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## RF Report

Proposed Wireless Facility  
100 Lowder Brook Drive  
Westwood, MA 02090



**verizon**<sup>✓</sup>

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May 24, 2017

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## 1. Overview

This RF Report has been prepared on behalf of Verizon Wireless in support of its application to the Town of Westwood for the installation and operation of a wireless facility located at 100 Lowder Brook Drive, Westwood, MA. Verizon Wireless' proposed facility consists of ground based equipment cabinets and equipment mounted on an existing 140' monopole tower.

This report concludes that the proposed site will fill in coverage gaps and provide additional capacity to sections of Westwood in order to improve deficient service areas along Route 109 (High Street), I-95, and the surrounding roads, neighborhoods, and business parks within the proximity of the proposed site.

Included in this report is: a brief summary of the site's objectives, maps showing Verizon Wireless' current network plan, and predicted Radio Frequency coverage of the subject site and the surrounding sites in Verizon Wireless' network.

## 2. Introduction

Verizon Wireless provides digital voice and data communications services using 3rd Generation (3G) CDMA/EVDO technology in the Cellular (800 MHz) and PCS (1900 MHz) frequency bands, and is in the midst of deploying advanced 4th Generation (4G) voice and data services over LTE technology in the 700 MHz, PCS, and AWS (2100 MHz) frequency bands as allocated by the FCC. These networks are used by mobile devices for fast web browsing, media streaming, and other applications that require broadband connections. The mobile devices that benefit from these advanced networks are not limited to basic handheld phones, but also include devices such as smartphones, PDA's, tablets, and laptop air-cards. With the evolving rollout of 4G LTE services and devices, Verizon Wireless customers will have even faster connections to people, information, and entertainment.

As explained within this report, Verizon Wireless has identified the need to add a new facility to its existing network of sites in the Westwood area to improve coverage and capacity to a significant gap in service that now exists in northern Westwood, in order to support reliable communications and meet the growing demand in the area.

To maintain a reliable and robust communications system for the individuals, businesses, public safety workers and others who use its network, Verizon Wireless deploys a network of cell sites (also called wireless communications facilities) throughout the areas in which it is licensed to provide service. These cell sites consist of antennas mounted on structures, such as buildings and towers, supported by radio and power equipment. The receivers and transmitters at each of these sites process signals within a limited geographic area known as a "cell."

Mobile subscriber handsets and wireless devices operate by transmitting and receiving low power radio frequency signals to and from these cell sites. Handset signals that reach the cell site are transferred through land lines (or other means of backhaul transport) and routed to their destinations by sophisticated electronic equipment. In order for Verizon Wireless' network to function effectively, there must be adequate overlapping coverage between the "serving cell" and adjoining cells. This not only allows a user to access the network initially, but also allows for the transfer or "hand-off" of calls and data transmissions from one cell to another, and prevents unintended disconnections or "dropped calls."

Verizon Wireless' antennas also must be located high enough above ground level to allow transmission (a.k.a. propagation) of the radio frequency signals above trees, buildings and other natural or man-made structures that may obstruct or diminish the signals. Areas without adequate radio frequency coverage have substandard service, characterized by dropped and blocked calls, slow data connections, or no wireless service at all, and are commonly referred to as coverage gaps.

The size of the area potentially served by each cell site depends on several factors including the number of antennas used, the height at which the antennas are deployed, the topography of the surrounding land, vegetative cover, and natural or man-made obstructions in the area. The actual service area at any given time also depends on the number of customers who are on the network in range of that cell site. As customers move throughout the service area, the transmission from the phone or other device is automatically transferred to the Verizon Wireless facility with the best reception, without interruption in service, provided that there is overlapping coverage between the cells.

Each cell site must be primarily designed to strike a balance between the overall geographic coverage area it will serve, and the site's capacity to support the usage within the coverage footprint. In rural areas, cell sites are generally designed to have broader coverage footprints because the potential traffic is sparser and distributed over a larger area. In more densely populated suburban and urban environments, the capacity to handle calls and data transmissions is of increasing concern, and cell sites must limit their coverage footprint to an area where the offered network traffic can be supported by the radio equipment and resources. Due to the aggressive historical and projected growth of mobile usage, particularly for mobile data (42% in 2016-2017, 35% CAGR 2016-2021 in North America)<sup>1</sup>, instances arise where the usage demand can no longer be supported by the site(s) serving an area, and new facilities must be integrated to provide capacity relief to the overloaded sites.

We have concluded that by utilizing the existing wireless communication facility at 100 Lowder Brook Drive at an antenna center line height of 104' AGL (above ground level), Verizon Wireless will be able to substantially fill the gap in service that it now experiences, and provide improved coverage and capacity to residents, businesses, and traffic corridors within sections of Westwood that are currently located within deficient service areas of Verizon Wireless' network.

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<sup>1</sup> "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update, 2016-2021", February 7, 2017, Cisco Systems, Inc. <http://www.cisco.com/c/en/us/solutions/collateral/service-provider/visual-networking-index-vni/mobile-white-paper-c11-520862.html>

### 3. The Proposed Facility

As shown on the plans submitted with the application, Verizon Wireless' proposal consists principally of the following elements:

- 1) Installation of telecommunication equipment cabinets, remote radio heads (RRH), diplexers, a diesel powered back-up generator, and a protective ice canopy, on the existing concrete pad within the fenced compound;
- 2) Modification of the existing cable bridge (as necessary) between the equipment pad and base of the monopole;
- 3) Three (3) panel antennas (one per sector) mounted on the existing 140' monopole tower, at a centerline elevation of 104' AGL;
- 4) Eighteen (18) 1 1/4" coaxial cables (six per sector), routed from the RRH's/diplexers at ground level, horizontally along the existing cable bridge, and vertically up the existing tower to the proposed antennas.

## 4. Coverage and Capacity Objectives

As mentioned above, Verizon Wireless is in the process of rolling out its 4G LTE high-speed wireless broadband system in the 700 MHz, PCS, and AWS frequency bands, in accordance with its licenses from the FCC. In order to expand and enhance their wireless services throughout New England, Verizon Wireless must fill in existing coverage gaps and address capacity, interference, and high-speed broadband issues. As part of this effort, Verizon Wireless has determined that insufficient network capacity and significant coverage gaps exist throughout much of Westwood, MA, as described further below.

Verizon Wireless currently operates wireless facilities similar to the proposed facility within Westwood and the surrounding cities/towns. Due in large part to the distances between the existing sites, the intervening topography, and volume of user traffic in the area, these existing facilities do not provide sufficient coverage and capacity to portions of Westwood. Specifically, Verizon Wireless determined that much of northern Westwood is without reliable service in the following areas and roads<sup>2</sup>, including but not limited to:

- Route 109 (High Street);
  - Serves ~ 28,000 vehicles per day, as measured west of I-95 (2007);
- I-95, between the Route 109 (High Street) overpass (Exit 16) and the Route 1A overpass;
- The surrounding roads, neighborhoods, and business parks within the proximity of the proposed site.

The proposed site located at 100 Lowder Brook Drive (“Westwood 6”) is needed to fill in these targeted coverage and capacity gaps, in order to improve network quality and reliability for Verizon Wireless subscribers traveling along these roads, as well as to the numerous residences, businesses, and visitors in this area.

