APPLICATION FOR TRANSPORTATION AND UTILITY SYSTEMS AND FACILITIES ON FEDERAL LANDS *(continuation sheets)*

7. Project Description: (See Concept Paper at Attachment 1)

(a) Type of system or facility: ***Celestial/atmospheric observatory.*** Pikes Peak Observatory (PPO) consists of an 18' diameter pre-fabricated clamshell observatory dome (shown in Figure 1), several astronomical telescopes, associated weather/atmospheric monitoring instrumentation, and signage. The dome will be manufactured in a color compatible with the natural terrain on the summit. PPO will be surrounded by a walkway to permit interaction with the public. The observatory will be operated for STEM education and research by students and the general public.

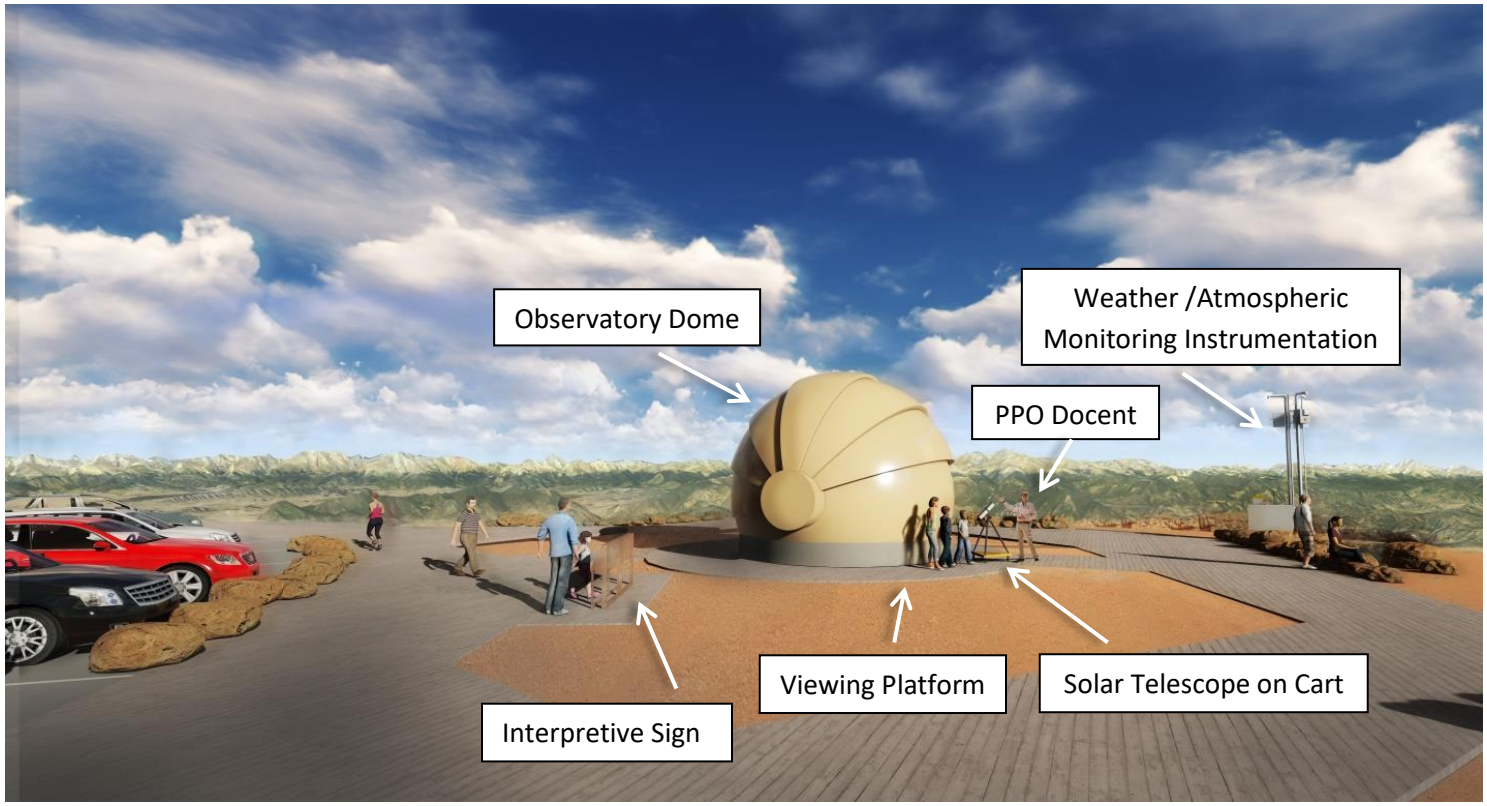


Figure 1: Architect Rendering of Pikes Peak Observatory (closed dome)

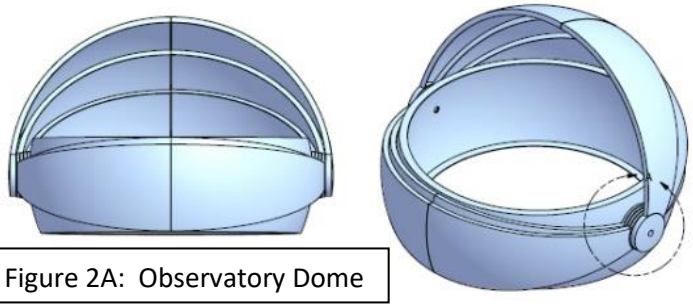


Figure 2A: Observatory Dome

The observatory dome is a 5-shutter clam-shell design (Figure 2) built by AstroHaven Enterprises to support both direct public viewing and remote operation. The non-rotating fiberglass clam-shell can be operated partially open for environmental protection during remote operation or fully open during regular Summit House operating hours to maximize visitor visibility. AstroHaven observatory domes are deployed worldwide in the harshest environments by universities, researchers and scientific organizations for use by astronomers, educational, non-profit, commercial and government institutions. The dome is constructed using state-of-the-art closed mold vacuum infusion so it is light, strong, and ecologically friendly, while capable of withstanding 200 mph winds. Computer Aided Design and Computer Aided Manufacturing provide aerospace precision. Attachment 4, p. 25 provides additional details on the dome.

Figure 2B: Configuration for Remote Operation

Figure 3: PW-1000 1-meter Telescope

A PlaneWave Instruments PW1000 1-meter Observatory System (Figure 3) is the centerpiece of the observatory. It is a fully automated telescope system which combines PlaneWave's revolutionary Corrected Dall-Kirkham (CDK) optical system with its innovative Alt-Az direct-drive mount technology. The PW-1000 is an open-truss telescope capable of fast-track operation which allows it to track asteroids, man-made satellites and the International Space Station, as well as more traditional celestial objects. With a diffraction-limited 100mm image circle, the PW1000 excels at imaging on the largest format CCD cameras available today. Light-weighted optics are made of zero expansion fused silica materials for excellent thermal stability and maximum throughput. The dual Nasmyth ports allow two instruments to be installed simultaneously, and a computer-controlled M3 mirror allows either instrument to be remotely selected in seconds. With direct drive motors on each axis for smooth telescope movement, high resolution absolute encoders on each axis for precise positioning, zero backlash and no periodic error, the PW1000 sets a new standard in 1-meter telescopes. Attachment 4, pp. 22-23 provides information on this telescope.

