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## VISUAL ASSESSMENT \& PHOTO-SIMULATIONS

Cellco Partnership, d/b/a Verizon Wireless is seeking approval for the development of a new wireless communications facility (the "Facility") at 5151 Park Avenue in Fairfield, Connecticut on the campus of Sacred Heart University ("SHU" or the "University) (the "Host Property"). The Facility is being developed to relocate existing Verizon Wireless equipment from a building located at 175 Jefferson Street on the main campus of SHU. At the request of Verizon Wireless, All-Points Technology Corporation, P.C. ("APT") completed this assessment to evaluate the potential visual effects of the proposed Facility from within a two-mile radius (the "Study Area"). The Study Area includes portions of the neighboring municipalities of Easton (to the north and west), Trumbull (to the northeast), and Bridgeport (to the east and southeast).

## Project Undertaking

Verizon Wireless plans to construct the Facility in the northern portion of the Host Property (the "Site"), west of a newly constructed SHU maintenance building. The Facility would include a 130 -foot tall steel monopole within an approximate 50 -foot by 50 -foot fenced equipment compound. The base of the Facility would be constructed at an approximate elevation of 230 feet above mean sea level ("AMSL"). The highest antenna platform would be installed so that the tops of the proposed panel antennas would extend to a height of approximately 134 feet above ground level ("AGL"). Access would be provided over an existing paved driveway that extends southward onto the Host Property from Jefferson Street and terminates adjacent to the Site. Please refer to the design drawings prepared by Hudson Design Group, LLC, Revision 0 dated February 11, 2020, provided under separate cover, for details regarding the proposed installation.

## Project Setting

The Host Property is located west of Park Avenue and south of Jefferson Street in the northeastern portion of Fairfield. Fairchild Wheeler Golf Course borders the Host Property to the west and south. Notre Dame Catholic High School is located across Jefferson Street north of the Site. The Merritt Parkway (Connecticut State Route 15 or the "Parkway"), a National Scenic Byway listed on the National Register of Historic Places, runs approximately 1,200 feet north of the Site. Exit 46 (egressed from the northbound side) of the Parkway and an adjacent commuter lot are approximately 1,300 feet west of the Site. Land use in the immediate vicinity also includes high density residentially-developed properties.

The topography within the majority of the Study Area consists of generally gently rolling terrain. Ground elevations range from approximately 68 feet AMSL in the southwestern portion of the Study Area to approximately 516 feet AMSL in the northwestern portion of the Study Area. Tree cover within the Study Area (consisting of mixed deciduous hardwoods and conifers) occupies approximately 2,312 acres ( $\pm 28.75 \%$ ) of the 8,042-acre Study Area.

## Methodology

APT used the combination of a predictive computer model, in-field analysis, and a review of various data sources to evaluate the visibility associated with the proposed Facility on both a quantitative and qualitative basis. The predictive model provides a measurable assessment of visibility throughout the entire Study Area, including private properties and other areas inaccessible for direct observations. The in-field analyses consisted of raising a brightly-colored flag with a crane to the proposed monopole height and field reconnaissance of the Study Area to record existing conditions, verify results of the model, inventory seasonal and year-round view locations, and provide photographic documentation from publicly accessible areas. A description of the procedures used in the analysis is provided below.

## Preliminary Computer Modeling

To conduct this assessment, a predictive computer model was developed specifically for this project using ESRI's ArcMap GIS ${ }^{1}$ software and available GIS data. The predictive model incorporates Project and Study Area-specific data, including the site location, its ground elevation and the proposed Facility height, as well as the surrounding topography, existing vegetation, and structures (the primary features that can block direct lines of sight).

A digital surface model ("DSM"), capturing both the natural and built features on the Earth's surface, was generated for the extent of the Study Area utilizing State of Connecticut 2016 LiDAR $^{2}$ LAS $^{3}$ data points. LiDAR is a remote-sensing technology that develops elevation data by measuring the time it takes for laser light to return from the surface to the instrument's sensors. The varying reflectivity of objects also means that the "returns" can be classified based on the characteristics of the reflected light, normally into categories such as "bare earth," "vegetation," "road," or "building." Derived from the 2016 LiDAR data, the LAS datasets contain the corresponding elevation point data and return classification values. The Study Area DSM incorporates the first return LAS dataset values that are associated with the highest feature in the landscape, typically a treetop, top of a building, and/or the highest point of other tall structures.

