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March 7, 2014

Jeff Clymer
Chairman-Acton Planning Board
472 Main Street
Acton, MA 01720

RE: Response to Isotrope Report on Coverage Analysis of 5 Craig Road Tower Application dated January 23, 2014

Dear Chairman:

The following is in response to Isotrope's report of January 23, 2014, regarding the SBA/AT&T application for a tower at 5 Craig Road. As a point of introduction, I am a radiofrequency (RF) Engineer for C Squared Systems, LLC and have been contracted by AT&T Mobility to provide supplemental radio frequency support for this Application.

I have reviewed the data submitted to date by both AT&T and the Town's consultant, Isotrope Wireless ("Isotrope"), including but not limited to: the narratives, coverage plots and drive test data. I have also had further discussions with the AT&T RF design engineers regarding: the existing sites in Acton and the neighboring communities, the proposed "Site", AT&T's existing coverage, the October 3, 2013 baseline drive test data and AT&T's objectives and network requirements for this area of Acton. Based on these discussions and the data submitted by AT&T, C Squared Systems completed additional propagation analyses and prepared supplemental coverage plots for review and consideration by Isotrope and this Board.

The supplemental report contained herein addresses the materials previously submitted by AT&T, the above referenced report prepared by Isotrope on January 23rd, and the *Memorandum on Drive Test Flaw* submitted by Isotrope to Attorney Sousa on January 22, 2014.

We hope that the information contained in the attached Supplemental Report will satisfy the questions and issues raised by Mr. Maxson and that we anticipate the Town of Acton will look favorably upon this application.

Sincerely;

A handwritten signature in black ink, appearing to read 'Dan Goulet'.

Dan Goulet
C Squared Systems, LLC
Contractor to AT&T Mobility



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Supplemental RF Report

SBA/AT&T Proposed Wireless Facility

MA-11845-S

5 Craig Road
Acton, MA 01720
(AT&T Site MA1037SA)

March 7, 2014

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- Exhibit 3: Existing AT&T 1900 MHz PCS Coverage (All Sectors Active)
- Exhibit 4: Composite AT&T 1900 MHz PCS Coverage with Proposed Craig Rd @ 95 Ft.
- Exhibit 5: Best Server Existing AT&T 1900 MHz PCS
- Exhibit 6: Best Server AT&T 1900 MHz PCS final Configuration with Proposed MAU1037A Craig Rd.

1. Background and Technology Evolution

AT&T provides digital communications voice and data services using 3rd Generation (3G) UMTS technology in the 800 MHz and 1900 MHz frequency band, and is in the midst of deploying advanced 4th Generation (4G) services over LTE technology in the 700 MHz, PCS and AWS frequency bands as allocated by the FCC. As part of their network expansion and enhancement in Massachusetts and elsewhere in the Country, the 4G LTE network rollout will build on the existing 3G data services that utilize UMTS technology.

AT&T currently provides 3G UMTS services in Acton and the neighboring area utilizing both the 800 MHz cellular frequency and the 1900 MHz PCS frequency bands. The base platform for their 3G UMTS was their 800 MHz cellular band but over time the incremental increase in voice and data usage and the increased demand for and expectation of competitive speeds exhausted the available 800MHz spectrum. AT&T's only option was to utilize the 1900 MHz PCS band as an overlay platform to address the ongoing network capacity issues in the market.¹

With the evolution of 4G LTE technology and services, AT&T, like other wireless service providers, purchased the additional spectrum needed to deploy their 4G LTE services. The only remaining spectrum available was the 700 MHz, 1900 MHz, AWS (1.7 GHz and 2.15 GHz) and WCS (2.3 GHz) frequency bands.

It is important to note that while AT&T also holds some licenses in the lower 700 MHz band, which has similar propagation characteristics as that of the 800 MHz cellular band, the LTE pilot signals transmit at a much lower power (ERP) and therefore one should not assume that the 700 MHz LTE coverage will be identical to that of the 800 MHz UMTS coverage. It should also be noted that even though the 4G LTE pilot power is lower, the corresponding 4G LTE receive thresholds are also lower. Similarly, the AWS and WCS operating frequency bands are higher than the 1900 MHz PCS band and will produce a smaller LTE coverage footprint than the 1900 MHz.

For the reasons stated above, the plots and signal thresholds presented by AT&T for their existing 3G UMTS network showing a coverage gap within Acton at PCS frequencies actually understate the gaps that will exist when they deploy their 4G LTE service at 1900, 2150 and 2300 MHz bands.

AT&T's goal is to design and maintain a wireless network that will meet the needs and expectations of its users. This includes meeting customer demand for quality voice and high-speed data services. In order to provide competitive service, AT&T must continue to be responsive to changes in the wireless industry and to proactively work to accommodate usage patterns and demand. While 3G speeds may have been acceptable in the past, users today expect 4G services and AT&T is committed to meeting that demand.

