
RF Report

Proposed Wireless Facility
92 Stallion Hill Road
Sturbridge, MA 01566



November 1, 2023

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1. Overview

This RF Report has been prepared on behalf of Verizon Wireless in support of Vertex Towers, LLC's ("Vertex Towers") proposal to the Town of Sturbridge for the installation and operation of a wireless facility located at 92 Stallion Hill Road. Verizon Wireless' component of the proposed facility would consist of ground-based equipment cabinets along with antennas and associated equipment mounted on the proposed 130' monopole tower.

This report concludes that the proposed site will fill in coverage gaps and provide additional capacity to Sturbridge, MA to improve deficient service areas along Route 20, Holland Road, Route 148 (Brookfield Road), and the surrounding roads, neighborhoods, businesses, and shopping areas in 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 modeled 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 4th Generation (4G) voice and data services over LTE technology in the 700 MHz, Cellular (800 MHz), PCS (1900 MHz), and AWS (2100 MHz) frequency bands as allocated by the FCC, along with the CBRS band (3.5-3.7 GHz). It is also in the midst of deploying advanced 5th generation (5G) NR services in its cellular, C-band (3.7-3.98 GHz) and 28 GHz licensed frequency bands. These 4G and 5G networks are used to provide high-speed wireless connections used by mobile devices for fast web browsing, media streaming, video conferencing, and other applications that require broadband connections. The mobile devices that benefit from these advanced networks include typical smartphones, tablets, laptops, and Wi-Fi hotspots. With the continual advancement of its networks, Verizon Wireless customers will enjoy even faster connections to people, information, and entertainment in a day and age when reliable wireless connectivity is an indispensable part of daily personal and business life.

As explained within this report, Verizon Wireless has identified the need to add a new facility to its existing network of sites in the Sturbridge area to improve coverage and capacity to a significant gap in service that now exists in town, 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 (more than tripled from 2016-2021 for mobile wireless data traffic in the U.S.¹), 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 proposed wireless communication facility at 92 Stallion Hill Road at an antenna centerline height of 125' AGL (above ground level), Verizon Wireless will be able to provide substantially improved coverage and additional capacity to residents, businesses, and traffic corridors within Sturbridge that are currently located within gaps in service of Verizon Wireless' network.

¹ "2022 Annual Survey Highlights", September 13, 2022, CTIA.
<https://www.ctia.org/news/2022-annual-survey-highlights>

3. The Proposed Facility

Verizon Wireless' component of the proposed facility consists principally of the following elements:

- 1) Telecommunication equipment cabinets, telco/power/fiber connections, and a diesel generator mounted on a 12' x 20' concrete pad / lease area within the proposed 60' x 60' fenced compound;
- 2) Up to twelve (12) panel antennas (4 sectors, 3 per sector) mounted on the proposed 130' monopole tower, at a centerline elevation of 125' AGL;
- 3) Remote Radio Heads (RRH) with accessory junction boxes and surge suppressors mounted alongside the antennas;
- 4) An ice bridge from its equipment area to the proposed monopole to protect cabling between Verizon Wireless' equipment cabinets and the cable entry port located near the base of the monopole.

4. Coverage and Capacity Objectives

As mentioned above, Verizon Wireless is in the process of advancing its 4G LTE high-speed wireless broadband system in the 700 MHz, Cellular, PCS, AWS and CBRS frequency bands, in accordance with its applicable licenses from the FCC. Verizon is also deploying a 5G NR system in its licensed cellular, C-Band, and 28 GHz frequency bands. 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 significant gaps in service exist in and around sections of Sturbridge, as described further below.

Verizon Wireless currently operates wireless facilities similar to the proposed facility within Sturbridge and the surrounding cities/towns. Due in large part to the distances between the surrounding sites, the intervening topography, and volume of user traffic in the area, these facilities do not provide sufficient coverage to portions of Town. Specifically, Verizon Wireless determined that much of Sturbridge is without reliable service in the following areas and town roads², including but not limited to:

- Route 20 (Main Street);
 - Serves ~ 19,000 vehicles per day as measured between Arnold Road and Cedar Street (2022);
- Holland Road;
- Route 148 (Brookfield Road);
- Old Sturbridge Village;
- The surrounding roads, neighborhoods, businesses, and shopping areas in the proximity of the proposed site.

