Cellular Voice Coverage in Rural Maine

An analysis of call performance and signal strength in the Bingham, Greenville, Jackman, Rangeley and Sedgwick telephone exchanges

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Office of the Public Advocate

24 February 2015

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Maine Office of the Public Advocate

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Acknowledgments

This study of cellular coverage performance in five rural exchanges in Maine was developed by:

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- William C. Black, Deputy Public Advocate

1.0 Executive Summary

1.1 TASK

This study was commissioned by the Maine Office of Public Advocate to examine the extent and quality of cellular voice coverage in five selected rural telephone exchanges in Maine—Bingham, Greenville, Jackman, Rangeley, and Sedgwick. Each of these exchanges lacks any wireline provider other than FairPoint Communications NNE (e.g., a cable provider). The objective of the study was to assess the availability of cellular voice service in these exchanges and its potential effectiveness as an alternative to traditional wireline voice service. To achieve this objective, Sewall:

- Evaluated the call completion rate, voice quality and cellular signal strength of calls placed within these exchanges using the available cellular voice services from three major cellular carriers—AT&T, US Cellular, Verizon; and
- Determined the highest level of cellular voice performance achieved by any carrier at all call locations within the exchanges.

This report presents results from the testing of cellular voice service conducted in the five rural exchanges during the months of December 2014 and January 2015. The findings provide current information on call performance of the three cellular carriers at specific test locations in each exchange and identify areas of no call completion and best call quality within the exchange. These findings also indicate those locations where customers have an alternative to wireline voice service in these five exchanges.

The collection, analysis and reporting of cellular voice data in this study is without bias or intention to endorse any specific carrier.

1.2 PROCESS AND METHODS

The process and methods used to select test locations and conduct the tests are outlined below:

Exchange and test locations selection

- Prior to field testing, the OPA identified five candidate exchanges that had little or no cable TV service and incomplete wireless coverage, based on data

from the ConnectME Authority broadband mapping project and the Maine Office of GIS. These locations were chosen to serve as a proxy for locations within the state without alternative wireline service.

- To preselect testing locations, the Sewall-Tilson team used Google Earth mapping software to identify clusters of homes and buildings. As a result, the selected sites represented the majority of households and businesses in each area, the sites were accessible, and the tests conducted in a cost-effective and safe manner.

Field testing

- Tests were performed from the center of the exchange area outward along major and minor highways in locations where housing existed. Terrain, tree growth, unplowed roads, and other potential radio frequency interference factors were considered and influenced the number, location and frequency of testing points. Some test locations were added while on location. Testing indoors was conducted utilizing public access buildings facilities.
- Consumer grade phones were used to conduct the tests so that results were based on the consumer's perspective.[1] To test voice and call quality performance, calls were placed that were in duration of at least one minute. Signal strength was recorded from the cellphones in dBm and ASU.[2] Data network performance was not gathered during these tests, only performance in regards to voice.
- All data was logged and points mapped for reporting purposes.

1.3 SUMMARY OF RESULTS

A summary of key findings from the testing and analysis follows. This information is based on the best results overall obtained at each location tested and does not reflect the performance of any individual carrier. Details, supporting data and maps—including location and carrier-specific performance–-are in the body of the report. Maps with additional detail on results by carrier are provided in the Appendices.

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[1] The phones used on the tests included the ZTE Model Z830 (AT&T), Motorola XT1019 (US Cellular), and Galaxy S4 (Verizon), a random and typical sampling of phones available on the commercial market.

[2] Signal strength received by a cellphone from the cellular network is measured in dBm (sometimes dBmW or decibel-milliwatts), which is the power ratio in decibels (dB) of the radio power per one milliwatt (mW). Arbitrary strength unit (ASU) is an integer value proportional to the received signal strength measured by the mobile phone.

Bingham

- Calls were completed from at least one carrier at 88 percent of locations tested in the Bingham exchange. Of the locations where calls were completed, 90.9 percent had clear voice connections, 4.5 percent had minor voice cracking (degraded voice quality), and 4.5 percent were of poor quality.[3]
- No calls were successfully completed by any carrier in Caratunk, the northernmost town in the exchange.

Greenville

- Calls were completed from all of the locations tested in the Greenville exchange from at least one carrier, and all of these calls were clear voice connections.

Jackman

- Calls were completed from at least one carrier at 93 percent of the locations tested in the Jackman exchange. Of the locations where calls were completed, 95 percent had clear voice connections, and 5 percent had minor voice cracking.
- No calls by any carrier were completed successfully in Sandy Bay Township, the northernmost town in the exchange, and in Johnson Mountain Township, the southernmost town in the exchange.

Rangeley

- Calls were completed from at least one carrier in 78.3 percent of the locations tested in the Rangeley exchange. Of the locations where calls were completed, all were able to obtain clear voice connections.
- No calls were successfully completed in 10 test locations in the exchange—7 in central and western Sandy River Plantation, 2 in Rangeley Plantation, and 1 in northwestern Dallas Plantation

Sedgwick

- Calls were completed from all the locations tested in the Sedgwick exchange from at least one carrier; 97.7 percent of these locations were able to obtain clear voice connections; 2.3 percent had minor voice cracking.

1.4 LIMITATIONS

While this study was intended to provide some baseline information to inform the OPA's approach to policies governing fixed wireline voice service, the scope of the

[3] A call was considered poor quality when it had frequent voice cracking or voice breakup, or when it was dropped or disconnected before call test time was completed.

testing by necessity limits the conclusions that can be drawn from the results. These limitations include:

- Nearly all of the locations tested were outdoors, and thus do not reflect the ability to complete a call or call quality inside a building. Thus the results do not show whether a call could be completed indoors at most of the locations tested, i.e., in a manner that reflects primary usage of fixed wireline voice service.
- The findings reflect results from testing during a discrete period of time from December 2014 to January 2015. Testing at different periods could yield different findings based on variations in foliage, weather, carrier maintenance or investment and other factors. The findings do not include information regarding the reliability of wireless voice service over time and other relevant service quality metrics.[4]
- The testing focused only on voice calls, though the fixed wireline network is used to provide many non-voice services for which wireless service may or may not provide a substitute.
- Similarly, the testing did not include evaluation of the ability to access the internet or data speeds. In many of the locations tested, the fixed wireline network also provides internet access via DSL.
- No testing of 911 location data was conducted.[5] [cite to FCC 911 location order]

1.5 CONCLUSIONS

The summary of results above and the detailed analysis that follows provide the basis for the following conclusions.

1. Rural areas of Maine are challenged by environmental factors that impact the reliability and quality of cellular voice service, including mountains, valleys, rock formations, vegetation and weather (particularly in winter). Major road corridors follow rivers and valleys between hills.

2. Of the five rural FairPoint exchanges tested in this study, two exchanges—Greenville and Sedgwick—appear to offer the ability to make a voice call

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[4] Historically the telecommunications industry has considered 99.999 percent of wireline voice calls completed (also known as the *five nines*) the standard of reliability. An equivalent standard for wireless performance is not yet established, however, and this study did not test to such a standard.

[5] The FCC recently adopted rules to assist emergency responders in locating wireless callers to 911, especially from calls made indoors. The new rules establish timelines for wireless providers to meet indoor location accuracy benchmarks for both horizontal and vertical location information. Fourth Report and Order (FCC 15-9), 3 February 2015. http://transition.fcc.gov/Daily_Releases/Daily_Business/2015/db0203/FCC-15-9A1.pdf

from all locations tested. These results suggest that cellular voice service in these two exchanges may provide an alternative to wired voice service.

3. Three of the five exchanges tested in this study— Jackman, Bingham and Rangeley—included locations where calls could not be completed on any carrier. In these locations, there is no acceptable alternative to wired voice service.

4. The maps depicting 3G and 4G coverage within these exchanges are not an accurate representation of the ability to complete a voice call. Calls were completed in many locations depicted without 3G/4G coverage, and calls could not be completed in some locations said to have 3G/4G coverage.

Overall, these results indicate that the availability of wireless voice service as an alternative to fixed wireless voice service can vary widely between exchanges and at locations within exchanges.

2.0 Introduction

Reliability and quality of cellular phone service (the ability to place and receive voice calls without interruption or failure) are determined by several interrelated factors, including the age and type of equipment infrastructure, antenna placement, the age and compatibility of cellphone devices, tower equipment maintenance, and signal strength, which is impacted by terrain, seasonal foliage, and other environmental influences. This section reviews major factors that affect cellular service performance, with a focus on the challenges to service in rural areas.[6] It also reviews specific factors that are likely to have impacted cellular performance in this study.

2.1 FACTORS INFLUENCING CELLULAR SERVICE PERFORMANCE

1. Equipment infrastructure design and installation. Base transceiver station (BTS) design is based on capacity—the number of mobile or cellphone devices the system must support—and coverage—the geographical area to be covered. In rural areas, with a smaller customer base, fewer devices can function optimally at the same time; performance is likely to degrade as the system reaches or exceeds designed capacity. In addition, the coverage area may not include all potential or unanticipated device users; service is likely to be disrupted as the device moves out of the designed covered area.

BTS transmit power and receiver sensitivity also affect the coverage area. Higher transmit power increases the distance a device can receive the signal. Higher receiver sensitivity increases the distance a mobile device can be "heard" by the BTS.

Last, antenna elevation and orientation can also affect system performance. Higher elevations often can cover greater distances. The manner in which cellular antennas are installed also play a critical factor in signal radius and performance. The height, down-tilt, array, and cellular frequency all have a direct effect on the signal radius.

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[6] Similar to internet access and availability, regional cellular phone service quality and reliability can be linked to its population. Findings suggest that the level of service is linked to the amount of potential billable customers—more robust in urban settings than in rural or remote areas.