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<sup>2</sup> Traffic counts are sourced from the Massachusetts Department of Transportation, Transportation Data Management System.

## 5. Site Search and Selection Process

To find a site that provides acceptable service, provides adequate capacity relief, and fills the gaps in coverage, computer modeling software is used to define a search area. The search ring identifies the area within which a site could be located (assuming that sufficient height is used) that would have a high probability of addressing the significant coverage gap and meeting the capacity objectives established by the Verizon Wireless RF (Radio Frequency) engineers.

Once a search ring is determined, Verizon Wireless' real estate specialists search within the proximity of the defined area for existing buildings, towers, and other structures of sufficient height that would meet the defined objectives. If none are found, then the focus shifts to "raw land" sites. A suitable site must satisfy the technical requirements identified by the RF engineers, must be available for lease, and must have access to a road and be otherwise suitable for constructing a cell site of the required size and height. Every effort is made to use existing structures before pursuing a "raw land" build to minimize the number of towers throughout the towns being serviced.

After the search of the area had been completed, Verizon Wireless determined that utilizing the existing wireless communications facility located at 100 Lowder Brook Drive is the most appropriate solution to address the targeted coverage and capacity objectives, with respect to its network requirements.

## 6. Pertinent Site Data

Table 1 below details the site-specific information for the existing, approved, and proposed Verizon Wireless sites used to perform the coverage analysis and generate the coverage plots provided herein.

Site Name	Address	City, State	Location		Structure Type	Antenna Height (ft AGL)	Status
			Latitude	Longitude			
Hyde Park	1605 Hyde Park Avenue	Boston, MA	42.2442	-71.1306	Monopole	100	On-Air
W Rox Georgetown	5050 Washington Street	Boston, MA	42.2655	-71.1520	Rooftop	46	On-Air
W Roxbury 2	225 Rivermoor Street	Boston, MA	42.2791	-71.1822	Monopole	75	On-Air
W Roxbury Msc	4620 Washington Street	Boston, MA	42.2751	-71.1392	Lattice	150	On-Air
Canton 2	95 Shawmut Road	Canton, MA	42.1867	-71.1552	Monopole	58	On-Air
Canton 5	120 Royall Street	Canton, MA	42.2042	-71.1293	Rooftop	54/57	On-Air
Dedham	55 Ariadne Road	Dedham, MA	42.2313	-71.1830	Rooftop	88	On-Air
Dedham 2	200 West Street	Dedham, MA	42.2550	-71.2094	Monopole	42	On-Air
Dedham 3	5 Incinerator Road	Dedham, MA	42.2559	-71.1667	Smokestack	105	On-Air
Dedham Oakdale	8 Industrial Drive	Dedham, MA	42.2372	-71.1431	Smokestack	109	On-Air
Dover Relo	2 Dedham Street	Dover, MA	42.2472	-71.2805	Monopole	113	On-Air
Walpole North	9 County Street	Dover, MA	42.2032	-71.2531	Monopole	81	On-Air
Needham	141 Cabot Street	Needham, MA	42.3033	-71.2177	Lattice	152	On-Air
Needham 2	858 Great Plain Avenue	Needham, MA	42.2800	-71.2333	Steeple	68	On-Air
Needham 5	1555 Central Avenue	Needham, MA	42.2760	-71.2653	Lattice	110	On-Air
Needham Heights	460 Hillside Avenue	Needham, MA	42.2911	-71.2364	Rooftop	49	On-Air
Needham Cutler	1 Wells Avenue	Newton, MA	42.2950	-71.2033	Rooftop	73.3	On-Air
Norwood	661 Washington Street	Norwood, MA	42.1933	-71.2018	Rooftop	48.5	On-Air
Norwood 2	59 Davis Avenue	Norwood, MA	42.1758	-71.2191	Monopole	96	On-Air
East Street	20 East Street	Westwood, MA	42.2236	-71.1693	Rooftop	46.5	Approved
Westwood	690 Canton Street	Westwood, MA	42.2018	-71.1609	Rooftop	40	On-Air
Westwood 3	213 Fox Hill Street	Westwood, MA	42.2289	-71.2155	Water Tank	76	On-Air
Westwood 5	90 Glacier Drive	Westwood, MA	42.2167	-71.1872	Stealth Monopole	95	Approved
Westwood 7	248 Nahatan Street	Westwood, MA	42.2144	-71.2127	Steeple	54.8	On-Air
Westwood MA SC12	402 High Street	Westwood, MA	42.2346	-71.2186	Utility Pole	24	Approved
Westwood 6	100 Lowder Brook Drive	Westwood, MA	42.2404	-71.2048	Monopole	104	Proposed

**Table 1: Verizon Wireless Site Information Used in Coverage Analysis<sup>3</sup>**

<sup>3</sup> Some sites listed in this table are outside the plot view but are included for completeness of information.



## 7. Coverage Analysis and Propagation Plots

The signal propagation plots provided in this report show coverage for the 700 MHz frequency range and were produced using deciBel Planner™, a Windows-based RF propagation computer modeling program and network planning tool. The software takes into account the geographical features of an area, land cover, antenna models, antenna heights, RF transmitting power and receiver thresholds to predict coverage and other related RF parameters used in site design and network expansion.

The coverage plots included as attachments show coverage based on RSRP signal strengths of -90 dBm and -95 dBm. All other areas (depicted in white) fall within coverage areas characterized by poor service quality, low data throughput, and the substantial likelihood of unreliable service.

Attachments A - E are discussed below:

**Attachment A** titled “Westwood 6 – Existing/Approved 700 MHz LTE Coverage” shows the coverage provided to areas of Westwood from the “On-Air” and “Approved” macro sites listed in Table 1. “On-Air” sites are existing Verizon Wireless facilities, and “Approved” sites are defined as those that are in the final stages of permitting or construction and are expected to be turned on-air in the near future. The green areas represent the minimum desired level of coverage for this area, whereas the orange areas represent a slightly lower signal strength. The deficient areas of coverage are defined by the unshaded or “white” areas. As shown in this plot and described in the Coverage and Capacity Objectives section of this report, much of northern Westwood is in an area of deficient coverage. These coverage gaps include, but are not limited to, Route 109 (High Street), I-95, and the surrounding roads, neighborhoods, and business parks within the proximity of the proposed site.

**Attachment B** titled “Westwood 6 - 700 MHz LTE Coverage with Proposed Site” shows the composite coverage with the proposed “Westwood 6” facility. As shown by the additional areas of coverage, the proposed facility will provide coverage improvement to:

- ~ 0.9 mi along Route 109 (High Street);
- ~ 0.6 mi along I-95;
- The surrounding roads, neighborhoods, and business parks within the proximity of the proposed site including Fox Hill Village and the business developments along Lowder Brook Drive.

**Attachment C** titled “Westwood 6 – Existing/Approved 700 MHz LTE Sector Footprints” depicts the areas primarily served by the sectors (a.k.a. signal “footprints”) of the “On-Air” and “Approved” Verizon Wireless sites in the area, which are shown by the unique color for each particular sector of interest. For clarity, all other sectors of less interest with respect to the proposed site are shown in grey. As demand for wireless voice and data services continues to grow, Verizon Wireless manages the footprint of each sector so that it can support the demand within the area it is primarily serving. In addition to improving coverage to the area, the proposed site is also needed to serve existing and anticipated demand in the vicinity and thereby offload some of the burden experienced by the surrounding sites. In that way, those sites will be able to more adequately serve the demand for service in the areas nearer to those surrounding sites. Please note that the outer parts of each sector footprint include areas that presently have signal strength below the targeted value required for reliable service to Verizon Wireless’ customers. The fact that low-level signal is capable of reaching these areas does not mean that these areas experience adequate coverage. These unreliable areas of low signal level impose a significant capacity burden on the sites primarily serving the area.

