

National Park Service
U.S. Department of the Interior

Grand Canyon National Park
Interior Regions 6, 7, & 8



Grand Canyon National Park Telecommunications Plan

Environmental Assessment

December 2019



Existing NPS Two-Way Radio Tower near Desert View in Grand Canyon National Park. NPS Photo, 2019.



NOTE TO REVIEWERS

The National Park Service (NPS) is seeking public comment on this Grand Canyon National Park Telecommunications Plan / Environmental Assessment. Public comments will be accepted through January 6, 2019.

Though all comments are welcome, we find comments most helpful when they:

- Provide factual corrections;
- Present new alternatives or alternative elements for meeting the project purpose and need that weren't already analyzed or dismissed in the environmental assessment; and/or
- Supplement, improve, or suggest modifications to the analyses.

During the comment period, you may submit comments on-line, through the regular mail, or by hand delivery.

Submit Comments via the Project Website: The most efficient way for the NPS to process comments is to receive them through the NPS Planning, Environment, and Public Comment (PEPC) project website (<http://parkplanning.nps.gov/GCTelecommunications>). At the project website, you will find the full text document, an on-line comment form, and instructions for submitting on-line comments.

Submit Comments by Mail or Hand Delivery: Comments may also be sent directly to: Superintendent's Office, ATTN: Telecommunications Plan / EA, Grand Canyon National Park, P.O. Box 129, Grand Canyon, AZ 86023.

Before including your address, phone number, e-mail address, or other personal identifying information in your comment, you should be aware that your entire comment, including your personal identifying information, may be made publically available at any time. While you can ask us in your comment to withhold your personal identifying information from public review, we cannot guarantee that we will be able to do so.

Comments will not be accepted by fax, email, social media, or in any other way than those specified above. Bulk comments in any format (hard copy or electronic) submitted on behalf of others will not be accepted.

Table of Contents

Chapter 1 – Introduction	1
Proposed Action	1
Purpose and Need for Action	1
Background	1
Issues and Impact Topics	4
Impact Topics Retained for Further Analysis	4
Issues and Impact Topics Dismissed from Detailed Analysis	4
Chapter 2 – Alternatives.....	11
Alternatives Carried Forward	11
Alternative A – No Action	11
Alternative B – Comprehensive Telecommunications Plan (Proposed Action and Preferred Alternative)	12
Alternatives Considered and Dismissed.....	21
No or No Additional Cellular Service within GCNP	21
Utilize Communication Sites on Land Outside GCNP to Provide Services	21
Co-Locate Commercial Facilities on NPS Radio Towers (No New Towers)	21
Utilize Existing Buildings Instead of Telecommunications Towers (No New Towers)	22
Rely on Small-Cell Sites Only for Coverage.....	22
Comparison of Alternatives	22
Chapter 3 – Impact Analysis.....	25
Scenic Resources: Expansive Views of the Grand Canyon and Other Important Views.....	25
Affected Environment	25
Environmental Consequences.....	28
Cultural Resources: Historic Districts.....	34
Affected Environment	34
Environmental Consequences.....	39
Visitor Use and Experience: Visitor Activities and Experiences, Visitor Information, and Public Safety	44
Affected Environment	44
Environmental Consequences.....	46
Chapter 4 – Consultation and Coordination	53
List of Agencies and Tribes Consulted	53
Acronyms.....	55
Glossary	57
Works Cited	61

Appendix A – Photos of Existing NPS Radio and Commercial Telecommunications Towers within Grand Canyon National Park	A - 1
Appendix B – Mitigation Measures and Best Management Practices.....	B - 1
Acoustic Environment	B - 1
Cultural Resources	B - 2
Vegetation.....	B - 3
Soils.....	B - 3
Wildlife.....	B - 3
Visitor Use and Experience.....	B - 5
Human Health and Safety	B - 5
Appendix C – Photos of Views and Visibility of Existing Towers within High Visitor Use Areas	C - 1
Appendix D – Visibility of Existing and Potential New and/or Relocated Towers from Primary and Secondary Views in High Visitor Use Areas	D - 1

LIST OF FIGURES

Figure 1.1: Map of Existing NPS Radio and Other Telecommunications Towers within and near Grand Canyon National Park	2
Figure 1.2: Map of Developed Areas in Grand Canyon National Park	3
Figure 2.1: Map of General Areas where Potential New Telecommunications Towers could be Sited under Alternative B	13
Figure 2.2: Example of Small-Cell Site.....	16
Figure 2.3: Map of General Areas where Potential Small-Cell Sites could be Located under Alternative B	17
Figure 2.4: Map of Existing Utility and Transportation Corridors that could be used for Fiber under Alternative B.....	19

LIST OF TABLES

Table 1.1: Existing NPS Radio and Other Telecommunications Towers.....	2
Table 2.1: Locations for Potential New Telecommunications Towers, Alternative B	13
Table 2.2: Summary of Alternatives	23
Table D.1: Visibility of Existing Towers and Potential New and/or Relocated Towers from High Visitor Use, Surveyed Views	D - 1

Chapter 1 – Introduction

PROPOSED ACTION

The National Park Service (NPS) is proposing to implement a Telecommunications Plan (Plan) that would provide a framework and guidance for the future construction and operation of telecommunications infrastructure—specifically, telecommunications towers, small-cell sites, and fiber optic communications cable (fiber)—within developed areas of Grand Canyon National Park (GCNP). The proposal also includes the removal and/or potential relocation of some existing telecommunications infrastructure.

The NPS is not proposing to directly develop new telecommunications infrastructure under this Plan. Rather, this type of infrastructure is typically proposed by private telecommunications companies through applications for right-of-way (ROW) permits. If and when ROW permits are approved and issued, the telecommunications company (permittee) is responsible for building and maintaining the related infrastructure according to the terms and conditions of the permit and pays a fair market value for the use of federal land. This planning effort is not in response to a specific application from a telecommunications company for a ROW permit within GCNP. Rather, the NPS is seeking to develop guidance for the types and locations of this infrastructure that would be used to inform the review of future ROW applications.

Considering the above, this environmental assessment (EA) analyzes the general environmental issues, impacts, and benefits related to broad, programmatic decisions about the design and siting of future telecommunications infrastructure in GCNP. Construction and operation of any new telecommunications infrastructure would require site-specific review (including additional compliance with laws such as the National Environmental Policy Act (NEPA)) and approval in accordance with current NPS policies.

PURPOSE AND NEED FOR ACTION

The purpose of this Plan is to identify appropriate types and locations of telecommunications infrastructure and services within GCNP that, if installed, would provide sufficient and reliable wireless (including cellular—voice and data) coverage, data network capacity (i.e., bandwidth), and two-way radio communications to meet the needs of visitors, the NPS, and park partners within developed areas of GCNP.

This Plan is needed to (1) comprehensively address telecommunications deficiencies within developed areas of GCNP that currently inhibit NPS operations as well as the activities of visitors and park partners and (2) ensure that telecommunications infrastructure is designed and located in a manner that minimizes impacts to park resources.

BACKGROUND

Close to 6.4 million visitors travel to GCNP every year. NPS and NPS-partner facilities and infrastructure, including telecommunications infrastructure within and surrounding GCNP, support visitors and NPS operations. The NPS owns and operates five two-way radio towers within the park that were evaluated through the *Narrowband/Digital Radio System Conversion Environmental Assessment* and associated Finding of No Significant Impact (2008) to support law enforcement, emergency medical services, and NPS operations. Commercial cellular antennas are located on the NPS radio tower at Desert View, and a separate commercially-owned and operated tower (the South Rim Village Tower) provides phone and data service to the NPS, backhaul to the park and surrounding area,

and cellular service to the public along portions of the South Rim. (See [Table 1.1](#) for a list and [Figure 1.1](#) for a map of these towers.) There are also several telecommunications towers on neighboring lands—primarily federal lands managed by the United States Forest Service (USFS)—that provide the necessary links between GCNP and the broader wireless network.

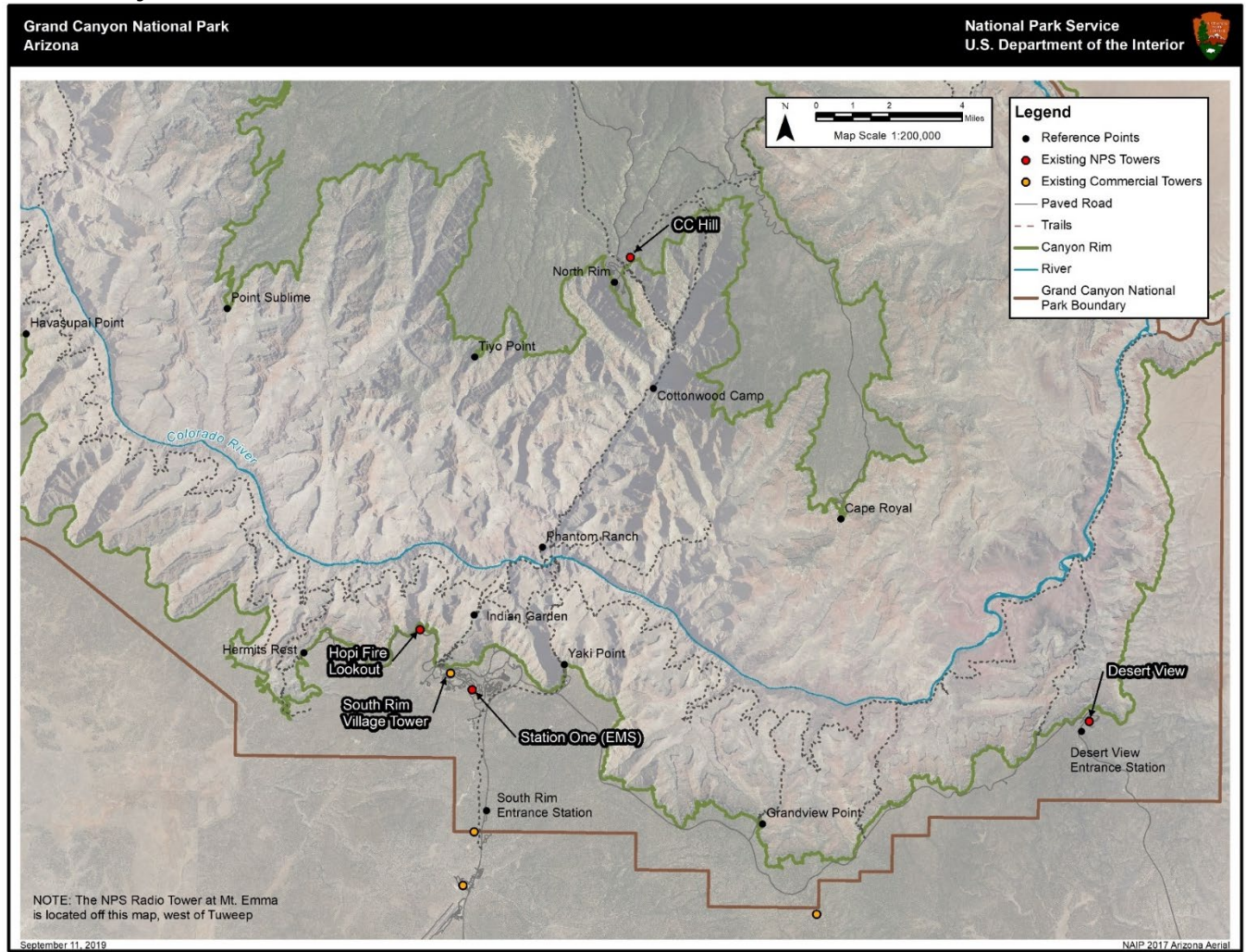
These existing telecommunications towers are physically limited in their ability to provide the suite of telecommunications services to support park visitors and NPS and NPS-partner operations. The five existing NPS towers are generally considered adequate to support NPS two-way radio communications

Table 1.1: Existing NPS Radio and Other Telecommunications Towers within Grand Canyon National Park

Tower and Location	Height (ft)	Distance from Rim (ft)
NPS Radio Tower near Hopi Fire Lookout	80	~520
NPS Radio Tower at Station One (Grand Canyon Village)	60	>3,500
South Rim Village Tower (Grand Canyon Village)*	107	~800
NPS Radio Tower at Desert View	80	~1,500
NPS Radio Tower at CC Hill	180	~600
NPS Radio Tower at Mt. Emma	20	>20,000

* Commercial tower operated under a ROW permit

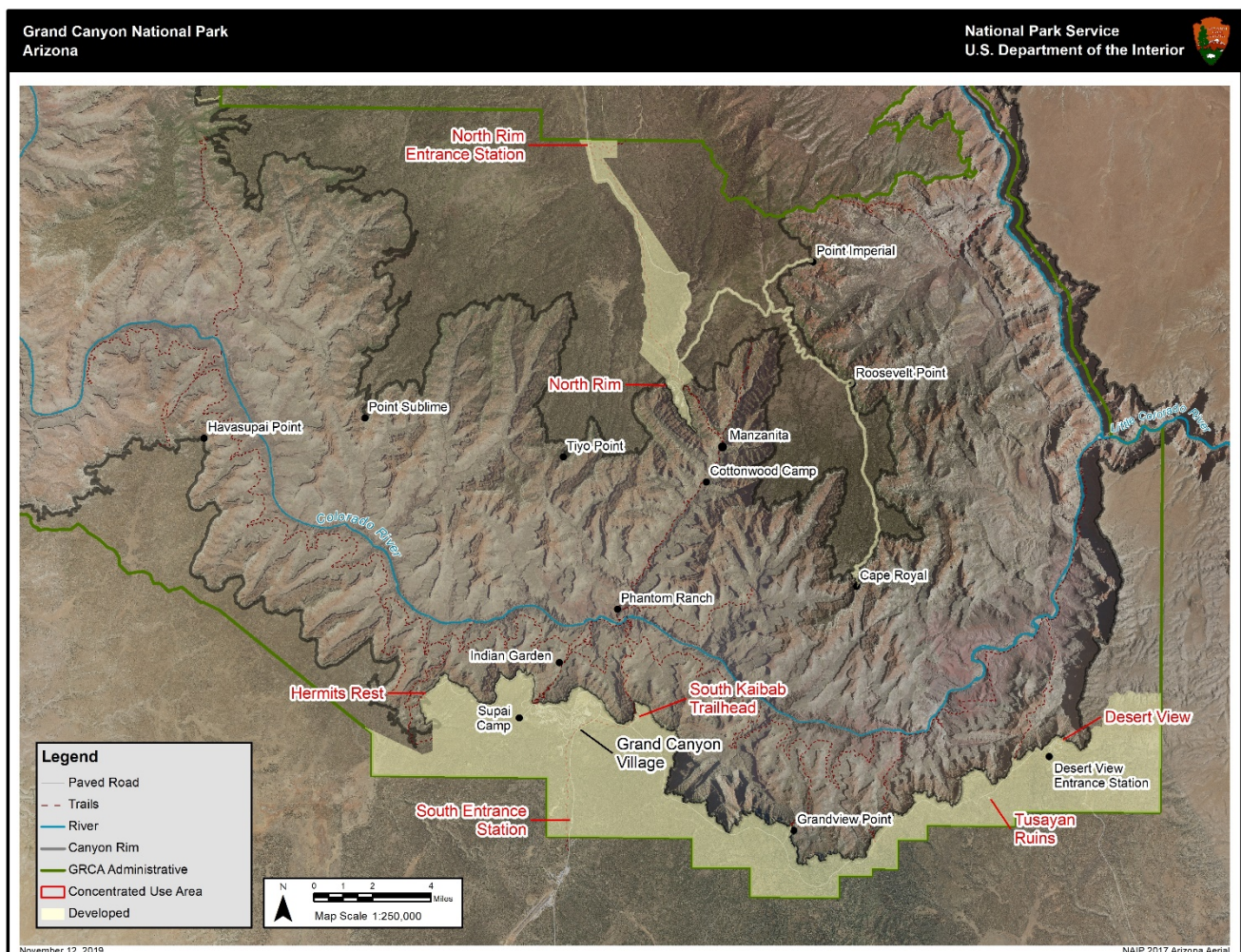
Figure 1.1: Map of Existing NPS Radio and Other Telecommunications Towers within and near Grand Canyon National Park



necessary for operations. However, commercial facilities co-located on one of the NPS radio towers have created conflicts with NPS radio frequencies and have raised issues concerning the physical security of the tower. The existing South Rim Village Tower is approaching or at physical and technological capacity and is further limited by its location, which is at a lower elevation compared to the surrounding area. Towers on surrounding USFS lands, though helpful, cannot fully extend services into the park due to topography and line-of-sight requirements between antennas (see [Alternatives Considered and Dismissed](#)).

Because of these limitations, telecommunications services to support visitors in GCNP, as well as the operations that serve these visitors, are not adequate. Based on feedback received from GCNP staff, partners, and the public, wireless (including cellular—voice and data) coverage, data network capacity (i.e., bandwidth), and some non-NPS two-way radio service within the developed areas of the park—particularly the North Rim, South Rim, and Desert View developed areas (including Supai Camp) and the two highway corridors (Hwy 64 and 67)—do not address current needs. (See [Figure 1.2](#) for a map of developed areas within GCNP.) Although cellular service is generally available within Grand Canyon Village on the South Rim and represents the best service within the park, it is provided by only one proprietary national commercial carrier and one wholesaler carrier (i.e., those with cellular plans not offered by these companies typically have no access to cellular services within the park), is limited by bandwidth particularly during busy times of day/year when demand on the network is higher, and does not extend to all visitor use, administrative, and residential areas. Bandwidth for all telecommunications

Figure 1.2: Map of Developed Areas in Grand Canyon National Park



services in the park (cellular and other wireless services) is also currently limited to roughly 850 Mbps (megabits/second) of data across the entire park; NPS operations alone (which currently utilize less than 4% of this data) could utilize all of this existing bandwidth, if not more. Finally, two-way radio communications, particularly for NPS partners such as concessioners, are not available in some areas of operations, such as at Hermit's Rest.

Although this Plan does not include any proposal that would accommodate additional telecommunications infrastructure or services at Lees Ferry (located outside of GCNP), the NPS has identified a need for improved telecommunications services for operations in this high use area. In addition, the NPS understands lands within GCNP may be necessary to accommodate infrastructure to provide improved telecommunications services to Supai Village on the adjacent Havasupai Reservation (not on NPS land). Actions concerning these areas are outside the scope of this Plan; compliance required for any future development in these areas would be completed on a case-by-case basis.

ISSUES AND IMPACT TOPICS

Impact Topics Retained for Further Analysis

The following topics are carried forward for further analysis in this Plan:

- **Scenic Resources:** Expansive Views of the Grand Canyon and Other Important Views
- **Cultural Resources:** Historic Districts
- **Visitor Use and Experience:** Visitor Activities and Experiences, Visitor Information, and Public Safety

Issues and Impact Topics Dismissed from Detailed Analysis

Archaeological Resources

Ground disturbance associated with any future installation of telecommunications towers, small-cell sites, and fiber has the potential to physically disturb known and unknown archaeological materials which could result in permanent adverse impacts to these resources. However, mitigations have been identified to avoid impacting known archeological resources. Any potential location for telecommunications infrastructure would be archaeologically surveyed prior to issuance of a ROW permit to identify and locate archaeological materials, and future construction and other project-related work would be designed to entirely avoid impacts to these resources. For example, if known archaeological resources were in a location of a proposed telecommunications tower, the NPS would work with a ROW applicant to relocate that tower to an area where no known archaeological resources exist. Similarly, if a proposed buried fiber route crossed an archeological site, the NPS would work with a ROW applicant to alter the course of the fiber route or consider hanging the fiber in that location so as to avoid impacts to the site. Given that much of the proposed project area has been archaeologically surveyed in accordance with current professional standards, the majority of archaeological resources within the project area have likely been identified and could be feasibility avoided during design phases.

That said, in the unlikely case where avoidance of archeological materials is not possible, a site may permanently lose physical attributes that illustrate the site and its ability to express what it is. In these unanticipated instances, the NPS would complete additional site-specific review, compliance, consultation, and data recovery (i.e., surface artifact collection, subsurface testing, or whole site excavation) in accordance with applicable laws and policies which would, among others, result in mitigating any potentially impacted site to permanently retain the artifacts and all scientific information contained in the site so the information is not lost. Mitigations have also been identified to similarly minimize any impacts to previously unidentified archaeological resources that are discovered through implementation of the proposed action such that these resources would not be lost entirely.

Despite these potential impacts, this issue has been dismissed from further analysis within this EA because potential project areas would be primarily within previously disturbed areas and site-specific review, in adherence to a programmatic agreement with the Arizona State Historic Preservation Officer (SHPO), would occur prior to any ROW approvals to identify archaeological resources within proposed project areas and modify the scope of the proposal, as necessary, to avoid impacts to archaeological resources. In the unlikely case that impacts to archaeological resources cannot be avoided, data recovery would occur to ensure resource information is not lost.

Bats

Tree removal associated with future construction or operation of new telecommunications infrastructure, specifically removal of trees that provide roosting habitat, could negatively affect tree roosting bats through injury or displacement. However, no bat hibernacula are known in the project area and mitigations have been identified to avoid roost disturbance during project implementation (such as siting infrastructure at least 500 ft from known bat concentration areas; timing any project construction in winter months when bat roosting in trees is less likely because most bat species migrate south or to lower elevations where temperatures are warmer; and/or completing surveys prior to implementation and avoiding action when roosts are present). There is also an abundance of roosting habitat surrounding each potential tower site such that displaced individuals would not have to travel far to find suitable habitat. Given mitigations identified to minimize the potential to impact bat species and the abundance of roosting habitat in areas surrounding any potential future project areas, this issue has been dismissed from further analysis. See [Migratory Birds](#) for a discussion on potential bat collisions with towers.

In addition, studies have shown that close (within 400m) exposure to an electromagnetic field (EMF) strength greater than 2 volts per meter (v/m) can reduce activity levels of foraging bats, and microwave radiation (associated with an EMF) can have a negative effect on the reproductive output of insects in the vicinity of telecommunications towers, thereby also reducing the food supply for bats near these locations. Noise frequencies generated by towers and associated infrastructure also have the potential to interfere with echolocation and/or social calls between bats (Bat Conservation Trust n.d.). This said, telecommunications infrastructure on towers typically transmit an EMF of 0.5-2 v/m, below the levels that have demonstrated an effect on bats, and ultra-high frequencies transmitted by telecommunications infrastructure on towers are generally considered too high for bats to hear. Bats also “exhibit an ability to tune out the calls of other bats...[suggesting] they may also be able to filter out these additional noises” should they occur within a species’ frequency range for echolocation (Bat Conservation Trust n.d.). Given that potential future operations would occur outside of frequency ranges that have shown to impact bats and the Plan would site all telecommunications towers at least 500 ft from known bat concentration areas such as areas of breeding, roosting, or foraging (i.e., wetlands), the potential to impact bats from exposure to EMF or from reduced food supply is very low. This issue has therefore been dismissed from further analysis.

