

August 7, 2014
W-P Project No. 12972A

Mr. James D Chaousis, II
Town Manager
1011 Wiscasset Road, PO Box 106
Boothbay, Maine 04537

Subject: Mariner Tower Project
RF Peer Review

Dear Jim:

We have completed our peer review of the Mariner Tower cellular and radio frequency related items for the Boothbay Board of Appeals. Following the July 22, 2014 Board of Appeals meeting, two conference calls were conducted with the applicant and the Town to review the data provided and inputs for the propagation models used in the coverage analysis presented with the application. The applicant has demonstrated there is a significant coverage gap in AT & T cellular service in the East Boothbay area. This was confirmed by IDK Communications in their review letter dated January 10, 2014 during their review of the previous site application. The IDK Communications letter of January 10, 2014 is included as Exhibit 1. The proposed Spaulding site, will improve cellular network coverage in the Ocean Point area, but it will not provide coverage for the entire East Boothbay region, nor is it designed to.

RF Model Data Inputs:

On July 15, 2014, the applicant provided a spreadsheet which outlines the power, antenna, azimuths, and propagation model used for preparing the various RF plots contained in the application. Information relative to antennae type, orientation, transmitter frequency, and pilot power are all listed in the table. The July 15th spreadsheet listed the Spaulding site with a tower height of 90-feet, whereas the plot for the Spaulding site indicated a 120-foot height. A revised data input sheet was submitted on August 4, 2014 showing the corrected tower height of 120-feet, and included here as Exhibit 2. The RF plot for the Spaulding site was run at the 120-foot height.

During the July 29th conference call, Wright-Pierce inquired about the pilot power used in the modeling. The power listed is an AT & T standard, amounting to approximately 10% of the maximum transmit power off the radio. The pilot power rating of 34.5 dBm is equivalent to approximately 2.8 watts of power. The information presented in the table appears to accurately represent the conditions for the proposed Spaulding site tower.



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Alternate Sites Reviewed:

Two alternate tower sites (Bigelow and Spyglass Hill) were included with the application to demonstrate the placement of towers on the East Boothbay peninsula with respect to providing cell service to the existing coverage gap. The Bigelow and Spyglass Hill sites assumed a 300-foot tower to demonstrate the extent of coverage to the area. The propagation model shows that each site does not meet the coverage objectives of the identified target area of Ocean Point. An existing tower (Red Hawk Reach) not considered with the original application was also evaluated for potential coverage within AT & T's target area. An additional plot was developed for the Red Hawk Reach tower site and submitted on August 4, 2014, see Exhibit 3. The Red Hawk Reach tower is an existing tower location that already has 2 cellular carriers on it, US Cellular and Verizon, Exhibit 4. If AT & T were to utilize this tower, the antennae would need to be placed at a centerline height of 165-feet. At this height and using this location, the coverage would not extend into the desired target area.

Other alternate sites discussed with the applicant during the conference calls, included a tower located on Spruce Point in Boothbay Harbor or to the east in the South Bristol area. Generally, cell signals do not propagate over large bodies of water well and therefore were not considered as alternatives.

Small Cell Alternate Technology:

Information relative to the use of small cell technology was presented to the Board of Appeals in January 2014 during deliberations on the previous tower site. The information for the small cell coverage is included in Exhibit 5. While small cell has uses for certain applications, it is not suited for medium to high speed roadways. Since the small cells cover a small area, this technology when used in conjunction with another tower site would require a large number of sites to meet the coverage objectives within the target area. Even with a large number of sites, the coverage would be affected by tree cover, and heavy foliage.

We look forward to discussing this project with the Board at the August 12, 2014 meeting. Let us know if there are any questions or comments on this aspect of the peer review.

Very truly yours,

WRIGHT-PIERCE

Jeffrey D. Preble, PE
Senior Project Manager

Enclosures

Exhibits:

- Exhibit 1: IDK Communications letter of January 10, 2014**
- Exhibit 2: RF Data Input Table**
- Exhibit 3: Red Hawk Reach Coverage Map**
- Exhibit 4: Red Hawk Reach Tower Information**
- Exhibit 5: Small Cell Macro Analysis**

EXHIBIT 1
IDK Communications Letter of
January 10, 2014



**IDK
Communications**



January 10, 2014

Town of Boothbay
c/o Richard Perkins, Board of Appeals Chairman
Boothbay Town Offices
P.O. Box 106
Boothbay, ME 04537-0106

RE: AT&T Application – 839 Ocean Point Road, Boothbay, Maine

Dear Mr. Perkins,

IDK Communications (“IDK”) has been tasked with the following scope pertaining to the above referenced subject.