**Attachment D** titled “Westwood 6 - 700 MHz LTE Sector Footprints with Proposed Site” shows the composite coverage with the overall footprint of the proposed facility in dark green. As shown in this map, the proposed “Westwood 6” facility is an effective solution to provide capacity relief to the area, particularly to the “Dedham” delta sector (yellow), the “Dedham 2” beta sector (orange), the “Dedham 3” gamma sector (purple), and the “Westwood 3” alpha sector (red). The proposed facility is centrally located in the area of deficient coverage making it particularly suited to distribute the traffic load across multiple sectors, and provide a dominant server to this pocket of heavy usage.

**Attachment E** titled “Westwood 6 – Area Terrain Map” details the terrain features around the proposed “Westwood 6” site. These terrain features play a key role in dictating both the unique coverage areas served from a given location, and the coverage gaps within the network. This map is included to provide a visual representation of the terrain variations that must be considered when determining the appropriate location and design of a proposed wireless facility. The darker blue and green shades correspond to lower elevations, whereas lighter the yellow, red, and grey shades indicate higher elevations.

## 8. Certification of Non-Interference

Verizon Wireless certifies that the proposed facility will not cause interference to any lawfully operating emergency communication system, television, telephone or radio, in the surrounding area. The FCC has licensed Verizon Wireless to transmit and receive in the Upper C-Block of the 700 MHz band, B Block of the Cellular (850 MHz) band, the F, C3, and C4 Blocks of the PCS (1900 MHz) band, and the A and B Blocks of the AWS (2100 MHz) band of the RF spectrum. As a condition of the FCC licenses, Verizon Wireless is prohibited from interfering with other licensed devices that are being operated in a lawful manner. Furthermore, no emergency communication system, television, telephone, or radio is licensed to operate on these frequencies, and therefore interference is highly unlikely.

## 9. Summary

In undertaking its build-out of 4G LTE service in Norfolk County, Verizon Wireless has determined that an additional facility is needed to provide reliable service and adequate capacity throughout areas of the Town of Westwood, MA. Verizon Wireless determined that utilizing the existing wireless communications facility at 100 Lower Brook Drive in Westwood at an antenna centerline of 104 feet (AGL) will provide additional coverage and capacity needed in the targeted coverage areas including key roadways such as Route 109 (High Street), I-95, and the surrounding roads, neighborhoods, and business parks within the proximity of the proposed site. Without the installation of the proposed site, Verizon Wireless will be unable to improve and expand their existing 4G LTE wireless communication services in this area of Westwood; therefore, Verizon Wireless respectfully requests that the Town of Westwood act favorably upon the proposed facility.

## 10. Statement of Certification

I certify to the best of my knowledge that the statements in this report are true and accurate.

