arecibo Observatory and an educator who regularly and continuously incorporates use of the Observatory facilities into the education and training of both undergraduate and graduate students at my home institution as well as others. I also frequently showcase the Arecibo Observatory in public talks and events addressing a wide spectrum of audiences and venues. My own personal introduction to professional scientific research came when I spent a summer as a research student assistant at the Observatory. The experience of being present at the Observatory inspired me scientifically and also introduced me to the many challenges and thrills of observatory operations. A student (like myself) can learn many things in a classroom, but there is so much more to being a scientific researcher, especially one who knows how to design, construct, commission and operate facilities and instruments. The hands-on training that I received during that first short summer experience, before I entered graduate school, hooked me on a scientific career that melds together instrument/software/technique development with the achievement of forefront scientific goals. Exposure to such training and experience at an early career stage is both motivating and beneficial to insure a continued population of students with research skills that are not likely to be honed in a classroom. Throughout my career, access to Arecibo has played a fundamental role in my own studies of the gas content of galaxies and its evolution over the history of the universe and in the use of the 21 centimeter line from neutral hydrogen for cosmological studies. Beyond my own personal gain, observational data acquired with the Arecibo telescope has served as the basis for the research of the 20 graduate students (13 women) whom I have supervised plus more than 50 undergraduate students who have worked for me on independ research projects. This kind of research on gas in galaxies and nearby universe cosmology is uniquely dependent on the physical size (collecting area) of the Arecibo telescope and the advanced state of its instrumentation and compuational systems. Because of my familiarity with the telescope and the intrinsic straightforward data path offered by a single dish radio telescope, I am able to give students AT ALL LEVELS exposure to how the telescope works and how radio astronomical data is gathered and processed. I work very closely with a group of faculty and students at principally undergraduate teaching colleges across the U.S. and Puerto Rico to engage their undergraduate students in research using Arecibo. During the last few years, the observations that I need to conduct for my research have been performed either by undergraduates at my own institution or by faculty and undergraduate students at these collaborating institutions. I know that this experience has been transformational for many of these faculty and students in enabling them to conduct scientific research and in motivating the students to further their education especially in STEM fields. As part of my educational mission, during the last two weeks, I have given lectures to two separate groups of undergraduate students on career options and outcomes for students receiving bachelor's degrees in physics/astronomy and related fields. I use as an example of the huge variety of career options the operation of an observatory like Arecibo. It has scientific users, but it also employs scientific managers/designed/engineers, people who understand the scientific aims and drivers but also have an interest and the background to deal with issues associated with the telescope location, legal aspects, contracts and purchasing, engineering requirements, technology developments, data acquisition, transmission and processing, observing strategies and so many others. These talks have reminded me just how critical to my own career my experiences at Arecibo over the last 40 years have been: as a summer research assistant, conducting my PhD research, as a postdoctoral research associate and as a professional research astronomer as I rose through the faculty ranks. Conveying this message, that there is more to learn and more to do, beyond the traditional walls of academia is a critical message to encourage more students from the broadest possible backgrounds to study STEM curricula to be ready to enter employment in a wide range of sectors, crossing academia, industry, the federal agencies, management consulting, journalism and communication and many others. Many students want to pursue careers in research and need to hear from senior faculty like me that research really remains exciting over a 40-year career. Many other students are not so sure of their direction. Our nation needs them to hear that there are other possible paths that an education in STEM fields will make open to them. Arecibo's location in the interior of Puerto Rico offers obvious advantages to students on the island. In fact, just a month ago, students and a faculty member from the University of Puerto Rico, part of our collaborative research team, conducted our observations at the Observatory. Visiting and spending time in Puerto Rico has been an enormously valuable culture experience to students visiting on the mainland. Friends are made, experiences are exchanged, creating long-lasting connections. Again, Arecibo provides the experiential learning that cannot be gained in a classroom. Wherever I travel, everyone -- scientists and laypeople alike -- know of the Arecibo Observatory. It is a unique facility for scientific research and perhaps even moreso for the education and hands-on training of future generations of scientists, engineers and software developers and scientifically-rooted lawyers, managers, journalists, consultants and perhaps, politicians. Such a platform for knowledge gathering, inspiration and education would be a terrible thing to lose.	Against Closure	Email	6/22/2016	

Comment Number	First Name	Last Name	Affiliation	Comment	Category	Comment Source	Date Comment Received	Attachments
154	Dr. Jason W.T.	Hessels	Associate Scientist - ASTRON, Netherlands Institute for Radio Astronomy Associate Professor (Universitair Hoofddocent) - University of Amsterdam Mobile Tel: +31 (0)610260062	This letter is in response to the Federal Register Notice of an EIS evaluating the potential environmental effects of proposed changes to operations at the Arecibo Observatory. I strongly request NSF to choose Alternative 1 of its "Notice of Intent to Prepare an EIS...", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." In fact, I strongly believe that NSF should research an option in which funding to Arecibo is increased, as I detail below. As background, I have been an active scientific user of the Arecibo telescope for the last 15 years, and have visited the observatory many times. Arecibo is a unique and world-famous scientific facility, as well as a cultural icon and powerful educational tool. In the last half century, it has inspired hundreds of thousands of visitors and delivered jaw-dropping scientific results beyond the reach of any other telescope on Earth. While Arecibo has an illustrious history of Nobel-prize-winning scientific discoveries, it also remains to this day on the cutting edge of astronomy, atmospheric and space science - with a huge potential for the future. Arecibo is a cultural icon in Puerto Rico, and an amazing tool for local STEM education, which is a vital part of improving the socio-economic situation on the island. In short, the Arecibo telescope is a sterling example of what humanity can achieve through the power of our minds and imagination. Mothballing or closing the facility would have a disastrous impact on the local economy, ongoing educational programs, and would waste the scientific potential of the instrument moving forward. Tens of thousands of school children visit Arecibo every year, and the telescope represents a rare opportunity for Puertorican students to come into contact with a cutting-edge scientific instrument. Keeping Arecibo funded as a purely educational facility or "landmark to visit" does not make sense in my mind. The power of the facility to inspire and educate - in a way that cannot be done in a classroom - stems from the fact that there is ground-breaking research being done at the telescope. The sense that "this is where things are happening and discoveries are being made" is electrifying for students and motivates them in a way no textbook or classroom lecture can. I find this critical, because I strongly believe that improving the quality of education, challenging young students to think critically, and fostering their innate curiosity can go a very long way to building a better society. Puerto Rico has suffered many socio-economic setbacks in recent years; education is a key ingredient to building a more positive future. At the same time, Arecibo continues to deliver world-class science. To give one example from my own research: the discovery of the first repeating Fast Radio Burst source, which our team recently published in the journal Nature (Spitler et al. 2016, Nature, 531, 202). This discovery was only possible using Arecibo's unparalleled sensitivity and its multi-pixel receiver system; it represents a major step forward in the field, and Arecibo will continue to play a leading role in deciphering the mystery of this phenomenon, which is currently one of the hottest topics in astronomy.	Against Closure	Email	6/22/2016	
155	Dr. Jason W.T.	Hessels	Associate Scientist - ASTRON, Netherlands Institute for Radio Astronomy Associate Professor (Universitair Hoofddocent) - University of Amsterdam Mobile Tel: +31 (0)610260062	In summary, Arecibo is priceless and the short-term savings that could be made through closure are greatly outweighed by the long-term cultural, educational and socio-economic impact for Puerto Rico. The telescope is also Puerto Rico's scientific calling card, and options should be investigated to see how Puertorican universities and Arecibo can form a center for excellence in education on the island. This proposed institution has been discussed elsewhere as the Puerto Rican Institute for Advanced Studies (PRIAS). It would greatly leverage the already firm impact that Arecibo has made across many communities.	Alternative Consideration	Email	6/22/2016	
156	David	Jacob		I write to urge that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . , namely "Continued NSF investment for science-focused operations (No-Action Alternative)." I had the opportunity to travel to Arecibo Observatory and study for a brief time as a college student at Miami University. This allowed me to study our natural world and improve as a researcher and scientist. The information about Radar technology was fantastic and I look back on this formative experience as one of the most important in my educational development. In addition, I believe that Arecibo is important to the local economy and the shutdown will have a major negative impact on Puerto Rico especially with the current issues the island faces.	Against Closure	Email	6/22/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
157	Dr. Rebecca A.	Koopman	Professor and Chair Department of Physics and Astronomy Union College Schenectady, NY 12308 (518) 388-6786 Email: koopmanr@union.edu Web: http://minerva.union.edu/koopmanr/	I write to urge strongly that NSF choose alternative #1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." As a scientific user of Arecibo Observatory for over 12 years and as director of an NSF-sponsored undergraduate consortium for research using Arecibo data, I have witnessed first hand its potential not only for ground-breaking science, but also its impact on over 270 undergraduates from across the nation. My own research is in the field of extragalactic gas and star formation and, thanks to the large collecting area of its dish, Arecibo is unique in its ability to study the faintest, low mass galaxies that are key to understanding galaxy formation and dark matter in the Universe. The large size of its dish also makes it possible to pinpoint the location of the galaxies at much higher resolution than is possible with smaller single-dish telescopes. These two properties make Arecibo indispensable to my extragalactic research. Here I would also like to emphasize the invaluable role of Arecibo in training the next generation of U.S. radio astronomers with one specific example. For the last 9 years I have led the NSF-sponsored Undergraduate ALFALFA Team, a consortium of 19 undergraduate-focused institutions from across the U.S. (list available at http://egg.astro.cornell.edu/alfalfa/ugradteam/ugradteam.php). Through this program, undergraduates, graduate students, and faculty collaborate with the ALFALFA (Arecibo Legacy Fast ALFA, where ALFA refers to the Arecibo L-band Feed Array detector) consortium (PI, Riccardo Giovanelli, Cornell) on a major legacy astronomical survey and associated followup of neutral hydrogen gas in the nearby Universe. This program has impacted more than 270 students (~40% women and members of underrepresented groups) and 24 faculty. Arecibo Observatory has been critical to the success of this program. It has hosted annual undergraduate workshops (8 to date, with 148 student attendees) and welcomed student (74 to date) and faculty observers for extended onsite observing runs. Data acquired by the project has led to more than 280 significant undergraduate research projects. The value of student experience at Arecibo Observatory goes beyond the physical instrument and their development as scientists as they recognize and discover the great vision and effort required for building and maintaining the observatory. Their understanding is not limited to specific ALFALFA training, but also extends to an appreciation of other research fields, as well as the geology and culture of Puerto Rico. It cannot be overstated how important a role the reality of Puerto Rico and the Arecibo Observatory is in their experience. More than 80% of the student attendees to date have completed undergraduate research projects within ALFALFA and many cite their visit to Arecibo as the major factor in their participation. Faculty and students trained onsite return to their campuses prepared to carry out remote observing. In this way students and faculty contribute to the ALFALFA survey while extending observing opportunities to students, staff, and faculty on their local campuses, many of whom would never have an opportunity to experience an astronomical observing run. Undergraduate ALFALFA Team training has had a positive, and often defining, impact on student development, as judged by their career paths to date. The majority of students involved in the project have completed or are still enrolled in an undergraduate STEM program. Of 174 students who have completed their undergraduate degrees and have known status, more than half are enrolled in graduate school, almost half of them women. The majority of those not in graduate school are pursuing careers in STEM fields, including teaching and engineering/industry. Thus, the partnering of Arecibo Observatory with the ALFALFA consortium has resulted in a model of undergraduate education in which a large number (>270) undergraduates contribute directly to the most extensive, deepest, most sensitive large scale 21cm survey of a cosmologically significant volume to date, and its associated followup. The undergraduates experience the workings of a major national observatory and the way that a science collaboration functions through their interactions with their faculty mentors, their peers, Arecibo Observatory staff, and the leaders of the ALFALFA project. Transformative research experiences develop student skills not only within ALFALFA, but also with other astronomical tools such as SDSS, NED, and programming. They present and publish their results in the astronomical community. Faculty at a wide range of U.S. schools contribute their expertise and improve their scholarly collaborations. The effectiveness of the program is especially relevant in the era of large astronomical surveys. The model we have developed will apply to future surveys by the next generation of Arecibo instruments, including the proposed 40-beam Phased Array Feed, AO40. Continued support of Arecibo will thus ensure the success of countless researchers and also provide meaningful experiences to very bright minds early in their careers, a contribution vital to the long term success of science in this country.	Against Closure	Email	6/22/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
158	Jonathan	Ladd		As an American citizen, a traveller of the world, and an amateur astronomer, I am responding to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations atArecibo Observatory. As an American, I am proud of the engineering and scientific uniqueness and value of Arecibo. To reduce Arecibo would be to reduce American prominence in astronomy. Please do not join the shameful deterioration of American infrastructure. As a traveller, visiting Arecibo has inspired me and I have observed dozens of other wealthy and well - educated travellers be similarly inspired. As an amateur astronomer, I have come to understand the cosmos better from the innumerable publications based on observations that can be made only at Arecibo. Furthermore, I know that the Arecibo facility has been the inspiration for hundreds of our youthful students to pursue astronomy professionally. With continued funding, Arecibo can maintain its status as a very significant contributor to astronomical science; remain a vigorous destination for travellers and thus be an economic driver for the region; and be a fundamental impetus to the next generation of astronomers. Frankly, the other alternatives suggested by the Notice of Intent to Prepare and Environmental Impact Statement strike me as travesty for the scientific community, for the American and Puerto Rican people, and for the environment. I strongly urge the NSF to choose alternqtive f, which is "Continued NSF investment for science-focused operations."	Against Closure	Email	6/22/2016	Arecibo EIS Response 6 22 16.pdf
159	Michael	Lam	Cornell University	I am writing in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory (AO). Arecibo Observatory has been and remains a unique institution nationally and internationally. It remains unique on a culture, scientific, and educational level and is economically important for the Commonwealth of Puerto Rico. You have undoubtedly received many similar letters outlining its importance in these areas. Arecibo has been of personal importance to myself and my research. I have traveled down to Arecibo on numerous occasions, the first being for the "NAIC/NRAO Single Dish School" as a summer REU student. Today, I am involved as an active member of the North American Nanohertz Observatory for Gravitational Waves (NANOGrav) after completing my PhD dissertation a month and a half ago. AO is absolutely critical for not only making NANOGrav competitive in pulsar timing array efforts internationally, but making it the reason we have the most sensitive low-frequency gravitational wave detector ever developed. My thesis work has involved characterizing the performance of this detector, and having lead international projects, the data quality from AO is both unparalleled and necessary for providing the sensitivity necessary for detecting and studying low-frequency gravitational wave sources. Arecibo is not simply a 50-year-old facility. It's upgrades, both past and continued, make it a modern institution capable of achieving a unique set of scientific goals. No other observatory can compete. And with improved funding, instrumentation, and support, it could continue to thrive for many years to come. I implore you to consider the broad impact of damaging the US single-dish radio astronomy community, and crippling radar astronomy, extragalactic hydrogen astronomy, and pulsar timing array astronomy, especially on the very recent opening of the gravitational wave Universe. A primary environment principle is to use well and not waste—in this case waste its scientific, educational, economic and cultural value. AO has enormously greater value than the cost of its support. It is unique in the world in all three of its science areas. AO is hardly 20 years old since its Gregorian renovation, still very much in its prime years. It could multiply, 2-3 times, more important and productive with adequate, rather than starvation, support. Replacing AO would take years and many times the cost of dismantling it. All such facilities/institutions have finite lifetimes, but crippling the Observatory before it become outdated would indeed be an environmental crime Arecibo was. Arecibo's attributes have been cultivated over many years, are interconnected and mutually supportive, and can cannot readily be separated. The Observatory's contributions in all four areas continue to be very strong, and they could multiply in future with a more appropriate level of support. The scientific contributions from AO have been outstanding, and its scientific future remains very bright indeed. The Observatoriy's cultural contributions to Puerto Rico and the world are beyond reconning. Here are a few examples:	Against Closure	Email	6/22/2016	

Comment Number	First Name	Last Name	Affiliation	Comment	Category	Comment Source	Date Comment Received	Attachments
				⍰ In my experience, Arecibo is the most exciting observatory for students on the planet. Students sometimes describe their experience at AO as "life changing" and this can be traced in the lives of students who visit for scientific work. ⍰ Arecibo is a work of art and is often apprehended in this manner by visitors. It is understood as a supremely elegant mechanical and electronic monument to the iThe Observatory is iconic nationally and internationally. Its very existence has raised consciousness about science, to say nothing of its several prominent movie roles! ⍰ AO is almost certainly the single best known and influential scientific institution in the Spanish speaking US and Caribbean basin. Puertoricans are very very proud of their "El Radar" and its presence has entered the culture and consciousness in a very deep and positive manner. ⍰ In Puerto Rico, the Observatory is of very considerable economic value and could be much more so. Its staff salaries are highly important in the Arecibo Town region. Its educated staff has significantly contributed to building up a further generation or two of educated people in the area, and the tens of thousands of tourist visitors are also important to the overall island economy. Withdrawal of support now would compound what is already a difficult situation for Puerto Rico and is citizenry. ⍰ Educationally, the Observatory is of key importances at every level: For the island high school students who visit AO in conjunction with their science classes. The Arecibo Institute students who go on to excel in STEM disciplines. Training programs for teachers in PR and elsewhere in Latin America. Graduate students in science and engineering both from PR and the mainland. Postdocs. As a facility for visits by US college students to do research with their mentors. A primary environment principle is to use well and not waste—in this case waste its scientific, educational, economic and cultural value. AO has enormously greater value than the cost of its support. It is unique in the world in all three of its science areas. AO is hardly 20 years old since its Gregorian renovation, still very much in its prime years. It could multiply, 2-3 times, more important and productive with adequate, rather than starvation, support. Replacing AO would take years and many times the cost of dismantling it. All such facilities/institutions have finite lifetimes, but crippling the Observatory before it become outdated would indeed be an environmental crime.				
160	Loris	Magnani	Professor of Astronomy Dept. of Physics & Astronomy University of Georgia Athens, GA 30602 USA	I am writing this letter in response to your request for public comments on the environmental impacts of the Arecibo Observatory. I am interpreting "environmental" in its true sense of the word; i.e., the aggregate of surrounding things, conditions, or influences; surroundings; milieu. Thus, I will address first how the Observatory influences the people and island of Puerto Rico, and then, how it affects all of us. I was a postdoc and staff scientist at Arecibo for 4 years (1987-1991) and have first-hand knowledge of the impact the Observatory has on the people of the island. While some Puerto Ricans are unhappy that the Observatory is mostly in the hands of "gringos", everyone is proud that this scientific and technological marvel is in Puerto Rico. Although the island is a marvelous place, there are severe problems for its inhabitants; education and work opportunities being some of the most difficult ones. I have heard horror stories about the educational state of the public elementary, middle, and high-schools on the island. It is difficult for children from mid- to lower-economic households to get the type of education that will help them prosper both on the island and in the United States. Tens of millions of dollars can be and have been spend in trying to inspire kids to stay in school and take up STEM disciplines there. The lack of role models is something that is difficult to appreciate if you are white and from upper-middle class backgrounds. Many Puerto Rican school children visit the Observatory every year. It is hard to assess the impact that the place has, but I have seen with my own eyes the excitement on children's faces as they toured the facility (this was back in the days before the Visitors' Center). My career in astronomy was inspired by a fifth-grade trip to the (then) Hayden Planetarium in New York City. I had a world class facility a short subway ride away. Take away Arecibo from the island and the children there have no opportunity to be inspired by real science. The first time I saw the telescope when I was 29, I was awestruck; I can only imagine what that impact would be on some youngsters who see the place for the first time. The hills around the Observatory are surprisingly populated. Aside from the dairy industry, there are no factories or large-scale work opportunities there. In its heyday, about 100 local families were supported by one or more people who worked at the Observatory. It is hard to see how many of those families could find local jobs once the Observatory is gone. And I am not factoring in the ancillary effects on the local economy that having the Observatory nearby provides. Those are local factors. and you are likely to hear others voice the points I have made above. I can't help but feel that if Puerto Rico had two Senators in Congress you would be "convinced" a little bit more forcefully on how important these things are. Too many people don't know that Puerto Rico is part of the United States; I know you do, but in the absence of Congressional representation, it is far too easy to ignore the plight of the people on the island. They are Americans and deserve all the opportunities that are available to all Americans, regardless of historical technicalities. There is one other thing I would like to mention that affects us all as humans on Earth. The Arecibo 305-meter radiotelescope is one of the engineering wonders of the world. Again, I think back to the first time I saw it. The visual impact was perhaps the most striking of my life. No-one talks about dismantling the Pyramids because of maintenance costs. They are part of our cultural heritage regardless of boundaries or ethnicity. The Arecibo radiotelescope is not far behind. As one of the very few structures that can be seen from Earth orbit, there is a majesty to it that transcends what cutting edge science may or may not be doable from there. There are some things that don't have a dollar value and that transcend budgets.	Against Closure	Email	6/22/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
161	Loris	Magnani	Professor of Astronomy Dept. of Physics & Astronomy University of Georgia Athens, GA 30602 USA	If there is a real movement to dismantle the Observatory and bring the site back to its "original" state, I would first consult with the Department of the Interior. Even if scientifically it can no longer be supported by the NSF, the place should at least be a National Monument.	Alternative Consideration	Email	6/22/2016	
162	Allison	Matthews		I am writing in response to the notice of intent to produce an Environmental Impact Statement regarding the future of the Arecibo Observatory. As an undergraduate student at Lafayette College, I undertook research using the Arecibo Observatory for studies of pulsar astrophysics as part of a summer research internship and continued senior thesis at Lafayette. During my research program, I visited, and made observations with the telescope. This was an incredibly influential experience, so much so that I included it in a future Goldwater Scholarship application under the category of "Motivation for Research Career." I paste this excerpt here: Throughout my studies, it has been the aspects of science that remain unseen and literally out of this world that are the most thrilling. Doing research in pulsar astronomy this summer allowed me to do more than simply conduct remote observations from the largest telescope in the world, Arecibo Observatory. I finally had the chance to actually control the telescope on site. As I sat down to calibrate the telescope for recording signals, my mind whirled with the task at hand; I had to insure that the power levels were properly set, to calibrate the receivers and to enter the coordinates of the pulsar into the telescope. I watched as the telescope moved into position and started recording. After adjusting the oscilloscope, pulses began appearing like clockwork on the screen. With a rush of adrenaline, my heart rate seemed to sync with the pulsar, an object that spins at almost inconceivable rates. That moment I cemented my future as a collaborator, investigator, and scientist. Through this project I learned skills in computer coding and algorithm development, in addition to astrophysics itself. This experience was a significant part of my development as a researcher, and was an important step leading to my present position as a graduate student in astronomy. I hope that the Observatory can remain in operation with a science-focused research program, and that it can continue to provide such valuable experiences for future students.	Against Closure	Email	6/22/2016	
163	David D.	Meisel	SUNY Distinguished Professor of Computational Astrophysics	I am writing to provide my comments on the environmental impact of Arecibo Observatory in Puerto Rico. This unique facility has served since the 1960's as a scientific institution of wide notoriety sited in a fairly remote part of the island. It is remarkable that over the years that it has grown into one of the most important tourist destinations in western Puerto Rico. During that time, scientific activities of extraordinary interest have been carried out with the cooperation of a dedicated staff of both island-born and mainland born employees. Since its beginnings the construction and operations have always been planned to make the installation compatible with both the cultural and natural settings of the region and while there have always been logistic challenges in maintaining its scientific and engineering standards, working there as a visiting scientist was always a pleasure as well as scientifically rewarding. I find it quite ironic that after all these years this environmentally friendly facility nestled so carefully in its setting that thousands of school children trustingly enjoy repeated visits there, is being reviewed for environmental impact and being compared with other more recent facilities of a similar nature that have leveled entire mountains and built long access roads just to be constructed. Sure Arecibo has had its share of mishaps over the years, but institutions that have a constant flux of visitors ranging from summer students to visiting scientists are bound to have unforeseen incidents that could not be planned for in advance. As for the health effects of the radar and radio transmitter operation, in an age when virtually everyone is exposed to aircraft landing radars, cell phone or computer radiation etc., it cannot be ascertained whether the stray radiation from this facility is a significant health risk or not. I hope that this investigation will be fair to all concerned and not muddled by the irrelevance that seems to be the trend of such things these days.	Against Closure	Email	6/22/2016	