Once the DSM was generated, ESRI's Viewshed Tool was utilized to identify locations within the Study Area where the proposed Facility may be visible. ESRI's Viewshed Tool predicts visibility by identifying those cells ${ }^{4}$ within the DSM that can be seen from an observer location. Cells where visibility was indicated were extracted and converted from a raster dataset to a polygon feature which was then overlaid onto an aerial photograph and topographic base map. Since the DSM includes the highest relative feature in the landscape, isolated "visible" cells are often indicated within heavily forested areas (e.g., from the top of the highest tree) or on building rooftops during the initial processing. It is recognized that these areas do not represent typical viewer locations and overstate visibility. As such, the resulting polygon feature is further refined by extracting those areas. The viewshed results are also cross-checked against the most current aerial photographs to assess whether significant changes (a new housing development, for example) have occurred since the time the LiDAR-based LAS datasets were captured.

[^0]The results of the preliminary analysis are intended to provide a representation of those areas where portions of the Facility may potentially be visible to the human eye without the aid of magnification, based on a viewer eye-height of five (5) feet above the ground and the combination of intervening topography, trees and other vegetation, and structures. However, the Facility may not necessarily be visible from all locations within those areas identified by the predictive model, which has limitations. For instance, it is important to note that the computer model cannot account for mass density, tree diameters and branching variability of trees, or the degradation of views that occur with distance. As a result, some areas depicted on the viewshed maps as theoretically offering potential visibility of the Facility may be over-predicted because the quality of those views is not sufficient for the human eye to recognize the Facility or discriminate it from other surrounding or intervening objects.

## Seasonal Visibility

Visibility also varies seasonally with increased, albeit obstructed, views occurring during "leaf-off" conditions. Beyond the variabilities associated with density of woodland stands found within any given Study Area, each individual tree also has its own unique trunk, pole timber and branching patterns that provide varying degrees of screening in leafless conditions which, as introduced above, cannot be precisely modeled. Seasonal visibility is therefore estimated based on a combination of factors including the type, size, and density of trees within a given area; topographic constraints; and other visual obstructions that may be present. Taking into account these considerations, areas depicting seasonal visibility on the viewshed maps are intended to represent locations from where there is a potential for views through intervening trees, as opposed to indicating that leaf-off views will exist from within an entire seasonally-shaded area.

## Crane Test and Field Reconnaissance

To supplement and fine-tune the results of the computer modeling efforts, APT completed in-field verification activities consisting of a crane test, vehicular and pedestrian reconnaissance, and photodocumentation. The crane test and field reconnaissance were completed on January 24, 2020. The crane test consisted of raising a brightly-colored, approximately 4' by 4' flag with a crane to a height of approximately 134 feet $A G L^{5}$ at the proposed monopole location. Weather conditions were favorable for the in-field activity with calm winds and sunny skies.

Once the flag was raised, APT conducted a Study Area reconnaissance by driving along local and State roads and other publicly accessible locations to document and inventory where the flag could be seen above and through the tree canopy and other visual obstructions. Visual observations from the reconnaissance were also used to evaluate the results of the preliminary visibility mapping and identify any discrepancies in the initial modeling.

[^1]
## Photographic Documentation and Simulations

During the Study Area reconnaissance, APT obtained photo-documentation of representative locations where the flag was visible. At each photo location, the geographic coordinates of the camera's position were logged using global positioning system ("GPS") technology. Photographs were taken with a Canon EOS 6D digital camera body ${ }^{6}$ and Canon EF 24 to 105 millimeter ("mm") zoom lens. APT typically uses a standard focal length of 50 mm to present a consistent field of view. On occasion, photos are taken at lower focal lengths to provide a greater depth of field and to provide context to the scene by including surrounding features within the photograph. During this evaluation, two (2) photographs were taken at a 24 mm focal length and two (2) photographs were taken at a 35 mm focal length as noted in the table (Table 1 - Photo Locations) on the following pages.

Photographic simulations were generated to portray scaled renderings of the proposed Facility from eighteen (18) locations presented herein where the Facility may be recognizable above or through the trees. ${ }^{7}$ Using field data, site plan information and 3-dimensional (3D) modeling software, spatially referenced models of the site and Facility were generated and merged. The geographic coordinates obtained in the field for the photograph locations were incorporated into the model to produce virtual camera positions within the spatial 3D model. Photo-simulations were then created using a combination of renderings generated in the 3D model and photo-rendering software programs, which were ultimately composited and merged with the existing conditions photographs (using Photoshop image editing software). The scale of the subjects in the photograph (the flag) and the corresponding simulation (the Facility) is proportional to their surroundings.

For presentation purposes in this report, the photographs were produced in an approximate 7 -inch by 10.5 -inch format. When reproducing the images in this format size, we believe it is important to present the largest view while providing key contextual landscape elements (existing developments, street signs, utility poles, etc.) so that the viewer can determine the proportionate scale of each object within the scene. Photo-documentation of the field reconnaissance and photo-simulations of the proposed Facility are presented in the attachment at the end of this report. The field reconnaissance photos that include the flag in the view provide visual reference points for the approximate height and location of the proposed Facility relative to the scene. All simulations were created to represent the proposed top antenna height of 134' AGL. The photo-simulations are intended to provide the reader with a general understanding of the different view characteristics associated with the Facility from various locations. Photographs were taken from publicly-accessible areas and unobstructed view lines were chosen wherever possible.