These criteria are all determined by the carrier to best meet their network design goals.[7]

2. *Mobile device compatibility and obsolescence*. Customer cellphone devices must be compatible with the infrastructure discussed above. Older stations may not support newer devices and their ever-increasing functions; newer infrastructure may not support older mobile devices. In addition, available mobile devices differ in quality and performance; some operate better—quicker, further, and more reliably—than others. With constantly evolving technologies, whether tower or cellphone, performance is a constantly evolving metric. Maintenance of tower sites can also greatly impact the operational effectiveness of cellular services.

3. *Signal strength*. Proper signals at the proper levels are necessary for satisfactory cellphone device operation. Performance degrades as signal levels are decreased or (attenuated) by free-space loss, obstruction, interference, or a combination of some or all of these factors.

- Free-space loss: Free-space loss is the normal "fading" of a signal as it travels away from a transmitter. Like visible light, signals fade with distance; further distance equals weaker signal strength. Increasing the transmitter power may increase the effective range.

- Obstruction by absorption: Solid objects and anything containing water may decrease signal strength, such as vegetation, trees, foliage (changeable by seasons); glass, in some instances; terrain; and wood and concrete structures.

- Obstruction by reflection: Almost any light-reflective surface can cause obstruction by reflection, such as metal and metal structures and glass, in some instances.

- Interference: Interference includes conflicting "bad" signals in the area; multi-path fading; a "good" signal interfering with itself (when it is reflected and arrives at different times); and a too-strong signal, which can degrade performance as well.

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[7] To access the network, AT&T uses a mobile phone standard entitled Global Service for Mobile (GSM) and US Cellular and Verizon use a method entitled Code Division Multiple Access (CDMA). Although GSM and CDMA standards differ, these differences would not necessarily influence the results as much as other factors, such as the location of the network towers, the power of the signal, or terrain. Neither did the study pinpoint performance based on one or the other. The technology used is far less important to call quality than the way the service carrier built the network.

4. *Operating location*: Outdoor and indoor environments present challenges to system performance. As stated above, cellphone users encounter problems any time the path to the service provider's antenna is obstructed. Outdoor challenges can be compared to late sunset—hills, mountains, valleys, rock formations, and even vegetation block the direct sunlight to valleys and depressions. Although some light exists in these low-lying areas, it is not sufficient to accomplish certain common tasks. Many of the major road corridors follow rivers and valleys between hills; numerous travelers experience service disruptions in these areas. Flat and open areas free of obstructions offer the best cellphone performance.

Several factors can impact signal quality while indoors, such as building type (concrete, brick, wood), location (distance from the source, angle from the source), and height. A cellular signal has less penetration with cement and brick than it does with a structure made of wood, which absorbs a significant amount of the signal. Location is a factor as well. The further the signal has to travel, the weaker it becomes. Last, height is a factor. A single-story home surrounded by trees is likely to have an obstructed signal, whereas a three-story home is likely to have a better signal at the top level versus at the lower levels. Any time that line of sight is obstructed, whether by foliage, tree branches, or buildings, some degree of signal degradation occurs between the device and signal source.

With all the variables to consider, it is impractical to draw hard conclusions on indoor versus outdoor performance. That said, the indoor signal is less likely to be as strong as an outdoor signal.

2.2 FACTORS INFLUENCING PERFORMANCE IN THIS STUDY

Several factors affected cellular signal performance during the testing phase of this project. First, the testing was conducted during winter conditions, which included unplowed roads and trees without foliage. Although cellular is designed for signals to penetrate obstructions such as inclement weather, degradation to the link still occurs.

Second, most tests were conducted at locations without line of sight to a cellular tower and with obstructions, such as mountains, hills, valleys, thick vegetation, and other elements. Testing was performed primarily in the vicinity of residential and commercial buildings to mimic the highest percentage of calls being placed and consistent with state policies supporting universal telephone service.

Third, two tests were conducted inside a building. It is to be expected that further cellular signal degradation occurred within these structures. Each building structure is unique, however, and the impact cannot be estimated without its own signal test for maximum accuracy.

3.0 Survey Results & Analysis

Results from the testing of cellular voice service in five rural exchanges in Maine—Bingham, Greenville, Jackman, Rangeley, and Sedgwick—are presented in this section. The findings provide current information on call performance of three cellular carriers at specific test locations in each exchange and identify areas of best call quality within the exchange.

Performance for each call was analyzed using four criteria of measurement: clear voice, minor voice cracking, poor quality call, or no signal. This information is detailed below by carrier, summarized, and mapped to show the best call quality available at locations within each exchange. Strength of the received signal per call is also detailed by carrier and summarized to indicate approximate overall signal strength within the exchange.

The objective of this analysis is to assess the reliability of wireless service in the five rural exchanges, not to endorse any specific carrier.

3.1 BINGHAM EXCHANGE

Cellphone coverage testing in the Bingham exchange was conducted at 25 outdoor locations in the following areas:

- Bingham (all of the town)
- Caratunk
- Moscow
- Concord Township (NE quadrant)
- Pleasant Ridge Plantation (eastern half)
- Forks Plantation (small section along the southern boundary).[8]

A total of 75 field tests were conducted, 25 tests for each of the three cellular providers within the region: AT&T, US Cellular and Verizon.

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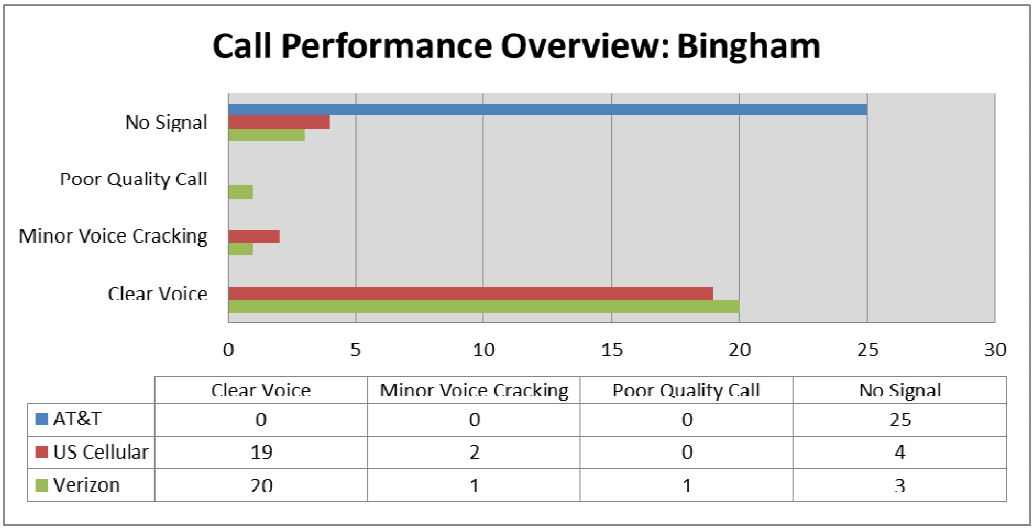
[8] Tests originally planned in the Pleasant Pond area of Caratunk and the Forks Plantation were not conducted due to lack of vehicle access. In addition, no signal was received in the central Caratunk town. Given that recent cellular tower data showed no nearby towers, this area was also excluded.

As shown in Figure 3-1, results of the tests indicate:

- None of the AT&T calls placed (0 out of 25) achieved a connection
- 76 percent of US Cellular calls (19 out of 25) had a clear voice connection
- 80 percent of Verizon calls (20 out of 25) had a clear voice connection



	Clear Voice	Minor Voice Cracking	Poor Quality Call	No Signal
AT&T	0	0	0	25
US Cellular	19	2	0	4
Verizon	20	1	1	3

Figure 3-1: Call Performance Overview: Bingham Exchange

This information is supported by the approximate strength of received signals observed and tallied for each carrier cellphone in the exchange.[9] Figure 3-2, for example, shows that at the time 25 calls were attempted using AT&T service, no signal bars were evident.

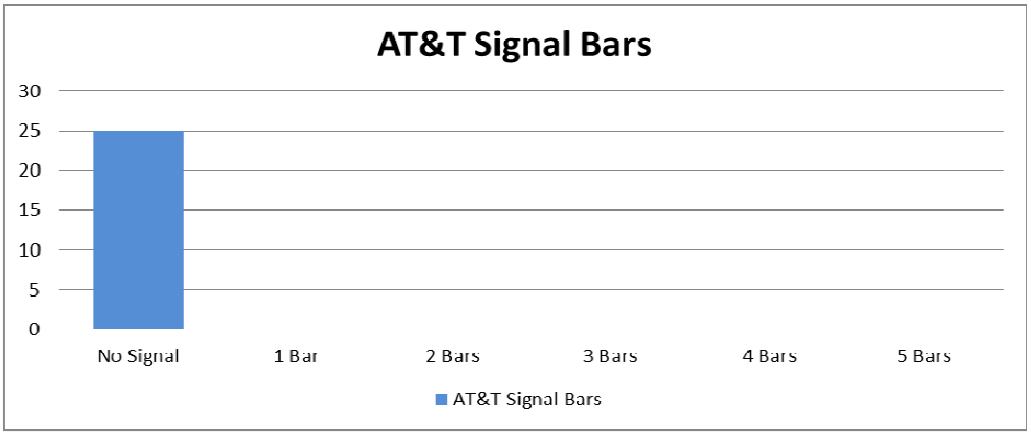


Figure 3-2: AT&T Signal Bars in the Bingham Exchange

[9] Most mobile phones display a set of five bars of increasing height to indicate the approximate strength of the signal received by the phone from the cellular network. In this analysis, signal bars are used to reveal overall signal strength in an area. Low bars do not in every case signify weak reception, or high bars, strong reception.