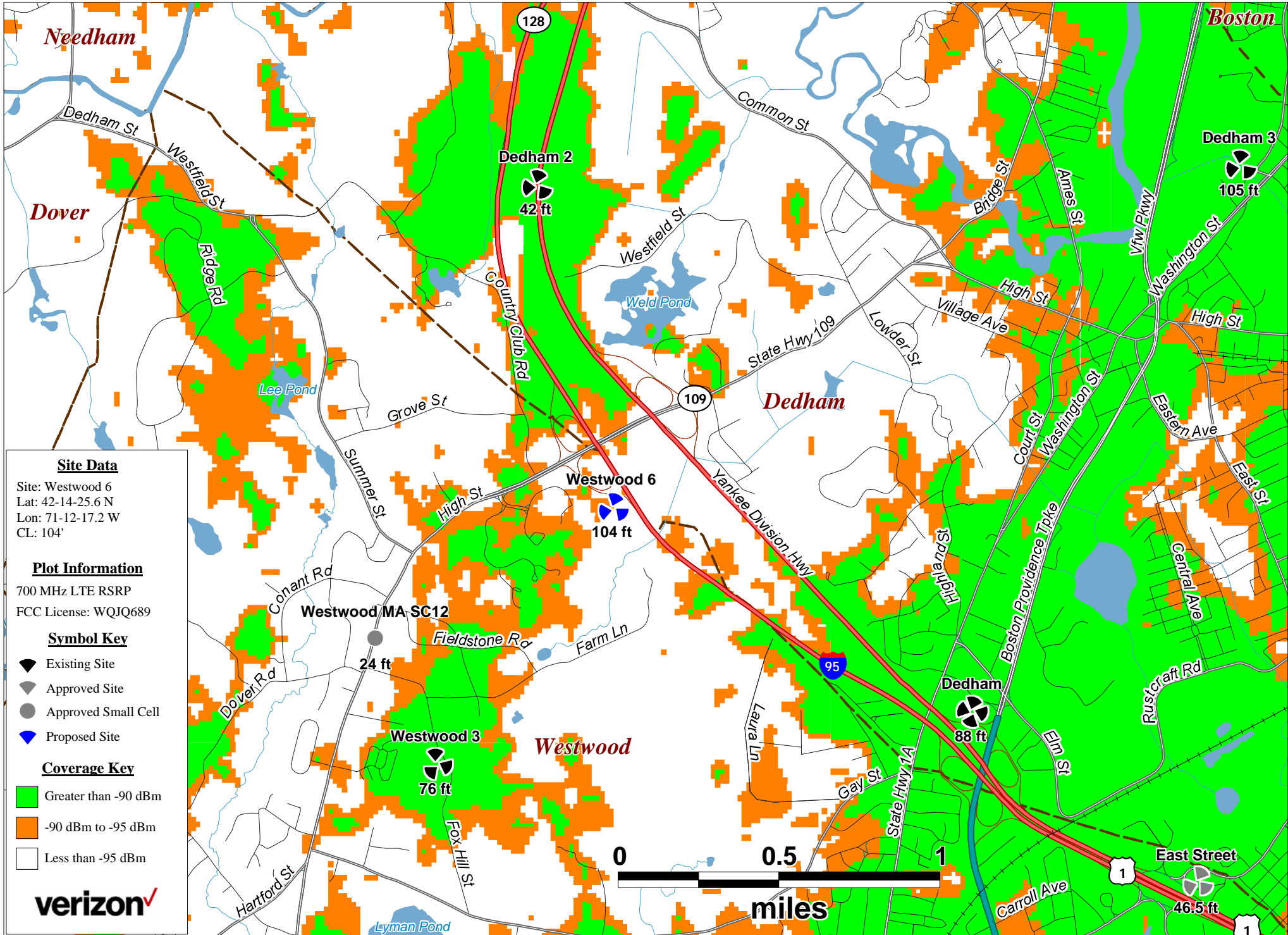
Keith Vellante

Keith Vellante  
RF Engineer  
C Squared Systems, LLC

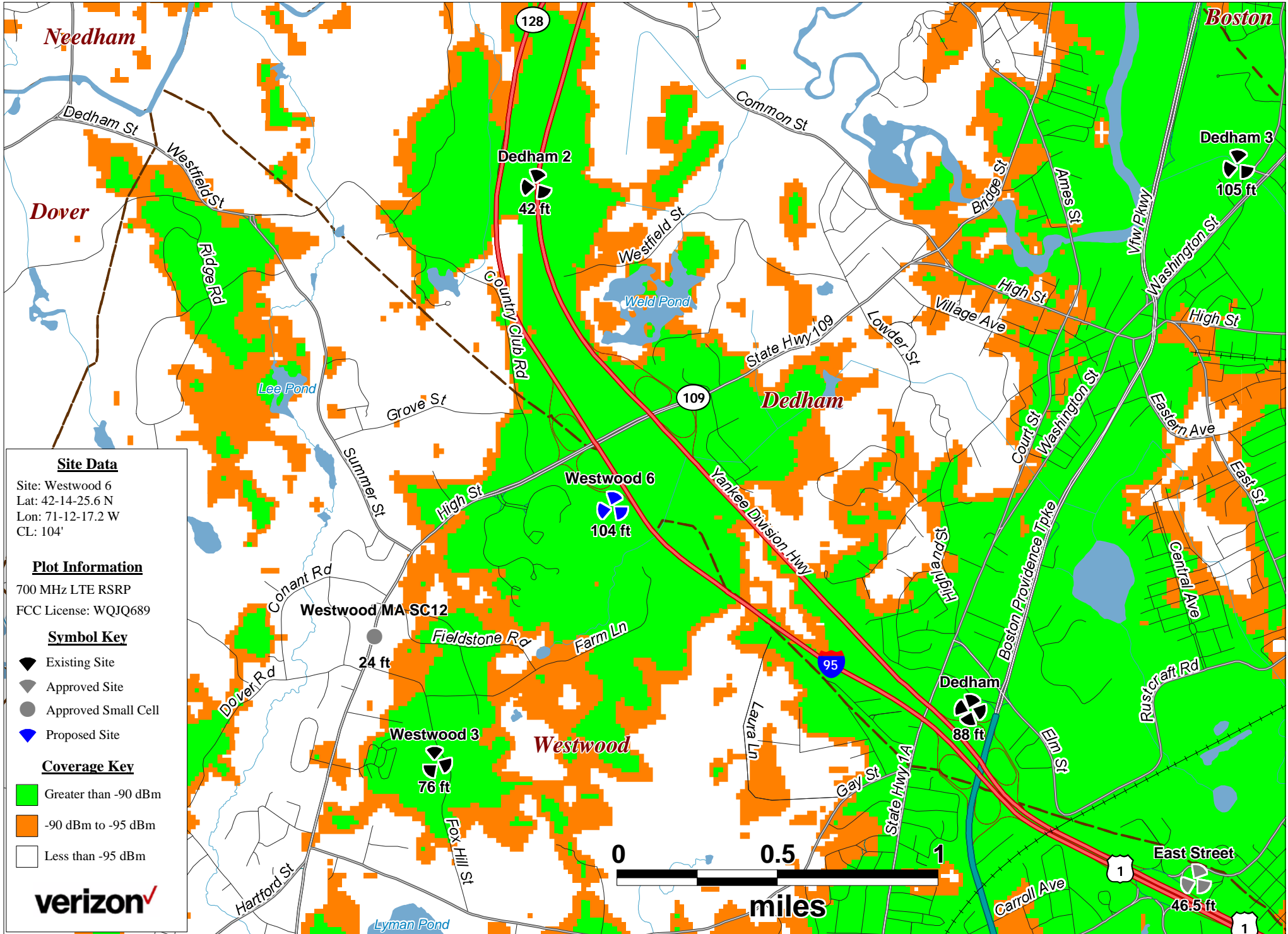
May 24, 2017  
Date

## 11. Attachments

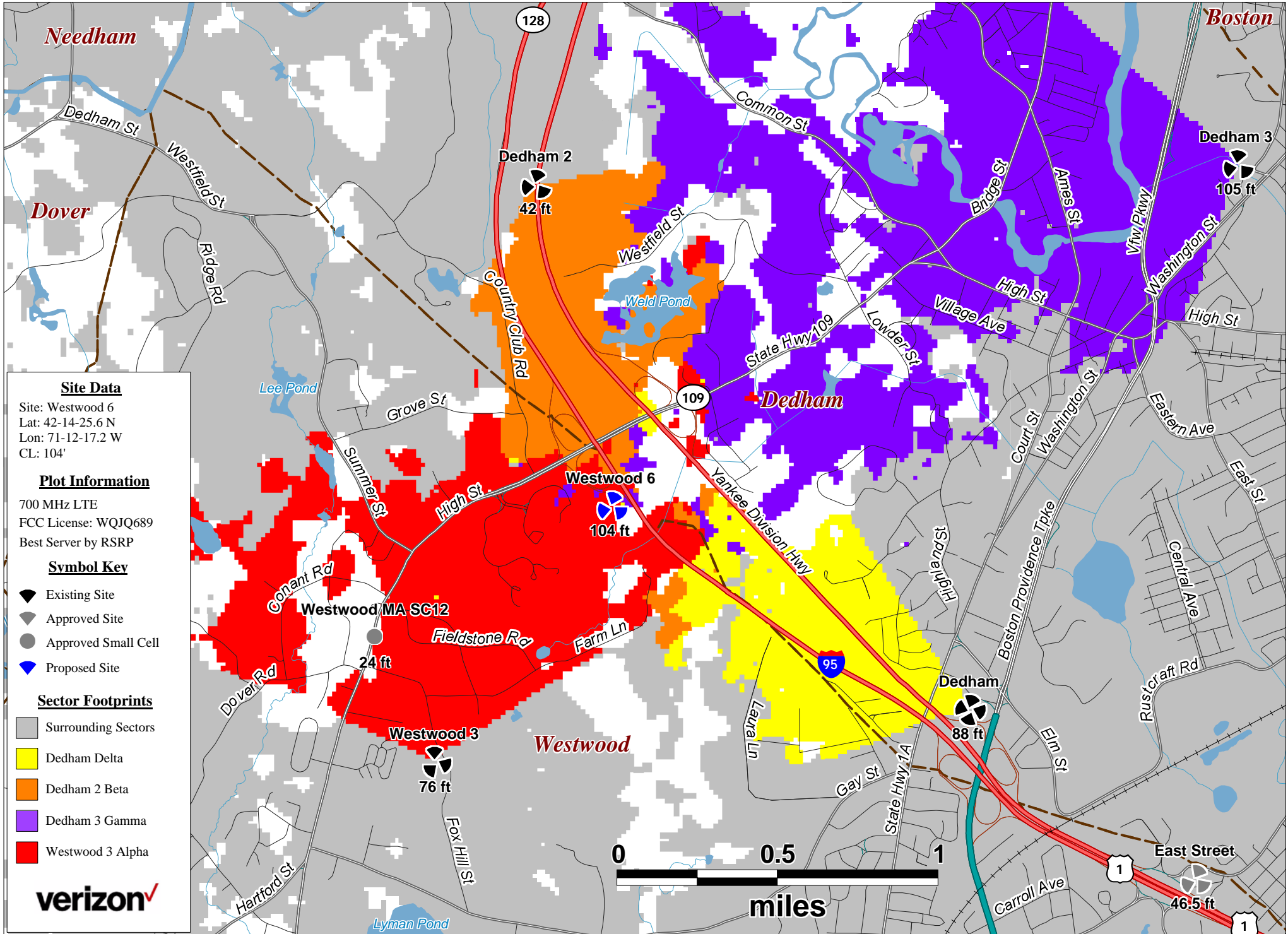
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**Westwood 6 - Existing/Approved 700 MHz LTE Coverage**