The proposed site located at 92 Stallion Hill Road (“Sturbridge W MA”) is needed to fill in these targeted gaps in service, in order to improve network quality and reliability for Verizon Wireless subscribers traveling along these roads, as well as to the numerous residents, businesses, and visitors in this area.

² Traffic counts are sourced from the Massachusetts Department of Transportation, Transportation Data Management System. <https://mhd.public.ms2soft.com/tcds/tsearch.asp?loc=Mhd&mod=>

5. Site Search and Selection Process

To find a site that provides acceptable service, adequate capacity, 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 sufficient height is considered) that would have a high probability of addressing the significant coverage gap and/or 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 new towers throughout the towns being served.

Since no suitable existing structures in the area have been identified, Verizon Wireless determined that collocating on the proposed wireless communications facility at 92 Stallion Hill Road is necessary to address its targeted coverage and capacity objectives.

6. Pertinent Site Data

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

Site Name	Address	City/Town	Location		Structure Type	Antenna Height (ft AGL)	Status
			Latitude	Longitude			
Brimfield	57 Dearth Hill Road	Brimfield	42.1090	-72.2430	Self-Support	140	On-Air
Charlton	130 Sturbridge Rd. (Rt. 30)	Charlton	42.1417	-72.0166	Self-Support	147	On-Air
Charlton 2	227 Carpenter Hill Road	Charlton	42.1159	-72.0038	Monopole	125	On-Air
Charlton 3	85 Masonic Home Road	Charlton	42.1400	-71.9740	Monopole	169	On-Air
East Brimfield	229 Sturbridge Road	Sturbridge	42.1150	-72.166914	Monopole	146.5	On-Air
Holland	Off Leno Road	Holland	42.0700	-72.1450	Self-Support	180	On-Air
Southbridge	41 Elm Street	Southbridge	42.0734	-72.0345	Steeple	120	On-Air
Southbridge 2	208 Clemence Hill Road.	Southbridge	42.0885	-72.0337	Monopole	80	On-Air
Sturbridge	315 Route 20, MA State Police	Sturbridge	42.1120	-72.0830	Self-Support	137	On-Air
Sturbridge 2	Route 84-Sturbridge Isle	Sturbridge	42.0609	-72.1100	Monopole	165	On-Air
Sturbridge 3	126 Clark Road	Sturbridge	42.1320	-72.1118	Monopole	108	On-Air
Sturbridge 4	174 Charlton Road	Sturbridge	42.1218	-72.0624	Monopole	170	On-Air
Wales	188 Stafford Road	Wales	42.038244	-72.240719	Monopole	189	On-Air
Wales 2	22 Holland Road	Wales	42.078114	-72.1975403	Self-Support	170	On-Air
Warren	Devils Lane	Warren	-72.1709	42.1576	Self-Support	178	On-Air
Sturbridge W	92 Stallion Hill Road	Sturbridge	42.1086	-72.1124	Monopole	125	Proposed

Table 1: Verizon Wireless Site Information Used in Coverage Analysis³

³ 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 were produced using deciBel Planner™, a Windows-based RF propagation computer modeling program and network planning tool. The software considers the topographical 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 -95 dBm and above. 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 “Sturbridge W MA – Existing 700 MHz & 2100 MHz LTE Coverage (Macro-Sites)” shows the coverage provided to areas of Sturbridge, MA from the existing “On-Air” sites listed in Table 1. The green and yellow shaded areas represent the minimum desired level of coverage for much of this area for the 700 MHz and 2100 MHz network layers, respectively. Because of the superior propagation characteristics of 700 MHz relative to 2100 MHz, the 2100 MHz coverage areas (yellow) are generally contained within the 700 MHz coverage areas (green). As such, the deficient areas of 700 MHz coverage are defined by the unshaded areas, whereas the deficient areas of 2100 MHz coverage consist of both the green and white areas. As shown in this plot and described in the Coverage and Capacity Objectives section of this report, much of Sturbridge are in an area of deficient coverage. These coverage gaps, particularly at 2100 MHz, include Route 20, Holland Road, Route 148 (Brookfield Road), and the surrounding roads, neighborhoods, businesses and shopping areas in the proximity of the proposed site.