Comment Number	First Name	Last Name	Affiliation	Comment	Category	Comment Source	Date Comment Received	Attachments
164	Dr. Robert	Minchin		On reading over the Environmental Baseline Study performed for the NSF by CH2M, I came upon the comment: “Surveys for RTE [rare, threatened, or endangered] species or detailed habitat assessments were not included in this effort to determine if these species or the RTE species located in the Río Abaja State Forest are present or are likely to use the subject property. Impacts to RTE species are unknown but are not anticipated because activities would be generally limited to previously disturbed areas within the subject property.” (p. 24). I would like to point out that the major disturbance to the area was in the period of the Observatory’s construction, 1960-1963. There has been plenty of time for recovery of wildlife and for endangered species to move into the area since then. In particular: • The endangered Puerto Rican parrot was re-introduced into the Río Abajo forest, adjacent to the Observatory, in 2006, having gone extinct in the area in the 1920s.[https://www.nwf.org/News-and-Magazines/National-Wildlife/Birds/Archives/2015/Puerto-Rican-Parrot-Comeback.aspx] The logic that the species already survived disruption in the 1960s and so will survive again is clearly false. • According to the Cornell eBird website, two adult broad-winged hawks have been reported as regularly seen at the Observatory.[http://ebird.org/ebird/view/checklist/S28471271] This may well be a rare breeding pair of this endangered species. For both of these species, the situation now is not the same as it was when the Observatory was constructed – the Puerto Rican parrot, in particular, was not found in the region at the time. It is clear that the argument of the EBS that no impact is expected as the only disruption would be to previously disturbed areas is not applicable to the Puerto Rican parrot and is probably also not applicable to the Puerto Rican broad-winged hawk. Given this situation, it seems absolutely necessary that a full assessment is carried out of the potential impact on the Puerto Rican parrot and the Puerto Rican broad-winged hawk of large-scale physical changes at the Observatory (e.g. decommissioning of the site).	Resource Considerations	Email	6/22/2016	
165	Dr. Dipanjan	Mitra	Associate Professor On Sabbatical to University of Vermont, USA	I write this letter to strongly request that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." The radio telescope at Arecibo in Puerto Rico is the finest example of cutting-edge technology, excellent research and a symbol of the ``most innovative scientific facility in the world''. I have worked in Arecibo Observatory as staff during my sabbatical, and have closely witnessed the unique role the Observatory plays culturally, educationally, scientifically and economically in Puerto Rico, the rest of the United states as well as internationally. Puertoricans are tremendously proud and respectful about the Arecibo Observatory. There is full acknowledgement of the fact that Arecibo telescope is a supremely powerful instrument, that has made Puerto Rico internationally renowned. The staff of the Arecibo Observatory are highly educated and skilled, and a large number of acclaimed scientist visit the Observatory. The ambience and intellectual activity that is generated, has a very positive effect on the Puerto Rican society. More people in the Island are educated and a new generation of highly intellectual society is being developed. The visitor center in Arecibo Observatory is pivotal in educating every young student in Puerto Rico. These young minds finds a sense of pride, dignity, and are exposed to forefront scientific research. The educational value also makes strong impact in the nearby Carrabian Island. Many Graduate and college students in the Mainland US visit AO as a part of their science curriculum. The observatory receives tens of thousands of visitor every year, and clearly contributes to the overall economy of Puerto Rico. It is also amazing to see how the Arecibo Observatory impacts students and researcher internationally. The high excellence of the Arecibo telescope in all fronts sets standards for studies related to telescope structural design, radio astronomy, Ionosphere etc. The telescope continues to make fascinating scientific discoveries and nurture international collaboration. I am an user of the Arecibo radio telescope for the last 15 years, and my study requires studying extremely faint radio signals from pulsars and I am entirely convinced that the sheer sensitivity and precision of the data obtained is par excellence. The observatory has over the years been mordernised with state of art receivers and backends, and continues to pay a pioneer role in all aspects of radio astrophysics. I firmly stand behind the fact Arecibo is the most important facility in radio astronomy in the world and will continue to hold its premier position for at least a decade, if not more.	Against Closure	Email	6/22/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
166	Kim	Morán-Irizarry	Doctor of Jurisprudence, 2016 Indiana University Maurer School of Law 787-240-0889 kmoranirizarry@gmail.com	My name is Kimberly Morán Irizarry, I'm 25 years old, and I grew up in Hatillo, a town adjacent to Arecibo, Puerto Rico. I'm writing to express my discontent with the upcoming budget cuts facing the Arecibo Observatory. Having lived in the Arecibo District for 18 years of my life, I can attest to the invaluable contributions the Arecibo Observatory has had in our community over the years. In addition to the value of the remarkable scientific discoveries, the Observatory has been an element of national pride, giving Puerto Ricans, and especially Arecibo locals a sense of ownership in a Nobel Prize winning institution. This may seem like a trivial concept, but in times where the Puerto Rican economy is in constant decline, having the best and largest radio telescope in the world is a morale boost for the entire Puerto Rican community. I still remember the impression the observatory had on me when I first visited it. I must have been about eight years old, and I was filled with excitement to think of all the amazing scientific research that was taking place there, in my own backyard. As a little kid, that gave me a sense of importance; a sense that one could achieve so many things, even when you come from a small town in PR. As it did for me, I am confident that the Arecibo Observatory continues to impact the lives of the people around it, whether it may be by instilling scientific interest in the students that visit it throughout the year, or by being a symbol of pride as the excellent world class research facility that it is. As the NSF continues to consider different options for the Observatory, I request that they continue with the present arrangement. Additional budget cuts would be very detrimental to the proper functioning of this excellent facility, and to the communities of Arecibo and Puerto Rico. As the Puerto Rican government struggles to pay its massive bond debt and continues to close schools, please do not deprive us of the opportunity to provide the world with a proper functioning observatory, one that fills us with pride, and that, with your help, will continue to contribute to the scientific community for years to come.	Against Closure	Email	6/22/2016	
167	Jade	Morton	Colorado State University	I write to strongly urge that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science---focused operations (No---Action Alternative)." As a scientific user of Arecibo Observatory for over 30 years, I can attest to its historical and continuing importance for studies of ionosphere. Its enormous collecting area (the largest in the world) has been and continues to be crucial in studies of structures in the ionosphere. Most importantly, although the facility is over fifty years old, it has undergone two major upgrades, each of which created an essentially new, far more powerful telescope. Consequently it remains in the prime of its scientific life, still able to make important and useful scientific discoveries. While there have been a number of instruments including new, distributed sensing capabilities to study ionosphere in recent years, the Arecibo Incoherent Scatter Radar remains an important, trusted system that provide un---disputed observations and measurements. For example, when developed a new algorithm to map the ionosphere total electron content based on GPS receiver's measurements, we turned to Arecibo ISR for validation of the algorithm accuracy. In fact, I am in the process of deploying an array of multiple constellations of global navigation satellite systems receivers around Arecibo to support development of various algorithms development using both ground---based and LEO satellite- ---based measurements. I could cite several other examples of the role that Arecibo alone can play in my other research, and many others can and will do so. The telescope remains a unique, powerful, and flexible instrument for the 21st century. I would also like to point out that China is building FAST, the Five---hundred---meter Aperture Spherical Telescope. FAST is based on the Arecibo telescope concept. Clearly, single dish large radio telescopes are still recognized for its unique merits elsewhere in the world.	Against Closure	Email	6/22/2016	Arecibo Support Letter_Morton.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
168	Mary Crone	Odekon	Professor and Chair, Department of Physics Skidmore College	This letter is in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory (AO). I hope this statement about the value of the AO helps inform any decisions for the future of the observatory. As a member of the NSF-funded “Undergraduate ALFALFA Team” (PI: Koopmann) I have seen the benefits of the AO for both scientific progress and for inspiring students to pursue and value science. At my home institution of Skidmore College alone, 38 undergraduates have been involved in research using the AO over the past eight years. Many of them have operated the Arecibo telescope on site or remotely, or have presented at national conferences. Some have co-authored refereed articles, for example Odekon et al. 2016, “The HI Content of Galaxies in Groups as Measured by ALFALFA," ApJ, in press. The impact of this project extends far more broadly than the students who have used the data directly. The results of these projects are presented to large groups on campus, through campus-wide research symposia, department presentations, and educational modules designed for introductory astronomy courses. Dozens of other educational institutions are part of this collaboration, and have similar stories to tell. The Undergraduate ALFALFA Team model, and the importance of the AO facility in particular, has been described in two recent articles, in Mercury magazine and the CUR Quarterly: Parker Troisht, Rebecca Koopmann, Aileen O'Donoghue, Mary Crone Odekon, and Martha Haynes, "The Undergraduate ALFALFA Team: A Collaborative Model for Undergraduate Research in Major Legacy Projects," 2016 CUR Quarterly on Undergraduate Research Collaborations: Partnering for High(er) Impact Mary Crone Odekon, 2015, "Harvesting ALFALFA," Mercury, Vol. 44, No. 3 An important lesson for us has been the power of integrating a major legacy survey from a world-class facility with undergraduate research. I hope this role for the AO is fully recognized.	Against Closure	Email	6/22/2016	Aerocibo 2016.pdf
169	Jeff	Ouellette	Cornell University, Class of 2017 CERN Summer Student	I would like to respond to the invitation for public comments regarding the investigation into the environmental impacts of the Arecibo Observatory in Puerto Rico. Unfortunately, I will be out of the country and unable to attend the public meetings, but I would still like to offer my own comments on the concern over this issue. First and foremost, I would like to say that the presence of the Arecibo Observatory has helped the scientific community gain a substantial amount of knowledge since its completion in 1963. It has been, and still is, among the world’s foremost radio telescopes. This fact cannot be understated in the slightest – Arecibo is one of the most powerful resources available to astronomers. On the island itself, the prominence of Arecibo has both contributed to the Puerto Rican cultural identity as a source of pride and, as it is reasonably close to San Juan, stimulated the local economy by attracting not only tourists to the island, but scientists from around the globe. This makes Arecibo not only a world-class research facility, but also an educational institution, as it motivates interest in STEM to those who visit. But Arecibo has a profound impact on the local population too. Thousands of local children routinely visit the telescope to learn about astronomy and stimulate their interest in STEM fields. Unfortunately, Hispanic professionals are still underrepresented in the hard sciences. By providing local children with an environment to explore scientific interests, this underrepresentation should gradually disappear over time. On a larger scale, Arecibo is an important resource in the search for potentially hazardous asteroids (PHAs). Searching for asteroids on potential collision trajectories with the Earth is critical in ensuring the planet’s future security. PHAs are, minimally, national security threats and should be treated accordingly. Most importantly, I advise that you consider the impressive scientific history and future of Arecibo Observatory. For instance, the telescope enabled research of a binary pulsar system that led to the 1993 Nobel Prize in Physics. From my own background in pulsar astrophysics, I know that Arecibo has been one of the most important telescopes to study such objects, having led to the discovery of many pulsars, as well as contributing to ongoing American efforts to detect very low frequency gravitational waves – a line of research that mandates the use of the Arecibo telescope. I urge you to consider these remarks on the educational, cultural, and scientific impacts of the observatory in making a decision. The telescope, in my opinion, has significantly benefitted not only the island of Puerto Rico, but the scientific community at large.	Against Closure	Email	6/22/2016	AreciboEISRespons e.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
170	Dr. Tim	Pennucci	Columbia University	I am writing with some dismay in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory (AO). As one of the many scientists who use Arecibo every month, I implore the NSF to take the No-Action Alternative. I trust that after hearing the landslide of feedback from all those who would be affected by a change in Arecibo's operations away from (1) doing pioneering science that cannot (and will not) be done elsewhere and (2) offering a veritable dream of an educational outpost for privileged and under-privileged individuals alike, and after realizing the lasting, propagating effects on those who will not be providing feedback to the NSF (that is, the much more numerous population of individuals who will not get a chance to be influenced by the telescope's activities and existence, either directly or indirectly, as well as the tax-paying individuals who value investment in basic R&D in science), the NSF will realize that no action is the best of the given choices. Without loss of impact, I encourage the reader to review the emails that have come before, instead of rereading here the same list of obvious talking points having to do with: -Arecibo's direct impact on countless individuals from grade school through grad school through professional retirement -Arecibo's grandeur on the international stage as an icon for human scientific achievement -Arecibo's continued contributions to basic astrophysical research and atmospheric science by way of ***unique capabilities that will not be replaced by any current, planned, or imagined telescope, including FAST, the GBT, Parkes, and MeerKAT*** -Arecibo's future potential, given the recent upgrades, the minimal upkeep, and the anticipated science to be probed (Nobel prizes are involved!) -the positive economic and scientific return on every dollar invested in Arecibo -the loss of American leadership in science when we willingly strangle our own world-class facilities -etc. What I will add is my own "environmental" analogy. Arecibo belongs to the endangered species of large single dish radio telescopes. Not only does it belong to this small group of powerful, yet economical and prolific scientific facilities, but it is the poster-child. It is the white rhino that everyone knows about, and it should not only be preserved and protected, but allowed to flourish. The kinds of science it can do are unique to it and other large single dish telescopes (at the very least, it is cheapest to do with a single dish), and yet there are only a handful of such facilities on the planet. It would be one thing to suggest that such facilities don't contribute significantly in terms of science or in terms of tax dollars invested, but this is just not true -- and especially so for Arecibo. Thus, the uniqueness of Arecibo alone should force NSF to trim the fat elsewhere, because there is no fat here. If for nothing else, we need to keep our science diversified; this is the most powerful and versatile single-dish telescope in the world (with the GBT as a close second), and to choke or eliminate its capabilities would be a crippling mistake. Don't go after the endangered species! Choose No-Action!	Against Closure	Email	6/22/2016	
171	Carolyn	Raithel	Graduate Student University of Arizona / Steward Observatory	I am writing in response to the proposed changes to Arecibo Observatory. Arecibo Observatory (AO) is an important US institution for scientific, cultural, and educational, purposes. On the scientific front, AO has been central to many exciting radio astronomy discoveries. It was the instrument used to discover the very first binary pulsar system (for which the discoverers were awarded the 1993 Nobel Prize in Physics) and has been critical in follow-up of that and countless other astronomical objects since. Just this past month, yet another paper was published on that particular binary system, using over thirty years of data collected at AO (Weisberg & Huang, Astrophysical Journal, in press). AO also plays a critical role in detecting and studying potential asteroid-based threats to life on Earth with the Arecibo Planetary Radar lab. While not the usual sort of environment concern that the EIS is likely accustomed to considering, the potential consequences of ignoring asteroid-based threats to the Earth could be severe. AO is a premiere single-dish radio telescope that remains the largest in the world; as such, it has unique capabilities and is a point of national pride. On the cultural front, AO provides vital scientific outreach programs to the often under-served island community. Not only does AO provide scientific and technical jobs for many Puerto Rican natives at a time when the local economy is deeply struggling, it runs many school programs and attracts thousands of student visitors every year, many of whom are low-income and come from under-funded schools. AO is a point of pride for island natives and it continues to inspire a whole generation of new, diverse students to pursue the sciences. Beyond the educational programs it provides to the local community, AO also serves as a hands-on facility for countless graduate and even undergraduate students. In an era where science is growing ever larger, it is of critical importance to maintain facilities where students can achieve first-hand experiences with the scientific equipment they are using. AO has a long tradition of providing such experiences, and the experiences I myself gained while visiting AO as an undergraduate are a large part of why I am in graduate school today. In conclusion, AO remains a unique, educational, and scientifically productive telescope.	Against Closure	Email	6/22/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
172	Dr. Timothy	Robishaw	Dominion Radio Astrophysical Observatory	I write to strongly state my opinion that the NSF should choose alternative #1 of its "Notice of Intent to Prepare an EIS", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." I have been a regular scientific user of Arecibo observatory for 17 years and can attest that the telescope is a unique device for measuring astrophysical phenomena. It makes little sense to me to shutter a facility that has many unique capabilities when there is no plan in sight to provide a replacement for these capabilities. To make a succinct case for its continued support, a telescope's collecting area dictates its ability to see faint light from the distant reaches of the universe. The 305-meter Arecibo telescope is the largest collecting area in the world (and is larger than its NSF-funded runners-up by a factor of many). By shuttering the Arecibo observatory, the NSF is making an active decision to black out a substantial window to the universe. To draw attention to a particular topic that can only be studied with the Arecibo observatory, I will briefly describe objects called megamasers. These objects are galaxies very far away that are undergoing an intense burst of star formation and in the process producing laser light at microwave frequencies. These megamaser galaxies are producing laser light millions of times brighter than similar laser light that we see in our own Milky Way galaxy, hence the "mega" in their name. In a coincidence of nature, the molecule that produces this laser light (known as hydroxyl, consisting of one oxygen atom bonded with one hydrogen atom) is very sensitive to magnetic fields. When the laser light is produced a fingerprint is embedded in the light telling us how strong the magnetic field was in the distant galaxy and what direction the magnetic field was pointing. This information travels millions and millions of light years and can only be measured using the Arecibo telescope. I am the world's observational expert in the study of magnetic fields in these megamaser galaxies. I used Arecibo as a PhD student in 2007 to make the world's first direct in-situ detection of a magnetic field inside a distant galaxy. I have recently used Arecibo in conjunction with three of America's largest radio observatories to make the very first high-resolution mapping of magnetic fields in a galaxy outside of our own Milky Way. No other observatory in the world has enough collecting area to detect the signature of magnetic fields in these distant galaxies. The study of cosmic magnetism in the universe would be directly affected by the decision to close this unique telescope. I will allow my colleagues to provide more examples of the unique observational astrophysical endeavors that are in peril by the NSF's potential decision.	Against Closure	Email	6/22/2016	
173	Sumanta	Sarkhel	Indian Institute of Technology Roorkee	I strongly request NSF to choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." I worked at the Arecibo Observatory (AO), Puerto Rico for nearly three years. I am an optical Aeronomer and used the AO's instrument facilities extensively. I found that AO is unique in many aspects. It is the largest single dish radar that can achieve several new targets till date. It is an incoherent scatter radar that can measure plasma parameters in the Earth's ionosphere. I have also worked in the lidar lab at AO which is capable of measuring Fe, Ca, Ca+, Na and K atoms in the upper atmosphere. AO also has airglow spectrometers and airglow imaging systems installed (owned by Boston University and Penn State University) that reveal upper atmospheric chemistry and dynamics. The newly commissioned ionospheric heater will open-up new era of upper atmospheric research at the observatory. AO is the only place in the planet which has both incoherent scatter radar and all these optical instruments (passive and active) for upper atmospheric research. It is such a wonderful working place which you probably will not find anywhere else. I believe that AO will continue its journey in the area of Aeronomy along with Radio Astronomy and Planetary Radar provided adequate funding is available. It is my sincere request to consider these factors for the preparation of the EIS for the Arecibo Observatory in addition to being a unique scientific facility.	Against Closure	Website	6/22/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
174	Allison	Smith	Dept of Physics and Astronomy University of Georgia	This is a response to the invitation for public comments on the environmental impact and future of the Arecibo Observatory. In particular, Arecibo Observatory has an extremely important impact on my career as a young scientist entering the radio astronomy field. As a graduate student I stayed on---site at the observatory for roughly 6 months while I acquired 200 hours of data for my dissertation. I received most of my training as a radio astronomer at this facility and have seen first hand the crucial role AO plays in the fields of radio astronomy, aeronomy, and planetary radar. As a student I benefitted immensely from my time there, and I implore the NSF to select Scenario 1, the No---Action Alternative for continued NSF investment for science--focused operations for reasons including but not limited to the following: o The sensitivity of AO is like no other instrument. As a large single dish telescope, Arecibo is critical for experiments like my own in which we try to detect very weak signals related to magnetic fields in interstellar gas. o There have been 2 major upgrades to the telescope. Arecibo is a productive facility that is working very well and should require no major maintenance for years to come. o Arecibo has earned a Nobel Prize (Hulse and Taylor 1982) and remains in its prime as a scientific facility. It is still very useful not only for radio astronomy, but also for aeronomy and planetary radar. o The expertise of the AO scientific staff is invaluable to observers like myself. They are available for 24/7 support and have been extremely knowledgeable and helpful despite the fact that my project involves experimental work that has not been done before at Arecibo. Having observed at many other telescopes, it is my experience that the staff at Arecibo is unusually insightful and should be considered a valuable asset to the astronomical community. o As a multi---user facility, Arecibo attracts top scientists in the fields of radio astronomy, aeronomy, and planetary radar. This creates an on---site scientific community with a synergy that I have yet to experience elsewhere. During my stay I interacted with and received useful input from scientists of all of these backgrounds. I have been present for many aeronomy campaigns and planetary radar observations. This is experience I can gain at no other facility, and as a young radio astronomer I cannot think of a better place to cultivate my own scientific knowledge. I conveyed above just a few reasons based on my personal experience to continue funding the observatory. The big picture, however, is that Arecibo is unique, powerful, and synergistic in its scientific capabilities. It has both produced groundbreaking science and can continue to do so for decades to come. Arecibo Observatory is inarguably a valuable scientific facility and a harbinger of scientific progress, the promotion of which is, after all, at the crux NSF's mission statement.	Against Closure	Email	6/22/2016	AO_NSFletter.pdf
175	Alessondra	Springmann	Lunar & Planetary Laboratory Kuiper 322 sondy@lpl.arizona.edu (m) 415-509-4124 (o) 520-621-1485 http://www.lpl.arizona.edu/~sondy	I worked at Arecibo Observatory as a data analyst and observing support from 2012-2014 in the planetary radar group. I had left a planetary science PhD program with a master's degree and was unsure of my next moves. Arecibo provided an incredible, unique opportunity to become a scientist, an independent researcher, and an advocate for the work the facility does. Nowhere else could I have been trained, trusted, and turned loose to run on my own a megawatt radar system to characterize potentially hazardous asteroids. I would not have been able to succeed in returning to a PhD program had I not had the opportunity to work at Arecibo. The name recognition of Arecibo has helped me immensely with networking, and the experienced I gained at the observatory was second to none. The facility is inspiring and helps various groups succeed in many ways. The cultural value of Arecibo cannot be quantified: instantly recognizable from Goldeneye and Contact, Arecibo continues to inspire. I had dozens of friends agitate to visit me for a tour of the observatory. I gave a talk at Lucasfilm two weeks ago about Arecibo, and almost everyone raised their hand in the audience as having played Goldeneye on the Nintendo 64 while growing up. For many friends, reading Contact and seeing the movie inspired them to be scientists and to learn more about astronomy. No other observatory is as iconic, as instantly recognizable as Arecibo. A colleague even proposed to his future wife at the edge of the dish. The observatory itself has a low impact on Puerto Rico compared to surrounding communities. Trash is collected regularly. The observatory encourages recycling. A cafeteria on site means employees bring less food packaging. The well on site means water is neither trucked nor pumped on site. During hurricanes the observatory provides vital support for surrounding communities, as it has a generator and most importantly a reliable well. People from the neighboring areas rely on the observatory as a source of water and power during and after hurricanes, when road access to the rest of the island is restricted due to downed trees and power lines. The observatory is the safest place to remain during a hurricane on the island due to its access to resources. Almost every school child in Puerto Rico visits the observatory, which is the only science museum on the island that is already underserved and lacks many basic resources. Taking away the visitor center would entirely decrease access to science for students in Puerto Rico; taking away the observatory would substantially cripple the ability of the visitor center to provide effective scientific education and outreach. I commuted to the observatory at all hours for observations, and never found traffic from tourists to be an issue on the roads that lead to the observatory. The larger road issues were dogs, chickens, horses, potholes, and drivers who lived in the area. Finally, the observatory provides gainful employment for scores of Puerto Ricans. UMET, USRA, and SRI International provide benefits, training, and steady employment in an area with few job opportunities. USRA recently hired Edgard Rivera Valentin, an astronomer who was born in Arecibo. He has been invaluable with providing outreach to the island as to the research done at the observatory, and is active in mentoring numerous students on the island regarding science.	Against Closure	Email	6/22/2016	

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176	Rhys	Taylor	Astronomical Institute of the Czech Academy of Sciences	The Arecibo Observatory provides capabilities to US and international radio astronomy which are unmatched by any other facility. It continues to offer unique contributions to a highly diverse range of studies including galaxy evolution, pulsars, asteroids, and atmospheric physics. No other comparable facility exists or is planned, and without Arecibo several avenues with the potential for major scientific discoveries would be closed as well as losing decades of accumulated experience. Discoveries from Arecibo routinely generate spin-off projects involving new lines of theoretical inquiry, numerical simulations, and further observations, which directly and indirectly support the research activities of scientists around the world. In addition, the Observatory operates highly successful outreach and teaching programmes, using its iconic status and the expertise of its staff to inspire young scientists and inform the general public. The Angel Ramos visitor centre attracts tens of thousands of visitors per year, and undergraduate research programs have helped many Puerto Ricans to choose a career in science, advancing the local knowledge economy. Sustained investment to maintain and further develop the telescope and its instrumentation will ensure it continues to play a leading role in US and international science for the next decade and far beyond. I myself was a post-doc at Arecibo for two and half years. The data I collected there have been essential to my research (and for my institute and my international collaborators) ever since, and will likely to remain the core part of my career for many more years to come. Yet without Arecibo, vital follow-up work to understand the discoveries will be impossible.	Against Closure	Website	6/22/2016	
177	Rhys	Taylor	Astronomical Institute of the Czech Academy of Sciences	There should be a full consultation with the staff regarding how the Observatory is to be managed. Mothballing/closure such a unique facility make absolutely no sense. A greater amount of teaching/outreach might be a very good idea, but moving exclusively to teaching would be impossible - you cannot use a 305m telescope for teaching without also doing science. Allowing greater sources of non-NSF funding should be encouraged (and one should be wary of treating the three sensible options under consideration as being mutually exclusive). Most importantly of all, the Observatory needs to exist as its own legal entity so that it can seek out other funding sources without having to negotiate everything through the NSF. That is not to say the NSF should not have some role in Observatory - it should, and it should be proud of its asset - but the Observatory needs to be able to determine its own future. The best people to decide the future of Arecibo are the people who actually work there.	Alternative Consideration	Website	6/22/2016	
178	Keeisi A. Caballero	Valdez	Arecibo Remote Command Center-Team Leader	I am writing to comment on issues related to human and cultural environment. Any option that NSF pursues that is incompatible with continued science-focused operations at Arecibo will put in serious peril the ongoing science and engineering training of students from high school through postdocs. I am part of the Arecibo Remote Command Center (ARCC) based at the University of Texas Rio Grande Valley. This program is highly involved in observations with the Arecibo telescope. We are also a leading recruiting force for Hispanic students into the STEM fields. Our program has been so successful that it has been expanded to a number of other NANOGrav institutions. We involve a diverse group of high school and undergraduate students in Arecibo observations of pulsars and gravitational wave astronomy. Arecibo has played a particularly inspiring role in training our students to become a substantial group of observers for the Arecibo telescope. Students in the Rio Grande Valley area are filled with excitement and pride themselves in personally operating the telescope and using these experiences to recruit students. This group has propelled me to pursue a higher education in the STEM field. Using Arecibo through ARCC was the strongest influence in my life to obtain my B.S in Physics. I am thrilled to live in these exciting times where the existence of gravitational waves has finally been proven. Their discovery has opened a new “window” to observe the universe and Arecibo plays a staggering role in doing so. I strongly believe that through Arecibo’s continued science-focused operations, hundreds of students will continue doing cutting edge research and hundreds more will receive the opportunity to work with the most sensitive radio telescope in the world. For me as a Hispanic student it has been a truly invaluable research and educational experience and I hope that with your help many other students can have such experience.	Against Closure	Email	6/22/2016	Caballero_Keeisi.pdf

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179	Anthony P	van Eyken	Deputy Director, Center for Geospace Studies SRI International, Menlo Park CA 94025 650 859 2359	The Arecibo management team, SRI International, USRA and UMET, envisions a bright, innovative, future for the Arecibo Observatory performing high-quality science investigations, supporting STEM education at all levels, playing a crucial role in tourism and the local economy, and supporting investigations for government and commercial clients. Within the present draft EIS Scope proposed by NSF, we support the preliminary alternative that includes NSF "collaboration with interested parties for continued science-focused operations". A plan to achieve this vision was outlined in the Arecibo management team's response to the NSF Dear Colleague Letter (DCL) requesting Concepts for Future Operation of the Arecibo Observatory. Fulfillment of any of the various possibilities within the second and third options of the draft EIS Scope may be dependent on extensive changes to the Observatory, its facilities, and usage as well as all such developments documented, or implied, in the responses to the DCL. Should this be the case, they would appear to fall within the scope of the necessary EIS but are not included explicitly, or even implicitly, in the presented draft EIS Scope. These changes include, but are not limited to: major technical upgrades/extensions to the main telescope and/or other Observatory instrumentation; major rebuilding and extension of site infrastructure; and major increases in the numbers of visitors and the facilities, roads, and other infrastructure to support them. The environmental impact of these possible changes on the site and surrounding area should be included in the EIS. In all cases, it is apparent that some existing government property, potentially including buildings and other infrastructure, will no longer be required. The environmental issues related to appropriate dispositions should therefore also be included for all cases considered in the draft EIS.	Resource Considerations	Email	6/22/2016	
180	Anthony P	van Eyken		The preliminary alternatives to be evaluated in the Arecibo-related EIS comprised the following: • Continued NSF investment for science-focused operations (NoAction Alternative) • Collaboration with interested parties for continued science-focused operations • Collaboration with interested parties for transition to education-focused operations • Mothballing of facilities (suspension of operations in a manner such that operations could resume efficiently at some future date) • Deconstruction and site restoration While the first, fourth, and fifth may be impractical, unaffordable, or both, the second and third do not appear to encompass all actually suggested alternatives, let alone all possible alternatives. Besides future scenarios principally constructed around science and future scenarios principally constructed around education, there are apparently viable scenarios principally constructed around tourism. Given the iconic and unique nature of the Observatory such scenarios cannot be dismissed. To be viable, they would need to generate considerable increases in the number of visits to the Observatory, may require substantial new infrastructure, including a variety of rides and other attractions, and would be expected to have quite dramatic effects on the environment, including substantial socio-economic impacts, both positive and negative. While in no way endorsing such a development, I believe that the EIS needs to be comprehensive and that it cannot ignore viable alternatives especially where such alternatives have actually been suggested and discussed at some length. Thank you for the opportunity to contribute to this endeavor; please note that this is a personal contribution and may not reflect the views or intentions of my employer or of any groups to which I am affiliated.	Resource Considerations	Email	6/22/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
181	Eskil	Varenius	PhD candidate, Onsala Space Observatory / Chalmers University of Technology, Sweden	Below I attach a brief summary of the role Arecibo has played in the studies of compact radio sources in the galaxy Arp 220. This work is still ongoing, and we plan to submit a comprehensive study of all available data (including many datasets with Arecibo) in the near future. However, since there is not yet a reference to the current work, we have instead tried to summarise the contributions of Arecibo leading up to the current work. We hope it can be of use. Title: The crucial role of Arecibo for multi-frequency monitoring of Arp 220 Authors: E. Varenius, J. Conway, and collaborators Text: The merging galaxy Arp 220 is the host of extremely intense star formation. In the 1990s, observations using very long baseline interferometry at 18cm wavelength discovered dozens of compact (<3 milli-arcseconds) sources thought to be supernovae (Smith et al. 1998) and supernova remnants (Lonsdale et al. 2006). Parra et al. (2007) successfully used Arecibo, together with the Effelsberg and Westerbork telescopes in Europe, to find the first evidence of detection of the compact sources in Arp 220 at wavelengths shorter than 18cm. This opened up for detailed studies of source spectra, as well as monitoring at multiple frequencies. Subsequent high-sensitivity monitoring enabled measurement of source sizes and classification of individual sources based on phases of supernova evolution (Batejat et al. 2011). Since then, the VLBI monitoring of Arp 220 have continued to deliver intriguing results (e.g. Batejat et al. 2012) and we are soon to submit a comprehensive analysis of the all available data. Arecibo was, with its high sensitivity, crucial for the initial 6cm observations by Parra et al. 2007 upon which all later multi-frequency studies build. In this way, Arecibo has proven crucial for multi-frequency studies of Arp 220, which offers a unique opportunity to learn about the physics of star formation and galaxy evolution in extreme environments. References: Smith, H. E., Lonsdale, C. J., Lonsdale, C. J., & Diamond, P. J. 1998, ApJ, 493, L17 Lonsdale, C. J., Diamond, P. J., Thrall, H., Smith, H. E., & Lonsdale, C. J. 2006, ApJ, 647, 185 Parra, R., Conway, J. E., Diamond, P. J., et al. 2007, ApJ, 659, 314 Batejat, F., Conway, J. E., Hurley, R., et al. 2011, ApJ, 740, 95 Batejat, F., Conway, J. E., Rushton, A., et al. 2012, A&A, 542, L24	Against Closure	Email	6/22/2016	
182	Dr. Bill	Vartorella	Craig & Vartorella, Inc. P.O. Box 1376 Camden, SC 29021 USA Tel.: 803.432.4353 Twitter: @racingelectrics	"Arecibo Observatory: Translating Ripples in Spacetime into the Fabric of a Networked Sustainable Future for an Iconic Radio Telescope" By William F. Vartorella, Ph.D., C.B.C., KJ4ORX, Camden, South Carolina Arecibo, in a very real sense, has spawned a science as revolutionary as Galileo's first observations with a rudimentary telescope. True to its purpose, it has sensed "ripples in spacetime," those mysterious, posited gravitational waves--the Holy Grail of Einstein's followers--that Albert Einstein predicted a century ago in his theory of general relativity. Arecibo Observatory, like space itself, needs to be flexible. This isn't about NSF's investigation of the "environmental impacts of potential Arecibo futures." To quote Galileo, "All truths are easy to understand once they are discovered; the point is to discover them." While NSF's universe is one of flattened budgets and "red-shifted" funding disappearing over some financial horizon, Arecibo's real challenge is to develop a new disruptive paradigm that addresses what scholars call the "cost-curve" of telescopes. U.S. $10 million—just less than NSF's and NASA's combined annual funding--is roughly the size and challenge of the Green Bank Radio Telescope's annual budget in West Virginia, another iconic 'scope seeking money and partners. Yet the NASA funding to Arecibo at U.S. $3.7 million is part of the broader Earth defense of detecting potentially Earth-destroying asteroids and comets. Moreover, Arecibo's extraordinary facilities spearhead upper atmospheric research and the space environment to help us understand Climate Change. Ignoring its search for distant galaxies, signs of extraterrestrial life, and exo-planets, Arecibo serves as a cosmic oasis for some 20,000 students who visit it annually in debt-strangled Puerto Rico. Its STEM-related programs are hyper-critical as Hispanic students are grossly underrepresented in the hard sciences. (See, for example, the Puerto Rico Space Grant Consortium.) The conundrum is that decommissioning Arecibo could cost some U.S. $100 million—which is roughly a decade's worth of current funding for telescope operations. U.S. $100 million is an achievable fundraising target for an endowment, particularly if Arecibo severs all ties and becomes a free-standing global Nongovernmental Organization (NGO). An endowment of U.S. $100 million would generate roughly U.S. $5 million in investment "interest" in a year—half the current Arecibo budget--which could be used as a creative "match" to attract long-term donors, corporate "underwriters," and green/science foundations worldwide.	Against Closure	Email	6/22/2016	