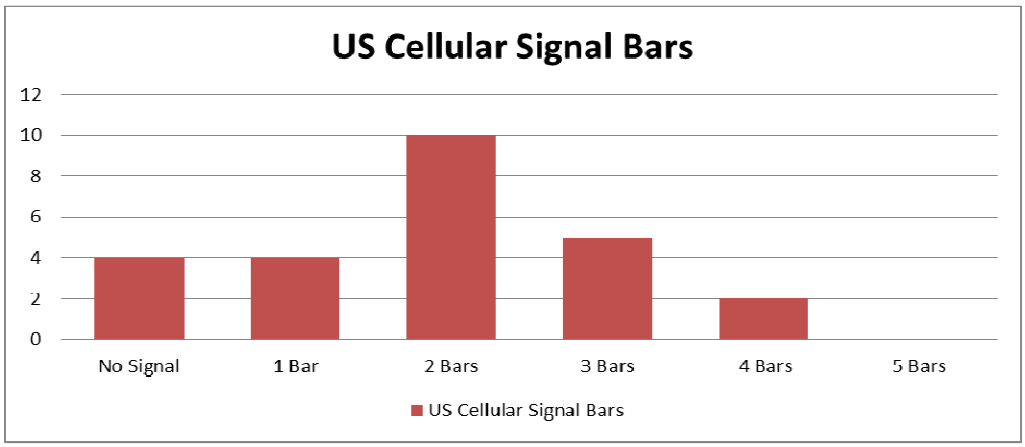


Figure 3-3: US Cellular Signal Bars in the Bingham Exchange

Two bars were observed on 10 calls conducted using US Cellular, 3 bars on 5 calls, and 4 bars on 2 calls. Signal strength on calls using Verizon was observed to be somewhat higher, with 9 calls at 3 bars, and 6 calls at 5 bars (Figure 3-4).

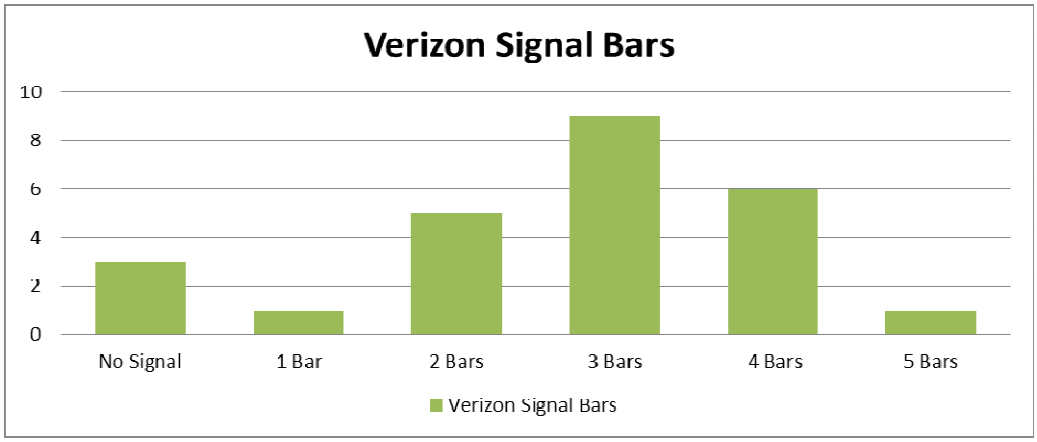


Figure 3-4: Verizon Signal Bars in the Bingham Exchange

Figure 3-5 shows the best call quality that was achieved by any of the carriers at each call location in the Bingham exchange.[10] No calls were successfully completed in Caratunk, the northernmost town in the exchange, from any carrier. Among all carriers, the highest level of call completion in the exchange was 88 percent (22 out of 25 locations); 90.9 percent of which were clear voice connections (20 out of 22), 4.5 percent had minor voice cracking (1 out of 22), and 4.5 percent was of poor quality (1 out of 22).

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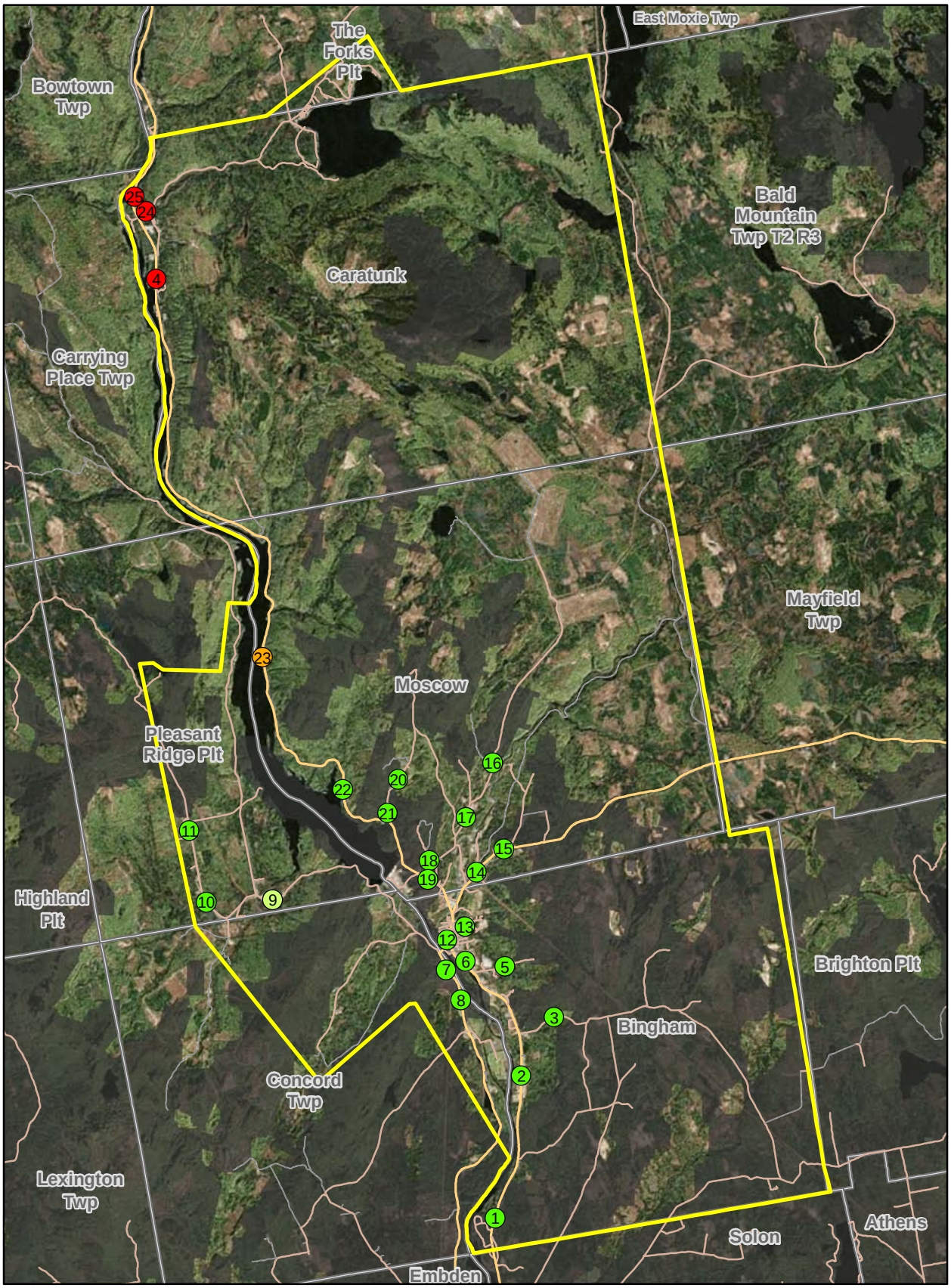
[10] Gray-shaded areas on Figure 3-5 indicate 3G or 4G mobile broadband coverage, based on ConnectME Authority broadband mapping. The parameters of mobile broadband coverage differ from cellular voice coverage, however, and voice coverage tests conducted outside the shaded areas show call performance of good quality.

Exchange Analysis: Bingham

Test Site Best Call Quality From AT&T, US Cellular and Verizon



Call Quality

- Clear Voice
- Minor Voice Cracking
- Poor Quality Call
- No Signal - No Call

Exchange Boundary

3G/4G Coverage

- AT&T, US Cellular and Verizon
- Town Boundary

Road Category

- Secondary
- Local
- Private

N W E S

0 1 2 4 Miles

Sources: Test Points - Tilson Technologies
Wireless broadband coverage - ConnectME Authority
Basemap - Esri, DigitalGlobe, GeoEye, I-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swIsstopo, and the GIS User Community

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Maps showing the call performance of each carrier at test locations in the Bingham exchange are provided in the Appendix (Figures A-1–A-3).

3.2 GREENVILLE EXCHANGE

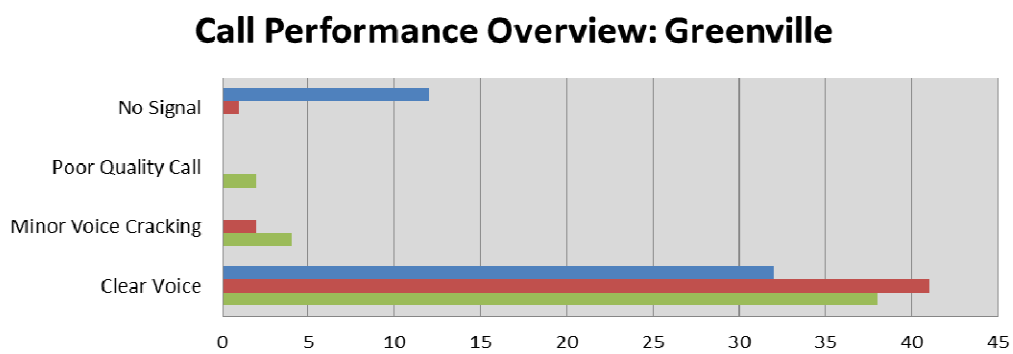
Cellphone coverage testing in the Greenville exchange was conducted at 44 outdoor locations in the following areas:

- Greenville (all of the town)
- Lily Bay Township
- Moosehead Junction Township
- Shirley
- Beaver Cove (western half)
- Big Moose Township (eastern half)
- Frenchtown Township (western three-fourths)
- Piscataquis County Island (southern islands)

A total of 132 field tests were conducted, 44 each using AT&T, US Cellular and Verizon service.