Attachment B titled “Sturbridge W MA – 700 MHz & 2100 MHz LTE Coverage with Proposed Site (Macro-Sites)” shows the composite coverage with the proposed “Sturbridge W” facility. As shown by the additional areas of coverage, the proposed facility will provide coverage to:

- ~ 1.3 mi (700 MHz and 2100 MHz) along Route 20 (Main Street);
- ~ 0.7 mi (700 MHz) and ~ 0.3 mi (2100 MHz) along Holland Road;
- ~ 0.5 mi (700 MHz) and ~ 0.4 mi (2100 MHz) along Route 148 (Brookfield Road);
- ~ 900 (700 MHz) and ~ 715 (2100 MHz) additional residents⁴;
- ~ 350 (700 MHz) and ~ 450 (2100 MHz) additional employees⁵;
- ~ 470 (700 MHz) and ~ 380 (2100 MHz) additional structures⁶;
- The surrounding roads, neighborhoods, and businesses in the proximity of the proposed site, including Old Sturbridge Village.

⁴ Residential population counts referenced here and elsewhere within this report are based upon the 2010 U.S. Census data.

⁵ Employee population counts referenced here and elsewhere within this report are based upon the 2017 U.S. Census Bureau LEHD database.

⁶ Structure counts referenced here in this report are based upon “roofprint” data sourced from MassGIS (Bureau of Geographic Information). The dataset contains two-dimensional roof outlines for all buildings larger than 150 ft² and may not necessarily include only dwellings. For additional information, refer to <https://docs.digital.mass.gov/dataset/massgis-data-building-structures-2-d>

Attachment C titled “Sturbridge W MA – Existing 700 MHz LTE Sector Footprints (Macro-Sites)” depicts the areas primarily served by the sectors (a.k.a. signal “footprints”) of the surrounding 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 will also 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 may 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 may reach these areas does not mean that these areas experience adequate coverage. These unreliable areas of low signal level can impose a significant capacity burden on the sites primarily serving the area.

Attachment D titled “Sturbridge W MA – 700 MHz LTE Sector Footprints with Proposed Site (Macro-Sites)” shows the composite coverage with the overall footprint of the proposed facility in dark green. As shown in this map, the proposed “Sturbridge W” facility is an effective solution to provide capacity relief to the area, particularly to the “Sturbridge” gamma sector (red), and the “Sturbridge 3” gamma sector (yellow). The proposed facility is located near the targeted area of deficient coverage making it particularly suited to distribute the traffic load across multiple sectors and provide a dominant server to this gap in service. Table 2 below details the capacity relief based on the sector footprints shown in Attachments C and D.

Sector	Current			With "Sturbridge W"			Offload Summary		
	Residential Pops	Business Pops	Structures	Residential Pops	Business Pops	Structures	Total Residential Pops Offloaded	Total Business Pops Offloaded	Structures Offloaded
Sturbridge Gamma	1451	1405	901	692	535	424	759 (52.3%)	870 (61.9%)	477 (52.9%)
Sturbridge 3 Gamma	481	113	243	251	68	128	230 (47.8%)	45 (39.8%)	115 (47.3%)

Table 2: Capacity Offload Summary

Attachment E titled “Sturbridge W MA – Area Topography Map” details the topographical features around the proposed “Sturbridge W” 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 blue and green shades correspond to lower elevations, whereas the orange and red 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 specific frequency blocks of the 700 MHz band, the Cellular band, the PCS band, the AWS band, the CBRS band, the C-band, and 28 GHz 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 and 5G NR service in Worcester County, Verizon Wireless has determined that an additional facility is needed to provide reliable service and additional capacity throughout areas of Sturbridge, MA. Verizon Wireless determined that collocating on Vertex Towers' proposed wireless communications facility at 92 Stallion Hill Road in Sturbridge at an antenna centerline height of 125 feet (AGL) will provide additional coverage and capacity needed in the targeted coverage areas including key roadways such as Route 20, Holland Road, Route 148 (Brookfield Road), and the surrounding roads, neighborhoods, businesses, and shopping areas in the proximity of the proposed site. Without the installation of the proposed site, Verizon Wireless will be unable to improve and expand their wireless communication services in this area of Sturbridge, MA; therefore, Verizon Wireless respectfully requests that the Town of Sturbridge 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

