Network Engineering

Verizon Wireless
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SEA Bromart RF Documentation

Overview:

Verizon Wireless strives to provide excellent wireless service for our customers with a network of cell sites that allows our customers to reliably place and receive mobile phone calls. In this particular case, we are trying to provide and enhance coverage in the residential areas in the town of Snohomish, in Snohomish County, within an area roughly located east to SR-2, west to Airport Way, north to 4th St. and south to Old Snohomish Monroe Rd. Development of the proposed site entail placing twelve antennas at the new tower. Providing coverage to our residential customers, along with continued growth in our customer base and call traffic in this area has dictated the need for the proposed site.

Coverage:

In order to provide excellent service, which Verizon Wireless defines as –80 dBm, the antenna height and site location need to provide a line of sight to the roads, offices, and homes where our customers work and reside. A total of twelve antennas are being proposed to be installed at 100' on a monopole, in order to provide the necessary radio frequencies supporting all of Verizon Wireless voice and data services. One key feature of the new cell site will be providing strong in-building coverage to the surrounding business and residential areas. Strong in-building coverage is often the most difficult goal to attain because of the degradation of the Radio Frequency (RF) signal through the building itself. A RF signal will quickly drop off when it must travel through solid obstacles such as tree foliage or buildings. For this reason a tower height that is greater than the existing tree and building clutter is required to provide a better, less obstructed view of the intended coverage area. Early cellular designs placed cell sites with tall towers on top of hills. This provided cellular companies the ability to cover the most area possible with very few cell sites. As cellular subscriber numbers have increased this has meant that these high cell sites have been forced to provide service to a large number of subscribers in a large area. Cellular design has evolved so that multiple, shorter cell sites, located near high traffic, high population areas are now favored. This allows for a single cell site to provide service for more subscribers in a smaller area. This ultimately results in fewer dropped calls and access failures for the user because the serving cell site is located closer providing a stronger RF signal.

Because of surrounding vegetation and the rolling terrain features of the proposed coverage area, a taller height would be preferable, as an obstruction before antennas degrades or block signal levels to our customers. While a taller height is desired, 100 feet is the minimum height necessary for the proposed site to provide adequate levels of coverage to the surrounding area, as vegetation around or other obstacles at the proposed site location are at or above 60 feet. There is a chance that our customers will not have a line of sight to antennas on the tower at the proposed location due to obstacles, so this is a reason to install RRU and TMA at antennas in order to amplify signal levels at the antennas on the tower and hence improve the quality service for our customers due to degradation of signals due to obstacles between customers and antennas on the tower. Verizon Wireless has a frequency licenses in 700 MHz, 850MHz, PCS and AWS frequency bands. In order to provide excellent service, Verizon Wireless would need to install a separate antenna for each frequency band in three directions that would require a total of 12 antennas.

Verizon Wireless has considered installing antennas on the existing power or light poles as micro cells or distributed antenna system (DAS) for the area. The height of power or light poles are not above the existing buildings in the area, so customers that do not have a line of sight to power poles will not have service or they will receive poor service. In this sense, Verizon Wireless has decided to build a 100 ft tower in order to provide service to all customers in the area.

Propagation Maps:

There are several methods for determining where coverage gaps exist within a given network of wireless sites. One of these is through the use of propagation maps. The propagation map is a computer simulation of the strength of Verizon Wireless signals at a given height and location in the context of the network. Propagation maps are one tool for determining whether a proposed site will meet the coverage objective and what antenna height is needed to provide robust service for Verizon Wireless customers. The radio propagation tool is designed to take factors such as terrain and tree coverage into account, and is calibrated with drive test data so that it depicts a reliable estimate of coverage that would be provided by a proposed site.

The propagation maps that follow show three levels of service, designated as the following colors:

Green = -80 dBm, a level of service adequate for providing reliable coverage inside a building

Yellow= -90 dBm, a level of service adequate for providing reliable coverage outdoors or inside a car

White= > -90 dBm, unreliable signal strength, not capable of reliably making and holding a call

Exhibit A is a propagation map that shows the existing level of coverage in the proposed service area in the context of surrounding Verizon Wireless sites.

