



**CELLCO PARTNERSHIP D/B/A  
VERIZON WIRELESS**

**ARBOR HILL CELL SITE**

**151 Henry Johnson Blvd  
City of Albany  
Albany County**

**RF JUSTIFICATION AND SITE SELECTION ANALYSIS  
DECEMBER 20, 2017**

## **RF JUSTIFICATION AND SITE SELECTION ANALYSIS**

CELLCO PARTNERSHIP d/b/a Verizon Wireless (“Verizon Wireless”) submits this RF analysis in association with its proposed “Arbor Hill” wireless communications facility. As proposed, Verizon Wireless plans to install and operate a new wireless telecommunications facility, including associated antennas, equipment platform and related appurtenances, on the rooftop at 151 Henry Johnson Blvd in the City of Albany, Albany County, New York. As proposed, Verizon Wireless’ antennas will be mounted to the roof of the building with the equipment platform on west corner of the property on the opposite side of the main parking area.

The purpose of this facility (referred to by Verizon Wireless as “Arbor Hill”) is to improve wireless in-building coverage and network capacity in the commercial and dense residential areas in the northeastern portion of the City of Albany. The facility will also add new 700 MHz, 1900 MHz Personal Communications Service (PCS) and 2100 MHz Advanced Wireless Services (AWS) frequencies to Verizon Wireless’ existing regional wireless network. Verizon Wireless is using these frequencies for commercial activation of its fourth generation (4G) Long Term Evolution (LTE) communication services.

This project will provide a necessary and critical improvement to Verizon Wireless’ telecommunications network in the City of Albany. Upon completion, new and improved advanced emergency and non-emergency 4G Verizon Wireless communication services will be extended to the densely populated and heavy vehicle traffic areas within the northeastern portion of the City including along Henry Johnson Blvd and into the Arbor Hill and West Hill neighborhoods.

This report documents the general methodology used by Verizon Wireless to select the location of this proposed communications facility. It includes a description of the coverage objectives for this particular facility and the Arbor Hill “search area”, as well as a discussion on why the proposed location is believed to be the best location for Verizon Wireless’ proposed facility.

### **1. QUALIFICATIONS**

This report was prepared by Verizon Wireless’ in-house RF Engineering Department, which consists of experienced and properly credentialed radio frequency engineers. The RF Engineering Department designs Verizon Wireless’ nationwide network to provide adequate and effective wireless communications services in compliance with all FCC requirements, including Verizon Wireless’ licensure requirements. The RF Design Engineers use proprietary software and tools in addition to industry-standard RF propagation modeling and network performance simulation programs to identify network coverage, performance and capacity deficiencies, and develop and implement solutions based on these analyses with the goal of maximize network performance and efficiency.

### **2. WIRELESS TELECOMMUNICATIONS SYSTEMS**

The FCC licenses a specific amount of RF spectrum to wireless service providers and stipulates that each carrier efficiently use that spectrum to provide adequate wireless communication to emergency services, businesses and individuals in the licensed areas. Wireless carriers achieve this mandate by continuously reusing the allocated radio frequencies throughout their licensed service area. This is accomplished by building small radio base stations, or cell sites, in a particular pattern (also known as a grid). The application of the grid

concept affords a wireless carrier the ability to effectively and efficiently plan the reuse of radio frequencies. Indeed, it is the only way a cellular system can adequately function. Following proper planning techniques (as originally defined by Bell Labs and further refined by the wireless industry), the same radio frequency is reused at reasonably close intervals throughout the licensed area, without causing harmful interference (noisy or dropped calls or the inability to originate a call are typical manifestations of harmful interference), but only if placed properly. There is extremely limited flexibility as to where a cell site can be located, and limited flexibility as to the proper height.