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183	Dr. Bill	Vartorella	Craig & Vartorella, Inc. P.O. Box 1376 Camden, SC 29021 USA Tel.: 803.432.4353 Twitter: @racingelectrics	Positioned with an aggressive grant-generating policy with an institutional overhead of 40% and U.S. $12 million in grants (cf. Arecibo's current NSF/NASA support levels) would yield nearly U.S. $5 million. In short, an endowment + grants' institutional overhead + asteroid and comet detection and Arecibo Observatory becomes self-sustaining. And, to take one example, the grants and "contract support" do not strictly have to focus on esoteric radio astronomy. As an emerging NGO, Arecibo could determine access, partners, and help set the agenda for broader global imperatives for radio telescopes. Lest we forget, radio telescopes worldwide are at risk—Green Bank, Very Long Baseline Array, Kitt Peak, Parkes Radio Telescope (Australia). The need here and what would potentially resonate with global donors is a "flagship initiative" in which Arecibo becomes the iconic face of radio astronomy, particularly in the "Global South." With more than 100 radio telescopes worldwide that are or have been used for radio astronomy, these single dishes and interferometric arrays are uniquely positioned for funding, particularly as the "developing South" agitates for greater support, access, and prominence in Big Science. "Access" is fundable. Unfortunately, Arecibo is "prioritized" below other observatories such as Atacama Large Millimeter/Submillimeter Array. This needs to change. Arecibo is on the National Register of Historic Places and has potential as an UNESCO World Heritage Site, particularly as its restrictions on AM, FM, and TV transmissions within the four-mile access perimeter have effectively prevented intrusive development and negative impact on the flora and fauna of the nearby forests. Arecibo, in a very real sense, is a Sentinel, a canary in the coalmine of cosmic research and a guardian of local biodiversity. This underscores the potential for grants and donors and STEM research (and students and economic impact of 100,000 tourists per year). NSF has listed five possible outcomes, ranging from continuing current operations to dismantling the telescope and returning the site to its natural state. What we advocate (and propose) here is a more creative approach-- a "thought experiment." We need to think through the consequences. NSF seems to take the position that this is Schrödinger's cat: that Arecibo is indeterminately alive or dead. Our thinking here is to quantify the event through live donors, what NSF has detailed as finding "partners." They are not Dark Matter. Examples abound in the visual universe. Some high-profile, historic venues such as the Lowell Observatory have taken dramatic steps to ensure scientific and public access to new instruments (see, the Discovery Channel Telescope--DCT—a U.S. $53 million "fusion of research and outreach"). The Vatican's Advanced Technology Telescope (VATT) outside Tucson, Arizona has a strong "Friends" component (a model that should be followed by all existing `scopes of varying form and function), which apparently is developing, to borrow the words of Don Keel (co-author of Funding Exploration) a cadre of donors with connectedness (involvement with the observatory), clout (access to philanthropic sources and/or corporate leadership + influence with sources to which s/he has access), and capacity (identified ability to give). While most observatories would salivate over the "windfall" of the Gordon and Betty Moore Foundation grant to California Institute of Technology and the University of California (Oakland) for U.S. $7.5 million each over 15 months to complete the Thirty Meter Telescope, the grim reality is "Big Science" often requires a "Big Idea" with a "Big Supporter." Funding shortfalls aside, Paul Allen stepped up to create the Allen Telescope Array—a joint effort by the SETI Institute and the Radio Astronomy Laboratory at the University of California, Berkeley to construct a radio interferometer suitable for a multitude of observations, plus the search for "ET." Simply put, for public institutions, a "red shift" from "state-supported" (largely tax-based) model to "state-assisted," in which institutions, departments, and faculty compete for a diminishing number of Federal and largely-non-existent State dollars. What observatories such as Arecibo face is a combination of "donor fatigue," the lack of an urgent, compelling, interesting Case for Support capable of attracting New Economy money (entrepreneurial and risk-taking), and a systematic approach to competing for STEM grants (Science, Technology, Engineering,	Alternative Consideration	Email	6/22/2016	

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				With perhaps 50 defunct or nearly-so observatories dotting the landscape from the Midwestern cornfields to worldwide venues with exotic names such as Nizhny Novgorod (former Gorky) with its rusting relics of radio astronomy or Mohon del Trigo, Spain, whose facility was displaced by new observatories—radio and optical, it should come as little surprise that part of the expensive "red shift" in U.S. dollars have been replaced locally in the Far East, as the Asian Century ratchets into high gear. In Guizhou, China, FAST (Five Hundred Meter Aperture Spherical Telescope) is under construction with a projected completion date of late 2016. It is touted as the world's largest and most sensitive radio telescope—an estimated three times more sensitive than the Arecibo Observatory. (Operate at 300 MHz to 5.1 GHz). Competition abounds. Yet, employing a decadal analysis, these corporate donors emerge for "Observatories, Planetariums, Physics, Astronomy"—Fireman's Fund Insurance Co., Genentech, Inc., Norton Co., Sedgwick, James, Inc., Toshiba America Foundation, Phillips Petroleum Foundation, Allied Signal, ARCO Chemical, Barnes Aerospace, Beech Aerospace, Boeing, EG&G Aerospace, Grimes Aerospace Foundation, Kaman Aerospace Corp. Giving Program, Sundstrand Corp. Aerospace Foundation, and Toyota USA (also active in STEM), etc. Scientific organizations are also potential funding sources, especially as companies such as Air France, Nestle, Unilever, Union Bank of Switzerland, and a host of mineral extraction, pharmaceuticals, and shipping companies support some arcane and typically low-profile academic societies. The same is true on the "mentorship" front: BP America, Michelin No. America, Beretta Corp., CIBA-GEIGY Corp., Glaxo Wellcome Foundation—name changes are relatively common in this environment, but the point here is made. (An interesting study would be a 50-year retrospective exploring all the companies—such as Union Carbide—which, at one time or another—expressed interest in or actively supported radio astronomy in the U.S. or abroad. These all deserve "revisiting" with strong proposals matching their current—if any—interest either in radio astronomy or broader, community-based STEM support.) An excellent example of the counter-intuitive, highly-restrictive, but financially luscious "trustee discretionary grants" are those occasionally served up by the W.M. Keck Foundation, perhaps best known for its Special Project, the Keck Observatory, home to the twin 10-meter Keck telescopes near the summit of Mauna Kea, Hawaii. Other Special Projects—"exclusively initiated by the Board of Directors"—include the intriguing Institute for Space Studies — California Institute of Technology (www.kiss.caltech.edu). "The Institute combines the brainstorming of new ideas on space science and technology with follow-up research and development." (For a broader discussion, also see www.wmkeck.org , which indicates scientific, engineering, and regional interests.) And, if the late Carl Sagan is to be believed, the definition of an "advanced civilization" is "one able to engage in long-distance radio communication using large radio telescopes." NRAO has embraced "Google Sky" as part of its educational outreach; radio sky images would be a natural outgrowth as an overlay to that "one-pixel backyard" that many amateur radio enthusiasts take a decade or so to "map" via home-brew radio telescopes. Equally interesting are proclamations that next-gen large radio telescopes at frequencies below 100 (or so) MHz will exploit wide-band dipole-like antennas, each with a receiver instrument and linked via digital signal processing. "Galactic-noise-be-damned," if proponents are to be believed, as noise can be mitigated, perhaps when such antennae are employed as compact array elements. Our recommendations, then, are these: 1. Re-purpose Arecibo Observatory as a free-standing, global NGO, with "flagship" status for radio telescopes in the Global South. Make it the networked bridge to the cosmos. 2. Bring meaning, motive, and method to the "squiggly lines" of radio astronomy through an urgent, compelling, and interesting Case for Support that embraces disruptive technologies as the central clearinghouse and waystation for STEM, young scientists in developing settings, and next generation of earth-based radio astronomy observatories. 3. Embrace the Asian Century and the New Money donors worldwide who have a long-range vision for New Frontiers of Knowledge. Recognize that innovation often occurs at the interface of non-monetized ideas (but push for contracts and causes, regardless). 4. Create a two-tiered global Board, with the "wealthy, wise, workers" bringing cash and conviction to an expanded Scientific Advisory Board, who seek to know the unknowable. 5. Cultivate Foundations—STEM projects, perhaps tied to the International Space Station, space-based Earth Observation of the rainforests, student-based searches for Pulsars (cf. Green Bank), and innovative small RadioJOVE, etc. projects initiated by KP4AO A.R.C. 6. Develop budgets whose 40% Institutional Overhead will enable timely, sustainable upgrades to Arecibo Observatory and its (emerging) consortial networked partners. 7. In the short term, move to decrease NSF's financial burden (and NASA's) to less than 50% of the total Budget, with an independent Five-Year Plan for aggressive science and a free-standing Endowment. An immediately-fundable baseline would include support for Hispanic Scientists/graduate students and STEM projects. Galileo Galilei gets the last word: "In the future, there will be opened a gateway and a road to a large and excellent science into which minds more piercing than mine shall penetrate to recesses still deeper."				

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				Selected References: Doty, Arch W7ACD. "Those Mysterious Signals: They may sound like noise to us, but to radio astronomers they are the desired signals." QST, October 2012, 37-39. Ekers, R.D. "The Future of Astronomy." Paper [73.01] delivered at AAS 199th meeting, Washington, DC, January 2002. Ferris, Timothy. Seeing in the Dark: How Backyard Stargazers Are Probing Deep Space and Guarding Earth from Interplanetary Peril. New York: Simon & Schuster, 2002. Hall, Jeffrey. "Director's Update," The Lowell Observer: The Quarterly Newsletter of Lowell Observatory, Issue 97, Spring 2013, 2. Matthews, Christine M. "The Arecibo Ionospheric Observatory." Congressional Research Service, February 23, 2012, [Summary], no page number. Munns, David P.D. A Single Sky: How an International Community Forged the Science of Radio Astronomy. Cambridge, MA: The MIT Press, 2013. "New Grants." The Chronicle of Philanthropy, April 11, 2013, 36. Sagan, Carl. The Cosmic Connection: An Extraterrestrial Perspective. Papermac, 1981. Vartorella, William F. and Keel, Donald S. Funding Exploration: the Challenge and Opportunity for Funding Science and Discovery in the 21st Century. Warren Center, PA: Marco Polo Monograph Series # 9, July, 2004. Vartorella, William F. "Exploiting the New Space Economy: Cryptocurrency, CubeSats, and Atypical Consortial Alliances in a Rural Broadband Setting." Delivered before the Northeastern Kentucky and the Broadband Economy Conference, Morehead State University, Morehead, Kentucky, 10 November 2014. Keynote Address. _____. "From the Earth to the Moon: `Barbicane,' `Nicholl,' and Jules Verne's Adversarial `Model' for Venture Capital." Delivered before the 2014 Aerospace Industry Day, Morehead State University, Morehead, Kentucky, 29 April 2014. _____. "Beyond RadioJOVE: a Case for a COSMIC Paradigm Shift to Embrace A Community-Based, All-Wavelength Funding Model that Showcases Small Instruments, Old Observatories, and Linked Research Agendas," pp. 6-1 to 6-17 in Proceedings of the 2013 SARA Conference held at National Radio Astronomy Observatory, Green Bank, West Virginia, July 14-17, 2013. _____. "`Lost Horizon'—Manned Missions focused on Nanotechnologies, Astrobiology, Space Telescopes, and Advanced Materials will Re-define NASA and NewSpace." White Paper, The National Research Council Committee on Human Spaceflight, July, 2013. _____. "Venture in a Vacuum: NewSpace and the Plight of the `Explorer-Investor." White Paper, AIAA Commercial Space Group, May, 2012. _____. "The New Space Race: The Quest for Venture Capital for Small Satellite Technologies." SatMagazine, Vol. 4, No. 12 (March, 2012), pp. 34-40.				
184	Haley	Wahl		I write to strongly urge that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS… ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." I do so in my role as an undergraduate researcher. Ever since I was a child, I have always had a strong interest in the sky. Stargazing has been a hobby ever since I was little and as I grew older, I developed a strong interest in astronomy. This interest led me to pursue formal astronomy research at the University of Vermont, where I began working with Dr. Joanna Rankin on pulsar research in the fall of my freshman year and have been for the past three years. During my first semester conducting research, I had the opportunity to travel to Arecibo for the first time for a NANOGrav conference. There I was able to meet many incredible scientists in the field who shared my passion for astronomy and while at the site of one of the most amazing instruments in the world. I was fortunate enough to return to Arecibo the following December and during that time, was able to do on-site observations from the control room, walk on the catwalk and under the dish, and really experience everything about the telescope. Since then, I have been able to do multiple remote observations with the telescope for a variety of different research projects. My experiences at Arecibo are ones that have greatly changed who I am as a person and have immensely shaped my future career path. Being at the observatory itself and being around people that share my passion has really made me realize that astronomy is the field that I want to go into. The NANOGrav conference I attended brought together scientists from all over the world who came together to use the instrument and attending the conference allowed me to do a great deal of networking and allowed me to meet people I could have possible collaborations with in the future and possibly work with in graduate school. Having the ability to travel to Arecibo, make both on-site and remote observations, and connect with others who use the instrument, so early in my astronomy career has opened countless doors in terms of my future in astronomy. I am currently working on multiple projects that require very precise pulsar observations and my work would not be possible without the amazing capabilities of Arecibo. The telescope itself and the science it conducts have inspired me to pursue radio astronomy as a career and the work I hope to do in graduate school and beyond would be greatly aided by the amazing capabilities of Arecibo. I am so thankful that Arecibo has allowed me to build the connections I have and to gain the experience I will need for my future in astronomy. It has been a crucial part of my undergraduate research career and hope that in the future other undergraduates will have the same opportunities that I have had and be as inspired by the telescope as I was the first time I laid eyes on the dish, a feeling of amazement and inspiration I continue to feel each time I use the telescope.	Against Closure	Email	6/22/2016	

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185	Joel	Weisberg	Stark Professor of Physics and Astronomy and the Natural Sciences Carleton College Northfield, MN 55057 USA email: jweisber@carleton.edu phone: (507) 222-4367	I write to strongly urge that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." Impact of Arecibo Observatory on Research As a scientific user of Arecibo Observatory for over 44 years, I can attest to its historical and continuing importance for studies of general relativity, pulsars, and the interstellar medium. Its enormous collecting area (the largest in the world) has been and continues to be crucial in studies of faint objects such as pulsars. Most importantly, although the facility is over fifty years old, it has undergone two major upgrades, each of which created an essentially new, far more powerful telescope. Consequently it remains in the prime of its scientific life, still able to make important and useful scientific discoveries. While most radio astronomers now use multiple-dish interferometers for their observations, there remains an important need for large single dish telescopes such as Arecibo, for observations of objects too faint to be studied with interferometers. I will cite a prime example from my own research. For thirty-eight years, I have been involved in observations of the first binary pulsar, B1913+16, which earned its discoverers Joseph Taylor and Russell Hulse a Nobel Prize. It was too faint to be discovered by any other telescope in 1974. It is also so faint that essentially all useful observations of it have been done from Arecibo, despite the fact that it is a crucial object for the study of general relativity. For example, it was Arecibo observations of this object that first demonstrated the existence of gravitational waves, thus paving the way for this year's stunning LIGO detection of them. Even today, we continue to observe this object from Arecibo and to derive from these observations new, meaningful measurements of general relativistic phenomena. For example, our latest observations and analyses were just accepted by Astrophysical Journal (J.M. Weisberg and Y. Huang, "Relativistic Measurements from Timing the Binary Pulsar PSR B1913+16," Astrophysical Journal, in press). Furthermore, there is more to learn from this system in the future, and Arecibo will remain the only telescope able to adequately observe it for at least the next several years. I could cite several other examples of the role that Arecibo alone can play in my other research, and many others can and will do so. The telescope remains a unique, powerful, and flexible instrument for the 21st century. Impact of Arecibo Observatory on Education I have traveled regularly to Arecibo Observatory for over 44 years, often in the company of students. The observatory is a profoundly inspiring installation for its users, and especially for students. Many of my students have been powerfully motivated to pursue scientific careers by their visits to the observatory. I will cite a recent trip as an example. A colleague and I brought seven students from a variety of institutions to the observatory for a week of study and observations. The observatory staff presented tutorials on a wide variety of topics related to observatory research, while the two tour leaders taught the students how to carry out radioastronomical observations, which the students then did. Because of the unique hands-on nature of the observatory, we were able to take the students behind the scenes and show them the full nature of the data gathering process, from antenna through radio receivers and into digital data acquisition devices. They connected an oscilloscope to the telescope in order to view a pulsar pulsing on the screen in real time, saw the complexities of the observatory's atomic clock, and helped to gather data for a real pulsar experiment. There is simply no substitute for the direct experience of the workings of an observatory, and indeed one student participant noted that the week had changed his life.	Against Closure	Email	6/22/2016	
186	Qihou (Herb)	Zhou	Professor & Chair Electrical & Computer Engineering Dept.; 260F Garland Hall; Miami University; Oxford, OH45056; Phone: 513-529-0743	I am a professor at Miami University. I support unequivocally the first option "Continued NSF investment for science-focused operations (No-Action Alternative)" in the recent EIS regarding Arecibo. I would like to elaborate the value of Areicbo for atmospheric and ionospheric studies. Simply put, Arecibo is a irreplaceable national jewel. Any attempts to duplicate the capabilities for atmospheric/ionospheric studies alone will take hundreds of millions of dollars. I have been an active Arecibo user dating back over 30 years. I would like to testify that Arecibo is the only facility that that can study the atmosphere continuously from the ground level to several thousand kilometers. This unmatched capability makes it a primary instrument in studying our spatial environment, including climate change. One indicator of climate change lies in the upper atmosphere temperature from 100 km to 600 km. As the surface temperature rises, the upper atmosphere cools. While ground temperature has significant local variations, the upper atmosphere temperature is more homogeneous. Clearly, the longer the data is available, the easier it is to discern any long-term trend. Continuous operation of Arecibo is important to understand climate change and our spatial environment. The unique capabilities afforded by the Arecibo incoherent scatter radar (ISR) in studying our atmosphere and ionosphere include: - Arecibo ISR is the only instrument that can study consistently the ionospheric D-region from 60-90 km and the topside above 1000 km. - Arecibo ISR is the only instrument that can study day-time ionospheric plasma line consistently. - Arecibo ISR is the only instrument that can detect night-time plasma line. - Arecibo ISR is the only ground based instrument that can study the connections of inter-hemospheric photoelectrons. - Arecibo ISR, along with the on-site lidar and optical instruments, is the best place to study dynamic coupling from near ground level to 1000 km. - There is no dispute that Arecibo ISR is the most versatile ground-based instruments for ionospheric studies, ".".	Against Closure	Email	6/22/2016	

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187	Qihou (Herb)	Zhou	Professor & Chair Electrical & Computer Engineering Dept.; 260F Garland Hall; Miami University; Oxford, OH45056; Phone: 513-529-0743	I am a professor at Miami University. I support unequivocally the first option "Continued NSF investment for science-focused operations (No-Action Alternative)" in the recent EIS regarding Arecibo. Each year, Miami has about 20-25 undergraduate/graduate students visiting Arecibo or working with Arecibo data. The Arecibo Observatory inspires many undergraduates engaged in the STEM fields. Miami University has an annual faculty-led winter study-away workshop using the Arecibo facility. Students come to the observatory to take and analyze the data, and to experience the local culture. In 2015 and 2016 there were 14 and 19 students, respectively, participating in the Miami-Arecibo workshops. Additionally, there are another 5-8 Miami students working on capstone and research projects using the Arecibo data every year. I will continue to lead Miami in the Arecibo study-away workshops in the coming years. The following is an excerpt from the reflection essay of one Miami student participating in the Jan. 2016 workshop: “All in all the experience of visiting Arecibo Observatory was extremely humbling and awe inspiring. To think that in the 1960’s that such an observatory could have been designed and built is truly amazing. What is even more exhilarating is to think of all the findings that originated from this observatory and how it’s shaped the world as we see it today. Doing something as simple as walking around control room and seeing all the photos compiled from the radar of distant comets and asteroids was very surreal and inspiring. I am extremely thankful for the chance to visit such a facility and see this extreme engineering feat for both mechanical and electrical engineers alike. I hope to one day revisit the facility and to see what new mysteries of the universe that have been uncovered. Hopefully one day I’ll play a small part in one of them myself.”	Against Closure	Email	6/22/2016	
188	Elizabeth A. K.	Adams		This letter is in response to the Federal Register Notice of an EIS evaluating the potential environmental effects of proposed changes to operations at the Arecibo Observatory. I strongly request NSF to choose Alternative 1 of its "Notice of Intent to Prepare an EIS...", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." I completed my PhD in 2014 with a dissertation based on data collected with Arecibo as part of the ALFALFA HI survey. Thanks to the Arecibo data, I undertook groundbreaking research identifying nearby low-mass galaxies that had been overlooked previously because most of their mass in is gas rather than stars. In addition, I was trained as a radio astronomer with Arecibo data, including many trips to Arecibo for observing experience and interaction with the support staff. I am currently a postdoctoral researcher and am applying the skills I learned from the use of Arecibo to other future radio surveys. In addition to my own education being strongly dependent on Arecibo, I had the opportunity during my PhD to mentor undergraduates and teach them radio astronomy through the Undergraduate ALFALFA Team (UAT). The UAT is a consortium of primarily undergraduate-only institutes (including Puerto Rican institutes) designed to involve undergraduate students in cutting edge scientific research. Through this program, undergraduate students are brought to Arecibo, trained to observe and participate in the data reduction and analysis of the ALFALFA survey. Importantly, the students are engaged in actual scientific research, gaining experience in how to formulate scientific questions and address them when the answers are not known. This critical aspect would be lost if Arecibo transitioned to an education-focused facility. Arecibo is also a landmark for the island of Puerto Rico. Over a hundred thousand people visit Arecibo every year, with almost a third of those visitors school children. A visit to Arecibo is inspiring - both for the impressiveness of human ingenuity and engineering in constructing it but also for the knowledge that the telescope is currently being used to increase our understanding of the Universe. In summary, I believe the continued scientific operation of Arecibo has a strong positive cultural and educational impact.	Against Closure	Email	6/23/2016	

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189	Yolián	Amaro-Rivera		I write to support NSF's alternative 1 of "Continued NSF investment for science-focused operations (No-Action Alternative)" for the Arecibo Observatory. The Arecibo Observatory has had some of the greatest impacts in my professional, academic, and personal life. Growing up in a rural area of Puerto Rico, the fact is there were no professionals in science or engineering to look up to. When I was about 7 years old, my parents took me to visit the Arecibo Observatory, and it was that same day that I decided I wanted to become an engineer. Later, when I was pursuing my undergraduate degree in Computer Engineering at the University of Puerto Rico at Mayagüez, I had the incredible opportunity to be part of the summer research program at the facility, and thus interact with well-known scientists and engineers. From this experience, I became interested in graduate school, and the skills and knowledge I obtained at Arecibo helped me get into my current graduate program. As a Puerto Rican in science and engineering, there are more positive contributions the Arecibo Observatory provides to the world than I could possibly list here. For example: • It is an attractive well-known facility that many young students visit each year, which can impact the lives of these kids the way it did with me by exposing them to state-of-the-art work in the atmospheric sciences, astronomy, and engineering. • Each year, a group of undergraduate students have the opportunity to conduct research at AO, which allows them to obtain important skills that they can use in many different areas. • It represents one of the most attractive touristic locations in the island because of its history, size, interactive Visitor Center, and appearance in iconic movies. • It is the source of great discoveries, including the 1993 Nobel Prize obtained by Russell Hulse and Joseph Taylor for discovering a pulsar binary system. • It represents an opportunity for global collaboration between scientists and engineers. • It also gives the island international recognition, which attracts tourists and supports the island economy. At a historic time when other foreign countries are doubling down on similar scientific institutions, keeping the Arecibo Observatory (which is on US soil) alive would be crucial if the United States of America intends to remain relevant at the cutting edge of science and innovation, both at national and international levels. The Arecibo Observatory continues to be one of the most important, powerful institutions to conduct research in atmospheric and space sciences. Many Puerto Ricans have been working at this facility for years, and losing their jobs during the economic crisis the island is currently facing would be devastating for many families. Teaching in my home island while conducting research at the Arecibo Observatory after finishing my PhD is my biggest goal and I am sure that many other Puerto Ricans have dreamed about working there someday.	Against Closure	Email	6/23/2016	NSF_letter.doc
190	Jason W.	Barnes	Chair, Division for Planetary Sciences American Astronomical Society	On behalf of the Division for Planetary Sciences (DPS) of the American Astronomical Society, I wanted to inform you of a relevant resolution that passed without any dissenting votes by the general membership at our annual meeting last fall in National Harbor, Maryland on 2015 November 11. The resolution reads: The Division for Planetary Sciences of the American Astronomical Society hereby recognizes the importance of the Arecibo Observatory and its planetary radar capability to our science and to planetary defense issues. We strongly encourage all of the concerned institutions to work together to resolve Arecibo's budgetary and other issues so that the Observatory can continue to be a scienti cally productive facility for planetary science, radio astronomy, and atmospheric studies. Please let me know if you have any questions about the importance of Arecibo Observatory to the Planetary Science community, as I would be happy to help in any way that I can.	Against Closure	Email	6/23/2016	Arecibo_NSF.pdf