The following table summarizes the photographs and simulations presented in the attachment to this report, and includes a description of each location, view orientation, distance from where the photo was taken relative to the proposed Facility, and the general characteristics of the view. The photo locations are depicted on the photolog and viewshed maps provided as attachments to this report.

[^2]
## Table 1 - Photo Locations

| Photo | Location | Orientation | Distance to Site | Visibility |
| :---: | :---: | :---: | :---: | :---: |
| 1 | Park Avenue* | Southwest | $\pm 0.40$ Mile | Not Visible |
| 2 | Park Avenue | Southwest | $\pm 0.39$ Mile | Year Round |
| 3 | Park Avenue | Southwest | $\pm 0.36$ Mile | Seasonal |
| 4 | Park Avenue | Southwest | $\pm 0.36$ Mile | Not Visible |
| 5 | Sacred Heart University Parking Lot - Park Avenue | Southwest | $\pm 0.30$ Mile | Year Round |
| 6 | Park Avenue | West | $\pm 0.40$ Mile | Year Round |
| 7 | Park Avenue | West | $\pm 0.40$ Mile | Not Visible |
| 8 | Park Avenue | West | $\pm 0.47$ Mile | Not Visible |
| 9 | Fairchild Wheeler Golf Course | Northwest | $\pm 0.51$ Mile | Not Visible |
| 10 | Fairchild Wheeler Golf Course | Northwest | $\pm 0.59$ Mile | Not Visible |
| 11 | Hawthorne Drive | North | $\pm 0.60$ Mile | Not Visible |
| 12 | Sacred Heart University West Campus | Northeast | $\pm 0.41$ Mile | Not Visible |
| 13 | Sacred Heart University West Campus | Northeast | $\pm 0.39$ Mile | Seasonal |
| 14 | Easton Turnpike | Northeast | $\pm 0.35$ Mile | Seasonal |
| 15 | Autumn Ridge Road | Northeast | $\pm 0.27$ Mile | Not Visible |
| 16 | Hillary Circle | Northeast | $\pm 0.24$ Mile | Seasonal |
| 17 | Park \& Ride - Jefferson Street | East | $\pm 0.15$ Mile | Seasonal |
| 18 | Weeping Willow Lane* | East | $\pm 474$ Feet | Not Visible |
| 19 | Weeping Willow Lane | Southeast | $\pm 0.13$ Mile | Year Round |
| 20 | Weeping Willow Lane | Southeast | $\pm 0.15$ Mile | Not Visible |
| 21 | Donna Drive | Southwest | $\pm 0.14$ Mile | Year Round |
| 22 | Donna Drive at Jefferson Street** | Southwest | $\pm 361$ Feet | Year Round |
| 23 | Sacred Heart University | West | $\pm 0.22$ Mile | Year Round |
| 24 | Sacred Heart University | Northwest | $\pm 0.17$ Mile | Year Round |
| 25 | Sacred Heart University | West | $\pm 0.12$ Mile | Year Round |
| 26 | Stevenson Road | Southeast | $\pm 0.29$ Mile | Seasonal |
| 27 | Easton Turnpike | Northeast | $\pm 0.32$ Mile | Year Round |
| 28 | Federal Street | East | $\pm 0.31$ Mile | Seasonal |
| 29 | Congress Street | Northeast | $\pm 0.37$ Mile | Year Round |
| *Photograph was taken at 24 mm focal length. <br> **Photograph was taken at 35 mm focal length. <br> (Table continued on the following page) |  |  |  |  |

Table 1 - Photo Locations (continued)

| Photo | Location | Orientation | Distance to Site | Visibility |
| :---: | :---: | :---: | :---: | :---: |
| 30 | Congress Street | Northeast | $\pm 0.40$ Mile | Not Visible |
| 31 | Morehouse Drive Overlooking Merritt Parkway | Northeast | $\pm 1.04$ Miles | Not Visible |
| 32 | Morehouse Road at Golf View Drive, Easton | Northeast | $\pm 1.00$ Mile | Not Visible |
| 33 | Ridgeway Drive, Easton | Southeast | $\pm$ 1.47 Miles | Not Visible |
| 34 | South Park Avenue adjacent to Easton Reservoir Dam, Easton | Southeast | $\pm 1.85$ Miles | Not Visible |
| 35 | Tuckahoe Road, Easton | South | $\pm 1.26$ Miles | Not Visible |
| 36 | Scattergood Circle at Madison Avenue, Trumbull | Southwest | $\pm 1.85$ Miles | Not Visible |
| 37 | Hitching Post Lane at Fieldstone Court, Trumbull | Southwest | $\pm 0.95$ Mile | Not Visible |
| 38 | Royce Place at Madison Avenue, Bridgeport | Southwest | $\pm 0.91$ Mile | Not Visible |
| 39 | Park Avenue, Bridgeport | Northwest | $\pm 1.89$ Miles | Not Visible |
| 40 | Lola Street at Stratfield Road | Northwest | $\pm 1.66$ Miles | Not Visible |
| 41 | Highland Lane | North | $\pm$ 1.20 Miles | Not Visible |
| 42 | Morehouse Highway at Lake Mohegan** | Northeast | $\pm 1.35$ Miles | Not Visible |
| *Photograph was taken at 24 mm focal length. <br> ${ }^{* *}$ Photograph was taken at 35 mm focal length. |  |  |  |  |

