

ATTACHMENT 5

Visibility Analysis

SR1887
STAMFORD
560 WEST HILL ROAD
STAMFORD, CT

Prepared in October 2013 by:
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New Cingular Wireless PCS, LLC dba AT&T



Project Introduction

New Cingular Wireless PCS, LLC, d/b/a AT&T is pursuing a Certificate of Environmental Compatibility and Public Need (“Certificate”) from the Connecticut Siting Council (“Council”) for the construction, maintenance and operation of a wireless communications facility (“Facility”) on property at 560 West Hill Road in Stamford, Connecticut (identified herein as the “Host Property”). At the request of AT&T, All-Points Technology Corporation, P.C. (“APT”) prepared this Visibility Analysis to evaluate potential views associated with the Facility from within a two-mile radius (“Study Area”). In addition to the City of Stamford, a portion of the Town of Greenwich is also included within the Study Area.

Site Description and Setting

The 3.20-acre Host Property is located at 560 West Hill Road in Stamford, Fairfield County, Connecticut. The Stamford Assessor’s Office identifies the Host Property as Map 001, Block 1379. Access to the Host Property is via an existing shared gravel drive extending from West Hill Road. The Host Property is developed with a 1,800 FT² residence built in 1939. The area surrounding the residence is cleared while the remainder of the Host Property is wooded. A 176 FT² outbuilding is located east of the residence. The surrounding area is generally wooded and developed with residential properties. A cemetery is located south and east of the Host Property.

The proposed Facility location (the “Site”) is adjacent to the existing gravel driveway in a wooded area of the Host Property approximately 150 feet northeast of the residence. The Facility would be located at a ground elevation of approximately 112 feet Above Mean Sea Level (“AMSL”) and consist of a 120-foot tall monopole (to be disguised as a stealth “monopine”), ground-mounted equipment shelter and enclosed back-up emergency generator located within an irregularly-shaped 3,017 FT² fenced, gravel compound. The Facility would also include telephone cabinet, pad-mounted electrical transformer, meter bank and telco box backboard immediately northeast of the compound. AT&T proposes to install antennas on the monopine at a center line height of 116 feet above ground level (“AGL”). The Facility is designed to accommodate multiple carriers and municipal emergency service providers, should the need arise.

The Host Property is zoned “RA1” single-family residence. The topography within the Study Area is characterized as generally level terrain with gently rolling hills; ground elevations range from approximately 10 feet AMSL to 300± feet AMSL. The tree cover within the Study Area (mixed deciduous hardwoods interspersed with stands of mature evergreens) occupies approximately 4,576 acres of the 8,042-acre study area (57%). The average tree canopy is estimated to be approximately 65 feet.

Methodology

APT used the combination of a predictive computer model and in-field analysis to evaluate the visibility associated with the proposed Facility. The predictive model provides an assessment of potential visibility throughout the entire Study Area, including private properties and other areas inaccessible for direct observations. A balloon float was also conducted to field verify results of the model, inventory visible and

nonvisible locations, and to provide photographic documentation from publicly accessible areas. A description of the procedures used in the analysis is provided below.

Preliminary Computer Modeling

Two computer modeling tools are used to calculate those areas from which at least the top of the proposed Facility is estimated to be visible: IDRISI image analysis program (developed by Clark Labs, Clark University) and ArcGIS®, developed by Environmental Systems Research Institute, Inc. Project- and Study Area-specific data were incorporated into the computer model, including the Site location, Facility height and ground elevation, as well as the surrounding topography and existing vegetation which are two primary features that can block direct lines of sight. Information used in the model included LiDAR¹-based digital elevation data and customized land use data layers developed specifically for this analysis. The LiDAR-based Digital Elevation Model (“DEM”) represents topographic information for the state of Connecticut that was derived through the spatial interpolation of airborne LiDAR-based data collected in the year 2000 and has a horizontal resolution of ten (10) feet. In addition, multiple land use data layers were created from the Natural Resources Conservation Service (through the USDA) aerial photography (1-meter resolution, flown in 2006, 2008, 2010 and 2012) using IDRISI image processing tools. The IDRISI tools implement light reflective classes defined by statistical analysis of individual pixels, which are then grouped based on common reflective values such that distinctions can be made automatically between deciduous and coniferous tree species, as well as grassland, impervious surface areas, water and other distinct land use features. This information is manually cross-checked with the recent USGS topographic land characteristics to quality assure the imaging analysis.