Due to the terrain characteristics and the distance between the targeted coverage area in Acton and the existing sites, AT&T's options are quite limited to address the coverage gaps identified within the Town. In order for AT&T's LTE network to function effectively, there must be adequate but not excessive overlapping coverage between the "serving cell" and adjoining cells. This not only allows access to the network, but once connected allows for the transfer or "hand-off" of calls from one cell to another, and prevents unintended disconnections and slow data rates or "high latency". AT&T's 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 poor voice quality, dropped and blocked calls, slow data connections and transmissions, or no wireless service at all. These areas are commonly referred to as "coverage gaps".²

The latter addresses the "significant gap" criteria of the Town's bylaw and whether or not it is sufficient to consider only the PCS spectrum without consideration of the other frequency bands employed by AT&T i.e., the 700 MHz and cellular bands.³

¹ Today, customers expect low latency and faster data speeds as evidenced by increasing data usage trends and customer demand.

² It should be noted that in addition to providing the needed fill-in network coverage and connectivity, AT&T is providing enhanced services for Public Safety and meeting E911 compliance for the Commonwealth of Massachusetts.

³ AT&T is no longer deploying GSM and 2G services.

2. AT&T Coverage Plots and Drive Test Data

The predictive coverage plots presented by AT&T at the January 7th meeting were intended to represent their existing and planned 1900 MHz 3G UMTS coverage and their planned 1900 MHz 4G LTE coverage for the area. The plots presented show that there are substantial gaps in coverage along the Route 2 corridor, Wetherbee St, Hosmer St, School St, Laws Brook Rd, Parker St, Concord Rd and several other residential areas in the western part of Acton, herein referred to as the “Targeted Coverage Area”. The baseline drive test of AT&T’s existing 1900 MHz UMTS network, performed on October 3, 2013, confirms the existence of these substantial gaps in coverage within the “Target Coverage Area” described above.

3. Independent Review and Findings

In response to the January 22, 2014 Memorandum on Drive Test Flaw and the January 23, 2014 Report on Coverage Analysis submitted by Isotope, C Squared Systems (“C Squared”) performed an independent review of all the data and materials submitted to the Town by both AT&T and the Town’s consultant. These materials included the narratives, coverage plots, existing and proposed site information, and the original drive test data. The following describes our findings based upon the completion of this review and further investigation.

3.1 Drive Test Data and Coverage Plot Inconsistencies

In Mr. Maxson’s memorandum of January 22, his statement noting that inconsistencies exist between the drive test data and the predictive coverage mapping is valid. However, his assumption that these inconsistencies are due to flawed drive test data is not valid. The inconsistencies are the result of misinformation regarding the surrounding two sites, Post Office Square in Acton (MAU3371) and Annursnac Hill in Concord (MAU3403), that serve portions of Main St (Route 27), Great Road, Nagog Hill Rd and other areas north of the “Targeted Coverage Area”.

A thorough review of the UMTS pilot information contained within the October 3, 2013 drive data and the site information submitted to Isotope, showed that the beta sector of site MAU3371 (Post Office Square) was not transmitting. This sector serves portions of Great Road, Esterbrook Road, Old Village Road and neighboring residential areas within Acton. This sector however does not reach Route 2 or the areas of Acton defined by the “Targeted Coverage Area”.

The attached Exhibit 1 shows the October 3, 2013 drive data over the predictive coverage of AT&T’s 1900 MHz PCS network, based on the information originally provided to Isotope.⁴ As can be seen in this plot, the predicted coverage along Great Road, southwest of the Post Office Square site, does not agree with the drive data, as noted by the consultant. Further inquiries to AT&T revealed that the one sector of Post Office Square (beta at 140°) was not transmitting the day of the drive test.

The attached Exhibit 2 shows the drive test data over the regenerated predicted coverage, with the beta sector off-air. As can be seen in this plot, the pilot signal levels of the drive test data align very well with the predicted coverage. This plot shows that the drive test data is accurate and presented actual network conditions at the time of the drive test. This plot also serves to verify the accuracy of the propagation model used by C Squared to complete our analyses.⁵

⁴ All coverage plots provided within this report were prepared by C Squared Systems, LLC using tuned propagation models for this geographic area.

⁵ No adjustments were made to the October 3, 2013 drive data used in the exhibits contained within this report.

3.2 Coverage Plot Inconsistencies

The second key point of the consultant's analysis and relative to the same general area is his valid assumption that the gamma sector of MAU3403 (Annursnac Hill in Concord) was either not transmitting or, that the sector was oriented in a direction different from the azimuth reported by AT&T. Our analysis of the drive test data supported the consultant's assumption. Upon presenting our pilot plots and the other information to AT&T, it was learned that the sector orientation information provided to the consultant for MAU3403 (30°, 150°, and 270°) was inaccurate. The actual sector azimuths confirmed by AT&T are 120°, 210° and 330°. The drive data validates the latter.

The attached Exhibit 2 (reference above) was generated using the correct azimuths for Annursnac Hill in Concord. As shown in this exhibit, with the site configuration corrections in place, the predicted coverage aligns with the October drive test data collected. Furthermore, the drive test data serves to validate the propagation model used to complete this analysis and subsequent analyses contained within this report. (Reference Table 1 of Attachments for updated site and sector information.)