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191	Dr. Lance A. M.	Benner	Mail Stop 183-601 Jet Propulsion Laboratory California Institute of Technology Pasadena, CA 91109 Phone: 818-354-7412 Email: lance.benner@jpl.nasa.gov Asteroid Radar Research Website: http://echo.jpl.nasa.gov/	This is a letter to express my strong support for continued operations of the Arecibo Observatory (the No-Action Alternative). As a scientific user of the Observatory since 1998, Arecibo has played a crucial role in my research on the physical properties of near-Earth and main-belt asteroids. Arecibo is the most sensitive planetary radar in the world by a factor of twenty relative to NASA's Goldstone Solar System Radar, the world's second most sensitive radar. Arecibo's range is double that at Goldstone, and despite its restricted pointing, significantly more asteroids are observable at Arecibo than at Goldstone. For example, in 2015 95 near-Earth asteroids were observed at Arecibo versus 39 at Goldstone. More generally, in a paper we recently submitted to the Astronomical Journal (S. P. Naidu, L. A. M. Benner, et al., in press), we found that Arecibo could, in principle, observe more than 250 near-Earth asteroids annually, so the observatory's radar capabilities are actually significantly underutilized. Two recent National Research Council reports have expressed strong support for continuing the planetary radar program at Arecibo: the 2010 "Defending Planet Earth" report led by Dr. Irwin Shapiro at the Harvard-Smithsonian Center for Astrophysics and the recent Planetary Science Decadal Survey. Tracking and characterizing near-Earth asteroids became part of United States National Space Policy in 2010 (https://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf), as formulated by the White House Office of Science and Technology Policy, and part of NASA's charter (https://www.nasa.gov/offices/ogc/about/space_act1.html), also updated in 2010. Thus, observations of near-Earth asteroids, with Arecibo as a key asset, is a national priority defined not only by multiple panels of planetary scientists with expertise in asteroids and comets but also by the White House. Scientific interest in near-Earth objects is increasing rapidly and the field is experiencing dramatic growth. This is attracting numerous undergraduate REU students and PhD students. In the last several years, observations at Arecibo have been utilized in Ph.D. theses by former and current students Michael Busch (Caltech), Shantanu Naidu (UCLA), Julia Fang (UCLA), Yu Takahashi (Univ. of Colorado), Anne Virkki (Univ. of Helsinki, Finland), Sean Marshall (Cornell), Agata Rozek (Univ. of Kent, UK), Adam Greenberg (UCLA), Jenna Crowell (Univ. of Central Florida), Tracy Becker (Univ. of Central Florida), and Alessondra Springmann (Univ. of Arizona). Arecibo has played a key role in support of numerous asteroid and comet robotic spacecraft missions by characterizing the properties of the targets and improving their orbits. Arecibo has made important contributions to the following missions: Dawn at Vesta and Ceres; NEAR-Shoemaker to asteroids Mathilde and Eros; EPOXI at Comet Hartley 2, where Arecibo played a crucial role with navigation of the spacecraft shortly before the flyby; JAXA's Hyabusa mission to asteroid Itokawa; the OSIRIS-REx mission to asteroid Bennu (scheduled for launch in September 2016); the proposed ESA/NASA Asteroid Impact Mission/Double Asteroid Redirect Test missions (AIM-DART), and NASA's proposed Asteroid Retrieval Mission (ARM). For the AIM-DART missions, currently in "Phase A" with both ESA and NASA and expected to enter "Phase B" later this year, Arecibo will play a vital role by observing the result of the impact between the spacecraft and the asteroid in October 2022. Diameters of near-Earth asteroids observed by Arecibo are also helping calibrate results from NASA's Wide-field Infrared Observer (WISE) mission. Those, in turn, form the foundation of our knowledge for the size-frequency distribution of the near-Earth population. Recently, the exciting discovery of fast radio bursts and gravitational waves have opened up new fields where Arecibo's unparalleled sensitivity could make major contributions. Rather than contemplating closure of the facility, the real discussion we should be having is how to augment its capabilities to exploit these important scientific discoveries. Due to its iconic status and the major discoveries that have occurred there, tens of thousands of Puerto Rican students visit the observatory annually. The Observatory is also a major tourist attraction and provides arguably the most effective venue for scientific outreach in the Caribbean. The observatory has provided some of the best scientific and engineering jobs to Puerto Ricans for decades and is a major employer locally, which is particularly important given the current economic crisis on the island. Arecibo is also an outreach engine for astronomy public outreach. Press releases describing new radar images of near-Earth asteroids at Arecibo are viewed by millions of people and appear widely on major online news websites.	Against Closure	Email	6/23/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
192	Dr. Lance A. M.	Benner	Mail Stop 183-601 Jet Propulsion Laboratory California Institute of Technology Pasadena, CA 91109 Phone: 818-354-7412 Email: lance.benner@jpl.nasa.gov Asteroid Radar Research Website: http://echo.jpl.nasa.gov/	In addition to its significance as an astronomical observatory, Arecibo Observatory is home to the US federally-endangered Puerto Rican broad-winged hawk, which occurs only on Puerto Rico. This species has been documented at the Observatory for many years by knowledgeable observers using the “eBird” online database of world-wide bird observations (for example, see http://ebird.org/ebird/hotspot/L682836?yr=all&m=&rank=mrec&sortBy=spp and links therein). An additional 12 endemic bird species found only on Puerto Rico breed regularly at the Observatory, and a thirteenth, the Puerto Rican Parrot, which is among the most endangered birds in the world, has been released nearby at Rio Abajo State Forest as part of a breeding program. The contiguous tract of relatively undisturbed forest between Rio Abajo and the Observatory are key elements in recovery efforts for that species. In summary, I urge strong support for continued operations at Arecibo Observatory. Its closure would be incredibly short-sighted given its substantial scientific potential for future discoveries. Due to its unique cababilities, the Arecibo Observatory is a globally-significant facility and the whole world will lose if it closes.	Resource Considerations	Email	6/23/2016	
193	Donald B.	Campbell	Professor of Astronomy Space Science Bldg. Cornell University Ithaca, NY USA 14853 Tel: 607 255 9580 e-mail: campbell@astro.cornell.edu	The Arecibo telescope is still by far the largest single dish radio telescope in the world and its collecting area combined with high quality instrumentation is a resource that should not be abandoned. As Arecibo’s history has made clear, big telescopes do make big discoveries. The Chinese FAST telescope may eventually have about 1.6 times the sensitivity of Arecibo but the difference is small and not a reason to deprive US scientists of access to a telescope with Arecibo capabilities. Four areas of astronomical research for which Arecibo plays a critical role are: Gravitational waves: It is widely accepted that precision timing of selected pulsars has the potential to detect gravitational waves in a different frequency regime than the one that LIGO is sensitive to. The Division of Physics (with a contribution from Astronomy) has provided extensive funding for the North American Nano-Hertz Gravitational Wave Observatory for this purpose. Given its sensitivity, Arecibo plays a critical role in this endeavor in both finding new millisecond pulsars that can be accurately timed and in the precision measurement of pulsar arrival times. Even if Arecibo's entire budget from AST were just to support the pulsar search and timing effort it would be well worth it given the possibility of such a giant payoff. Fast radio bursts: A recently published paper (Spitler et al, Nature, 531, 202-205, March 2016) makes clear Arecibo’s unique capability to study the enigmatic Fast Radio Bursts. Cosmology: Arecibo's sensitivity and relatively small beam area also makes it the only U.S. instrument capable of determining the volume density of small gas bearing haloes in the local universe by sampling a sufficiently large area of the sky. Solving the problem of the ubiquity of these haloes has strong implications for the currently preferred cosmological model. Near-Earth asteroids: Radar studies of near-Earth asteroids provide critical astrometric and characterization information about these scientifically interesting and potentially hazardous objects. While NASA is providing ~$3.9M per year to support this program at Arecibo its continuation is very dependent on the overall health of the telescope and the observatory. Education: Arecibo is one of the very few large radio telescopes that still allow “hands on” observing, often remotely but also sitting in the telescope’s control room. This makes it a tremendous learning environment for students, graduate and undergraduate. A number of graduate students working with me have spent time at Arecibo. Hundreds of undergraduates have participated in the NSF supported ALFALFA Undergraduate Program either visiting Arecibo or using it remotely. A large number of students have used Arecibo remotely through the Arecibo Remote Control Centers (ARCCs) at U. of Texas at Brownsville, U. of Wisconsin at Milwaukee and at Franklin&Marshall College. All of these promote STEM at, primarily, undergraduate universities. Hundreds have gone through Arecibo’s REU program many of who went on to graduate studies in astronomy. Finally, there are the ~100,000 visitors per year, primarily from Puerto Rico including many thousands of school children, who gain some appreciation of scientific research through the visit. The Gregorian upgrade to the Arecibo telescope completed in 1997 was, perhaps, the most radical modification of the large telescope that has ever been done. It resulted in a very modern telescope with tremendously enhanced capabilities. The installation of the 7-beam ALFA system, the only multi-pixel cm wavelength system on a US telescope, in 2004 further increased these capabilities. The NSF needs to find a means by which Arecibo can continue as a critically needed telescope for the nation’s astronomers and as an outstanding educational resource.	Against Closure	Email	6/23/2016	NSF Arecibo EIS letter June 23 2016.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
194	Al	Clayton		First allow me to say "kudos" for allowing public input into these decisions. I am not a professional scientist by any means, but have an extensive science background. I am also a former student of Dr. Kerr's, from his final days at Boston University. That being said, I think the public would best be served if Arecibo could endeavor to relate its science directly to the average American. Science has a very bad reputation among the ignorant in this country; they just can't understand it or the need for it; or they are all so close minded. (& when I point to things they use everyday like GPS I am scoffed at) I think you need to educate the average American (most likely at a 5th grade level) and inspire the children. My kids are 6 & 4 and love the sky, space, planets, stars, moon, and ask questions. I'm afraid most parents don't have the right answers. People need to understand why the science you are doing is important and what it means to their daily lives. This is no easy task. Americans are irrationally skeptical of science, look how many people believe Creationism should be taught with evolution! I think it's necessary to connect with the general public and relate to them what your science is doing for them.	Against Closure	Email	6/23/2016	
195	James	Cordes	George Feldstein Professor of Astronomy Cornell University Cornell	I am an astrophysicist who has used the Arecibo Observatory for more than 40 years, first as a graduate student, then as a post doc, and for the last 36 years, as a professor at Cornell. As a professor I have trained over 20 PhD students who have used Arecibo as part of their dissertation research, including two students who have finished in the last year. Cornell has had a Research Experience for Undergraduates program since 1989 and I have typically had two students per summer work on Arecibo-related research. The common thread to my research that also is highly attractive to students is discovery science at radio wavelengths. As the world's largest reflector, Arecibo plays center stage in these activities. I am involved in two large collaborations that make heavy use of Arecibo: the Pulsar ALFA (PALFA) Consortium and NANOGrav, the North American Nanohertz GravitationalWave Observatory. Letters from these consortia are being sent separately so my only comment here is to emphasize that Arecibo has a primary role in the activities of these groups. NANOGrav in particular relies on regular timing of pulsars as part of its effort to detect gravitational waves. Arecibo (along with the Green Bank Telescope) are the best radio telescopes in the world for use in GW detection using pulsars. Of great importance is the stability of Arecibo's performance in achieving high timing precision (since the signal we are looking for is very weak). Also key is access to the telescope because we need highcadence observations (monthly in some cases, weekly in others). It is doubtful that adequate time will be available on the FAST telescope being built by China for these kinds of observations. The PALFA Consortium does an ongoing survey for pulsars with the goals of finding neutron stars in binary systems with other neutron stars (and potentially a black hole); also finding new members of the special class of pulsars (those rotating with millisecond periods) that are needed to further NANOGrav's mission'; and also finding 'transient' signals. We have been successful in all of these categories. Most notable is our discovery of a fast radio burst that comes from outside our galaxy but is otherwise an enigma; we do not know what produces it. More such bursts need to be discovered and PALFA has improved its algorithms for finding such bursts in the data taken. More recently, we found by monitoring the same sky position of the original burst that it was emitting repeated bursts. This was a landmark discovery and has gotten great notice from around the world after its publication in Nature magazine. Very recently (2016 February), a group of us led by Professor Brian Jeffs at Brigham Young University submitted a proposal to NSF Astronomy's Midscale Innovation Program (MSIP) to build a new phased-array feed (ALPACA) for Arecibo that would dramatically enhance our efforts to find more pulsars and fast radio bursts. Phased array feeds for radio astronomy are at the technology forefront so they are of interest solely from a technical point of view but the driver is Arecibo science. The review panel ranked our proposal very highly and it is poised for funding after going through a very competitive review. The program officer has informed us that the project is fundable and that funds are being held in reserve. Evidently the reviewers saw significant merit in the science enabled by the combination of the phased-array feed with Arecibo's collecting area. However, funding is on hold until the outcome of the process of Proposed Changes to Arecibo Observatory Operations is resolved. This example makes clear what the situation is: Arecibo is highly important for high-visibility science that is of great interest to the broader astrophysics community and also to the public. Fast radio bursts have gotten much attention in the public press. I have given interviews to the (on line) Wall Street Journal, NPR, and Sky and Telescope and my colleagues have done similar interviews across the U.S., Canada, and Europe. New technology (ALPACA) was recognized in a peer review process to provide important scientific capabilities. All it needs is a telescope to go on! So please make the choice of Continued NSF investment for science-focused operations. Or stated more strongly, there should not only be continued investment in operations, but enhanced investment in new technology and in students who will use the largest telescope in the world available to U.S. scientists for making landmark discoveries.	Against Closure	Email	6/23/2016	Arecibo_JMC2016.pdf

Comment Number	First Name	Last Name	Affiliation	Comment	Category	Comment Source	Date Comment Received	Attachments
196	James	Cordes	George Feldstein Professor of Astronomy Cornell University	Response to the Notice of Intent, Proposed Changes to Arecibo Observatory Operations From the Pulsar Arecibo L-band Feed Array (PALFA) Survey Consortium This letter is in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory. It is written on behalf of the PALFA Consortium, a group of scientists concentrated in North America but including worldwide participation who are focused on key science being done with the Arecibo Observatory. Members of the Consortium are based in the U.S., Canada, Germany, the Netherlands, South Africa, and the United Kingdom. We strongly urge the evaluation to focus on the first option under consideration, Continued NSF investment for science-focused operations. The PALFA Consortium has directly involved many undergraduate, graduate students, and postdoctoral researchers who have taken part in the project and have used data from the Arecibo Observatory for a wide range of scientific applications. However, Arecibo's impact extends much further: the data we obtain at Arecibo are used in the Einstein@Home project, a citizen science program that enables volunteers to participate in the discovery of new astronomical objects (neutron stars/pulsars with data from PALFA and gravitational waves from the LIGO project). There are currently 44,000 active users of Einstein@Home and there have been a total of 850,000 participants from 221 countries. Volunteers have discovered 25 new pulsars in PALFA data. Neutron stars discovered by the PALFA search program serve as astrophysical laboratories for fundamental physics, and have been used to probe the nature of gravity as well as the strong force. Some of the pulsars we have discovered are ultra-accurate clocks. Their precise ticks enable the NANOGrav collaboration to use them as elements of a Galactic-scale detector of long-period gravitational waves. That gravitational wave band is completely different from, and thus complements, the band sampled by the LIGO project, which has recently made spectacular discoveries of merging black holes. Fast radio bursts (FRBs) are enigmatic isolated radio pulses that appear to be coming from beyond our Galaxy, hinting at prodigious energies underlying their production. The peer reviewed literature has dozens of conflicting proposals for their origin, including active stars, neutron stars, hypernovae, merging black holes, and cosmic strings. Arecibo is playing a key role in the mystery, with our recent discovery of the first repeating FRB source. Collaborative joint follow-up observations of this source have involved (in order of wavelength) Fermi, Chandra, Swift, XMM-Newton, Gemini, Keck, the Very Large Array, the Green Bank telescope, Effelsberg, GMRT, LOFAR, and LWA, reflecting the wide breadth of interest in the astronomical community. These and other results are topics of wide interest to communities that extend well beyond the astronomers who make direct use of Arecibo. The Arecibo telescope has been at the cutting edge of radio astronomy for over 50 years and its capabilities continue to increase. As the largest aperture on the planet, it provides unique capabilities that are exploited by deploying more powerful digital processors, better astroinfomatics, and management of big data sets. The complexity and challenge of handling our data sets has been and continues to be a perfect opportunity for students to learn about big-data methods and to develop new algorithms that enable new discoveries. Arecibo is a key, unique resource for the worldwide science community. What cannot be understated is that it is the underpinning of collaborations of U.S. scientists with foreign colleagues. Without Arecibo, we not only lose the technical capabilities of the instrument, but we lose a basis for our international collaborations. We also urge continuation of Arecibo's science-focused operations because the Observatory is of great importance to Puerto Rico. Not only does the Observatory provide jobs to the local community, but it brings great prestige to the entire island, which is important for attracting Puerto Rican students into STEM fields. The Visitor Center at the Observatory has been enormously successful in exposing students on the island (as well as the broader public) to the highly attractive science areas that astronomy delivers. However, the attractiveness of the Visitor Center is due in large part to its connection to a vibrant, active observatory that delivers brand new, real science results at the cutting edge of research. It would be much less effective as a stand-alone educational facility without that connection. However, creative approaches that better meld research and education activities at the site with the Puerto Rican community should be pursued. Finally, we note that the Chinese FAST telescope, which is slated to have its "first light" later this year, is an Arecibo-like telescope with larger collecting area. In principle, its technical capabilities may surpass some of those of Arecibo. However, as with all new telescopes, commissioning and ramp up to full capabilities takes years. Moreover, it will not allow high-frequency observations that extend up to Arecibo's 10 GHz limit owing to the precision of FAST's primary surface. Such frequencies are becoming more important for precision pulsar timing that underlies NANOGrav's gravitational wave program. In addition, FAST will not have the radar capability that Arecibo provides for the incredibly important role in tracking near-Earth objects that can potentially impact the Earth with great consequence. For human resource development, there is no guarantee that adequate telescope time on FAST will be available for NANOGrav's program, which requires regular and frequent observations of a large number of pulsars. Indeed, there is no guarantee that U.S. scientists will have the same access to FAST as do our European and Australian colleagues (and competitors). Multiple, large radio telescopes are in fact needed to fulfill the requirements of cutting-edge science, just as there is scientific need for the largest optical telescopes, three of which are now about to be constructed. Reiterating, we strongly urge the evaluation to focus on the first option under consideration, Continued NSF investment for science-focused operations.	Against Closure	Email	6/23/2016	Arecibo_PALFA2016.pdf

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197	Lucy	Crespo	Chief Executive Officer Puerto Rico Science, Technology & Research Trust	My name is Lucy Crespo, Chief Operating Officer (CEO) of the Puerto Rico Science Technology and Research Trust ("the Trust"). Thank you very much for the opportunity to present our publics comments as inputs to the Environmental Impact Statement (EIS) of the Arecibo Observatory. The Puerto Rico Science Technology and Research Trust is a private non---profit organization created by law in 2004 to encourage and promote innovation, transfer and commercialization of technology and to foster the creation of jobs in the technology sector. We are also responsible for Puerto Rico's public policy for science, technology, research and development. Our mission is to invest, facilitate and build capacity to continually advance Puerto Rico's economy and its citizens' well---being through innovation---driven enterprises, science and technology and its industrial base.. Our vision is that by 2022, Puerto Rico is a globally recognized innovation hub that develops, attracts, and retains scientists, technology entrepreneurs, and enterprises to unlock world---class creativity and competitiveness. During the last two years the Trust has implemented several key initiatives to accelerate Puerto Rico's transformation into knowledge economic that includes: • Established the first local Research Grants Program to empower scientists and researchers to take Puerto Rico's knowledge economy to a higher level of excellence. The initiatives seek to impact researchers in the academia, non--- profit research organizations and at the private sector. The first cohort of grantees from 2015, include various projects in aerospace technology. of these projects belongs to the Puerto Rico Photonics Institute and its director, Dr. Jonathan Friedman from "Universidad Metropolitana" currently a partnering institution of the Arecibo Observatory. • The Center for Tropical Biodiversity and Bio---prospecting, which will enable a number of efforts aimed at advancing the exploration of tropical biodiversity, the development of searchable collections of biological specimens from tropical environments, the conservation of biodiversity resources and the commercialization of biodiversity---derived products. • The Puerto Rico Consortium for Clinical Investigation (PRCCI), a not---for---profit cooperative of top academic and private research sites. PRCCI enhance clinical research quality and speed by driving performance and efficiencies across our sites, leveraging strategic partnerships, and establishing world--- class capabilities. • Parallel18, an economic development initiative sponsored by the Trust, the Puerto Rico Economic Development and Commerce Department (DDEC), and the Puerto Rico Industrial Development Company (PRIDCO) aim to attract and create high impact start---ups that can scale from Puerto Rico to global markets including Mainland US, Latin America, and Europe leveraging Puerto Rico's location, bicultural and bilingual culture, lifestyle and competitive tax incentives. • Established the Puerto Rico Technology Transfer Office that offers services to public and privates universities in Puerto Rico to enable commercialization of Intellectual Capital. • For more than 50 years, the Arecibo Observatory has been the Puerto Rico's most recognized scientific and technological facility. As the largest radio/radar telescope in the world, it used in three major areas of research: radio astronomy, atmospheric science, and radar astronomy. Many scientific discoveries have been made in the Observatory, leading to more than 500 publications in peer---review scientific journals that include the most prestigious such as Nature and Science journals, and specialized publications such as the Astrophysical Journal and others in related disciplines. The number of citations of such important work is close to 20,000. The discoveries and knowledge originated from the Observatory have been recognized with many awards, including a Nobel Prize in Physics in 1993. The Observatory continues its valuable scientific contributions as it is evidenced in the consistency and the number of publications and other work, which is similar to previous years. • One of the most critical roles of the Arecibo Observatory is to be a source of inspiration for the minds of our young Puerto Rican students in areas of science, technology, engineering, mathematics and physics. The Arecibo Observatory is one of the few places in Puerto Rico that provide the opportunity of understanding and appreciating scientific work. As a major resource for scientific outreach thousands of students every year experienced science, technology, engineering, mathematics, and physics thru their visit, orientations, and tours to the Observatory facilities. The new science and visitor centre recently remodelled with the support of the Angel Ramos Foundation is providing a unique interactive and operating scientific experience for all the visitors. Close to 90,000 visitors, including 30,000 students, come to the observatory, each year. The observatory has served as a training ground for both scientists and engineers from universities within Puerto Rico. • The Observatory played also a critical role in Puerto Rico's economy. The observatory employs about 100 people, including scientists, engineers, and technicians as well as maintenance, grounds, and housekeeping staff. The Arecibo Observatory is a center of international scientific collaboration, and as such brings every year scientists and researchers around the world that directly and indirectly contributes to the Puerto Rico's economy. It is well know how the great economies of the world are empowered by their investments in basic and applied scientific research, the one that generates, knowledge and the economic activity. • Another economic area that is impacted by the Arecibo Observatory is the tourism sector. As a globally recognized scientific facility and a place registered in the American National Register of Historic Places since 2008, thousands of tourists visit and enjoy the Observatory every year. Another positive economic impact is in Puerto Rico's film and television industry given that the Observation had appeared in several productions.	Against Closure	Email	6/23/2016	Arecibo Observatory-PRSTRT.pdf

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198	Lucy	Crespo	Chief Executive Officer Puerto Rico Science, Technology & Research Trust	• We invite NSF to Continued its investment for science---focused operations and if possible expand the commercialization and educational components. The Trust in particular will be interested in collaborating with scientists and engineers to provide support and collaborations thru our initiatives. Also we will be interested in facilitating the commercialization of technologies developed at the observatory with companies located at Puerto Rico and in particular technologies that can be commercialize thru startups. Please, don't hesitate to contact the Trust in regard of this important local and global issue for the advancement of science.	Alternative Consideration	Email	6/23/2016	Arecibo Observatory-PRSTRT.pdf
199	Rafael Cortes	Dapena	President of Fundación Ángel Ramos	A "Notice of Intent to Prepare an Environmental Impact Statement and Initiate Section I 06 Consultation for Proposed Changes to Arecibo Observatory Operations, Arecibo, Puerto Rico and Notice of Public Scoping Meetings and Comment Period" (the "Notice ") was published by the National Science Foundation (NSF) on May 23, 2016. Pursuant to the Notice the NSF has requested public comments from stakeholders and other parties that may be affected by any future decision regarding operations of the Arecibo Observatory (the "Observatory" or the "Facilities "). Specifically, the NSF is asking for comments as to the following five possible courses of action with respect to the Facilities and it operation: 1. Continued NSF investment for science-focused operations (No-Action Alternative) 2. Collaboration with interested parties for continued science focused operations 3. Collaboration with interested parties for transition to education-focused operation 4. Mothballing the facilities (suspension of operations in a manner such that operations could resume efficiently at some future date) 5. Deconstruction and site restoration Fundación Ángel Ramos Inc., a Puerto Rico private foundation, (the "Angel Ramos Foundation" or the "Foundation ") takes this opportunity to present its views as to the future of the Observatory , its importance to Puerto Rico, especially in education and tourism , and our commitment to, and interests in, the Observatory. For reasons hereinafter indicated we strongly believe that mothballing or deconstruction and site restoration (alternatives 4 and 5 cited above) would: a. Result in the closing of the newly renovated Fundación Angel Ramos Science and Visitor Center b. Constitute an important setback to the efforts being carried by many public and private institutions towards improving education on the Island, especially in the important fields of science and mathematics. c. Result in a serious blow to tourism on the Island d. Have severe adverse effects, direct and indirect, real and psychological, on the people of Puerto Rico and its economy. Furthermore, the Angel Ramos Foundation cannot think of a worse time for the Federal Government to take either of the two courses of action mentioned above. We are extremely concerned about the consequences that will result from any of these alternatives and sincerely hope that they are promptly disregarded. Puerto Rico greatly needs the support of the Federal Government to successfully overcome the social and economic crisis it is living through. President Obama has repeatedly indicated the commitment of the Federal Government to helping Puerto Rico during this time of need. In his weekly address to the nation on June 11 he stated that "Puerto Ricans are American citizens, just like the folks in Maine, Oklahoma, or New Mexico [. ..] Today the island continues to face a crippling economic crisis [...] We do not turn our backs on our fellow Americans [...] We come together when it is hard". Therefore, the Angel Ramos Foundation hopes the Federal Government supports the Island in this particular juncture. As to the other options, and as hereinafter explained, we believe that the best alternative is for NSF to continue funding the operations of the Observatory, and together with other stakeholders (including the Angel Ramos Foundation), aggressively explore alternatives to diversify funding for the existing operations and/or to bring additional research related activities to the Facilities.	Against Closure	Email, Letter	6/23/2016	Elizabeth Pentecost 6-21-2016.pdf (converted to *.doc)

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				The Foundation The Angel Ramos Foundation was founded in 1958 by the late Angel Ramos, owner and president of El Mundo Media Conglomerate. The Foundation's mission is to improve the quality of life in Puerto Rico. From its inception as a grant-making foundation, it has benefited a large number of worthy projects in the fields of art and culture, education, and human services. The Foundation is the largest philanthropic institution in Puerto Rico and has contributed approximately $100 million to hundreds of charitable causes across the island. To many residents the Angel Ramos Foundation is the leading institution in the philanthropic sector. Supporting the Observatory has been one of our flagship projects, and it reflects our commitment to improving education in Puerto Rico, especially in science and mathematics. We firmly believe the Observatory is a very valuable educational asset for Puerto Rico and an important contributor to its economy. The Angel Ramos Foundation: A consistent donor with a significant linkage to the Observatory Here is where the Foundation's and the Observatory's work intersect: on their mission. The Foundation's mission is to improve the quality of life in Puerto Rico, on the other hand, the Observatory's mission as a renowned research facility has been performing cutting-edge research and acting as an academic facilitator for astronomical, atmospheric and geospace science careers. Therefore, the Foundations ' philanthropic focus on education (which we all know is key to the future of Puerto Rico) dovetails seamlessly with the Observatory's scientific and academic goals. For over 25 years the Angel Ramos Foundation has been a firm ally and consistent donor of the Observatory. The Foundation's investment began in 1989 when it awarded $25,000 towards the design of the Angel Ramos Foundation Visitor Center (the "Angel Ramos Visitor Center" or the "Visitor Center"). In 1991 the Foundation donated $650,000 for the actual construction of the Center. In 1995 $75,000 was donated for construction improvements. In 1997 an additional $10,000 was granted to finalize the construction. On March 1, 1997 the Angel Ramos Foundation Visitor Center opened its doors to the public. Between 1997 and 2009 the Foundation donated $690,000 for diverse projects to improve the Visitor Center's offering. Some of the projects include the financing of the production of a film about the Arecibo Observatory (for the Visitor Center 's Auditorium) ; a donation to build for the Learning Center (audio/visual resources for special groups, scientific workshops, and other student-oriented programs) ; a grant for exterior exhibit programs (the 'Paseo Educativo') including a series of exhibits - such as a scale model of the solar system, a solar clock, and a graphic panel describing our geology among others; and finally, for 6 years the Foundation sponsored a series of summer workshops for 250 distinguished science teachers throughout the Island. In 2011 there was a change of administration in the Observatory from Cornell University to that of a consortium made up of the SRI International, the Universidad Metropolitana (UMET), and the Universities Space Research Association (USRA). Between 2011 and 2015 the Foundation donated $900,000 to substantially renovate the Angel Ramos Visitor Center. The name of the center was changed to the "Angel Ramos Science and Visitor Center" in order to underline its focus in science education. At present the Foundation's total investment in the Arecibo Observatory is $2.35 million. The inauguration of the renovated Visitor Center The newly renovated Angel Ramos Foundation Science and Visitor Center re-opened on May 10th 2016. In demonstration of commitment and solidarity, the launch was attended by the head partners of the Arecibo Observatory: National Science Foundation, SRI International, Universities Space Research Association, and Universidad Metropolitana of the Ana G. Mendez University System, as well as local government officials and members of the "Puerto Rico Chancellors and Stakeholders Committee". It is also important to note that on the same day, the Foundation also held the Tina Hills Award ceremony at the "new" Visitor Center. The Award recognizes the trajectory, quality of program and services and the outstanding contribution of a nonprofit organization in improving the quality of life in Puerto Rico. The winner of the 2016 Award was The Sociedad de Educaci6n y Rehabilitaci6n (SER) de Puerto Rico, an organization devoted to provide services to children and adults with physical and/or developmental disabilities. The ceremony was attended by more than 150 leaders representing the top nonprofit institutions in the island. For all of those present the Observatory represented a source of pride and a hope in our future in the field of science. The activity was widely covered by the media in Puerto Rico. The Angel Ramos Foundation Science and Visitor Center: Education and tourism				

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				The Visitor Center is an educational facility that receives 30,000 student visits every year, and a tourism destination that attracts 100,000 visitors a year. The Center is an impo11ant attraction which channels tourism to a part of the island with very limited economic activity. The Visitor Center offers guests permanent and temporary exhibits, workshops, and interactive experiences in order to keep the public's interest in the Observatory's scientific investigations. Also there are academic courses and curriculums in the works. But engagement with the public does not end there. For example, events such as the Digital Planet Fair, "Inflalandia," and Puerto Rico STEM's UP have brought over 50,000 participants to the Observatory. The Center has established a regular program for school visits and offers daily group talks as well as educational workshops and learning activities, like Nano Days, Yury 's Day, "Noches de Observaci6n" (Nights at the Observatory), Solar Observations, and videoconferences with renown NASA and University professors. The Visitor Center also designed a program for the hearing impaired, as well as working to help people with other disabilities. There is currently an interpreter available for the hearing impaired. Scientists from the Observatory participate in "Education Public Outreach" to bring to life the research they are conducting. Workshops focused on science, technology, engineering and mathematics ("STEM") for teachers as well as students are given regularly. Early exposure to school-to-work programs are promoted through Academic Guidelines, giving schools guidance on how to provide university students with a taste of what the working environment will feel like. The discoveries made at the Arecibo Observatory help explain the history of the universe, the history of our solar system, the spatial geography of Earth's ionosphere , and tell the story of how life began. There are no bigger "Big Picture" questions than these. They form the basis of our search for who we are and where we came from. In essence, the Observatory is a living, breathing network that ties science to the general public in an engaging and exciting manner. It's potential as inspiration and jumping-off point for young people just beginning to think about their future in science is incalculable. Scientific achievements and the public It is important to mention that the scientific achievements of the Observatory are well known by the scientific community. However, the general public has little or no knowledge of the Observatory's accomplishments or its importance. The Visitor Center has been an effective mean of communicating to the general public, and to the visitors in particular, of the many important astronomical, atmospheric and planetary science discoveries that have taken place at the Observatory, such as: • Pulsars: the first binary pulsar was discovered using the radiotelescope at Arecibo Observatory. The discovery rewarded a Nobel Prize in Physics. • Planets: established the rotating rate and the molten core of the planet Mercury; discovered ice in craters at Mercury's north and south poles; discovered the first planets outside the solar system; made the first radar ranging of an Earth-crossing asteroid; created the first radar maps of Venus; found hydrocarbon lakes on Saturn's moon Titan among others. • Asteroids : developed images and videos of binary asteroids, revealed the exotic physical and dynamic properties of asteroids; generated incredibly detailed images of asteroids; discovered the first triple asteroid system among near-earth asteroids; established that the previously discovered asteroid 2000 DP I 07 was in fact a binary system; • Galaxies: established the presence of a 'starburst ' galaxy 250 million light years away, showing how pre-biotic molecules, the primary ingredients of life, may have arisen, and how widespread they are in the cosmos ; published the largest single-source collection of galaxy rotation velocity data with galaxy intrinsic luminosity data, including photometric and spectroscopic data, used to accurately map distances to galaxies; discovered the 'megamaser' emission in the starburst galaxy Arp 220; created the first detailed maps of the distribution of galaxies in 3D.				