Dark Skies

Future towers may include emergency lighting, specifically for emergency helicopter flights at night, which would likely be visible from miles away such that towers could be seen from the opposite rim when lit. Some safety or security lighting could also be necessary on the facilities surrounding the tower.

However, the proposed plan includes mitigation measures to reduce the duration and intensity of lighting. Namely, any future telecommunications tower would be lit only at night during emergency situations that require a helicopter landing/take-off at a helibase in close proximity to a tower. Parkwide, these instances occur less than 20 times per year, and towers would be lit less than three hours per incident, estimated on the generous side to accommodate landing, staging, and takeoff at a nearby helibase (NPS 2017a). Given the limited instances (less than 20 per year, parkwide) and duration of lighting (less than three hours), this issue has been dismissed from further consideration. Tower

lighting, if utilized, would occur less than 1.4% of nighttime hours per year, and none of the lighting would jeopardize the park's certification as an International Dark Sky Park.

In addition, any security lighting around the potential towers would meet the standards utilized by the International Dark-Sky Association and would be motion- or heat-sensitive, down-shielded, and of a minimum intensity (lumens and color) to reduce nighttime bird attraction and eliminate constant nighttime illumination. Given the low levels of use within the locations where future towers might be constructed, it is assumed that this lighting would rarely be utilized and would be comparable to existing lighting within surrounding developed areas. This issue has therefore also been dismissed from further analysis.

Historic Buildings and Structures

The potential installation of new telecommunications infrastructure would have some impacts on historic buildings and structures depending on the equipment being installed, the size of the equipment, and where it would be placed.

The physical impacts of adding minor telecommunications infrastructure, such as installing antennas (small-cell, microwave, etc.) on and connecting fiber to historic buildings and structures, could include the introduction of modern materials on the resource and could create small, but new penetrations into buildings and structures where they do not currently exist. These impacts would be adverse and long-term (10-15 years or more), but are not likely to impact a property's eligibility for listing in the National Register for the following reasons. The scale of this infrastructure as well as the size and number of penetrations would be very small in comparison to the building or structure; this equipment is generally designed and grouped with other infrastructure so that its addition does not stand out visually; and this infrastructure would be designed in adherence to the *Secretary of the Interior's Standards for the Treatment of Historic Properties* so that the fabric of the historic building or structure is maintained and remains largely intact.

The visibility of new telecommunications infrastructure from the surrounding areas, which could range from *not visible*, to *visible, but not conspicuous*, could also adversely affect these resources as the addition of non-contributing feature(s) would adversely affect the setting and/or feeling of the building or structure. The intensity of this adverse effect would depend on the degree of visibility, but again, would not diminish a building/structure's eligibility for listing on the National Register given that (1) the infrastructure would not be visible from all locations outside of or within a historic building or structure (most impacts would occur outside of the building or structure); and (2) when visible this infrastructure would not be visually obtrusive given the surrounding infrastructure, vegetation, and topography. For these reasons, the eligibility for listing historic buildings or structures within GCNP on the National Register would not be impacted by the proposed action. This issue has therefore been dismissed from further analysis.

In addition, the Hopi Fire Tower (referred to as the Hopi Fire Lookout throughout the rest of this document) and Hermit Fire Tower Cabin would be impacted by the proposed plan in that existing equipment would be removed from the Hopi Fire Tower and surrounding area. The proposed clean-up of the area would remove non-contributing infrastructure from a potential historic structure and would help restore some of the setting and feeling of the surrounding area—beneficial, permanent impacts to both the Fire Tower and Fire Cabin. Given that no physical alternations to the Hermit Fire Cabin would occur; the physical/material features of the Hopi Fire Tower would be beneficially impacted; and the setting and feeling of both structures would primarily benefit, this issue has been dismissed from further analysis.

Impacts Related to Construction Activities on Resources Carried forward for Analysis in this EA

Future construction activities associated with the installation of potential telecommunications infrastructure, particularly towers, small-cell sites, and the installation of fiber, would have impacts on a number of resources including those carried forward for analysis in this EA. Construction activities may temporarily and adversely impact the visitors that hear construction noise and/or experience some traffic associated with construction or the transportation of construction vehicles and equipment. Large construction equipment and workers may also be seen onsite, and dust may periodically obscure views. These noise, traffic, and viewshed impacts associated with construction, which could occur within historic districts, would last intermittently throughout a work day and would cease upon the completion of construction activities, generally within two months within any particular area. Because most of these activities would occur outside of high visitor use areas and visitors, regardless of duration and timing of their visit, would still be able to access visitor use facilities and services as currently provided, these impacts associated with implementation are unlikely to impact the overall visitor experience or visitor activities. Similarly, while these actions would adversely impact views in GCNP, the area of potential impact, which would notably be within a developed area, would be limited to several hundred feet of the construction activities, and views of these activities would be largely screened by the surrounding vegetation and/or existing development and would generally be consistent with the surrounding area such that the construction activities would not dramatically stand out within the view. Construction activities are also very unlikely to impact any expansive views of the Grand Canyon. Similarly, because these impacts are temporary and would not physically alter a historic district except for the infrastructure that would remain following construction (analyzed within this Plan / EA), the integrity of historic districts would not be more than temporarily impacted by construction activities. For these reasons, impacts associated with construction activities are dismissed from further analysis.

Migratory Birds

Noise during future construction and use of generators on-site may temporarily deter birds from nesting in nearby trees, and, depending on proximity to nests during the active breeding season, may cause birds to abandon existing nests. Tree removal on the South Rim or pruning in the vicinity of potential new and/or relocated telecommunications infrastructure also has the potential to disturb active bird nests. However, mitigations have been identified to avoid direct disturbance to nests (such as surveying prior to work and avoiding activities that would impact a nest) and to minimize sound levels and disturbance during acoustically sensitive times of day (i.e., dawn and dusk) when birds may be more active. Implementation of these mitigations would avoid direct nest disturbance and would reduce the likelihood of nest avoidance or abandonment, such that nest abandonment, if it occurs, would be limited to a few individuals and would not noticeably affect the populations of migratory birds within the park. There is also an abundance of nesting habitat surrounding each potential tower site such that displaced individuals would not have to travel far to find suitable habitat for nesting. Given measures to avoid direct nest disturbance and minimize sound levels to reduce nest abandonment, and, given the abundance of surrounding habitat to accommodate displaced birds, this issue has been dismissed from further analysis.

There is also the potential for birds and bats to collide with new towers, if and when they would be operational. Research has shown towers with the most collision risks are those that are over 350 ft tall, illuminated, guyed, near wetlands, or in migration pathways/corridors. Water sources are especially critical for these species' survival as they provide an abundance of aquatic and terrestrial feeding opportunities for birds and bats, in addition to fulfilling the requirement of large amounts of water for reproductive success (Seibold 2013). Studies have also shown birds, especially night migrating birds, become confused and disoriented by lights, particularly during low visibility weather conditions such as fog or overcast skies (Manville 2014). Birds drawn to the lights tend to circle and collide with the tower, wires, or fall to the ground from exhaustion (USFWS 2018). To minimize the likelihood of collisions,

the proposed plan would require that any potential new towers meet United States Fish and Wildlife Service's (USFWS) *Recommended Best Practices for Communication Tower Design, Siting, Construction, Operation, Maintenance, and Decommissioning*, including the use of free-standing towers, prohibiting guy wires, siting new towers near existing towers, siting towers in already degraded areas and outside of migratory bird routes and wetland areas, minimizing the duration of lighting to emergency situations only (less than 1.4% of nighttime hours per year), utilizing only flashing red lights (rather than steady burning lights), co-locating facilities, and minimizing vegetative clearing. These mitigations minimize the number of features that can be cause for collision, site infrastructure in areas where birds and bats may be accustomed to avoiding human-made structures while in flight, and minimize opportunities for birds to be disoriented by lighting. Additionally, due to the relatively short height of the proposed towers, the risk of collision is minimized when compared to taller (350 ft or taller) towers. Implementation of these guidelines would reduce the risk of possible collision for birds and bats, such that mortality rates, if they occur, would be very low and would not noticeably affect the populations of migratory birds or bats within the park.

Finally, telecommunications infrastructure, especially lattice towers, may introduce new nesting possibilities for birds which could subsequently be disturbed during maintenance activities. Given mitigations to reduce birds' ability to construct nests on towers (i.e., installation of anti-perching and anti-nesting features), the likelihood of birds perching or nesting on towers is expected to be very low and would not noticeably impact breeding or rearing trends within the population.

For the reasons described, these issues have been dismissed from further consideration.

Threatened and Endangered Species

Future construction and operation of any future telecommunications infrastructure has the potential to impact two federally listed species within the park, the California condor (*Gymnogyps californianus*) and Mexican spotted owl (*Strix occidentalis lucida*).

Potential impacts to these species are similar to those described under *Migratory Birds* and also include visual stimuli/attraction. However, the potential of condors perching on towers is reduced as condors are now actively conditioned against such behaviors prior to release. The risk for tower collisions with condors is also unlikely as there is no record of a California condor colliding with a telecommunications tower and these birds typically soar during daylight hours and above the proposed tower heights when searching for carrion. Mexican spotted owls may be at higher risk for collision due to their nocturnal activities. However, owls are well adapted to avoiding collisions with trees, and these towers could mimic tree trunks, particularly if monopoles are utilized, which may reduce risk for collision. Furthermore, while Mexican spotted owls have been detected above the rim within 0.5 miles of the canyon, both species spend the majority of their time in the canyon below any potential future project areas, and tower locations would be greater than 0.5 miles from known Mexican spotted owl nest/roost areas and California condor historic and current nest/roost areas.

Impacts to the California condor and Mexican spotted owl have been dismissed from further consideration because habitat would not be disturbed; measures would be taken to deter perching/nesting on towers; species behavior makes the likelihood of colliding with any new towers low; and the distance between any areas where new towers may be sited to nest/roost areas is more than 0.5 miles. Additional information on aforementioned potential impacts to these species has been provided to the USFWS.

Vegetation and Soils

Vegetation (ponderosa pine forests, juniper/pinyon pine forests, white fir and Douglas fir blue spruce forests, and forests with engelmann spruce, and subalpine fir) and soils may be trampled or removed during future construction of telecommunications towers and future installation of small-cell sites

and/or fiber to accommodate large vehicle access, small-scale staging, activities such as the replacement or installation of utilities, and the long-term (10-15 years or more) existence of this infrastructure. To accommodate for this access and use, the implementation of the proposed plan could disturb up to 0.75 acres of vegetation and soils during future construction of a new or relocated telecommunications tower (total of 4.5 acres if five new towers are constructed and the South Rim Village Tower is relocated) and could disturb up to an additional 25 acres of vegetation and soils along existing roads, pathways, utility lines for the installation of fiber. This temporary disturbance is estimated at no more than 29.5 acres during construction activities; up to 1.5 of these 29.5 acres could be disturbed to accommodate tower infrastructure into the future. Some of the disturbance from construction could also impact trees through damage to roots or direct removal, which would be long-term (i.e., decades) adverse impact as opposed to a more temporary impact.

This impact topic has been dismissed from further analysis for several reasons. First, the soils and vegetative community within potential future project areas have been largely disturbed and modified overtime. Much of the footprint that could be disturbed during implementation of the proposed plan would likely be within an already disturbed area—where the surface is paved, gravel, or where only minimal grass and small brush remain; there are no important geologic features in the potential future project areas. Second, the soils and vegetation types that could be impacted outside existing disturbed areas are prevalent throughout the park and on adjacent lands. Any new disturbance would be extremely small relative to the surrounding area such that any soil or vegetation disturbance would not change the overall soil profile or the character or density of vegetation in or surrounding the potential project area. Third, mitigations have been identified to minimize, if not avoid, impacts to soils and vegetation, and areas where vegetation is removed during construction would be revegetated following project activities with seeds of similar species and diversity as the immediate surrounding area. Finally, no action would be taken in areas with rare plants, wetlands, or important geologic features, and there would be little removal of the native soil nutrient layer given that much of the potential future project areas are within existing disturbed footprints. Given impacts to sensitive vegetative and soil resources would be avoided, most impacts would occur in previously disturbed areas, and implementation of the proposed plan would not alter the soil profile or character or density of vegetative communities surrounding the potential project area, this impact topic has been dismissed from further analysis.

Wilderness Character: Opportunities for Solitude or Primitive and Unconfined Recreation

Approximately 1,117,457 acres within GCNP are proposed wilderness and an additional 26,461 acres are proposed potential wilderness (NPS 1980). Per NPS Management Policies, proposed wilderness is managed for the protection of wilderness character which is defined by five qualities: *natural*, *undeveloped*, *untrammeled*, *opportunities for solitude and a primitive and unconfined recreation*, and *other* (e.g., cultural resources).

All infrastructure considered within this Plan would be located outside of proposed and proposed potential wilderness areas within GCNP. Furthermore, it is not the purpose or intent of this Plan to provide cellular (voice and data) services within proposed and proposed potential wilderness. In fact, when reviewing future proposals to expand and/or improve telecommunications services in developed areas of the park, the NPS would consider technologies to avoid spillover of cellular frequencies into the backcountry (which includes all proposed and proposed potential wilderness in GCNP, as well as additional lands) to the extent practicable.

Despite these measures, the proposed plan could unintentionally expand cellular services into proposed and proposed potential wilderness areas that do not currently have this service, and in areas that currently have cellular service, this type of service would likely improve (e.g., data speeds could increase). This could have an adverse effect on *opportunities for solitude and a primitive and unconfined recreation* should a visitor observe others utilizing personal electronic devices to access cellular (voice

and data) services, but the degree or intensity of this impact would largely be subjective, depending on individual preference and would depend on the location of the visitor and their proximity to other visitors. Evidence of impacts is anecdotal, but reported as feelings of annoyance to frustration, or even anger, associated with what some visitors may perceive as intrusive behavior, such as people talking on phones, phone noises related to notifications, and streaming or playing of music (some of which could occur without access to cellular service). These impacts would hopefully be less common and less obtrusive given NPS efforts to encourage visitors who use their personal electronic devices to do so in ways that minimize disturbance to other visitors such that visitors would only see or hear others using their personal electronic devices when in close proximity (less than 20 ft). Personal access to wireless, namely cellular, services could also reduce a visitor's perception of self-reliance (i.e., access to what some visitors may consider a more primitive and/or unconfined form of recreation) within proposed and proposed potential wilderness, but this impact would affect only visitors who have access and choose to utilize these services. Visitors could choose not to utilize wireless, namely cellular, services, even if available.

Other than these impacts to *opportunities for solitude and a primitive and unconfined recreation*, the potential future extension of cellular service would not affect other qualities of wilderness character and would not impact the wilderness eligibility of these proposed and proposed potential wilderness areas because no action would occur within proposed or proposed potential wilderness (e.g., helicopter flights or direct development of these areas). Proposed and proposed potential wilderness in much of western Grand Canyon, as well as areas within eastern Grand Canyon would not be impacted by implementation of the proposed plan.

For the reasons described, this issue has been dismissed from further consideration.

Chapter 2 – Alternatives

Two alternatives, the no action alternative and one action alternative, are carried forward for evaluation in this environmental assessment. Several alternatives were also considered and dismissed (see [Alternatives Considered and Dismissed](#)).

ALTERNATIVES CARRIED FORWARD

Alternative A – No Action

The NPS would continue to be required by the Telecommunications Act of 1996 to consider all ROW permit applications to install telecommunications infrastructure on NPS lands. Under Alternative A, No Action, the NPS would receive and review applications to install telecommunications infrastructure within GCNP on a case-by-case basis, and the NPS may elect to approve or deny these applications. Future ROW permit applications for telecommunications infrastructure would continue to be evaluated by the NPS in accordance with applicable laws, regulations, and policies but without comprehensive, park-specific guidance as to where such services should be provided; criteria for placement of associated infrastructure would be identified on a case-by-case basis with the goal of avoiding or minimizing impacts to resources.

Telecommunications Services

Wireless (including cellular—voice and data) coverage, data network capacity, and two-way radio communications within GCNP may somewhat increase as modifications to existing infrastructure are made and/or new infrastructure is installed (see [Telecommunications Infrastructure](#)). These changes in service, however, would not be guided by a comprehensive plan and are unlikely to fully address existing deficiencies in telecommunications services within developed areas of GCNP (see [Figure 1.2](#)). For example, because no major telecommunications infrastructure, such as towers, would be authorized under this alternative (see below), it is assumed that expansion of cellular services would continue to be limited to only one or two cellular carriers given physical limitations of existing infrastructure to accommodate antennas of other, additional carriers. That said, some two-way radio services could be expanded for NPS-partners if governmental or other emergency services antennas could be accommodated on existing NPS infrastructure.

Telecommunications Infrastructure

Under this alternative, the existing telecommunications infrastructure that is either NPS-owned or authorized (via existing ROW permits) would remain. This includes NPS radio towers near the Hopi Fire Lookout, Station One (the Emergency Operations Center in Grand Canyon Village), Desert View, CC Hill, and Mt. Emma, as well as the commercial South Rim Village Tower near the Magistrate's Office.¹ [Table 1.1](#) includes the names, locations, and heights of the existing towers; [Figure 1.1](#) shows locations of existing telecommunications towers in the park (the NPS radio tower on Mt. Emma is located off the map); and Appendix A includes photos of this existing infrastructure.

The NPS would also consider future renewals for existing telecommunications ROW permits on a case-by-case basis, with minor modifications and upgrades anticipated over time. In addition, new, minor telecommunications equipment, such as small-cell sites on existing infrastructure, could be considered and approved. For example, facilities owned and operated by other federal (non-NPS), state, and local government entities, or other entities providing direct communications for emergency services, could

¹ Although the existing NPS radio tower at Mt. Emma (located west of Tuweep) would remain under this alternative and in Alternative B, this tower and its operations are not influenced by, nor does it influence, the scope of this Plan. This tower is therefore outside of the action area and is not included within the impact analysis in Chapter 3.

be sited on NPS radio towers or other infrastructure provided the tower or building has the physical capacity and such facilities would not conflict with NPS use.

The NPS has not approved a permanent commercial telecommunications tower in GCNP since the 1960s. Under Alternative A, GCNP would continue to not authorize major telecommunications infrastructure, such as telecommunications towers, within the park.

Alternative B – Comprehensive Telecommunications Plan (Proposed Action and Preferred Alternative)

Similar to Alternative A, the NPS would continue to be required by the Telecommunications Act of 1996 to consider all ROW permit applications for the installation of telecommunications infrastructure on NPS lands and may elect to approve or deny these applications. However, Alternative B—the implementation of a comprehensive telecommunications plan—would provide a framework and guidance that would inform the processing and review of future ROW permit applications for telecommunications infrastructure throughout the park. If a ROW permit application is inconsistent with this alternative (i.e., plan) or other NPS policies, it may be denied. Similarly, if GCNP receives multiple conflicting ROW permit applications, the NPS may deny these applications. In either of these scenarios, GCNP may initiate a formal, structured ROW permit application process consistent with NPS policy. Implementation of this alternative would require site-specific review of future ROW permit applications in compliance with NEPA, the National Historic Preservation Act (NHPA), and other applicable laws and approval in accordance with current NPS policies.

Telecommunications Services

The NPS would review and potentially approve telecommunications ROW permit applications that would provide and/or improve telecommunications services in the North Rim, South Rim, and Desert View developed areas and along the two highway corridors (Hwy 64 and 67) (see [Figure 1.2](#)). The goal of these services would be to enhance telecommunications particularly within operational, visitor use, and residential areas (displayed as “concentrated use areas” in [Figure 1.2](#)).

Telecommunications Infrastructure

Similar to Alternative A, the NPS would consider renewals for existing telecommunications ROW permits on a case-by-case basis, with minor modifications and upgrades anticipated over time. The following types of telecommunications infrastructure could also be considered and approved.

Telecommunications Towers

The NPS would consider permitting the construction, installation, operation, and maintenance of up to five additional commercial telecommunications towers within the North Rim, South Rim, and Desert View developed areas of GCNP. If approved, these new towers would be permitted, sited, designed, constructed, installed, operated, and maintained in adherence to the [Parameters for All Telecommunications Towers and Associated Infrastructure](#) section. More specifically, one additional tower would be considered in each of the following five areas: In the vicinity of Hopi Fire Lookout, within or near Grand Canyon Village (outside the National Historic Landmark District (NHL)), and near Desert View (outside the historic district) on the South Rim; and in the vicinity of Lindberg Hill and in the vicinity of CC Hill on the North Rim. (See [Figure 2.1](#) for a map of these general locations.) Specific tower locations within these areas would be refined in the future by adhering to the [Parameters for All Telecommunications Towers and Associated Infrastructure](#) section. [Table 2.1](#) also shows the maximum height for these towers and minimum distance from the rim that would be considered. No commercial telecommunications towers would be permitted below the rim.