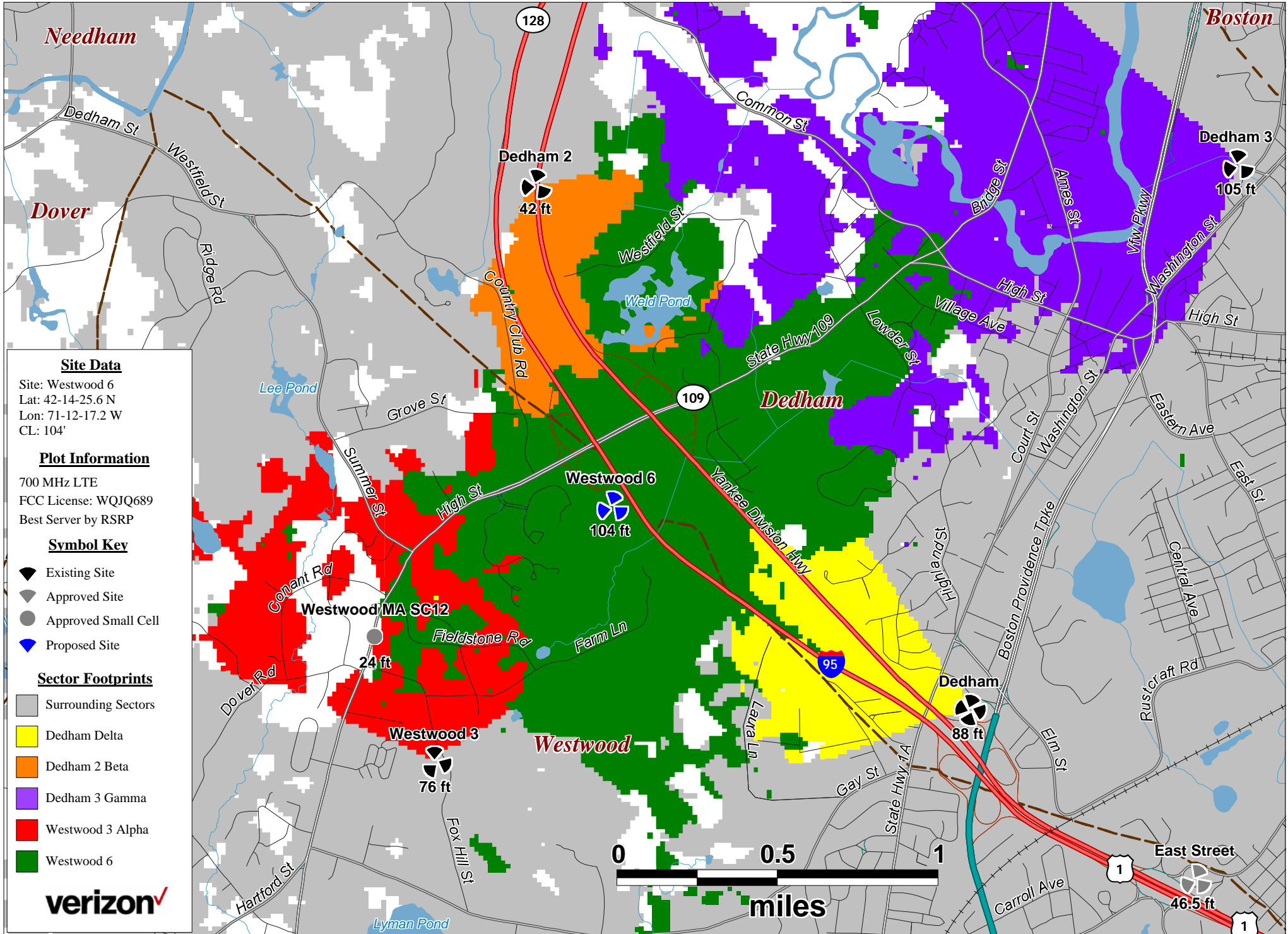
**Attachment B:**  
**Westwood 6 - 700 MHz LTE Coverage with Proposed Site**