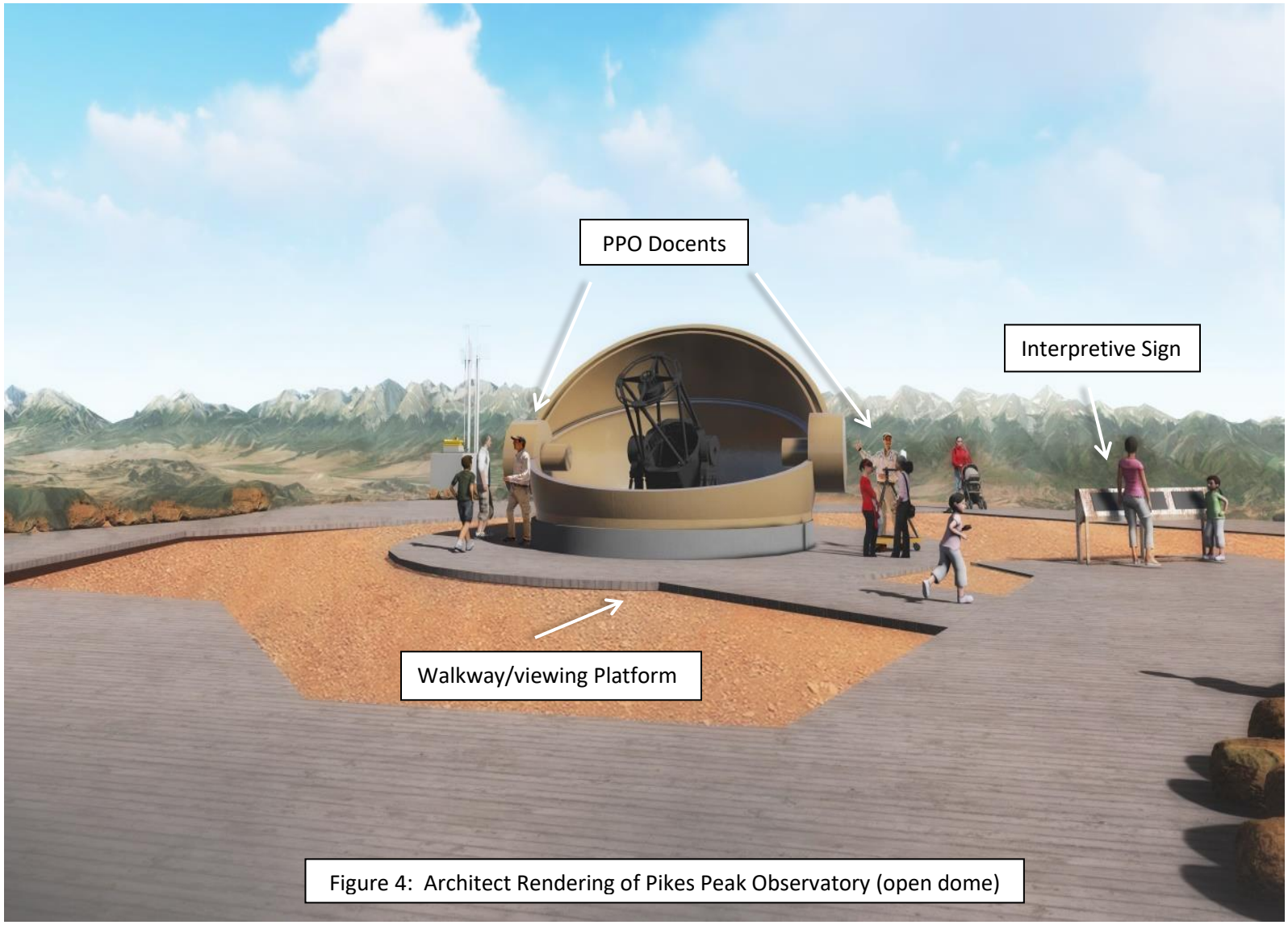


Figure 4: Architect Rendering of Pikes Peak Observatory (open dome)

(b) Related Structures and Facilities: ***Weather instrumentation/atmospheric monitoring equipment, walkway/viewing platform, solar telescopes, interpretive sign.*** Architect renderings (Figures 1 and 4) depict the observatory, key components, and its related structures.

Weather instrumentation includes sensors for data measurements such as temperature, relative humidity, precipitation, barometric pressure, and wind speed, plus data recording instrumentation.

Atmospheric monitoring necessary to support observatory operation includes the All-Sky Infrared & Visual Analyzer (ASIVA) by Solmirus Corporation (Figure 5). The ASIVA is a ground based cloud detection and sky analysis system with applications ranging from astronomy, to solar forecasting, to a variety of meteorological applications. This equipment is a critical component of PPO, providing data essential to support remote observatory operation and atmospheric/solar research.

A**vailable data analysis capabilities include:**

- Cloud/no cloud reporting; cloud cover and height determination
- Photometric quality assessment
- Sky opacity/transmission determination
- Visible/IR image correlation and integration
- Water vapor and ozone determination
- Sky/cloud temperature (brightness and color) measurements
- All sky (180 degree field-of-view) radiometric maps and analysis

Technical Specifications:

- Weight: base unit ~250lbs (configuration dependent)
- Peltier heating/cooling subsystem
- Weatherproof stainless steel and aluminum construction
- Dimensions: 33”W x 24”D x 42”H
- Power: 120/230V
- On board data analysis and image processing
- Web-based User Interface

Figure 5: ASIVA Instrument

Attachment 2 provides more information on the ASIVA equipment.

Walkway/Viewing Platform: RTA Architects has designed and GE Johnson Construction will build a walkway and viewing platform surrounding the observatory as shown in architect renderings (Figures 1 and 4 above), using the same materials that are to be used for the public pathways on the Pikes Peak Summit and at the West Overlook.

Figure 6: 6” H-alpha Telescope

Figure 7: 4” H-alpha Telescope

Hydrogen-alpha Solar Telescopes: A 6” (152 mm) Lunt H-alpha solar telescope (Figure 6) will be mounted on the PlaneWave 1-meter telescope for solar observations. Images seen by the telescope will be displayed on a flat screen at the observatory and on a display within the Summit House for viewing by visitors to the summit. The Lunt LS152THa is currently the largest LUNT solar telescope available, designed to balance resolution and performance. The 100% unobstructed system will perform to the highest level at both low and high magnifications. Utilizing both advanced high-contrast coatings, and the new Doppler True Pressure Tuning system, users will be able to experience crisp, sharp, high magnification visual images, as well as utilize this system for high end digital processes. True Doppler Tuning allows for a shift into and away from the user, adding a 3D-like component to the viewing experience. While it has minimal effect on prominences due to their location at the edge of the disk, it does have an effect on filaments and active regions on the surface. While looking at a filament at the center of the Sun, the user has the ability to Doppler shift from the base of the filament to the tip, following the filament through its structure toward and away from users, allowing for enhanced visual and imaging capability for the observer as well as a research tool. The pressure tuning system provides an order of magnitude more precision to the tuning of the desired features. This system has an optional, interchangeable, CaK module allowing for the research of multiple wave lengths through the same platform. It weighs 30 pounds. In addition to the 6” solar telescope, two 4” (100 mm) Lunt Hydrogen-alpha solar telescopes (Figure 7) will be kept at the observatory on carts for use by docents interacting with the public. Attachment 3 provides more information on the Lunt H-alpha telescopes.

Interpretive Sign: An interpretive sign will be placed at the West Overlook, as shown in Figure 4. The sign will be designed by RTA Architects consistent with US Forest Service guidelines and with the other interpretive signs at Summit Complex overlooks.

(c) Physical Specifications *(Length, width, grading, etc.)*: *The 18' diameter Observatory occupies 250 sq. ft., surrounded by a 650 sq. ft. viewing platform, plus two additional walkways. Inside, a 42" diameter pad for a telescope mount is independent of the floor of the observatory to isolate the telescope from vibration. The unheated observatory is located on level grade on previously disturbed surface.* Being an unheated structure will allow PPO telescopes to remain at ambient temperature. The maximum height of the telescope when it is vertical is 130” (10’ 10”); the maximum operating radius of the telescope is 135” (11’ 3”). The height of the top of the observatory dome (when it is closed) is 16’ above ground level, the same height as the weather instrumentation tower. Weather station and atmospheric sensors are mounted on the tower. Instrumentation is contained in a 4’x4’x4’ enclosure at the tower’s base. Figure 8 shows observatory dimensions.