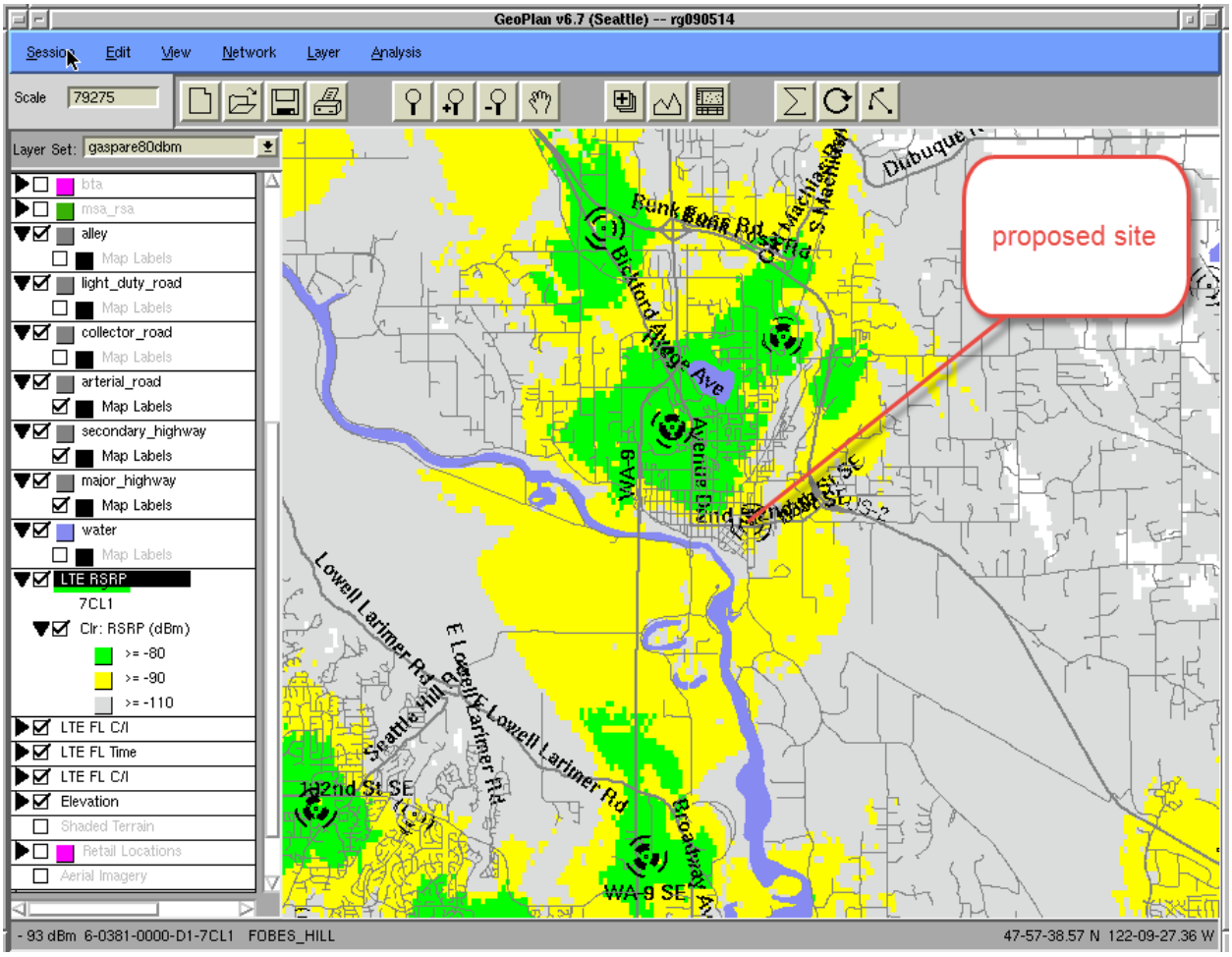