**Attachment C:  
Westwood 6 - Existing/Approved 700 MHz LTE Sector Footprints**

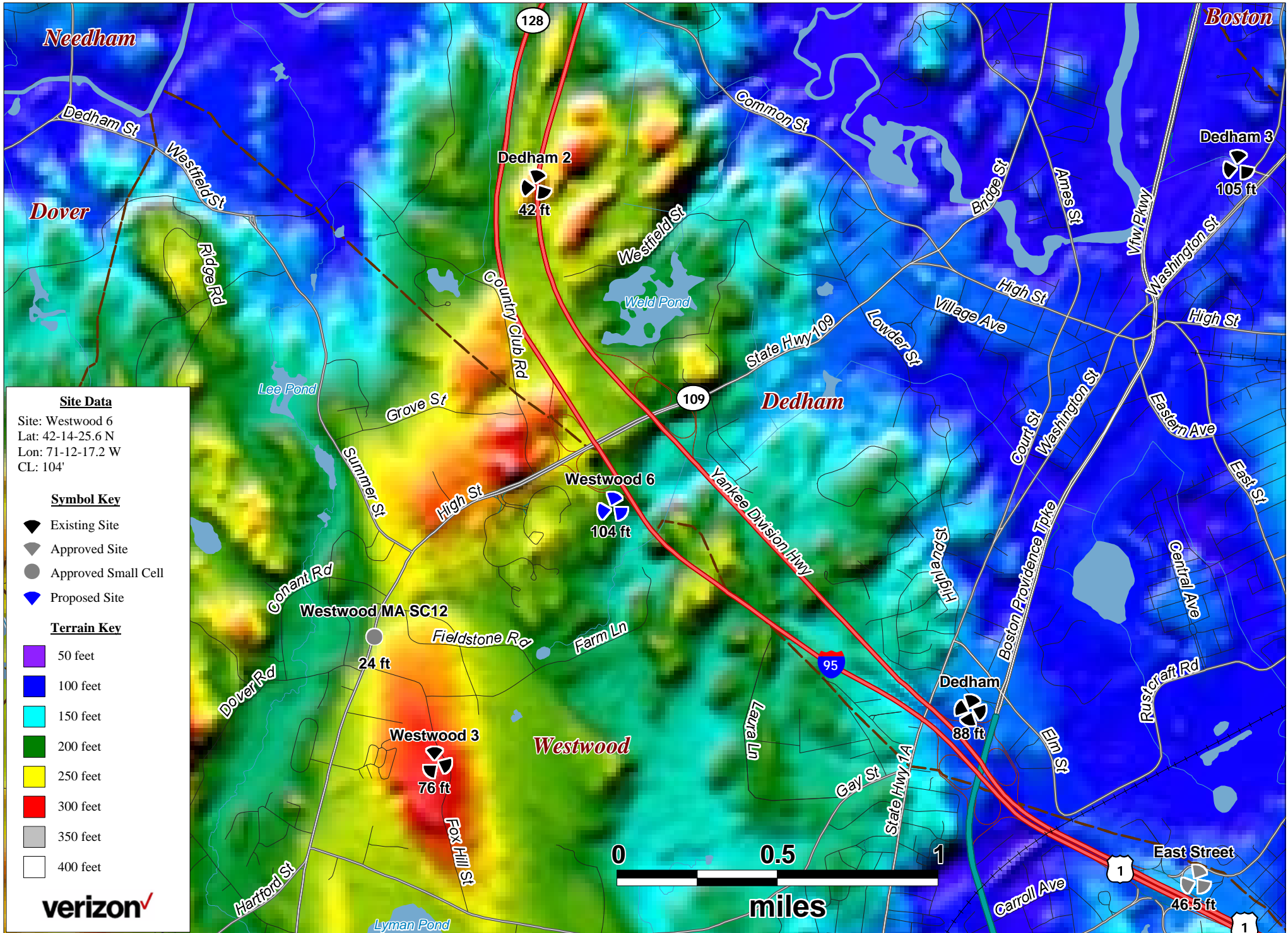


**Attachment D:  
Westwood 6 - 700 MHz LTE Sector Footprints with Proposed Site**





**Attachment E:  
Westwood 6 - Area Terrain Map**



**MAP SYMBOL LEGEND**

 **SUBJECT SITE LOCATION**

 **PHOTO LOCATION NUMBER**



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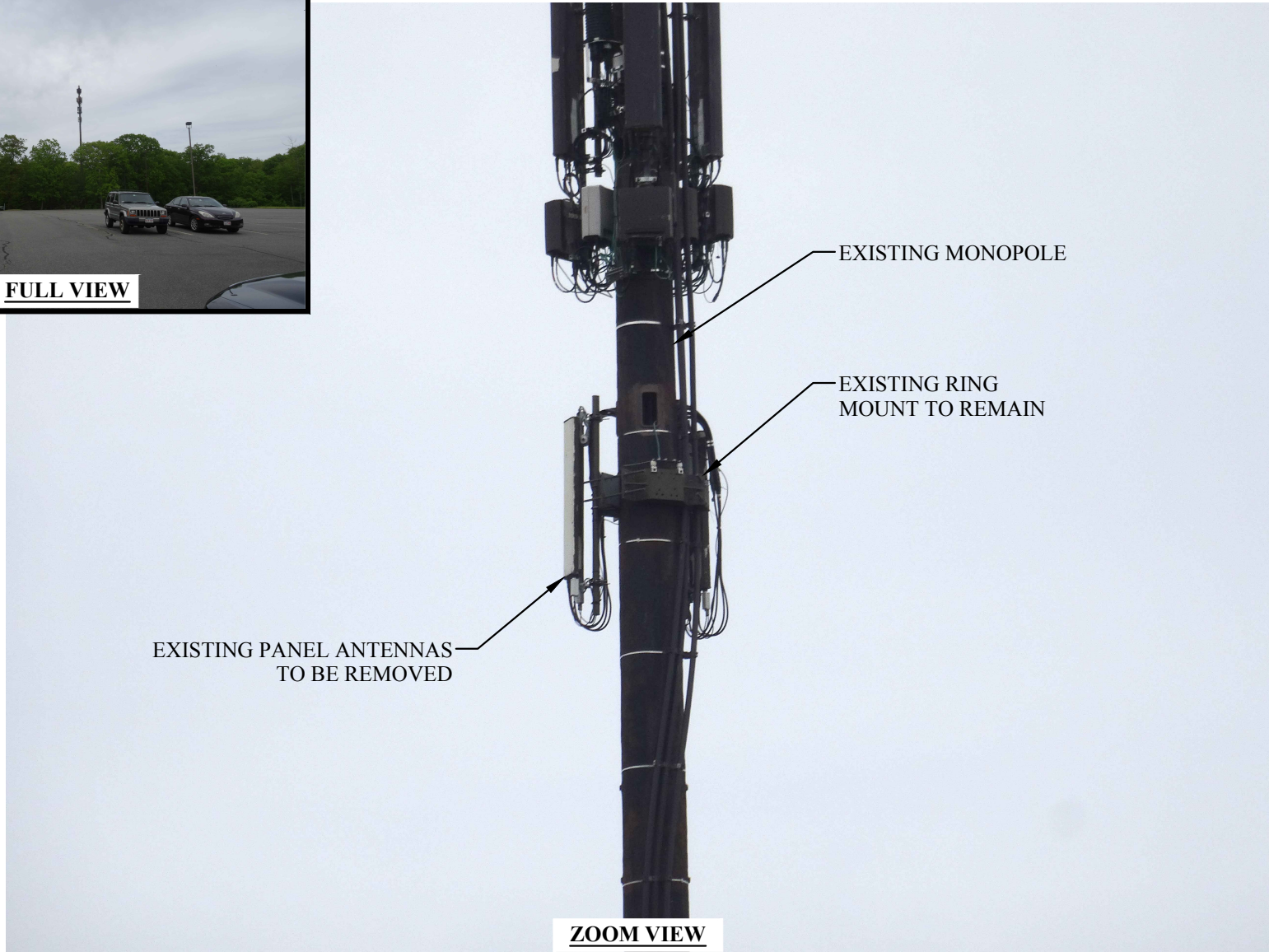
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**CROWN#:** 842905  
**ADDRESS:** 100 LOWDER BROOK DRIVE  
WESTWOOD, MA 02090