As shown in Figure 3-7, results of these tests indicate:

- 72.7 percent of AT&T calls (32 out of 44) had a clear voice connection
- 93.2 percent of US Cellular calls (41 out of 44) had a clear voice connection
- 86.4 percent of Verizon calls (38 out of 44) had a clear voice connection



	Clear Voice	Minor Voice Cracking	Poor Quality Call	No Signal
AT&T	32	0	0	12
US Cellular	41	2	0	1
Verizon	38	4	2	0

Figure 3-6: Call Performance Overview: Greenville Exchange

Signal strength in the exchange overall appears to be relatively high as compared to the other exchanges (Figures 3-7–3-9).

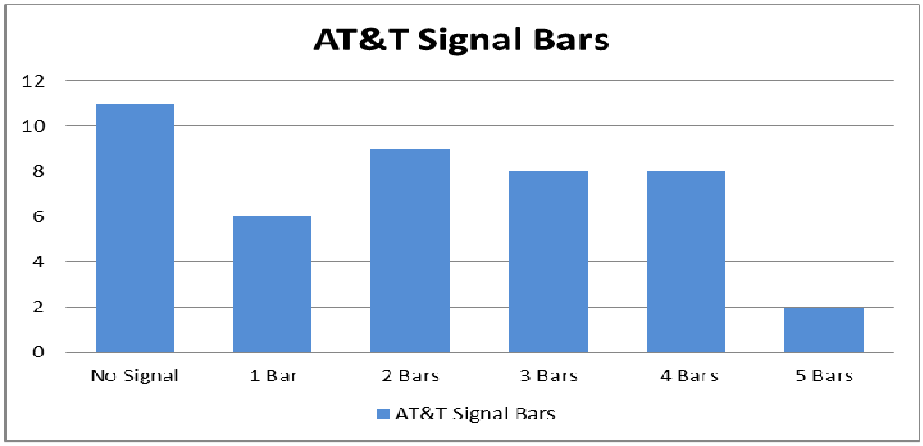


Figure 3-7: AT&T Signal Bars in the Greenville Exchange

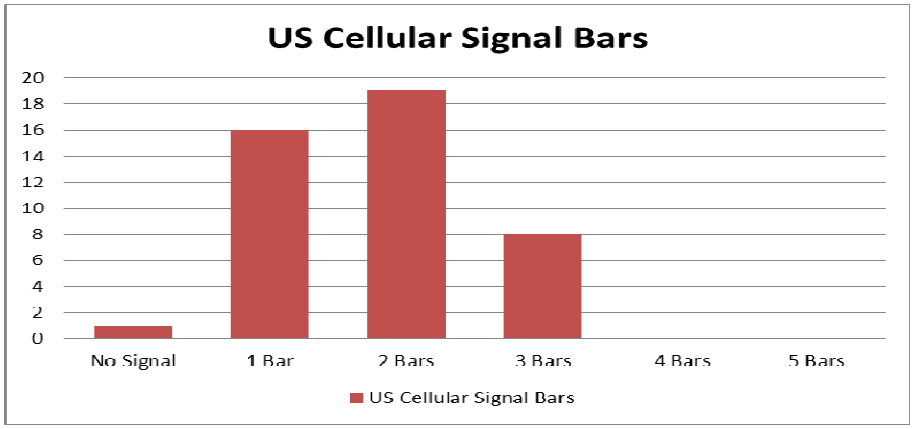


Figure 3-8: US Cellular Signal Bars in the Greenville Exchange

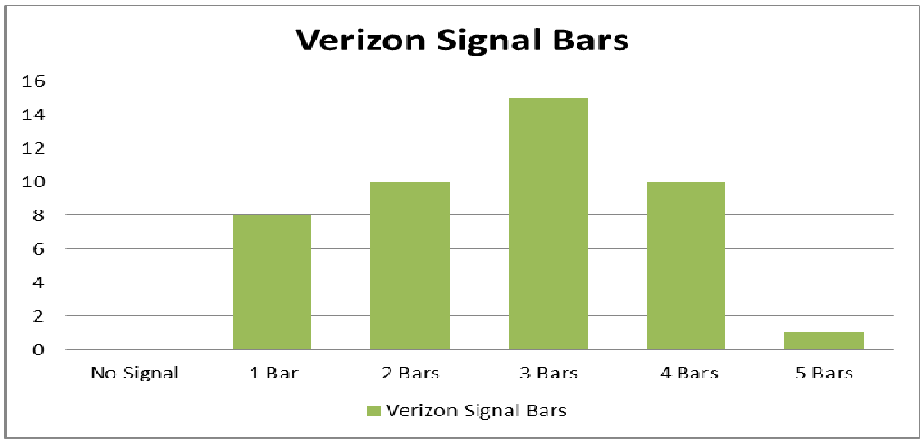
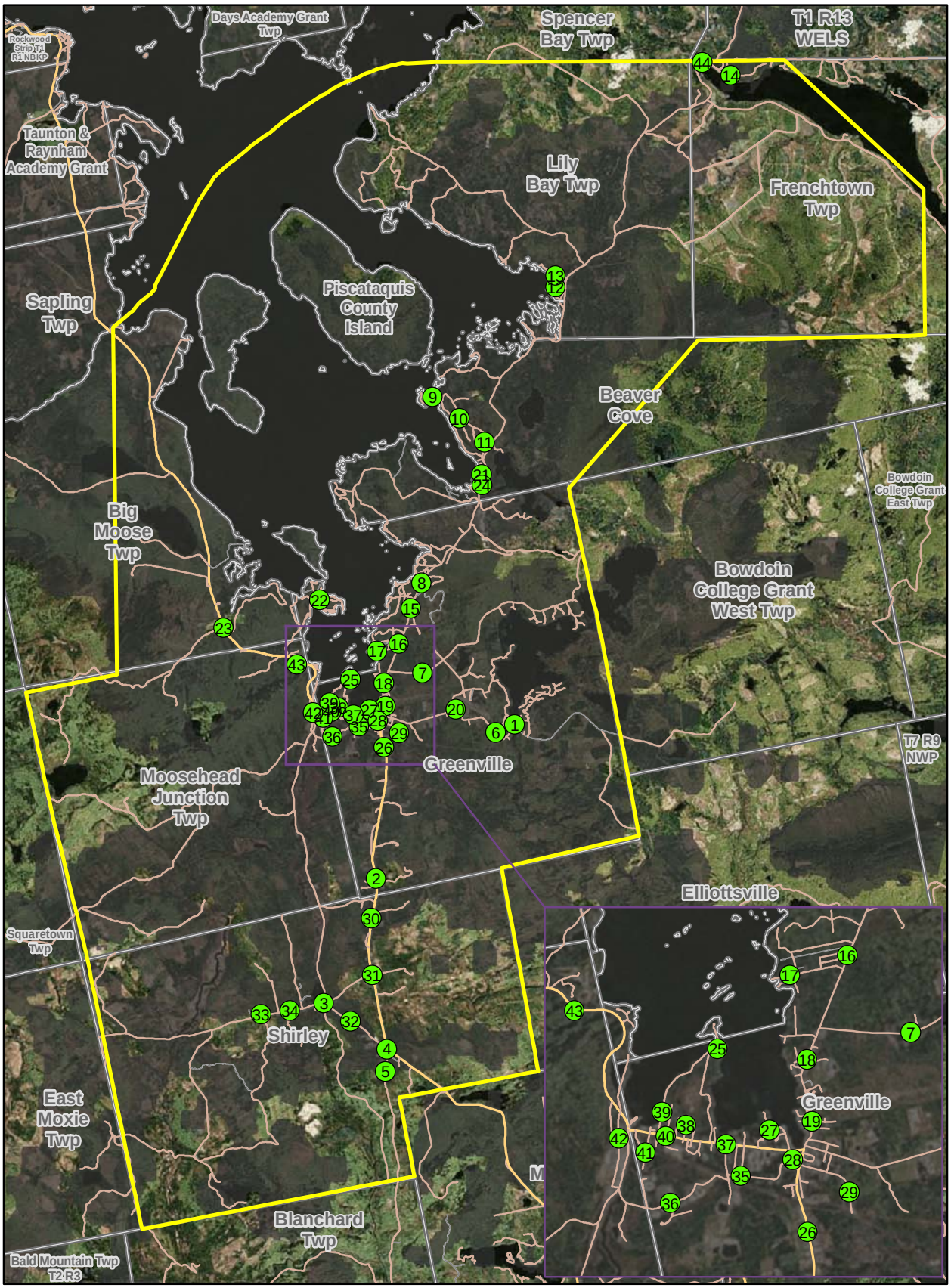


Figure 3-9: Verizon Signal Bars in the Greenville Exchange

All 44 test locations had at least one call with a clear voice connection from one of the carriers (Figure 3-10). Among all carriers, voice coverage was thus 100 percent (44 out of 44), with 100 percent clear voice connections.