When designing a wireless network, an RF Design Engineer starts with a theoretical grid pattern and applies it to the licensed area. Each licensed area has many variables that can affect the design and must be considered. These variables include terrain features, use of existing structures, traffic distribution, and many others. In order to provide effective coverage while maintaining an appropriate frequency reuse plan, the RF Design Engineer must perform a balancing test of all applicable technological variables. The primary variables that the engineer must balance/take into consideration are location, and the overall height of the cell sites. Sites located too close to one another will result in unacceptable network interference. If the sites are too far apart, service will significantly degrade in the area where the signal does not reach ultimately resulting in the potential for dropped calls or ineffective connection attempts. If a cell site is too high, it will have increased coverage but will cause interference throughout the rest of the wireless network, thereby significantly affecting network efficiency. If a cell site is too low, it will not provide effective coverage to the target area.

Therefore, a properly designed wireless network begins with strategically located cell sites. A common denominator for each cell site involves a tall structure, typically a building, tower, water tank or other structure on which antennas are mounted. Typically, radio-transmitting equipment (base station) is located at the base of the structure. Radio signals leave the base station and travel through transmission lines to the antennas or to fiber optic cable to the remote radio head (RRH) at the top of structure and then to the antennas. Radio signals are broadcast through the antennas and travel to the customer's wireless device, thereby establishing a connection between the wireless network and the end user of the wireless device. When a wireless device transmits back to the cell site, the signal is received by the antennas, travels down the transmission line and into the base station. The base station converts the signal into digital data and combines it with all the other wireless calls and digital traffic at that cell site. This data is then sent over fiber optic digital lines to the main switching computer. The main switching computer or Mobile Switching Center (MSC) is interconnected to the national Public Switched Telephone Network (PSTN) and Internet service providers where calls are routed to other wireless or land-line phones, or Internet locations.

As this technology enables mobile calling, once a wireless call is originated and the customer travels away from the cell site of origination, the system tracks the changes and begins a process of determining if there is a better serving cell site (a "dominant server"). Upon determination of a stronger serving site, the system automatically switches the wireless customer over to the new cell site. This process is known as a handover and allows for seamless coverage within a wireless carrier's service area. By design, this process is supposed to happen so quickly, the wireless customer does not perceive it. If the network is designed properly, there is no interruption of service and connection quality remains adequate. Proper, effective RF design requires the location (and height) of cell sites in fairly rigid parameters to ensure that the above-described process works in an adequate manner.

### **3. PERFORMANCE METRICS**

#### **(a) Coverage**

The critical issue for Verizon Wireless is the provision of “adequate and substantial” Radio Frequency (RF) service to serve its wireless customers. The wireless industry is governed by the Rules of the FCC. The FCC mandates in CFR 47, Parts §22.940 and §24.16 that each carrier must provide “substantial service” in its licensed service area, or risk having their license revoked. The FCC defines “substantial service” as service which is sound, favorable, and substantially above a level of mediocre service. Similarly, New York State law, recognizing the importance of deploying the infrastructure for wireless communications, has deemed cellular transmitting facilities to be public utilities for purposes of zoning. As such, the facilities must be permitted in order to provide “safe and effective” service.

A metric called Reference Signal Received Power (“RSRP”) is used to specify the coverage capabilities of wireless networks. This standard best represents the Long-Term Evolution (“LTE”) data technology (also known as 4G) being utilized as well as the Voice-Over LTE (“VoLTE”) technology, which is being deployed on 4G to augment and ultimately replace Verizon Wireless’ legacy Third Generation (3G) voice services and capacity. RSRP is the average received power measured across an LTE broadband channel.

RSRP is measured in units of “decibels” referenced against 1 milliwatt, or dBm. The decibel is a logarithmic unit that allows ratios to be added or subtracted. The definition formula for decibels referenced against 1 milliwatt is  $dBm = 10 \log(P / 1mW)$  with  $P$  measured in milliwatts. So 10 mW would be 10 dBm, 100 mW would be 20 dBm, etc.

The service boundary of a 4G site is defined using a RSRP equating to an acceptable receiver signal threshold. This value is derived from industry standards, 4G receive signal levels and quality and acceptable signal to noise ratios, along with statistically quantifiable variations in terrain. This threshold must also take into account additional losses associated with location of the mobile user.