4. Coverage Analysis

Exhibit 3 titled: "Existing AT&T 1900 MHz UMTS PCS Coverage (All Sectors Active)" shows the predicted coverage of the existing sites in Acton and the surrounding communities, at the thresholds used by AT&T for in-building and in-vehicle service. Note that Exhibit 3 and subsequent exhibits assume the beta sector of Post Office Square has been placed back in service.

As noted earlier in this report, while AT&T also holds licenses in the 700 MHz and 2150 MHz (AWS) frequency bands, the LTE pilot signals transmit at a much lower ERP due to the bandwidths of the LTE channels. Similarly, the AWS radiofrequencies operating at the slightly higher frequency than the PCS band but at a lower operating power will produce a smaller coverage footprint than the PCS band presented here. For these reasons, the plots and signal thresholds presented by AT&T for their existing 3G UMTS network are not "pessimistic" since they have been produced using substantially higher ERP levels than those available for the LTE technology platform. Furthermore, the PCS coverage shown in the exhibits contained within this report more likely overstates the 4G LTE coverage for deployment at the 1900 and 2150 MHz bands.

Exhibit 4 titled: "Composite AT&T 1900 MHz Coverage with Proposed Craig Rd Site @ 95 Ft" shows the aggregate predicted in-building and in-vehicle coverage with proposed site integrated into AT&T's network. A comparison of Exhibit 3 with Exhibit 4 shows the areas of Route 2, Lawsbrook Rd, School St, and the neighboring residential roads, with needed fill-in coverage from the proposed site.⁶

It is important to note that while some of these areas were previously covered by the surrounding sites, that coverage is only reliable when the usage demand is minimal. Providing reliable and competitive service to a given area requires the presence of a "dominant server" that is, a cell whose signals are well above the signals of neighboring hand-off cells. Meeting the capacity requirements of a network is a key component in network design, especially with the continued increase in data usage.

Wireless communications is no longer limited to just providing mobility for voice services. It has evolved into a wider range of advanced services to include wide-area voice, video calls, and broadband wireless data, all in a mobile environment. In order for AT&T to offer these competitive services to more residents, businesses and commuters traveling in and through Acton, they need to first improve the quality of their coverage by filling in as many of the existing gaps as possible with signal strengths conducive to in-building and in-vehicle usage and, to provide the capacity and bandwidth requirements needed to meet the increasing demand on their network.

⁶ While network connections may be possible in the areas depicted as white, service may be characterized by poor voice and data quality, slow data speeds, and the substantial likelihood of unreliable service.

Exhibit 5 titled: “Best Server Existing AT&T 1900 MHz PCS” shows the coverage footprint of each sector of each site serving the Acton/Concord area. You will note that the beta sector of Annursnac Hill (MAU3403) is currently serving Great Rd (Route 2A), portions of Route 2, Wetherbee St, Commonwealth Ave, and other neighboring roads within the current footprint of this sector. It is important to note that the MA DOT reported the following AADT (Average Annual Daily Traffic) counts for the areas identified below:

- Route 2 just east of Commonwealth Ave - 38,300,
- Commonwealth Ave just south of Route 2 - 8,900
- Great Rd south of Pope Rd - 26,000.

The heavy commuter traffic in this area of Acton, combined with the demand from local residents and businesses in the area, greatly impacts the capacity demands for the serving sectors of the neighboring AT&T sites. The beta sector of the Annursnac Hill site is carrying excessive traffic, which negatively impacts the quality of service in the areas described above and the Targeted Coverage Area”. AT&T needs the proposed Craig Rd site to off-load this sector and provide capacity relief for the area.

Exhibit 6 titled: “Best Server AT&T 1900 MHz LTE final Configuration with Proposed MAU1037A Craig Rd” shows the coverage footprint of each sector of each site serving the Acton/Concord area once the proposed site is activated. As can be seen in this plot much of Route 2 and the areas south of it previously served by one sector of the Annursnac Hill site will now be served by two sectors of the proposed site. The integration of the Craig Rd site will entail azimuth and antenna downtilt changes at the neighboring sites to achieve the optimal but balanced coverage footprint from the neighboring sites and sectors.

6. Summary

While the Town’s consultant appropriately noted the inconsistencies between the drive test data and coverage plots provided by AT&T, his subsequent conclusions that the drive test data was flawed and, that AT&T’s predictive coverage plots understate the actual 3G and 4G coverage are not accurate.

In conclusion, the baseline drive test of AT&T’s existing 1900 MHz UMTS network, performed on October 3, 2013, confirms the existence of substantial gaps in coverage within the “Targeted Coverage Area” of Acton. The same drive test data validates the accuracy of the models used by C Squared in producing the coverage plots contained in this report. The plots produced by C Squared show that (1); there are substantial coverage gaps in AT&T’s PCS network in Acton and (2); that a dominant server is needed to provide reliable service to the “Targeted Coverage Area” and off-load the Annursnac Hill sector currently serving Routes 2 and 2A.

Given the proportional differences in operating power and thresholds between 3G UMTS and 4G LTE, where coverage gaps exist today for 3G UMTS, the same coverage gaps will exist following the deployment of the 4G LTE network.

8. Statement of Certification

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



Dan Goulet
C Squared Systems, LLC

March 10, 2014
Date

9. Attachments

Table 1 below provides the corrected pilot assignments and sector information for the sites used in the analysis.