Exchange Analysis: Greenville

Test Site Best Call Quality From AT&T, US Cellular and Verizon



Call Quality
- Clear Voice
- Minor Voice Cracking
- Poor Quality Call
- No Signal - No Call

Exchange Boundary

3G/4G Coverage
- AT&T, US Cellular and Verizon
- Town Boundary

Road Category
- Secondary
- Local
- Private

N W E S

0 1.25 2.5 5 Miles

Sources: Test Points - Tilson Technologies
Wireless broadband coverage - ConnectME Authority
Basemap - Esri, DigitalGlobe, GeoEye, I-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swIsstopo, and the GIS User Community

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Maps showing the call performance of each carrier at test locations in the Greenville exchange are provided in the Appendix (Figures A-4–A-6).

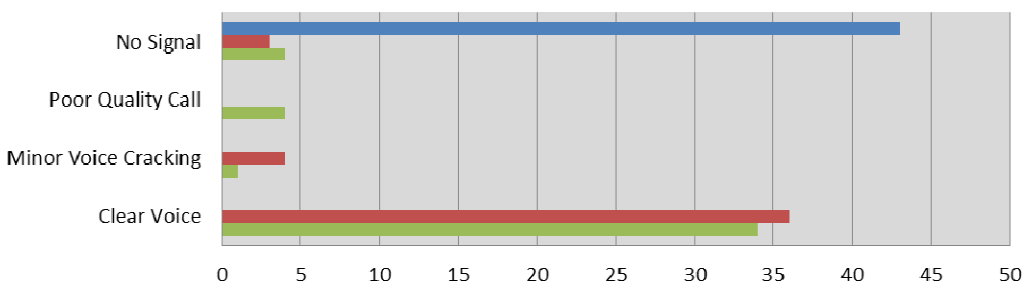
3.3 JACKMAN EXCHANGE

Cellphone coverage testing in the Jackman exchange was conducted at 43 outdoor sites in the following areas:

- Jackman (all of the town)
- Johnson Mountain Township
- Long Pond Township
- Parlin Pond Township
- Sandy Bay Township
- Attean Township (northeast corner)
- Bald Mountain Township T4 R3 (small portion of southwest corner)
- Dennistown Plantation (northeast half)
- Misery Gore Township (western tip)
- Moose River (western half)
- Upper Enchanted Township (small section eastern boundary)

A total of 129 outdoor field tests were conducted, 43 each for each of the three carriers. Results of the tests indicate the following (Figure 3-11):

- None of the AT&T calls (0 out of 43) achieved a connection
- 83.7% of the US Cellular calls (36 out of 43) had a clear connection
- 79.1% of the Verizon calls (34 out of 43) had a clear connection



	Clear Voice	Minor Voice Cracking	Poor Quality Call	No Signal
AT&T	0	0	0	43
US Cellular	36	4	0	3
Verizon	34	1	4	4

Figure 3-11: Call Performance Overview: Jackman Exchange

Signal bar strength of each of the carriers is shown in Figures 3-12–3-14. These results in general support the results in call performance.

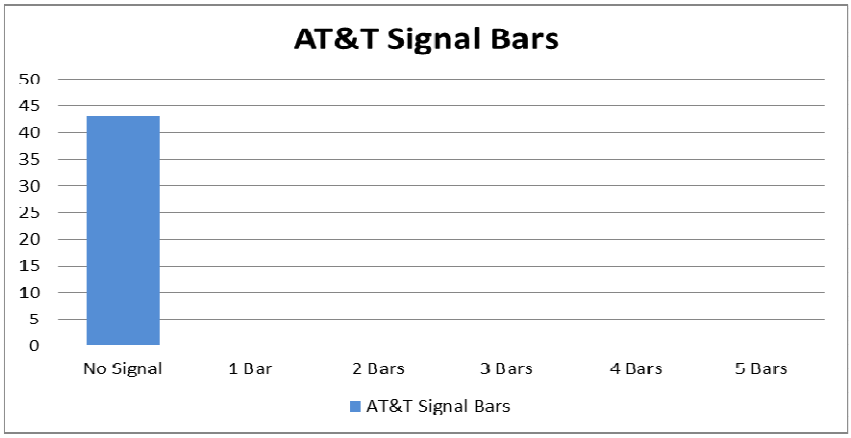


Figure 3-12: AT&T Signal Bars in the Jackman Exchange

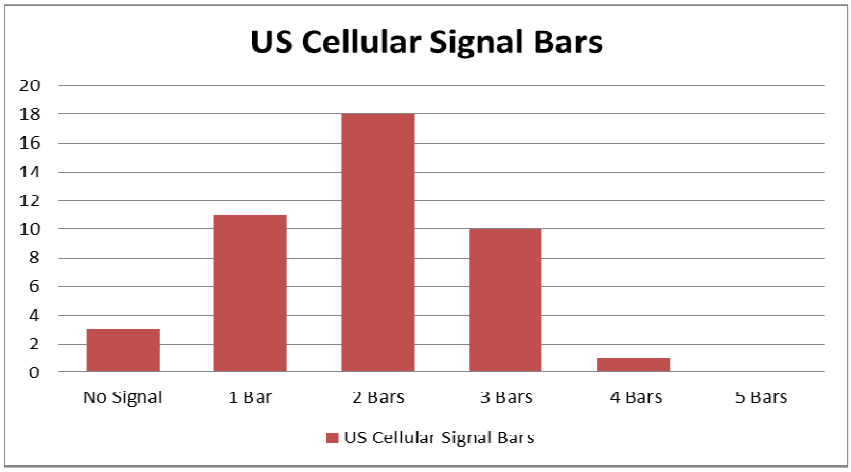


Figure 3-13: US Cellular Signal Bars in the Jackman Exchange

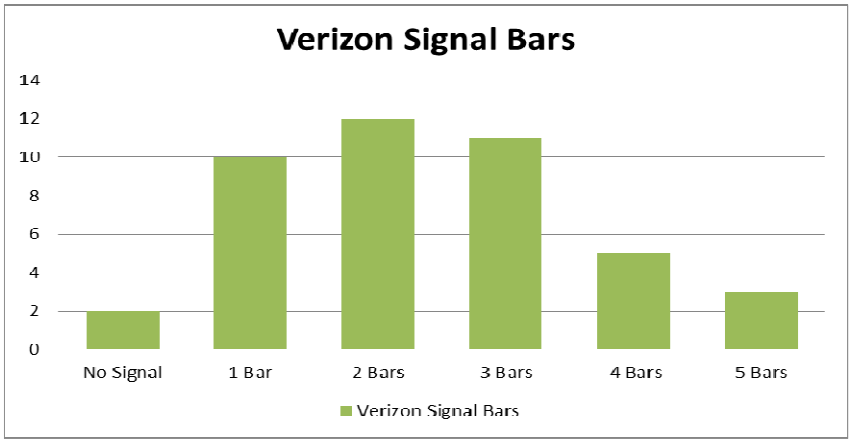
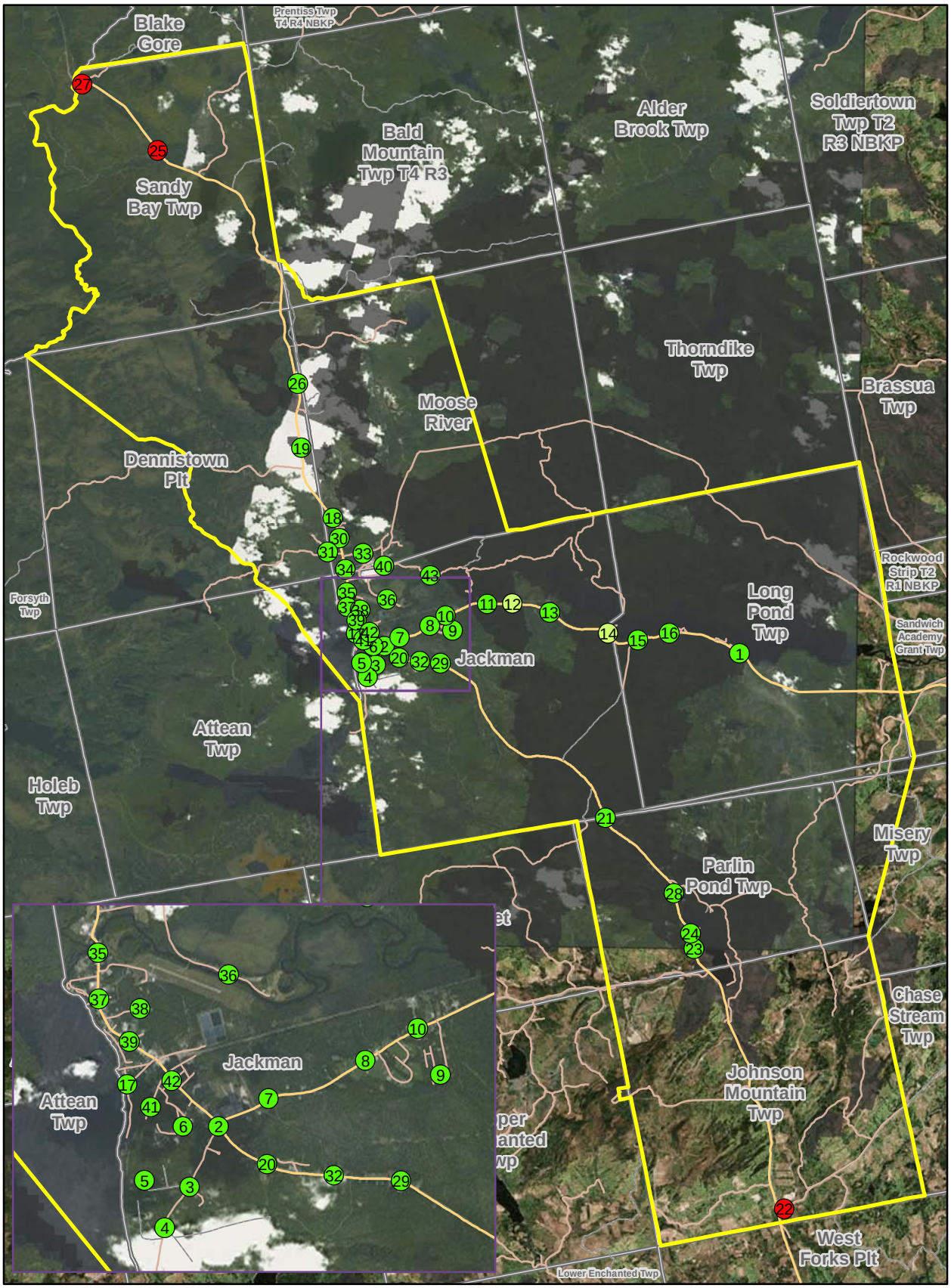