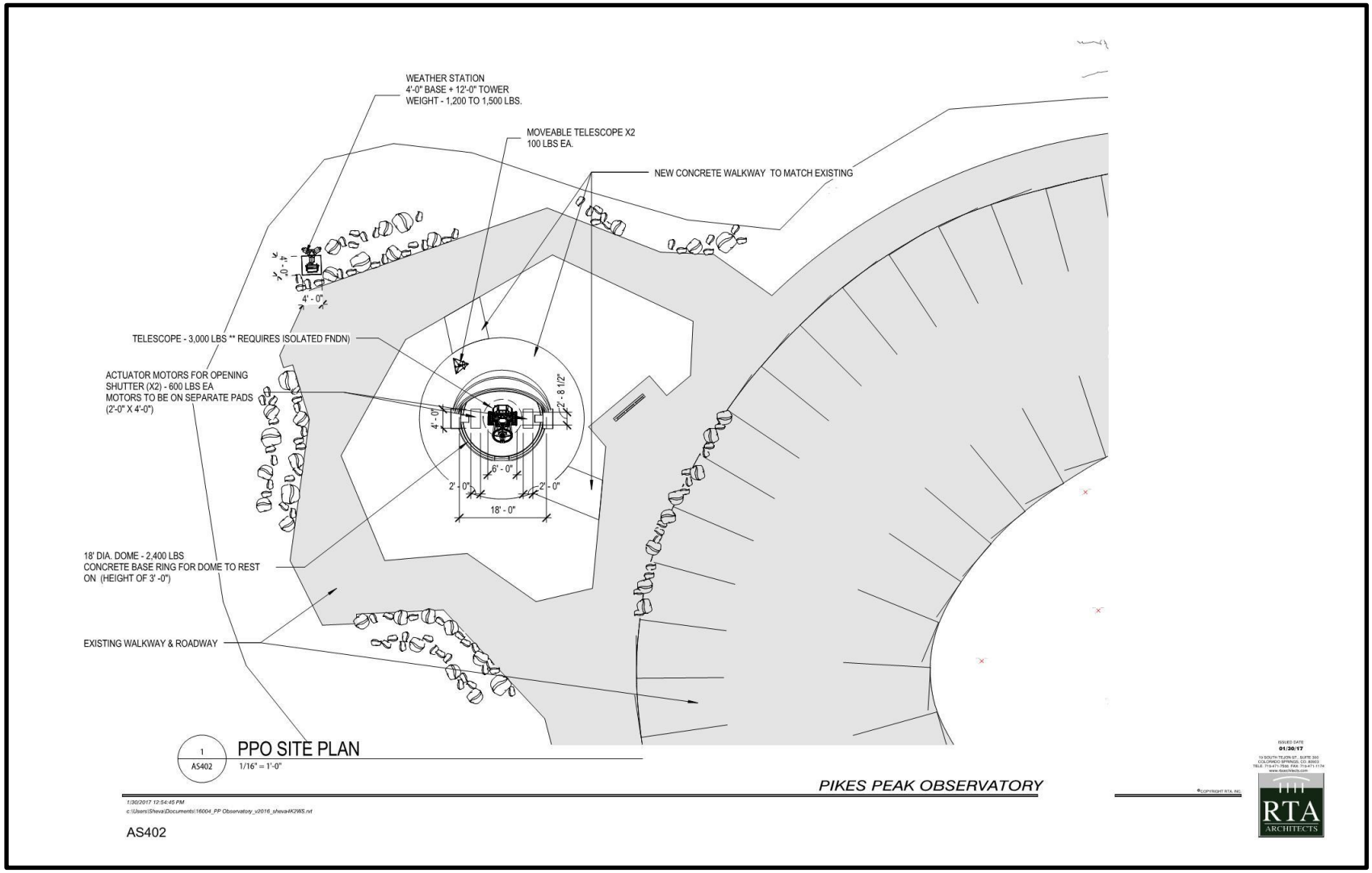


Figure 8: Dimensions and Weights of Observatory Components

(d) Term of Years Needed: ***30.***

(e) Time of Year of Use or Operation: ***The observatory will be visited by summit guests during the tourist season/whenever the Summit House is open; the observatory and telescopes will be operated remotely year-round.***

(f) Volume or amount of product to be transported: ***Components of the observatory will be transported to the summit of Pikes Peak only during the construction phase. Scientist educators (docents) will travel to the summit during the operations phase to interact with and educate summit visitors.*** Observatory components include an off-the-shelf observatory dome (to be assembled after delivery), telescopes, weather station equipment, atmospheric monitoring instrumentation, electro-mechanical components for computer-driven operation of the observatory dome and positioning of the telescopes, cameras for recording images viewed by the telescopes, computers, and flat-screen displays. Construction materials include concrete for the pad used for anchoring the telescope and for the floor of the observatory and materials for the walkway/viewing platform the same as those used for walkways installed as part of the new Summit Complex. After construction is complete, scientist educators (astronomers trained as docents) will travel to the observatory daily when the Summit House is open to interact with the public, provide informal STEM education relating to space and atmospheric sciences, explain how the telescopes and scientific instrumentation work, allow visitors to look through a solar telescope, and describe how data collected benefits mankind. If the city operates a shuttle to the Summit, observatory docents will use the shuttle for transportation; otherwise, they carpool, so that a single parking spot is required at the summit. Travel to the Summit at other times will be via the Pikes Peak Highway in response to equipment failures/issues requiring maintenance, component adjustment or replacement to preserve safe and effective observatory operation.

(g) Duration and Timing of Construction: ***Construction will commence and be completed during the summer of 2021 after demolition of the existing U.S. Army High Altitude Research Laboratory (HARL) facility.*** The City of Colorado Springs and the U.S. Army Corps of Engineers plan to complete construction of the new Summit House and High Altitude Research Laboratory during the summer of 2020. Beginning in June 2021, the original HARL will be demolished and the West Overlook built on this disturbed site, incorporating the Pikes Peak Observatory as depicted in the photos and schematics included in this application. Construction will be completed by the end of October 2021.

(h) Temporary Work Areas Needed for Construction: ***Work area needed for construction will be disturbed surface on the site on which HARL stands prior to demolition and/or other work areas used by GE Johnson Construction Company for the completion of the new Summit Complex.*** Figure 9 depicts the West Overlook area of the summit of Pikes Peak, and the footprint of the 2017 HARL facility location.

8. Map covering area showing location of proposed project: Figure 10 is a photograph of the summit of Pikes Peak, showing the present location of the HARL. This location will become the West Overlook of the Pikes Peak Summit Complex, as shown in Figure 11. Figure 12 is a schematic of the proposed Pikes Peak Summit Complex, showing the location of Pikes Peak Observatory as part of the West Overlook. Figure 13 depicts the Pikes Peak Observatory in the context of the overall Summit Complex design to be implemented prior to observatory construction.

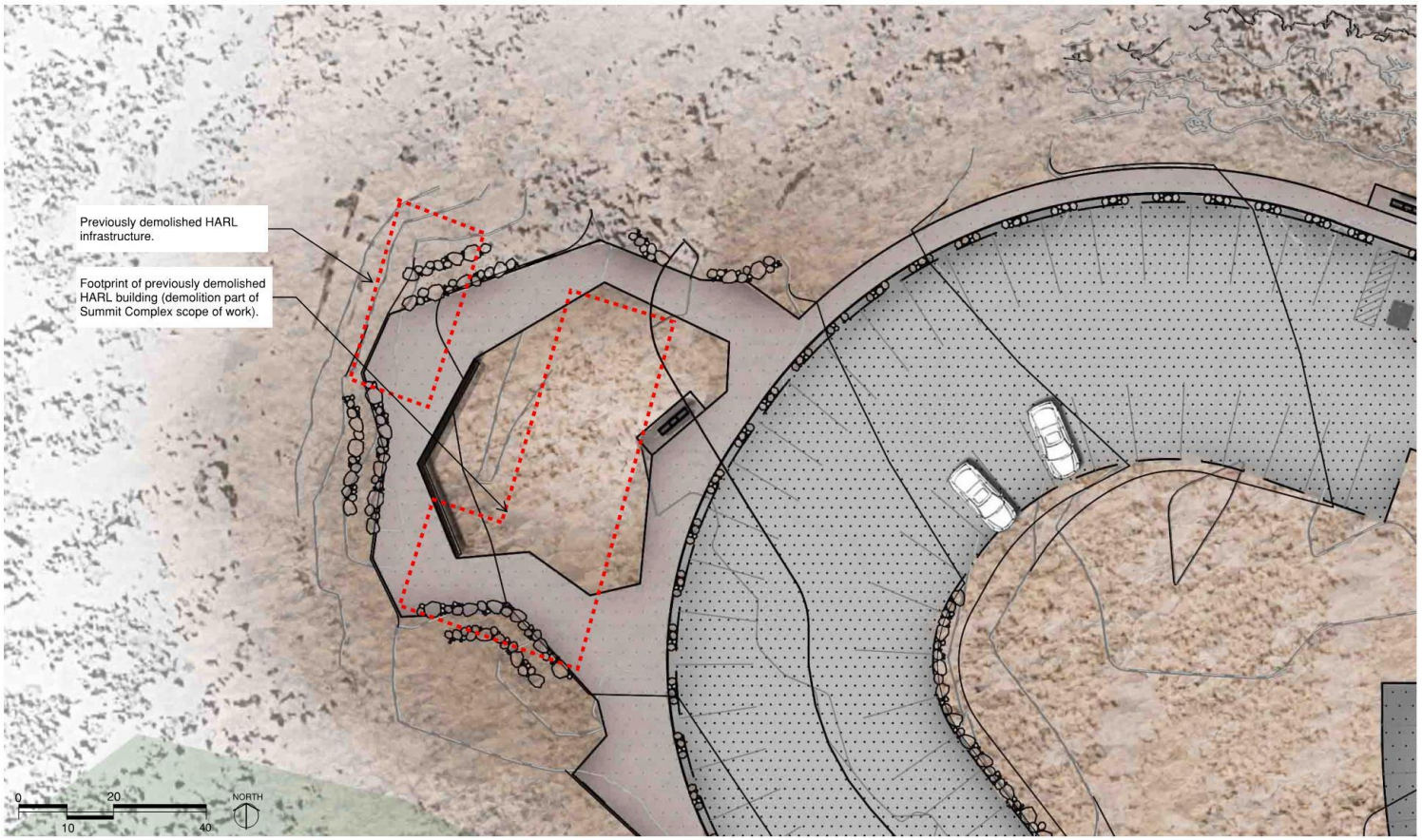


Figure 9: West Overlook, showing the footprint of the HARL, which is to be removed. This will be the primary work area for the observatory.