Verizon Wireless must provide adequate service to all of its users. In order to account for users within buildings, additional margin must be added to RSRP so that adequate coverage exists inside. Industry and Verizon Wireless engineering standards include an additional 10dB of margin to RSRP to be used for light suburban areas, with increasing values for higher density land usage. This additional margin is also required for in-vehicle service specifically to account for increased attenuation associated with the use of hands-free headsets, where the phone is typically placed on the seat or in the center console.

An industry standard RF computer-aided engineering tool is used in the design of wireless networks. This tool is used to generate a plot of RSRP that shows underlying geographic data (highways, arterial roads, etc.). The propagation map is drawn showing the region where the RSRP equates to the minimally acceptable received signal level for adequate service, as measured at the device’s receiver. The propagation map depicts the RSRP of the surrounding environment including the attenuation of in-building and in-vehicle use of service and visually demonstrates existing coverage patterns. Plots can also be generated to demonstrate proposed coverage patterns.

With the preceding in mind, Verizon Wireless’ network standard for reliable 4G LTE wireless service in Upstate New York for dense residential and commercial settings is -95 dBm RSRP. Network reliability and accessibility decreases dramatically for mobile devices operating in or traveling into RF environments outside (or weaker than) the -95 dBm RSRP coverage boundary (represented as white space in the provided coverage plots). Additionally, -95 dBm

RSRP is used in areas where additional signal strength is needed to penetrate into buildings (e.g., city centers, dense residential, commercial and industrial type environs). Since the overall environment for the Arbor Hill facility and associated targeted coverage improvement area is a mixture of dense residential and commercial areas, the -95 dBm RSRP signal strength standard was applied.

Lastly, in addition to the sites shown on a propagation map, and toward the edges of these maps, there may be coverage from other more-distant sites but these sites are eliminated from this report as they do not impact the area surrounding the subject location.

#### **(b) Capacity**

Significant deficiencies in service can occur in Verizon Wireless' telecommunication network in and around the existing sites. These deficiencies can be a result of capacity demands that are taxing the surrounding sites in the Verizon Wireless network. The FCC mandates in CFR 47 Part §22.940 that when a Commercial Mobile Radio Service ("CMRS") licensee (i.e. "wireless carrier") is up for renewal, the carrier must demonstrate its proposal for expanding system capacity in a coordinated manner in order to meet anticipated increasing demand for both local and roamer service, or be at risk of license revocation.

Verizon Wireless regularly monitors customer traffic on each site in its network and identifies which sites are reaching 4G capacity limits or are projected to reach these limits over a rolling four-year window. Capacity is defined as the amount of customer data traffic (voice and data) a given site can process before significant performance degradation occurs. Performance issues include an inability to access the network (make a call), calls being abruptly dropped from the network (dropped calls), or poor call or data throughput performance while connected to the network (delayed upload or download speeds). Data volume, or throughput, is the main factor used to determine the existing 4G capacity for a given site and to project when that site is expected to run out of capacity (i.e., reach a point where it can no longer process the volume of data requested by local wireless devices). Capacity relief solutions, typically development of additional sites capable of "offloading" the "loaded" sites, are then required to solve the problem.

Forward Data Volume ("FDV"), a measure of usage (data throughput) on a particular site over a given period of time, is the performance metric used to evaluate the capacity of an existing facility. The "forward link" is used since there is generally more data being downloaded<sup>1</sup> (or transmitted) from a given site to the mobile devices within its coverage area, than uploaded. Therefore, it is the "forward link", not the "reverse link" that is used to determine the capacity limitations. Spikes resulting from anomalies such as seasonal events (tourist spikes, major outdoor concert venues or sporting events, etc.), college breaks, holiday sales events or celebrations, and major accidents or emergencies are accounted for as they can inflate the capacity demand and result in a premature capacity offload prediction. Trending actual and recorded throughput data over time for a site and comparing it to the theoretical maximum throughput capabilities for that site determines when that site will require capacity relief.