Site Name	Site ID	Sector	Azimuth	PN Assignment	Status
Deaconess Rd	MAU3206	Alpha	30	303	On-Air
		Beta	150	311	On-Air
		Gamma	270	319	On-Air
Annursnac Hill	MAU3403	Alpha	120	63	On-Air
		Beta	210	71	On-Air
		Gamma	330	79	On-Air
Acton Water Works	MAU3031	Alpha	30	42	On-Air
		Beta	150	50	On-Air
		Gamma	270	58	On-Air
Post Office Square	MAU3371	Alpha	20	31	On-Air
		Beta	140	471	Off-Air
		Gamma	260	39	On-Air

Table 1: AT&T Pilot and Sector Information

Table 2 below provides the pertinent information for sites used in the analyses.

Site ID	Name	Longitude	Latitude	Antenna Height	Antenna Sector	Azimuth	Antenna Model	Antenna Mech DTilt	ERP	Status
MAU1037SA	Craig Rd	-71.4188	42.4674	95	1	65	AM-X-CD-16-65-00T-RET_1910MHz_02DT	1	45.1	Proposed
MAU1037SA	Craig Rd	-71.4188	42.4674	95	2	220	AM-X-CD-16-65-00T-RET_1910MHz_02DT	1	45.1	Proposed
MAU1037SA	Craig Rd	-71.4188	42.4674	95	3	310	AM-X-CD-16-65-00T-RET_1910MHz_02DT	1	45.1	Proposed
MAU3031	Acton Water	-71.4543	42.4683	133	1	30	80010121_1920-MHz_M45pol_040dt	0	46.66	On-Air
MAU3031	Acton Water	-71.4543	42.4683	133	2	150	80010121_1920-MHz_M45pol_040dt	0	46.66	On-Air
MAU3031	Acton Water	-71.4543	42.4683	133	3	270	80010121_1920-MHz_M45pol_030dt	0	46.66	On-Air
MAU3041	Sudbury Landfill	-71.3846	42.419	147	1	30	80010121_1920-MHz_M45pol_020dt	0	46.84	On-Air
MAU3041	Sudbury Landfill	-71.3846	42.419	147	2	150	80010121_1920-MHz_M45pol_020dt	0	46.84	On-Air
MAU3041	Sudbury Landfill	-71.3846	42.419	147	3	270	80010121_1920-MHz_M45pol_020dt	0	46.84	On-Air
MAU3206	Emerson Hospital	-71.3756	42.4523	109.9	1	30	80010121_1920-MHz_M45pol_000dt	0	46.23	On-Air
MAU3206	Emerson Hospital	-71.3756	42.4523	109.9	2	150	80010121_1920-MHz_M45pol_000dt	0	46.23	On-Air
MAU3206	Emerson Hospital	-71.3756	42.4523	109.9	3	270	80010121_1920-MHz_M45pol_000dt	0	46.23	On-Air
MAU3340	Deaconess Rd	-71.4271	42.4462	160	1	30	80010121_1920-MHz_M45pol_050dt	0	47.39	On-Air
MAU3340	Deaconess Rd	-71.4271	42.4462	160	2	150	80010121_1920-MHz_M45pol_000dt	0	47.31	On-Air
MAU3340	Deaconess Rd	-71.4271	42.4462	160	3	270	80010121_1920-MHz_M45pol_000dt	0	47.31	On-Air
MAU3371	BostonUMTS	-71.4249	42.4897	146	1	20	AM-X-CD-16-65-00T-RET_1910MHz_02DT	-2	45.1	On-Air
MAU3371	Post Office Sq	-71.4249	42.4897	146	2	140	AM-X-CD-16-65-00T-RET_1910MHz_02DT	-2	45.1	On-Air
MAU3371	Post Office Sq	-71.4249	42.4897	146	3	260	AM-X-CD-16-65-00T-RET_1910MHz_02DT	-2	45.1	On-Air
MAU3403	Annursnac Hill	-71.3947	42.4775	67.5	1	120	80010121_1920-MHz_M45pol_040dt	0	47.39	On-Air
MAU3403	Annursnac Hill	-71.3947	42.4775	67.5	2	210	80010121_1920-MHz_M45pol_050dt	0	47.39	On-Air
MAU3403	Annursnac Hill	-71.3947	42.4775	67.5	3	330	80010121_1920-MHz_M45pol_030dt	0	47.39	On-Air

Table 2: AT&T Pertinent Site Information⁷

⁷ Some sites listed in this table are outside the plot view but are included for completeness of information.