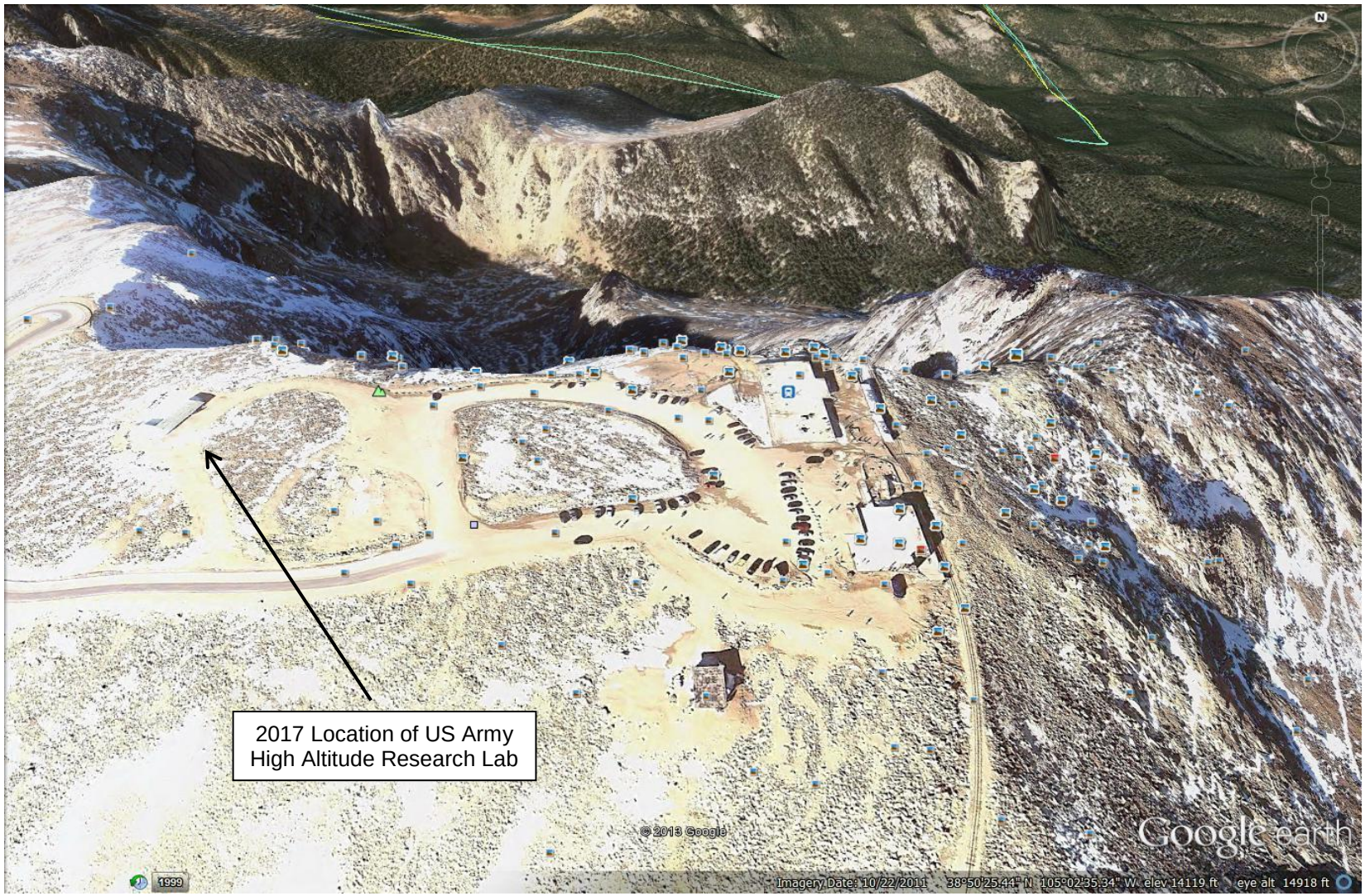


Figure 10: Photograph of Pikes Peak Summit showing location of HARL Structure

Figure 11: Pikes Peak Observatory will be integrated into the design of the West Overlook of the Pikes Peak Summit Complex

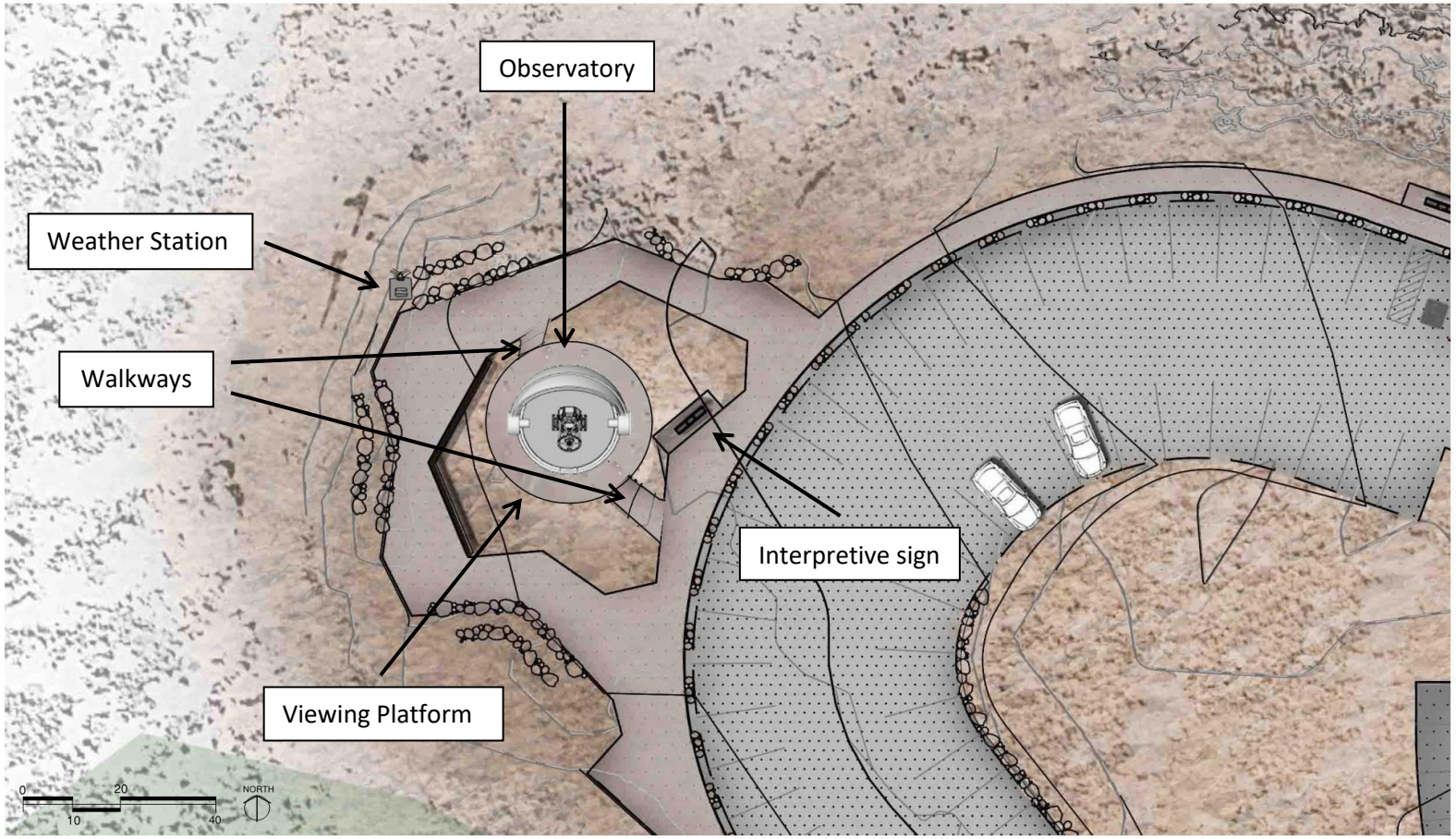


Figure 12: West Overlook showing proposed placement of the Pikes Peak Observatory, viewing platform, walkways, weather station, and interpretive sign.