The above are some of the concepts and parameters used when determining adequacy of the existing network.

## **4. PERFORMANCE SOLUTIONS**

When the Verizon Wireless Radio Frequency Engineer identifies coverage gaps in the system or sites that have or will reach data capacity exhaustion, they issue a "search area." A

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<sup>1</sup> By comparison the reverse link, or information transmitted from mobile devices to an associated wireless facility, generally carries in the order of 1/10th of the data volume as the forward or downlink path.

search area is a geographical area located within the inadequately serviced area, and it is designed such that if a wireless telecommunications facility is located within the search area, and at an appropriate height, it will likely provide the required coverage. For the most part, locations outside of the search area will fail to provide adequate service to the cell. Due to technological constraints, there is limited flexibility as to where a new facility can be located, and still function properly. The goal of the search area is to define the permissible location for placement of a cell site that will provide adequate service in the subject cell, and also work properly as part of the overall network.

## **5. VERIZON WIRELESS SERVICE AND PROPOSED SOLUTION IN THE ARBOR HILL CELL**

### **(a) New Facility Need and Targeted 4G Wireless Network Performance Improvement Area**

As mentioned previously, the purpose of the Arbor Hill wireless telecommunications facility is to provide an adequate and safe level of emergency and non-emergency Verizon Wireless communications services to the northeastern portions of the City of Albany including the Arbor Hill and West Hill neighborhoods, and along portions of Northern Blvd (US-9), Henry Johnson Blvd, and Livingston Ave. More specifically, the facility will offer significant improvements in both capacity (ability for the network to adequately satisfy the demand for high speed wireless services) and in-building coverage to 0.5± miles along Northern Blvd, 0.5± miles along Henry Johnson Blvd, 1.2± miles combined along Livingston Ave and Clinton Ave, to the dense residential Arbor Hill and West Hill neighborhoods, and to the business and government buildings in and around the intersection of Livingston Ave and Henry Johnson Blvd. This facility will also provide similar wireless service improvements to several busy secondary roads and the residents living along them (e.g., Lark St, Sheridan Ave, 1st St., 2<sup>nd</sup> St, 3<sup>rd</sup> St., etc.) including several local restaurants, shops, and businesses across the targeted service improvement area.

Network capacity and in-building service in and around the northeastern portions of the City is currently insufficient and unreliable, mainly due to heavy network usage generated in the downtown and state capitol portions of the City (which limits the amount of network resources available to customers in the Arbor Hill area) and the lack of a dedicated wireless facility in/near Arbor Hill to serve customers in and traveling through the area. Also, as a result of changes in mobile wireless communications technology, dramatic increases in wireless usage patterns (particularly data services), a rapidly expanding Verizon Wireless subscriber base and other factors, existing service and capacity from surrounding communications facilities is insufficient as these nearby facilities are incapable of handling capacity demands across the proposed site's targeted coverage area.

To provide a dominant (i.e., continuous) adequate and safe level of 4G communications service to the target area, a new wireless facility in the Arbor Hill / West Hill area is required. Importantly, coverage from this proposed site must also integrate to the extent practicable with service from Verizon Wireless' adjoining existing and planned communications facilities in order to resolve the significant gap in Verizon Wireless coverage and network performance in this part of the City of Albany.

The primary existing Verizon Wireless sites serving the Arbor Hill area (its "Patroon Island" facility located on the Leo O'Brien Federal building rooftop at 11 Clinton Ave. and "North

Albany” facility located on the Thurlow Terrace Apartment building at 116 Western Ave.) have reached maximum capacity in 2017 and have become overloaded to the point where they are providing reduced performance to Verizon Wireless customers being served by them. The proposed Arbor Hill facility is strategically placed to provide capacity relief to both of these capacity-limited facilities (i.e., Patroon Island and North Albany) by offloading customer traffic from them in the Arbor Hill / West Hill area.