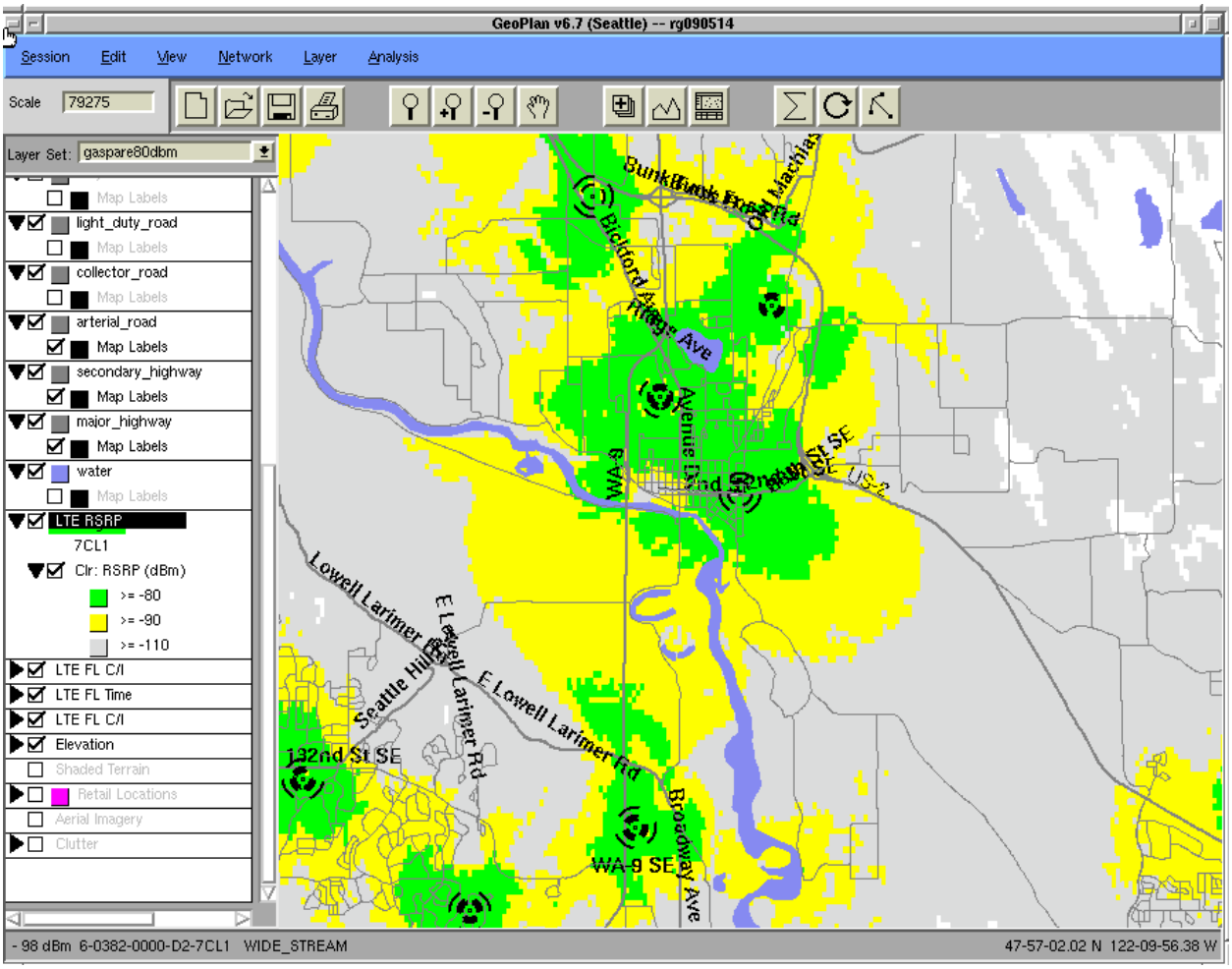