- 1.) Review the technical information and coverage analysis for existing and proposed sites provided by the applicant
- 2.) Review the application and site plans provided by the applicant
- 3.) Perform an independent coverage analysis
- 4.) Provide a written summary report with outputs

Radio Frequency (RF) Coverage Analysis:

When analyzing a site for radio frequency propagation several factors contribute to the overall performance. Of great importance are factors such as height above average terrain, tree density, building density and construction, frequency and equipment performance specifications.

The following paragraphs identify characteristics of each item used in determining overall performance.

Equipment specifications:

It is important to first determine whether a candidate site is limited by the radio path from the handset in a vehicle or building to the radio base station at the tower or by the radio path from the base station at the tower to the handset in a vehicle. In most cases because of the limited output power of the handset the path from the vehicle or inside a building to the radio base station at the tower is your limiting factor. Once this is known input parameters for both the base station and the handset are used to calculate the overall receive parameter used in the propagation modeling.

Height above average terrain:

Another important factor in determining a site's viability is how high the antennas will be in relation to the surrounding terrain. In the cellular/PCS world being at a maximum height above the average terrain is not necessarily a good thing since the systems are designed to provide handoffs to adjacent sites. Cellular/PCS carriers will re-use frequencies at different sites so it is important not to create interference with themselves. This philosophy differs from that of older wireless paging systems for example where sites were picked for their greater heights above average terrain. Cellular/PCS sites are picked by how they relate to the area that requires coverage. These areas are where the general population lives and commutes. A site that provides for coverage within a geographical area does not need to be on the highest point for that area but rather an area that provides enough clearance above the average terrain.

Tree Density:

Going along with height above average terrain is tree density. This factor is important because where the height of the antennas just clears the overall tree canopy in the surrounding area there may be additional losses associated with foliage. This loss can vary depending on types of trees and the density of the area. These losses are taken into account when determining propagation. It is also important to note that tree losses at the PCS frequencies of 1900 MHz are greater than the cellular frequencies of 800 MHz. AT&T application is for operating in the 1900 MHz frequency range.

Building Density and Construction:

Another factor in the determination of propagation is the building density and construction. Buildings can exhibit different types of losses depending on the construction material. Appropriate RF parameters for building density can be used when modeling coverage for areas such as Boothbay.

Input parameter values are chosen and then used in statistical calculations to determine if a viable signal is available for a particular area. In some cases coverage deficient areas are caused by shadows from particularly high terrain. Elimination of the deficient area may sometimes only be accomplished by increasing antenna height or by selecting an alternative site if the heights become too great.

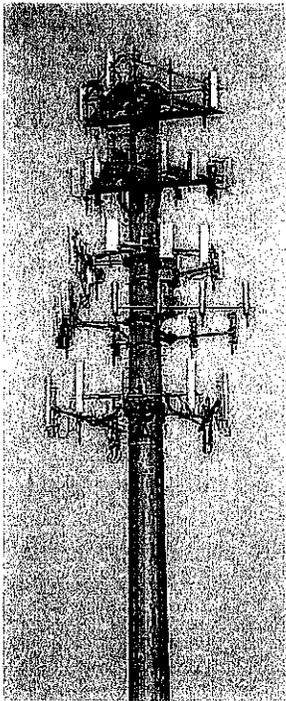
Site Configuration Options

Antenna Support Structures

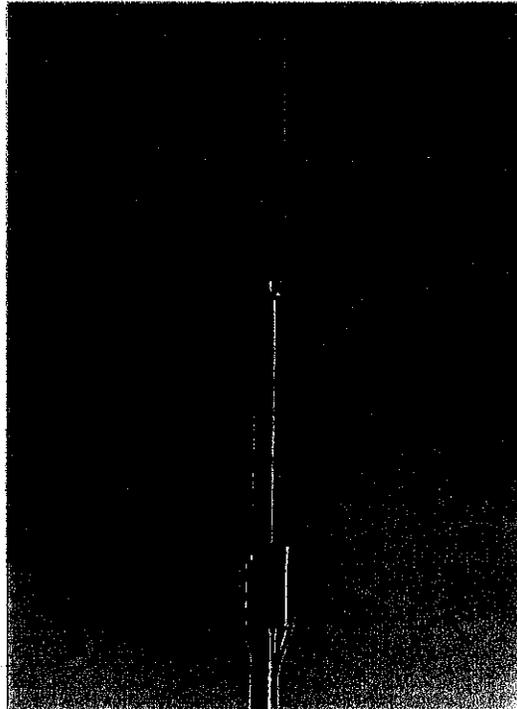
When designing an antenna site there are several options with respect to the structure that supports the antennas. Two of the most basic structures are lattice and monopole towers.