Figure 3-14: Verizon Signal Bars in the Jackman Exchange

Exchange Analysis: Jackman

Test Site Best Call Quality From AT&T, US Cellular and Verizon



Call Quality
- Clear Voice
- Minor Voice Cracking
- Poor Quality Call
- No Signal - No Call

Exchange Boundary

3G/4G Coverage
- AT&T, US Cellular and Verizon
- Town Boundary

Road Category
- Secondary
- Local
- Private

N W E S

0 1.25 2.5 5 Miles

Sources: Test Points - Tilson Technologies
Wireless broadband coverage - ConnectME Authority
Basemap - Esri, DigitalGlobe, GeoEye, I-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swIsstopo, and the GIS User Community

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As Figure 3-15 shows, no calls by any carrier were completed successfully in Sandy Bay Township (2 locations), the northernmost town in the Jackman exchange. Neither was any call completed in Johnson Mountain Township (1 location), the southernmost town in the exchange. Two calls of degraded quality (minor voice cracking) were completed in Jackman.

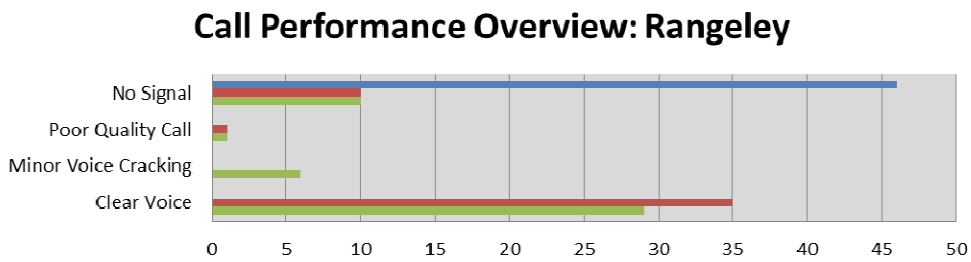
Among all carriers, the highest level of call completion in the Jackman exchange was 93 percent (40 out of 43 locations), 95 percent of which were clear voice connections (38 out of 40), and 5 percent had minor voice cracking (2 out 40).

Maps showing the call performance of each carrier at test locations in the Jackman exchange are provided in the Appendix (Figures A-7–A-10).

3.4 RANGELEY EXCHANGE

Cellular voice coverage testing in the Rangeley exchange was conducted at 46 outdoor locations in the following areas:

- Rangeley (all of the town)
- Dallas Plantation[11]
- Davis Township
- Rangeley Plantation
- Sandy River Plantation
- Adamstown Township (northeast corner)
- Lang Township (all except northeast corner)
- Lower Cupsuptic Township (eastern third)
- Stetsontown Township (southwest corner)



	Clear Voice	Minor Voice Cracking	Poor Quality Call	No Signal
AT&T	0	0	0	46
US Cellular	35	0	1	10
Verizon	29	6	1	10

Figure 3-16: Call Performance Overview: Rangeley Exchange

[11] Tests originally planned in the Gull Pond area of Dallas Plantation were excluded due to lack of vehicle access.

A total of 138 field tests were conducted, 46 each for the three carriers. Results of the tests indicate the following (Figure 3-16):

- None of the AT&T calls (0 out of 46) achieved a connection
- 76.1 percent of US Cellular calls (35 out of 46) had a clear voice connection
- 63.0% of Verizon calls (29 out of 46) had a clear voice connection
- All three carriers shared the same 10 test locations with no signal/no connection

Signal bar strength of each of the carriers is shown in Figures 3-17–3-19. Although the signal bars indicate that Verizon signal strength was greatest in the test areas, US Cellular had the higher percentage of clear voice call connections.

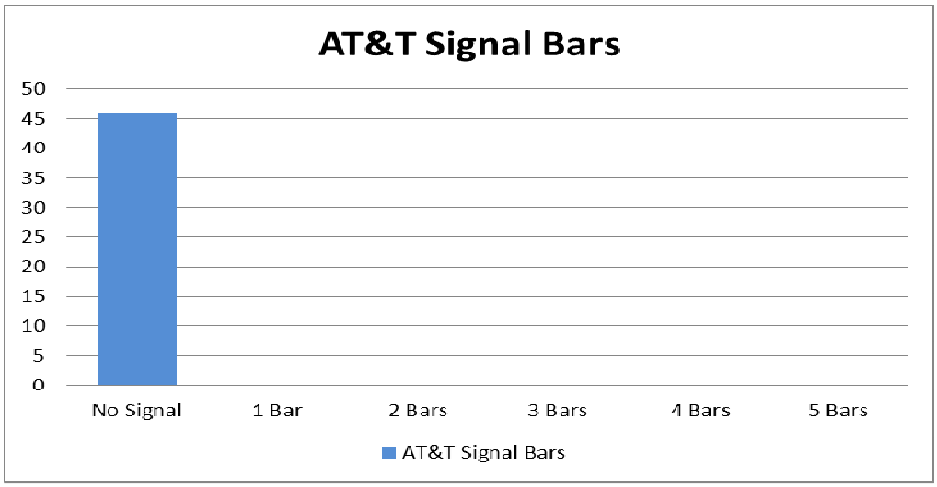


Figure 3-17: AT&T Signal Bars in the Rangeley Exchange

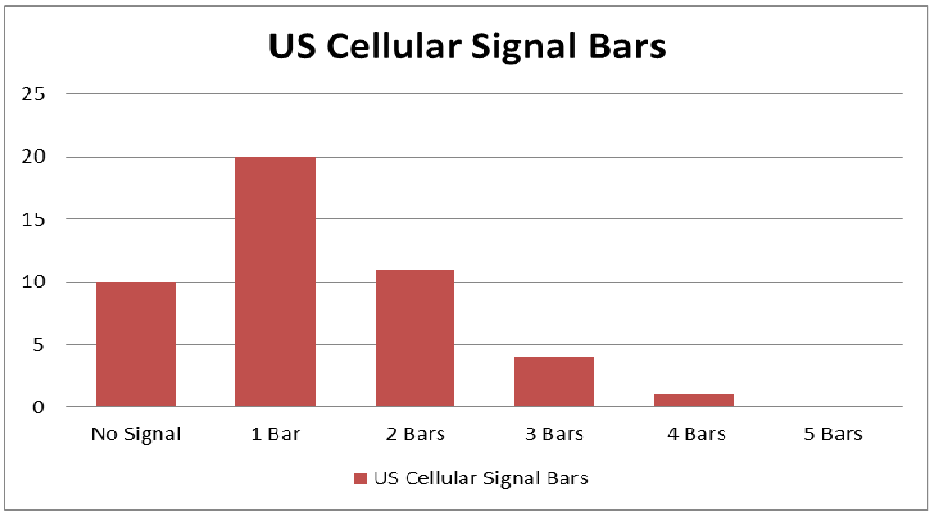


Figure 3-18: US Cellular Signal Bars in the Rangeley Exchange

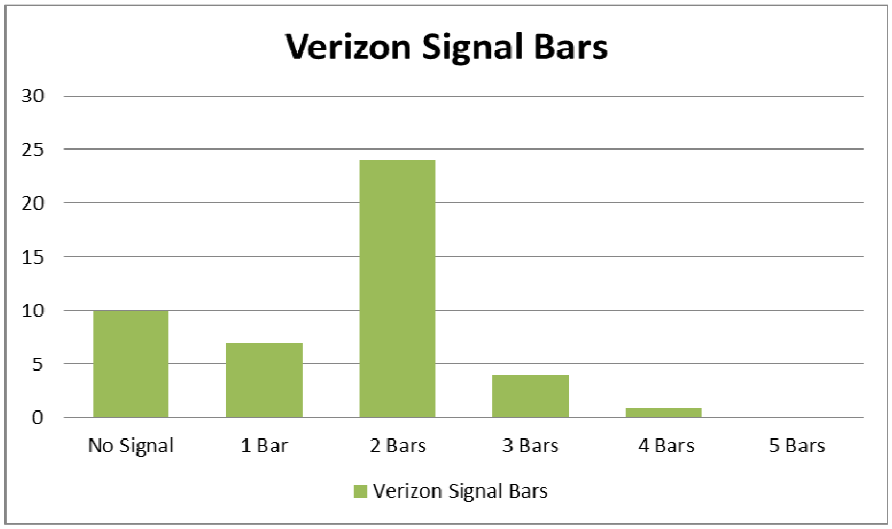


Figure 3-19: Verizon Signal Bars in the Rangeley Exchange

As Figure 3-20 shows, no calls were successfully completed in 10 test locations of the exchange (7 in central and western Sandy River Plantation, 2 in Rangeley Plantation, and 1 in northwestern Dallas Plantation). Among two carriers, the remaining 36 calls were completed with clear voice connections. The highest level of call completion in the Rangeley exchange was thus 78.3 percent (36 out of 46 locations), 100 percent of which were clear voice connections.