In addition, if a new telecommunications tower is constructed within the general area of Grand Canyon Village, the NPS may require the existing South Rim Village Tower to either be removed or relocated to an area near (approximately within 200-600 ft) the new tower. The existing South Rim Village Tower is

currently located within the Grand Canyon Village NHL, and removing or relocating it would remove this facility and associated infrastructure from the NHL. Should GCNP require this change, the relocated tower would be required to adhere to the [Parameters for All Telecommunications Towers and Associated Infrastructure](#). Since the existing South Rim Village Tower serves as the primary hub for the park's wired communications system and primary microwave backhaul facility, relocation could require several years for a successful transition. Regardless of the tower's location, equipment that is not related to the operations of the Incumbent Local Exchange Carrier for GCNP (the company that

Figure 2.1: Map of General Areas where Potential New Telecommunications Towers could be Sited under Alternative B

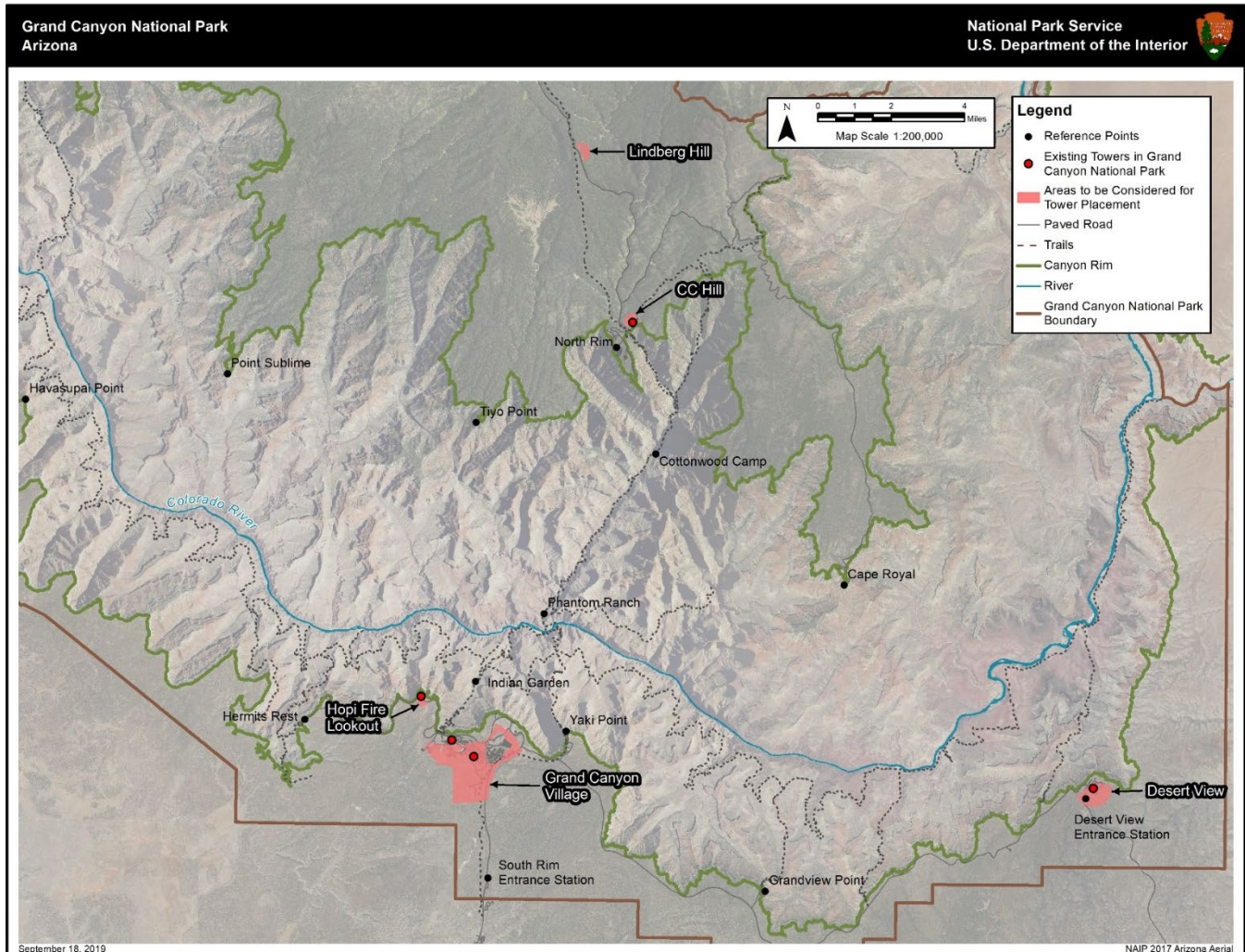


Table 2.1: Locations for Potential New Telecommunications Towers, Alternative B

Tower and Location	Height (ft)	Distance from Rim (ft)
Hopi Fire Lookout Area*	80	500
Grand Canyon Village*	120	1,500-6,999
	-----OR-----	
	180	7,000
Desert View*	80	750
Lindberg Hill	180	> 20,000
CC Hill*	180	500

* An NPS radio tower and/or commercial tower is within the general vicinity and is of similar height to the potential new tower in this location. The potential new tower in Grand Canyon Village is the only exception to this. The existing South Rim Village Tower is slightly shorter (107 ft) and much closer to the Rim (800 ft) than a potential new tower would be in this area.

provides telecommunications services, such as phone lines and data, directly to the NPS for operations), or is otherwise no longer necessary, would be removed, and microwave antennas would be upgraded to the best available technology. This clean up would reduce the infrastructure on this structure and its visual footprint on the landscape.

Potential new or relocated telecommunications towers under this alternative would be self-supporting towers that must be designed to accommodate co-location from other users whenever practicable. These towers would include antennas (microwave, cellular, and/or radio), a shared equipment shelter and/or cabinets (typically around 33 ft x 15 ft) for all co-locators, a shared generator shelter (typically around 12 ft x 15 ft) and fuel tank (which could be external depending on fuel type), electrical service equipment and wiring, safety lighting, and a perimeter fence. These facilities and infrastructure, including antennas, would be shared by all entities operating on the tower whenever practicable. GCNP would not support single entity occupied standalone infrastructure (e.g., towers) under this alternative. (See design and equipment requirements outlined under [*Parameters for All Telecommunications Towers and Associated Infrastructure*](#).) The maximum, total disturbed footprint for each telecommunications tower, including construction and staging, would be approximately 180 ft x 180 ft, or no more than 0.75 acres in size; the final developed footprint would be no more than approximately 0.25 acres.

Finally, all NPS radio towers would remain (see [*Table 1.1*](#)). As additional towers are permitted and constructed, all temporary telecommunications infrastructure would be removed from the park, and the NPS may require all non-governmental infrastructure on NPS telecommunications towers to be removed from this infrastructure.

Parameters for All Telecommunications Towers and Associated Infrastructure

Any new or relocated telecommunications towers within GCNP would adhere to the following parameters and criteria. Parameters may be modified or additional criteria may be developed in the future through site-specific analysis and/or as additional information about resources and potential impacts becomes available; the Plan may be updated accordingly.

Location and Siting Requirements

- Telecommunications towers would be constructed in or immediately adjacent to developed and/or previously disturbed areas that have available power in close proximity and are accessible via existing roads.
- Telecommunications towers would not be constructed within residential areas unless no other tower location is feasible in the surrounding area.
- Telecommunications towers would be constructed outside NHL and historic district boundaries, and, to the extent possible, located to minimize impacts to National Register eligible or listed historic properties and visitor use areas.
- Telecommunications towers would be sited away from prominent views or features. A site-specific review of impacts to scenic resources, particularly below the rim, may be required and proposals modified (i.e., proposed tower relocated or height reduced) to minimize visibility of towers to the greatest extent possible.
- Telecommunications towers would be sited at least 500 ft from known bird and bat concentration areas such as areas of breeding, roosting, or foraging (e.g. along the rim of the canyon and wetlands); migratory bird movement routes; and daily movement flyways. Towers would not be sited within 0.5 miles of known Mexican spotted owl or California condor nest or roost areas.
- Telecommunications towers would be sited outside of wetlands.
- Telecommunications towers and associated facilities would be designed, sited, and constructed to avoid or minimize disturbance to and removal of trees.

- All electrical power service, fiber, and other communications lines to new telecommunications towers would generally be buried, except when resource impacts are of particular concern (for example, archeological resources are present and impacts to these resources would be unavoidable if the line is buried), in which case above-ground lines may be approved.
- Telecommunications towers would be located in close proximity to existing NPS radio towers (if present in the general area) as long as the operation of the new tower would not interfere with the existing.
- Towers must be designed to accommodate current and/or future co-locations in order to minimize the number of additional towers that could be proposed by ROW applicants who would otherwise not be accommodated.

Design Requirements

- Telecommunications towers would be no higher than the minimum height necessary to provide telecommunications services to developed areas of the park (identified under [Telecommunications Services](#)). Ultimately, towers would be no taller than the height guidelines identified in [Table 2.1](#).
- A site-specific review of complete ROW applications for telecommunications towers may be required to evaluate selection of the proposed location and proposed height, in view of the relative merits of any feasible alternative, to ensure that proposed tower heights are the minimum necessary to provide services within the developed areas of the park and/or are technologically required to meet conditions such as line-of-sight requirements.
- All tower designs must be self-supporting; no guy lines would be permitted.
- Monopoles, lattice towers, and alternative designs, such as mimicked trees (only within forested areas and when not greatly exceeding surrounding vegetation), could be considered for tower design. Final tower design would be determined on a case-by-case basis that considers infrastructure needs and minimizes impacts to resources, including wildlife and scenic views. Monopoles would be preferable to lattice towers at locations within 1,500 ft of the rim unless alternative designs are determined necessary or demonstrate better blending with the environment.
- Telecommunications towers and associated facilities would be sited and designed to blend into the surroundings as much as possible to reduce the impact on National Register eligible or listed historic properties, scenic resources, and other resources.
 - Design and materials would be selected to blend with the existing landscape, for example through selection of appropriate colors, surface treatments, and use of non-reflective coatings for structures to reduce color contrast with the surrounding environment.
 - All antennas would adhere to the USDOJ-BLM camouflage guidelines to improve aesthetics (for example, two-way radio antennas are often sky blue or white in color to blend in with the skyline). Final colors would be determined on a case-by-case basis as part of permitting, and would be dependent on the location.
- Tower lighting would be considered on a case-by-case basis for safety purposes. If lighting is deemed necessary, the tower would be required to remain unlit except for during emergency situations such as when aircraft are needing to access a nearby helibase at night. For example, lighting could be activated by emergency personnel or technology such as an Aircraft Detection Lighting System, or equivalent, could be utilized to keep a tower unlit unless aircraft are detected by radar. Any lighting would be red and flashing when activated.
- Facilities surrounding the tower would remain unlit except when lighting would be required for safety or security purposes. Lighting would be designed to minimize impacts and would be motion- or heat-sensitive, down-shielded, and of a minimum intensity (lumens and color) to reduce nighttime bird attraction and eliminate constant nighttime illumination. External lighting would meet the standards utilized by the International Dark-Sky Association.

Infrastructure Requirements

- Telecommunications towers would promote facility and site sharing by multiple users. All telecommunications equipment including, but not limited to, towers, equipment shelters, outdoor cabinets, radios, backup power, and fuel supply would be co-located within the telecommunications site.
- The NPS would prefer that all service providers share antennas on the tower, but if not feasible, all towers primarily constructed for cellular purposes would have the capacity for multiple carriers.
- A site-specific review of complete ROW applications may be required to evaluate the feasibility of accommodating co-locators and to identify co-location strategies that would minimize the number, size, and height of a proposed co-located site.
- Applications for any co-located infrastructure on a tower near Hopi Fire Lookout would have to demonstrate the importance of and need for operations at this particular site as opposed to other tower locations within the park.
- The generator at each potential tower location would operate only during utility power failures and as required for proper maintenance and testing (per manufacture requirements). The generator would be fitted with a muffler, or equivalent, to reduce noise to a level that does not exceed 60 dBA within 50 ft of the generator. Diesel tanks would be double walled with leak detection.
- All wires would be contained or cleanly attached and colored similarly to blend in.
- To the extent practicable, the NPS would consider technologies to avoid spillover of cellular frequencies into the backcountry. The NPS acknowledges that spillover into the backcountry cannot be entirely avoided and that some unintended coverage in backcountry areas is possible, if not likely, considering available technologies.

Small-Cell Sites on Existing Infrastructure

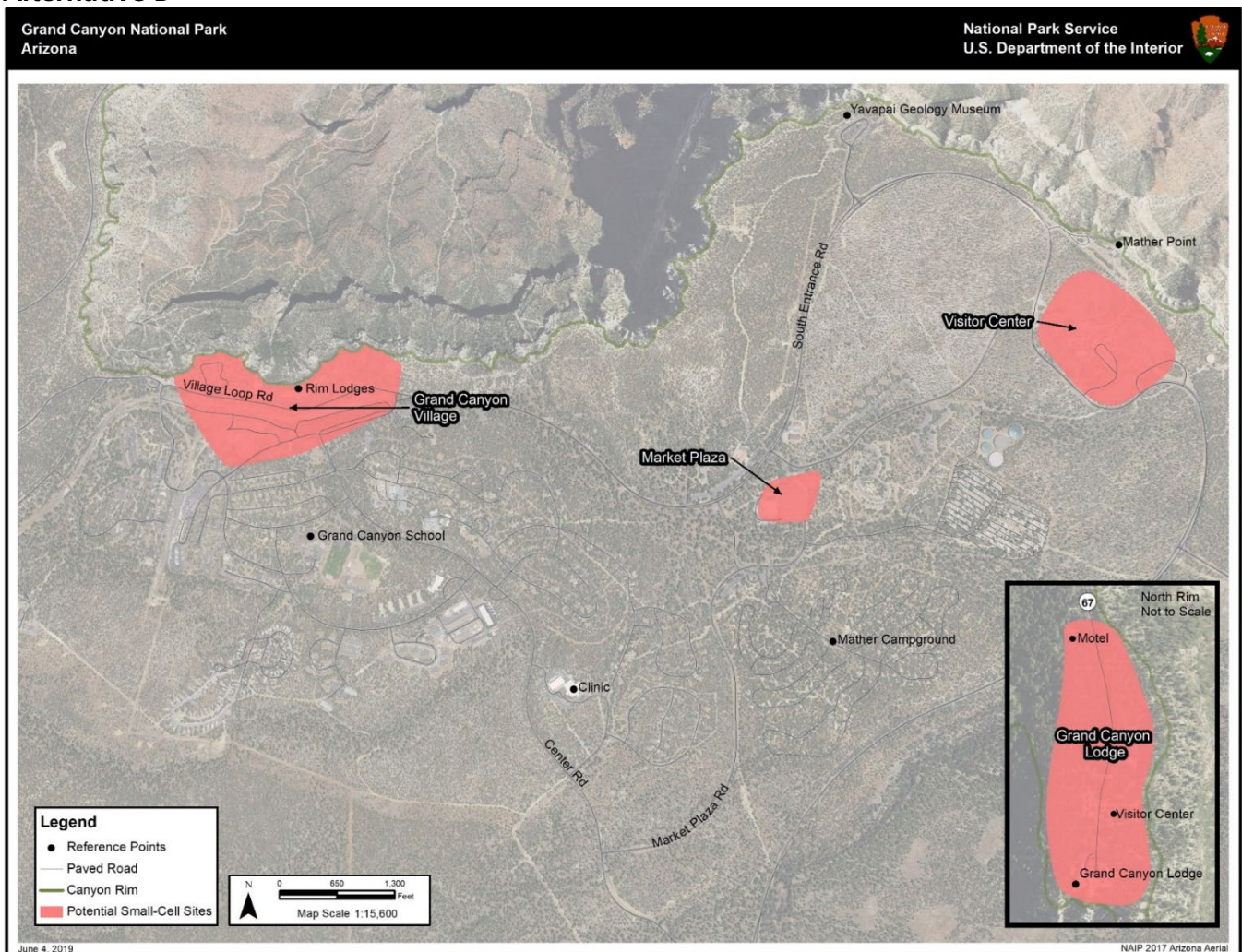
In addition to telecommunications towers, GCNP could also consider allowing the placement of small-cell sites in the following high visitor use areas: Grand Canyon Visitor Center, Grand Canyon Village, and Market Plaza on the South Rim, and surrounding Grand Canyon Lodge on the North Rim (see [Figure 2.3](#)). A small-cell site consists of an antenna panel and associated equipment that is mounted, within the context of this Plan, on or within existing infrastructure such as streetlights or buildings, generally at some elevation. A typical antenna panel could be three to four feet tall, about six inches wide, and four to six inches thick, with two to four of these mounted on a light pole, wrapping the pole (visually similar to having three power transformers that are wrapped on top of a power pole) (see [Figure 2.2](#)). If approved, these new small-cell sites would be permitted, sited, designed, constructed, installed, operated, and maintained in adherence to the [Parameters for All Small-Cell Sites and Associated Infrastructure](#) section.

Figure 2.2: Example of Small-Cell Site



Tim Gilk, NPS photo, 2019

Figure 2.3: Map of General Areas where Potential Small-Cell Sites could be Located under Alternative B



Parameters for All Small-Cell Sites and Associated Infrastructure

Any future potential small-cell sites within GCNP would adhere to the following parameters and criteria. Parameters may be modified or additional criteria may be developed in the future through site-specific analysis and/or as additional information about resources and potential impacts becomes available; the Plan may be updated accordingly.

- Small-cell sites would be considered only when there is a demonstrated need for additional capacity on the network.
- Small-cell sites would be able to accommodate multiple wireless telecommunications carriers through the use of combiners or equivalent technology.
- Small-cell sites would be mounted to existing buildings or fixtures (such as a light pole) and would be sited on these features to reduce its visibility from high visitor use areas as much as possible.
- No small-cell antenna or equipment would be placed on the roofs of historic structures that have no other modern equipment. Should a historic structure have existing, modern, equipment on the roof, small-cell antenna could be placed in close proximity to this other equipment.

- If located within NHLDs or historic districts, equipment would be sited out of sight or internally to avoid visual obstructions. Wireless carriers could be required to use various stealthing options to make installations blend with existing architecture or background.
- All small-cell antennas would be backhauled by high capacity fiber, or other technology such as T-1 lines or copper, that would need to be buried in conduit. Any boring or trenching to install fiber and conduit in areas where it does not currently exist would adhere to the description outlined in [Fiber Optic Communications Cable](#).
- Power would be fed from a connected building or facility (such as a light pole). Solar could also be used if installed out of sight and on an existing structure (like a roof).
- All wires would be contained or cleanly attached and colored similarly to blend in. Ideally, wiring and cables would be contained.
- Exterior equipment would be painted to blend into the environment.
- Any exterior support equipment such as cabinets or electronics would be sited close to the ground and adjacent to the antennas unless the equipment is placed on top of a building. Exterior support equipment would need to be sited outside of typical visitor views.

Two-Way Radio Communications Infrastructure

Under this alternative, non-governmental two-way radio communications infrastructure would be removed from the park and/or co-located on new telecommunications towers following the [Parameters for All Telecommunications Towers and Associated Infrastructure](#). Infrastructure owned and operated by other federal (non-NPS), state, and local government entities, or other entities that provide direct communications for emergency services, would also need to co-locate but may be allowed to be sited on NPS radio towers or other infrastructure provided the tower or building has the physical capacity and such infrastructure would not conflict with NPS use. NPS two-way radio communications would continue to be provided via existing NPS radio towers within GCNP.

Backhaul

In order to expand the capacity of bandwidth in the park for all public and private entities, the Plan would allow for a mixture of microwave antennas on new telecommunications towers and/or, preferably, high capacity fiber optic communications cable (fiber), along existing utility lines, roadways, or otherwise developed corridors within GCNP.

Microwave Antenna

This alternative would allow for microwave antennas (it is assumed for the purposes of this analysis that most microwave antennas on the rim could be 24 inch diameter integrated antennas, mounted at the top of towers with line-of-sight to other existing or potential new towers), of new but proven technologies, and associated boxes to be placed on any new commercial telecommunications tower where fiber is not present. Large (likely around 48 inch diameter) microwave antennas could also be placed on telecommunications towers within Grand Canyon Village, but the antennas would ultimately be reduced and/or removed if fiber is extended to the area. Similar to parameters identified for telecommunications towers and small-cell sites (which apply to this infrastructure as well, as applicable), these dishes would need to accommodate the backhaul of all users on the tower to avoid proliferation of dishes on each tower and would be designed to blend into the surrounding environment as much as possible.

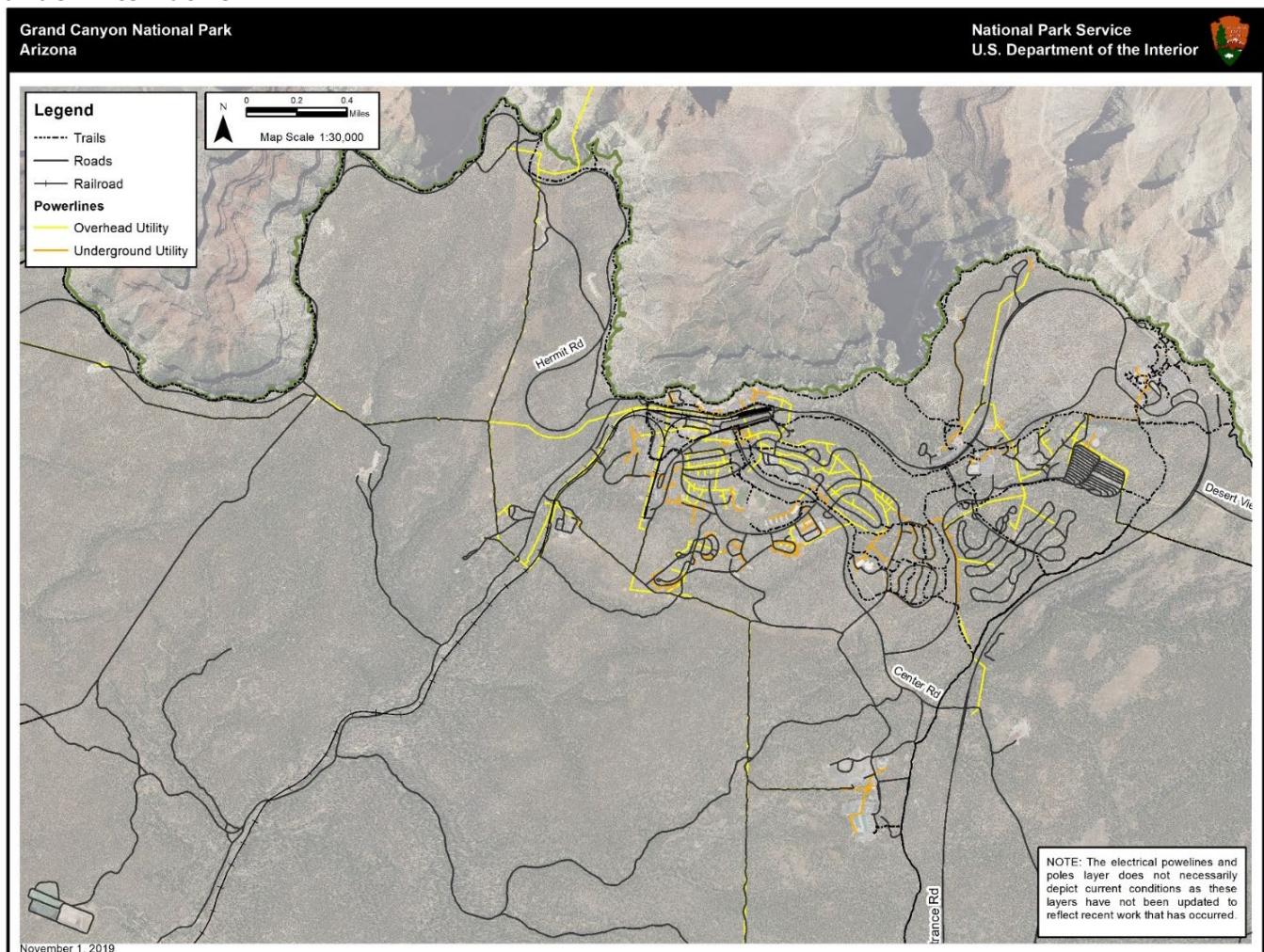
Fiber Optic Communications Cable

Backhaul via microwave may be a necessity given the remoteness of GCNP and the expense associated with installing fiber; however, preference would be given to providing backhaul via fiber. If and when possible, a new fiber network would be installed to and within the South Rim developed area to provide reliable telecommunications services to all users.