Exhibit 1: Baseline Drive Test Data Over Existing AT&T Mobility 1900 MHz PCS Coverage (Analysis 1)

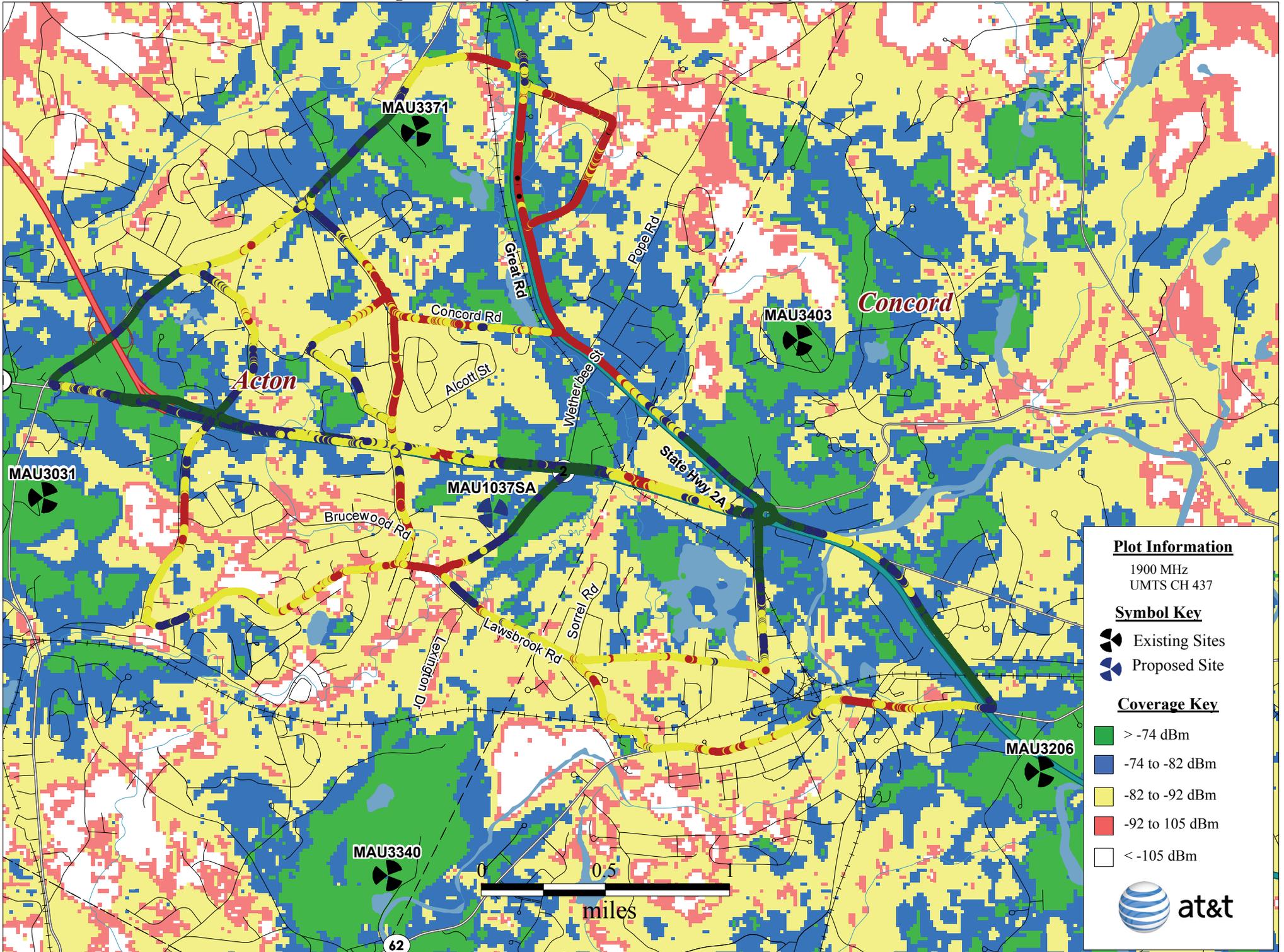


Exhibit 2: Baseline Drive Test Data Over Existing AT&T Mobility 1900 MHz PCS Coverage (MAU3371 Sector Off-Air)