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				Indeed, it is an immense source of pride for Puerto Rico and for the Angel Ramos Foundation to be part and support the Arecibo Observatory and it is our hope that the Visitor Center will continue to disseminate information to a broader audience about the important scientific contribution produced at the largest radio/radar telescope in the world. The Foundation hopes the positive relationship it has had with the Observatory for almost three decades will continue to grow and serve the scientists, the students, Puerto Ricans, and the Observatory's stakeholders, as well as serve the broader interests of science, education and development around the world. We must work together to save what has been such a productive relationship. NSF's other alternatives and the best option As previously stated, the position of the Angel Ramos Foundation is that the Observatory should not be mothballed or subject to deconstruction. The damage to Puerto Rico, and to those of us who are living through the current social and economic crisis, would be enormous. We believe that the Observatory continues to be a valuable asset to its stakeholders. The Foundation cannot emphasize enough the importance of the Visitor Center as a tool to improve education, promote tourism, disseminate scientific information, and contribute to the island's economic development. The other three alternatives mentioned in the Notice are: I. Collaboration with interested parties for transition to education-focused operation 2. Continued NSF investment for science-focused operations 3. Collaboration with interested parties for continued science-focused operations Regarding the first alternative, since the 1960's the Observatory has been focused on astronomy and scientific research. In reality it is a "single purpose entity." To transition away from science into academia, or to focus solely on education, would change its character and the very reason for its existence. An education component without the research component will constitute a passive mothballing. Should this become the selected option, the basic concept of the Angel Ramos Visitor Center would be substantially altered and practically nullified. Our efforts in education and science would face a big setback. We believe that the best option for all parties concerned is a combination of the following two options: Continued NSF investment for science- focused operations with an aggressive plan to eventually enter into collaboration with interested parties for continued science- focused operations. We fully understand the budget restraints on the NSF. However, a plan could be developed to add interested parties and income streams to the Facilities in order to reduce NSF funding. The Angel Ramos Foundation is willing to contribute -- in collaboration with UMET-- in finding new partners and identifying potential sponsors. Conclusion The Angel Ramos Foundation has been a consistent and committed stakeholder in the Arecibo Observatory since the late 80's and today we would like to reinforce that commitment. We are dedicated to the Observatory and what it represents to Puerto Rico, its people and its stakeholders. The Foundation is also committed to continue supporting the public outreach component and promoting educational activities focused on STEM for teachers, students, and the general public because believes in the importance of this extraordinary and unique facility. In this particular juncture, the Foundation will do our part in reaching a solution that is best for all parties involved. We ask the NSF to continue funding the scientific research conducted at the Arecibo Observatory and at the same time, together with other stakeholders, search for ways to diversify the funding of the operations.				
200	Rafael Cortes	Dapena	President of Fundación Ángel Ramos	As to the other options, and as hereinafter explained, we believe that the best alternative is for NSF to continue funding the operations of the Observatory, and together with other stakeholders (including the Angel Ramos Foundation), aggressively explore alternatives to diversify funding for the existing operations and/or to bring additional research related activities to the Facilities.We fully understand the budget restraints on the NSF. However, a plan could be developed to add interested parties and income streams to the Facilities in order to reduce NSF funding. The Angel Ramos Foundation is willing to contribute -- in collaboration with UMET-- in finding new partners and identifying potential sponsors.	Alternative Consideration	Email, Letter	6/23/2016	Elizabeth Pentecost 6-21-2016.pdf (converted to *.doc)

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201	Megan E.	DeCesar	Postdoctoral Research Associate University of Wisconsin-Milwaukee, Physics Department Center for Gravitation, Cosmology, and Astrophysics (P) 414.229.6360 (E) decesar@uwm.edu http://www.cgca.uwm.edu/decesar	I am writing in response to the invitation for comments on environmental impacts of Arecibo Observatory (AO). My response is focused on the human and cultural impacts of losing this observatory, both for scientists and for the general public. I strongly encourage the NSF to choose option #1 of its "Notice of Intent to Prepare an EIS…", namely "Continued NSF investment for science-focused operations (No-Action Alternative." 1. Arecibo Observatory's positive impact on global citizenship I am a postdoctoral researcher in astrophysics. I study pulsars and gravitational waves, in large part because of how influential AO has been in both my personal and professional life. As a young girl, I was fascinated by astronomy, and from the time I learned about AO, I dreamed of visiting the observatory and using the telescope. As an undergraduate, I was fortunate to be a summer student at AO through the Research Experience for Undergraduates (REU) program and to learn how to observe pulsars and other astronomical phenomena with this incredible instrument. Even more important than the way AO expanded my horizons scientifically is that my world view was also greatly expanded, through interactions with the other students and especially with the locals. Every year, there would be at least two Puerto Rican students in the REU program, and all the visiting students and I became close friends with the Puerto Rican students who studied there that summer. Additionally, all the people who kept the observatory running, as well as most of the operators and some of the astronomers, were native Puerto Ricans. Through speaking, working, living, and traveling with these individuals, I became proficient in Spanish, I explored much of the island, and I came to love the people and culture in this place that is very different from the US. I grew up in a conservative, rural town in Pennsylvania, where Puerto Ricans and other non-white groups are viewed as second-class citizens at best; this was my first real and extended exposure to a group of people who are significantly different, both in appearance and culture, than my mostly white, middle-class, educated-but-sheltered family and friends. Coming back to the States, I had a new perspective to share with the people around me, and to this day I use examples from my summer in Puerto Rico to encourage tolerance and acceptance of other cultures when discussing these issues with others. Thus, living in Arecibo gave me the opportunity to feel and think as not only a US citizen but as more of a global citizen as well. Although I am sharing my personal experience, I want to stress that I am only one of the many students, scientists, and other visitors who have spent time at AO—people from many different countries have had this opportunity to become more globalized and understanding of other cultures through visits to the observatory and region around it, especially during extended visits that are common in scientific research. 2. The impact of Arecibo Observatory on equity for STEM students and researchers I am a woman in a field that is still male-dominated, and in which inequity for underrepresented groups is usually subtle but still prevalent. In college and graduate school, I experienced some gender-related setbacks, in particular from significant sexual harassment as a graduate student. I also have friends who have experienced inappropriate behavior and discrimination due to their ethnicity or gender identity. Therefore, I understand the importance of addressing these issues head-on, through raising awareness and implementing anti-harassment and discrimination policies (not only for gender, but for all forms of discrimination). The North American Nanohertz Observatory for Gravitational Waves (NANOGrav) and the International Pulsar Timing Array (IPTA), two collaborations that use AO extensively in their ongoing efforts to detect gravitational waves from black holes, have both adopted anti-harassment and discrimination policies. For at least the last two years, these groups have held pro-diversity/anti-harassment training sessions during their collaboration meetings (NANOGrav does this three times per year, and the IPTA once per year). These policies and sessions have opened the door for many of us to speak more openly about our experiences and to engage in conversations with people who were previously unaware of the problem, and have led to near-elimination of inappropriate behavior within NANOGrav (I am less involved in the IPTA and therefore do not know how effective this has been). If the members of these collaborations saw AO as a more secure resource, they would have more time to focus on diversity and anti-harassment, and I think that they would actually use that time because it is an issue that everyone is now taking very seriously.	Against Closure	Email	6/23/2016	AreciboObervatory_EIS_MeganDeCesar.pdf

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				Additionally, the deputy director of AO, Dr. Joan Schmelz, is very involved in raising awareness about this issue and also in giving a voice to people who have been sexually harassed. She writes blog posts on the topic, invites people to write their own posts (anonymously or not), and speaks with harassment victims in confidence. I can personally attest that her work helps harassment victims become more empowered. NANOGrav and the IPTA are also connected with the Arecibo Remote Command Center (ARCC) and the Pulsar Search Collaboratory (PSC). ARCC, which originated at the University of Texas-Brownsville (now Rio Grande Valley) and has expanded to a dozen or so other institutions, is a group of undergraduate students who run AO observations of pulsars and search for pulsars in the data. The PSC, which began in West Virginia but has spread to several states, is a group of high school students who search for pulsars and in the process learn about astronomy and what it is like to be a scientist. Both groups have had a significant impact on the students, many of whom go on to study physics in college. ARCC is especially increasing the number of Hispanic students in STEM fields, while the PSC boasts large increases in the number of young women in STEM. Finally, for me personally, the impact that AO had on me contributed to my remaining in the field of pulsar astronomy, despite considering leaving during the difficult times that I referenced above. I know what incredible science can be done with this instrument, and that helps me to rise above personal troubles and continue working toward my goals. I think this is really important, because if I stay in the field then I will have opportunities to inspire more girls to enter STEM fields in the future. 3. Impact on education and employment in Puerto Rico In Puerto Rico, AO is of very considerable economic value and could be made even more so. Its staff salaries are highly important in the Arecibo Town region. Its educated staff has significantly contributed to building up current and future generations of educated people in the area, and the tens of thousands of tourist visitors are also important to the overall island economy. Withdrawal of support now would compound what is already a difficult situation for Puerto Rico and its citizenry—in the current Puerto Rican economy, quality jobs are almost impossible to find. AO is a very important part of STEM education on the island: thousands of school children visit the facility to learn about the scientific and engineering accomplishments made there and become inspired about their own futures. The primary and secondary contributions to STEM Hispanic STEM professionals are still vastly underrepresented: in spite of being 20% of the college-age population, only 5-9% of physical sciences, mathematics, and engineering degrees (https://www.aps.org/programs/education/statistics/hispanicmajors.cfm) are awarded to Hispanic college graduates. The AO ducational programs get children interested, and the student research programs (summer and Saturday) have a huge impact in recruiting and retaining talented Latino/as into the STEM workforce. Approximately 20,000 K-12 students travel to the Arecibo Observatory Visitor Center each year, most of which come from low-income families. The Visitor Center resembles a miniature air and space museum and is inspiring to say the least. Students need such exposure so that they see what higher education brings and how it offers a path to an exciting and productive career. Also Arecibo upgrades the teaching capabilities of high school teachers through STEM learning and conducts a Saturday School Space Academy for local high school students, essentially providing advanced placement-level education for these students. This is a cultural as well as socioeconomic impact that extends way beyond the island itself.o other observatory worldwide does more to advance the socioeconomic development of the underprivileged. The educational problem that will arise from the proposed AO changes will be much deeper than even the unemployment disaster of laying off more than one hundred local Puerto Rican residents who work at the Observatory, and the proposed changes to AO will be highly detrimental to the education of underprivileged children in Puerto Rico. 4. Human pride in human endeavors, and pride for the people of Puerto Rico As a national facility located in the US territory of Puerto Rico, the observatory is a major cultural resource on the island. The facility attracts large numbers of tourists, both from the island and from the rest of the world, forming part of Puerto Rican cultural identity and a strong point of pride. Puerto Ricans have a lot to be proud of—as anyone who goes to the AO visitor center will learn, AO has been used for many important discoveries in many different subfields of astronomy and ionospheric science. Its unique radar capability has been used to map the Moon, Mercury, Venus, and asteroids. In pulsar astronomy, it was used to discover the first millisecond-spin-period pulsar in 1982, and the first extrasolar planets (which were orbiting a pulsar) in 1990. The discovery of the Hulse-Taylor pulsar-neutron star binary system was made at AO in 1974; this pulsar system was used to show that gravitational waves must exist, earning its discoverers the 1993 Nobel Prize. The forthcoming discovery of gravitational waves from supermassive black holes—the black holes in the centers of galaxies, which are millions to billions of times more massive than those discovered by LIGO and which will give us more information about gravity, black holes, galaxy evolution, and cosmology—will be made possible by the ongoing pulsar observing programs at AO. That discovery will be a major source of pride for the people of Puerto Rico, not to mention for the rest of the US! (As an example, I cite the recent gravitational wave discovery by LIGO. Many US citizens were very excited and proud to be part of the country that made the discovery. In Milwaukee, where I work, the ~250-300 people at our outreach events following LIGO's announcement were thrilled to learn that Milwaukee scientists played a major role in that discovery.) Additionally, the construction and functionality of AO demonstrate the incredible ingenuity of human scientists and engineers. The appearance and sheer size of the telescope are breathtaking; it is both an engineering feat and a work of art. The Arecibo Observatory is a reminder of the great things humans can accomplish, and its use as a site for research and education continues to bring people from different backgrounds together to work toward their common goals.				

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				1. Arecibo Observatory's positive impact on global citizenship I am a postdoctoral researcher in astrophysics. I study pulsars and gravitational waves, in large part because of how influential AO has been in both my personal and professional life. As a young girl, I was fascinated by astronomy, and from the time I learned about AO, I dreamed of visiting the observatory and using the telescope. As an undergraduate, I was fortunate to be a summer student at AO through the Research Experience for Undergraduates (REU) program and to learn how to observe pulsars and other astronomical phenomena with this incredible instrument. Even more important than the way AO expanded my horizons scientifically is that my world view was also greatly expanded, through interactions with the other students and especially with the locals. Every year, there would be at least two Puerto Rican students in the REU program, and all the visiting students and I became close friends with the Puerto Rican students who studied there that summer. Additionally, all the people who kept the observatory running, as well as most of the operators and some of the astronomers, were native Puerto Ricans. Through speaking, working, living, and traveling with these individuals, I became proficient in Spanish, I explored much of the island, and I came to love the people and culture in this place that is very different from the US. I grew up in a conservative, rural town in Pennsylvania, where Puerto Ricans and other non-white groups are viewed as second-class citizens at best; this was my first real and extended exposure to a group of people who are significantly different, both in appearance and culture, than my mostly white, middle-class, educated-but-sheltered family and friends. Coming back to the States, I had a new perspective to share with the people around me, and to this day I use examples from my summer in Puerto Rico to encourage tolerance and acceptance of other cultures when discussing these issues with others. Thus, living in Arecibo gave me the opportunity to feel and think as not only a US citizen but as more of a global citizen as well. Although I am sharing my personal experience, I want to stress that I am only one of the many students, scientists, and other visitors who have spent time at AO—people from many different countries have had this opportunity to become more globalized and understanding of other cultures through visits to the observatory and region around it, especially during extended visits that are common in scientific research.				
202	Dr. Timothy	Dolch	Assistant Professor of Physics Dept. of Physics, Hillsdale College 33 E. College St. Hillsdale, MI 49242 Email: tdolch@hillsdale.edu Phone: (517) 607-2449	In this letter, I write with significant concern about some of the proposals for the future of Arecibo Observatory (ARECIBO) outlined in the National Science Foundation's "Notice of Intent To Prepare an Environmental Impact Statement" released on 23-May 2016. As a first-year faculty member at Hillsdale College, a small liberal arts institution in rural Michigan, I've spent significant time and energy with a team of five undergraduate researchers. These bright, young men and women have learned to remotely operate the William E. Gordon telescope at ARECIBO, making a fantastic contribution to our gravitational wave (GW) science collaboration, the North American Nanohertz Observatory for Gravitational Waves (NANOGrav). Hillsdale students were the first undergraduate observers in our nation to obtain regular timing data for NANOGrav, which is a long-term dataset that will result in the detection of long-period GWs. Their contribution has not gone unnoticed in the field, resulting in their co-authorship on NANOGrav publications. In addition to these five students, many other interested young people, both undergraduates and high school students, have come by to watch a live Arecibo observation. In the wake of the LIGO Collaboration's announcement of the first direct GW detection, my students were thrilled to be part of the GW field. They are not unaware of some of the current proposals being put forward for the facility's future. Mothballing, deconstruction, or otherwise ramping down ARECIBO's science-focused operations is perplexing to them, coming at the very moment when the GW sky has opened up. Unfortunately, all I can currently say is that I am as perplexed as they are. The result of these research experiences has been the formation of concrete plans for my students' future STEM careers. Some of them are in the process of applying to graduate school in physics; others want to incorporate their experiences into future teaching careers. Hillsdale College is amongst the lowest-tuition top tier liberal arts schools in the country. As a result, not a few students with whom I have interacted come from disadvantaged socioeconomic backgrounds. The experience of using a world-class radio telescope, as part of GW science, the most groundbreaking subfield of astrophysics, is simply irreplaceable. The irreplaceability of Arecibo is even more apparent at Hillsdale College than at the other liberal arts colleges associated with NANOGrav. Our institution does not receive federal funding, and providing research experiences through individual AST grants is simply not an option. NANOGrav also observes with the Green Bank Telescope, but the GW detection effort requires both telescopes (http://arxiv.org/abs/1210.5998) and experience has shown that Arecibo is significantly more compatible with student observers, given its less complex scheduling algorithm, and its long history of student involvement through the various ARCC (Arecibo Remote Command Center) institutions, a list which now includes Hillsdale College. While our institution is a unique case with regard to federal grants, we are a living highlight of the fact that Arecibo's benefits are society-wide, and not limited to those immediately awarded funding for research.	Against Closure	Email	6/23/2016	dolch_aerecibo.pdf

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				Large radio telescopes are being built in other parts of the world – namely, the FAST telescope in China and the Square Kilometer Array (SKA) in South Africa. It has been at times pointed out that these telescopes could continue the GW detection effort. However, US involvement and access to data is not a given. Additionally, FAST is still years away from regular operation, and in the case of the SKA, the telescope's construction has become less certain due to austerity measures in Germany, one of its principal consortium members. Clearly, the socioeconomic benefits within the US have no parallel at these future telescopes, even if the uncertainties about these facilities were resolved. If anything, the case of FAST demonstrates a desire for nationalistic competition, sparked by the success of Arecibo. While speaking of society-wide benefits, it also must be said that Arecibo's role in detecting potentially hazardous asteroids is unparalleled. The consequences of a major impact on humanity and on the environment are well-known, and only the Arecibo Planetary Radar system possesses the radio transmitting capability to obtain crucial data on potential objects. The FAST telescope possesses no transmitting capability whatsoever. To summarize, the socioeconomic impact on society through student involvement with, and inspiration from, the Arecibo Observatory should not be underestimated. This is especially the case when, through the efforts of NANOGrav, Arecibo has become a gravitational wave detector at the fraction of the cost of LIGO. Nationwide, it should not be forgotten that many students touched by Arecibo are from disadvantaged backgrounds or groups, and frequently from Puerto Rico itself. While other large radio telescopes are indeed being built around the world, it is very unlikely that students at many smaller US institutions like mine would have any chance of involvement, nor that Arecibo's asteroid-detecting capability could be matched. While the option of transitioning Arecibo to an education-focused role is admirable, the reality is that serious STEM education is only possible if students are truly involved in cutting-edge research such as pulsar discoveries and gravitational wave detection. The only feasible option is the No-Action Alternative.				
203	Casey	Dreier	Director of Space Policy The Planetary Society	The Planetary Society, which represents over 52,000 members worldwide, wishes to express our strong support for the National Astronomy and Ionosphere Center (NAIC) at Arecibo and urges the National Science Foundation (NSF) to continue to fund the operation of this important and unique scientific capability. Our organization is actively involved in near-Earth object detection and defense, and we have funded projects to help characterize the orbits of newly found asteroids as well as early technology studies for deflection techniques. Arecibo's radar allows for the characterization of near-Earth asteroids and is a critical capability to maintain. Closing down Arecibo is not in the nation's interest, and its unique capabilities are crucial to providing insight into the low probability, high impact event of an asteroid collision. We believe that the small operating cost of Arecibo must be maintained within the NSF, particularly considering the cost to re-create Arecibo's capabilities at a later date. We know that there is a large community of scientists expressing support for Arecibo's continued operations as well as representatives at NASA, who have signaled their intention to continue using Arecibo's capabilities for the foreseeable future. For over 50 years, the Arecibo Observatory has provided the world with a uniquely sensitive instrument for listening to the cosmos, as well as a uniquely powerful radar to directly interrogate it. While it was forged during the Cold War, Arecibo represents how our worst instincts can be channeled to create something truly beneficial by advancing humanity's frontiers of knowledge. We urge the NSF to continue Arecibo's operations, and to preserve this unique asset of scientific exploration and near-Earth object characterization.	Against Closure	Email	6/23/2016	

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204	Dr. Robert	Ferdman	Research Associate Department of Physics McGill University 3600 rue University Montréal, QC Canada H3A 2T8 http://www.physics.mcgill.ca/~rferdman	This letter is a comment in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory. The future of the Arecibo Telescope is particularly crucial to the astrophysics research community. As a radio astronomer, it is a facility that has been, and continues to be, unparalleled in providing the highest quality data for high-impact scientific studies that a great many of my colleagues and I regularly perform. This includes probing fundamental physics such as testing the limits of Einstein's theory of general relativity—for which Arecibo data has led to a Nobel Prize—and excitingly, performing gravitational-wave astrophysics in regimes that are not possible with other current and proposed gravitational-wave observatories, such as LIGO/VIRGO and eLISA. Arecibo truly provides a unique window to the Universe, and this is possible due to its place as the world's largest and most sensitive radio telescope. It will continue to be a vital instrument that will complement future telescope arrays such as the Extended Very Large Array, which probes very different astrophysical scales, and the Square Kilometer Array, which will certainly be a higher sensitivity instrument, but cannot access large portions of the sky that are visible to Arecibo. My experience with the Arecibo Telescope has provided me with the skills and training to continue to perform high-profile science. As a doctoral student, for example, I was heavily and centrally involved in developing backend instrumentation for the Arecibo Telescope that helped to greatly improve the capabilities and quality of the data it collected. Since then, I have utilized the Arecibo Telescope for several exciting endeavors, which include projects that continue to constraining the predictions of gravitational theory, and aim to understand the astrophysics that govern the evolution of stars and stellar systems. I am also a longstanding member of high-profile collaborations that depend on the high sensitivity of the Arecibo Telescope. These include the North American Nanohertz Observatory for Gravitational Waves (NANOGrav), a highly regarded collaboration that currently holds a prestigious National Science Foundation Physics Frontier Center Grant, and the Pulsar-Arecibo L-band Feed Array (PALFA) survey, which has now discovered nearly 200 radio pulsars in and around the Galactic plane, allowing my colleagues and I to probe fundamental physics and astrophysics with extremely high precision. These projects and their undeniable merits are discussed in greater detail in separate letters submitted by the NANOGrav and PALFA collaborations. I am particularly enthusiastic about the future possibilities that Arecibo will allow me. Specifically, I am commencing a faculty position this fall at the University of East Anglia (UEA) in the United Kingdom. I look forward to training many talented students in observing with, and analyzing data from, the Arecibo telescope. This will be done in part through the Arecibo Remote Command Center (ARCC), a network of institutions that provide undergraduate students with the opportunity to work with the world's largest telescope, and gain valuable analysis, leadership, and communication skills in the process. At UEA, we would become the first European outpost of the ARCC network, reflecting the global scale of Arecibo's impact on observational astronomy. It is my aim to continue to have the privilege of using this truly unique observatory as a central part of my research and educational goals. I therefore conclude this letter by stating emphatically that I am in strong favor of continued NSF investment of the Arecibo Telescope for science-focused operations. Thank you for your consideration, and please do not hesitate to contact me if there is any further information I can provide.	Against Closure	Email	6/23/2016	Arecibo_Letter.pdf

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205	Paulo C. C.	Freire	Max-Planck-Institut für Radioastronomie Auf dem Hügel 69, D-53121 Bonn, Germany Phone: (+49) 228 525 - 496 ; Fax: (+49) 228 525 - 229	I am writing to urge NSF to choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." The reasons are manifold, I will list them now: The Arecibo Telescope is a completely new instrument. Not only that, but we have barely scratched the surface in regards to what we can do and find with this new instrument. I will attempt to present this point graphically. In 2013, we found one new millisecond pulsar, PSR J2234+0611, in the Arecibo 327 MHz drift-scan survey. In recent observations with the Arecibo L-wide, it appears like this: The signal-to-noise ratio (S/N) of this observation is 650, in an integration time of for Radio Astronomy It is incredible to think that previous surveys had not found this pulsar. With the new instruments at Arecibo, we are truly looking at the sky anew, and finding many new pulsars that, given Arecibo's new instrumentation and radically improved sensitivity, appear to be incredibly bright - but could not even be detected by previous generations of instruments. So, it is a completely new instrument looking at a completely new, unexplored sky. This brings me to my second point. Arecibo is 5 times more sensitive than the next radio telescope in the world. Similar improvements in sensitivity have been made for other telescopes. However, the fact remains that the GBT has a gain of 2.0 K/Jy, Arecibo has a gain of 10 K/Jy. And, as you can see in the picture above, it shows. This unique sensitivity is crucial for many areas of research. I will go into some that are related directly to my own area of research. The mystery of fast radio bursts One of the great mysteries in astrophysics at the moment is the nature and origin of fast radio bursts (FRBs). If it were not for the unequaled sensitivity of Arecibo, we would not have learned that they are repeating sources (see Spitler et al. 2016, Nature, 531, 202). This enormously constrains the range of possibilities for these objects. New tests of general relativity As is well known, Arecibo was the telescope that led to the discovery of the first binary pulsar, PSR B1913+16. Arecibo timing of this pulsar resulted in the first detection of gravitational waves, decades before LIGO. This resulted in the Nobel Prize in physics for Russell Hulse and Joe Taylor in 1993. Continued Arecibo timing of this system continues producing cutting-edge results. In 2012, me and my collaborators published an Arecibo experiment that probes, more deeply than ever, the nature of gravitational radiation - to an extent that LIGO will never be able to do. The experiment concluded that, to a very tight limit, gravitational radiation is purely quadrupolar, as predicted by Einstein's general relativity (see Freire et al. 2012, MNRAS, 423, 3328). These for Radio Astronomy measurements also introduced the tightest constraints on the best studied classes of alternative theories of gravity, all of which predict emission of other types of gravitational waves that we don't observe. The Arecibo PALFA survey has recently discovered a new double neutron star system (PSR J1913+1102) with a strong mass asymmetry and tight orbital period that will likely allow an order of magnitude improvement on this test of the fundamental nature of gravitational radiation. However, to do that experiment, we will need at least a decade of timing. Arecibo is the instrument to do this - this pulsar is too faint to be timed properly with any other instrument. An even better (but non-radiative) test of the best studied alternative theories of gravity is the pulsar in the triple system, PSR J0337+1715 (see Ransom et al. 2014). The unique sensitivity of Arecibo applied to this system represents an improvement of six orders of magnitude in the test of the Strong Equivalence Principle, compared to previous tests like Lunar Laser Ranging. This experiment is our best hope of detecting gravitational effects beyond general relativity. Arecibo is fundamental for achieving this.	Against Closure	Email	6/23/2016	Freire_EIS_input.pdf

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				Direct gravitational wave detection The sensitivity of Arecibo implies that it will very likely be the first telescope to achieve a direct detection of the very low-frequency gravitational waves produced by supermassive black hole binaries, the goal of NANOGrav. The reason is that such a detection will require the precise timing of many faint millisecond pulsars, like the object shown above (PSR J2234+0611). Measurement of neutron star masses Given its high sensitivity, Arecibo has allowed the measurement of many neutron star masses (about half of those known). The most massive NS currently known, PSR J0348+0432, was extensively studied with Arecibo (see Antoniadis et al. 2013, Science, 340, 448). This result is of fundamental importance to the study of super-dense matter and nuclear physics; it has a large number of astrophysical implications, as attested by the 723 citations in the 3 years since it was published. The sensitivity of Arecibo is now allowing the measurement of many more neutron star masses - we are working on 25 of them. To finish these measurements, we need Arecibo to stay open. For a recent example of these, for Radio Astronomy see the first double neutron star with a strong mass asymmetry - discovered and timed with Arecibo (Martinez et al. 2016, ApJ, 812, 143). I could go on very long with the scientific motivation. Please do not hesitate to contact me for a discussion on these topics. Non-scientific aspects I worked at the Arecibo telescope for 8 years, between 2001 and 2009. I can say, from first hand observation, that the staff at Arecibo has world class expertise, is extremely professional and dedicated to their facility. Arecibo is located in an island, Puerto Rico, where such inspirational examples of technical competence and world-class scientific achievement are rare. Arecibo inspires students into the study of science and mathematics; through the REU program is has allowed many under-graduate students - from the US, from many other countries, but particularly from Puerto Rico - to start productive scientific careers. From all of this, I have no doubts that any option other than continued NSF investment for science-focused operations would not only be a scientific tragedy, but it would also be a disaster for the future of Puerto Rico.				