Under the proposed plan, fiber would be hung or, preferably, laid within conduit and buried along right-of-ways for existing park roads or greenways (paved trails), railways, power or other utility lines, or a mix of these options within the South Rim developed area and out toward Hopi Fire Lookout area and the Desert View developed area. A primary distribution line would extend from the southern boundary of the park to Grand Canyon Village and then extend to each of the existing and new telecommunications towers and small-cell sites on the South Rim, as feasible. Additional fiber would be connected to this system to provide services to park administrative, housing (including Supai Camp), visitor, and concessioner use facilities.

The precise location of buried fiber along existing roadways, railways, utility lines, etc., would be informed by the path of least impact. Wherever possible, the line would be sited to avoid archaeological resources, technical installation concerns, vegetation, safety considerations, and precise locations of existing utilities, including water, sanitary sewer, stormwater, communications, and electric. Above ground sections may be approved in instances where resource impacts are of particular concern (for example, archeological resources are present and impacts to these resources would be unavoidable if the line is buried). This hung fiber would only occur on existing lines. See [Figure 2.4](#) for potential fiber routes on the South Rim.

Figure 2.4: Map of Existing Utility and Transportation Corridors that could be used for Fiber under Alternative B



When buried, the fiber network would likely include one or two conduits within a common, narrow (approximately 18 inches wide) trench, buried at a typical depth of 20-30 inches, along up to 10 miles within the South Rim developed area. Each conduit could accommodate one or more fiber optic communication cables, and possibly other conductors such as copper wire, coax cable, or low voltage electric distribution and service lines. The fiber provider(s) would also include locator wires and marker tape to minimize the potential for accidental damage to the fiber. Buried fiber networks also include below grade handholes (visually similar to manholes but more shallow below grade) which are utilized for future splices and repairs without requiring excavation.

At the point when fiber is extended to the park, existing ROW permits within Grand Canyon Village and any other areas serviced by fiber would be renewed only if the permittee converted to fiber for backhaul. A condition of the new permit would be that the permittee connect to the fiber network within a reasonable timeframe and that any microwave dishes used for backhaul be removed. It is assumed that while some microwave antennas would be removed, antennas required for the backhaul to in-park towers that are not connected to fiber (i.e., those on the North Rim) would remain necessary.

Construction and Installation

Installation of telecommunications infrastructure that could be approved under this alternative would likely occur intermittently over the next two to five years as ROW permit applications are received, reviewed, and ROW permits for approved applications are issued. It is generally assumed that construction and installation of telecommunications towers would take place over the course of a month or two; installation of small-cell sites would take place over a few days for each location; and installation of fiber would take multiple days per mile if buried. Rehabilitation and revegetation would immediately follow installation, and monitoring for plant reestablishment would occur post treatment. If additional facilities are added to a tower post construction (for example, a company could obtain a ROW to add antennas to a potential new tower after it is constructed), additional work would occur at that site at a time other than initial construction and installation of the tower. The timing of all construction and installation would be closely coordinated with the NPS to minimize impacts to wildlife, visitors, and operations of the park and its partners.

Access to all sites for construction and installation would be by motorized vehicles on existing roads. In addition to access routes, the disturbance areas for construction and installation of telecommunications infrastructure would be less than 0.75 acres for each telecommunications tower (the final developed footprint is estimated at no more than 0.25 acres per site) and a typical 30 foot-wide corridor along the linear ROW permit route for the installation of fiber, which would occur along existing roads, railways, and other utility corridors. Should fiber be hung along existing utility corridors, this disturbance corridor could be up to 150 ft wide in specific locations to accommodate the installation of anchors to support the additional weight of fiber along existing poles. Staging areas would either be immediately adjacent to the project site if in an already developed area or within already established staging areas in the park.

Tools required for construction and installation of telecommunications towers would include an auger, excavator and/or backhoe, and crane. Tools required for installation of fiber include standard construction equipment such as cable plows, small backhoes/excavators, boring equipment (including jackhammers), trucks hauling conduit and fiber, and fuel trucks. All of this equipment would be on-site for the duration of installation in a particular area.

Operations and Maintenance

Any ROW permit issued for telecommunications infrastructure within GCNP would include permissions for the ongoing operation and maintenance of the infrastructure. Tools required for the maintenance of telecommunications infrastructure (including towers and fiber) are primarily mechanized or electronic hand tools. While heavier equipment would be required to address failures in

buried fiber (similar to the equipment used in construction), such failures are highly unlikely given the protected nature of buried fiber.

Any telecommunications infrastructure that is no longer in use or determined to be obsolete would be removed from the site within 12 months of cessation of use, preferably sooner.

Emerging Technologies

As technologies change overtime, the NPS may consider use of emerging technologies. Additional NEPA and other compliance and consultation may be necessary for these future projects.

ALTERNATIVES CONSIDERED AND DISMISSED

The following alternatives were considered during the development of the proposed plan but were dismissed from further consideration for the reasons explained below.

No or No Additional Cellular Service within GCNP

During public scoping, the NPS received public comments that suggested variations of this alternative, including: no cellular service, no cellular service to backcountry areas, no cellular service to the North Rim, and no expanded cellular service. The suggested alternatives that ranged from no or no additional cellular service within developed areas of GCNP were dismissed from further analysis as they do not meet the purpose and need for action.

As pointed out in *Visitor Use and Experience*, cellular coverage currently spills over into backcountry areas of the park. While it is not the intent of this Plan to increase or improve cellular services to/within backcountry areas, it is not technologically feasible at this time to prevent all cellular service from spilling over into these areas when providing services within developed areas. For this reason, this alternative was also dismissed from further analysis.

Utilize Communication Sites on Land Outside GCNP to Provide Services

While telecommunications infrastructure on adjacent lands outside the park, such as within Tusayan and the Kaibab National Forest, provide some cellular service to park lands and may have the potential to expand backhaul into the park, this development cannot provide cellular coverage to all developed areas within GCNP due to topography and line-of-site requirements between antennas. For example, even though the recent construction (since 2017) of a telecommunications tower at Grandview (on USFS land) expanded service toward Desert View, cellular coverage along Hwy 64 and at Desert View remains poor and spotty, if not non-existent, in some locations. While the NPS would certainly rely on external infrastructure as part of a larger telecommunications network, this alternative element, on its own, does not meet the purpose and need for action and was therefore dismissed from further consideration.

Co-Locate Commercial Facilities on NPS Radio Towers (No New Towers)

There are currently five NPS two-way radio towers within GCNP whose primary purposes are for visitor and resource protection, including law enforcement, emergency medical services, and wildfire response. While GCNP has previously allowed limited utilization of the NPS radio towers and communications sites for commercial telecommunications equipment, the NPS has dismissed further consideration of this alternative because additional antennas on NPS radio towers have the potential to cause technical interference with NPS radio frequencies, and raise security concerns about physical access to NPS facilities and infrastructure. For these reasons, this alternative has been dismissed from further consideration.

Utilize Existing Buildings Instead of Telecommunications Towers (No New Towers)

The use of existing buildings for macro sites (i.e., in lieu of telecommunications towers) would not meet the purpose and need for action as these structures are limited in their ability to provide service by existing heights and surrounding topography, the mass of the structure itself (which could block signal), and/or the structure’s inability to accommodate multiple carriers/equipment. That said, should technology evolve such that this alternative could meet the purpose and need for action while minimizing impacts to historic structures and other cultural resources, this alternative could be considered in the future, subject to additional planning and compliance and potential amendment to this Plan.

Rely on Small-Cell Sites Only for Coverage

Although the proposed plan includes the use of some small-cell technology *in addition* to telecommunications towers, the NPS also considered relying on small-cell sites only, *in lieu* of telecommunications towers. (In this context small-cell sites, which could be located on some existing light poles and buildings, would also need to be sited on new poles, generally around 30 ft tall.) However, this alternative was dismissed from further analysis because it largely fails to meet the purpose and need for action. First and foremost, small-cell sites provide wireless (including cellular—voice and data) data services; these facilities do not typically provide two-way radio communications, which is an additional need particularly within the Hopi Fire Lookout area. Second, small-cell sites have some of the same requirements as telecommunications towers with regards to backhaul and line-of-site requirements, making them almost completely ineffective without a taller telecommunications tower supporting the overall network. Vegetation and topography pose obstructions to line-of-sight requirements for this type of infrastructure that is typically at lower elevation than surrounding tree height. Third, the primary purpose of this technology is to expand capacity—providing service to more people at higher speeds and efficiently distributing the coverage to users; small-cell sites are not as efficient as expanding coverage, which is another need of this Plan. Rather than extending service in the metric of several miles, such as a telecommunications tower, small-cell sites are limited to less than a mile and a half on the far end of their range. Hermit’s Rest is over seven miles from Grand Canyon Village; Desert View is over 20 miles; and the North Rim Entrance Station is approximately 15 miles from Grand Canyon Lodge on the North Rim.

Finally, the primary benefit of considering small-cell sites is that they are typically shorter than a standard telecommunications tower and could have fewer and/or less intense impacts to views in the surrounding area. Under the proposed plan, the NPS would complete site-specific review of each proposal for a new telecommunications tower to ensure it is the minimum height required to provide coverage to developed areas. Nothing in this Plan prohibits the use of a shorter tower (i.e., small-cell site) in lieu of a more standard telecommunications tower should the technology prove capable of providing the coverage identified in the proposed plan. For these reasons, this alternative was dismissed from further consideration.

COMPARISON OF ALTERNATIVES

Table 2.2 includes a summary of the two alternatives considered within this Plan.

Table 2.2: Summary of Alternatives

Alternative Elements	Alternative A – No Action	Alternative B – Comprehensive Telecommunications Plan (Proposed Action and Preferred Alternative)
OVERALL		
	Consider all complete ROW permit applications to install telecommunications infrastructure on NPS lands	Same as Alternative A
	Site-specific review of future ROW permit applications in accordance with applicable laws, regulations, and policies	Same as Alternative A, but Plan would also inform reviews
	No comprehensive, park-specific guidance to inform reviews	Park-specific Plan, including parameters, would inform reviews
TELECOMMUNICATIONS SERVICES		
	Improvements in wireless services would occur as applications are reviewed and approved; unlikely to address existing deficiencies in service within developed areas of GCNP	Improvements in wireless services would occur as applications are reviewed and approved; infrastructure would be likely to fully address existing deficiencies in service within developed areas of GCNP
TELECOMMUNICATIONS INFRASTRUCTURE		
Existing Telecommunications Infrastructure	Renewals on a case-by-case basis, with minor modifications and upgrades anticipated over time	Same as Alternative A
	Additional minor telecommunications infrastructure, such as small-cell sites (below), considered on case-by-case basis	Same as Alternative A, though parameters established for infrastructure (below)
Telecommunications Towers	Existing telecommunications towers remain including five NPS radio towers and one commercial tower	Existing NPS radio towers remain
	No new telecommunications towers	Five new towers could be considered, one in each of five geographic areas: Hopi Fire Lookout area, Grand Canyon Village, Desert View, CC Hill, and Lindbergh Hill
		Existing South Rim Village Tower (commercial) could have equipment removed or the entire facility removed; tower could be relocated near a potential new tower in Grand Canyon Village
		Parameters apply with additional site-specific review
Small-Cell Sites	Could be considered on existing infrastructure	Could be considered on existing infrastructure within Grand Canyon Village, Market Plaza, Grand Canyon Visitor Center, and Grand Canyon Lodge
	Criteria considered on a case-by-case basis	Parameters apply with additional site-specific review

Alternative Elements	Alternative A – No Action	Alternative B – Comprehensive Telecommunications Plan (Proposed Action and Preferred Alternative)
Two-Way Radio Communications	Existing NPS radio towers remain Facilities owned and operated by other federal (non-NPS), state, and local government entities, or other entities providing direct communications for emergency services, could be sited on NPS radio towers or other infrastructure	Same as Alternative A, plus non-governmental two-way radio communications infrastructure would be removed and/or co-located on new telecommunications towers
Backhaul	Provided by microwave antenna; see <i>Existing Telecommunications Infrastructure</i>	Provided by microwave antenna and fiber optic communications cable

Chapter 3 – Impact Analysis

SCENIC RESOURCES: EXPANSIVE VIEWS OF THE GRAND CANYON AND OTHER IMPORTANT VIEWS

Affected Environment

Grand Canyon National Park was designated a national park (1919) and a World Heritage Site (1979) in large part because of its “exceptional natural beauty” and its consideration as “one of the world's most visually powerful landscapes” (UNESCO n.d.). The park’s inspirational scenic landscapes—its plunging depths, temple-like buttes, and vast, multihued labyrinthine topography—have been identified as fundamental to the park’s significance and establishment as a unit of the national park system (NPS 2017b). These scenic resources are also the primary reason for the park’s popularity as a tourist destination. In 2016, 94% of visitors surveyed indicated that they viewed “wildlife, natural features, scenery, and wildflowers” during their visit to the park—by far the most popular visitor use activity—and 53% reported that this activity was the most important reason for visiting the park (RSG 2017).

Best known of the park’s scenic resources are the expansive views of the Grand Canyon. The majority of the park’s approximately 1,218,375 acres are undeveloped; views toward the canyon are largely unimpeded by human-made structures, and those developments that are visible within these expansive views remain visually subordinate to the characteristic landscape being viewed, that of the Grand Canyon itself. These expansive views of the canyon are primarily visible only at or along the canyon rim or below the rim itself due to vegetation and topography. For visitors at almost any distance (i.e., more than 200 ft) from the rim, views of the canyon are largely screened, if not blocked entirely, by topography, vegetation, and, to a lesser extent, buildings and other human-made features. Because of this screening, views from areas other than below or at the canyon rim are largely characterized by sparse-to-dense forest canopy and/or buildings.

Existing telecommunications infrastructure, primarily towers, are currently visible from some locations within developed areas of GCNP. In 2016, the NPS identified 26 views (consisting of the viewpoint, the viewed landscape when facing a specific direction—often looking towards the canyon, and the potential viewers) within developed areas of GCNP that see high levels of visitor use and were identified as being of high value to the visitor experience. Visual surveys were then conducted of each of these views (Meyer and Schenk 2018).² Using these surveys as a baseline, GCNP staff conducted field visits to these viewpoints and the surrounding developed areas in 2019 to identify where, and to what extent, existing towers and related infrastructure are visible from these high use visitor areas (see Appendix C, which includes photos of the 26 surveyed views, some photos of secondary views from these same viewpoints, and photos of views from other locations in developed areas of the park where existing towers are visible). Of the 26 specific views identified and surveyed by the NPS in 2016, three are currently impacted by towers—meaning an existing telecommunications tower is within the frame of the surveyed, or primary, view (e.g., when facing toward the expansive views of the canyon). Eight other surveyed views have towers that are visible within secondary views (e.g., when facing away from the canyon) from that viewpoint or are visible from another viewpoint in the general vicinity such that a visitor may see the tower as they travel through the area. The visibility of existing towers from the 26 surveyed views (as well as secondary, non-surveyed views from the same viewpoint) and other high visitor use areas is described below (see also Appendix D).

The degree to which a tower, or other telecommunications infrastructure, may be visible is impacted by a number of factors, including:

² This report includes one additional view (for a total of 27 total views) that is from a viewpoint not within GCNP: Lees Ferry.

- The distance between a viewer and infrastructure often dictates the visibility of the infrastructure. For example, a tower may dominate a view at 100 ft, but would not be discernible from several miles away.
- The topography, vegetation, and development between the viewer and the infrastructure can fully or partially obstruct visibility of the infrastructure, even at relatively close distances. This can change dramatically as one travels through an area such that the degree of visibility of infrastructure, such as a tower, may change (e.g., from *not visible* to *visible and conspicuous* or vice versa) even within a couple of feet.
- The physical profile of telecommunications infrastructure, particularly towers (i.e., the design of the tower and the amount of antennas and microwave dishes on the structure) can make the tower more visually conspicuous or less visually conspicuous.
- The visual context (background) of a view can impact how conspicuous infrastructure may be within the view. For example, a tower may blend into a view more easily when other infrastructure is present or a tower may be more conspicuous if it is located on the horizon.

Considering these factors, GCNP has identified the following degrees of visibility to allow for some consistency in describing the impacts of existing and potential new towers and other telecommunications infrastructure. When completing the field visits in 2019, GCNP staff rated the visibility of each existing telecommunications tower based on the following criteria:

1. Not Visible
2. Visible, but not Distinguishable: Need to know what you are looking for.
3. Visible, but not Conspicuous: May be visible, but does not overshadow everything.
4. Visible and Conspicuous: May be considered obtrusive by some.

Based on these defined degrees of visibility, current visibility of existing telecommunications towers within developed areas of GCNP is as follows:

- NPS radio tower near Hopi Fire Lookout: As a visitor travels along West Rim Drive and West Rim Trail between the Abyss Overlook and Trailview One, this 80 ft tower and some of the surrounding two-way radio antennas are generally *not visible* when facing toward the canyon but can range from *not visible* to *visible and conspicuous* in specific locations when facing away from the canyon.

As a visitor travels along the rim trail between El Tovar and Yavapai Geology Museum, or from viewpoints east toward Yaki Point, this tower and some of the surrounding two-way radio antennas are generally *not visible* but may be *visible, but not conspicuous* from some stretches along this trail. At Yaki Point (which is over four miles away), this tower becomes *visible but not distinguishable*.

While the tower may be visible within a visitor's view of the canyon from areas discussed above, the tower is generally to the west and not within the primary view of the canyon itself. See pages C-4 to C-6, C-13 to C-15, C-16 and C-21 in Appendix C for photos of the current visibility of the NPS radio tower near Hopi Fire Lookout.

- NPS radio tower at Station One: As a visitor travels along West Rim Trail from Powell Memorial to Trailview One or along the rim trail from west of Yavapai Geology Museum to the junction with the trail to Park Headquarters, this 60 ft tower is generally *not visible* or *visible, but not distinguishable*, but may be *visible, but not conspicuous* in some discreet locations. For the most part, if it is visible, visitors need to know what they are looking for to see this tower from these locations (i.e., *visible but not distinguishable*), and all views of this tower are when facing away

from expansive views of the canyon. See page C-9 in Appendix C for photos of the current visibility of the NPS radio tower at Station One.

- South Rim Village Tower: As a visitor travels along West Rim Drive and West Rim Trail from Powell Memorial to Trailview One or along the rim trail from west of Yavapai Geology Museum to the junction with the trail to Park Headquarters, this 107 ft tower is generally *not visible* but may be *visible, but not conspicuous* along some sections of the trails. From these trails, all views of this tower are when facing away from expansive views of the canyon and looking toward Grand Canyon Village; these views toward this tower also contain development within the Village such as the El Tovar, parking lots, and the roofs of buildings (e.g., the school).

As a visitor walks or drives along Village Loop Road near Bright Angel Lodge or around the Powerhouse area, this tower is regularly blocked entirely from view by buildings, but can be *visible and conspicuous* when not screened by buildings or vegetation. This tower is *not visible* from the Grand Canyon Depot or surrounding area, and most views of the tower are when facing away from visitor amenities within this area. There are no expansive views of the canyon within this area.

The South Rim Village Tower is also visible from some residential areas within Grand Canyon Village, such as along Tonto Drive as one approaches Center Road. Although it may be considered *visible and conspicuous*, the number of locations from which this tower is visible are so few that it is very possible a resident could drive through this area many times without noticing the tower.

See pages C-7, C-9 to C-11, C-13, and C-15 in Appendix C for photos of the current visibility of the South Rim Village Tower.

- NPS radio tower at Desert View: This 80 ft tower is intermittently *visible, but not conspicuous* as a visitor stops at Lipan and Navajo Points and travels along Hwy 64 within a half mile of Desert View from the west. The tower is also *visible and conspicuous* as a visitor travels along Hwy 64 from the eastern entrance of the park (approximately $\frac{1}{4}$ mile), enters the Desert View area, and parks their vehicle. However, once they enter the primary visitor use area of Desert View (equivalent to the Desert View Historic District), this tower is not visible until one reaches floors two-five of the Desert View Watchtower, from which the tower is *visible and conspicuous* when facing away from the canyon and toward other visitor use and administrative infrastructure, such as the Trading Post, General Store, and parking lots. Although the tower may also be *visible, but not conspicuous* from some portions of the campground, you typically need to know what you are looking for in order to spot the tower given some of the surrounding vegetation (i.e., the tower is mostly *visible but not distinguishable* within the campground). From the residential and administrative areas, the tower is also *visible and conspicuous* given its proximity to these areas. All views of this tower from visitor use areas at Desert View are when facing away from the canyon. See pages C-25, C-27, and C-28 in Appendix C for photos of the current visibility of the NPS radio tower at Desert View.
- NPS radio tower at CC Hill: When traveling north along short segments of the Bridal Path or north along Hwy 67 a half mile before the South Kaibab Trailhead, this 180 ft tower may be *visible, but not conspicuous* within some discreet locations, but one typically needs to know what they are looking for to spot this tower as it is often framed by vegetation (i.e., the tower is primarily *visible but not distinguishable* when it is visible). This tower is also *visible and conspicuous* along a short segment of the Ken Patrick Trail as visitors walk in close proximity to this structure. All of these views are characterized by dense forest and do not contain expansive views of the canyon.