The targeted Arbor Hill wireless facility’s service improvement area encompasses approximately 1 square mile, or generally the area bounded in red in the aerial map provided at **Figure 1** below. The proposed site will provide localized coverage to this area and offer a significant level of capacity relief to the existing capacity-limited macro sites Patroon Island and North Albany, shown in the lower right and center left portions of the map, respectively. Note that when viewing the map in **Figure 1** that the Red sectors indicate sites that have or are expected to reach their capacity limitations in 2017, while the yellow sectors demonstrate cell site sectors that are projected to reach their capacity limitations in 2018.



Figure 1. Targeted Coverage and Capacity Offload Area from the Proposed Arbor Hill Facility.

**(b) Proposed Arbor Hill Wireless Facility Search Area and Candidate Analysis**

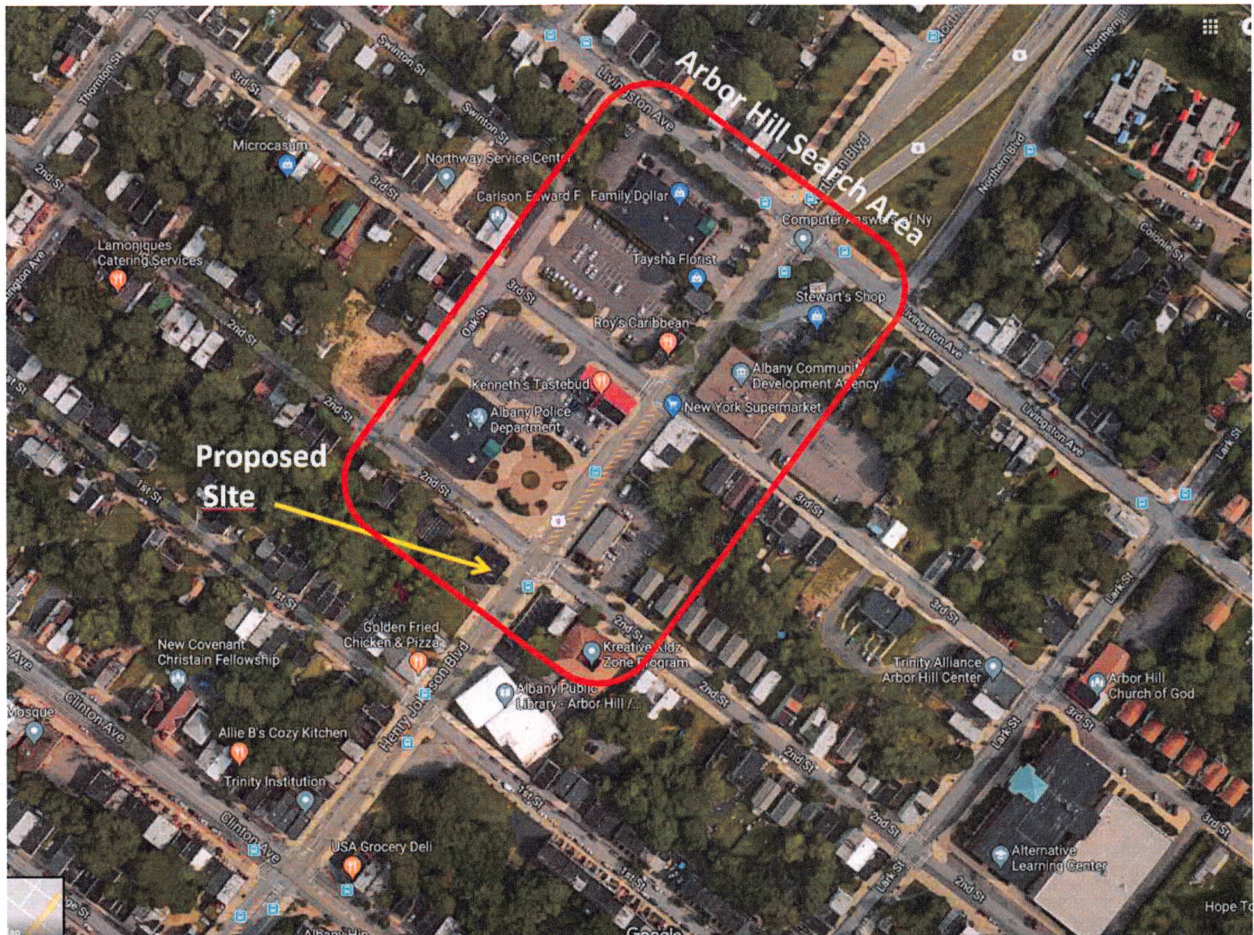
Verizon Wireless' approach to cell site location begins with recognition that a particular geographic area cannot be sufficiently served from the existing communications facilities in the surrounding network. A "search area" is then created by a qualified in-house Radio Frequency (RF) Engineer, to identify the areas from which a new communications facility would remedy the coverage gap.