Once the data layers were entered, image processing tools were applied and overlaid onto USGS topographic base maps and aerial photographs to achieve an estimate of locations where the Facility might be visible. First, only the topography data layer (DEM) was incorporated to evaluate potential visibility with no intervening vegetative screening. The initial omission of the forest cover data layer results in an excessive over-prediction, but provides an opportunity to identify and evaluate those areas with potentially direct sight lines toward the Facility.

Eliminating the tree canopy altogether as performed in the preliminary analysis exaggerates areas of visibility because it assumes unobstructed sight lines everywhere but in those locations where intervening topography rises above the height of the proposed Facility. However, using this technique not only allows for an initial identification of direct sight lines, but also to gain some insight regarding seasonal views when the leaves are not on the trees². This preliminary mapping is especially useful during the in-field activities (described below) to further evaluate “leaf-off” scenarios. A purposely low average tree canopy height of 50 feet was incorporated into the forest data layer and added to the DEM for a second iteration of the visibility maps, thus providing a conservative assessment of intervening vegetation for use during the in-field activities to compare the outcomes of the initial computer modeling with direct observations of the balloon float.

¹ LiDAR is an acronym for Light Detection and Ranging. It is a technology that utilized lasers to determine the distance to an object or surface. LiDAR is similar to radar, but incorporates laser pulses rather than sound waves. It measures the time delay between transmission and reflection of the laser pulse.

² Visibility varies seasonally with increased, albeit obstructed, views occurring during “leaf-off” conditions. Each individual Study Area includes mature vegetation with a unique composition and density of woodlands, with mast or pole timber and branching providing the majority of screening in leafless conditions. Because tree spacing, dimensions and branching patterns as well as the understory differ greatly over even small areas, creating an accurate Study Area-specific “leaf-off” tree density data layer covering a two-mile radius becomes unmanageable. Considering that a given Study Area has its own discrete forest characteristics, modeling for seasonal variations of visibility is problematic and, in our experience, even when incorporating conservative constraints into the model, the results tend to over-predict visibility in “leaf-off” conditions.

Additional data was reviewed and incorporated into the visibility analysis, including protected private and public open space, parks, recreational facilities, hiking trails, schools, and historic districts. The Mianus River Park trail network is located in the western portion of the Study Area and straddles the boundary between Stamford and Greenwich. Fort Stamford Park is also located in the western portion of the Study Area.

No Connecticut blue-blazed trails are located within the Study Area. The Merritt Parkway, a National Scenic Byway, is located in the northern portion of the Study Area. Based on a review of publicly-available information, no locally designated scenic roads exist within the Study Area.

In-Field Activities

To supplement and substantiate the results of the computer modeling efforts, APT completed in-field verification activities consisting of a balloon float, vehicular and pedestrian reconnaissance, and photo-documentation.

Balloon Float and Field Reconnaissance

A balloon float was conducted on October 14, 2013. The balloon float consisted of raising an approximately four-foot diameter, helium-filled balloon tethered to a height of 120 feet AGL at the proposed Facility location. Once the balloon was secured at the proposed Facility height, a Study Area reconnaissance was performed by driving along the local and State roads and locations where the balloon could be seen above/through the tree mast and canopy were inventoried. 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. Weather conditions on the day of the balloon float included sunny skies with a temperature of approximately 65 degrees Fahrenheit and calm winds (less than 3 mph).

During the balloon float, several trees were randomly surveyed using a hand-held infrared laser range finder and Suunto clinometer to ascertain their heights. Numerous locations were selected to obtain tree canopy heights, including along roadways, wooded lots, and high- and low-lying areas to provide for the irregularities associated with different land characteristics and uses found within the Study Area. The average canopy height was developed based on measurements and comparative observations, in this case approximately 65 feet AGL. Throughout Connecticut, the tree canopy height varies from about 55 feet to in excess of 80 feet (where eastern white pine becomes a dominant component of the forest type, average tree heights may be even slightly higher). This general uniformity is most likely the result of historic state-wide clear cutting of forests to produce charcoal and fuel wood, not only for home use, but also for the local brick, brass, and iron industries from the late 1800s to early 1900s³. Approximately 69% of Connecticut's forests are characterized as mature⁴.

Information obtained during the balloon float was subsequently incorporated into the computer model to refine the visibility map.

³ Ward, J.S., Worthley, T.E. Forest Regeneration Handbook. A guide for forest owners, harvesting practitioners, and public officials. The Connecticut Agricultural Experiment Station and University of Connecticut, Cooperative Extension. Pg. 5.