Visitors may also be able to see the NPS radio tower from the end of the Bright Angel Trail as they look back toward Grand Canyon Lodge, but viewers typically need to know what to look for in order to spot the tower given the surrounding topography, vegetation, and dramatic views that draw the viewer to look elsewhere. At almost two miles away, this tower is primarily *visible but not distinguishable* but may be considered *visible, but not conspicuous* by some observers who are more attuned to this type of infrastructure.

See pages C-30 and C-32 in Appendix C for photos of the current visibility of the NPS radio tower at CC Hill.

In addition to telecommunications towers, some minor telecommunications infrastructure (such as antennas on existing buildings and equipment shelters associated with NPS radio towers) are *visible but not conspicuous* within discreet locations throughout the developed areas of GCNP. Given the relatively small size and profile of these facilities in comparison to surrounding infrastructure and the complexity of the built environment within developed areas of GCNP, this infrastructure is largely screened from most views by vegetation, buildings, and/or topography and when visible, this telecommunications infrastructure is visible only within close proximity and typically it visually blends into the surrounding area (visual contrast levels are low). While some secondary views include existing antennas or similar telecommunications infrastructure, none of this infrastructure impacts the 26 primary, surveyed views or other expansive views of the Grand Canyon.

Environmental Consequences

Impacts of Alternative A – No Action Alternative

Direct and Indirect Impacts

Under Alternative A, ongoing adverse impacts to scenic resources from the six existing telecommunications towers and other telecommunications infrastructure within developed areas of GCNP would continue into the future (see [Affected Environment](#)); however, modifications or upgrades to existing telecommunications infrastructure could result in some additional adverse and/or beneficial long-term (generally for the duration of a ROW permit, which is typically 10-15 years; or more as these permits can be renewed) impacts to scenic resources. Larger, replacement infrastructure could be proposed in order to improve telecommunications services within GCNP which would increase the visual footprint of facilities, resulting in adverse impacts to scenic resources. Upgrades to equipment could also reduce visual footprints as technology becomes more efficient and requires less physical space to provide services, resulting in a reduction of adverse impacts to scenic resources, or otherwise a beneficial impact in comparison to existing conditions. This said, because the locations of this infrastructure would not change and are typically outside of primary visitor views, these adverse and/or beneficial impacts are not expected to measurably impact scenic resources. Neither would change the degree of visibility of existing infrastructure such that a facility which is, for example, currently *not visible* or *visible, but not distinguishable* would become more visible (i.e., *visible, but not conspicuous*, etc.) or visible from more locations as a result of implementing the No Action Alternative.

Similarly, the installation of new, minor telecommunications infrastructure such as new antennas (e.g., microwave or small-cell antennas) on existing infrastructure is not expected to have measurable impacts on scenic resources because these facilities would be attached to existing infrastructure, would be small in comparison to the surrounding infrastructure, and would generally be outside typical visitor views. While these facilities may introduce a new feature within a view—such that a facility could be visible from certain, discreet vantage points—given the relatively small size of these facilities in comparison to surrounding infrastructure and the complexity of the built environment within developed areas of GCNP, new telecommunications infrastructure would likely be visually screened by surrounding vegetation and/or other infrastructure from most viewpoints, and visual contrast levels

would be low. Any views of these facilities would likely be intermittent and would be unlikely to arise to the level of *visible and conspicuous* such that observers would find the facilities obtrusive.

Considering the factors above, the No Action Alternative could lessen existing impacts to some scenic resources into the future if improved technologies are utilized that minimize the footprint of existing telecommunications infrastructure. However, scenic resources would also be adversely impacted, long-term (10-15 years or more) from the addition of infrastructure within scenic views. Although a few (less than five) of the 26 views surveyed in 2016 could include updated or new telecommunications infrastructure (for example, three views are currently impacted by telecommunications infrastructure which could be modified and another two have some existing buildings within the view on which telecommunications infrastructure could be added), none of these facilities would arise to the level of *visible and conspicuous*, and no telecommunications infrastructure is expected to be added within surveyed views where no other infrastructure exists given the nature of these views (most are of expansive views of the canyon and include very little area on the canyon rim on which infrastructure could be placed). Because any telecommunications infrastructure approved under the No Action Alternative would be relatively small and placed within the context of other infrastructure, these facilities would be unlikely to stand out as more visually obtrusive than current conditions. None of these impacts would alter expansive views of the Grand Canyon.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions have and will continue to adversely impact scenic resources in GCNP such that human-made infrastructure is *visible and conspicuous* in much of the developed areas of the South and North Rims and Desert View. Past and present developments (including some existing telecommunication towers in the park), particularly those visible within views toward the canyon, would remain and would continue to be visible to visitors from high visitor use areas such as the West Rim Trail and the Grand Canyon Village NHL. Reasonably foreseeable actions, such as installation of two temporary towers within Grand Canyon Village, hung fiber on existing poles to and through the Grand Canyon NHL, and some visitor use facilities at Desert View would add infrastructure that would be visible within some developed areas of the park. Other reasonably foreseeable actions, such as the relocation of the power substation (currently next to the Powerhouse) to an area outside of the Grand Canyon Village NHL and the relocation of the former visitor center at Desert View to a location outside of the visitor use area would remove at least one large piece of infrastructure from views in the Village and Desert View, respectively. Because this alternative would result in the potential modification to existing and addition of some new minor telecommunications infrastructure within views at GCNP, this alternative would result in minimal adverse impacts on scenic resources. When the effect of the no action alternative are combined with the effects of the past, present, and reasonably foreseeable actions, the total cumulative impact to scenic views—particularly expansive views of the Grand Canyon—within developed areas of park would be adverse, with a minimal contribution of adverse impacts from the no action alternative. That said, the characteristic, expansive views of the canyon and within the canyon itself would continue to remain largely untouched, demonstrated by minimal number of surveyed views that would include human-made development and the far greater expanse of lands beyond the developed areas of GCNP that would continue to retain a high degree of scenic integrity.

Impacts of Alternative B – Preferred Alternative

Direct and Indirect Impacts

Impacts outlined under Alternative A from the continued existing of existing telecommunications infrastructure, modification or upgrade to existing telecommunications infrastructure, and installation of new minor telecommunications infrastructure would be similar under Alternative B, except some additional criteria would apply to the installation of small-cell antennas such that this infrastructure would not impact scenic views outside of Grand Canyon Village, Market Plaza, the Visitor Center, and

the Grand Canyon Lodge. In addition, the installation of fiber and telecommunications towers and removal of some telecommunications infrastructure, including the potential removal and/or relocation of the South Rim Village Tower, have the potential to impact scenic resources within the park, including some expansive views of the Grand Canyon, for the next 10-15 years or more.

Installation of fiber is not expected to impact scenic resources because the cable would be buried in most cases. If there were a reason to hang the cable above ground, for example to avoid impacts to an archaeological site or sensitive natural resources, the impacts on scenic resources would be minimal because the cable would generally be placed on existing poles within existing utility corridors that are typically outside of characteristic views of the canyon. This fiber, if hung, would introduce a visual component but would easily blend into the surrounding environment such that it would likely be *visible, but not conspicuous* within views that already include other utility lines.

Potential new towers and the removal and/or consolidation of existing telecommunications infrastructure would impact views in developed areas of GCNP, many of which contain existing towers. In addition, some new towers could be visible within views that do not currently include this type of infrastructure. Impacts related to the installation of towers would be adverse and would last 10-15 years or more. Impacts related to the removal of existing infrastructure would be permanent and beneficial.

The most apparent impacts to scenic resources are expected to be in developed areas of GCNP – either in close proximity to potential new or relocated towers and associated infrastructure and/or in higher visitor use areas where visitors are frequently present to experience views of the canyon. In general, views within areas immediately surrounding new and potentially relocated towers could be impacted by these developments, but the degree of visibility would change as observers move further from the infrastructure. Shelters and fencing, which are more noticeable close up, would quickly be screened by vegetation, topography, and other developments, and the uppermost sections of the towers would become the visible feature from further away, with the visible portions of the tower being situated just above the tree line. Towers, which could be screened, if not blocked entirely, by surrounding topography, vegetation, and development even in areas of close proximity, would eventually become obscured from view at distances of several miles. Considering these factors, most views of towers within developed areas of the park would largely be intermittent and would likely require a discerning eye that knows what to look for in order to see a new or potentially relocated tower (i.e., equivalent to *visible, but not distinguishable* or *visible, but not conspicuous* to those with a discerning eye).

Views within the South Rim Developed Area would be:

- **Adversely impacted by one additional tower near Hopi Fire Lookout** that would be in close proximity to the existing tower and of comparable height and visibility. Impacted views would be similar to those that are currently impacted by the NPS radio tower near Hopi Fire Lookout, such as: from Powell Memorial and Hopi Point, views along the rim near El Tovar, along the rim trail west of the Yavapai Geology Museum, and at Yaki Point. Given the distance from these viewpoints—except for those within several hundred feet of the tower (e.g., Powell Memorial)—this additional tower would range from *not visible* to *visible, but not conspicuous* and would not dominate the landscape. The tower would likely be *visible and conspicuous* from Powell Memorial and the Hopi Point area, similar to the visibility of the existing NPS radio tower in the area, but would only be visible when facing south, away from the canyon.

While views of this tower from West Rim Drive and West Rim Trail (between the Abyss Overlook and Powell Memorial) would face away from the canyon, views along the rim trail east of the Grand Canyon Village NHLD would typically include expansive views of the Canyon. Because the potential new tower would be at minimum 1.25 miles away from these viewpoints, it would be small in scale and would not dominate the landscape.

- **Beneficially impacted by the removal of antennas and other infrastructure from the Hopi Fire Lookout area** which are currently *visible and conspicuous* from some locations along West Rim Drive (e.g., Powell Memorial) and are *visible but not distinguishable* from locations along the rim trail within the Village (e.g., El Tovar). This infrastructure would no longer be visible (*not visible*) if an when removed. Impacted views would be the same as those that are currently affected by the telecommunications infrastructure near Hopi Fire Lookout, such as: southern facing views from Powell Memorial (away from the canyon) and northwestern facing views from along the rim (e.g., from El Tovar) that include expansive views of the canyon.
- **Adversely impacted by one to two additional towers within Grand Canyon Village** (depending on whether or not the South Rim Village Tower is relocated) that would be on or below the horizon. Impacted views could include those that are currently impacted by the existing NPS radio tower at Station One and/or some additional areas within and surrounding Grand Canyon Village that do not currently include a telecommunications tower, such as: the parking lot of the Visitor Center, the tribal medallion near Mather Point, some residential areas within the Village, the Horace M. Albright Training Center, short segments of South Rim Entrance Road and Center Road (estimated at no more than a mile of these roads), and any area within the immediate vicinity of the new tower(s). Given the surrounding vegetation and development within the Village, the distance at which these towers could be from many viewpoints, and the NPS efforts to reduce the visibility of new and relocated towers through additional site-specific reviews, the visibility of this tower(s) would range from *not visible* to *visible, but not conspicuous* and would not dominate the landscape as there would be low levels of visual contrast between the tower(s) and surrounding development. None of the impacted views would include expansive views of the Canyon, particularly because the tower would be at least 1,500 feet from the rim.
- **Beneficially impacted by the decreased visual footprint or removal of the South Rim Village Tower** that is currently *visible and conspicuous* from some locations within the Village and is *visible, but not conspicuous* from locations along the West Rim Trail and rim trail to the east of the Grand Canyon Village NHTLD. Impacted views would be the same as those that are currently affected by the South Rim Village Tower, such as: along the West Rim Trail, from the Bridge Angel Lodge and staircase at the railroad tracks, the Powerhouse and surrounding area, some residential areas within the Village, and along the rim trail just west of Yavapai Geology Museum. These beneficial impacts would range from decreasing the prominence of the tower by reducing its visual footprint to completely removing a prominent feature within the view. While most of these views would not include expansive views of the Canyon, views along the West Rim Trail and rim trail within and east of the Grand Canyon Village NHTLD include views of the canyon, looking back toward the Village.

Views within the Desert View Developed Area and Hwy 64 Corridor would be:

- **Adversely impacted by one additional tower near Desert View** that would be of comparable height and visibility as the existing tower. Impacted views would be similar to those that are currently affected by the NPS radio tower at Desert View, such as: Lipan Point, Navajo Point, approximately ½ mile of Hwy 64 near Desert View, the parking lots, the residential area, some parts of the campground, and floors two-five of the Desert View Watchtower. From areas from which this tower would be visible, it would likely range from *visible, but not conspicuous* to *visible and conspicuous* and could impact views of the San Francisco Peaks and Kendrick Mountain from the Desert View Watchtower by either framing the peaks in conjunction with the existing tower or partially obstructing the view of these mountain ranges. The level of impact would depend on the final site selection and the perspective from which the tower would be viewed.

All views of this additional tower would be facing south, away from expansive views of the canyon and toward other visitor use infrastructure including the Trading Post, General Store, restroom building, former visitor center, and parking lots. None of the impacted views would include expansive views of the Canyon.

Views within the North Rim Developed Area and Hwy 67 Corridor would be:

- **Adversely impacted by the introduction of one additional tower in the vicinity of CC Hill** that would be in close proximity to the existing tower and of comparable height and visibility. Views impacted by this tower would be similar to those that are currently impacted by the NPS radio tower at CC Hill, such as: along a short section (less than a half mile) of Hwy 67 south of the North Kaibab Trailhead, intermittently along the Bridal Path, and along the Ken Patrick Trail as it goes through the CC Hill area. Because tower visibility would be heavily framed or screened by vegetation or at a great distance from viewpoints, the new tower would largely be unnoticed unless one is searching for the tower and knows where to look for it. This additional tower would therefore range in visibility from *not visible* to *visible, but not conspicuous* and would not dominate the landscape. None of the impacted views would include expansive views of the Canyon.

This tower could also be *visible but not conspicuous* from Bright Angel Point when looking back toward the Grand Canyon Lodge (which includes views of the canyon), but given the surrounding topography, vegetation, and dramatic views that draw the viewer to look elsewhere, viewers typically need to know what to look for in order to see the tower (i.e., *visible but not distinguishable*). Most visitors are unlikely to notice a new tower within the vicinity of CC Hill from this location.

- **Adversely impacted by the introduction of one tower in the vicinity of Lindbergh Hill** that would be intermittently *visible, but not conspicuous* along some short sections (several hundred feet) of Hwy 67 a few miles south of the entrance station. Given the surrounding vegetation and topography along Hwy 67 (the tower would be almost directly above the road, making it challenging to see from a vehicle), any visibility of a tower would be heavily framed or screened by vegetation, and the tower would largely go unnoticed from this area. This new tower could also be visible along one to two miles of the Point Sublime Road, but given the distance between the potential tower location and viewpoints along the road (about 2.5 miles between Lindbergh Hill and the Basin) and NPS efforts to reduce the visibility of this potential tower through additional site-specific review, it is unlikely to be more than *visible, but not conspicuous*. As views from these areas do not currently contain infrastructure other than a road, this alternative would have long-term (10-15 years or more) adverse impacts to scenic resources in these areas by introducing a non-conforming feature within an area currently characterized by natural attributes that would be noticeable when visible (potentially higher visual contrast with surrounding area). That said, the tower would be unlikely to dominate the landscape from either location given the factors identified above.

Given the distance this potential tower would be from the rim (over 20,000 feet), none of the views impacted include expansive views of the canyon.

In summary:

- There would be few views in the park in which a new tower would be introduced where one does not already exist. Three of the five potential new tower locations would be adjacent to existing towers (Desert View, CC Hill, and Hopi Fire Lookout). In these instances, the viewpoints from which these towers are visible are already adversely affected by existing towers, but one additional tower, of similar degree of visibility, would be added within these views. This

would be a noticeable adverse impact and may rise to the level of *visible and conspicuous* for views in which existing towers are apparent (Desert View Watchtower and views along West Rim Drive like Powell Memorial), but the degree of visibility would be unlikely to change from existing conditions because factors that influence the visibility of existing towers would be the same for potential new towers. In addition, some new views on the South Rim and North Rim (around Grand Canyon Village and Lindberg Hill) could be adversely impacted by the addition of one or two new towers where this type of infrastructure does not currently exist. This would be a noticeable adverse impact and may rise to the level of *visible, but not conspicuous* within these new viewpoints. Actual visibility would often be much less than the degrees of visibility identified above given that GCNP would conduct site-specific reviews on potential tower locations to further minimize impacts to scenic resources, particularly to reduce a potential tower's visibility below the rim.

- Despite the possible visibility of potential new towers, new infrastructure that could be considered under this alternative is not expected to dominate the landscape nor noticeably impact expansive views of the Grand Canyon. Except for the potential new tower near the Hopi Fire Lookout, views of these towers would be directed away from expansive views of the canyon, and most views of these towers would be characterized by surrounding vegetation and/or development which would serve to visually screen, if not entirely block, these towers from much of the surrounding areas.
- Some existing views, particularly those within the Grand Canyon NHTL and along West Rim Drive would also be noticeably and beneficially impacted from the removal of existing infrastructure near the Hopi Fire Lookout and the decrease in the visual footprint, if not potential removal, of the South Rim Village Tower that is currently *visible and conspicuous* from some locations.

Ultimately, Alternative B would have long-term (10-15 years or more) adverse impacts on scenic resources within the park; three of the 26 surveyed views, which are currently impacted by existing towers, could be additionally impacted by this alternative, and secondary views from another eight surveyed viewpoints, which are also currently impacted by existing towers, could be adversely impacted as well. That said, expansive views of the Grand Canyon both within and along the rim would remain largely intact under this alternative. Scenic resources in no more than 5% of the park could be impacted; a large expanse of lands beyond the developed areas of GCNP would continue to retain a high degree of scenic integrity.

Cumulative Impacts

The cumulative impacts of past, present, and reasonably foreseeable future actions are similar to those described under the No Action Alternative. When combined with past, present, and reasonably foreseeable actions, this alternative would incrementally add features within views that already contain human-made structures of comparable intensity but would also adversely impact some views that either do not contain towers (within Grand Canyon Village) or are currently characterized primarily by natural attributes (such as views along Hwy 67 near Lindberg Hill), thereby increasing the number of scenic resources in the park, by a small amount comparable to existing, that include human-made infrastructure. This alternative could also result in the visual downsizing or potential removal or relocation of an existing tower that is *visible and conspicuous*, which would remove existing adverse impacts on scenic resources within the Grand Canyon NHTL and West Rim Drive. When the effects of Alternative B are combined with the effects of the past, present, and reasonably foreseeable actions, the total cumulative impacts to scenic views—particularly expansive views of the Grand Canyon—within developed areas of park would be adverse, with a noticeable contribution of adverse impacts from Alternative B. That said, the characteristic, expansive views of the canyon and within the canyon itself would largely remain untouched, demonstrated by minimal number of surveyed views that would

include human-made development and the far greater expanse of lands beyond the developed areas of GCNP that would continue to retain a high degree of scenic integrity.

CULTURAL RESOURCES: HISTORIC DISTRICTS

As mentioned in Chapter 1, site-specific analysis is not possible within this EA due to the level of uncertainty regarding what telecommunications companies may propose via ROW permit applications in the future. The NPS has therefore conducted a higher level of analysis in this EA to assess the general environmental issues, impacts, and benefits relating to broad, programmatic decisions about the design and siting of future telecommunications infrastructure in GCNP. When a complete ROW application is received in the future, site-specific reviews and additional compliance with NHPA would occur to identify, evaluate, and avoid or mitigate potential impacts to cultural resources. During these reviews, any impacts to historic properties would be further evaluated and mitigated as appropriate.

Affected Environment

The implementation of this Plan could affect up to eleven National Historic Landmark Districts (NHLDs) and historic districts (HDs) and their contributing resources within GCNP. These districts have been documented in National Register nominations, cultural landscape reports (CLRs), and/or cultural landscape inventories (CLIs).

Five of the six existing telecommunications towers within GCNP are visible within and/or from some of the districts as described below. While views of this infrastructure are often partially obscured or obstructed by topography, vegetation, or other buildings, as described within [Scenic Resources](#), visibility of these towers within and from districts ranges from *not visible* (most common) to *visible and conspicuous* in some discreet locations within a district. In addition to telecommunications towers, some telecommunications infrastructure is located within and/or is visible from some of these districts, including: antennas, which are located on utility poles, building roofs, and towers; equipment sheds or cabinets and fencing, which are located adjacent to existing towers; and fiber, which is primarily buried underground. Although this infrastructure occurs within some of the districts described below, the visibility of this infrastructure ranges from *not visible* (again, most common) to *visible, but not conspicuous* given that all of these properties are within developed areas and the infrastructure is either sited out of view or largely blends into the built environment. Because the siting of this infrastructure within a district or within views of a district adds a non-contributing element that is within and/or visible from the cultural property, this infrastructure has existing adverse impacts on the materials (if sited within) and/or setting and feeling of these districts. That said, these adverse impacts do not diminish the eligibility of listing these properties in the National Register because the areas impacted by existing telecommunications infrastructure are often a small percentage of the much larger district and the districts impacted by this infrastructure continue to retain a high level of integrity.

South Rim Developed Area

Grand Canyon Village National Historic Landmark District

The 130-acre Grand Canyon Village NHLD (Village NHLD) was designated in 1997. Contributing resources within the Village NHLD include 212 buildings, 44 structures, and one site. The district is significant for its association with the American park movement and as an example of American landscape architecture, specifically as a unique and outstanding example of community planning and development. The period of significance spans from 1897 to 1942 (NPS 1997).

The Village NHLD is recognized as a cultural landscape. The 2004 CLR (John Milner Associates Inc. 2004) and the 2006 CLI (Shapins Associates 2006) identify the following contributing views and vistas of the NHLD/landscape:

- Panoramic views toward the canyon (Rim Area)

- Panoramic vistas of the canyon (Rim Area)
- Long view through the central utility yard (Utility Area)
- Long views down the railroad tracks (Railroad Area)
- View to depot from railroad tracks (Railroad Area)
- View from Railroad Depot to El Tovar Hotel (Railroad Area), and
- Views of buildings around central work plaza (NPS Service Area)

The existing NPS radio tower near the Hopi Fire Lookout is located northwest of the Village NHL. It ranges in visibility from *not visible* to *visible, but not conspicuous* from some contributing resources and locations within the NHL that are along the rim, including the El Tovar, as the tower is over a mile from the NHL. Views of the tower are frequently screened by buildings or vegetation, regardless of distance from the canyon; views that are impacted by the tower near the Hopi Fire Lookout are those directed northwest along tower. Some of the contributing views in the Village NHL along the rim are north towards the canyon and east and west along the rim towards the canyon rim.