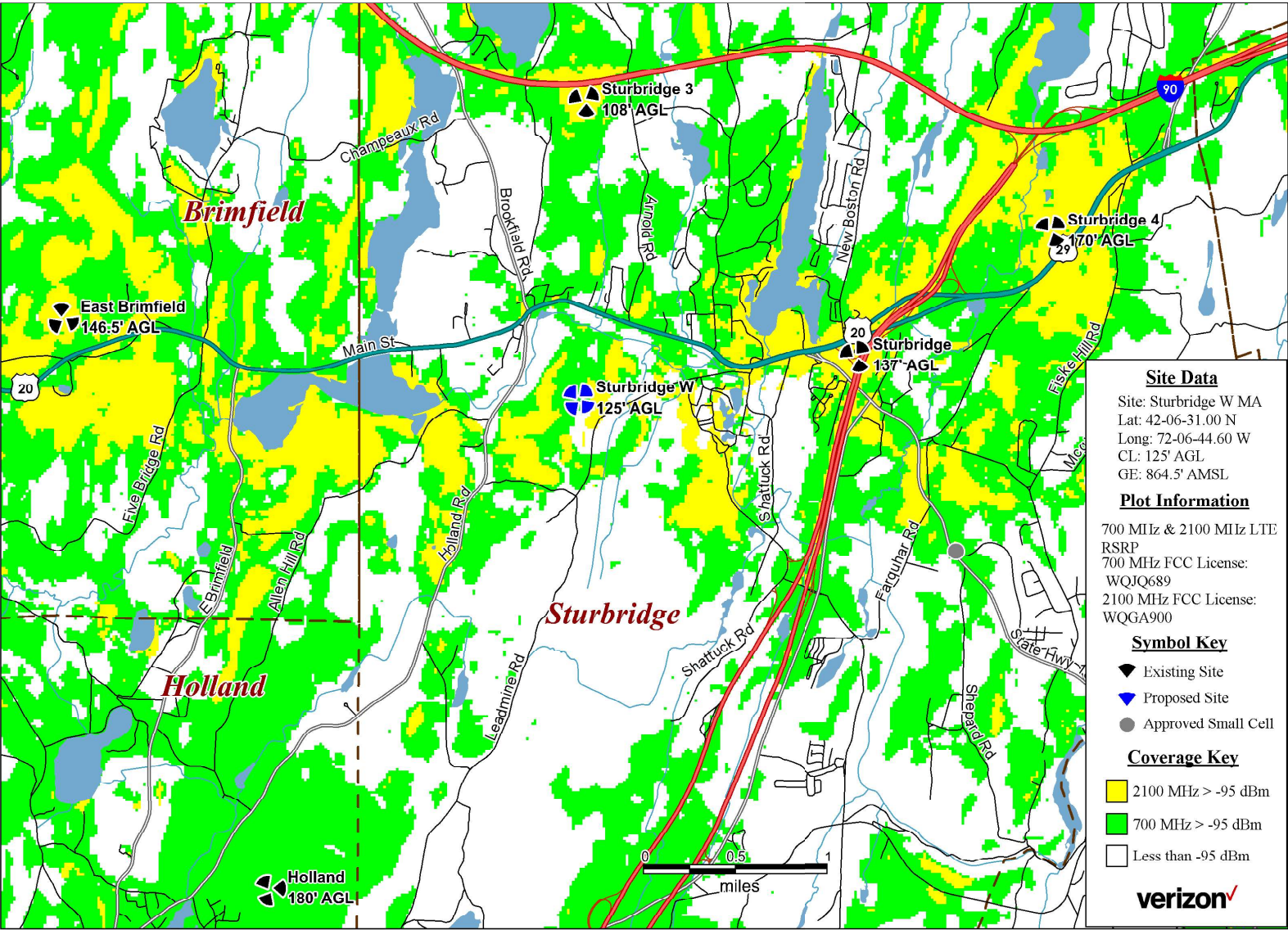
Keith Vellante
RF Engineer
C Squared Systems, LLC