Exhibit B1 shows the level of service that would be provided with the proposed site with the antenna tip height of 100'.



The plot below marks the area that will still have poor service with the new site since antenna height of 100', at the new site, will not have a line of sight to the area.

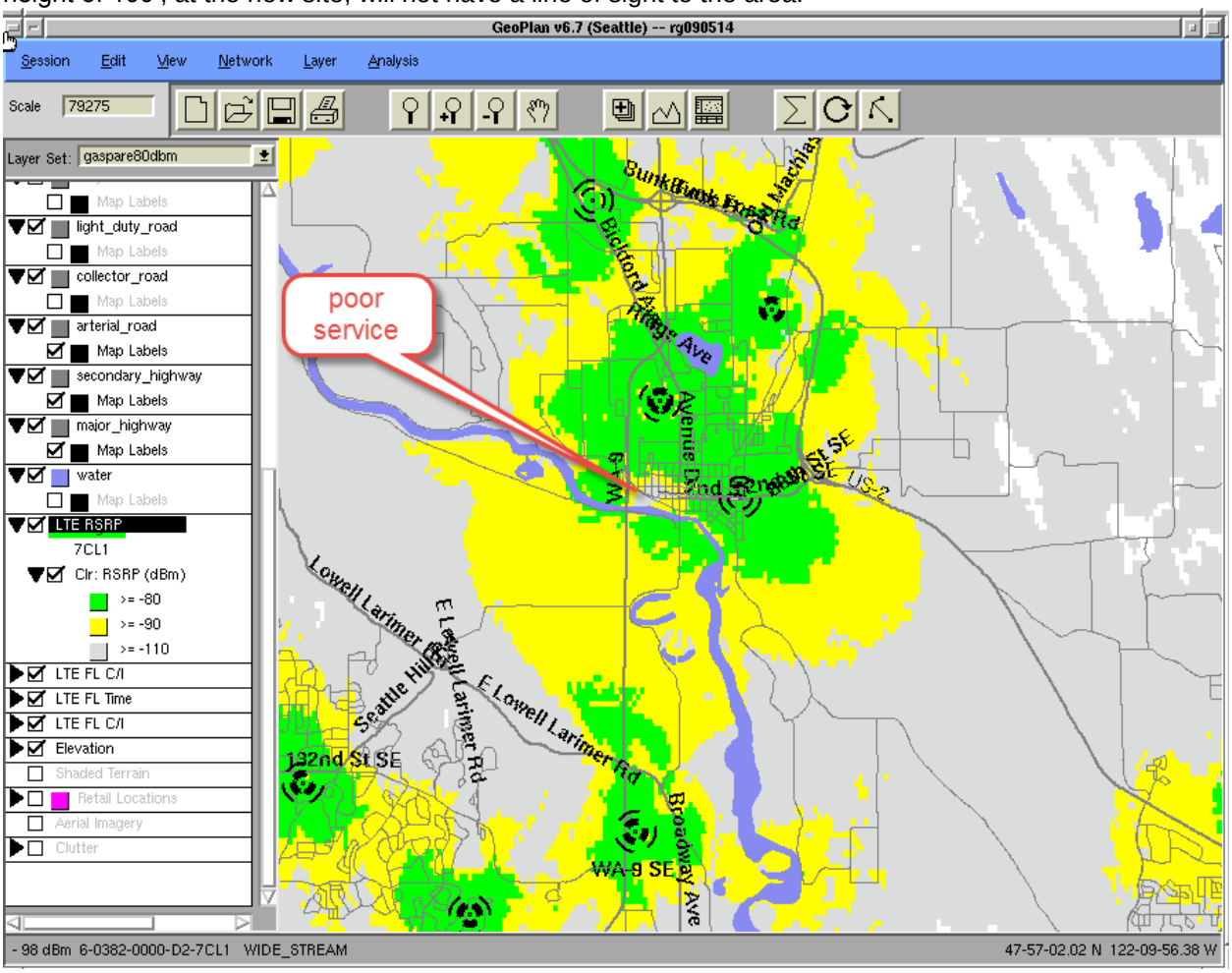


Exhibit B2 shows the level of service that would be provided with the proposed site with the antenna tip height of 80' that shows additional degradation of the coverage around of the new site since the area that used be covered with good signal (colored with green color) are now covered with only adequate signal (colored with yellow color)