⁴ USDA Resource Bulletin NE-160, 2004.

Photographic Documentation

During the balloon float, a field reconnaissance was completed by driving the public roads within the Study Area and recording observations, including photo-documentation, of those areas where the balloon was and was not visible. Photographs were obtained from several vantage points to document the view towards the proposed Facility. At each photo location, the geographic coordinates of the camera’s position were logged using global positioning system (“GPS”) equipment technology.

Photographs were taken with a Nikon D-3000 digital camera body and Nikon 18 to 135 millimeter (“mm”) zoom lens. For all but one of the views the lens was set to 50 mm. Photo point location 1 was taken using a 24 mm focal length in order to provide a greater depth of field for presentation in this report. Focal lengths ranging from 24 mm to 50 mm approximate views similar to that achieved by the human eye. However, two key aspects of an image can be directly affected by the specific focal length that is selected: field of view and relation of sizes between objects in the frame. A 24 mm focal length provides a wider field of view, representative of the extent the human eyes may see (including some peripheral vision), but the relation of sizes between objects at the edges of the photos can become minimally skewed. A 50 mm focal length has a narrower field of view than the human eye but the relation of sizes between objects is represented similar to what the human eye might perceive.

“The lens that most closely approximates the view of the unaided human eye is known as the normal focal-length lens. For the 35 mm camera format, which gives a 24x36 mm image, the normal focal length is about 50 mm.”⁵

When taking photographs for these analyses, APT prefers a focal length of 50 mm; however there are times when wider views (requiring the use of the 24 mm lens setting, in this case) can better reflect “real world” viewing conditions by providing greater context to the scene. Regardless of the lens setting, the scale of the subject in the photograph (the balloon) and corresponding simulation (the Facility) remains proportional to its surroundings.

The table below summarizes the photographs presented herein, including the photo number (as it corresponds to the photolog contained on the visibility maps), a description of each photo location, view orientation, the distance from where the photo was taken relative to the proposed Facility location and the projected visibility.

Photo	Location	Orientation	Dist. To Site	Visibility
1	West Hill Road at Congregation Agudath Sholom Cemetery	West	± 0.06 Mile	Year-round
2	West Hill Road at Congregation Agudath Sholom Cemetery	West	± 0.07 Mile	Year-round
3	West Hill Road adjacent to #545	Northwest	± 0.12 Mile	Year-round
4	Akbar Road at MacGregor Drive	Southeast	± 0.11 Mile	Year-round
5	Roxbury Cemetery	Southeast	± 0.97 Mile	Not Visible
6	Akbar Road adjacent to #24	Southeast	± 0.10 Mile	Year-round
7	Congregation Agudath Sholom Cemetery	Northwest	± 0.10 Mile	Year-round

⁵ Warren, Bruce. Photography, West Publishing Company, Eagan, MN, c. 1993, (page 70).

Final Visibility Mapping

Field data and observations were incorporated into the mapping data layers, including the photo locations, areas that experienced land use changes since the 2012 aerial photo flight, and those places where the initial model was found to either under or over-predict visibility.

The revised average tree canopy height data layer (using 65 feet AGL) was merged with the DEM and added to the base ground elevations. As a final step, forested areas were extracted from areas of potential visibility, assuming that a person standing within a forest would not be able to view the Facility from beyond a certain distance due to the presence of intervening tree mast and/or understory. APT elected to use a distance of 500 feet for this analysis. Each location is dependent on the specific density and composition of the surrounding woodlands, and it is understood that some locations within this distance could provide visibility of at least portions of the Facility at any time of the year. In “leaf-on” conditions, this distance may be overly conservative as the deciduous vegetation would substantially hinder direct views in many cases at close range. However, even in “leaf off” conditions when views expand, tree mast can still serve to block lines of sight, even at distances less than 500 feet. For purposes of this analysis, it was reasoned that contiguous forested land beyond 500 feet of the Facility would consist of light-impenetrable trees of a uniform height.

Once the additional data was integrated into the model, APT re-calculated the visibility of the Facility from within the Study Area to produce the final visibility map.

Photographic Simulations

Photo simulations of the proposed Facility were generated for the corresponding photographs where the balloon was visible above the tree canopy during the in-field activities. The photo simulations portray scaled renderings of the Facility from these locations. Using field data, site plan information and 3-dimension (3D) modeling software, spatially referenced models of the site area 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. Corresponding photo simulations were then created using a combination of renderings generated in the 3D model and photo-rendering software programs⁶.