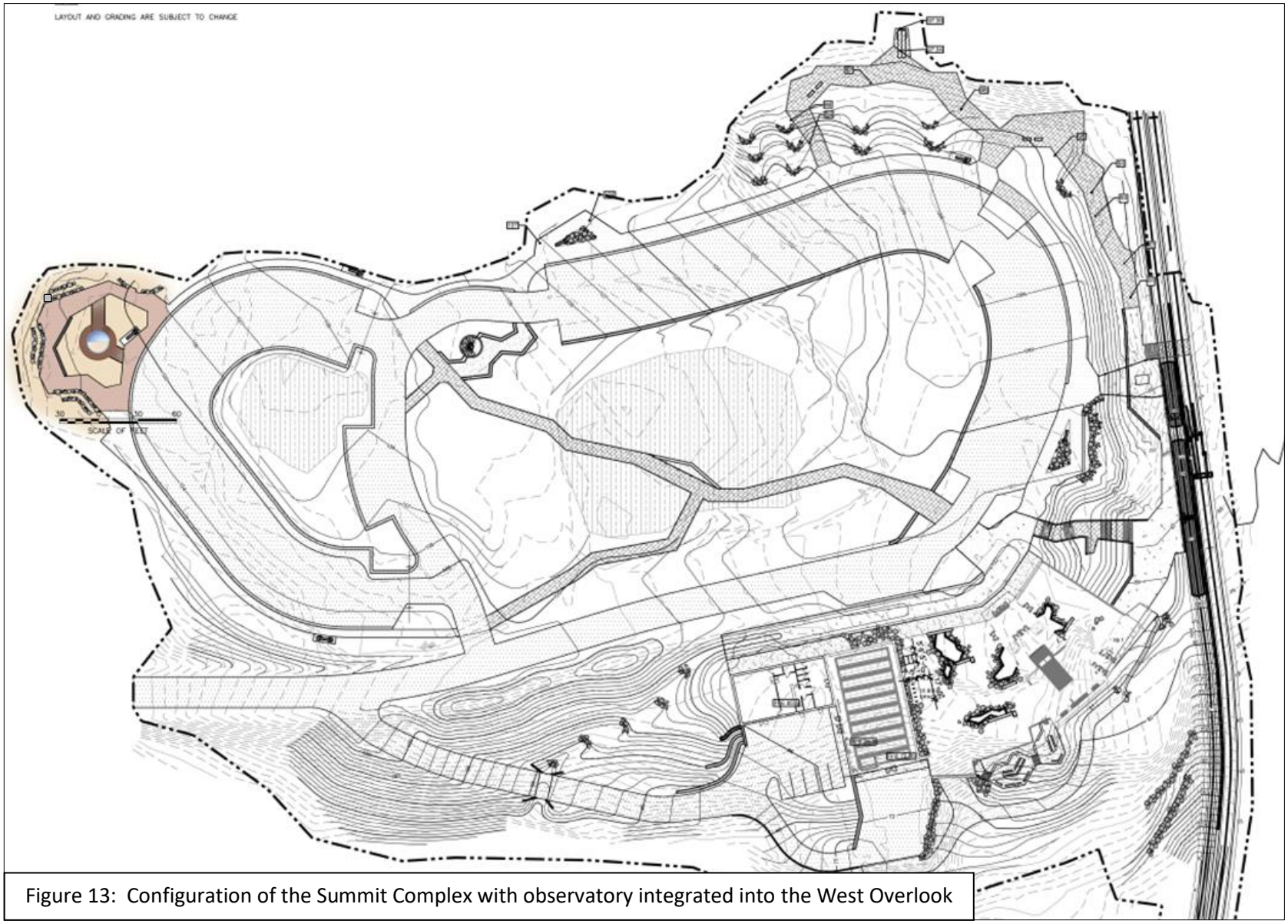


Figure 13: Configuration of the Summit Complex with observatory integrated into the West Overlook

9. State or Local government approval: ***Not required.*** Local government approval is limited to building permits. GE Johnson Construction Company will obtain necessary building permits for construction. While local government approval of Pikes Peak Observatory is not needed, the City of Colorado Springs has annually endorsed this concept since 2015. State approval is not required. Because Pikes Peak Observatory is a STEM initiative and education is a state responsibility, informational presentations will be offered to the Governor's office and state legislatures.

10. Nonreturnable application fee: ***Not required.***

11. Does project cross international boundaries or affect international waterways? ***No.***

12. Technical and Financial Capability to Construct, Operate, Maintain, and Terminate Pikes Peak Observatory: ***Pikes Peak Observatory, Inc. and its partners/collaborators have the education, technical experience and access to the financial resources necessary to oversee observatory construction, outfitting [with an optical telescope, two H-alpha solar telescopes, a weather station and All-Sky Infrared & Visual Analyzer (ASIVA)], operation, maintenance and termination. PlaneWave Instruments (which produces optical telescopes), Lunt Solar Systems (which produces H-alpha solar telescopes), AstroHaven Enterprises (which manufactures observatory domes) and Solmirus Corporation (which manufactures the ASIVA) will provide operating and maintenance instructions and technical assistance as necessary. RTA Architects, who assisted with the evaluation of sites on the summit and provided architectural renderings, will provide design support for construction. GE Johnson Construction, who developed construction estimates, will be contracted for construction. The Benefactor Group, who is supporting the City of Colorado Springs with fund-raising support for the Summit Complex, has been contacted about supporting NSSTI with a capital campaign.***

a. Technical Capability:

(1) **Observatory Construction**: The National Space Science & Technology Institute (NSSTI) will engage GE Johnson Construction to accomplish observatory construction and outfitting with 1-meter optical telescope, 152mm and 100mm H-alpha solar telescopes, a weather station and All-sky Infrared & Visual Analyzer (ASIVA). PlaneWave Instruments (which manufactures optical telescopes), Lunt Solar Systems (which manufactures H-alpha solar telescopes), AstroHaven Enterprises (which manufactures observatory domes) and Solmirus Corporation (which manufactures the ASIVA) will provide construction support and technical assistance as necessary. RTA Architects, who assisted with the evaluation of sites on the summit and provided architectural renderings, will provide design support for construction. GE Johnson Construction, who developed construction estimates, will be contracted for construction.

(2) **Observatory Operation**: The National Space Science & Technology Institute (NSSTI) will oversee operation and maintenance of the observatory, in collaboration with equipment manufacturers and local organizations wanting to be a part of Pikes Peak Observatory. The National Space Science & Technology Institute is affiliated with the Colorado Consortium of Earth & Space Science Education (CCESSE) which operates the Challenger Learning Center of Colorado and with COOL SCIENCE, which runs the Colorado Springs Cool Science Festival. Members

of the NSSTI Board of Directors and Board of Advisors include the CEO of the Challenger Learning Center; Professors of the Physics Departments of the Colorado College and the United States Air Force Academy; a Staff Scientist with background from the High Altitude Observatory of the National Center of Atmospheric Research; a Research Scientist from BSCS (a science curriculum study, conducting STEM education research); Professor emeritus of Meteorology from Pikes Peak Community College; Planetarium Director emeritus from the Air Force Academy; and the co-founder of Solmirus Corporation whose background includes developing atmospheric measuring instrumentation (the ASIVA). NSSTI is coordinating with the City of Colorado Springs (which will oversee the operation of the new Summit House and Pikes Peak Highway), the Executive Director of the Colorado Commission of Indian Affairs (helping NSSTI connect with Ute and other Native American Tribes with a connection to Pikes Peak); and the non-profit Advocates for Pikes Peak Summit House (collaborating with the City of Colorado Springs to ensure community values and needs are adequately considered and advising on communications and fund-raising). NSSTI Board members are affiliated with the Colorado Springs Astronomical Society (which has offered to provide docents) and the American Astronomical Society. We will coordinate with the Broadmoor Pikes Peak Cog Railway (which has its own weather station), the U.S. Army (which operates the High Altitude Research Laboratory), the El Paso County Board of County Commissioners, and local organizations involved with operating/maintaining hiking trails to the summit. Scientist-educators on the NSSTI Board of Directors and Board of Advisors will compile vendor operating and maintenance procedures and develop curriculum resources for volunteer docents who will provide informal S.T.E.M. education to observatory visitors.

(a) **Observatory Dome**: AstroHaven Enterprises (which manufactures observatory domes) will provide an 18' diameter observatory dome (Figure 2) capable of remote operation. (See descriptive information on the observatory dome at Attachment 2.) This dome is equipped with wind sensors and motors to detect when wind speeds are reaching the limits for effective observing to automatically close the dome. The clamshell design of the dome will allow the dome to be collapsed during the day when docents are speaking with guests to permit unobstructed viewing from any direction. The dome is oriented toward the south for optimal viewing of the sun with solar telescopes during the daytime, and is permanently affixed (the dome does not rotate.) AstroHaven will provide technical support during installation, operation and maintenance of the dome, and provide resources necessary to train NSSTI staff and volunteers in the proper operation and maintenance of the dome. The 18' observatory dome is designed to withstand winds of 200 mph, exceeding the 195 mph standard set for the Summit Complex.

Figure 4 depicts Pikes Peak Observatory with the dome partially open, allowing visitors to observe the 1-meter telescope, while other guests look at images seen by the 152 mm solar telescope mounted on the primary telescope, and view the sun directly through a 100 mm telescope mounted on a cart. The solar telescope can be used by docents to provide informal education to guests during hours the Summit House is open, and then rolled into the observatory to be secured during times when the Summit House is closed to the public.