November 1, 2023

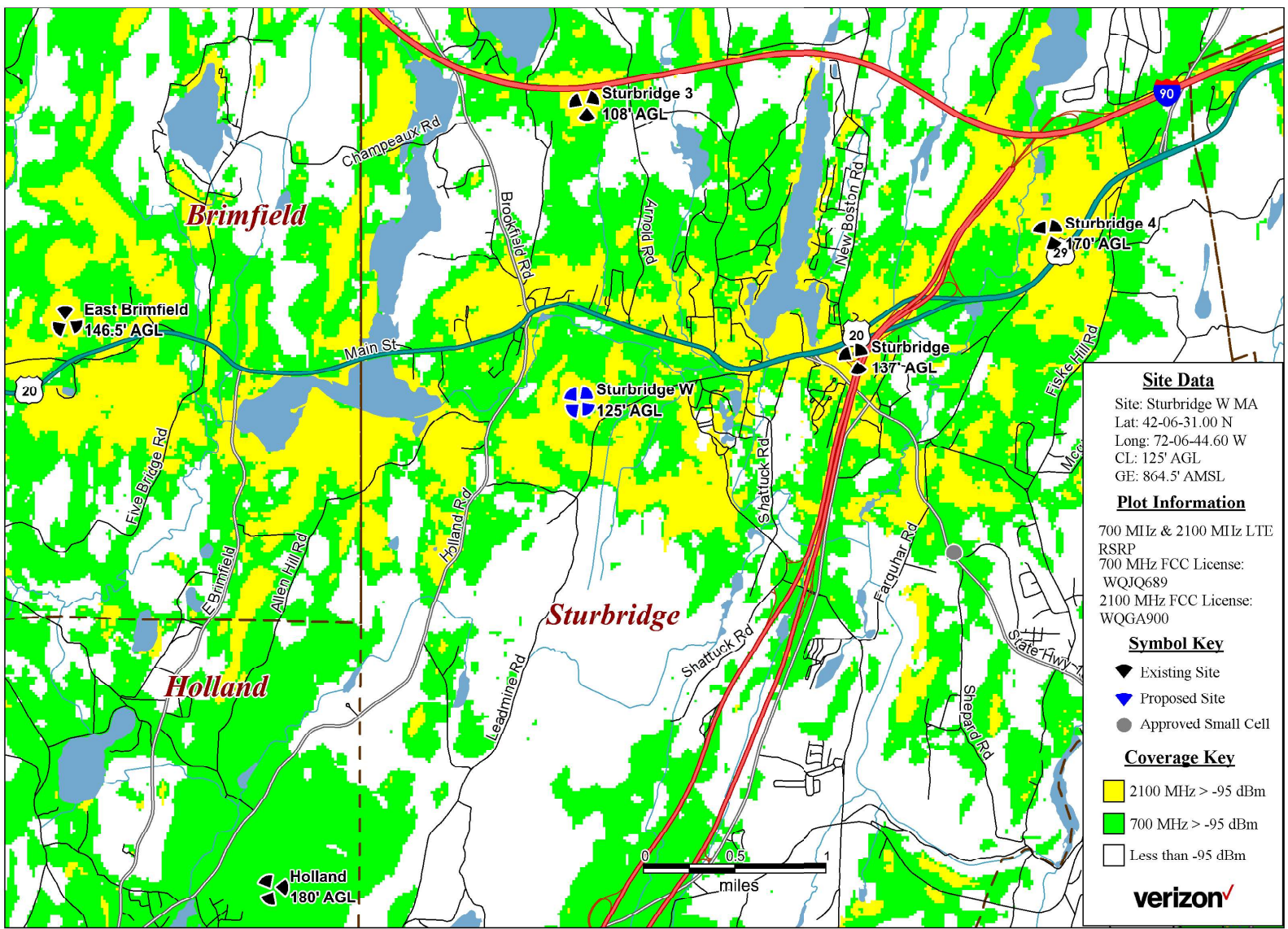
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11. Attachments