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206	Ricardo J. Rodriguez	Garcia	MIT Class of 2019 Department of Aeronautics and Astronautics	As requested by the NSF, the purpose of this message is to comment on the socioeconomic and cultural influence of the Arecibo Observatory in order to aid in the preparation of an Environmental Impact Statement (EIS). Through the combined efforts of the Angel Ramos Foundation Science and Visitor Center and the Arecibo Observatory Space Academy (AOSA), the Arecibo Observatory has enabled careers in the STEM fields in an island with a lack of educational resources. It does so by challenging students to carry out the scientific method with rigor in a field of their choosing and by having professionals guide their research. The final result is not advanced expertise, but the ability to observe a system and understand it by asking simpler questions: a type of common sense for science. Learning by asking contrasts highly with my high school learning experience. Though the school's professors and administrators may have the best interest of the students in mind, it is too easy to memorize simple procedures and facts right before a test, score good grades, and feel accomplished. Of course, science is not merely about knowing the equations that govern our world, but also about how to derive them and how they work together, because, in research, the only use of knowledge is expanding it. As such, thinking about learning from distinct perspectives is not a skill taught by the school systems, and requires extracurricular opportunities such as a science club or research to grasp. AOSA is one of these opportunities. I attended AOSA for two years when I was in high school. My peers there traveled every Saturday from as close as Arecibo to as far as Fajardo. Since the island lacks public transportation in rural areas, students relied on their family members for travel back and forth. Every week, we discussed a different set of deliverables and facts about life in space. Sometimes we designed a space settlement for the NASA Ames Space Settlement Contest and at other times we worked on our research projects, but we always interfaced with our peers and helped each other complete their research when possible. Meeting students with a similar interests in STEM fields was an invaluable source of determination and connected future professionals that may work together in the future. To this day, I collaborate with some of my AOSA peers to organize and carry out the student program of the International Space Development Conference (ISDC) of the National Space Society (NSS). The Arecibo Observatory itself has been an integral part of the process. First, the variety of professional backgrounds within the observatory's scientific community allowed us to explore different fields, which ultimately led me to pursue aerospace engineering in college. Second, there was natural potential for biology research in the flora under the dish, an opportunity that many of the students used. Third, being near such a massive system as the radio receiver and the dish almost forced us to learn how it all works together, which was knowledge that the engineering team appreciated. As a result of these factors, all AOSA alumni have gone on to join either college or the military, and most are completing technical degrees in STEM. With Puerto Rico's crumbling economy, these alumni are the island's hope for the future. For now, that is all. I hope this information is useful in writing the EIS.	Against Closure	Email	6/23/2016	
207	Steven	Gibson	Western Kentucky University Bowling Green, KY	I am writing in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory (AO) in Puerto Rico. I strongly urge that NSF choose Alternative 1 of its "Notice of Intent to Prepare an EIS...", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." As a science educator, I can testify to the power of AO to inform and inspire students in STEM education. Arecibo Observatory is a magnet for school children from all over the island of Puerto Rico and beyond, with tens of thousands of K-12 students passing through the AO Visitor Center every year, a great many from economically disadvantaged backgrounds. I've also made heavy use of AO-related materials in my own teaching at Western Kentucky University, building considerable interest among WKU students to pursue careers in scientific and technical fields, including radio astronomy. Two of my students have been fortunate enough to take part in the NSF-REU summer internship program at AO, where they gained invaluable hands-on research experience while also learning about Puerto Rico's rich cultural and environmental heritage. As a scientific visitor and past AO employee, I have myself witnessed the positive role that AO plays on the island, where it is all at once an educational institution, a research powerhouse, a cultural touchstone, and a point of great pride for Puertorriqueños amidst the challenges that they face every day -- even more now with the recent financial crisis. As a major employer in the region, AO provides a stable economic anchor through its 100+ paid staff, the services it hires, and the ripple effects of this activity that spread throughout the local economy. In addition, AO is a top tourist draw for visitors coming to Puerto Rico, regularly ranking favorably among other major attractions including Old San Juan, the El Younque rain forest, Taino Indian ruins, and bioluminescent bays like La Parguera. These unique assets combine synergistically, so AO directly impacts the likelihood of visitors coming to the island to boost the economy and learn about local history and ecology. As a scientific researcher, I have made considerable use of AO observations in my own work over many years, including current work to discover and understand how cold gas clouds assemble in interstellar space prior to the formation of new stars, and how magnetic fields influence this hitherto elusive process. This research would not be possible without AO's unique sensitivity, leveraged by the tremendous collaborative efforts of some of the brightest scientists and engineers in the field, whose ongoing dedication to AO testifies to its premiere role as a cutting-edge science facility. For these reasons and many more, I hope the NSF will continue to support AO in its current operational mode, or even to increase its support to a level more sustainable for AO's long-term health.	Against Closure	Email	6/23/2016	

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208	Leonid	Gurvits		The RadioAstron International Science Council (RISC), currently in its annual session in Moscow, Russia, expresses its deep concern about the future of the most sensitive currently operational radio telescope on Earth, the W. E. Gordon Arecibo Radio Telescope. The immense capability of this unique facility in advancing fundamental knowledge and science applications are outstanding and are not matched by any other radio science facility. The Arecibo Telescope plays an irreplaceable role as the most sensitive component of the International Space Very Long Baseline Interferometer, RadioAstron, involving Russia, the United States, Australia, China, Japan, India, as well as numerous countries in Europe. We strongly support the continued global open access to the Arecibo Radio Telescope for radio astronomy research. Members of RISC: Philip Edwards, Australia (co-chair) Yuri Kovalev, Russia (co-chair) Willem Baan, The Netherlands Norbert Bartel, Canada Leonid Gurvits, The Netherlands Carl Gwinn, USA David Jauncey, Australia Bhal Chandra Joshi, India Nikolai Kardashev, Russia Kenneth Kellermann, USA Andrei Lobanov, Germany Leonid Matveenko, Russia Ilya Pashchenko, Russia Victor Stepanyants, Russia Mikhail Popov, Russia	Against Closure	Email	6/23/2016	
209	Gregory	Hallenbeck	Union College	I am writing in response to the notice of an EIS evaluating potential environmental effects of proposed changes to operations at the Arecibo Observatory (AO). I strongly recommend that the NSF choose alternative 1, namely “Continued NSF investment for sciencefocused operations (NoAction Alternative).” I am writing both in my role as a science educator at Union College and user of Arecibo. Over the past two years as a faculty member, I’ve brought four of my own undergraduate students to Arecibo to learn about the telescope and perform handson observation. Before that, while a graduate student, I participated in organizing the Undergraduate ALFALFA Team (UAT) workshop, which brought dozens of undergraduate students each year, from across the mainland United States and Puerto Rico, to Arecibo. There, students have been taken on tours of the telescope and platform, heard lectures on radio astronomy, performed observation as members of major surveys, and interacted with the telescope staff. The experience for them is informative and transformative in a way that working with the small radio telescope at Union could never be. I have frequently heard students say that, as a result of attending the workshop and working at the observatory, that they have gained confidence in their ability to become successful professional astronomers. Of course, this impact is not limited to astronomy: constructing, maintaining, and operating the observatory are major accomplishments of mechanical, electrical, and computer engineering which have been appreciated by students from those fields. Finally, it is impossible to speak of the impact of the Observatory without discussing the people of Puerto Rico directly. The Visitors’ Center at Arecibo receives thousands of schoolaged children and young adults each year from across the island and beyond. Every time I have visited the Observatory, the Visitors’ Center has been packed throughout its operating hours. Whenever I tell anyone visiting that I am a professional astronomer, I receive many questions and stories of how the Observatory has inspired them (either from that visit, or in one case, a visit which happened forty years earlier!). The excitement is palpable. There is simply nowhere else offering a comparable experience, and definitely nothing within the reach of children from lowincome families on the island.	Against Closure	Email	6/23/2016	AOEnvironmentallmpact-Ghallenbeck.pdf

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210	Ast. Prof. Marijke	Haverkorn	Member of the Young Academy of the Dutch Royal Academy of Science and Arts IMAPP, Dept of Astrophysics Radboud University Nijmegen the Netherlands +31 (0)24 365 2809	I am writing in response to the Federal Register Notice of an Environmental Impact Statement (EIS) evaluating environmental impacts of the Arecibo Observatory. Arecibo Observatory is a unique facility. Apart from producing cutting-edge science results it has a crucial impact on its surroundings and is an icon for the island of Puerto Rico and the United States in general. Arecibo plays an important role for education in Science, Technology, Engineering and Mathematics (STEM). The dish, the observatory and the visitors center have a great attraction for young people who contemplate going into STEM. The observatory holds activities like the weekend schools and summer schools that grow and nurture that interest among children and students. Arecibo's location at Puerto Rico is especially important, since the STEM field has a severe underrepresentation of Hispanic students and scientists. Arecibo is a signficant part of efforts to lessen that underrepresentation. The observatory is training the next generation of sientists, consultants and leaders. I strongly prefer EIS Action #1 "Continued NSF Investment for science-focused opertaions", and I kindly request that you consider these arguments in the EIS.	Against Closure	Email	6/23/2016	
211	Dr. Ellen	Howell	and Michael Nolan, University of Arizona Tucson, AZ 85721	Near-Earth asteroids (NEAs) represent a wealth of scientific information for understanding the origin of the Earth, the connection to meteorites, as well as accurately assessing the impact hazard to the Earth. Radar is the only groundbased observing technique capable of spatially resolving near-Earth asteroids at a fraction of the cost of spacecraft missions. To date, over 300 asteroids have been detected using the Arecibo planetary radar system, one of only two planetary radar facilities in the world, and more than 20 times more sensitive than the other one, Goldstone Solar System Radar in CA. The sizes and shapes of NEAs resulting from analysis of radar images has led to a number of fundamental breakthroughs in our understanding of the formation and evolution of small solar system bodies: formation of binary systems, Yarkovsky and YORP (non-gravitational radiation effects on small bodies), high porosity of NEA rubble-pile structures, and more. The Arecibo planetary radar facility is crucial in determining the orbital parameters for near-Earth asteroids, and can prevent objects from being lost, and extend the time frame for which impact predictions can be made with certainty. This capability is not available at any other telescope either existing or planned (i.e. FAST, SKA, LSST). The loss, if support for Arecibo were to be withdrawn or significantly reduced, would be catastrophic. Although current NASA support is sufficient for the fraction of the telescope time and effort needed to continue at or near current levels, the overall operation of the facility must also be maintained. Current levels of NSF support through both astronomy and aeronomy divisions are barely adequate to maintain the facility operation. Our ongoing efforts to understand the detailed thermophysical charateristics of near-Earth asteroid depend critically on continued operation of the Arecibo planetary radar, and thus the facility itself. We use detailed shape models together with thermal emission measurements to understand the thermal properties and internal structure of near-Earth astroids. We have found a wide variety of behaviors of objects having different sizes, rotation rates, compositions and surface properties. Without radar shape models, this work could not continue. Radar imaging is essentially a fly-by mission of an asteroid at a fraction of the cost for tens of objects per year. Closing or reducing the effectiveness of such a resource would be extremely short-sighted, and a poor choice for economizing on an irreplaceable and precious scientific facility.	Against Closure	Email	6/23/2016	Arecibocase.nsf2016.doc
212	Mary	Ide		With a lifelong interest in historic preservation, I was surprised to learn that the National Science Foundation is considering dismantling or crippling one of our most notable and historically significant scientific instruments, the Arecibo Observatory in Puerto Rico. I understand that it is on the National Register of Historic Places, not only because of the significant scientific developments there – one of which led to a Nobel Prize – but also because of the engineering feat that it represents. No one who has visited the telescope could imagine tearing it down, any more than we would tear down Mount Vernon. Moreover, the Observatory has ongoing value and can be used, whereas Mount Vernon is purely a museum. While we hope our country is known for many kinds of accomplishments, our contribution to the scientific world, and astronomy in particular, is an important part of our national heritage. The Arecibo Observatory gives a glimpse of an era when anything could be built that could be dreamed – and foretells a future where the US can continue to make real contributions to science around the world.	Against Closure	Email	6/23/2016	
213	Henrick-Mario	Ierkic	Prof. ECE - UPRM	This letter is in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory (AO). I am a professor at the Electrical and Computer Engineering Department of the University of Puerto Rico Mayaguez. Arecibo helps my academic duties in three areas : teaching, research and service. My preference is for Action #1 : Continued NSF investment for science-focused operations (No- Action Alternative).	Against Closure	Email	6/23/2016	

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214	Eric	Korpela	Berkeley	This letter is in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory. I feel strongly that the NSF should choose continued NSF investment for science-focused operations (the no-action alternative). Arecibo's cultural impact is as large as the Arecibo dish itself. As the source of data for the SETI@home project, the worlds largest volunteer computing project, Arecibo has been part of the both the formal and informal science education of millions of Americans and millions of other people worldwide. SETI@home and Arecibo have been incorporated into the primary and secondary education in many school districts. Arecibo continues to inspire the scientific pursuits of children and adults every day. These pursuits would be diminished by its absence. The social and economic impact of Arecibo on the local and Puerto Rican economy should also not be understated. At a time of financial crisis in Puerto Rico, continued support of Arecibo can be a stabilizing influence.	Against Closure	Email	6/23/2016	
215	Joseph	Kwasizur	Indiana University	I am writing in response to the notice of intent to produce an Environmental Impact Statement regarding the future of the Arecibo Observatory. As an undergraduate student at Lafayette College, I undertook research using the Arecibo Observatory for studies of pulsar astrophysics as part of a summer research internship and a senior thesis. During my research, I visited and made observations with the telescope. Through this project I learned skills in computer coding and algorithm development, in addition to gaining knowledge of pulsar astrophysics itself. This experience was a significant part of my development as a researcher, and an important step leading to my present position as a graduate student in physics. I hope that Arecibo can remain in operation with a science-focused research program, and that it can continue to provide valuable experiences for future students.	Against Closure	Email	6/23/2016	
216	Luke	Leisman	PhD Candidate Department of Astronomy Cornell University	I am writing to urge the NSF to continue full scientific funding for the Arecibo Observatory. I should acknowledge that as a graduate student in astronomy and a regular user of Arecibo, I have a vested interest in the future of the observatory; the science I do depends on its unique capabilities. Other telescopes simply aren't sensitive enough to efficiently search for the faint emission from from the nearly dark galaxies I study, searching for clues to how galaxies form. However, I understand that the NSF is in a difficult position. Important scientific telescopes like Arecibo are expensive to operate, and new exciting telescopes like ALMA demand substantial funding, requiring some form of operations cuts elsewhere. While I strongly feel that Arecibo's budget is justified given the cutting edge science I, and others, do with Arecibo each day, I recognize that Arecibo is just one of many national telescope that does unique science, just one tool in a suite of tools we use to better understand the universe. Yet, Arecibo stands out in my mind less for its substantial scientific usefulness, and more because of the way that it contributes to the inspiration and education of students nationwide. As a graduate student I have the opportunity to work with a team of astronomers from institutions across the country, from Chicago State University to the University of Puerto Rico. We involve undergraduate students from these institutions in our observations, both on site and remotely. More than any other teaching I do, working directly with this leading facility inspires and engages students. Some of it may be that, larger than three football fields from end to end, Arecibo is the most impressive of many telescopes I've used or visited. But more than that, unlike most observatories where students cannot contribute to the data taking process, student thrive on the direct engagement with new discoveries as they happen at Arecibo. On a more personal note, Arecibo has also been an important part of my education as a budding scientist. From conversations with observatory staff, to all night observing runs in the control room, the fascinating science we do with this unique and powerful instrument have shaped my view of what is possible in astronomy. So I will conclude by emphasizing that by investing in science at Arecibo, the NSF is investing in the careers of young scientists, many, like the students at UPR, who would not otherwise have exposure to real, cutting edge science. I am thankful for the inspirational role this telescope has played in my career, and hope it will continue to inspire students of astronomy for years to come.	Against Closure	Email	6/23/2016	
217	Sergio A. Colón	López		El radiotelescopio de Arecibo, no solo ha sido una atracción turística sino también una fuente de inspiración para estudiantes que estudian las ciencias. Sería una pérdida inmensa el dejar de apoyar a esta maravilla de la ingeniería que tantos descubrimientos ha hecho para la astronomía. Yo como arecibeño me siento orgulloso de que este radiotelescopio esté en mi pueblo. Por eso, como me identifico con el mencionado radiotelescopio le pido a la NSF que nos siga dando todo su apoyo.	Against Closure	Email	6/23/2016	

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218	Jean-Luc	Margot	Professor and Chair Dept. of Earth, Planetary, and Space Sciences University of California, Los Angeles 595 Charles Young Drive East Los Angeles, CA 90095 (310) 206 8345 http://mel.epss.ucla.edu/jlm	I am writing to submit comments about the NSF's preparation of an Environmental Impact Statement related to the Arecibo Observatory. Losing the Arecibo Observatory would result in incalculable losses, affecting both the scientific and broader impacts missions of the NSF. I attended the town hall meetings and understand that the curvature in the AST Division budget is flatter than that of the Universe. Nevertheless, I urge you to consider the fact that Arecibo, unlike most telescopes supported by the NSF, is a unique facility. There is no other telescope on the planet, for instance, that enables a direct, dynamical measurement of the oblateness of the sun by tracking the orbits of near-Earth asteroids. Goldstone, the only other planetary radar facility in the world, does not approach Arecibo in terms of sensitivity (factor of 20), accessibility (both in terms of telescope time and observer affiliation), or broader impacts (both in terms of student training and public outreach). This Spring, a class of 14 UCLA undergraduate and graduate students in astrophysics, engineering, and computer science were inspired and engaged by the data that they collected at the Arecibo Observatory. They wrote computer programs to analyze the data, producing an impressive data processing pipeline as a team in a short 10-week period. There is no doubt that Arecibo's flexibility in enabling these observations accounted in large part for the students' motivation and success. These students will now bring their signal processing and software development skills to the workplace. After taking the course, one of the graduate students in electrical engineering declared an interest in developing astronomical instrumentation. An anonymous student evaluation read "I looooove how we actually had telescope time, that definitely made the course so much more meaningful!" As I write this letter, UCLA graduate student Adam Greenberg is using Arecibo for his PhD research. Previous users of Arecibo in my group include graduate students Shantanu Naidu (PhD 2015, now Postdoc at JPL), Julia Fang (PhD 2013, now Staff Scientist at MIT Lincoln Laboratory), Carolyn Nugent (PhD 2013, now Staff Scientist at IPAC), Patrick Taylor (PhD 2009, now Staff Scientist at Arecibo Observatory), as well as a dozen undergraduate students. There is little doubt that my postdoctoral position at the Arecibo Observatory was the decisive turning point in my career in research and teaching. It is at Arecibo that I had an opportunity to design and build instrumentation that improved the science return of the planetary radar. This instrumentation was later cloned and deployed at Goldstone and Green Bank. It produced the overwhelming majority of asteroid radar images obtained since 2000. It is also at Arecibo that I was noticed by a senior Caltech astronomer who encouraged me to apply for a prize fellowship at Caltech. If it had not been for Arecibo, I might have gone into industry or business. Finally, I urge you to consider the symbolic value of your actions. Arecibo is the largest telescope on Earth. It is a monument to mankind's curiosity. Imagine what you will signal to generations of students by nurturing this unique facility, or by dismantling it.	Against Closure	Email	6/23/2016	nsf2016dps.pdf
219	Sean	Marshall	PhD candidate Department of Astronomy Cornell University	I am writing to urge the NSF to choose alternative 1 of its "Notice of Intent To Prepare an Environmental Impact Statement" for Arecibo Observatory: "Continued NSF investment for science-focused operations (No-Action Alternative)". As a graduate student who focuses on the analysis of radar observations of near-Earth asteroids, I am relying heavily on data from Arecibo. I am hoping to build a career on studies of asteroids. Observations from Arecibo will yield scientific breakthroughs for many years to come. Arecibo Observatory is a unique facility, and its enormous collecting area gives it unparalleled sensitivity. While many radio astronomers use multiple-dish interferometers in order to achieve better angular resolution, arrays like ALMA have a total collecting area that is an order of magnitude less than that of Arecibo. If Arecibo is closed, astronomers will lose the world's most sensitive radio telescope, a facility which has been critical for studies of near-Earth objects. Radar observations from Arecibo are a critical component of efforts to monitor potentially hazardous asteroids and comets. Without Arecibo, our capabilities to assess future impact hazards would be greatly diminished. Without radar observations, predictions of asteroids' future trajectories are less accurate, and many asteroids would have been lost if they had not been observed from Arecibo. Recognizing Arecibo's importance, the members of the Division for Planetary Sciences of the American Astronomical Society passed a resolution at the annual meeting last November encouraging all concerned institutions to work together to keep Arecibo open so that it can continue to be a scientifically productive facility. For asteroid radar observations, there is no other current or planned facility that is nearly as sensitive as Arecibo Observatory. The only other active facility, the Goldstone Solar System Radar in California, is much smaller and thus much less sensitive than Arecibo. Furthermore, Goldstone spends most of its time communicating with spacecraft, so if Arecibo were closed, Goldstone would not be able to replace it. The Five hundred meter Aperture Spherical Telescope (FAST), currently under construction in China, will not be able to mount a radar transmitter on its platform. And even if FAST had the capability to do asteroid radar observations, it would be extremely short-sighted for the NSF to abandon American leadership on a topic which is of great interest to the public. I implore the NSF to maintain the funding necessary to keep Arecibo Observatory operating.	Against Closure	Email	6/23/2016	

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220	Dr. Michael C	Nolan	Senior Research Scientist Lunar and Planetary Laboratory, University of Arizona Tucson, AZ 85721 USA +1 520 626 1978	The Arecibo Observatory is the premier scientific facility in Puerto Rico, and as such attracts numerous minority and underprivileged students to its STEM education programs, such as the Arecibo Observatory Space Academy. There, these students learn they can be scientist and engineers by interaction with the scientific and technical staff of the Observatory. Any option except scientific operation would eliminate these programs, which depend vitally on the scientific mission of the observatory. A purely educational facility that did not maintain the telescope scientifically operational would have little appeal: A crumbling edifice does not inspire future leaders. In addition, the Observatory hosts numerous external instruments, such as seismometers from the Puerto Rico Seismic Network, level benchmarks from the National Geodetic Survey, and GPS receivers to study the local tectonics. All of these rely on the scientific infrastructure of the Observatory. In summary, any mode of operation that does not preserve the scientific mission of the Arecibo Observatory will be an enormous loss to Puerto Rico and to the local communities.	Against Closure	Email	6/23/2016	
221	Kyra Zola	Norsigian		I visited the Arecibo Observatory only once, when I was ten years old, but it made a lasting impact on me. Even as a child, I could glimpse the value and importance of its contributions not just to science but to the education of both school children and tourists. As an experienced educator now, I can attest to the crucial importance of children being exposed at an early age to scientific instruments and experiences which will inspire them to consider science or engineering as a career, or simply to appreciate and marvel at the universe we live in. Losing the cultural and educational resource that the Observatory represents would be a sad loss for tens of thousands of Puerto Rican school children. There is a commitment to ensure that each child in the school system there will visit the Observatory at some point, which also instills pride in having this instrument which is important worldwide located in Puerto Rico, and staffed by many professional Puerto Ricans. I hope you will not consider any options other than continuing the future of this great instrument.	Against Closure	Email	6/23/2016	
222	Tim	Olszanski		I am writing in response to the invitation for public comments on environmental impacts of the Arecibo Observatory. I write to strongly urge that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." Ever since I was young, I was fascinated by the night sky, and this eventually inspired me to pursue a career in physics. I never truly had the chance when I was working on my Bachelor's degree at New Mexico Tech to truly experience my passion. It only has been just recently possible now that I am working towards a M.S in physics at University of Vermont. I currently am involved in the study of Pulsars, which Arecibo Observatory plays a major scientific role in observing. Though Pulsars were discovered in the 1960's, many things about them remain unknown and mysterious. Pulsars are important because they provide us a look at extreme phenomena that cannot be recreated in a lab. By studying them, we can apply this knowledge of how these phenomena behave to modern day applications. Arecibo also plays a major part in the detection of gravitational waves using Pulsars and is one of the only Planetary physics observatories. If Arecibo were to be defunded, even partly, astronomical science would be put back years. Indeed, the users of Arecibo would be forced to use other instruments. Though there are some exceptional proposals submitted to observatories, most tend to be of an equal quality. Without Arecibo, observers would be forced to us other instruments with already competitive standards, which will overall reduce the amount of meaningful scientific observations conducted. Graduate students who in general have less experience with research and writing proposals, will be put even at more of a disadvantage with obtaining observation time for there research. This could potentially lead to less graduate students pursuing observational astrophysics because of the time they have to wait to simply obtain there data. That is not the only concern to worry about if Arecibo were to be defunded. Arecibo has played a historic role in helping us understand our universe, and the Puerto Rican people consider it a source of cultural pride. In fact, numerous children, including minorities and poor, of Puerto Rico visit Arecibo. A fair portion choose to go to college and some chose the STEM field. If Arecibo were to be mothballed, a major representation of both the NSF and science itself to minorities and those of poor backgrounds (in Latin America) would be lost. I again strongly urge the NSF to continue funding Arecibo, and allowing future generations to continue using this phenomenal instrument.	Against Closure	Email	6/23/2016	