**KEY MAP OF PHOTOS**

PAGE: MAP-1  
DATE: 5/24/2017  
DRAWN BY: MR  
REVISION: 0



**FULL VIEW**



**ZOOM VIEW**

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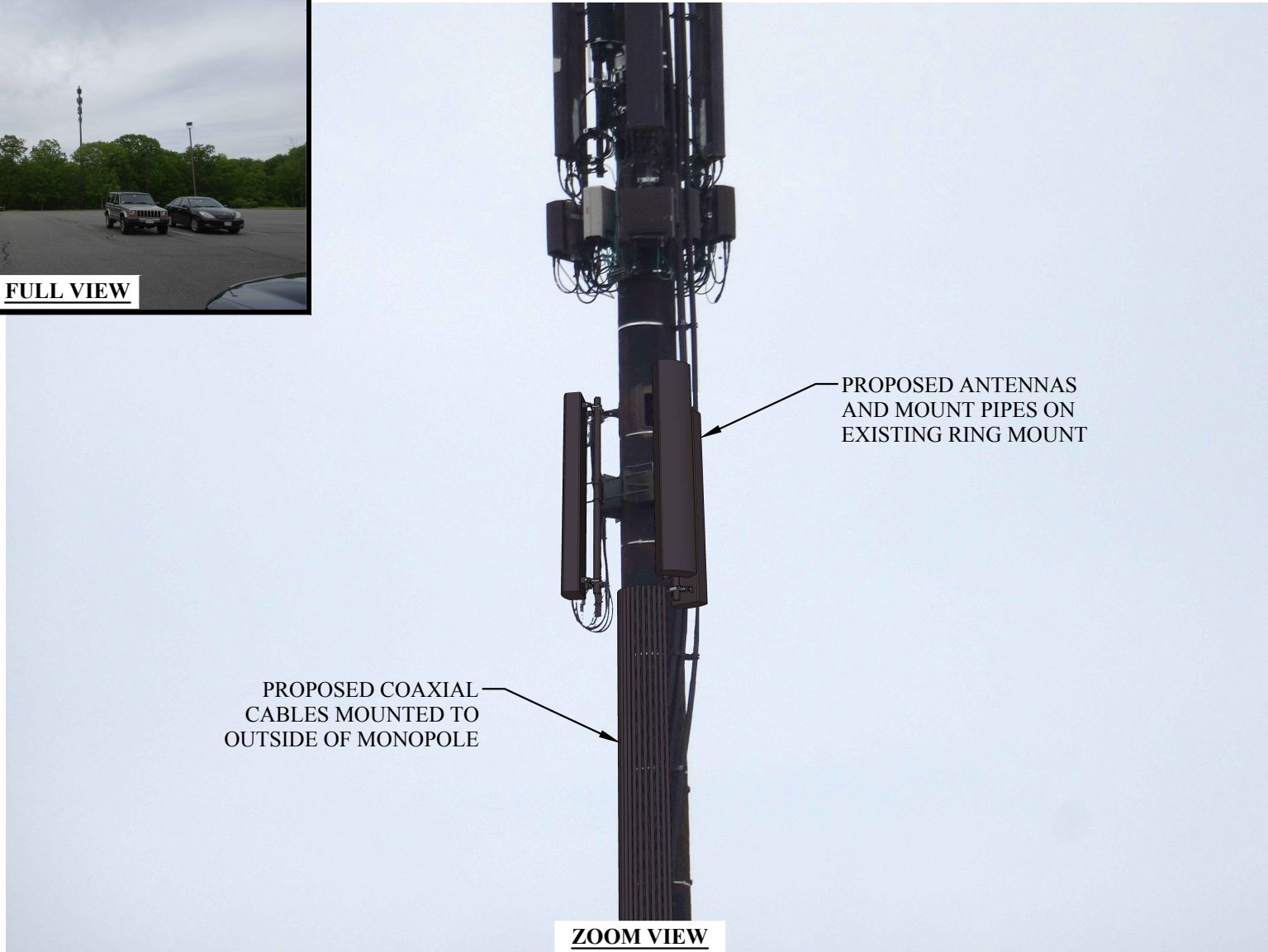
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**ADDRESS:** 100 LOWDER BROOK DRIVE  
 WESTWOOD, MA 02090

**VIEW #1**  
 EXISTING VIEW FROM THE WEST,  
 ON PRIVATE PROPERTY

PAGE: V-1E  
 DATE: 5/24/2017  
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**FULL VIEW**



PROPOSED ANTENNAS  
AND MOUNT PIPES ON  
EXISTING RING MOUNT

PROPOSED COAXIAL  
CABLES MOUNTED TO  
OUTSIDE OF MONOPOLE

**ZOOM VIEW**

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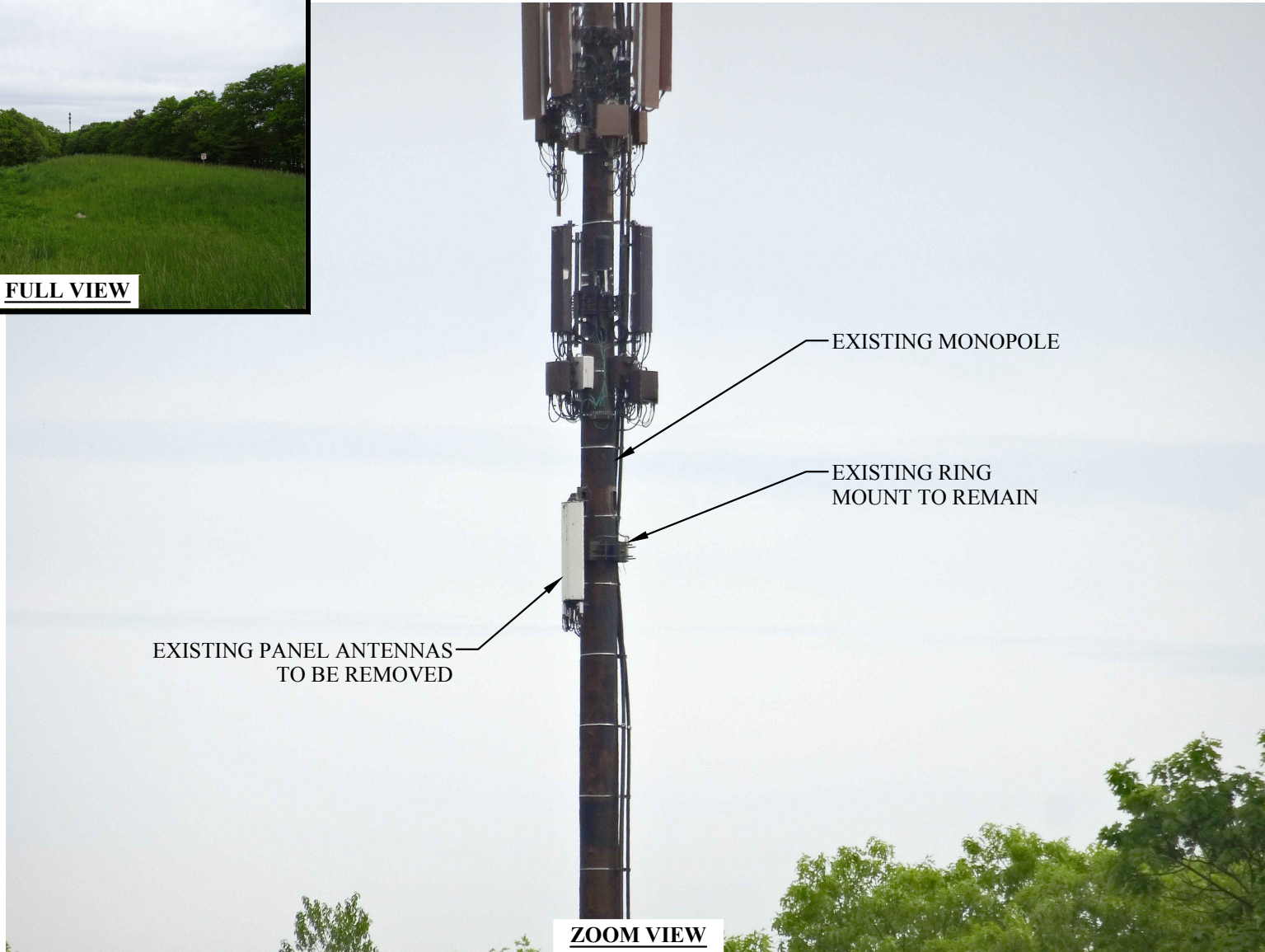
SITE NO: WESTWOOD 6  
CROWN#: 842905  
ADDRESS: 100 LOWDER BROOK DRIVE  
WESTWOOD, MA 02090

**VIEW #1**  
PROPOSED VIEW FROM THE WEST,  
ON PRIVATE PROPERTY

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REVISION: 0



**FULL VIEW**



**ZOOM VIEW**

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**SITE NO:** WESTWOOD 6  
**CROWN#:** 842905  
**ADDRESS:** 100 LOWDER BROOK DRIVE  
 WESTWOOD, MA 02090