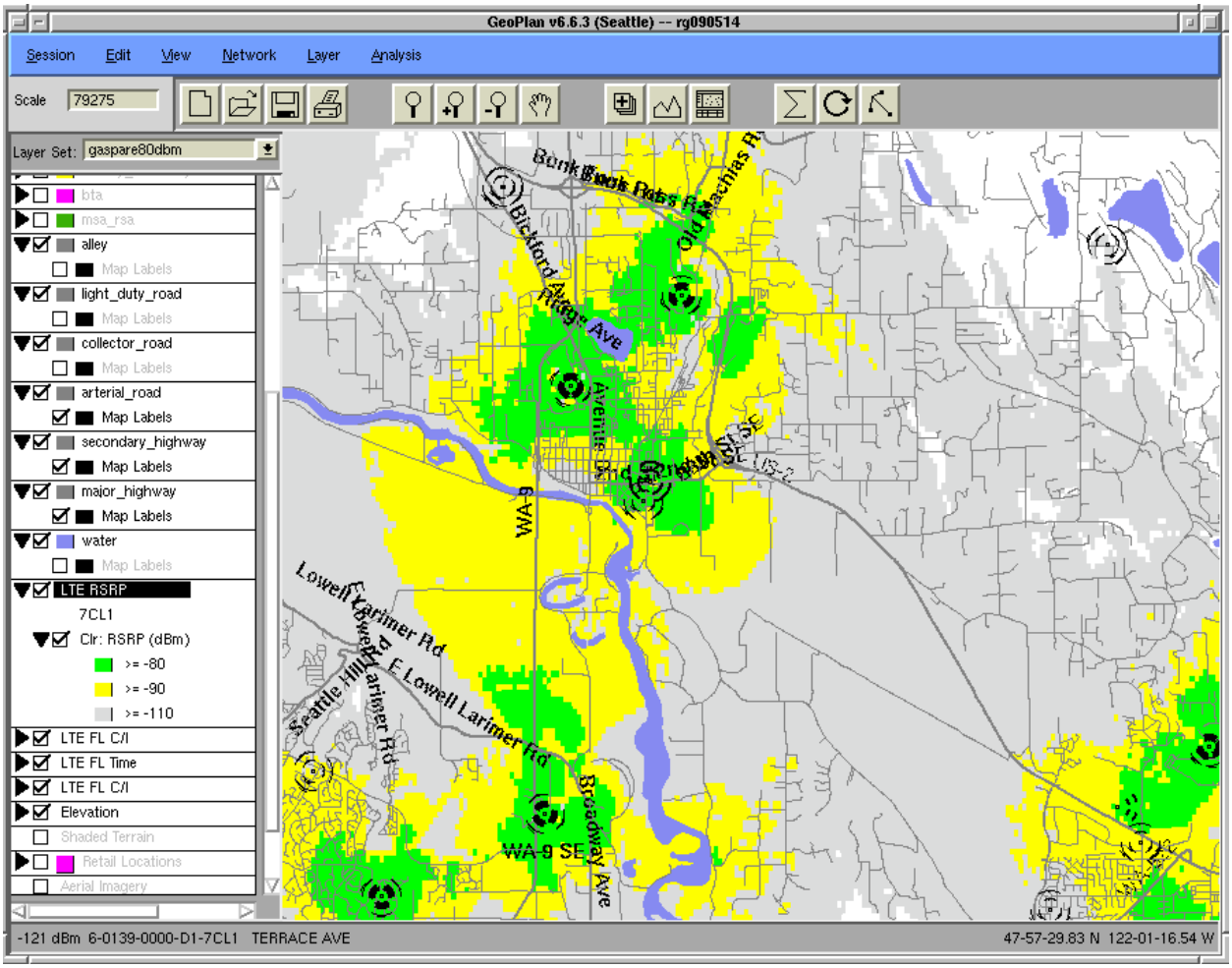


Exhibit B3 shows the level of service that would be provided with the proposed site with the antenna tip height of 60’ that shows additional degradation of the coverage around the new site since the area that used be covered with good signal (colored with green color) are now covered with only adequate signal (colored with yellow color)