(b) **1-Meter Optical Telescope**: PlaneWave Instruments (which manufactures observatory telescopes) will provide a research-grade open truss 1-meter high altitude observatory telescope and mount (Figure 3), which can be operated manually or remotely to observe objects in the visible and near-infrared spectra. The mount is capable of being operated in a fast track mode to observe earth satellites,

asteroids, and the International Space Station. Cameras affixed to a second eye-piece of the telescope will allow images of what the telescope is observing to be captured and displayed on flat screens at the observatory and in the Summit House. PlaneWave Instruments will provide technical support during installation, operation and maintenance of the 1-meter telescope, providing resources needed to train NSSTI staff and volunteers in the proper telescope operation and maintenance.

(c) **H-alpha Solar Telescopes**: Lunt Solar Systems (which manufactures H-alpha solar telescopes) will provide solar telescopes to be mounted on the primary telescope assembly (Figure 6) and on movable carts (Figure 7). Lunt Solar Systems will provide technical support during installation, operation and maintenance of the solar telescopes, providing resources needed to train NSSTI staff and volunteers in the proper telescope operation and maintenance.

(d) **All Sky Infrared & Visual Analyzer**: Solmirus Corporation (which manufactures atmospheric monitoring devices and scientific instrumentation) will provide an All-Sky Infrared & Visual Analyzer (Figure 5) to support observatory operations by examining cloud cover so its impact on seeing conditions can be accurately assessed, as well as collecting other atmospheric measurements to support educational and research users.

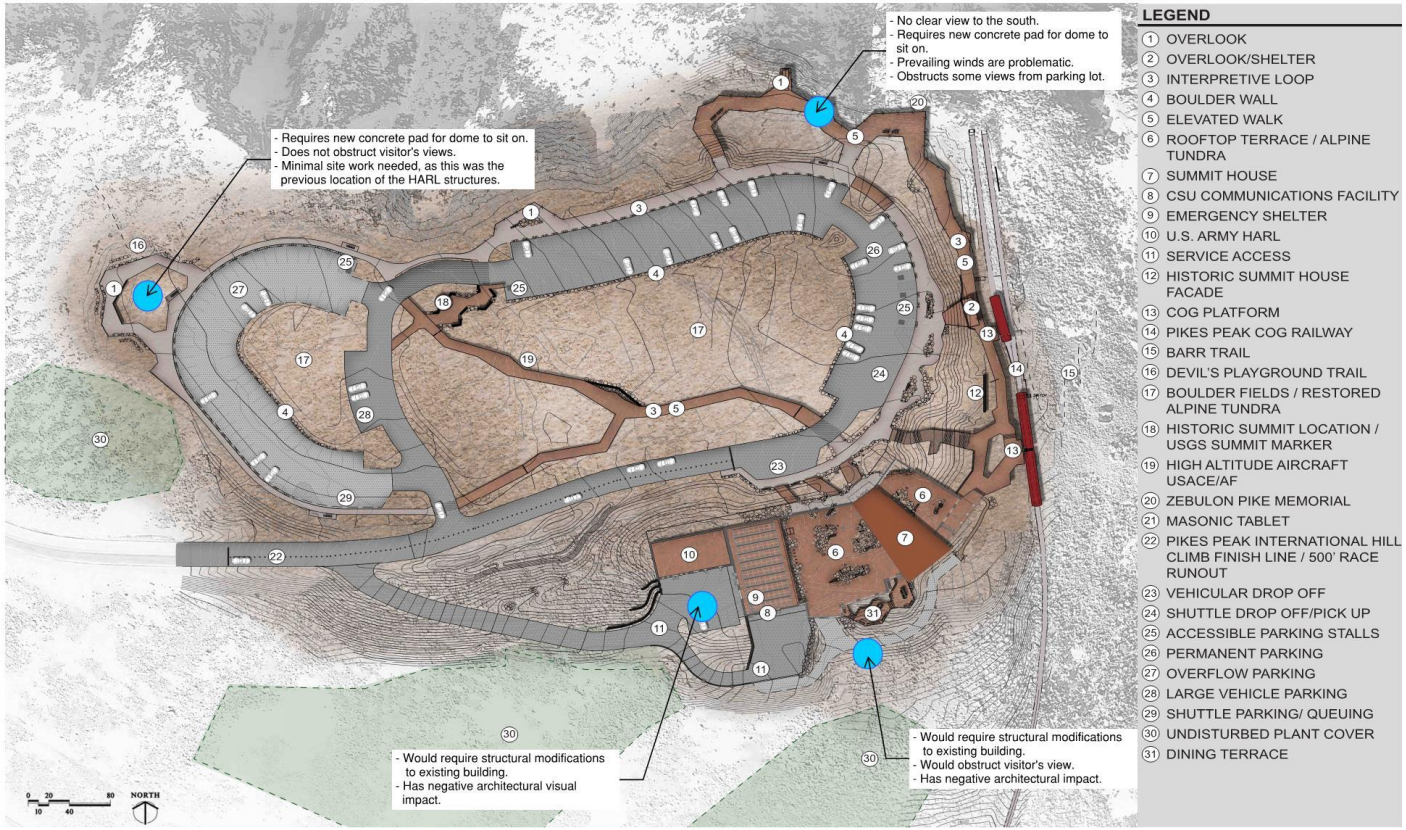
(e) **Weather Station**: NSSTI will arrange for ongoing operation, maintenance and support of the weather station and atmospheric monitoring instrumentation, coordinating with those currently collecting weather data to avoid unnecessary duplication of effort.

(3) **Observatory Maintenance**: NSSTI will arrange for ongoing operation, maintenance and support of the observatory dome and all observatory components.

(4) **Observatory Termination**: NSSTI will coordinate termination of Pikes Peak Observatory should it become necessary during or at the end of the thirty-year period of operation in the event the use permit is non-renewed by the US Forest Service.

b**. Financial Capability**: NSSTI will work with The Benefactor Group to develop and conduct fund-raising activities, including a capital campaign, to ensure funds are available to acquire and install observatory equipment, develop informal education programs consistent with Colorado science education standards, train docents, and fund on-going operation and maintenance of Pikes Peak Observatory. The Benefactor Group has been selected by the City of Colorado Springs to guide the development of a plan to raise funds for the Summit Complex. We have relationships with several like-minded informal STEM education non-profit organizations in the Pikes Peak region and will complete fund-raising in 2018 through 2020 to allow purchase of needed equipment before the proposed start of construction in 2021. The total cost of constructing and assembling the facility on the summit and acquiring/installing the components is estimated at $1.95 million. This includes $650,000 for the 1-meter telescope, $150,000 for the observatory dome, $95,000 for the ASIVA instrument, $21,000 for the three solar telescopes (1 mounted on main telescope, 2 installed on carts), $5,000 for weather station equipment, and $834,000 for construction. It also funds cameras mounted to telescopes, computers for remote telescope operation and telescope camera image displays, and integration and test of the components.

13a. Describe other reasonable alternative routes and modes considered. ***Other locations on the Summit, along the Pikes Peak Highway, and on Mount Evans near Denver, were considered as possible locations. Each location was examined in terms of seeing conditions, wind, accessibility/availability of restrooms, suitability for remote telescope operation, and the ability to reach, educate and inspire the general public.*** **Figure 14** reflects other possible locations on the summit of Pikes Peak. These included the North Overlook (which lacks a clear view to



PIKES PEAK OBSERVATORY
EXISTING COMPLEX SITE - POTENTIAL OBSERVATORY LOCATIONS

FIGURE 14: Summit Locations Considered

the south, obstructs some views from the parking lot, and for which prevailing winds are problematic); the walkway on south side of Summit House (which would require structural modifications to the building, obstruct visitors' views, and have a negative architectural impact); and the roof of the HARL (which would require structural modifications to the building, encounter air turbulence and dust stirred up by prevailing westerly winds, and have a negative architectural visual impact). Of four Summit locations considered, only the West Overlook is deemed acceptable based on technical, architectural/structural, and environmental considerations.

Figure 15 reflects the only location for Pikes Peak Observatory along the Pikes Peak Highway which is considered viable, while being located off of the summit. Other locations along the highway have unfavorable winds, terrain-generated air turbulence and airborne particulate matter degrading telescope "seeing conditions." This Location, while viable from a technical perspective, does not allow the same public access provided by the location at the West Overlook. It would offer very little parking and require a shuttle service, running continuously while the Summit House is open, to and from the Summit House to transport visitors to and from the observatory to summit parking, transportation and facilities. Because this location is off the Summit, it would be less accessible to Summit guests, especially to riders of the cog railway, due to their limited loiter time.