Photo-documentation and simulations are presented in the attachment at the end of this report. The photographs of the balloon are included to provide visual reference points for the location, height and proportions of the proposed Facility relative to the scene.

As stated earlier, APT has elected to use a 50 mm focal length whenever possible; however, there are occasions when the use of a wider-angle lens setting is preferred. For presentation purposes in this report, the photographs are produced in an approximate 7" by 10.5" format. When viewing in this format size, we believe it is important to provide the largest representational image while maintaining an accurate relation of sizes between objects within the frame of the photograph.

Due to the close proximity to the proposed Facility, the photograph for View 1 was taken with a 24 mm focal length to balance preserving the integrity of the scene's setting while depicting the subject (the Facility) in a way similar to what an observer might see to the greatest extent possible.

Visibility Analysis Results

Results of this analysis are graphically displayed on the visibility analysis maps provided in the attachment at the end of this report. The maps include a photolog depicting the photo locations. Those shaded areas of predicted visibility shown on the maps represent locations from which the proposed Facility may be visible year-round (in yellow) or seasonally (in orange), when the leaves are off the deciduous trees.

Year-round visibility associated with the proposed Facility would be limited to a very small geographic footprint (20± acres) surrounding the immediate area (within less than 0.25 mile) of the Host Property, extending north and south over parts of the Congregation Agudath Sholom cemetery, westward out to portions of West Hill Road, and eastward to locations along Akbar Road. Partial views of the Facility extending above the surrounding trees would occur at select locations in this general area, as depicted in the photographic simulations. However, a large portion of this extent would offer either obstructed views of the Facility or be limited to seasonal visibility, when the leaves are off the deciduous trees.

⁶ As a final step, the accuracy and scale of select simulations are tested against photographs of existing Facilities with recorded camera position, focal length, photo location, and Facility location.

Although the balloon was not visible beyond the areas photo-documented herein, we have conservatively estimated that an additional 300± acres within approximately 0.5 mile of the Host Property have the potential for limited seasonal visibility when the leaves are off the deciduous trees. This is likely a vast over-prediction of the total area of “leaf off” visibility. If portions of the Facility are visible from some locations within this area, seasonal views would be limited to the upper portion of the monopine among the surrounding tree canopy.

No views are anticipated from the Merritt Parkway, the Mianus River Park trails or Fort Stamford Park.

The combination of the stealth design, relatively flat terrain and mature stands of trees throughout the Study Area would serve to substantially minimize the visibility of the proposed Facility. The monopine is intended to camouflage the antenna arrays and soften views of the Facility from nearby receptors. The ridgelines that exist within the Study Area are broad and heavily vegetated; ground elevations do not vary significantly enough to offer raised viewpoints where observers would have unobstructed lines of sight towards the Facility location, particularly at distances beyond 0.5 mile of the Host Property. In addition, the dense, mature tree cover found throughout the majority of the Study Area further assists to obscure sight lines towards the Facility. Photo number 5 is representative of views from locations beyond the immediate vicinity of the Host Property.

Proximity to Schools and Commercial Child Day Care Centers

No schools or commercial child day care facilities are located within 250 feet of the host property. The nearest school is Roxbury Elementary School located at 751 West Hill Road in Stamford, ±0.40 mile northeast of the Host Property. The nearest pre-school/daycare is The Learning Center at Piper’s Hill located at 17 Roxbury Road (State Route 104), approximately 0.62 mile northeast of the Facility. No views are anticipated from either of these locations.

ATTACHMENTS



DOCUMENTATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
1	WEST HILL ROAD AT CONGREGATION AGUDATH SHOLOM CEMETERY (24 mm Focal Length)	WEST	+/- 0.06 MILE	YEAR ROUND



SIMULATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
1	WEST HILL ROAD AT CONGREGATION AGUDATH SHOLOM CEMETERY (24 mm Focal Length)	WEST	+/- 0.06 MILE	YEAR ROUND



DOCUMENTATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
2	WEST HILL ROAD AT CONGREGATION AGUDATH SHOLOM CEMETERY	WEST	+/- 0.07 MILE	YEAR ROUND



SIMULATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
2	WEST HILL ROAD AT CONGREGATION AGUDATH SHOLOM CEMETERY	WEST	+/- 0.07 MILE	YEAR ROUND



DOCUMENTATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
3	ADJACENT TO #545 WEST HILL ROAD	NORTHWEST	+/- 0.12 MILE	YEAR ROUND



SIMULATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
3	ADJACENT TO #545 WEST HILL ROAD	NORTHWEST	+/- 0.12 MILE	YEAR ROUND



DOCUMENTATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
4	AKBAR ROAD AT MACGREGOR DRIVE	SOUTHEAST	+/- 0.11 MILE	YEAR ROUND



SIMULATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
4	AKBAR ROAD AT MACGREGOR DRIVE	SOUTHEAST	+/- 0.11 MILE	YEAR ROUND



DOCUMENTATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
5	ROXBURY CEMETERY	SOUTHEAST	+/- 0.97 MILE	NOT VISIBLE



DOCUMENTATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
6	ADJACENT TO #24 AKBAR ROAD	SOUTHEAST	+/- 0.10 MILE	YEAR ROUND



SIMULATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
6	ADJACENT TO #24 AKBAR ROAD	SOUTHEAST	+/- 0.10 MILE	YEAR ROUND



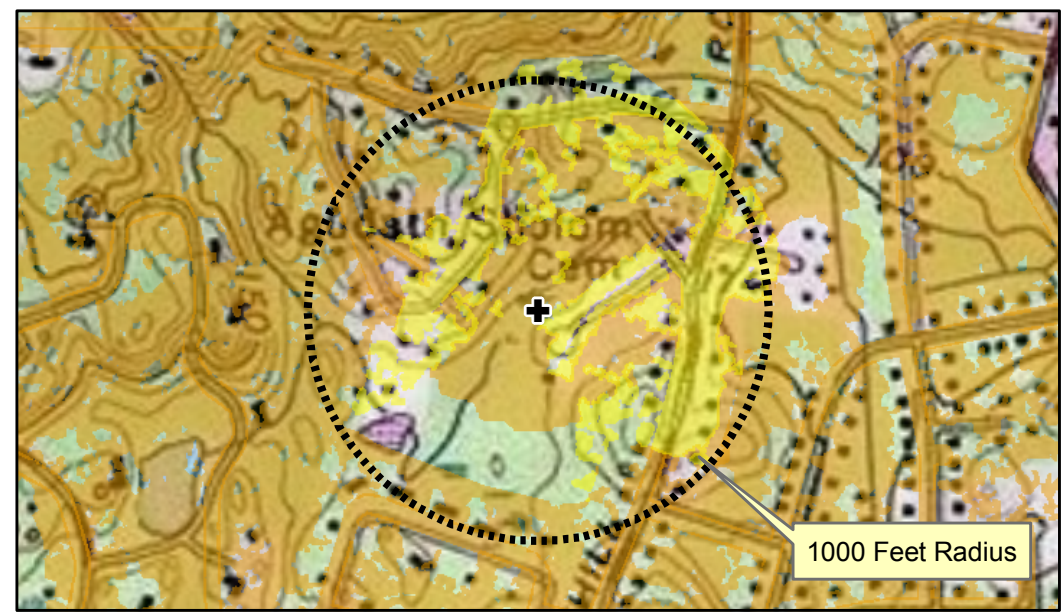
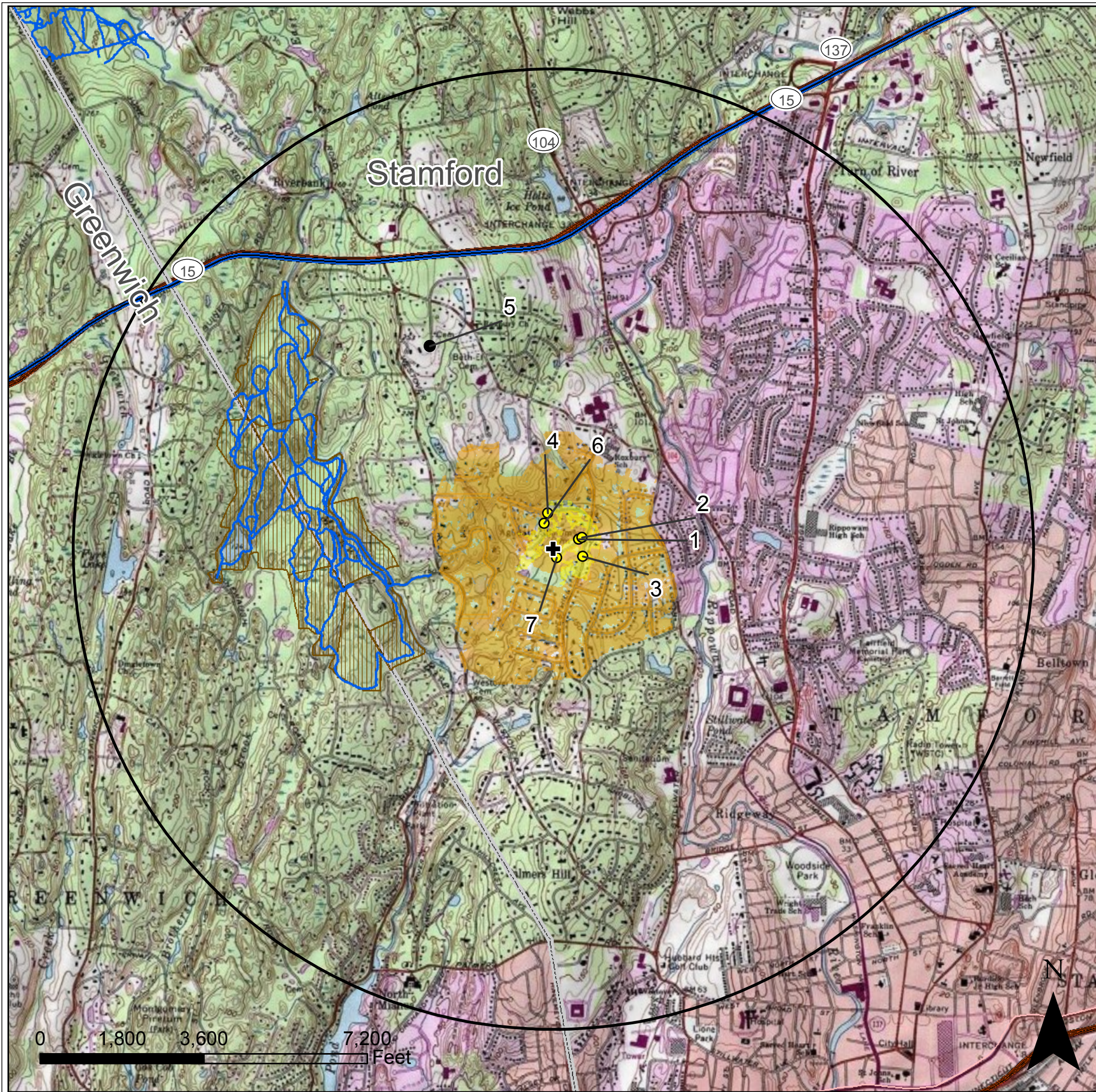
DOCUMENTATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
7	CONGREGATION AGUDATH SHOLOM CEMETERY	NORTHWEST	+/- 0.10 MILE	YEAR ROUND