The South Rim Village tower is located within this district, near the Magistrate's Office (old Post Office, bldg. 166, constructed in 1936) and next to the Mountain Bell Building (bldg. 500, constructed in 1936). This tower is visible from a number of buildings and locations throughout the district, including near the Hopi House; along Village Loop Road; near Victor Hall; within the area surrounding the Powerhouse, Mule Barn, and Livery; along Apache and Boulder Streets; and in areas along Juniper, Tonto, and Sunset Drive. Given its location within the NHL, the existing South Rim Village Tower can be a more prominent feature in the view, ranging from *not visible* to *visible and conspicuous* (may be considered intrusive), depending on location and perspective of the viewer. Vegetation and buildings provide some screening, including from areas along the rim, but the tower is *visible and conspicuous* from areas surrounding the Magistrate's Office and Powerhouse.

The visual impacts from both towers described above adversely impact the setting and feeling of the Village NHL but do not diminish the district's eligibility for National Register listing. While the South Rim Village tower is *visible and conspicuous* from some locations within the district and the NPS radio tower near Hopi Fire Lookout can be *visible, but not conspicuous* from some locations, these towers are *not visible* from most of the NHL, do not impact the primary views within the district, and therefore do not dramatically alter the setting or feeling of the district, which is largely retained through the continued existence of contributing buildings and other features that have a high degree of integrity.

Grand Canyon Railway Historic District

The Grand Canyon Railway HD (Railway HD) was listed in the National Register in 2000. The district is significant in the categories of transportation, engineering, and architecture; its period of significance spans from 1898, when construction of the railway began, to 1948. Reaching Grand Canyon in 1901, the Grand Canyon Railway is the only railroad to enter and service a national park in the United States, and continues to operate today. This railroad is directly responsible for "the development of the park as a destination for Americans and visitors from around the world nineteen years prior to it becoming a National Park; and, the development of the Grand Canyon infrastructure on the south rim to include unique water reclamation and delivery systems, electrical power, and steam service" (NPS 2000). A small portion of the Railway HD is located within and is a contributing feature to the Village NHL, but the majority of the HD is located outside the boundaries of the Village NHL and outside the affected environment as this HD extends 64 miles between the Grand Canyon Railroad Depot within GCNP to Williams, AZ (almost all of which is outside of GCNP).

The South Rim Village Tower is *visible and conspicuous* from a few locations in this district, but these adverse visual impacts have not affected the district's National Register eligibility given the minimal

percentage of the district impacted by these views (several hundred feet of the railroad would be impacted in comparison to its length of approximately 64 miles).

Stables – Blacksmith Shop Historic District

The Stables – Blacksmith Shop HD was listed in the National Register in 1974; it is located within and is a contributing feature to the Village NHL. This district consists of three buildings, the Livery (bldg. 563, constructed in 1907), the Mule Barn (bldg. 562, constructed in 1905), and the Blacksmith Shop (bldg. 564, constructed in 1908). These buildings were referred to as the El Tovar Stables and were part of the “Transportation Department,” which provided the horses, carriages, mules, and stages that the early-day visitor to Grand Canyon used in touring the park or traveling its trails. All three of these buildings were important in the early history of tourism at Grand Canyon. They are physical reminders of times past, showing the important role that horses and mules, and the vehicles they pulled, had in how visitors experienced the Grand Canyon. In addition, the turn-of-the-century barns and stables are superb examples of barn architecture of that period. The district is significant for architecture, commerce, and transportation (NPS 1974).

The South Rim Village Tower is *visible, but not conspicuous* from some locations in this district, but these minimal adverse visual impacts have not diminished the district’s National Register eligibility given that these views do not dramatically alter the setting or feeling of the district, which is largely retained through the continued existence of contributing buildings and other features that have a high degree of integrity.

M.E.J. Colter Buildings National Historic Landmark District

M.E.J. (Mary Elizabeth Jane) Colter Buildings NHL was listed in the National Register in 1987. The M.E.J. Colter Buildings NHL includes the Hopi House (bldg. 545), Lookout Studio (bldg. 532), Hermit’s Rest (bldg. 863), and the Desert View Watchtower (bldg. 907), and associated features, which were designed by M.E.J. Colter and constructed in 1905, 1914, 1914, and 1932, respectively. The M.E.J. Colter Buildings NHL is significant based on architecture and tourism. Its period of significance begins with the construction date for each building (except for the Watchtower, which begins in 1931) and extends to the present (NPS 1987a).

The existing NPS radio towers near the Hopi Fire Lookout and at Desert View are visible from the M.E.J. Colter Buildings NHL. While the NPS radio tower at Desert View is *visible and conspicuous* from the upper floors of the Watchtower and the NPS radio tower near the Hopi Fire Lookout is *visible, but not conspicuous* within the vicinity of the Hopi House, both towers are *not visible* within most of the NHL and do not impact the primary views within the district. The setting and feeling of the district, although adversely impacted, is largely retained; the visibility of the existing towers from the NHL has not diminished the integrity of this NHL and its National Register eligibility.

West Rim Drive Historic District

The West Rim Drive HD, which encompasses 60 acres along the 7.1 mile long West Rim Drive between its intersection with Village Loop Road (adjacent to the northwest boundary of the Village NHL) and Hermit’s Rest Trailhead, was identified as eligible for listing in the National Register in 2005. There are 45 contributing resources within the West Rim Drive HD including: Hermit’s Rest, Orphan Mine, West Rim Drive, all named and unnamed pullouts/overlooks, West Rim Trail, and existing views from West Rim Drive, overlooks, and trail. The district is significant for its association with the physical and political development of GCNP and its physical design and construction, some of which was by the Civilian Conservation Corps (CCC). The district’s period of significance is 1934-1936 (the period of New Deal Era construction of the West Rim Drive and West Rim Trail) (NPS 2005).

The district is recognized as a cultural landscape, and according to the CLI, “The most important feature of the road, is the many overlooks and pullouts designed into the original plan, to allow visitors a safe vantage point to view the canyon. . . . Views and vistas are the reason for the road’s existence, and

some of the features visible from the road (and trail) include the Colorado River, the north rim, Grand Canyon Village, Bright Angel Trail, Indian Garden, and many, many more” (NPS 2005).

The NPS radio tower near Hopi Fire Lookout, as well as a number of telecommunications poles and antennas, are approximately 350 feet south of the West Rim Drive, and are *not visible* within the western half of the district. Within the eastern half of the district, the visibility of this infrastructure ranges from *not visible*, due to vegetative screening and topography, to *visible and conspicuous* when looking away from the canyon at Powell Memorial. See Appendix C for photos of existing conditions. The primary views from the West Rim Drive HD are of the canyon to the north, east, and west; there are very few of these primary views that are currently impacted by the existing tower and surrounding infrastructure.

The existing South Rim Village Tower and NPS radio tower at Station One are also visible from the easternmost mile of this district along the rim. The NPS radio tower at Station One is *visible, but not distinguishable* from some viewpoints given its small profile and distance from the district. The South Rim Village Tower ranges from *not visible* (due to vegetative shielding) to *visible, but not conspicuous* given its physical profile and closer proximity to viewpoints such as Trailview One.

While the South Rim Village tower can be *visible, but not conspicuous* from some locations within the district and the NPS radio tower near Hopi Fire Lookout and surrounding infrastructure can be *visible and conspicuous* from some discreet locations such as Powell Memorial, this infrastructure is *not visible* from most of the NHLHD and does not impact the primary views within the district. The setting and feeling of the district, though adversely impacted by the visibility of this infrastructure, is largely intact. The visibility of existing telecommunications infrastructure has not diminished the district’s eligibility for National Register listing given the areas impacted represent a very small percentage of the district and the primary views within this district are largely unimpacted.

Horace M. Albright Training Center Historic District

The Horace M. Albright Training Center HD was listed in the National Register in 2013. This six-building training center complex was built during the National Park Service’s Mission 66 construction program (1956-1966) and is significant at the state level for its funding and construction and for its Modernist style architecture characteristic of the Mission 66 era. The district’s period of significance is 1961-66 (NPS 2013).

No telecommunications towers or other major telecommunications infrastructure are currently visible from this HD; however, Alternative B could consider a new and relocated tower in Grand Canyon Village that could be visible from this district.

Mather Business Zone Historic District

The Mather Business Zone HD includes a grocery store, post office, bank, Yavapai Lodge and cafeteria, Trailer Village, Camper Services, and Mather Campground; thirty buildings are contributing to the HD (NPS 2016). The district is being treated as eligible for National Register listing. It is not listed on the National Register or been determined eligible for listing through a consensus DOE with the SHPO. The final design of Mather Business Zone was completed in 1967 with construction beginning in 1969. A draft National Register nomination identifies Mather Business Zone as being locally significant for its association with the development of Mission 66 at Grand Canyon National Park and nationally significant for its contribution to the service-wide Mission 66 Village concept (NPS 2016).

No telecommunications towers or other major telecommunications infrastructure are visible from this HD; however, Alternative B could consider a new and relocated tower in Grand Canyon Village that could be visible from this district.

Desert View Developed Area and Hwy 64 Corridor

Desert View Watchtower Historic District

The Desert View Watchtower HD was determined eligible for National Register listing in 1995. The 16-acre district includes three buildings constructed in 1932 that are also included in the M.E.J. Colter Buildings NHL: the Desert View Watchtower (bldg. 907), the Ruin (bldg. 909), and the Store Room (bldg. 908). There are four additional buildings that are also contributing to the HD: Old Bookstore (bldg. 41), Search and Rescue/Fire Cache (bldg. 83), Caretaker's Residence (bldg. 914), and Shed (bldg. 912). The Desert View Watchtower HD is significant for its nationally significant architectural components as well as its role in the railway's development of tourist facilities in GCNP and the NPS response to facility development in the park. The period of significance for the district spans from 1930 to 1941 (NPS 1994).

The NPS radio tower at Desert View is approximately ¼ mile south of the Desert View Watchtower HD boundary and is screened from most views within the HD by buildings and vegetation. It is therefore *not visible* from most of the HD except for within the Watchtower itself. From the Watchtower on floors two-five, this tower is *visible and conspicuous* when looking south, away from the canyon. Similar to the existing conditions of the M.E.J. Colter Buildings NHL, these visual impacts have not diminished the setting and feeling of the district nor the HD's eligibility for National Register listing as the tower is *not visible* within most of the HD and it does not impact the primary views within the district.

North Rim Developed Area and Hwy 67 Corridor

North Rim Entrance Road Corridor Historic District

The North Rim Entrance Road Corridor HD includes the North Rim Entrance Station and 10.6 miles of the North Rim Entrance Road and its associated pull offs, viewsheds, and other adjacent features (the final three miles of the road is included in the Bright Angel Peninsula HD). The HD boundary begins at the northern boundary of the park and extends to CC Hill, ending just before the northern edge of the North Kaibab Trailhead parking lot turnoff. The North Rim Entrance Road Corridor HD is also recognized as a cultural landscape (NPS 2011b). The North Rim Entrance Road National Register form (2011b) notes that the road corridor retains the "highest levels of integrity" and that "the appearance and character of the scenic entrance road" that most visitors associate with their experience of park scenery and wilderness remains intact from the North Rim Entrance Road's period of significance (1928–1931) (NPS 2006, 2011b). This HD is being treated as eligible for National Register listing. It is not listed in the National Register or been determined eligible for listing through a consensus DOE with the SHPO.

No towers or other major telecommunications infrastructure are currently visible from this district; however, Alternative B could consider a new tower on Lindberg Hill that could be visible from this district.

Bright Angel Peninsula Historic District

The Bright Angel Peninsula HD includes the Bright Angel Peninsula bounded to the north by CC Hill, to the south by the Grand Canyon Lodge NHL, and to the west and east by the Transept and Roaring Springs Canyons, respectively. Contributing resources to the HD include 71 buildings, 5 sites, 19 structures, and 1 object. The Bright Angel Peninsula HD is significant for "its association with national park planning movements between 1917 and 1942, and for its association as a masterwork of the Civilian Conservation Corps and National Park Service landscape architects" (NPS 2011a). This HD is being treated as eligible for National Register listing. It is not listed in the National Register or been determined eligible for listing through a consensus DOE with the SHPO.

The 2011 National Register nomination states that the district is divided into seven sub-areas: The Bright Angel Peninsula Entrance Road Corridor (three miles of the entrance road from CC Hill to

Grand Canyon Lodge); NPS Headquarters, Housing, and Maintenance; Campground; Concessionaire; Transept Trail Corridor; Wastewater Treatment; and Water Tank sub-areas. Within these areas, National Register nominations already exist for the Grand Canyon North Rim Headquarters HD and Grand Canyon Inn and Campground HD. Listed in 1982, both districts focus on the buildings of the two areas (NPS 1982a, 1982c).

The CC Hill tower is *visible, but not conspicuous* from a few discreet locations in this HD, but is *not visible* from most locations. Because views of this existing tower are intermittent and do not represent a sizeable portion of the district, these visual impacts do not noticeably impact the district's setting and feeling and have not diminished the district's eligibility for listing in the National Register.

Grand Canyon Lodge National Historic Landmark District

The 45-acre Grand Canyon Lodge NHL was listed in the National Register in 1982 and designated a National Historic Landmark in 1987. This NHL centers on the 1936-37 Grand Canyon Lodge and its 114 cabins. In addition to the lodge and cabins, a small linen storage building is also a contributing resource to the NHL (NPS 1982b, 1987b). The district is considered one of the most intact rustic hotel developments in the national parks from the era when railroads fostered construction of "destination resorts." It is also significant for its association with architect Gilbert Stanley Underwood, an architect characterized as one of the shapers of the standards known as the "Rustic" style of park design. The period of significance is from 1927 to the present (NPS 1987b).

No towers or other major telecommunications infrastructure are currently visible from this district; however, Alternative B could consider the installation of small-cell sites on existing infrastructure within the district.

The Grand Canyon Lodge NHL was included in the 2003 CLR, 2006 CLI, and 2011 CLI and National Register nomination for the Bright Angel Peninsula HD.

Environmental Consequences

Impacts of Alternative A – No Action

Direct and Indirect Impacts

Under Alternative A, ongoing adverse impacts to HDs and NHLs from existing telecommunications infrastructure within and/or visible within these districts would continue into the future (see [Affected Environment](#)) but could slightly change if this existing infrastructure is modified or upgraded under Alternative A. The impacts from these changes would vary depending on the equipment being upgraded, the size of the upgraded equipment, and its location, but would likely be of similar minimal intensity as existing conditions and would be unlikely to alter the setting or feeling of the HD or NHL as the visibility of this infrastructure within HDs and NHLs would continue to range from *not visible*, to *visible, but not conspicuous*, similar to existing conditions (assuming equipment would be replaced and/or upgraded in the same location as existing equipment and of similar size or smaller). Most of these impacts are expected to be adverse and long-term (10-15 years or more), but some impacts could reduce negative impacts already occurring. For example, if existing facilities are removed or are replaced with smaller facilities as technology becomes more efficient, existing infrastructure may require less physical space in the future and would therefore have less visual impacts on HDs and NHLs.

The installation of new, minor telecommunications infrastructure such as new antennas (e.g., microwave or small-cell antennas) on existing infrastructure within a district could also adversely impact these resources by installing a non-contributing feature within an HD or NHL. As described in *Scenic Resources*, any views of these facilities would likely be intermittent and would be unlikely to arise to the level of *visible and conspicuous* within an HD or NHL and would therefore be unlikely to alter

the overall setting and feeling of these historic properties as the infrastructure would largely be sited out of view and/or would blend into the surrounding built environment and the areas that would be impacted would represent a small percentage of the large district, similar to existing infrastructure.

In summary, no modified, upgraded, or new telecommunications infrastructure that would be installed under Alternative A are expected to impact a district's eligibility for listing in the National Register because these facilities would be attached to existing infrastructure, would be small in scale in comparison to infrastructure it is attached to, and/or would not be visibly apparent within a district such that a district's overall setting or feeling is noticeably altered.

Cumulative Impacts

Past, present, and reasonably foreseeable future actions with the potential to impact the cultural resources outlined in the *Affected Environment* section include construction of modern improvements such as the recent upgrades to and development of the Bright Angel Trailhead. Past projects have resulted in the incremental introduction of modern materials to HDs and NHLDs which diminishes the historic feeling, setting, materials, and workmanship (aspects of integrity) of these districts. However, these materials have not diminished these districts enough to impact their eligibility for National Register listing because enough of the original materials and features remain to convey the significance of the districts. Reasonably foreseeable actions include installation of two temporary telecommunications towers within the Village, installation of hung fiber for the Grand Canyon Unified School District along existing utility lines through the Grand Canyon Village NHLD, the relocation of the power substation (currently located next to the Powerhouse) outside of the Village NHLD, and both the installation and removal of some visitor use infrastructure at Desert View. Both temporary towers would *not be visible* in much of the surrounding areas but would be *visible, but not conspicuous* from some locations within the Horace M. Albright Training Center HD, and one temporary tower would be *visible, but not conspicuous* from portions of the Village NHLD, M.E.J. Colter Buildings NHLD, and West Rim Drive HD due to screening by vegetation and other buildings. The hung fiber would also be *visible, but not conspicuous* within the western portion of the Village NHLD because it would be hung along existing utility poles and would replace an existing cable. In comparison, the removal of the power substation from next to the Powerhouse would remove a visual intrusion that is currently *visible and conspicuous* from areas within the NHLD. Finally, the installation and removal of facilities at Desert View would result in the removal of features within the HD that are not currently compatible with the district and the installation of features outside of the NHLD that could be *visible and conspicuous* within and near the boundary of the HD. Similar to past actions, the installation of these additional facilities are not expected to diminish these districts enough to impact their eligibility for National Register listing because enough of the original materials and features remain to convey the significance of the districts. Collectively, the past, present, and reasonably foreseeable future actions would have adverse impacts. The no action alternative would result in some incremental, minimal adverse impacts due to modifications and/or upgrades to existing infrastructure and/or addition of minor telecommunications infrastructure that could be visible within and from HDs and NHLDs. When the effects of the no action alternative are combined with the effects of other past, present, and reasonably foreseeable future actions, the total cumulative impacts would be adverse, with a slight contribution of adverse impacts from the no action alternative.

Impacts of Alternative B – Preferred Alternative

Direct and Indirect Impacts

In addition to the impacts described under Alternative A, the development of telecommunications infrastructure under Alternative B, including towers and fiber, would primarily have adverse impacts to historic districts within GCNP.

Installation of fiber could occur in NHLDs and HDs and on contributing historic structures within these districts, but impacts to these resources are expected to be minimal. Fiber installation would avoid

adversely impacting contributing landscape features, such as walls, walks, and vegetation, and as described in [Scenic Resources](#), longer term (10-15 years or more) visual impacts would be *not visible* for buried fiber to *visible, but not conspicuous* for hung fiber as cable would be on existing lines and within views that already include other utility lines. For this reason, this potential action(s) would not alter the integrity of HDs.

The following sections address impacts to NHLDs and HDs from potential telecommunications towers and other telecommunications infrastructure. As described in Chapter 2, design criteria and mitigations would be implemented to minimize impacts to cultural resources, such as general siting (i.e. towers would be placed outside of HD boundaries), minimizing tower heights, and designing buildings (including color and size) to blend and harmonize with the surroundings. Because of these parameters, potential new towers would not physically alter HDs or NHLD, but, despite the parameters, potential new towers would result in visual impacts to NHLDs and HDs that could adversely affect the setting and/or feeling of an HD or NHLD. Development of other telecommunications infrastructure could also result in both visual and physical impacts to these historic properties. While visual impacts from telecommunication infrastructure are specified below, it is assumed that any installation of equipment sheds, cabinets, and similar features associated with telecommunications towers would be installed near the related tower and would generally not be visible from these districts and would therefore not impact these historic properties. Refer to the [Scenic Resources](#) section for more specific information on visual impacts.

South Rim Developed Area

Grand Canyon Village National Historic Landmark District, Grand Canyon Railway Historic District, and Stables – Blacksmith Shop Historic District

Potential removal of the current South Rim Village Tower from the Village NHLD would have a permanent beneficial impact on the Village NHLD, Railway HD, and the Stables – Blacksmith Shop HD. This existing tower is visible from much of the NHLD and portions of the HDs and its removal would reduce the amount of modern intrusions in this area and would reduce the number of locations within the districts from which a telecommunications tower is visible.

Construction of potential new towers would not occur in the districts, but up to three new towers—towers within the Hopi Fire Lookout area and one or two within the Village if the South Rim Village Tower is relocated (not just removed)—could be visible from portions of the Village NHLD which would have long-term (10-15 years or more) adverse impacts on the integrity (i.e., setting or feeling) within some portions of the NHLD from which these towers would be visible. The visual impacts to the NHLD from the construction of an additional tower at the Hopi Fire Lookout area would slightly increase from locations within the NHLD that are already affected by the existing tower, mostly along the rim in the eastern half of the NHLD. As described in the [Scenic Resources](#) section and shown in Appendix C, this tower is over a mile from the NHLD and currently *visible, but not conspicuous* from some locations, such as between El Tovar and the rim. (The potential new tower within the Hopi Fire Lookout area would not be visible from the Railway HD or the Stables – Blacksmith Shop HD.) A new tower in the village area (outside of the districts) is expected to be *not visible* from most of the Village NHLD, Railway HD, and Stables – Blacksmith Shop HD, but could be either *visible, but not distinguishable* or *visible, but not conspicuous* from some locations in these districts, specifically on the rim within the Village NHLD, which is at a slightly higher elevation than much of the districts, when facing south and away from the canyon. Although more towers could be visible from the NHLD and HDs under Alternative B, these adverse impacts are not expected to impacted the districts' eligibility for National Register listing as these towers would mostly be visible from areas already affected by telecommunications towers, the visibility of new towers would not be more than *visible, but not conspicuous*, and most of the NHLD and HDs would remain unaffected by these external developments. It is also possible that current adverse impacts to this NHLD and HDs would be reduced

by the removal and/or relocation of the South Rim Village Tower, in which case the percentage of the districts from which a tower would be visible would decrease.

The installation of small-cell technology and other minor telecommunications infrastructure could be considered in this area of high visitation which could also adversely affect the districts, long-term (10-15 years or more) if implemented. Visual impacts to the NHLD and HDs, which could adversely impact the setting and feeling, would be minimized by installing this infrastructure only on existing structures or buildings with existing utility infrastructure, such as antennas, and clustering this infrastructure to avoid the proliferation of technology and additions to historic structures in the districts. These design criteria, along with the other parameters identified in Alternative B, would ensure small-cell sites and other minor telecommunications infrastructure would blend into the surrounding areas as much as possible such that they are not obtrusive and do not impact the overall setting and feeling of the Village NHLD, Railway HD, and Stables – Blacksmith Shop HD.