Once the search area is identified, Verizon Wireless looks for a site within the search area that is both technically appropriate and sensible from a zoning and land use perspective. Subject to technical limitations, co-location on an existing tower or other tall structure is generally preferred by municipalities and wireless carriers alike, as co-location typically results in a cost effective and expedited solution to bring new and or improved service to a currently under-served area. If there are no existing (or available) tall structures in the area, a site search for the location of a new tower generally involves consideration of the following: Municipal properties; industrial and commercial zones; agricultural zones; and lastly, residential zones. Fortunately for the Arbor Hill search area; there is a sufficiently tall structure (the rooftop of 151 Henry Johnson Blvd) that can be used by Verizon Wireless to achieve its stated 4G network performance improvement objectives.

The search area for the Arbor Hill cell site is located in a relatively small geographic area focused on the commercially-developed area at the Livingston Ave / Henry Johnson Blvd intersection. The location of the search area is based primarily by the coverage objectives – Verizon Wireless' facility must be located where it can provide the needed coverage and capacity offload detailed in the previous section. The size and shape of the search area is driven by topography, surrounding vegetative and building clutter, existing coverage, and usage demands (i.e., capacity limitations) on neighboring wireless facilities.

An illustration of the Arbor Hill search area is set forth at **Figure 2** below, where the red boundary represents the designated search area and the rooftop at 151 Henry Johnson Blvd is shown at the end of the yellow arrow. This specific search ring area location was chosen for its near-optimal placement near the center of the targeted coverage and capacity improvement area and includes a cluster of commercial and government buildings for potential colocation opportunities (compared to attempting to build a new facility in the surrounding dense residential areas).