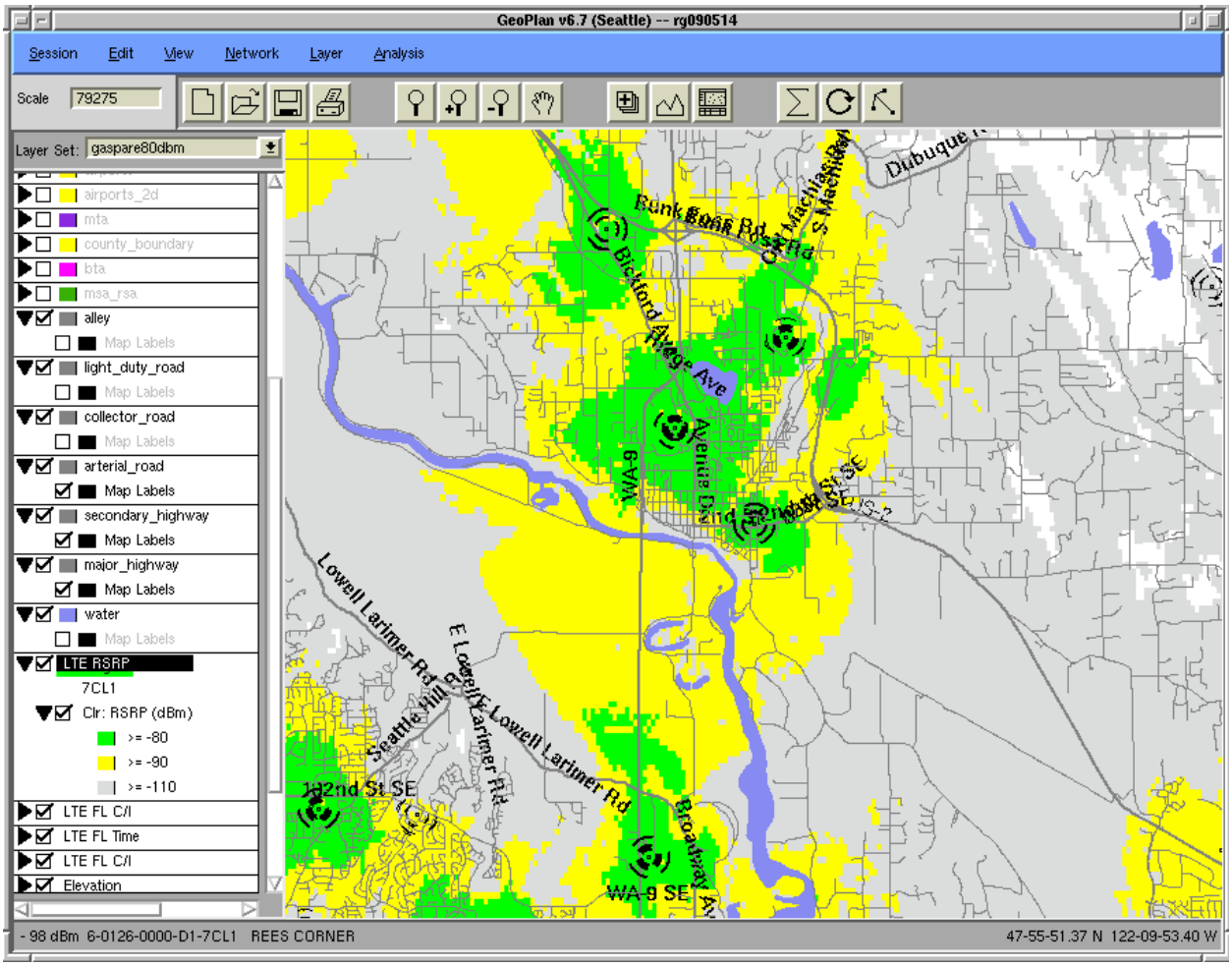
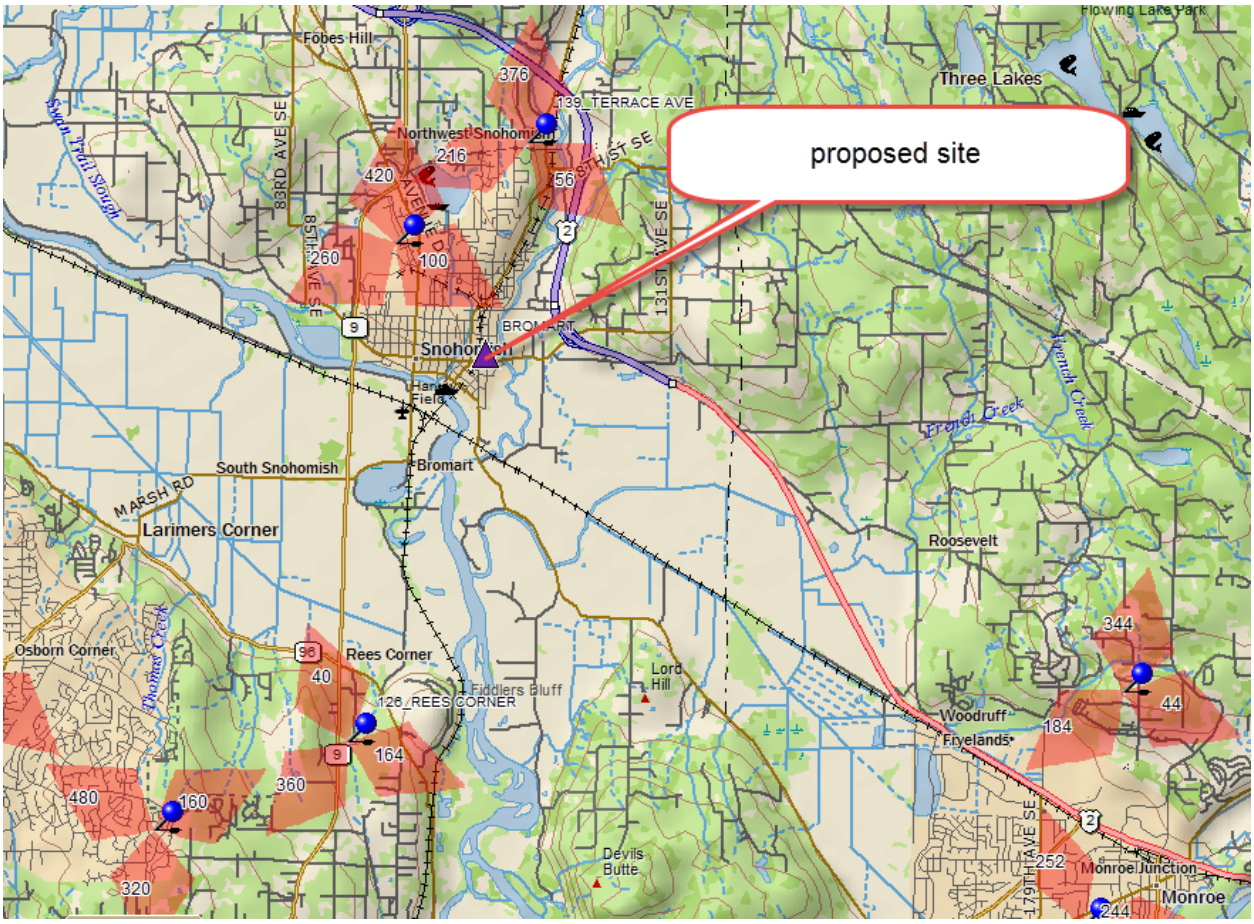