SIMULATION

PHOTO	LOCATION	ORIENTATION	DISTANCE TO SITE	VISIBILITY
7	CONGREGATION AGUDATH SHOLOM CEMETERY	NORTHWEST	+/- 0.10 MILE	YEAR ROUND



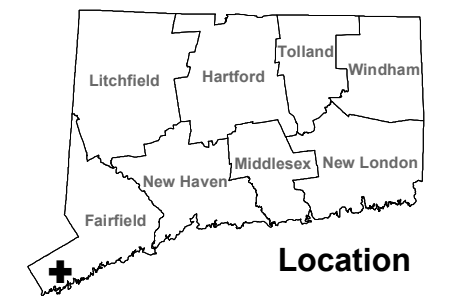
VISIBILITY ANALYSIS MAP - TOPO BASE
 Proposed Wireless Telecommunications Facility
 560 West Hill Road
 Stamford, CT

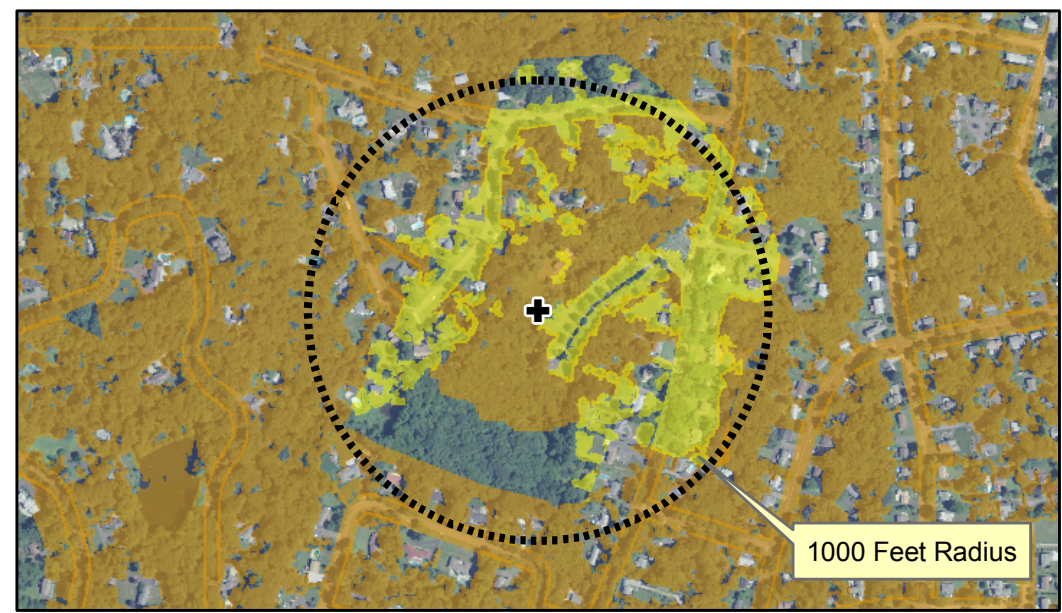
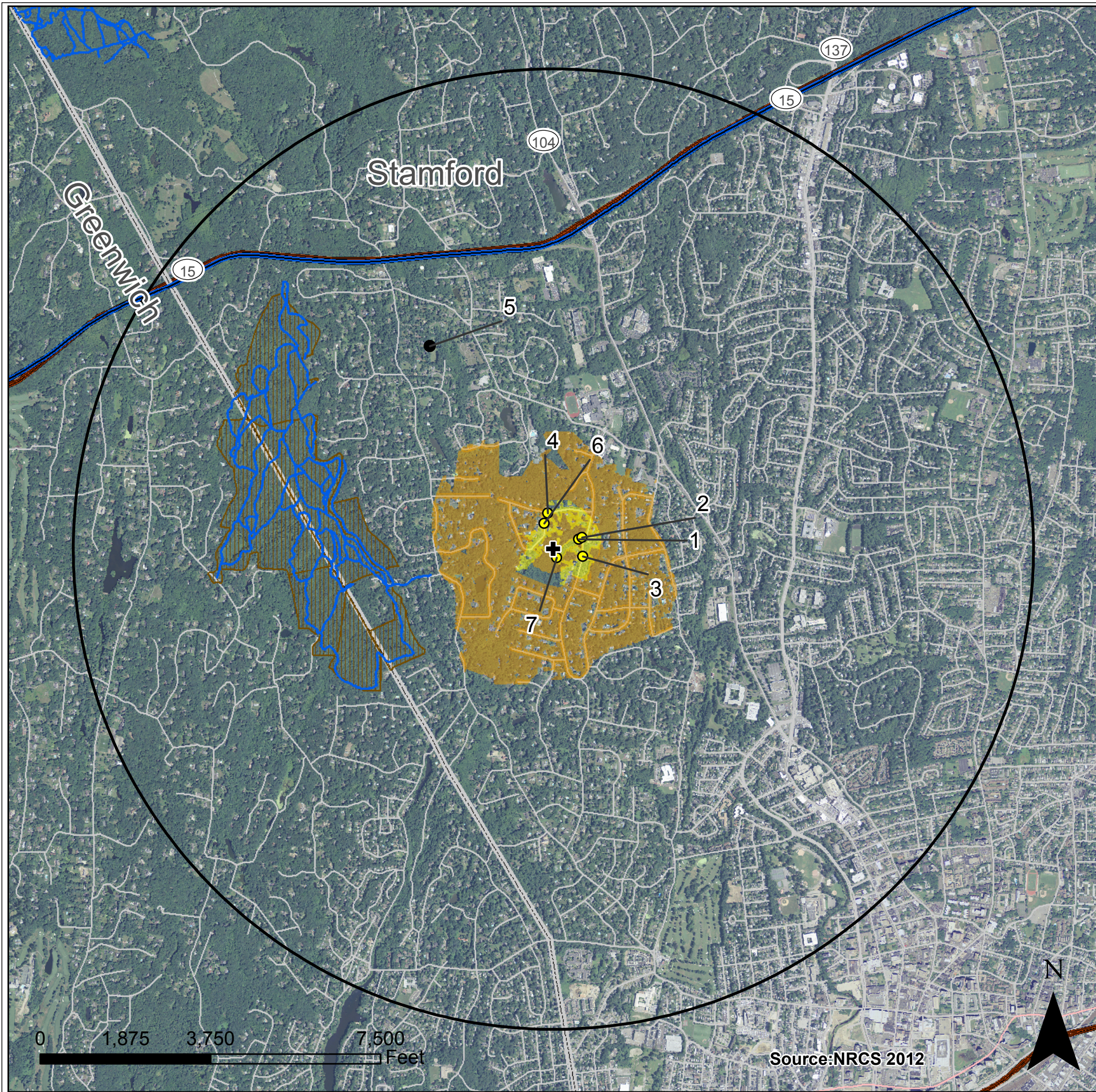
Proposed facility height is 120 feet AGL
 Existing tree canopy height estimated as 65 feet
 Study area is a two-mile radius surrounding the site and includes 8,042 acres of land