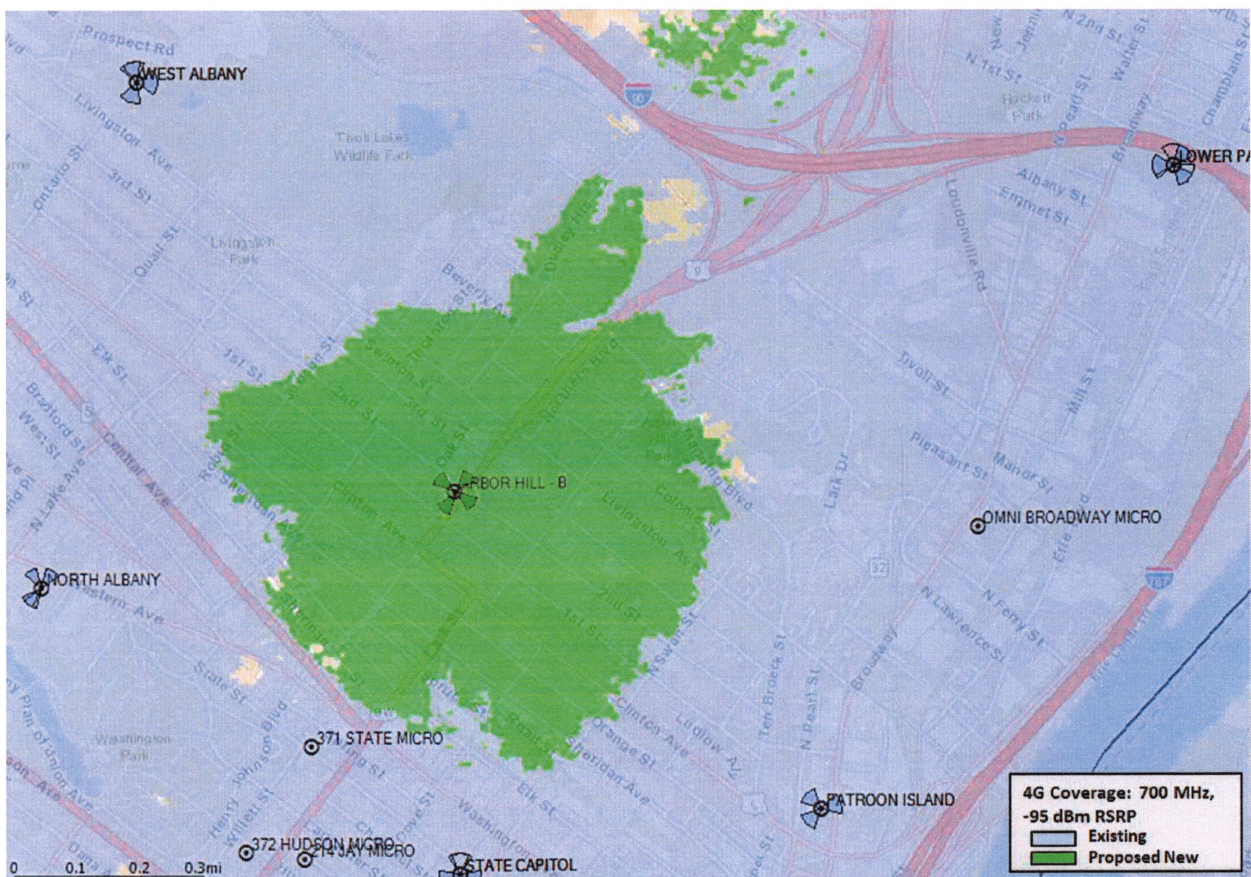
**Figure 2 – Arbor Hill Search Area and Proposed Wireless Facility**

The Arbor Hill search area was analyzed to determine potential locations for the proposed facility. The search area primarily consists of commercial and government buildings and is surrounded by thickly treed dense residential neighborhoods. The existing rooftop of 151 Henry Johnson Blvd offers sufficient height to “see” over or around the majority of the local building and vegetative clutter in the area, and is positioned such that antennas placed on the rooftop are able to satisfy VZW coverage and capacity objectives without the need for Verizon Wireless to develop a new tower facility. Verizon Wireless also inquired about the possibility of collocating a wireless facility on the Albany Police Department building at 165 Henry Johnson Blvd. and the Albany Community Development Agency Building at 200 Henry Johnson Blvd., but representatives of both facilities conveyed that these buildings are not available for collocation.

In addition to the above properties that were contacted The Albany Public Library at the corner of 1<sup>st</sup> Street and Henry Johnson Blvd and the lattice structure on the corner of 2<sup>nd</sup> Street and Henry Johnson Blvd were evaluated and determined to not be viable candidates. The Albany Public Library at the corner of 1st St and Henry Johnson Blvd was removed from consideration after evaluation as the rooftop is surrounded by taller vegetation and buildings (including the 3 story apartment building we are proposing to collocate on) RF coverage from this rooftop would be blocked and significantly attenuated in areas to the north, south and east. Conversely, the proposed rooftop collocation offers relatively unobstructed RF propagation in most directions, but most importantly across open areas to the north including to the Albany

Community Development Agency Building and intersection of Livingston Ave, US-9, Northern Blvd and Henry Johnson Blvd, and to the south along Henry Johnson Blvd to Central Avenue. The lattice structure was determined be both insufficient in terms of structural capacity and height to support colocation by Verizon wireless.