Maps showing the call performance of each carrier at test locations in the Rangeley exchange are provided in the Appendix (Figures A-11–A-13).

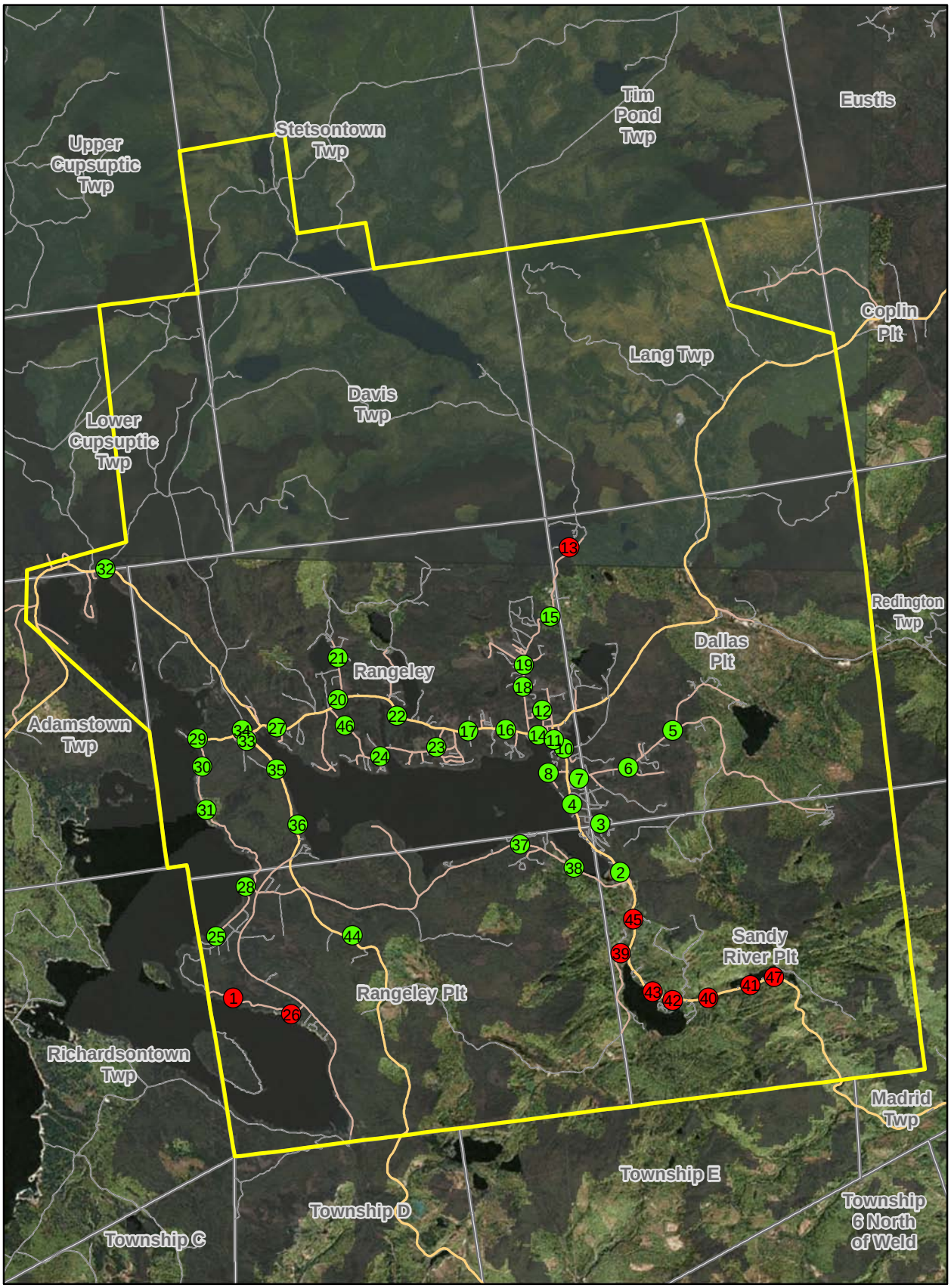
3.5 SEDGWICK EXCHANGE

Cellular coverage testing in the Sedgwick exchange was conducted at 43 call locations, two of which were indoors, in the following areas:

- Brooklin (all of the town)
- Sedgwick (all but the northwest corner)
- Brooksville (southeast corner)
- Tremont (westernmost islands)

Exchange Analysis: Rangeley

Test Site Best Call Quality From AT&T, US Cellular and Verizon



Call Quality
- Clear Voice
- Minor Voice Cracking
- Poor Quality Call
- No Signal - No Call

Exchange Boundary

3G/4G Coverage
- AT&T, US Cellular and Verizon
- Town Boundary

Road Category
- Secondary
- Local
- Private

N W E S

0 1.25 2.5 5 Miles

Sources: Test Points - Tilson Technologies
Wireless broadband coverage - ConnectME Authority
Basemap - Esri, DigitalGlobe, GeoEye, I-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swIsstopo, and the GIS User Community

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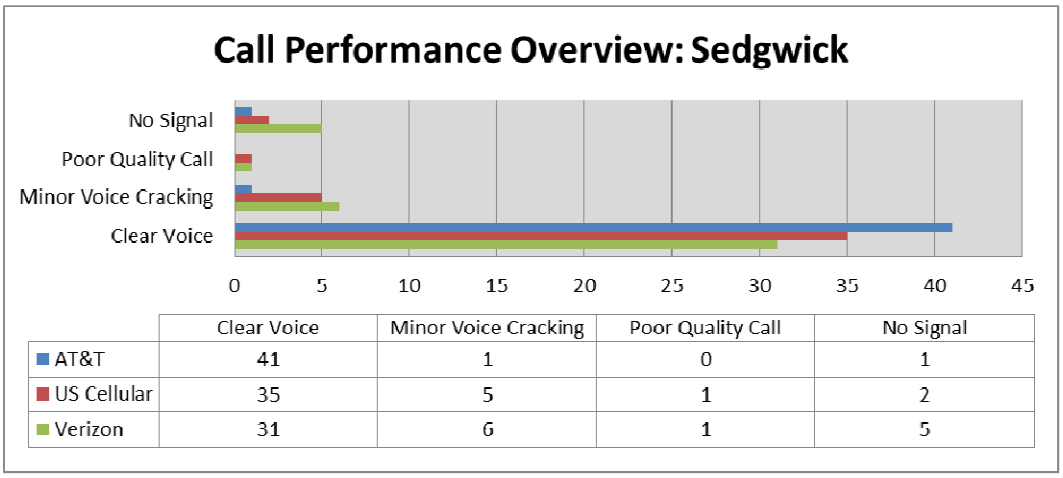
A total of 129 tests were conducted, 43 for each carrier, with the following results (Figure 3-21):

- 95.3 percent of AT&T calls (41 out of 43) had a clear voice connection
- 81.4 percent of US Cellular calls (35 out of 43) had a clear voice connection
- 72.1 percent of Verizon calls (31 out of 43) had a clear voice connection



	Clear Voice	Minor Voice Cracking	Poor Quality Call	No Signal
AT&T	41	1	0	1
US Cellular	35	5	1	2
Verizon	31	6	1	5

Figure 3-21: Call Performance Overview: Sedgwick Exchange

Signal bar strength of each of the carriers in this exchange, shown in Figures 3-22–3-24, is relatively high.