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223	Joanna	Rankin	Arecibo Science Advocacy Partnership Board Members Frank Djuth Geospace Res. Timothy Hankins NM Tech Carl Heiles UC Berkeley Amy Lovell Agnes Scott John Mathews Penn State Dipanjan Mitra Univ. Vermont David Nice Lafayette College Joshua Peek Space Telescope Science Institute Joanna Rankin Univ. Vermont Scott Ransom NRAO Julio Urbina Penn State Joel Weisberg, Carleton College Daniel Werthimer UC Berkeley Qihou Zhou Miami University	We are writing as the Board of the Arecibo Science Advocacy Partnership (ASAP, http://www.areciboscience.org), an organization of 150 scientist-users of Arecibo, representing its three major disciplines and including many of the most prominent and distinguished scientists using the Observatory and its science. Any discussion of changing the current operation of the world's largest and most sensitive radio telescope, the Arecibo Observatory, must first consider the positive impacts of this culturally significant resource on the human environment, as well as the negative impacts of its decommissioning. Why is Arecibo culturally significant? 1. It has been crucial to past contributions to scientific discovery in its three major disciplines of atmospheric studies, radar and radio astronomy, including Nobel Prizewinning research, such as the Hulse-Taylor discovery of the Binary Pulsar. It is a unique resource in understanding aspects of the Earth's environment. In addition, the Arecibo Observatory is an important part of the human and cultural environment of Puerto Rico. Any examination of the environmental repercussions of mothballing or decommissioning the Arecibo Observatory that does not consider these impacts would be insufficient. More details can be found in ASAP's response to NSF's "Dear Colleague" letter, http://www.areciboscience.org/ASAP_DCL_Reply_Post.pdf. 2. The Observatory is listed on the National Register of Historic Places of the United States Department of Interior's National Park Service because it qualifies under multiple criteria: The Observatory has a nationwide significance under Criterion A because of its contributions to the sciences of atmospheric studies and the development of radar and radio astronomy in the United States. It is also eligible under Criterion C because it represents a significant work of mechanical and electrical engineering. The Observatory's scientific achievements attest to its exceptional importance, thus it qualifies under Criterion G: "The contribution of the Arecibo Radio Telescope to the human knowledge of space is, literally, beyond this world." "The Arecibo Radio Telescope has become a popular icon." For the full description of why the Observatory qualifies for the National Register, see https://www.nps.gov/nr/2008nrlist.htm. Under 54 U.S.C. § 306108 of the National Historic Preservation Act, the effects of any undertaking on the Arecibo Observatory site must be considered and require their own process 3. The Observatory is an engineering marvel, cited jointly by the Institute of Electrical and Electronic Engineers (IEEE) and the American Society of Mechanical Engineers (ASME). It has also been designated an IEEE Milestone in Electrical Engineering (http://ieeemilestones.ethw.org) and an ASME Landmark in Mechanical Engineering (https://www.asme.org/about-asme/engineering-history/landmarks). This is the only such designation in Puerto Rico and one of only a few joint designations nationwide. (http://ethw.org/Milestones:NAIC/Arecibo_Radiotelescope,_1963).	Against Closure	Email	6/23/2016	EIS_Board_Letter_V3.0.pdf
				4. The Observatory is a longstanding and vital contributor to the culture of Puerto Rico. Every Puerto Rican knows of it and hears of it often on local media. Many of their educators participate in its teacher-training programs and then take the Observatory back to their classrooms, as well as bringing students directly to the Observatory. It is closely associated with Puerto Rican conceptions of science, excellence and accomplishment. In short, the Observatory is a major symbol of Puerto Rican pride. There is no comparable facility of international prominence in the Caribbean basin. Its fame literally puts Puerto Rico on the map and this in turn continues to provide significant cultural benefits. It attracts tourists who form a different impression of the island and its culture because it hosts and nurtures a world-class scientific institution. 5. A large proportion of all Puerto Rican school children visit the Observatory at some point. They are exposed to the excitement of scientific and engineering research and careers, showing them direct role models of other Hispanic people who are succeeding. Some participate in the Observatory's Saturday Academies and go on to win science fairs and university scholarships. The Arecibo area in Puerto Rico is an island center of excellence for such accomplishment in science. 6. The Observatory is a significant employer in a part of the island where there is little well paid, much less professional, work. The quarter-million residents of the City of Arecibo have a 12.8% unemployment rate. Most of the Observatory's Puerto Rican employees have worked at the facility for decades, weathering administration changes and many other storms. They have supported their local economies, and sent their children to school and, in many cases, to college, which would have been an unattainable goal without steadily and decently paid Observatory employment. This changes the culture of what students believe is possible and what they try to attain, and provides role models which are crucial to their development. 7. Intertwined with these cultural factors, the Observatory also attracts significant revenue to the area through tourist visits and supports the local economy through its purchasing locally and in San Juan. As eco-tourism emerges as an ever more important factor, visiting Arecibo and the nearby caverns provides an appealing alternative to far more damaging tourist options. Eco-tourism is expected to increase on the island and elsewhere. If the Observatory drops off the list of recommended visiting sites, many tourists will choose more environmentally damaging alternatives.				

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				All our remarks above are in the context of strongly urging that NSF choose “Continued NSF investment for science-focused operations (No-Action Alternative)” as cited in its “Notice of Intent to Prepare an EIS.” ASAP replied earlier this year to the AST’s “Dear Colleague Letter.” Some of the cultural, educational and scientific accomplishments and resources of the Observatory which we reviewed are relevant here, since science is a part of the human environment and culture. We, the Arecibo Science Advocacy Partnership (ASAP), replied earlier this year to the AST’s “Dear Colleague Letter” outlining in detail our recommendations for the NSF’s implementation of this alternative #1 (and reviewing some of the cultural, educational and scientific accomplishments and resources of the Observatory). Highlights include --- Arecibo Observatory is the most sensitive radio telescope, planetary radar and incoherent scatter radar (ISR) on the planet. AO serves a highly international scientific community and is recognized worldwide as an iconic scientific facility and human achievement. One of the Observatory’s principal strengths is its ability to adapt quickly to new science and techniques, a capability rapidly being lost on other more complex and/or array instruments configured towards certain fixed science goals. AO is uniquely powerful for planetary and Near-Earth-Asteroid (NEA) radar. AO and the GBT could, as in the past, be paired for unique new observations particularly of Near-Earth Asteroids (NEAs). AO’s great sensitivity is required for gravitational wave detection and study. Single dishes provide important advantages over arrays for certain types of astronomy. For example, AO pulsar timing activities cannot be superseded by the Very Large Array (VLA). The capabilities of AO and the Green Bank Telescope (GBT) are highly complementary—and the loss of either one would cripple leading areas of US astronomical research. The most sensitive ISR (Incoherent Scatter Radar) in the world combined with metals lidar, other optical instruments, and the VHF radar make AO the premiere facility for studying the role of meteoroid flux metals in the upper atmosphere and ionosphere. The full document is at http://www.areciboscience.org/ASAP_DCL_Reply_Post.pdf). This document represents only a first pass at potential impacts of the options NSF is considering. We trust that as the process proceeds, these will be amplified so that the conclusion is clear: we have a culturally unique treasure whose value is recognized by scientists, engineers, tourists and schoolchildren. We trust that the NSF will follow suit.				
224	Joanna	Rankin	Arecibo Science Advocacy Partnership Board Members Frank Djuth Geospace Res. Timothy Hankins NM Tech Carl Heiles UC Berkeley Amy Lovell Agnes Scott John Mathews Penn State Dipanjan Mitra Univ. Vermont David Nice Lafayette College Joshua Peek Space Telescope Science Institute Joanna Rankin Univ. Vermont Scott Ransom NRAO Julio Urbina Penn State Joel Weisberg, Carleton College Daniel Werthimer UC Berkeley Qihou Zhou Miami University	In summary, an environmental impact analysis would be insufficient without conducting a full examination of these economic, cultural, and related impacts. These overall impacts are so interrelated that they probably entail “cumulative” or “indirect” effects [e.g., U.S. Code 40 C.F.R. 1508.8 (b)]. The interrelated economic impacts of all options considered by NSF with regard to the future of Arecibo need to be addressed in the Environmental Impact Statement. If the NSF were to diminish the scientific mission of the Observatory, it would sacrifice the underlying fundamental reason for the Observatory’s existence: to explore and further understand human beings in relation to our environment, or, in NEPA language, the human environment. Nothing is more fundamental than that. To operate the Observatory only as an educational institution would keep the facility alive, but would remove the research function from which it’s educational facility derives. The Observatory’s three research areas are highly interdependent, and its role as an educational institution depends on the scientific and engineering activities of them all. The alternative of mothballing the Observatory would affect the human environment in countless ways. It would turn a source of pride into a source of shame. It would turn out on the street Puerto Rican people who have given decades of their lives to an institution that has contributed importantly to humankind everywhere. Once those people are gone — at every level from its highly skilled and dedicated platform staff to its trained technical staff — they cannot be replaced without a commitment to years of training, and the rents in the social fabric of their communities caused by their being terminated would last longer than the Observatory itself. The deterioration of the physical plant of the Observatory in a tropical salt-air climate can only be imagined by those who have experienced what it can do to a painted metal structure. During its mothballing, it would have to be guarded so as not to be a local hazard, and if ultimately the physical structures were disassembled, the lack of maintenance would make the process more costly and hazardous with much more devastating environmental impacts (including the landfill impacts). Because climate change is expected to make hurricanes more frequent, the mothballed instrument would become more vulnerable to natural destructions that would in turn create uncontrolled environmental disasters. Because most school children in Puerto Rico visit the Observatory at some point, the new generations who will not have that opportunity would learn the opposite of the lesson we have been trying to instill for decades, that science and engineering careers are open to Hispanics and other “minorities,” and that people have rewarding and remunerative lives as a result of their education and training. This would be a blow not only in Puerto Rico, but in our country as a whole. We all lose when we instill despair rather than hope in the rising generation. These potential circumstances need to be studied and assessed in the EIS. What would the environmental impact be if NSF decided on the most draconian option of destroying the Observatory?—that is, attempting to return the property to its original natural state. Such destruction would result in compromised habitat for plants and animals which still have not been fully catalogued. Both the process of destruction and its result would compromise the water quality of the Tanama River which runs under the dish and its tributaries—and consequently the plants and animals which depend on it. It is hard to imagine that it is even possible to decommission the Observatory, dismantle its structures and buildings and return the site to its original condition at any cost. The amount of landfill material that would be generated is almost unthinkable, and it would consist primarily of materials which are slow to deteriorate and have some amount of toxicity. The Observatory was constructed at a time when Puerto Rico’s environmental regulations were hardly existent, and now they are reasonably strict as the recent triangle painting exercises have clearly demonstrated. Who knows what materials will be found if the NSF makes this wrong choice? Restoring the natural environment would be impossible without an accurate catalogue of the existing plants and animals, which are almost surely fewer in species and number than they were before the Observatory was built.	Resource Considerations	Email	6/23/2016	EIS_Board_Letter_V3.0.pdf

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				There are currently 145 species in Puerto Rico on the Endangered Species list. It would be astonishing if none of these is present at the Observatory, and this would need to be verified by the appropriate experts. Historic evidence from other similar environments would need to be brought in. Even in the presence of that data and a contemporary inventory — assuming that no endangered species were found — a huge amount of clean soil and numerous, costly native plants and animals would be required to return the valley floor to its original condition. Where would that soil be excavated, and at what cost to that location? How and where would the plants and animals be bred, and at what cost? Restoring the valley profile would cause huge damage to existing vegetation, so the contractors would be starting from scratch — and doing so on top of a vulnerable river and sinkhole of unknown character. Restoring the drainage system alone would be a nightmare. Even apart from all of these issues, the process of destruction and its result would compromise the water quality of both the Tanama River which runs under the dish and the Arecibo River into which it drains—and consequently the plants and animals which depend on these essential waterways. In addition, decommissioning activities may require temporary road building and additional impaction of the soil due to the use of heavy machinery. All of these negative repercussions on the natural environmental of the Observatory site need to be examined. If NSF chooses any option but continuation, all the impacts discussed above would disproportionately affect a “minority” population—that is, the 99% of Puerto Ricans who are Hispanic. As E.O. 12898 concerning environmental justice specifies, Federal agencies are ordered to avoid disproportionate impacts on minority populations. The same stricture applies to low-income populations. The median income in Puerto Rico is $19,429, compared to $51,371 in the US at large. These issues need to be addressed in the assessment of the impacts on the human and socio-economic environment				
225	Joanna M.	Rankin	Professor of Physics and Astronomy	I write in response to the Federal Register Notice of an EIS evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory (AO). Arecibo Observatory is a unique institution nationally and internationally culturally, educationally, scientifically and also economically in Puerto Rico. Arecibo’s attributes have been cultivated over many years, are interconnected and mutually supportive, and can cannot readily be separated. The Observatory’s contributions in all four areas continue to be very strong, and they could multiply in future with a more appropriate level of support. The scientific contributions from AO have been outstanding, and its scientific future remains very bright indeed. The Observatoriy’s cultural contributions to Puerto Rico and the world are beyond reconning. Here are a few examples: • In my experience, Arecibo is the most exciting observatory for students on the planet. Students sometimes describe their experience at AO as “life changing” and this can be traced in the lives of students who visit for scientific work. • Arecibo is a work of art and is often apprehended in this manner by visitors. It is understood as a supremely elegant mechanical and electronic monument to the in service to the human imagination. • The Observatory is iconic nationally and internationally. Its very existence has raised consciousness about science, to say nothing of its several prominent movie roles! • AO is almost certainly the single best known and influential scientific institution in the Spanish speaking US and Caribbean basin. Puertoricans are very very proud of their “El Radar” and its presence has entered the culture and consciousness in a very deep and positive manner. • In Puerto Rico, the Observatory is of very considerable economic value and could be much more so. Its staff salaries are highly important in the Arecibo Town region. Its educated staff has significantly contributed to building up a further generation or two of educated people in the area, and the tens of thousands of tourist visitors are also important to the overall island economy. Withdrawal of support now would compound what is already a difficult situation for Puerto Rico and is citizenry. • Educationally, the Observatory is of key importances at every level: For the island high school students who visit AO in conjunction with their science classes. The Arecibo Institute students who go on to excel in STEM disciplines. Training programs for teachers in PR and elsewhere in Latin America. Graduate students in science and engineering both from PR and the mainland. Postdocs. As a facility for visits by US colleague students to do research with their mentors. A primary environmental principle is to use well and not waste—in this case waste its scientific, educational, economic and cultural value. AO has enormously greater value than the cost of its support. It is unique in the world in all three of its science areas. AO is hardly 20 years old since its Gregorian renovation, still very much in its prime years. It could multiply, 2-3 times, more important and productive with adequate, rather than starvation, support. Replacing AO would take years and many times the cost of dismantling it. All such facilities/institutions have finite lifetimes, but crippling the Observatory before it has become outdated or malfunctional would indeed be an environmental crime.	Against Closure	Email	6/23/2016	EIS_Arecibo_June2016_JMR.pdf

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226	Alessandro	Ridolfi	Ph.D. candidate at Max-Planck-Institut für Radioastronomie Auf dem Hügel 69 D-53121 Bonn, Germany	This letter is in response to the Federal Register Notice “Proposed Changes to Arecibo Observatory Operations”, evaluating potential environmental effects of proposed changes to operations at Arecibo Observatory. I am writing to strongly urge the National Science Foundation to choose the first option under consideration, namely “Continued NSF investment for science-focused operations”. Since its construction in 1963, the Arecibo radio telescope has proved to be an outstanding research facility, always capable of world-class scientific breakthroughs. Its huge collecting area is clearly the main, but not the only, reason of its success. Over the decades, the observatory was able to greatly improve itself, with new instrumentation and computing power. This has allowed the Arecibo science to be always at the top of astronomical research. As a pulsar astronomer and science enthusiast, I am very keen to remind you of the discovery of the very first pulsar in a binary system, made at Arecibo by R. A. Hulse and H. J. Taylor in 1974. The object found showed strong relativistic effects and opened up unprecedented possibilities for the study of gravitation. Such a discovery was worth the Nobel Prize for the two astronomers. This was just one the first of the amazing findings that Arecibo can boast. To take a much more recent example, I would like to highlight the detection of the first repeating Fast Radio Burst, recently published in Nature (Spitler et al. 2016). As a Ph.D. candidate at the Max-Planck-Institut für Radioastronomie in Bonn, Germany, I would hereby like to call attention to how much the Arecibo Observatory is crucial not only for my personal research, but also for a huge community of young students and researchers from all over the world. The project that I am currently carrying out for my Doctoral studies finds its own foundations in the aforementioned work of Hulse and Taylor. The focus of my work is indeed to study a particular effect predicted by Einstein’s General Relativity in the binary pulsar PSR B2127+11C (see, e.g. Jacoby et al. 2006, Kirsten et al. 2014). This pulsar resembles for many aspects the system that Hulse and Taylor found and, as the latter, it is a unique object for studying gravitation. According to Einstein’s equations, the spin of the pulsar couples to the orbital motion of the binary; this effect, called “Geodetic Precession”, causes the direction of the pulsar radiation beam to vary over time, consequently changing the amount and the characteristics of the pulsar signal that we can collect on Earth. Such a modification in the signal allows us to test whether the changes are indeed occurring in the way that Einstein’s General Relativity predicts. However, despite being a fantastic natural laboratory, PSR B2127+11C is a very weak source that, because of the very same effect that we want to study, it is getting fainter and fainter very quickly. The Arecibo radio telescope is currently the only instrument available to study this source with the necessary sensitivity and we have now been using it for more than two years to monitor the changes in the pulsar (Arecibo Project P2910). However, over the next 5-10 years, PSR B2127+11C is expected to become so weak that it will be impossible to observe it. It is thus of utmost importance to have Arecibo available to be able to continue our monitoring campaign. In the above paragraph I described just one, and very personal, example of how the Arecibo telescope is still, after more than 50 years, an indispensable tool for leading-edge fundamental physics experiments and top-class science. Many other scientists (see, e.g. http://areciboscience.org/WhoAreWe.html) share the same opinion and are continuously demonstrating the immense capabilities of Arecibo with great scientific achievements. Therefore, I strongly encourage the NSF to continue to support Arecibo as a worldleading astronomical facility by choosing the first option, namely “Continued NSF investment for science-focused operations”.	Against Closure	Email	6/23/2016	Ridolfi_Letter_in_response_to_Proposed_Changes_to_Arecibo_Observatory_Operations.pdf
227	Xiomara	Rivera		I sing for arecibo obsevatory.	Against Closure	Email	6/23/2016	
228	Alberto	Sensana	(Chair) and the IPTA Steering Committee	We are writing this email in support of the Arecibo Observatory on behalf of the International Pulsar Timing Array collaboration (IPTA). The IPTA comprises more than one hundred scientists in ten countries (and counting) who are using radio telescopes around the world for their science. The primary goal is the detection of low-frequency gravitational waves that are distinct from those discovered recently by the LIGO project. The IPTA's primary sources are supermassive binary black holes in merging galaxies and hence the IPTA is instrumental to our understanding of supermassive black hole assembly and astrophysics, galaxy evolution and cosmology. The detection of low-frequency gravitational waves is a critical step towards the goal of a complete characterization of the gravitational wave universe. The entire worldwide collaboration benefits from the data obtained with the Arecibo Observatory by scientists within NANOGrav, the North American component of the IPTA. The Arecibo data are pooled with data from other telescopes, including the Green Bank Telescope in West Virginia, and multiple telescopes in Europe and Australia. Soon, we expect to be joined by scientists in South Africa and China. Arecibo is an important linchpin in the collective effort because it provides the highest precision data due to its large aperture. In addition, instrumental effects are well understood given the many decades of experience we have with using it. Loss of Arecibo would have a severe detrimental impact on the scientific collaborations between scientists working within the IPTA, which have developed over many years. In recent years those collaborations have grown because new instrumentation developed for Arecibo and the other telescopes in the context of the IPTA are now placing us at the doorstep of detection of long-wavelength gravitational waves. These will be as distinct from those detected by LIGO as X-rays are distinct from radio waves, and hence this effort must be continued. We strongly urge the National Science Foundation to continue operation of the Arecibo Observatory to ensure the success of this large international effort.	Against Closure	Email	6/23/2016	

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229	Xavier	Siemens	Chair, NANOGrav Director, NANOGrav Physics Frontiers Center Associate Professor Center for Gravitation, Cosmology, and Astrophysics Department of Physics University of Wisconsin--Milwaukee Milwaukee, WI 53201 (414) 229-6439 (Office) (414) 793-5047 (Cell) (414) 229-5589 (FAX) E-mail: siemens@gravity.phys.uwm.edu http://www.lsc-group.phys.uwm.edu/~siemens	The Arecibo Observatory is a Key Instrument for Gravitational---wave Astronomy Introduction We are the North American Nanohertz Observatory for Gravitational waves (NANOGrav), a collaboration that involves over 100 students and scientists from 15 institutions in the US and Canada. The US portion of NANOGrav is largely funded by the National Science Foundation's NANOGrav Physics Frontiers Center. Using the Arecibo Observatory and the Green Bank Telescope, our collaboration is doing gravitational wave astronomy: we are leading the search for low---frequency gravitational waves produced by the mergers of supermassive black holes at the centers of galaxies. These low---frequency gravitational waves have periods 11 orders of magnitude longer than those discovered by LIGO and announced earlier this year. By regularly monitoring millisecond pulsars with our telescopes, we are building an observatory, much like LIGO, that will open a window onto a completely new part of the gravitational wave spectrum. We are now at a time when we have reached unprecedented sensitivities and are exploring astrophysically relevant parts of galaxy evolution parameter space. A detection could therefore happen soon. The Importance of Arecibo Arecibo is the most sensitive radio telescope in the world and will continue to be for several more years. Lack of access to this instrument will delay the first detection of gravitational waves in the regime accessible to pulsar timing, and significantly hamper efforts to maximize astrophysical studies using these waves once they are detected. Given the unprecedented sensitivity of NANOGrav, and LIGO's recent gravitational wave discovery------which was appropriately announced with much fanfare by both LIGO and NSF, and has already received several major scientific prizes------we were surprised to learn about NSF's decision to consider the shutdown of Arecibo, thus triggering the need to develop a scoping notice for an Environmental Impact Statement. The scientific context of prior reviews of Arecibo in 2006 (Senior Review) and 2012 (Portfolio Review) has changed profoundly, so that their conclusions about the scientific merits of this facility need to be re---examined. Human and Cultural Importance We are writing to comment on issues related to human and cultural environment. Any option that NSF pursues that is incompatible with continued science---focused operations at Arecibo will put in serious peril 1) the ongoing science and engineering training of students from high school through postdocs, discussed further below, 2) the research and careers of our more than one hundred students and scientists in NANOGrav, 3) US leadership in low---frequency gravitational wave astronomy and high precision pulsar science, and 4) a new scientific discovery as profound as the one announced by LIGO earlier this year. Over the past decade NANOGrav has involved a diverse group of hundreds of US high school and undergraduate students in Arecibo observations of pulsars and gravitational wave astronomy. Arecibo has played a particularly inspiring role in training our Hispanic students who, through the Arecibo Remote Command Center based at the University of Texas Rio Grande Valley and expanded to a number of other NANOGrav institutions, form a substantial part of our group of observers. Arecibo is a source of cultural pride for our Hispanic students (as well as the people of Puerto Rico). The excitement of our students in personally operating Arecibo has propelled many of them into careers in physics, astronomy, engineering, and other STEM fields. Indeed, the career---defining moment for many of the senior researchers and faculty in NANOGrav was using Arecibo as a student. With Arecibo's continued science---focused operations, over the coming years hundreds more students will continue doing cutting edge research by operating the most sensitive radio telescope in the world in our search for gravitational waves, a truly valuable research and educational experience for them. We emphasize that, scientifically, the Arecibo Observatory is not the same telescope it was when it was first constructed, or even a few years ago. It is a far superior instrument. The modern telescope structure, including the Gregorian dome, was inaugurated twenty years ago, but instrumentation capable of using the full instantaneous telescope band has been available for less than five years. Additionally, upcoming wideband and multibeam systems promise to greatly increase the sensitivity of the telescope in the next few years. We recognize that other telescopes, particularly the FAST telescope now under construction in China or the proposed SKA phase 2 telescope in southern Africa, could eventually be suitable replacements for Arecibo for our gravitational wave science program (though not for the educational mission described above). However, their suitability for our program ultimately depends on the instrumentation and observing programs implemented at those facilities. Even more importantly, we will not know for several years the true sensitivity of upcoming telescopes or the ability of scientists from the United States to access these international facilities, which are not expected to operate under "open skies" policies. Given the timescales for building and commissioning these new instruments, as well as our need for overlapping observations to link existing data sets to data collected with the new instruments, it is critical that Arecibo continue to operate in the coming years. Arecibo's status among US and world radio facilities should be re---evaluated when the new facilities are in full operation and when it is understood whether U.S. scientists and their international collaborators have access to them.	Against Closure	Email	6/23/2016	NANOGravNSFNOI Response.pdf

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				If you have any questions or would like to reply to our letter please contact the NANOGrav Management Team (nano- ---mt@nanograv.org). Signed by 123 NANOGrav students and scientists: Zaven Arzoumanian, USRA, NASA Goddard Space Flight Center Paul Baker, West Virginia University Robert Bavisotto, University of Wisconsin---Milwaukee Adam Brazier, Cornell University Paul Brook, University of Oxford Sarah Burke---Spolaor, National Radio Astronomy Observatory Keeisi Caballero, University of Texas---Rio Grande Valley Richard Camuccio, Franklin and Marshall College Fernando Cardoso, West Virginia University Rachel Chamberain, Franklin and Marshall College Sydney Chamberlin, Penn State University Shamibrata Chatterjee, Cornell University Brian Christy, Notre Dame of Maryland University John Combs, Franklin and Marshall College James Cordes, Cornell University Neil Cornish, Montana State University Marcus Covington, Franklin and Marshall College Froney Crawford, Franklin and Marshall College Steve Croft, University of California, Berkeley Thankful Cromartie, University of Virginia Kathryn Crowter, University of British Columbia Megan DeCesar, University of Wisconsin---Milwaukee Paul Demorest, National Radio Astronomy Observatory Julia Deneva, Naval Research Laboratory Timothy Dolch, Hillsdale College Eric Edwards, University of Wisconsin---Milwaukee Justin Ellis, Jet Propulsion Laboratory, California Institute of Technology Rob Ferdman, McGill University Elizabeth Ferrara, University of Maryland William Fiore, University of Wisconsin---Milwaukee Emmanuel Fonseca, University of British Columbia Ellen Friesen, Hillsdale College Nate Garver---Daniels, West Virginia University Pete Gentile, West Virginia University Simon Gilbert, Oberlin College Daniel Halmrast, Hillsdale College Steven Hawkins, University of Wisconsin---Milwaukee Sarah Henderson, Lafayette College Eliu Huerta, West Virginia University Thomas Hull, Cornell University Ben Izmirli, Oberlin College Fredrick Jenet, University of Texas---Rio Grande Valley Cody Jessup, Hillsdale College Lou Jing, University of Texas---Rio Grande Valley Glenn Jones, Columbia University Megan Jones, West Virginia University David Kaplan, University of Wisconsin---Milwaukee Victoria Kaspi, McGill University Filip Keri, Franklin and Marshall College Tonia Klein, University of Wisconsin---Milwaukee Zachary Komassa, University of Wisconsin---Milwaukee Michael Koop, Penn State University Stasia Kuske, Franklin and Marshall College Joseph Kutil, Hillsdale College Michael Lam, Cornell University Joseph Lazio, Jet Propulsion Laboratory, California Institute of Technology Han Le, Franklin and Marshall College Kat Lefebvre, Franklin and Marshall College Lina Levin, University of Manchester Tyson Littenberg, University of Alabama Andrea Lommen, Franklin and Marshall College Duncan Lorimer, West Virginia University Hao Lu, Lafayette College Jintao Luo, National Radio Astronomy Observatory Ryan Lynch, National Radio Astronomy Observatory Dustin Madison, National Radio Astronomy Observatory Walid Majid, Jet Propulsion Laboratory, California Institute of Technology Kaleb Maraccini, University of Wisconsin---Milwaukee Allison Matthews, University of Virginia Margaret Mattson, West Virginia University Maura McLaughlin, West Virginia University Sean McWilliams, West Virginia University Chiara Mingarelli, Jet Propulsion Laboratory, California Institute of Technology Dan Mix, Franklin and Marshall College Chifu Moua, University of Wisconsin---Milwaukee Rusty Mundorf, University of Wisconsin---Milwaukee Ryan Nesselrodt, Franklin and Marshall College Sophia Newton, Franklin and Marshall College Cherry Ng, University of British Columbia Benjamin Nguyen, Franklin and Marshall College David Nice, Lafayette College Stella Ocker, Oberlin College				