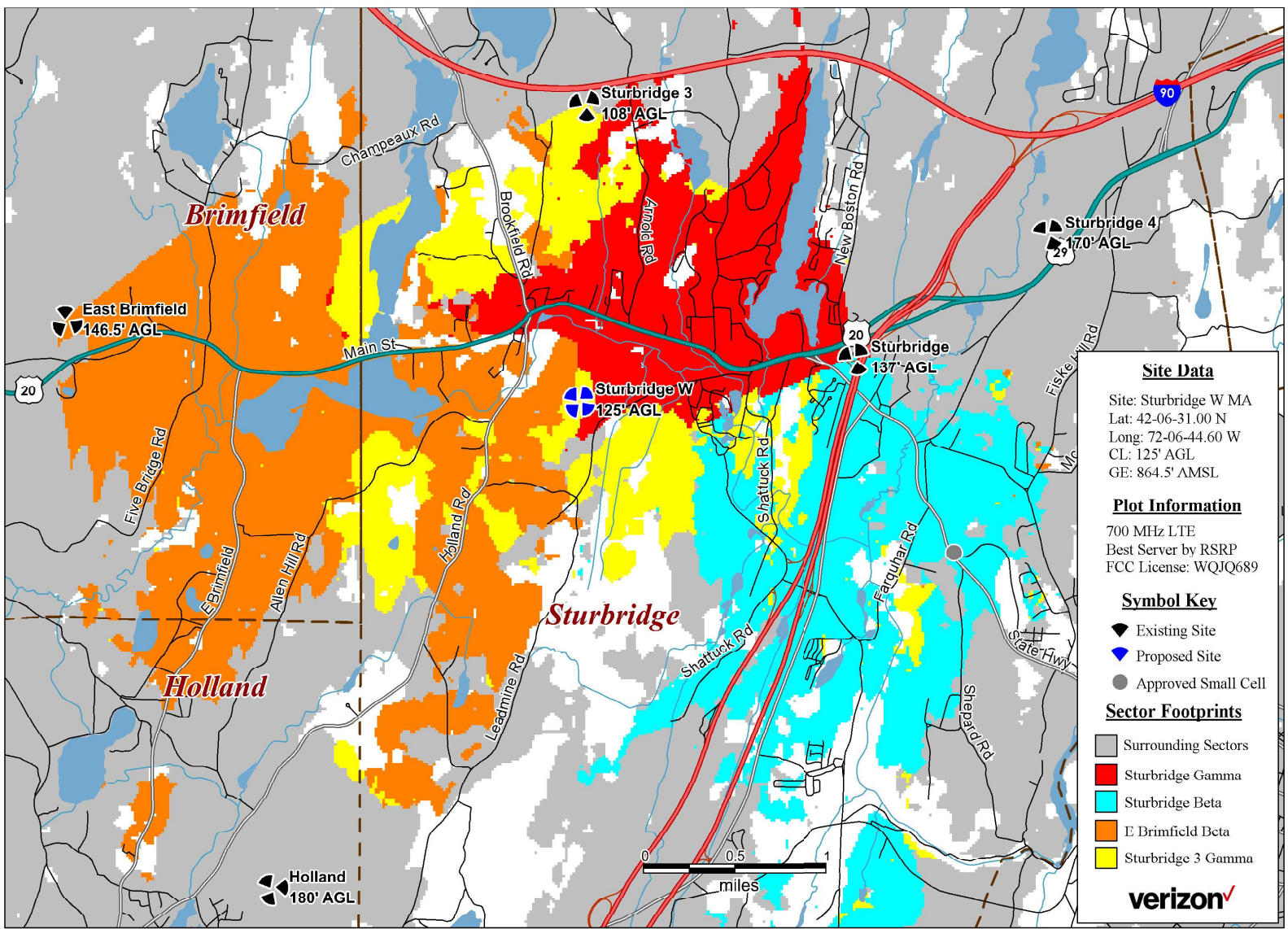
Attachment A:
Sturbridge W MA - Existing 700 & 2100 MHz LTE Coverage (Macro-Sites)