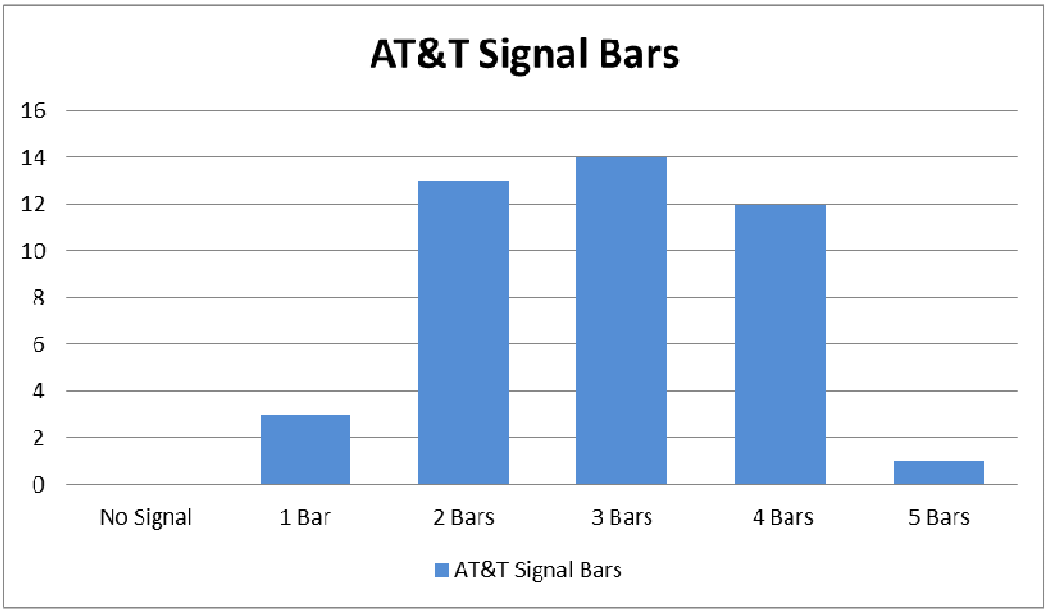


Figure 3-22: AT&T Signal Bars in the Sedgwick Exchange

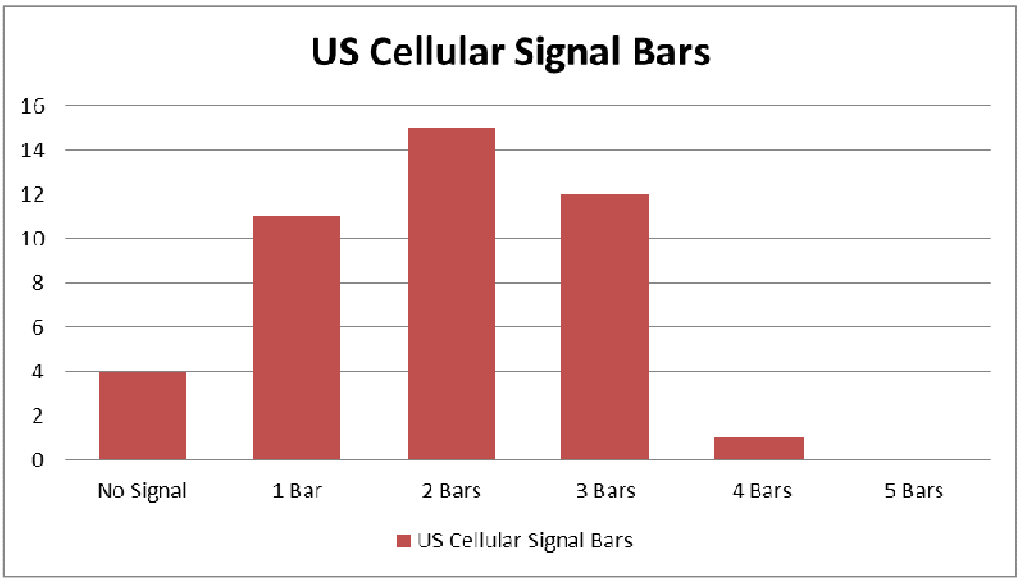


Figure 3-23: US Cellular Signal Bars in the Sedgwick Exchange

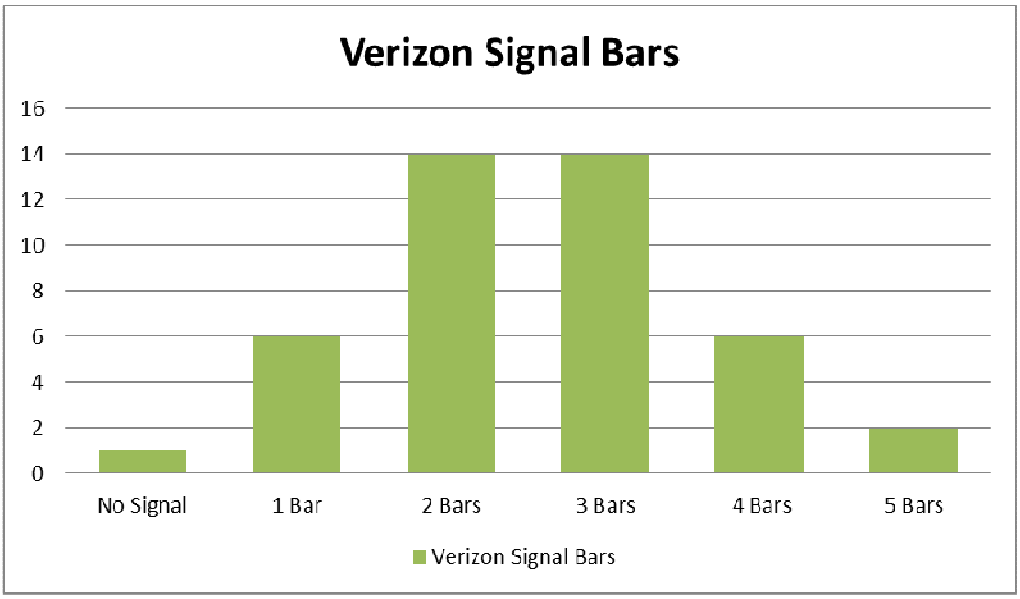
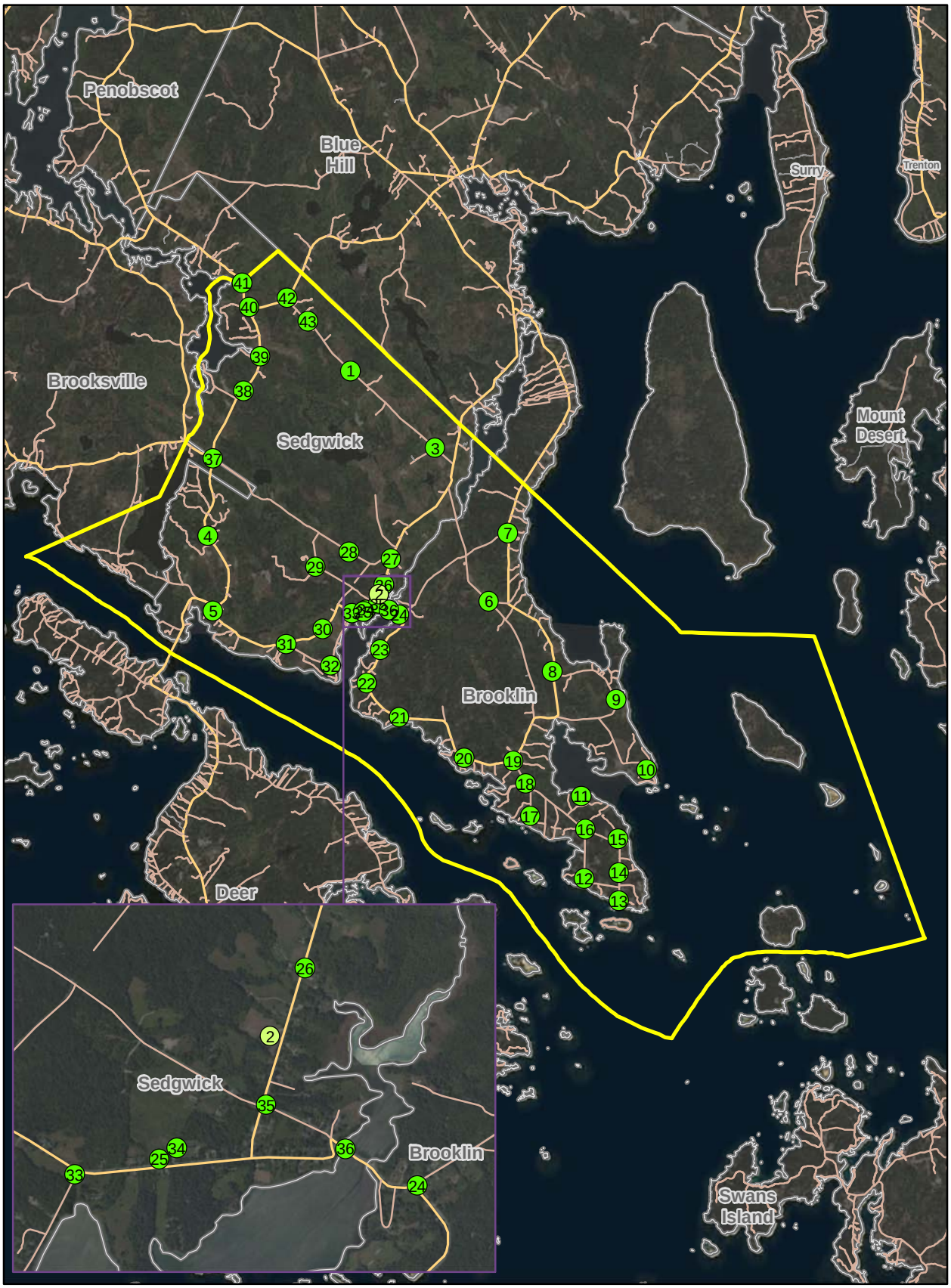


Figure 3-24: Verizon Signal Bars in the Sedgwick Exchange

As Figure 3-25 shows, 42 out of 43 test locations had at least one call with a clear voice connection from one of the carriers. The test location with minor voice cracking was inside the town office building. The highest level of call completion among all carriers in the Sedgwick exchange was 100 percent (43 out of 43 locations), 97.7 percent of which were clear voice connections (42 out of 43); 2.3 percent of which had minor voice cracking (1 out of 43).

Exchange Analysis: Sedgwick

Test Site Best Call Quality From AT&T, US Cellular and Verizon



Call Quality

- Clear Voice
- Minor Voice Cracking
- Poor Quality Call
- No Signal - No Call

Exchange Boundary

3G/4G Coverage

- AT&T, US Cellular and Verizon
- Town Boundary

Road Category

- Secondary
- Local
- Private

N W E S

0 1 2 4 Miles

Sources: Test Points - Tilson Technologies
Wireless broadband coverage - ConnectME Authority
Basemap - Esri, DigitalGlobe, GeoEye, I-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swIsstopo, and the GIS User Community

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Maps showing the call performance of each carrier at test locations in the Sedgwick exchange are provided in the Appendix (Figures A-14–A-16).

3.6 SUMMARY

A summary of the highest level of completed call performance among all carriers achieved in each exchange is shown in Table 3-1:

Table 3-1: Summary of Completed Call Performance Among All Carriers by Exchange

Exchange	Calls Completed (%)	Clear Voice (%)	Minor Voice Cracking (%)	Poor Quality Call (%)
Bingham	88%	90.9%	4.5%	4.5%
Greenville	100%	100%	--	--
Jackman	93%	95%	5%	
Rangeley	78.3%	100%	--	--
Sedgwick	100%	97.7%	2.3%	--