Considering the factors above, adverse impacts to these districts would be minimal and would not diminish the integrity of the districts, much less their eligibility for listing on the National Register.

M.E.J. Colter Buildings National Historic Landmark District (Hopi House)

A new tower in the Hopi Fire Lookout area and a new tower(s) within the Village (though unlikely) could potentially be visible from Hopi House and the surrounding area. The NPS radio tower near the Hopi Fire Lookout, as previously mentioned and shown in Appendix C, is *visible, but not conspicuous* from the rim area near Hopi House, due to distance and screening from vegetation. Visual impacts to the NHLD from a new tower within the Hopi Fire Lookout area would slightly increase the minimal adverse impacts to setting and feeling described in the [Affected Environment](#) section, but this long-term (10-15 years or more) impact would not diminish the integrity or significance of the NHLD because the areas impacted would represent a small percentage of the larger NHLD and within those areas impacted, the tower(s) would be partially screened by vegetation or other buildings such that the tower(s) would not appear obtrusive from the Hopi House.

West Rim Drive Historic District

A new tower in the Hopi Fire Lookout area would be *not visible* from most of this district due to screening by vegetation and topography, but would likely be *visible, but not conspicuous* from some areas of the district, particularly those within close proximity to the tower location. Appendix C shows the visibility of the existing NPS radio tower near Hopi Fire Lookout from several locations along West Rim Drive, within the district. It is also likely that one or two new tower(s) in the Village (if the South Rim Village Tower is relocated) would be *visible, but not conspicuous*, or possibly *visible, but not distinguishable*, from some locations in the district given the distance from which this tower(s) could be located from the HD (a mile or more). Because these towers would only be visible from parts of the district (e.g., the whole western half of this district would remain visually unaffected by telecommunications towers), these long-term (10-15 years or more) adverse visual impacts would not diminish the overall integrity (i.e., setting or feeling) of the district.

Some current adverse impacts to this HD from the visibility of the South Rim Village Tower could also be reduced if the visible footprint of the South Rim Village Tower is minimized or removed. These impacts would be similar as those described under [Grand Canyon Village National Historic Landmark District](#).

Horace M. Albright Training Center Historic District

Depending on the location of a new tower(s) within the Village, this HD may not be impacted by the proposed action. However, one to two new towers within Grand Canyon Village could be visible from this district and could be constructed in close proximity to the district boundary. Trees would provide some screening, but due to proximity, the base of the tower, its associated facilities, and/or the upper portion of the tower could be *visible, but not conspicuous* from the district. However, these visual

impacts, should they occur, would not diminish the integrity (i.e., setting or feeling) of the district because most of the district would remain unaffected, and in areas where the potential tower could be visible, it would be partially screened by vegetation or other buildings such that it should not appear obtrusive. The district's eligibility for listing in the National Register would not be affected.

Mather Business Zone Historic District

Depending on the location of a new tower(s) within the Village, this HD may not be impacted by the proposed action. While the upper portions of this tower(s) could be visible from this district (e.g., on the small rise behind the Market Plaza parking lot); because of topography, vegetation, and buildings, most of this district is unlikely to be impacted. For the few locations from which a tower could be visible, it is expected that the tower(s) would be *visible, but not distinguishable* such that a viewer would need to know what they were looking for to see the tower(s). Given the small area that could be impacted and the minimal visibility of a potential new tower(s), this alternative would have minimal to no adverse visual impacts on the Mather Business Zone HD and would therefore not diminish the integrity (i.e., setting or feeling) of the district or its eligibility for listing in the National Register.

Desert View Developed Area and Hwy 64 Corridor

M.E.J. Colter Buildings National Historic Landmark District (Desert View Watchtower)

A new tower at Desert View would likely be *visible and conspicuous* from the upper floors of the Desert View Watchtower when facing south, away from the canyon. Construction of a tower in this location would increase the existing adverse visual impacts to the Watchtower, long-term (10-15 years or more). However, impacts would not diminish the integrity (i.e., setting or feeling) of the NHLHD and the significance of the district because a tower would not be located within the primary views towards the canyon or obscure the views of the Watchtower itself.

Desert View Watchtower Historic District

A new tower at Desert View could be visible from this district, which would slightly exceed the current adverse visual impacts in the district, long-term (10-15 years or more). As noted previously, the tower would be seen from the Watchtower (see impacts to [M.E.J. Colter Buildings NHLHD](#)), but not from any other location in the district and therefore would not diminish the overall integrity (i.e., setting or feeling) of the district or affect its eligibility for National Register listing.

North Rim Developed Area and Hwy 67 Corridor

North Rim Entrance Road Corridor Historic District

A new tower at Lindbergh Hill could be *visible, but not conspicuous* from a short section (several hundred feet) of the 10.6 mile entrance road (Hwy 67) that is located within the district, resulting in long-term (10-15 years or more) adverse visual impacts to the integrity (i.e., setting or feeling) of this district. However, because views of this tower would be intermittent along this stretch of road and because the majority of the district would not be impacted by this infrastructure, the integrity (i.e., setting or feeling) of the district would largely be retained; this alternative would not affect the HD's eligibility for National Register listing.

Bright Angel Peninsula Historic District and Grand Canyon Lodge National Historic Landmark District

A new tower at CC Hill could be *visible, but not conspicuous* from one or two locations in the Bright Angel Peninsula HD, but would not be visible from the Grand Canyon Lodge NHLHD. Given the minimal locations from which this potential new tower could be visible, the visual impacts are unlikely to alter the overall setting and feeling of this district and would not diminish the HDs eligibility for National Register listing.

The installation of small-cell technology could be considered in the Grand Canyon Lodge NHLD which would have long-term (10-15 years or more) adverse impacts to the NHLD, if implemented. These impacts would be similar as those impacts described under the Grand Canyon Village NHLD; impacts would be minimal and would not diminish the integrity (i.e., setting or feeling) of the district nor its eligibility for listing on the National Register.

Cumulative Impacts

Impacts from past, present, and reasonably foreseeable future actions on HDs and NHLDs from the incremental introduction of modern materials would be the same as those described for the no action alternative. Collectively, the past, present, and reasonably foreseeable future actions would have adverse impacts. Alternative B would result in adverse impacts due to the construction of up to 5 new and one potentially relocated telecommunication towers, addition of small-cell technology, installation of fiber, and replacement or addition of minor telecommunications infrastructure. This alternative could also result in the visual downsizing or potential removal of an existing tower that is *visible and conspicuous* within Grand Canyon NHLD and *visible, but not conspicuous* from West Rim Drive. When the effects of Alternative B are combined with the effects of other past, present, and reasonably foreseeable future actions, the total cumulative impacts would be adverse, with a moderate contribution of adverse impacts from Alternative B given the addition of new infrastructure within views from some locations within HDs.

VISITOR USE AND EXPERIENCE: VISITOR ACTIVITIES AND EXPERIENCES, VISITOR INFORMATION, AND PUBLIC SAFETY

Affected Environment

Visitor Activities and Experiences

Visitation to Grand Canyon National Park, which has increased by an average of 4% annually since 2008, approached 6.4 million people in 2018 (NPS n.d.). Though no day use limits exist, overnight use on the North and South Rims is limited to the roughly 8,000 visitors GCNP and its partners can accommodate per night in hotels and lodges (approximately 1,129 rooms with 3,649 “pillows”) and frontcountry campgrounds (603 total campsites with a capacity of approximately 4,419 people). During their stay within GCNP, most visitors remain within the developed areas along the North and South Rims.

According to the 2016 survey, 91% of visitors reported that viewing wildlife or natural scenery was very, if not extremely important; 56% reported that it was the most important reason for visiting the park and, outside of hiking, it was listed as the most liked aspect of their visit to GCNP (RSG 2017).

During this same 2016 survey, slightly more than 70% of visitors surveyed indicated that use of their personal electronic device was at least moderately, if not very or extremely, important during their visit to GCNP; poor cellular or Internet service was listed as one of the aspects visitors least liked about their visit, second only to crowded and hot conditions (RSG 2018, RSG 2017). There is cellular service in the North Rim, South Rim, and Desert View developed areas of the park—some of which bleeds into the canyon and backcountry areas as well—and Internet services are available at the lodges for guests only and the local library for members of the public. That said, the coverage can be spotty or non-existent in developed areas (particularly on the North Rim), can be slow depending on the number of people accessing the network, and is provided by only one proprietary national commercial carrier and one wholesaler carrier (that provides roaming services for other commercial cellular companies); those with plans outside of these carriers cannot typically access telecommunications services. Over 12% of respondents reported that they had no service to complete a text message and/or phone call within the park; another 7% reported they had no service for searching the internet or sharing information via social media (RSG 2018). GCNP has received complaints from visitors who wish to access cellular or

other wireless services during their stay in the park and have been dissatisfied with current service levels. These complaints have focused on the need for service to communicate with family or with an employer, to conduct personal business (e.g., log into a bank account, etc.), or for safety (e.g., separated parties or 911 emergencies).

Regardless of the level of cellular and/or Internet service, visitors are commonly seen utilizing their personal electronic devices on the North and South Rims of the park whether for taking photos, reading, playing games, communicating with others, etc. Approximately 83% of respondents to the 2016 visitor survey reported that use of their personal electronic devices was at least slightly important during their stay in GCNP (RSG 2018). This suggests that a majority of visitors utilize their personal electronic device during their visit to GCNP. The ongoing impacts of this use on visitors and visitor experience is likely variable and depends on the user and their activity. Studies (e.g., Duncan et. al. 2012, Lepp et. al. 2014, Kuznekoff et. al. 2015, Felisoni & Godoi 2018) have shown a correlation between increased cell phone use and lower academic performance, which could suggest that the use of personal electronic devices within GCNP could adversely impact visitors' attention to and connection with park resources during their visit. However, other studies (e.g. Berge and Muilenburg 2013, Noel et. al. 2015, Chen et. al. 2009) have shown a correlation between use of technology and student learning and engagement, which could suggest the use of personal electronic devices within GCNP could beneficially impact visitors' engagement with park resources. No data specific to GCNP is available to support or discount these possibilities, but it is assumed that both are possible. The ongoing impacts of the use of personal cellular devices on others' experience are likely also variable. Although GCNP has received no formal complaints, at least since 2015, via NPS comment cards about other visitors' use of communications devices, access to telecommunications services may be disruptive to visitors who visually and/or audibly observe others using their personal electronic devices.

Visitor Information

As communication technology becomes more prevalent throughout society, new generations of visitors are seeking ways to find information and to connect with park resources through digital media that provide current, if not real-time, information (NPS 2017c). The official Grand Canyon National Park website currently includes trip planning information—including maps, lodging and camping information, weather and road conditions and shuttle information, critical safety information, hours of operation of various facilities and amenities throughout the park, and ranger program schedules. The website also includes extensive information about park's natural and cultural resources and science information. In addition to the website, the park has an interactive mobile app that has self-guided tours, maps, photo locations, digital postcards, and up to date accessibility information for trails and facilities. The NPS and its partners have also developed a growing range of new and social media resources to support park education programs (e.g., GCNP's Facebook page), and there is a plethora of other online information, such as online reservations systems with companies that provide tours within the park, that inform and connect park visitors to the park and its resources. Approximately 72% of visitors use the park's official website or another website to help them plan for their visit to the park; 5% use social media (RSG 2017). Currently visitors can access these resources before visiting the park, but access to online and information is limited once inside the park due to a lack of reliable connectivity and the limited number of carriers that provide cellular service within the park.

Public Safety

Visitor safety programs at Grand Canyon National Park include emergency medical services (EMS), search and rescue (SAR), structural fire, wildland fire, and law enforcement. In 2017, the NPS responded to 1,135 EMS incidents (close to 70% were in developed areas), 290 SAR incidents (12 of which were fatalities), and 68 structural fire incidents. Four incidents required full incident management team coordination (NPS 2017a).

The park's land-based telephone system, cellular communication system (voice conversations and text messages), and two-way radio system are the primary communications methods to support these essential law enforcement and public safety functions. Specifically, NPS radios are the primary means of communication among park personnel working in the field, and radio repeaters at strategic locations in the park enable communication from most locations.

Despite the number of incidents to which the NPS responds, without access to two-way radio communications, it can currently be challenging for the public to access emergency services even in frontcountry areas of the park. GCNP has received complaints from visitors who had an emergency and who were unable to contact others in their party and/or NPS emergency services. While personal tracking devices that rely on satellite technology are increasingly common within backcountry areas, visitors may rely on their cellular device to access emergency services in both backcountry and frontcountry locations. This reliance can be troublesome due not only to the lack of coverage and limited carriers that can prevent these devices from working, but it also limits NPS emergency services from locating a party, even if communications are feasible. At times, the NPS must rely on triangulation to pinpoint the geographic position of a party in need; this technology is limited by the number of transmitters or antennas that receive the emergency signal. With a limited number of antennas, the NPS may have only one or two data points to rely upon for triangulation.

Environmental Consequences

Impacts of Alternative A – No Action

Direct and Indirect Impacts

Visitor Activities and Experiences

To the extent that the NPS receives, reviews, and approves future ROW applications for wireless telecommunications infrastructure within GCNP, the no action alternative may result in an improvement in cellular and other wireless services within developed areas of the park that have a NPS and/or NPS-partner staff presence and/or see a high volume of park visitors, beyond existing conditions.

However, these improvements would largely be limited to those who have existing cellular services (new carriers are not expected under the no action alternative given the physical limitations of existing telecommunications towers); a percentage of the 83% of visitors who report that use of their personal electronic device is at least somewhat important during their stay in the park would continue to lack access to wireless services unless they are able to connect to a wireless hotspot such as at a lodge or the public library. These visitors who do not utilize the services of existing carriers within GCNP would continue to be largely unable to make phone calls, place texts, post on social media or access real-time information on the Internet, etc., similar to existing conditions. In this sense, some percentage of visitors who wish to access cellular services during their stay at GCNP would continue to lack access, and these visitors' level of satisfaction with wireless services would likely remain low.

Visitors that can already access cellular services in GCNP may see some improvements in cellular coverage and capacity. Although the coverage area is unlikely to expand to developed areas that currently do not have coverage (e.g., Hermit's Rest, most of the North Rim, backcountry areas that do not already have coverage, etc.), the coverage these visitors have may be more consistent and reliable than existing conditions such that phone calls are dropped less frequently and/or text messages may be more consistently be sent/received. It is also possible that businesses or other entities could install technology within buildings that enable users to continue to access services within, and not just outside, of the structure. Some expansion in capacity (e.g., bandwidth) may also improve under this alternative, but without fiber, these improvements are unlikely to be noticeable to the average visitor because data speeds, for example, would remain subpar in comparison to those often available in cities, where most

visitors live. When current cellular download speeds, for example, are very slow (less than 5 Mbps) and they improve by several Mbps, the improved speeds would still be slow if not very slow to any visitor who has access to faster speeds at home; activities that rely on wireless services would remain limited (e.g., streaming video would be very challenging). Furthermore, as more and more visitors try to access and compete for wireless services in GCNP, improvements in capacity under this alternative may be absorbed by an increasing number of users. For these reasons, visitors who feel that cellular and/or other wireless services enhance their experience, and who have access to these services, may enjoy some improved consistency and reliability of service as part of their visitor experience. However, these visitors may also continue to be dissatisfied with the wireless services provided within GCNP under this alternative, though the degree of their dissatisfaction may dissipate somewhat as less calls are dropped, etc. This slight beneficial impact would extend into the future (10-15 years or more).

Because some visitors would continue to lack cellular services and other visitors would likely continue to have some level of dissatisfaction with cellular services (even if somewhat less than existing conditions), the number of visitors utilizing the personal electronic devices (i.e., accessing cellular and other wireless services) within GCNP as a direct result of this alternative may increase but is unlikely to change dramatically under this alternative.

At the same time, visitors who choose to use their personal electronic devices while in GCNP may miss observations that they might otherwise make or experience (e.g., a visitor might not see wildlife if they are looking elsewhere). However, it is unlikely that such use would result in visitors failing to be awed by the Grand Canyon and its splendor—the primary reason visitors come to GCNP.

Visitors may also observe increased disruptions (e.g., noise or social impacts) from their own or other visitors' use of personal electronic devices that may degrade some individuals' experiences, particularly those who prefer a more primitive experience and/or feel cellular and other wireless services detract from their experience. Evidence of these adverse impacts is anecdotal, but reported as interruptions from one's own personal electronic device and encounters with people talking on phones or texting. Because the area impacted would be limited largely to areas that already have coverage and the number of visitors using their personal electronic devices is not likely to increase, this alternative is unlikely to change visitor behavior beyond existing conditions but may decrease visitor satisfaction and/or cause some annoyance in visitors who within these areas. This adverse impact would extend into the future (10-15 years or more).

Overall, this alternative is not likely to change visitation levels or visitation patterns, because access to wireless services is not the reason visitors come (or not come) to GCNP. While some visitors would have more consistent and reliable cellular and other wireless service within areas that already have these services, many visitors would continue to lack access to cellular service and many developed areas would continue to lack service for anyone in the area. Existing visitor dissatisfaction would likely continue, though visitor dissatisfaction may decrease in those who have current access to services.

Overall, the No Action Alternative could improve cellular and Internet services for visitors who already have some access to these services within GCNP such that cell- or web-based tools are more readily accessible and activities such as staying connected to family and friends while visiting the park—including calls, texts, emails, and use of social media; completing personal or professional business, such as managing bank accounts; navigation and trip planning, etc.; and accessing emergency services are easier and more reliable. However, visitors who do not utilize the services of existing carriers within the park would continue to be largely unable to access cellular and/or Internet services. Portions of the developed areas of the park would also continue to lack cellular and/or Internet services altogether. The beneficial impacts from this alternative would therefore affect only a portion of visitors but would extend into the future (10-15 years or more).

Visitor Information

Some visitors may have improved access to information about park resources and conditions in developed areas. For example, route finding and trip planning could be easier to do via personal electronic devices than at present for those visitors who utilize the services of existing carriers in the park, but again, those visitors who don't have service through these carriers would continue to lack these services inside the park, similar to existing conditions. Visitors who utilize cellular and/or Internet services and access this information inside the park would directly benefit from increased knowledge and understanding of park resources and/or decreased confusion and stress in being able to effectively trip plan in response to changing conditions.

Visitor Safety

Visitors who utilize the services of existing carriers in the park may have more reliable cellular service within developed areas under the No Action Alternative such that these visitors could more assuredly contact NPS Dispatch or 911 in the case of an emergency; however, visitors who don't have service through these carriers would continue to lack access to these communications, similar to existing conditions. Because no additional visitors would be impacted, this beneficial impact is unlikely to be measureable.

That said, similar to Alternative B, improvements in existing infrastructure or installation of some additional, minor infrastructure (for example, antennas placed on existing NPS radio towers that provide communications for emergency services) could improve emergency communications, particularly within developed areas of GCNP by increasing access to NPS Dispatch or 911 services. These currently do not exist in some portions of park's developed areas, such as the North Rim; so this would result in an introduction of service where it does not presently exist.

Cumulative Impacts

Past, present, and reasonably foreseeable actions occurring within and surrounding GCNP have and would result in an increase in wireless (including cellular—voice and data) service and two-way radio, communications within and at least slightly beyond developed areas of the park. Past actions such as the development of the NPS two-radio towers and the installation of non-NPS radio infrastructure near the Hopi Fire Lookout have improved two-way radio communications throughout the park, enhancing communications for operations and visitor safety. The ongoing operation of commercial antennas on two towers within GCNP and on surrounding USFS lands have extended some cellular, Internet, and data services into GCNP, the foreseeable development of two-temporary commercial towers with Grand Canyon Village will further enhance those services, enabling more visitors to more easily and reliably access these services. While these impacts could be beneficial or adverse, depending on an individual's view of these technologies (notably, the majority of visitors are assumed to primarily benefit from these improved services), this alternative would only marginally contribute to these ongoing and reasonably foreseeable impacts. When the effects of this alternative are combined with other past, present, and reasonably foreseeable future impacts, the total cumulative impacts to visitor experiences under this alternative would continue to be primarily beneficial in the long-term.

Impacts of Alternative B – Preferred Alternative

Direct and Indirect Impacts

Visitor Activities and Experiences

To the extent that the infrastructure that could be allowed under this Plan is fully developed and operational, this alternative would expand and enhance cellular and other wireless services within developed areas of the park that have a NPS and/or NPS-partner staff presence and/or see a high volume of park visitors, beyond existing conditions. As discussed in more detail below, these expansions and enhancements would have variable long-term (10-15 years or more) impacts on existing visitor activities and experiences in areas where cellular and other wireless services would be available

that are largely dependent on individual values, preferences, expectations, and utilization of telecommunications technologies (e.g., personal electronic devices).

Enhanced cellular and other wireless services within expanded coverage/service areas would directly benefit those 83% of visitors to GCNP who report that use of their personal electronic device is at least slightly important during their stay within the park. Access to cellular and other wireless services would be more consistent and reliable throughout the developed areas of GCNP (including within some buildings which currently block cellular frequencies that are currently too weak to penetrate this infrastructure) and would extend to some locations within developed areas in which cellular and other wireless services are not currently provided, particularly across the North Rim developed area. Increasing the number of cellular carriers within GCNP (assumed likely given the potential increased physical capacity for additional carriers that could be accommodated on future telecommunications towers) would also increase the number of visitors who can and may choose to access these services. The capacity (i.e., speed) of cellular and other wireless services would also noticeably improve if fiber is extended into the park, such that all visitors who have cellular plans or who have other access to a wireless signal in developed areas of the park would be able to more quickly access cellular and other wireless services such as emails, texts, and online information (i.e., rather than waiting seconds or minutes for data to download, information could be accessed more instantaneously). For these reasons, this alternative could result in a higher number of visitors utilizing cellular and other wireless services, with greater ease and access. Activities could include, among others: staying connected to family and friends while visiting the park—including calls, texts, emails, and use of social media; completing personal or professional business, such as managing bank accounts; navigation and trip planning, etc.; and accessing emergency services. For those visitors that feel cellular and/or other wireless services enhance their experience, they would enjoy increased cell phone coverage and other wireless services as a part of their visitor experience and existing visitor dissatisfaction levels associated with telecommunications service would decrease. This beneficial impact would extend into the future (10-15 years or more).