Since the proposed rooftop colocation is located in a relatively open area in the south end of the designated search area and offers sufficient height such that Verizon Wireless' antennas are able to achieve the specified coverage and capacity objectives for the proposed Arbor Hill facility, this rooftop was targeted and subsequently leased for development of the proposed facility. A radio frequency (RF) propagation map showing the in-building and mobile coverage that will be achieved from the proposed Arbor Hill facility is shown at **Figure 3** below (where proposed new coverage is depicted as the green region):



**Figure 3 – Proposed New / Improved 4G Coverage in the Arbor Hill Area**

As noted (and demonstrated in **Figure 3**), Verizon Wireless will be able to satisfy all applicable RF coverage (and capacity) objectives for its proposed Arbor Hill facility by placing its antennas on the existing rooftop of 151 Henry Johnson Blvd with an antenna centerline height of 44.0± ft.

Based upon the foregoing, Verizon Wireless believes that co-location on the rooftop of 151 Henry Johnson Blvd will be as consistent as possible with the purpose and intent of the City of Albany Zoning Ordinance. As this location meets all applicable RF coverage and capacity

objectives, and also complies with the City of Albany Unified Sustainable Development Ordinance to the extent practicable, no further site analysis is required.

## 6. TECHNICAL INFORMATION

### Frequency / Modulation / Type of Service

The frequency, modulation and class of service of Verizon Wireless' radio equipment will be:

Frequencies:            Cellular – Legacy 3G Cellular; Future conversion to 4G  
Tx 880.020 – 889.98 and 891.51 - 893.970 MHz  
Rx 835.020 – 844.98 and 846.51 - 848.970 MHz

Personal Communications Service (PCS 4G)  
Tx 1980.00 – 1990.00 MHz  
Rx 1900.00 – 1910.00 MHz

WU 700 MHz Upper Band (4G)  
Tx 746.00 – 757.00 MHz  
Rx 776.00 – 787.00 MHz

Advanced Wireless Services (AWS 4G)  
Tx 2145.00 – 2155.00 MHz  
Rx 1745.00 – 1755.00 MHz

Modulation:            Long Term Evolution (LTE)

Class of Service:      Handheld Mobile Communications

### Categorical Exclusion / Maximum Permitted Exposure (MPE)

A completed report entitled "RF Safety FCC Compliance of Proposed Communications Facility" prepared by Millennium Engineering, P.C. is included at **Appendix A**, to document that the proposed modifications will be: (a) in full compliance with the current FCC RF emissions guidelines (NIER); and (b) categorically excluded from local regulation under applicable federal law.

### Non-Interference Certification

A Non-Interference Letter prepared by the Verizon Wireless Radio Frequency Design Engineer is included at **Appendix B**, to document that the proposed antennas will not cause interference with existing communications devices in the surrounding area.

## 7. Conclusion

Verizon Wireless is not able to adequately serve customers in the dense residential and high 4G network usage areas in and around the Arbor Hill and West Hill neighborhoods in northeastern Albany from existing or planned sites in the vicinity, or by upgrading nearby facilities. By co-locating on the rooftop of 151 Henry Johnson Blvd at an antenna centerline height of 44.0± ft. AGL, Verizon Wireless will be able to provide an adequate and safe level of in-building coverage, mobile service, and network capacity to an important section of the City of Albany. Additionally, service from this facility will integrate to the extent practicable with coverage from Verizon Wireless' neighboring facilities in the City of Albany, which are located a range of approximately 0.4 to 1.2 miles from the proposed site.

Colocation on this existing rooftop is consistent with the requirements of the City of Albany Zoning Ordinance, and therefore is the most appropriate means of improving coverage in this area of the City. Upon completion, the Arbor Hill communications facility will enhance the public welfare by providing businesses and individuals with a modern, more efficient system of 4G communications services for police, fire and other emergency or non-emergency use.

Respectfully submitted by:

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Dated: December 20, 2017