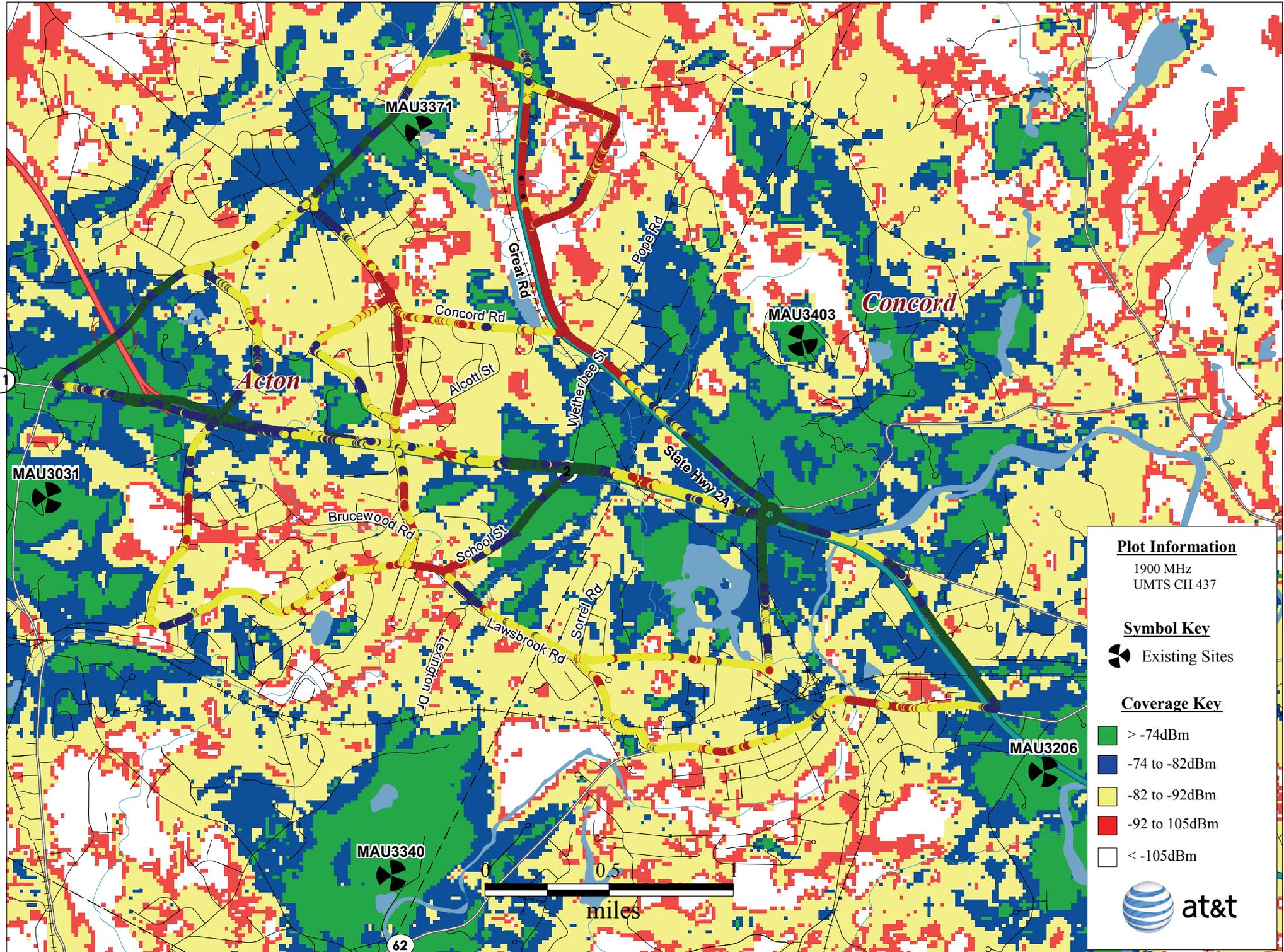


Exhibit 3: Existing AT&T 1900 MHz PCS Coverage - (All Sectors Active)