At the same time, visitors who choose to use their personal electronic devices while in GCNP may miss observations that they might otherwise make or experience (e.g., a visitor might not see wildlife if they are looking elsewhere). However, it is unlikely that such use would result in visitors failing to be awed by the Grand Canyon and its splendor—the primary reason visitors come to GCNP.

Visitors may also observe increased disruptions (e.g., noise or social impacts) from their own or other visitors' use of personal electronic devices that may degrade some individuals' experiences, particularly those who prefer a more primitive experience and/or feel cellular and other wireless services detract from their experience. Evidence of these adverse impacts is anecdotal, but reported as interruptions from one's own personal electronic device and encounters with people talking on phones, broadcasting music or videos, or playing games (or doing other activities) with electronic noises. Although these impacts may be minimized by NPS efforts to encourage visitors who use their personal electronic devices to do so in ways that minimize disturbance to other visitors, these adverse impacts could range from decreased visitor satisfaction and/or annoyance (impacting visitor experience only) to frustration that results in visitor displacement (impacting visitor experience and use) as individual visitors may feel that they need to pursue their activities in other areas in order to have the experience they are seeking. This adverse impact would extend into the future (10-15 years or more).

Cellular coverage is not proposed outside of developed areas; however cellular frequencies may extend or spillover to areas within line-of-sight of the towers, including within backcountry areas, and the limited backcountry areas that currently have spillover cell phone coverage from developed areas could be expanded beyond current conditions despite considered parameters to prevent spillover as technologically feasible. For example, based on modelling, some sections of the Colorado River between river mile 62 and 100 (less than 14% of river miles within GCNP) could have some additional,

spotty, coverage above existing conditions. Similar to visitor impacts in the front country, effects would likely be both adverse and beneficial depending on visitor's perceptions. Some individuals would likely be adversely impacted by additional noise associated with expanded cell service backcountry areas where solitude and natural sounds are more expected, while some visitors may choose to take advantage of some cellular service, where they find it, to connect to friends and family and reach emergency services if necessary. Notably, backcountry areas in much of western Grand Canyon, as well as areas within eastern Grand Canyon (including many of the hiking trails and backcountry areas) would not be affected by the placement of new infrastructure or extension of telecommunications services within the park. Again, these impacts would extend into the future (10-15 years or more).

Overall, this alternative is not likely to noticeably change visitation levels or visitation patterns, because access to wireless services is not the reason visitors come to GCNP. More visitors would be able to access telecommunications services during their stay in GCNP and access to these services for all visitors would be easier and more reliable; existing visitor dissatisfaction with these services would decrease. While this increased access may enhance the majority of visitors' experiences, some visitors may be adversely impacted by others' use of this technology such that their visitor satisfaction is decreased and/or they choose to pursue their activities in less developed areas of the park which do not have telecommunications services. A large area of GCNP would not be impacted by this alternative.

Visitor Information

In addition to existing methods that the NPS uses to share information with visitors, enhanced telecommunications within developed areas of GCNP would also give more visitors in these areas improved access, beyond existing conditions, to information about park resources and conditions through online venues while they are in the park. For example, visitors could have increased educational opportunities due to improved access to online interactive information to support park education programs such as the park website and other sources (including park-developed applications, interpretive programming, alerts, maps, Google earth, etc.), and the NPS would have opportunities to more easily and quickly communicate park conditions to visitors. In areas with improved cellular and other wireless services, visitors may increase their use of personal electronic devices for route finding, trip planning, and ready access to park information, such as real-time information on reservation systems, parking, camping, etc. These changes would be most readily apparent within the North Rim developed area, where the current lack of these services is the most pronounced. Those who utilize this technology and access this information would directly benefit from increased knowledge and understanding of park resources and/or decreased confusion and stress in being able to effectively trip plan in response to changing conditions. These impacts to visitors would largely be beneficial and would extend into the future (10-15 years or more).

Visitor Safety

The potential enhancements to and expansion of wireless services (particularly cellular—voice and data) that could occur under Alternative B, would give more visitors, across a larger area, more reliable access to communications with emergency services in order to report emergencies or other incidents which could, in turn, increase response times. NPS and NPS-partner staff would also be able to more reliably use cell phones in more locations to supplement the NPS radio and land-line telephone systems that also support emergency services. These improvements within emergency response communications would make emergency services more accessible via phone, particularly on the North Rim, where the current lack of cellular services is the most pronounced. Similarly, expanded coverage outside of targeted developed areas could also improve backcountry user connectivity with cellular service which would potentially enhance access to 911 and other services in the event of an emergency in these areas. However, backcountry users should not expect to have cellular connectivity once they leave the park developed areas. While some emergency communication needs may be served via the spillover effect, park information would explain to backcountry users that the uncertain nature of this communication does not support additional risks in the backcountry.

Similar to the no action alternative, improvements in existing infrastructure or installation of some additional, minor infrastructure (for example, antennas placed on existing NPS radio towers that provide communications for emergency services) could improve emergency communications, particularly within developed areas of GCNP by increasing access to NPS Dispatch or 911 services. These currently do not exist in some portions of park's developed areas, such as the North Rim; so this would result in an introduction of service where it does not presently exist.

Despite the benefits to public safety from improved wireless services, any increase in cellular coverage along roadways could also increase the number of drivers who seek to utilize this technology along park roads. While drivers may safely use this technology for navigation or for hands-free voice communications, some members of the public raised concerns during public scoping for this Plan that expanded cellular services could result in more distracted drivers on the road. Despite this possibility, the State of Arizona has laws against distracted driving (these laws prohibit drivers from doing anything that can impair their driving ability or cause a driver to take their eyes off the road for more than five seconds) which are expected to minimize (ideally eliminate) this activity and avoid impacts to public safety.

Overall, this alternative would improve emergency response communications in developed and potentially some backcountry areas, and would thus improve visitor safety into the future (10-15 years or more).

Cumulative Impacts

Impacts from past, present, and reasonably foreseeable future actions on visitor use and experience would be the same as those described for the no action alternative. While these impacts could be beneficial or adverse, depending on an individual's view of these technologies—particularly their use within units of the national park system, the incremental impacts to visitor experiences from this alternative with regards to increased telecommunications services would be apparent and largely beneficial. The potential expansion in areas where visitors can communicate with emergency services, as well as the increase in visitors who would have access to these communications, would have beneficial impacts on visitor safety through improved response times. Past and ongoing improvements in NPS web-based information for visitors could also be fully utilized at GCNP through the implementation of this alternative, such that visitors would be able to more readily access real-time NPS and other visitor use information. Finally, in combination with past developments within the park and past, present, and reasonably foreseeable developments on surrounding lands, all visitors to developed areas within GCNP would be able to more easily and reliably utilize telecommunications services during their stay in developed areas of the park, and some visitors may be able to access these services within backcountry areas as well, if they so choose. Given these factors, this alternative would contribute noticeably and beneficially to past, present, and reasonably foreseeable future actions on visitor use and experience. When the effects of this alternative are combined with other past, present, and reasonably foreseeable future impacts, the total cumulative impacts to visitor experiences under this alternative would continue to be primarily beneficial in the long-term.

[This page intentionally left blank]

Chapter 4 – Consultation and Coordination

LIST OF AGENCIES AND TRIBES CONSULTED

The following American Indian tribes and agencies were contacted and were invited to participate in the planning process:

American Indian Consultation

- Hopi Tribe
- Havasupai Tribe
- Kaibab Band of Paiute Indians
- Pueblo of Zuni
- Paiute Indian Tribe of Utah
- Yavapai-Apache Nation
- Las Vegas Tribe of Paiute Indians
- Navajo Nation
- Hualapai Tribe
- San Juan Southern Paiute Tribe
- Moapa Band of Paiute Indians

Agency Consultation

- United States Fish and Wildlife Service
- Arizona State Parks – State Historic Preservation Officer
- Advisory Council on Historic Preservation

[This page intentionally left blank]

Acronyms

CCC	Civilian Conservation Corps
CLI	Cultural Landscape Inventories
CLR	Cultural Landscape Reports
DOE	Determination of Eligibility
EMF	Electromagnetic Field
GCNP	Grand Canyon National Park
HD	Historic District
Hwy	Highway
FCC	Federal Communications Commission
NEPA	National Environmental Policy Act
NHL	National Historic Landmark
NHLD	National Historic Landmark District
NHPA	National Historic Preservation Act
NPS	National Park Service
RF	Radio Frequency
ROW	Right of Way
SHPO	(Arizona) State Historic Preservation Officer
UNESCO	United Nations Educational, Scientific, and Cultural Organization
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service

[This page intentionally left blank]

Glossary

Antenna: A device for transmitting and receiving radio frequency (RF) signals. Often camouflaged on existing buildings, trees, water towers or other tall structures, the size and shape of antennas are generally determined by the frequency of the signal they manage.

Backhaul: The physical way a core network is connected to edge networks. The core network can be thought of as a backbone, the edge network can be thought of as hands and feet, and the backhaul can be thought of as the arms and legs that connects the backbone to hands and feet.

Bandwidth: The transmission capacity of a communications pathway. It is expressed in bits per second, bytes per second or in hertz (cycles per second).

Capacity (related to telecommunications): The measurement of the maximum amount of data (includes voice) that may be transferred between network locations over a link or network path in a given time period.

Carrier (related to telecommunications): Also known as service provider or operator, a carrier is the communications company that provides customers service (including air time) for their wireless phones.

Cell: The basic geographic unit of wireless coverage. Also, shorthand for generic industry term "cellular." A region is divided into smaller "cells," each equipped with a low-powered radio transmitter/receiver. The radio frequencies assigned to one cell can be limited to the boundaries of that cell. As a wireless call moves from one cell to another, a computer at the Mobile Telephone Switching Office (MTSO) monitors the call and at the proper time, transfers the phone call to the new cell and new radio frequency. The handoff is performed so quickly that it's not noticeable to the callers.

Cell Site: The location where a wireless antenna and network communications equipment is placed in order to provide wireless service in a geographic area.

Cellular: A mobile communications system that achieves enhanced system capacity by dividing up a coverage area into regions called cells, then reusing the available spectrum from cell to cell (Frequency Reuse). When a mobile user moves from a cell to an adjacent cell, a hand-off must be performed to ensure uninterrupted service.

Commercial (related to telecommunications): Services available to the general public for a fee provided by CLEC (Competitive Local Exchange Carrier), ILEC (Incumbent Local Exchange Carrier), or wireless carrier.

Co-Location: Placement of multiple antennas at a common site.

Coverage (related to telecommunications): The extent of the area to which the cellular or other wireless signals are transmitted to and received.

Coverage/Service Area (related to telecommunications): The geographic area within which wireless signals are transmitted to and received by mobile devices.

Data: Information in digital form that can be transmitted or processed.

Equipment (related to telecommunications): Refers to hardware used mainly for telecommunications such as transmission lines, multiplexers and base transceiver stations. It encompasses different types of communication technologies including telephones, radios and even computers. Since the early 1990s, the line between telecommunications equipment and IT equipment (like routers and switches) has

started to blur as the growth of the Internet has resulted in the increasing importance of telecommunications infrastructure for data transfer.

Facility (related to telecommunications): A fixed, mobile, or transportable structure, including (a) all installed electrical and electronic wiring, cabling, and equipment and (b) all supporting structures, such as utility, ground network, and electrical supporting structures.

Fiber optic communications cable (fiber): Thin glass or silica strands used to carry data signals from pulsed laser or light emitting diode transmitters.

Frequency: Describes the number of waves that pass a fixed place in a given amount of time. So if the time it takes for a wave to pass is 1/2 second, the frequency is 2 per second. If it takes 1/100 of an hour, the frequency is 100 per hour. Frequency in terms of wireless use is the electromagnetic waves in a frequency range (i.e., 30 Hz to 300 GHz).

Infrastructure (related to telecommunications): The basic facilities, equipment, and installations needed for the functioning of a system. When related to telecommunications, infrastructure typically refers to equipment such as antennas, but can include all facilities, equipment, and other installations related to a telecommunications site.

Internet: Global computer network providing a variety of information and communication facilities, consisting of interconnected networks using standardized communication protocols.

Lattice tower: Three or Four legged tower and interconnected support bracing. Uses thinner individual support members than a single monopole to support the same weight.

Microwave antennas: A physical transmission device used to broadcast microwave radio transmissions between two or more locations.

Microwave equipment: System of equipment used for microwave RF data transmission typically in a point-to-point or point-to-multipoint system.

Microwave relay: A site for the sole purpose of receiving and re-transmitting microwave signals. Usually the systems “clean up” the signal and remove any acquired noise before re-transmitting and to increase distances for microwave links.

Monopole tower: A single legged structure, usually round, for supporting microwave, cellular and two-way radio antenna.

Network: A group or system of interconnected people or things. In this Plan, “network” often refers to a data network that transfers data over a system.

Right-of-way permits (ROW): A permit that can be issued by the NPS to allow a utility to pass over, under, or through NPS property. The permit may be issued only pursuant to specific statutory authority and generally if there is no practicable alternative to the use of NPS lands, regardless of whether the equipment is serving the NPS and its visitors or crossing the park to reach other communities. Examples of utilities and other uses that could be authorized by a NPS ROW permit include electrical power lines, telephone lines, water conduits, canals, and communications infrastructure including radio, television, and telecommunications infrastructure. The ROW permit is a revocable license and does not give permittees an estate in fee, limited estate, or any property interest or ownership in the land; it is not exclusive, and the NPS reserves the right to allow visitor use of the land where appropriate.

Satellite: An artificial object placed in Earth's orbit that is used for communication, television, espionage, weather, or military purposes.

Service(s) (related to telecommunications): The offering of telecommunications such as voice and data and may include Internet, television, or networking for businesses and homes.

Shielding (related to telecommunications): Techniques and methods to prevent interference or transmission of telecommunications signals.

Small-cell site: A telecommunications site designed to enhance cellular system coverage and/or provide more capacity of users to a cellular system. A small-cell site consists of an antenna panel and associated equipment that is, within the context of this Plan, mounted on or within existing infrastructure such as streetlights or buildings, generally at some elevation. A typical antenna panel could be three to four feet tall, about six inches wide, and four to six inches thick, with two to four of these mounted on a light pole, wrapping the pole (visually similar to having three power transformers that are wrapped on top of a power pole). In some cases, the antennas are placed within a larger diameter monopole and are not visible.

Small-cell antenna: A physical transmission device used to broadcast low-powered cellular radio frequencies between a fixed sites and mobile devices.

Telecommunications: Communication of signs, signals, messages, words, writings, images and sounds or information of any nature by cable, telegraph, telephone, or broadcasting.

Tower (related to telecommunications): Free-standing or guy-wired masts or towers built to hold telecommunications antennas such as two-way radio, microwave, and cellular antennas.

Two-way radio: Radio that can both transmit and receive a signal (a transceiver). Also referred to as Land Mobile Radio (LMR).

Wireless: Radio-based systems that allow transmission of voice and/or data signals through the air without a physical connection, such as a metal wire or fiber-optic cable.

Wireless Internet: A general term for using wireless services to access the Internet, e-mail and/or the World Wide Web.

Wireless Services: Any of a number of technologies or services "typically electronic" that allow the transfer of information over a distance without the use of electrical conductors "wires" using various radio frequencies without being physically wired together.

[This page intentionally left blank]

Works Cited

- Bat Conservation Trust. n.d. The Potential Impact of Radio Frequencies and Microwaves on Wildlife. www.bats.org.uk.
https://cdn.bats.org.uk/pdf/About%20Bats/Radiowaves_and_bats_2011.pdf?mtime=20190425112350. Accessed September 19, 2019.
- Berge, Z.L., & Muilenburg, L. 2013. How Mobile Learning Facilitates Student Engagement: A Case Study from the Teaching of Spanish. *Handbook of Mobile Learning*. Routledge. New York, NY. 680 pages.
- Chen, P.D., Guidry, K.R., & Lambert, A.D. 2009. Engaging online learners: A quantitative study of postsecondary student engagement in the online learning environment.
- Duncan, D.K., Hoekstra, A.R., & Wilcox, B.R. (2012). Digital Devices, Distraction, and Student Performance: Does In-Class Cell Phone Use Reduce Learning?. *Astronomy Education Review*. 31 July 2012.
<https://pdfs.semanticscholar.org/d40a/471d2c260291ad25176d8ed198d24c539e14.pdf>. Accessed September 12, 2019.
- Felisoni, D.D., & Godoi, A.S. (2018). Cell phone usage and academic performance: An experiment. *Computers & Education*, 117, 175-187.
- John Milner Associates Inc. 2003. Bright Angel Peninsula HD National Register Form. Grand Canyon National Park.
2004. Grand Canyon Village National Historic Landmark District Cultural Landscape Report. Grand Canyon National Park.
- Kuznekoff, J.H., Munz, S.M., & Titsworth, S. (2015). Mobile Phones in the Classroom: Examining the Effects of Texting, Twitter, and Message Content on Student Learning. *Communications Education*, 64:3, 344-365 pages.
- Lepp, A., Barkley, J.E., & Karpinski, A.C. (2014). The relationship between cell phone use, academic performance, anxiety, and Satisfaction with Life in college students. *Computers in Human Behavior*, 31, 343-350.
- Manville, A.M. 2014. Status of U.S. Fish and Wildlife Service Developments with Communication Towers with a Focus on Migratory Birds: Updates to Service Staff Involved with Tower Issues – A Webinar. United States Fish and Wildlife Service. Arlington, VA. 7 March 2014.
<https://www.fws.gov/midwest/es/planning/pdf/USFWS2013RevisedGuidanceCommTowersSupportingInfo27Sept.pdf> . Accessed August 21, 2019.
- Meyer, M., & Schenk. 2018. Enjoy the View – Visual Resources Inventory Report for Grand Canyon National Park. Unpublished manuscript.
- National Park Service, U.S. Department of the Interior (NPS). n.d. National Park Service Visitor Use Statistics. “Annual Park Recreation Visitation 1904-Last Calendar Year for Grand Canyon National Park”. 15 March 2018.
[https://irma.nps.gov/Stats/SSRSReports/Park%20Specific%20Reports/Annual%20Park%20Recreation%20Visitation%20\(1904%20-%20Last%20Calendar%20Year\)?Park=GRCA2015](https://irma.nps.gov/Stats/SSRSReports/Park%20Specific%20Reports/Annual%20Park%20Recreation%20Visitation%20(1904%20-%20Last%20Calendar%20Year)?Park=GRCA2015).

1974. Stables – Blacksmith Shop Complex National Register Nomination Form. Grand Canyon National Park.
1975. Grand Canyon Village Historic District National Register Nomination Form. Grand Canyon National Park.
1980. Final wilderness recommendation: Grand Canyon National Park. National Park Service, Grand Canyon, Arizona.
- 1982a. Grand Canyon Inn, North Rim Inn, and NPS Campground National Register Nomination Form. Grand Canyon National Park.
- 1982b. Grand Canyon Lodge Historic District National Register Nomination Form. Grand Canyon National Park.
- 1982c. North Rim Headquarters Area National Register Nomination Form. Grand Canyon National Park.
- 1987a. National Register of Historic Places Inventory-Nomination Form – M.E.J. Colter Buildings. Grand Canyon National Park.
- 1987b. Grand Canyon Lodge National Historic Landmark National Register Nomination Form. Grand Canyon National Park.
1994. National Register of Historic Places Registration Form – The Desert View Watchtower Historic District. Grand Canyon National Park.
1997. Grand Canyon Village National Historic Landmark Nomination Form. Grand Canyon National Park.
2000. Grand Canyon Railway Historic District National Register Nomination Form. U.S. Forest Service and National Park Service, Grand Canyon National Park.
2005. Cultural Landscapes Inventory West Rim Drive 1998, Revised 2005. Grand Canyon National Park.
2006. Cultural Landscape Inventory North Rim Historic Entrance Road Corridor. Grand Canyon National Park.
2007. Memorandum of Agreement Regarding Collections, Inadvertent Discovery, and Intentional Excavation of Native American Human Remains, Funerary Objects, Sacred Objects, and Objects of Cultural Patrimony. Grand Canyon National Park.
- 2011a. Bright Angel Peninsula Historic District Cultural Landscape Inventory and National Register form. Grand Canyon National Park.
- 2011b. North Rim Entrance Road National Register form. Grand Canyon National Park.
2013. Horace M. Albright Training Center National Register of Historic Places Registration Form. Grand Canyon National Park.
2015. National Park Service Mission 66 Era Resources National Register Multiple Property Documentation Form.
2016. Draft Mather Business Zone National Register Form. Grand Canyon National Park.

- 2017a. Grand Canyon 2017 Annual Report Branch of Emergency Services. Grand Canyon National Park.
- 2017b. Grand Canyon National Park Foundation Document.
- 2017c. National Park Service Digital. <https://www.nps.gov/subjects/digital/index.htm>. Accessed August 7, 2019.
- Noel, D., Stover, S., & McNutt, M. 2015. Student perceptions of engagement using mobile-based polling as an audience response system: Implications for leadership studies. *Journal of Leadership Education*. https://journalofleadershiped.org/wp-content/uploads/2019/02/14_3_noel.pdf. Accessed September 19, 2019.
- Resource Systems Group (RSG). 2017. Grand Canyon National Park socioeconomic monitoring pilot implementation: Summer 2016. Natural Resource Report NPS/GRCA/NRR—2017/1488. National Park Service, Fort Collins, Colorado.
2018. SEM-Pilot_GRCA_2016_Survey-Data_FINAL-CERTIFIED. Unpublished raw data. October 2, 2018. Compiled by Ellen Rovelstad. White River Junction, VT.
- Seibold, S., et al. 2013. Ponds in acidic mountains are more important for bats in providing drinking water than insect prey. *Journal of Zoology*.
- Shapins Associates. 2006. Cultural Landscapes Inventory Grand Canyon Village. Grand Canyon National Park. United Nations Educational, Scientific, and Cultural Organization (UNESCO). n.d. World Heritage List: Grand Canyon National Park. <http://whc.unesco.org/en/list/75>. Accessed August 6, 2019.
- United States Fish and Wildlife Service (USFWS). 2018. Recommended Best Practices for Communication Tower Design, Siting, Construction, Operation, Maintenance, and Decommissioning. Falls Church, Virginia. <https://www.fws.gov/migratorybirds/pdf/management/usfwscommtowerguidance.pdf>. Accessed September 17, 2019.

[This page intentionally left blank]