Exhibit 1C shows location of the existing Verizon Wireless sites in the area (shown as red polygons on the below map)



Capacity:

An additional function of some wireless sites is to provide additional capacity in an area. The capacity of wireless networks is limited by the number of available antennas and the radios associated with those antennas. When a mobile user attempts to make a call on a wireless network where capacity is limited by these factors, the resulting busy signal can be very frustrating. To remedy capacity issues, additional antenna sites are added to an area to provide additional calling capacity for Verizon Wireless customers.

Antenna Diversity:

Antenna diversity, also known as space diversity, is one method of enhancing wireless signal to improve the quality and reliability of a wireless link. Often, in cluttered environments such as the environment surrounding the subject site, there is not a clear line of sight between the antennas and customers' handsets. In these cases, the signal may be reflected along multiple paths before it finally reaches the receiver. These deflections can result in phase shifts, time delays, attenuations, and signal distortion that the customer may experience as an echo or warbling in the signal, or the signal dropping altogether.

Antenna diversity is especially effective at remedying these types of issues because multiple antennas provide several "observations" of the same signal. Each antenna will experience a different interference environment. So, for example, if one antenna is experiencing a deep fade, it is likely that another antenna in the same sector will have sufficient signal. Providing signal diversity then, is absolutely necessary for providing robust signal at the proposed location.

Wireless E- 911

Approximately 230,000 Wireless 911 calls are made every day nationwide, and this number continues to increase. (source: CTIA, the Wireless Association) Wireless E-911 service depends on reliable signal strength and a fairly dense network of antenna sites in order to function effectively. Because of our federally-mandated obligation to provide wireless E-911 service, ssignal reliability is paramount. Using multiple antennas with spatial diversity is an effective way to decrease the number of drop-outs and lost connections to ensure that coverage in this area is robust and reliable.

Summary:

In summary, the proposed site with antenna height of 100 feet would be marginally better than the 80' height. The proposed site with antenna height of 60' will provide poor service to the customers in the area. The height of the proposed antenna and the twelve antenna array is the minimum required for the effective functioning of the proposed wireless communication facility, as vegetation around the proposed site location is at or above 60 feet.

Sincerely,
Renald Gasparovic
Verizon Wireless