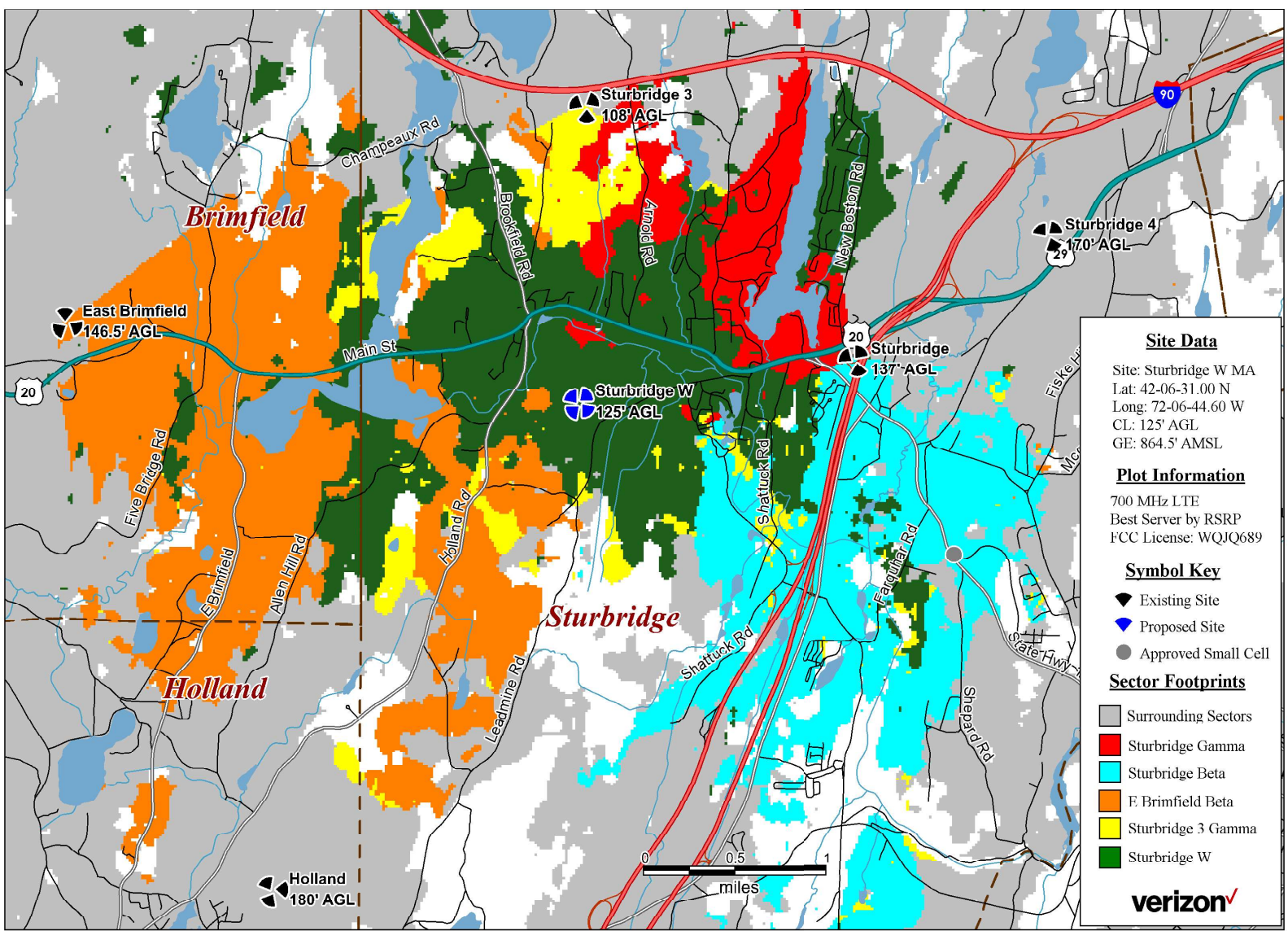
Attachment B:
Sturbridge W MA - 700 & 2100 MHz LTE Coverage with Proposed Site (Macro-Sites)



Attachment C:
Sturbridge W MA - Existing 700 MHz LTE Sector Footprints (Macro-Sites)



Attachment D:
Sturbridge W MA - 700 MHz LTE Sector Footprints with Proposed Site (Macro-Sites)



Attachment E:
Sturbridge W MA - Area Topography Map