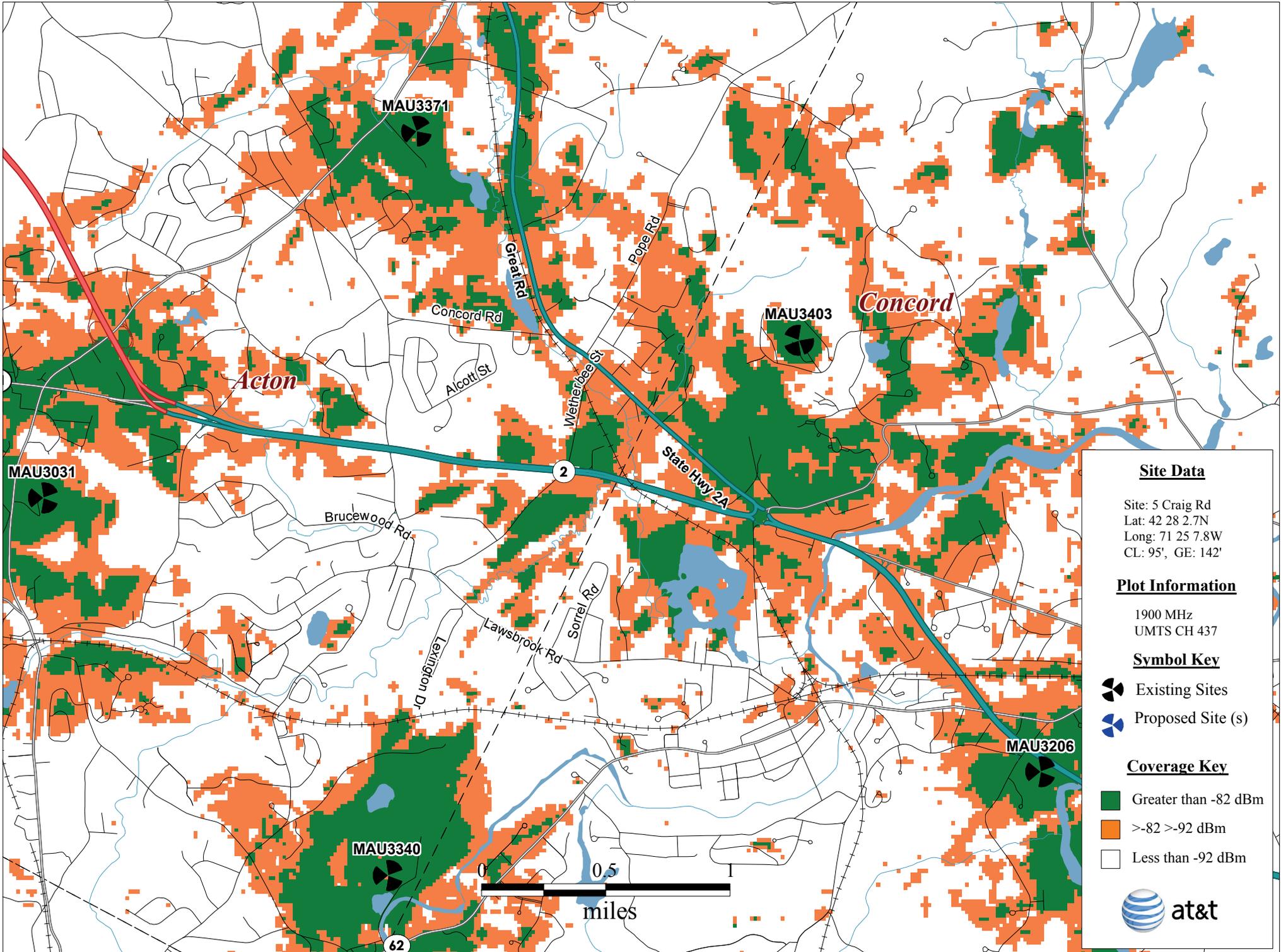
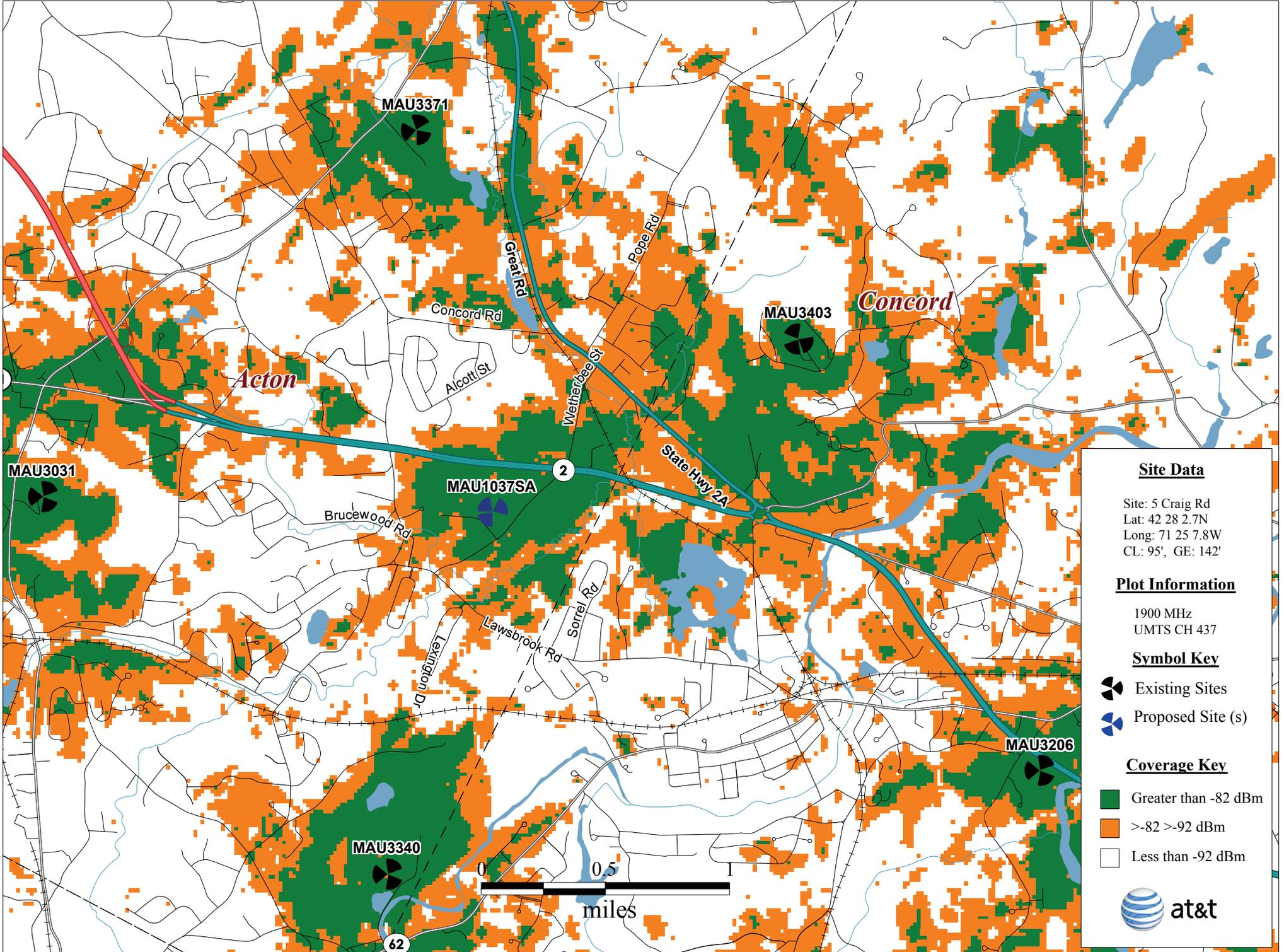


Exhibit 4: Composite AT&T 1900 MHz Coverage with Proposed Craig Rd Site @ 95 Ft.