**VIEW #2**  
 EXISTING VIEW FROM THE NORTHWEST,  
 ON HIGH STREET,  
 A.K.A MASSACHUSETTS ROUTE# 109

PAGE: V-1E

DATE: 5/24/2017

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REVISION: 0



**FULL VIEW**



PROPOSED ANTENNAS  
AND MOUNT PIPES ON  
EXISTING RING MOUNT

**ZOOM VIEW**

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**SITE NO:** WESTWOOD 6  
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**VIEW #2**  
PROPOSED VIEW FROM THE NORTHWEST,  
ON HIGH STREET,  
A.K.A MASSACHUSETTS ROUTE# 109

PAGE: V-1P

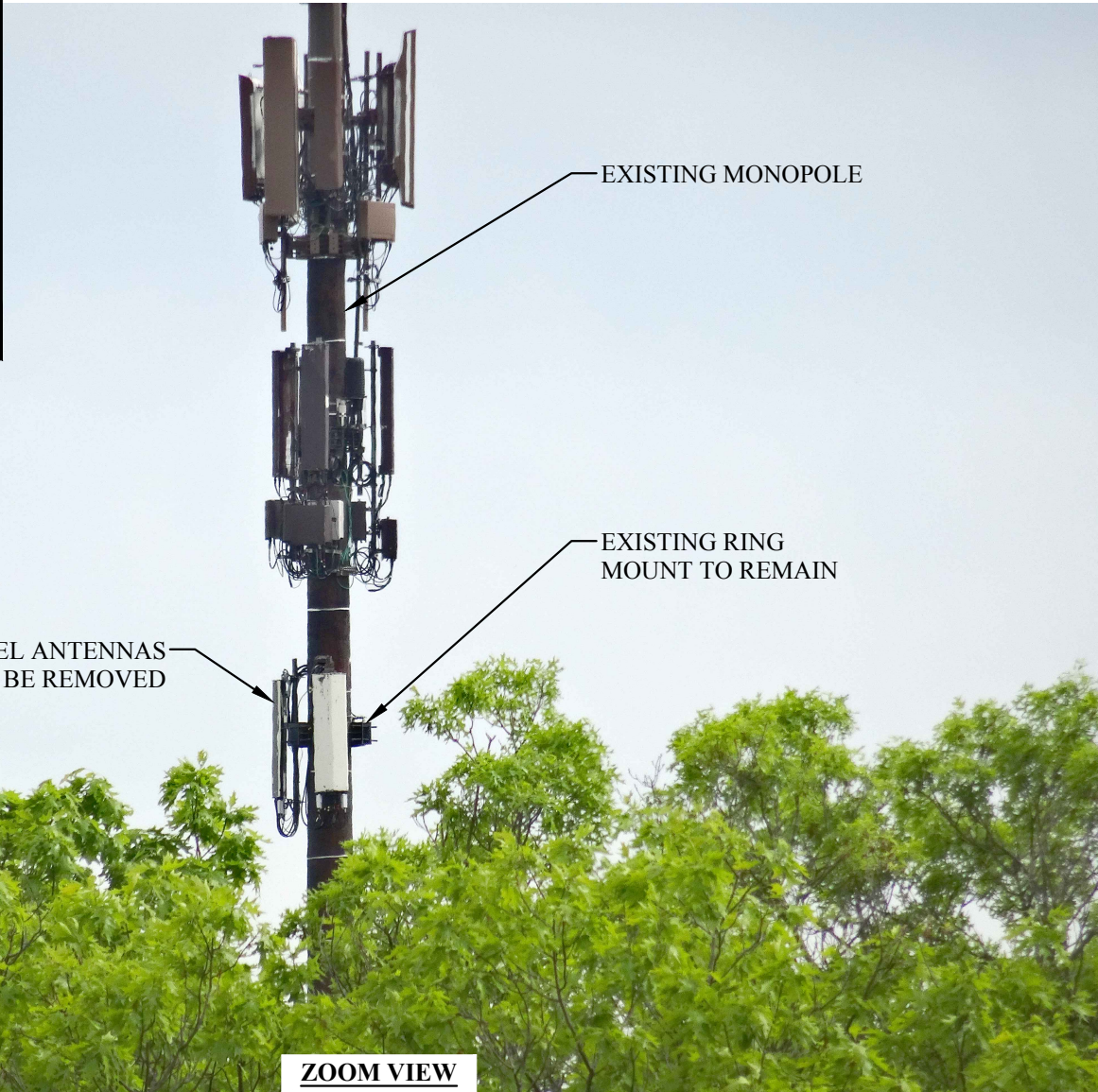
DATE: 5/24/2017

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REVISION: 0



**FULL VIEW**



**ZOOM VIEW**

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**SITE NO:** WESTWOOD 6  
**CROWN#:** 842905  
**ADDRESS:** 100 LOWDER BROOK DRIVE  
 WESTWOOD, MA 02090

**VIEW #3**  
 EXISTING VIEW FROM THE NORTH, ON  
 HIGH STREET,  
 A.K.A MASSACHUSETTS ROUTE# 109

PAGE: V-1E  
 DATE: 5/24/2017  
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**FULL VIEW**



**ZOOM VIEW**

PROPOSED ANTENNAS  
AND MOUNT PIPES ON  
EXISTING RING MOUNT

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**SITE NO:** WESTWOOD 6  
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WESTWOOD, MA 02090

**VIEW #3**  
PROPOSED VIEW FROM THE NORTH, ON  
HIGH STREET,  
A.K.A MASSACHUSETTS ROUTE# 109

PAGE: V-1P

DATE: 5/24/2017

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**PROPOSED ANTENNAS WILL NOT BE VISIBLE FROM THIS LOCATION**

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**SITE NO:** WESTWOOD 6  
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**VIEW #4**  
 EXISTING VIEW FROM THE NORTHEAST,  
 ON BOOTH ROAD

PAGE: V-4E

DATE: 5/24/2017

DRAWN BY: MR

REVISION: 0



**PROPOSED ANTENNAS WILL NOT BE VISIBLE FROM THIS LOCATION**

PREPARED FOR:

**verizon**<sup>v</sup>  
 400 FRIBERG PARKWAY  
 WESTBOROUGH, MA 01581  
 (508) 330-3300 TEL

PREPARED BY:

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**SITE NO:** WESTWOOD 6  
**CROWN#:** 842905  
**ADDRESS:** 100 LOWDER BROOK DRIVE  
 WESTWOOD, MA 02090

**VIEW #5**  
 EXISTING VIEW FROM THE SOUTHEAST,  
 AT THE END OF FARM LANE

PAGE: V-5E

DATE: 5/24/2017

DRAWN BY: MR

REVISION: 0



**PROPOSED ANTENNAS WILL NOT BE VISIBLE FROM THIS LOCATION**

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**SITE NO:** WESTWOOD 6  
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**VIEW #6**  
 EXISTING VIEW FROM THE SOUTHWEST,  
 ON FARM LANE

PAGE: V-6E

DATE: 5/24/2017

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**PROPOSED ANTENNAS WILL NOT BE VISIBLE FROM THIS LOCATION**

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**SITE NO:** WESTWOOD 6  
**CROWN#:** 842905  
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**VIEW #7**  
 EXISTING VIEW FROM THE EAST, AT  
 THE INTERSECTION OF HIGH STREET  
 AND LOWDER BROOK DRIVE

PAGE: V-7E

DATE: 5/24/2017

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REVISION: 0