Mount Evans and other mountain locations were considered, and Mt. Evans was the best option after Pikes Peak Observatory. There is a road to the Summit of Mt. Evans; however, the road is closed during the winter months, precluding physical access to the Observatory, precluding off-season visitors or maintenance and repair necessary to sustain remote observatory operation.

b. Why were these alternatives not selected? ***Pikes Peak alone is situated within the free troposphere, which means the atmospheric turbulence for the proposed observatory is minimal, offering the best seeing conditions. In addition, Pikes Peak provides the year-round access needed to operate and maintain a remotely tasked observatory, in the event of mechanical problems.***

The topography (arrangement of the natural and artificial physical features of the area) makes the summit of Pikes Peak unique and the premier site for celestial observation. The West Overlook has particular advantages including superb "seeing" conditions for telescopes, directly relating to the topography of Pikes Peak itself, which has no 14,000' peaks for 75 miles to the west to disturb the atmosphere. The location of the summit of Pikes Peak in the free troposphere 90% of the time is a key factor in selecting Pikes Peak for this observatory, as this eliminates the ground effects prevalent in the boundary layer, the portion of the atmosphere most affected by physical processes relating to the topography.

The atmosphere is divided into a boundary layer and the free troposphere. Specific physical processes that modify the atmosphere in the boundary layer include 1) heat transfer to and from the ground, 2) frictional drag, 3) evaporation/transpiration, 4) terrain-induced airflow modification (turbulence), and 5) pollution emissions. Heat transfer to and from the ground, friction, and terrain effects all cause air turbulence, which stirs up particulate matter. The evaporation and transpiration cycle injects moisture into the atmosphere. Because the summit is located within the free troposphere most of the time, there is very little disturbed air, particulate matter, or moisture, creating excellent "seeing."

Because of the small amount of particulate matter (dust particles) or moisture in the atmosphere above the boundary layer, there is also very little light pollution, which is created when ground sources of light illuminate matter suspended in the atmosphere. Figure 16 depicts the boundary layer and free troposphere, citing boundary layer effects.

Figure 15: Potential alternate site on Pikes Peak

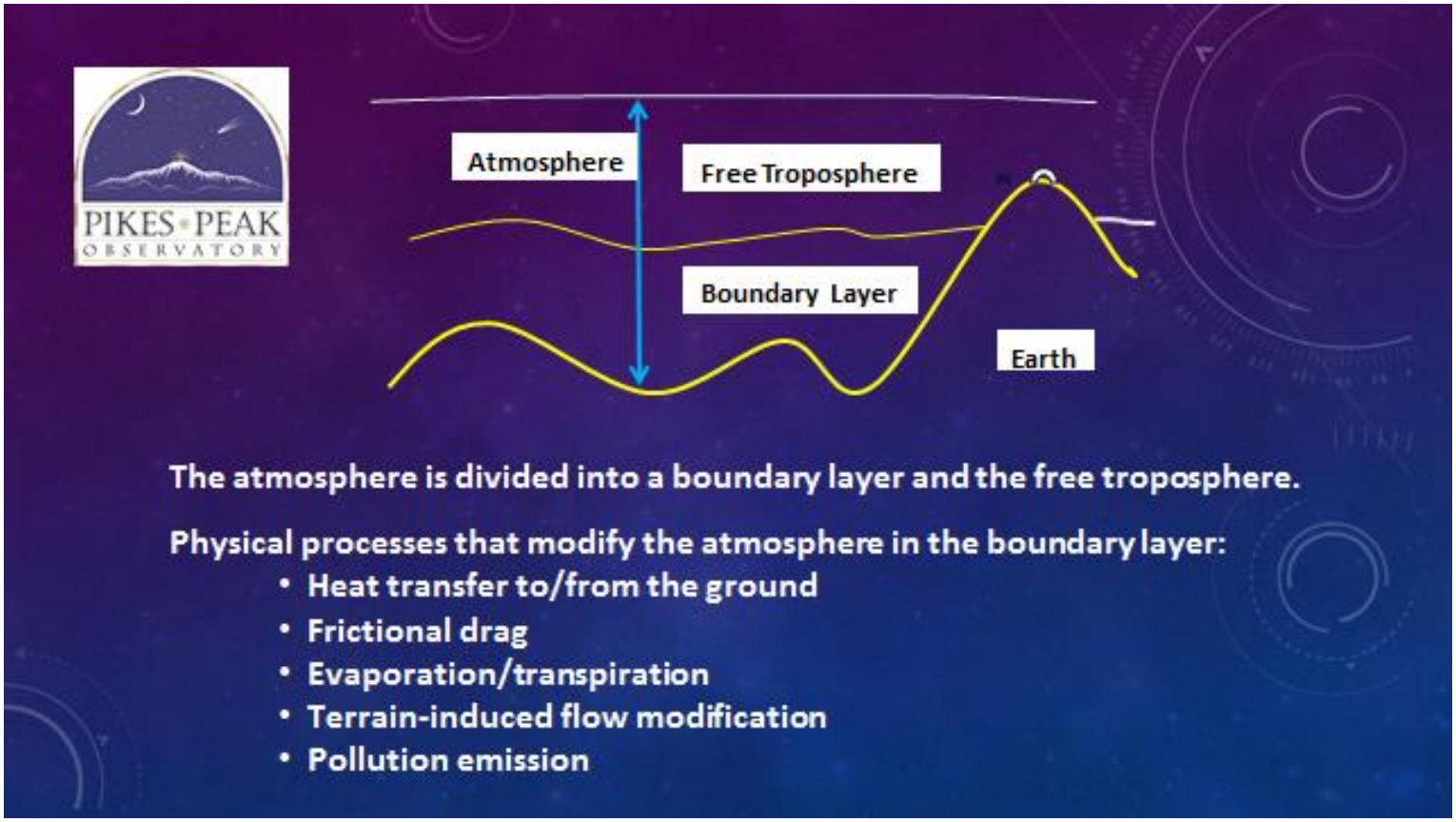


Figure 16: Pikes Peak is situated within the free troposphere, creating excellent "seeing" conditions.

c. Give explanation as to why it is necessary to cross Federal Lands. ***It is necessary to cross Federal Lands to access the observatory and interact with Pikes Peak Summit Visitors interested in the research and/or education capabilities and contributions of the Pikes Peak Observatory, past, present and future.*** The ability of docents to provide informal science education directly to the public, while telescopes permit direct and remote observations of celestial objects with exceptional clarity and collection of valuable atmospheric research data, informs citizens and students of all ages.

14. List authorizations and pending applications filed for similar projects which may provide information to the authorizing agency. (Specify number, date, code, or name): ***There are many observatories nationwide associated with federal lands. In Colorado, the Meyer-Womble Observatory on Mt Evans is a high altitude observatory but it is not accessible to the general public. Nationally, the Mt Wilson Observatory near Pasadena, California (in the San Gabriel Mountains)*** provides public access and relevant STEM education opportunities to students and the general public. However, Mount Wilson Observatory ***is not a high altitude observatory.***

Meyer-Womble Observatory on Mount Evans Summit/Interpretive Site. There are three structures on the Mt. Evans' summit. Interpretive signs on site tell the story of each of these structures: 1) historic ruins of the Crest House, which first opened to the public in 1942, serving as a restaurant and souvenir shop until it burned in a propane fire in 1979, 2) a High Altitude Lab, a wooden double A-frame building constructed by the University of Denver in 1935 to support cosmic ray research, and 3) the Meyer-Womble Observatory, elevation 14,148', built in 1997 to house a telescope placed on the summit in 1972. The observatory is a seasonal research facility operated by the University of Denver for its own use. The observatory does not offer public access due to the limited summer-only schedule. The educational value to visitors to the summit is limited to interpretive signage. Pikes Peak Observatory will be available remotely to users locally, nationally, and internationally.

Figure 17: Meyer-Womble Observatory

Figure 18: Mount Wilson Observatory

Mount Wilson Observatory: Mount Wilson Observatory is a celestial observatory within the Angeles National Forest/San Gabriel Mountains National Monument, which is managed by the US Forest Service. This observatory, located at an elevation of 5,715' near Pasadena, California, is used for research and education, and has a history dating to the Mount Wilson Solar Observatory founded in 1904 by George Ellery Hale.

The infrastructure and staffing needs of this large observatory, and the associated budget, are substantial. Pikes Peak Observatory, on the other hand, will have no permanent on-site staffing on the Summit. While informal STEM education is provided to visitors to the summit of Pikes Peak, most formal and informal STEM education are provided to students who access the observatory and its primary celestial and solar telescopes remotely from their classrooms and laboratories.

Mount Washington Observatory: The Mount Washington Observatory is a nonprofit research and educational institution working to advance understanding of Earth's weather and climate. Like Pikes Peak Observatory, Mount Washington Observatory is a privately funded 501(c)(3) corporation.