Site Data

Site: 5 Craig Rd
Lat: 42 28 2.7N
Long: 71 25 7.8W
CL: 95', GE: 142'

Plot Information

1900 MHz
UMTS CH 437

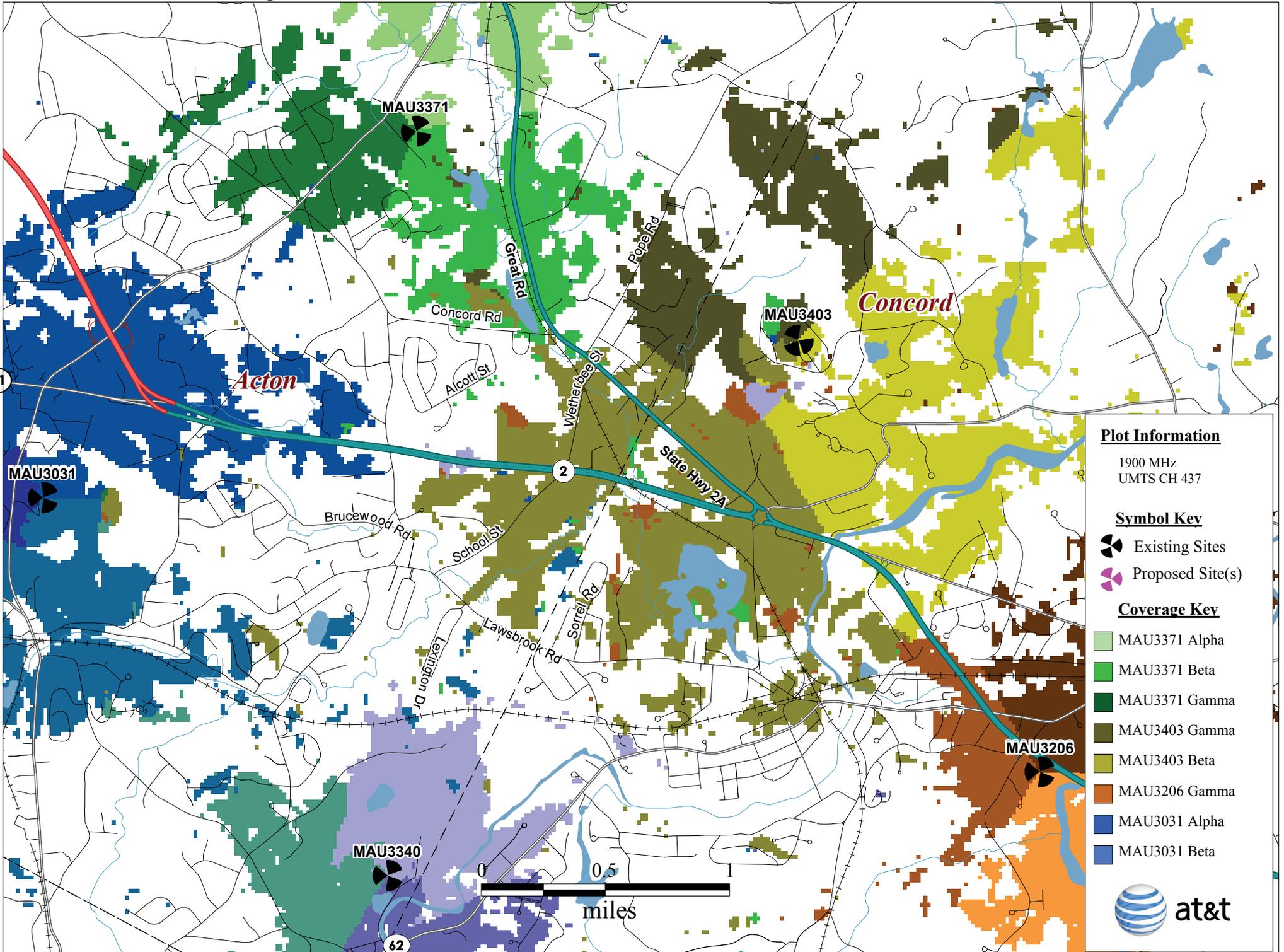
Symbol Key

- Existing Sites
- Proposed Site (s)

Coverage Key

- Greater than -82 dBm
- >-82 >-92 dBm
- Less than -92 dBm

Exhibit 5: Best Server Existing AT&T 1900 MHz PCS



Plot Information

1900 MHz
UMTS CH 437

Symbol Key

- Existing Sites
- Proposed Site(s)

Coverage Key

- MAU3371 Alpha
- MAU3371 Beta
- MAU3371 Gamma
- MAU3403 Gamma
- MAU3403 Beta
- MAU3206 Gamma
- MAU3031 Alpha
- MAU3031 Beta



Exhibit 6: Best Server AT&T 1900 MHz LTE Final Configuration with Proposed MAU1037SA Craig Rd