Map compiled 10/23/2013

*Map information field verified by APT on 10/14/13.
 Only those resources located within the Study Area are depicted. For a complete list of data sources consulted for this analysis, please refer to the Documentation Page.*

- Legend**
- Proposed Tower
 - 2-Mile Study Area
 - Predicted Year-Round Visibility
 - Predicted Seasonal Visibility
 - Trails
 - Municipal Private Open Space
 - Scenic Highways
 - Towns





VISIBILITY ANALYSIS MAP - AERIAL BASE
 Proposed Wireless Telecommunications Facility
 560 West Hill Road
 Stamford, CT

Proposed facility height is 120 feet AGL
 Existing tree canopy height estimated as 65 feet
 Study area is a two-mile radius surrounding the site and includes 8,042 acres of land

Map compiled 10/23/2013

Map information field verified by APT on 10/14/13.
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- Legend**
- Proposed Tower
 - 2-Mile Study Area
 - Predicted Year-Round Visibility
 - Predicted Seasonal Visibility
 - Trails
 - Municipal Private Open Space
 - Scenic Highways
 - Towns



Source:NRCS 2012

DOCUMENTATION

SOURCES CONSULTED FOR VISIBILITY ANALYSIS MAPS 560 West Hill Road Stamford, CT

Physical Geography/Background Data

Center for Land Use Education and Research, University of Connecticut (<http://clear.uconn.edu>)

*LiDAR data – topography (2000)

United States Geological Survey

*USGS topographic quadrangle maps – Stamford, Glenville, NY (1984)

National Resource Conservation Service

*NAIP aerial photography (2006, 2008, 2010, 2012)

Heritage Consultants

^State Scenic Highways (based on Department of Transportation data, updated monthly)

^Municipal Scenic Roads (by website, phone and/or email/fax - current)

Cultural Resources

Heritage Consultants

^National Register

^Local Survey Data

Dedicated Open Space & Recreation Areas

Connecticut Department of Energy and Environmental Protection (DEEP)

*DEEP Property (May 2007)

*Federal Open Space (1997)

*Municipal and Private Open Space (1997)

*DEEP Boat Launches (1994)

Connecticut Forest & Parks Association

^Connecticut Walk Book West – The Guide to the Blue-Blazed Hiking Trails of Western Connecticut, 19th Edition, 2006.

Town of Greenwich Website

^Mianus River Park trails map

Other

^ConnDOT Scenic Strips (based on Department of Transportation data)

*Available to the public in GIS-compatible format (some require fees).

^Data not available to general public in GIS format. Reviewed independently and, where applicable, GIS data later prepared specifically for this Study Area.

LIMITATIONS

The visibility analysis map(s) presented in 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 5 feet above the ground and intervening topography and an assumed tree canopy height of 65 feet. This analysis may not necessarily account for all clearings, as it is based on a combination of 2012 aerial photographs and in-field observations from publicly-accessible locations. 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. Further, it may be possible to view the Facility from within portions of the shaded areas indicating potential visibility, but not necessarily from all locations within those shaded areas. No access to private properties was provided to APT personnel.

The photo-simulations in this report are provided for visual representation only. Actual visibility depends on various environmental conditions, including (but not necessarily limited to) weather, season, time of day, and viewer location.