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
				Jeff Ouellette, Cornell University Nipuni Palliyaguru, Texas Tech University Tim Pennucci, Columbia University Indira Rahman, Franklin and Marshall College Joshua Ramette, Hillsdale College Joanna Rankin, University of Vermont Scott Ransom, National Radio Astronomy Observatory Paul Ray, Naval Research Laboratory Douglas Reigel, Cornell University Nora Rice, Oberlin College Miguel Rodriguez, University of Texas---Rio Grande Valley Joseph Romano, University of Texas---Rio Grande Valley Caitlin Rose, Franklin and Marshall College Laura Sampson, Northwestern University Andrew Seymour, NAIC Arecibo Observatory Brent Shapiro---Albert, West Virginia University Joey Shapiro Key, University of Texas---Rio Grande Valley Xavier Siemens, University of Wisconsin---Milwaukee Joe Simon, University of Wisconsin---Milwaukee Renee Spiewak, University of Wisconsin---Milwaukee Ingrid Stairs, University of British Columbia Daniel Stinebring, Oberlin College Kevin Stovall, University of New Mexico Joseph Swiggum, University of Wisconsin---Milwaukee Stephen Taylor, Jet Propulsion Laboratory, California Institute of Technology Matthew Tibbetts, Franklin and Marshall College Lam Tran, Franklin and Marshall College Michael Tripepi, Hillsdale College Jacob Turner, Oberlin College Rachel Umberger, Franklin and Marshall College Michele Vallisneri, Jet Propulsion Laboratory, California Institute of Technology Rutger van Haasteren, Jet Propulsion Laboratory, California Institute of Technology Sarah Vigeland, University of Wisconsin---Milwaukee Yan Wang, Huazhong University of Science and Technology Ryan Wilber, University of Wisconsin---Milwaukee Kathryn Williamson, West Virginia University Emily Wilson, Franklin and Marshall College Caitlin Witt, Cornell University Alex Wolszczan, Penn State University Enia Xhakaj, Lafayette College WeiWei Zhu, Max Planck Institute for Radio Astronomy				
230	Thomas	Sorenson	sorenson gunsmithing services	This facility is important for research of our universe and for SETI. To close this facility would severely hamper ongoing research of our universe and the search for extraterrestrial life. I urge you reconsider and keep this facility open for the new generations of astronomers.	Against Closure	Website	6/23/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
231	Ingrid	Stairs	Professor, THE UNIVERSITY OF BRITISH COLUMBIA Department of Physics and Astronomy 6224 Agricultural Road Vancouver, BC Canada V6T 1Z1 Tel: (604) 822-3853 Fax: (604) 822-5324	The Arecibo Observatory has been a vital instrument in my research program since my very first and extremely memorable trip as a beginning graduate student in 1993. For my Ph.D. degree, I had what is rapidly becoming a rare opportunity in astronomy: the chance to assemble an observing instrument, write data acquisition and reduction software for it, install it at the telescope in late 1997 at the end of the Gregorian-dome upgrade, and acquire data with it. That instrument, the Princeton “Mark IV” pulsar observing machine, was one of the instruments used by several of us for years in monitoring the fastest-spinning millisecond pulsars, a project that in 2007 extended its scope and collaboration to become the North American Nanohertz Observatory for Gravitational Waves (NANOGrav). This collaboration is on the road to making a direct detection of gravitational waves passing near the Earth; the loss of Arecibo would delay the time of detection and late reduce our ability to carry out astrophysical studies of the waves. I have led or been involved with numerous other radio pulsar projects at Arecibo throughout my career, including the large-scale PALFA survey of the Galactic Plane for pulsars and Fast Radio Bursts, a project to find pulsars in the globular clusters visible to Arecibo, and long-term monitoring of relativistic binary pulsars which test Einstein’s theory of General Relativity (GR). I helped build the “Arecibo Signal Processor” (ASP) pulsar instrument, successor to Mark IV and precursor to the current “Puerto Rico Ultimate Pulsar Processing Instruemnt” (PUPPI) machine. ASP in particular afforded me the opportunity to train my own graduate student on the commissioning and detailed understanding of an observing instrument. I have seen similar benefits in the PALFA collaboration, with students learning to understand the details of instrument operation and telescope beam shapes in order to correctly interpret their data. I have so far mentored 10 trainees ranging from undergraduates to postdoctoral fellows on the use of Arecibo data and hope to be able to continue doing this for years to come. Losing Arecibo would have a tremendous negative impact on my research program, on my collaborations with US-based scientists, on the training of US, Canadian and international students, and on significant and highly successful public outreach programs such as the Angel Ramos Visitor Center and the Einstein@Home “citizen science” pulsar search program. Arecibo reaults only receive widespread press coverage. Examples that I have been involved with include the first quantitative, model-independent measuremnt of the GR-predicted “wobble” of the pulsar’s spin in a double-neutron-star system, a qualitative measurement of the same effect in another relativistic system (this garnered considerable media attention in 2015, including an interview I did for CBCRadio’s Quirks and Quarks science show), the discovery of a repeating Fast Radio Burst, and the discovery of unexpected and therefore extraordinarily interesting pulsars in the PALFA survey, such as an eccentric millisecond pulsar binary that required development of new evolutionary scenarios. None of these results would have been possible without Arecibo. Arecibo’s scientific and cultural reach is worldwide, providing everything from training opportunities and a sense of local pride and accomplishment in Puerto Rico to invaluable research infrastructure for the world radio astronomy community. With its unique sensitivity and infrastructure, Arecibo is poised to make fundamental astrophysical contributions for years to come. In summary, I advocate strongly for the first option under consideration: Continued NSF investment for science-focused operations. A recent Arecibo-based paper likely not listed in any letters from my collaborations: We used Arecibo data to derive precision measurements of 5 relativistic corrections to a basic elliptical Keplerian orbit for a double-neutron-star system. These parameters provide multiple selfconsistency verifications of the predictions of General Relativity (GR) and also allow us to make a precise measurement of the distance to the pulsar. We also confirmed our earlier measurement of the precession “wobble” of the pulsar’s spin axis; again it is consistent with GR. This paper has garnered 20 citations in just two years. Fonseca, Emmanuel, Stairs, Ingrid H. and Thorsett, Stephen E., “A Comprehensive Study of Relativistic Gravity Using PSR B1534+12,” Astrophysical Journal 787, article 82 (2014). We present updated analyses of pulse profiles and their arrival times from PSR B1534+12, a 37.9 ms radio pulsar in orbit with another neutron star. A high-precision timing model is derived from 22 yr of timing data and accounts for all astrophysical processes that systematically affect pulse arrival times. Five "post-Keplerian" parameters are measured that represent relativistic corrections to the standard Keplerian quantities of the pulsar's binary orbit. These relativistic parameters are then used to test general relativity by comparing the measurements with their predicted values. We conclude that relativity theory is confirmed to within 0.17% of its predictions. Furthermore, we derive the following astrophysical results from our timing analysis: a distance of d GR = 1.051 ± 0.005 kpc to the pulsar-binary system, by relating the "excess" orbital decay to Galactic parameters; evidence for pulse "jitter" in PSR B1534+12 due to short-term magnetospheric activity; and evolution in pulsedispersion properties. As a secondary study, we also present several analyses on pulse-structure evolution and its connection to relativistic precession of the pulsar's spin axis. The precession-rate measurement yields a value of Ω1 spin = 0.59+0.12 -0.08° yr-1 (68% confidence) that is consistent with expectations and represents an additional test of relativistic gravity.	Against Closure	Email	6/23/2016	Arecibo_EIS_Stairs.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
232	Daniel R.	Stinebring	Federighi Professor of Natural Science Oberlin College Oberlin, OH 44074	I write to strongly urge that the NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." I have been using the Arecibo Observatory since 1976 and have made an observing trip to it in almost all of the years since then. During the period 1985-90 when I was an Assistant Professor at Princeton University I took many graduate students (~ 10 to the Observatory) as well as a few undergraduates. Since 1990 I have been a professor at Oberlin College in Ohio. During that time I have taken about 30 Oberlin undergraduates to the Observatory and worked with about 45 other students on Arecibo data, much of which we obtained through remote observing that they participated in. (Please see the list appended at the end for more details.) I am a member of the NANOGrav collaboration that is on track to detect long-wavelength gravitational waves in the next five years if our access to our two detectors – the Arecibo Observatory and the Green Bank Telescope – is not impaired. In fact, we hope that in the aftermath of the stupendous LIGO announcements of gravitational wave detection in the high- frequency GW regime our effort to open another gravitational wave window will be supported fully by the NSF, including crucial support for the Arecibo Observatory. My research into turbulence and structure in the interstellar medium, as probed by pulsar signals, has been supported by the NSF since 1993. More than 70 Oberlin College undergraduates have worked with me on that research, and most of them have gone on to careers in science or related fields. Small- group, high-quality science is a key component in our national science effort, and Arecibo excels in that area as well as in larger-scale efforts. The Arecibo Observatory is an extraordinary research instrument and a training ground for the next generation of astronomers. It certainly has been for me and for my students. The Arecibo Observatory is at the peak of its scientific productivity and remains a leading instrument of discovery in astronomy. In the more than 40 years that I have been using it, the telescope has never been more capable, reliable, and better instrumented than it is today. Much of this capability is due to a far-sighted NSF initiative in the 1990's that completely upgraded Arecibo's capabilities. Since the telescope is approximately 5 - 8 times more sensitive than any other telescope on Earth over much of its broad frequency range, there are crucial projects that can be done nowhere else. These include fundamental tests of General Relativity, ultra-deep searches for neutral hydrogen gas between galaxies, and the discovery of pulsars that are undetectable elsewhere. Arecibo is also a crucial element in the international effort to detect gravitational waves by monitoring a bank of pulsar clocks distributed around the sky. Arecibo is a world-class instrument that is a beacon of excellence in U.S. science. The unique capabilities of Arecibo could not be duplicated for an amount approaching half a billion dollars. By comparison, the annual NSF support of about $5M/year buys an enormous capability that garners national and international respect for U.S. science. There are many other compelling reasons for choosing Option #1: Continued NSF investment for science-focused operations (No-Action Alternative): the extraordinary impact that the Observatory has on minority serving education and outreach in Puerto Rico being one of the most salient. However, to these other reasons, I would add these two: * NANOGrav is on track to detect long-wavelength gravitational waves from pulsars in the next five years using Arecibo and the Green Bank Telescope. This will be a transformative achievement in gravitational wave astronomy, and the NSF will be able to take great pride in having robustly supported that science. * The Arecibo Observatory is a hands-on telescope with unique and extraordinary capabilities. It has been a training ground for numerous generations of US radio astronomers who have gone on to accomplish world-class science based on its unique capabilities. The research training – and the resulting exceptional science – that has resulted from NSF support of the instrument is a national resource that should not be downscaled at this propitious moment. My more than 25 years of research with Oberlin College undergraduates depends crucially on continued access to this national resource.	Against Closure	Email	6/23/2016	Arecibo support letter - EIS - v2.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
				Best regards, Daniel R. Stinebring Federighi Professor of Natural Science Department of Physics and Astronomy Oberlin College Oberlin, Ohio 44074 Appendix: I am attaching a list of the students who have worked with me on Arecibo data since my arrival at Oberlin College in 1990. The students marked with a + have spent time at the Observatory, and those marked with an * have observed remotely with the telescope. OC grad year 1 James Chapman 1993 2 Eric Freeman 1993 3 + Michael Faison 1994 4 + Laura Francavilla 1995 5 + Jennifer Hovis 1995 6 Eric Miller 1996 7 Edward Myers 1996 8 + Bryce Denney 1997 9 + Joshua Kempner 1997 10 + Naomi McClure-Griffiths 1997 11 Ross Patty 1997 12 Karen Hole 1998 13 Matthew Schick 1999 14 + Jim Sheckard 2000 15 Miranda Balkin 2001 16 + Kate Becker 2001 17 + Joaquin Espinoza Goodman 2001 18 + Mark Kramer 2001 19 + Clait Smith 200 20 * Henry Barnor 2003 21 Collin Powell 2003 22 Aaron Webber 2003 23 + Alex Hill 2004 24 * Ilana Percher 2004 25 * Daniel Berwick 2005 26 + Natalie Hinkel 2005 27 Tyler Solomon 2005 28 + Wendeline Everett 2007 29 + Curtis Asplund 2005 30 Benjamin Sulman 2006 31 Jon Myers 2006 32 * Margaret Putney 2006 33 + Maxwell Rudolph 2006 34 + Robert Yatteau 2006 35 Daniel Hemberger 2007 36 John Matters 2007 37 Kelty Allen 2007 38 Kerry Neal 2007 39 Brandon McClintock 2007 40 Courtney Epstein 2008 41 + Everett Schlawin 2009 42 Ben Breslauer 2009 43 + Keith Spencer 2009 44 + Sydney Harris 2010				

Comment Number	First Name	Last Name	Affiliation	Comment	Category	Comment Source	Date Comment Received	Attachments
				45 * Rossina Miller 2011 46 Vladimir Ilic 2011 47 Suman Giri 2011 48 * Brendan Chambers 2011 49 James Rees 2011 50 * Jacob Baron 2011 51 Hassaan Anis 2012 52 + Chris Haddad 2012 53 + Alex Spatzier 2012 54 + Johnathan Nelson 2013 55 + Mikaela Larkin 2013 56 * Samuel Berney 2013 57 + Elizabeth Garbee 2014 58 + Kara Kundert 2014 59 + Willie Kunert 2014 60 + Jocienne Nelson 2014 61 Gregory Stevens 2015 62 + Jason Rosenblum 2016 63 * Ben Izmirli 2017 64 * Keeley Hagenbuch 2016 65 * Simon Gilbert 2017 66 Timothy Liptrot 2016 67 * Nora Rice 2016 68 * Stella Ocker 2018 69 Jacob Turner 2017 70 * Adam Jussila 2018 71 * Alex Fox 2018 72 Gabriel Lee 2018 73 Terrence Pierre Jacques 2018 74 Lele Mathis 2018				
233	Kevin	Stovall	Postdoctoral Researcher University of New Mexico	Observatory has operated as the most sensitive radio telescope in the world for the entirety of its scientific existence and remains such to this day. There is no currently oper ational radio telescope in the world, much less in the U.S., that can replace its scientific abilities. It is essential that the Arecibo Observatory continue to operate in a manner as it has for decades in order for the U.S. to remain a world leader in radio astronomy. Additionally, the Arecibo Observatory has a large impact on high school, undergraduate, and graduate students within the U.S. My own PhD dissertation not only used data from Arecibo, but also involved getting high school and undergraduate students from a minority serving area (Brownsville, TX) involved in the scientific process early in their careers. Many of these students are now pursuing degrees in STEM fields and their interest in these fields is almost certainly the result of their experience working with real scientific data from the most sensitive radio telescope in the world. The success of these students shows the great socioeconomic impact of the Arecibo Observatory. In addition to its direct contribution to science and the development of the future STEM workforce within the U.S., the Arecibo Observatory is an iconic telescope known throughout the world. It attracts thousands of visitors every year and has been featured in popular media as well as many documentaries. As a scientist, Arecibo's public prominence make it a valuabletool for discussions that I have with members of the general public, who are in awe of the largest dish in the world. Thank you for the opportunity to express my opinion on this matter. I again urge the NSF Astronomical Sciences to continue contributing to the Arecibo Observatory.	Against Closure	Email	6/23/2016	Arecibo_EIS (2).pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
234	Joe	Swiggum	Postdoctoral Research Associate Center for Gravitation, Cosmology, and Astrophysics University of Wisconsin — Milwaukee 3135 N. Maryland Ave. Milwaukee, WI 53211 (608) 215-6734 swiggumj@uwm.edu	I write to strongly urge that NSF choose to continue investment for science-focused operations at the Arecibo Observatory (option 1: no action alternative). Arecibo is the most sensitive radio telescope in the world and although the facility is over fifty years old, it has undergone two major upgrades, each of which created an essentially new, far more powerful telescope. Consequently, Arecibo remains a viable, cutting-edge scientific instrument for high-impact discoveries. I am a member of two collaborations (PALFA and NANOGrav) that rely significantly on Arecibo's unrivaled sensitivity to achieve their scientific goals and deliver high-impact results. PALFA is currently carrying out the deepest survey for pulsars in the Galactic plane and recently, discovered the first repeating Fast Radio Burst. NANOGrav, with continued use of the Arecibo radio telescope, will likely detect low-frequency gravitational waves within the next decade. The discovery of the first binary pulsar system (B1913+16) in 1974 benefited from Arecibo's sensitivity and earned its discoverers Joseph Taylor and Russel Hulse a Nobel Prize for providing a laboratory, opening up new possibilities for the study of gravitation. While Arecibo provided the first hints of the existence of gravitational waves, NANOGrav is now poised to use the telescope to directly detect them. Over the past decade, NANOGrav has involved a diverse group of hundreds of US high school and undergraduate students in Arecibo observations of pulsars and gravitational wave astronomy. The excitement of our students in personally operating Arecibo has propelled many of them into careers in physics, astronomy, engineering, and other STEM fields. As a young pulsar astronomer, I had the good fortune to attend the "Fab Five Fest," in 2011, a meeting held at Arecibo Observatory to honor five of the most influential scientists in the field (and one of the most influential telescopes!). I can attest to the fact that visiting and using the telescope has a significant impact on a young scientist's decisions to pursue STEM-related career paths. I urge you to consider these factors as you prepare the EIS for Arecibo Observatory: in addition to being a unique scientific facility, which will continue to make high-impact scientific discoveries, it serves as a model for interdisciplinary scientific and technical accomplishment — inspiration for a diverse group of students, our next generation of scientists.	Against Closure	Email	6/23/2016	
235	Andrea	Tellez	Research Assistant B.S. in Physics UTRGV	My name is Andrea Tellez and I am part of the Arecibo Remote Command Center (ARCC) at the University of Texas at Rio Grande Valley (UTRGV) in Brownsville, Texas. Arriving at this country [USA] four years ago, this program opened me the doors to education and to understand the mysteries of the universe. My first encounter with astronomy in my college education was with these fascinating rotating neutron stars called pulsars. I fell in love instantly with these celestial bodies. My passion was increasing by the day and with it, my thirst to observe more pulsars. Having the opportunity to detect these stars with the Arecibo Radio Telescope was like a dream come true. I have been part of this center for more than four years. I have monitored and directed many observations with the telescope at all hours. From a weekday in the afternoon to a Sunday at midnight. Arecibo is an essential part of my life, as well as, for all the students who are part of ARCC. It is my greatest desire continue to keep up this magnificent telescope that takes us to the depths of the beautiful universe.	Against Closure	Email	6/23/2016	6232016ARCC.pdf
236	Bárbara	Trejo Ortega		My name is Bárbara Trejo and the nature of this letter is to serve as a public comment in response to the Arecibo Observatory Review Process that is underway. The Arecibo Observatory made a lasting impression on my education in Puerto Rico, and I wish to express my strongest recommendation against detrimental changes to the Observatory's operations. I spent most of my childhood and adolescence in Arecibo's neighboring city, Hatillo. Since the age of five, I studied at the Colegio Nuestra Señora del Carmen, in Hatillo, and had the great fortune to share an educational upbringing with several classmates whose parents worked in the Arecibo Observatory. Visits to the Observatory, with classmates and my own family, were not uncommon, to the extent that being exposed to such amazing scientific breakthrough became a strong motivator for me to pursue studies in the sciences in the United States. I also fondly remember the many times that Observatory scientists were guest speakers at my school. Their impact goes beyond the content of the lectures they gave. They made science accessible to someone like me, who had grown up in a small town in Puerto Rico. The motivation to become a great scientist, very much like the ones I had the chance to interact with, led to my completing a Bachelor's degree in Stem Cell and Regenerative Biology at Harvard University in 2014. I strongly believe that, the presence of the Arecibo Observatory can motivate other students to pursue science as well. As a Latina woman, I cannot emphasize the importance of incentives like this one in environments that may otherwise lack incentivizing resources. As such, I hope that my experience helps shed some light on the socioeconomic impact of any decision regarding the Arecibo Observatory. It is my strongest wish that the initiative that has been a source of motivation and pride for me and for Puerto Rico, continues to have the resources it needs to thrive.	Against Closure	Email	6/23/2016	NSF Letter-Arecibo Observatory 06-22-2016.pdf

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
237	Parker W.	Troischt	Associate Professor Hartwick College	I write to strongly urge that NSF choose alternative 1 of its "Notice of Intent to Prepare an EIS . . . ", namely "Continued NSF investment for science-focused operations (No-Action Alternative)." The National Astronomy and Ionosphere Center (NAIC) at Arecibo is an amazing teaching/science facility, which is not only used for astronomy, but is also used to monitor aspects of climate change through studies of the ionosphere and used to monitor the trajectories of near Earth asteroids with radar (which may threaten life on Earth itself). Its flexibility, combined with the sheer size of the 305m dish, make the this a powerful, unique and versatile scientific instrument. I have personally had over a dozen students directly benefit from the observatory, the research being done there, and the willingness of staff members to assist and instruct them. The NAIC is a tremendous research and teaching tool, and the largest radio dish in the world (~26 football fields in collecting area). It has minimal upkeep cost compared to the cost of re-constructing a similar facility (as China is investing in) or just about any the space based missions. The cost of dismantling it and returning the area to pre-observatory conditions is prohibitively expensive and incredibly difficult to do, so it seems financially unwise to begin this process. More than likely, the cost would increase significantly after the dismantling process has begun. The impact of stopping operations at Arecibo on science education and science collaborations throughout the United States would likely be severe, to say nothing of the repercussions on the education, financial status, and overall well being of the island of Puerto Rico. I have traveled regularly to Arecibo Observatory since 2008, and I typically bring students with me for research and educational purposes. While there, we work with students and faculty from several colleges and universities (George Mason University, Colgate University, Cornell University, Siena College, Skidmore College, Union College, University of Wisconsin- Madison, Saint Mary's College of California, Macalester College, Lafayette College, Georgia State University, University of Puerto Rico and others) as well as NAIC staff members. The observatory is profoundly inspiring for all users and especially the undergraduate students. All 6 of my summer research student alumni have gone on to receive awards and entrance into strong STEM based graduate programs. These students have gone on to many different areas of science including: nanotechnology, medical research, neuroscience and engineering. I am part of a large research collaborative team (The Undergraduate ALFALFA Team - UAT) and similar success has occurred at the other schools as well. Typically about 80% of the ALFALFA team alumni go on to attend STEM graduate programs or to work in STEM based companies. (For more information about the UAT and impact on undergraduate alumni, please see the Council of Undergraduate Research Summer Quarterly 2016). There is nothing is quite like the direct experience of working at a major observatory to prepare our science majors. This is especially true in light of the fact that the United States is currently falling behind (over twenty other countries) in STEM based education. There is no substitute for this type of meaningful research experience for undergraduate college students. These types of immersive, hands-on experiences have been recently touted as a "high impact" practices in a wide array of education literature, indicating they are one of the most important ways to prepare US students for careers in all sorts of STEM fields. Lastly, I'd like to emphasize that without the Arecibo Observatory, I have no doubt that all my physics majors at Hartwick would not have been able to participate in any type of high-impact research experience here at all. My Arecibo-based collaborative research has been the only option for students to be immersed in a summer research experience at my institution for over a decade. These experiences have propelled them in their careers to earn awards, acceptance into strong STEM graduate programs, and on to promising jobs in STEM disciplines. Please consider the severe negative impact on astronomy/STEM education without Arecibo. Thank you.	Against Closure	Email	6/23/2016	areciboimpactletter edit.pdf
238	Ron	Verback		Title: Probing asteroid complexity using infrared and radar observations PI: Ronald J. Vervack, Jr. (JHU/APL), Co-Is: Ellen Howell and Mike Nolan (U. Arizona), Yanga Fernández (UCF), and Christopher Magri (U. Maine-Farmington) Near-Earth asteroids (NEAs) represent a wealth of scientific information for understanding the origin of the Earth and connections to meteorites, as well as accurately assessing the impact hazard to the Earth. Our program is one of the first systematic studies of NEAs that combines realistic shape models derived from Arecibo radar observations, thermal infrared measurements over multiple viewing geometries, and a thermophysical model to investigate asteroid properties in detail. The radar-derived shape models are a critical element of this project because they allow the effects of shape to be accurately accounted for, thus allowing us to focus on other physical effects contributing to the observed thermal flux from the asteroids. With Arecibo, we can measure the shapes of tens of asteroids each year; only spacecraft missions can provide more detailed shapes, but they do so at a significantly higher cost and for just a few asteroids. Understanding the NEAs for which we have radar-derived shapes is not just important for the inherent scientific gain but it provides valuable context for the large telescopic surveys such as NEOWISE that measure the vast majority of asteroid properties. Our work thus sheds valuable light on just what the surveys can tell us about those asteroids. Without Arecibo Observatory, this ongoing project would not be possible.	Against Closure	Email	6/23/2016	

Comment Number	First Name	Last Name	Affilation	Comment	Category	Comment Source	Date Comment Received	Attachments
239	Dan	Werthimer	Principal Investigator, SETI@home Chief Scientist, Berkeley SETI Program Director, Center for Astronomy Signal Processing and Electronics Research Associate Director, Berkeley Wireless Research Center	I'm writing to provide you with an example of how Arecibo Observatory engages the public and school children, and also an example of how Arecibo continues to make important scientific discoveries. Arecibo Observatory is engaging the public and school children in a global science project. 95% of data for the SETI@home project comes from the Arecibo Observatory. SETI@home has built a following of nine million users in 226 countries, including about 200,000 children, who have volunteered their PCs and cell phones for scientific research. Thousands of K12 teachers are using SETI@home to get kids interested in astronomy, physics, biology and chemistry as they explore the question "Are we alone?". SETI@home is part of the Great Explorations and Math (GEMS) science curriculum developed by and the Lawrence Hall of Science, used in classrooms around the planet. Arecibo observatory continues to make astonishing discoveries about our universe, even just a few months ago: Fast Radio Bursts are one of astronomy's big mysteries. Astronomers don't understand what causes these incredibly powerful radio bursts that last only about 1/1000 of a second. There has been considerable speculation and theories – could the bursts be from cosmic strings? Evaporating primordial black holes? Some have even proposed these could be signals from ET. In March this year, using Arecibo, astronomer Laura Spitler announced the discovery of the first fast radio burst that repeats (Nature, March 2016). This Arecibo based discovery has ruled out most classes of the fast radio burst theories, and will soon enable astronomers to pinpoint the precise location of Arecibo's repeating fast radio burst and finally figure out what is causing these mysterious explosions.	Against Closure	Email	6/23/2016	arecibo_environmental_impact_letter_from_dan_werthimer.pdf
240	Armando	Caussade	President, editor-in-chief and founding member	This statement is to express our position on the proposed changes to Arecibo Observatory operations. We are issuing this as a response to an announcement by the National Science Foundation (NSF) posted on May 23, 2016 at http://federalregister.gov/a/2016-12036. Through this announcement the NSF has requested community responses for a Environmental Impact Statement (EIS) that will be drafted regarding changes to operations at the Arecibo Observatory. The specific area of concern to the Puerto Rico Astronomy Society (PRAS) is the detrimental effect that the proposed changes at the observatory might have on STEM education in the island. We contend that any change in Arecibo has to take into account its contributions to society, as the observatory provides informal STEM education for 100,000 visitors per year. Considering that the Arecibo Observatory is currently the only large-scale facility devoted to scientific research in the island, it is astonishing that anyone would even consider cutting funding. Historically Puerto Ricans have been an underserved population in STEM disciplines, and a reduction of research operations at the observatory has the potential to obliterate any semblance of research (or by extension, education) on STEM fields in Puerto Rico. Additionally—and as we publicly stated exactly ten years ago—the Arecibo Observatory adds significant value to our educational efforts. Through our visits to Arecibo, PRAS members are able to stay current with contemporary astronomical research, and changes at the observatory would significantly hamper our chances of interaction with professional scientists. While we ignore the exact details involved (or the specific reasons or policy behind) we strongly plea that Arecibo continue to enjoy NSF investment for science-focused operations. Decisions in this matter should not be taken from a purely economic point of view, but should also consider the social implications for STEM education in the Puerto Rican society as a whole.	Against Closure	Email	6/23/2016	arecibo_observatory.pdf

5-E List of Research Papers Associated with Arecibo Observatory

List of Research Papers

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