## Final Visibility Mapping

Information obtained during the field reconnaissance was incorporated into the mapping data layers, including observations of the field reconnaissance, the photograph locations, areas that experienced recent land use changes and those places where the initial model was found to over or under-predict visibility. Once the additional data was integrated into the model, APT recalculated the visibility of the proposed Facility within the Study Area.

## Conclusions

As presented on the attached viewshed maps, the Facility would be visible from select locations within approximately 0.40 -mile of the Site. Photos $5,23,24$, and 25 depict representative views from locations on the SHU main campus. Photos 18 through 22 characterize views towards the Site from within the Weeping Willow Lane and Donna Drive neighborhoods to the north. Views would also extend onto Park Avenue east and northeast of the Site (Photo 2 and 6). A small corridor of visibility extends approximately

2,000 feet west of the Site over a short portion of the Easton Turnpike (Route 59) overpass above the Parkway and onto Congress Street, which is located immediately west of the Parkway. These views are represented in Photos 27 and 29; respectively. Isolated views of the Facility may be experienced from select locations along the Parkway and to the north in Easton; any such views would be diminished by intervening vegetation, structures and distance from the Facility.

Seasonally, when the leaves are off the deciduous trees, visibility could extend slightly north and west of the Parkway (Photo 26 and 28). Seasonal views are also likely to extend east onto portions of Park Avenue (Photo 3). Seasonal views would also extend southwestward onto the SHU West Campus (Photo 13).

Predicted year-round visibility of the proposed Facility is estimated to include approximately 26 acres ( $<1 \%$ of the 8,042 -acre Study Area). Predicted potential seasonal visibility is estimated to include an additional approximately 49 acres ( $<1 \%$ of the Study Area).

## Proximity to Schools And Commercial Child Day Care Centers

Notre Dame Catholic High School (220 Jefferson Street) is located approximately 800 feet northeast of the Site. APT did not access the grounds of Notre Dame Catholic High School because it is a private school. However, based upon the viewshed analysis, the proposed Facility would likely be visible at least seasonally from portions of the school property. ABC Day Care is located approximately 1.2 miles east of the Site. The proposed Facility would not be visible from the vicinity of ABC Day Care.

## Limitations

The viewshed maps presented in the attachment to this report depict areas where the proposed Facility may potentially be visible to the human eye without the aid of magnification based on a viewer eye-height of five (5) feet above the ground and intervening topography, tree canopy and structures. This analysis may not account for all visible locations, as it is based on the combination of computer modeling, incorporating aerial photographs, and in-field observations from publicly-accessible locations. No access to private properties was provided to APT personnel. This analysis does not claim to depict the only areas, or all locations, where visibility may occur; it is intended to provide a representation of those areas where the Facility is likely to be seen.

The photo-simulations provide a representation of the Facility under similar settings as those encountered during the field review and reconnaissance. Views of the Facility can change throughout the seasons and the time of day, and are dependent on weather and other atmospheric conditions (e.g., haze, fog, clouds); the location, angle and intensity of the sun; and the specific viewer location. Weather conditions on the day of the field review included calm winds and sunny skies.

ATTACHMENTS


















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[^0]:    ${ }^{1}$ ArcMap is a Geographic Information System desktop application developed by the Environmental Systems Research Institute for creating maps, performing spatial analysis, and managing geographic data.
    ${ }^{2}$ Light Detection and Ranging
    ${ }^{3}$ An LAS file is an industry-standard binary format for storing airborne LiDAR data.
    ${ }^{4}$ Each DSM cell size is 1 square meter.

[^1]:    ${ }^{5}$ The top of the flag represented the top of the antennas.

[^2]:    ${ }^{6}$ The Canon EOS 6D is a full-framed camera which includes a lens receptor of the same size as the film used in 35 mm cameras. As such, the images produced are comparable to those taken with a conventional 35 mm camera.
    ${ }^{7}$ Photo-simulations were not created for all locations where seasonal views may be experienced due to the difficulty of accurately representing the proposed Facility due to the nature of the tree cover between those locations and the proposed Facility.