In 1870, scientists embarked on an expedition to observe the mountain's winter weather, hoping to improve forecasting knowledge. Failure was universally predicted, but the team persevered and gathered a wealth of data widely recognized by the scientific community.

Their observations captured the attention of the United States Signal Service, who maintained a weather station on the summit until 1892, a history similar to that of Pikes Peak. Both Mount Washington and Pikes Peak are accessible by roadway and cog railway.

The principal focus on Mount Washington is meteorology whereas the principal focus on Pikes Peak will be astronomy. Mount Washington Observatory is permanently staffed by two resident scientists; Pikes Peak Observatory will have no permanent staff on the Summit and will utilize remote operation. Mount Washington Observatory is located in Mount Washington State Park, NH, 60 acres on the 6,288' summit of the Northeast's highest peak, surrounded by the 750,000-acre White Mountain National Forest.

The modern summit building houses The Sherman Adams Visitor Center, a cafeteria, rest rooms, gift shops, the Mount Washington Observatory and its museum. The historic Tip-Top House is located adjacent to the summit building. Pikes Peak Summit Complex will include a visitor's center with interpretive displays providing informal education of Pikes Peak past, present and future, a cafeteria, restroom, gift shop, and overlooks, one of which can support Pikes Peak Observatory.

The Mount Washington State Park (summit building) is closed from November to April; no public buildings are open for hikers, no shelter, no food/water, and no road access are available during these months. Pikes Peak Observatory, however, will be accessible year-round, weather permitting.

Figure 19: Mount Washington Observatory

15. Provide statement of need for project. ***This project fulfills a need to provide/inspire science, technology, engineering and math (STEM) education relating to Earth and space sciences, using high quality scientific data collected from the vantage point of a 14,115' mountain peak, exposing hundreds of thousands of people to the application of this data to address human concerns.*** Pikes Peak Observatory (PPO) will support STEM education and research relating to Earth and space science and the impact of our sun on weather and climate, improving student, teacher and public environmental literacy. With direct and remote access, PPO will serve people of all ages, with a reach that is nationwide. By serving organizations such as the Air Force Academy Falcon Telescope Network, the reach of Pikes Peak Observatory will be international. The content focus of PPO STEM education will relate atmospheric and space science to the precious resource of water, demonstrate the Earth-sun connection and its impact on weather and climate, and show how that impacts water, and support research in search of life on other planets, a search which includes a search for evidence of water. The observatory, with its telescopes, weather station and atmospheric instrumentation, will allow students to gather data remotely from their schools, so that they experience directly how to collect scientific data and how that data informs and improves the human condition. The ability to access the largest telescope in Colorado, and the one best suited for excellent "seeing," provides a level of quality to student and teacher investigations not otherwise available.

While other observatories focus on on-site tours for student groups, Pikes Peak Observatory focuses on hands-on student research which is of a caliber to contribute to national and international databases maintained by the *Global Learning and Observations to Benefit the Environment* (GLOBE) program and the *American Association of Variable Star Observers* (AAVSO). Pikes Peak Observatory will specifically provide students with: 1) an understanding of the importance of water to our ecosystem (addressing the importance of Pikes Peak Watershed, which feeds Fountain Creek and Bear Creek, directly serving the water needs of Colorado Springs and Pueblo, ultimately flowing into the Arkansas River); 2) quality scientific data demonstrating the importance of the Earth-sun connection, and the impact of the sun not only on life on Earth but also on technology such as telecommunications and renewable energy; and 3) the opportunity to participate in the search for other planets capable of supporting life, study asteroids, and examine orbital anomalies of manmade satellites.

Include the economic feasibility.

With a total cost projected to be under $2,000,000 and an operating cost estimated at 10% of that amount-- $200,000, this project is economically feasible. While fund-raising and corporate/philanthropic support are planned, a cost per visitor to the Summit of just $0.33 would be sufficient to sustain the observatory. Volunteer docents available through the Colorado Springs Astronomical Society, donated technical expertise from equipment manufacturers and professors/scientists at local institutions of higher education, and contributions from participating schools are expected to lower operating costs substantially.

Include items such as:

(a) Cost of proposal (construction, operation, and maintenance): Costs of Pikes Peak Observatory components (observatory dome, telescopes, weather and atmospheric monitoring instrumentation, computers for remote operation, cameras and flat-screen/interpretive displays and signage are estimated at $1,100,000. Construction costs are estimated at $834,000. Operating and maintenance costs (primarily salary for a director of observatories and part-time/on-call maintenance support) are estimated at $200,000 per year.

(b) Estimated cost of next best alternative: Locating Pikes Peak Observatory off of the Summit would require additional architectural engineering, soil engineering, and construction design costs. Actual construction costs for the observatory dome are expected to be comparable. However, additional costs would be incurred to provide for limited parking (for observatory staff/docents and for a shuttle to be operated to and from the summit to transport visitors to the observatory overlook and take visitors to restroom, dining and interpretive displays at the Pikes Peak Summit House.) A more expensive alternative would be to provide facilities (restroom, snack bar, interpretive display) facilities at a Pikes Peak Highway overlook, an unnecessary duplication of what is already incorporated into the new Summit Complex. A serious opportunity cost of the proposed alternate location, is the loss of exposure to half of the summit visitors, those who do not use the Pikes Peak Highway. In the event the City of Colorado Springs implements a permanent shuttle to the Summit following Summit Complex construction, a pull-off area and stop would be needed at the Pikes Peak Highway overlook to give visitors an opportunity to interact with docents and experience actual solar observations using H-alpha solar telescopes.

(c) Expected public benefits. ***Pikes Peak Observatory (PPO) responds to a federal call to improve Science, Technology, Engineering and Math education with projects and programs which excite and engage students, teachers and the general public through formal and informal instruction. With both direct and remote access, PPO will reach users nationwide.*** A key benefit is to inspire the next generation of scientists and, at the same time, to create a more scientifically literate public, better able to discern the facts relating to public policy issues around such topics as water rights, global warming, and access to space. In addition, Pikes Peak Observatory will provide scientific data in support of atmospheric, solar and astronomical research. (Reference: *Federal Science, Technology, Engineering, and Mathematics (STEM) Education 5-Year Strategic Plan – a Report from the Committee on STEM Education by the National Science and Technology Council*)

16. Describe probable effects on the population in the area, including the social and economic aspects, and the rural lifestyles. ***The principal effect will be to educate visitors concerning the societal benefits of understanding how atmospheric and celestial sciences prepare us for dealing with impacts of solar activity and atmospheric contamination, while motivating students to consider higher education/careers in atmospheric and space science.***

17. Describe likely environmental effects that the proposed project will have on:

(a) air quality; ***No effect.***

(b) visual impact; ***The west overlook location minimizes visual impact (see architect's renderings on continuation sheets).***

(c) surface and ground water quality and quantity; ***No effect.***

(d) the control or structural change on any stream or other body of water; ***No effect.***

(e) existing noise levels; and ***the observatory creates minimal noise levels during operation, permitting human conversation.***

(f) the surface of the land, including vegetation, permafrost, soil, and soil stability. ***Placement on disturbed surface (former HARL foundation) and lack of facility heating minimize environmental impact.***

18. Describe the probable effects that the proposed project will have on (a) populations of fish, plant life, wildlife, and marine life, including threatened and endangered species; and (b) marine mammals, including hunting, capturing, collecting, or killing these animals. ***Because the viewing platform will be raised, consistent with the plan for the summit complex walkways, the effects of this project on wildlife will be minimal, primarily causing them to react to human presence during daytime operation with summit visitors, possibly causing them to take cover, interrupting normal daytime behavior.***

19. State whether any hazardous material, as defined in this paragraph, will be used, produced, transported or stored on or within the right-of-way or any of the right-of-way facilities, or used in the construction, operation, maintenance or termination of the right-of-way or any of its facilities. ***No hazardous material, as defined in this paragraph, will be used, produced, transported or stored on or within the Pikes Peak Summit right-of-way or any of the right-of-way facilities, or used in Pikes Peak Observatory construction, operation, maintenance or termination of the right-of-way or any of its facilities.***

20. Name all the Department(s)/Agency(ies) where this application is being filed.
Pikes Peak Ranger District, US Forest Service, 601 S Weber St, Colorado Springs, CO 80903

Attachments:

1. Concept of Operations for Pikes Peak Observatory
2. Brochure on Solmirus Corporation All-Sky Infrared & Visual Analyzer (ASIVA)
3. Lunt H-alpha Solar Telescope Descriptions
4. PPO Input to the Environmental Assessment (Parts 1 and 2) [The PPO Input to the EA contains information on the 1-meter PlaneWave Telescope and the AstroHaven Observatory Dome and details on the historical relevance.]
5. NSSTI Articles of Incorporation
6. NSSTI Bylaws
7. NSSTI Colorado Certificate of Good Standing
8. Resolution Authorizing Filing