The lattice tower consists of three or four legs with interconnecting braces and is capable of heights in excess of 300 feet. The lattice towers can be either guyed with wires or self-supporting. With structural capacity being equal the self-supporting structures are wider than the guyed counterpart version.

The monopole structures are possible to heights of 190 feet. As their heights increase so does the complexity of the foundations used to support the structure. Antennas can be either mounted on the exterior of the pole with the transmission lines inside the pole or they can be mounted inside the pole with the transmission lines. Mounting the antennas inside the pole creates a more stealth design and they can also be disguised as flagpoles or trees. Doing this however will cause the carriers to take up more vertical space and thus the amount of co-location will decrease. If antennas are mounted outside the pole they can be flush mounted to the exterior of the pole to reduce the visual impact. Doing this would also have the same result as mounting the antennas inside with respect to the co-location opportunities. The pictures below offer two types of antenna installations outside of a monopole.



Non-Flush Mount Install



Flush Mount Install

In the case of Boothbay the applicant is proposing a stealth structure disguised as a tree. This structure may require a little more maintenance than a standard monopole due to the additional material used for branches.

Equipment Powering

Typically a cell/PCS carrier constructs a site with an electrical feed and a backup option in the event of an AC failure. The electrical feed to a site is either supported overhead by utility poles or is trenched underground through conduits.

The backup power option can consist of various options such as a propane or diesel generator, batteries or fuel cells. Out of all these options the generator would be the loudest when activated. Typically for maintenance purposes the generators are run a few times a month.

Sometimes sites are designed to have one backup power option to supply multiple Cell/PCS installations. This eliminates additional equipment on the ground.

Coverage Analysis:

IDK was tasked to validate the radio frequency performance of the AT&T data that was supplied to the Board. AT&T provided proposed and existing system information for its radio sites. The site data together with information from the Town were used in IDK's RF analysis. The output of these analyses is a map or plot that depicts the radio frequency propagation prediction for each site. IDK has presented an analysis using the 1900 MHz frequency band currently used by AT&T.

The sites used by IDK in the analysis are as follows:

- 1.) Existing and planned AT&T radio sites in Boothbay and adjoining towns
- 2.) Alternative Site at Bigelow Laboratory – 60 Bigelow Drive
- 3.) Proposed Site at Ocean Point Road

Results:

Propagation analysis was performed using the existing and proposed AT&T radio sites. Maps are included at the end of this report that depict the results with the coverage areas in green, red and blue. The green represents in-building coverage, the red represents additional in-vehicle coverage while the blue is the additional on street coverage. Areas with no reliable coverage are depicted in white. The following paragraphs identify each scenario with the associated results:

FIGURE 1

IDK ran coverage for all existing AT&T sites to determine if a coverage gap existed in the Town of Boothbay. The results show that indeed there exist significant gaps in coverage in the East Boothbay area.

FIGURE 2

IDK ran a coverage analysis to determine the impact to coverage by adding the proposed site on Ocean Point Road at a height of 120 feet. The site offers coverage to the East Boothbay areas of Ocean Point, Spruce Shores and Linekin.

FIGURE 3

IDK next ran a coverage analysis to determine the impact to coverage by using an alternative site at the Bigelow Laboratory on Bigelow Drive in lieu of the proposed location. An antenna height of 120 feet was used. The site does not provide in building coverage to the East Boothbay areas shown in Figure 2; only some in vehicle and on street coverage with some areas still having no coverage.

Coverage Summary

The following summarizes the findings of the coverage scenarios:

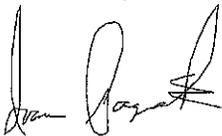
- Today there exist coverage gaps in the Town of Boothbay for AT&T, specifically in the East Boothbay area.
- The proposed site at Ocean Point Road at 120 feet provides coverage to the East Boothbay area in the coverage gaps.
- An alternative site at Bigelow Laboratory does not provide the level of coverage to the gap area as the proposed location.

IDK also reviewed the site plans provided by the applicant and offers only the following comment:

- 1.) Drawing C-103 identifies a proposed generator pad within the compound. This assumes that a generator will be installed at some point. There is no identification of the location for a fuel supply. IDK suggests that the location be identified on a drawing to insure compliance with codes.

IDK has no other comments regarding the referenced application or drawings and find that standard engineering practice was used in their coverage analysis. If you have any questions please feel free to contact me at (978) 375-7914.

Yours truly,

A handwritten signature in black ink, appearing to read "Ivan Pagacik", with a stylized flourish at the end.

Ivan Pagacik

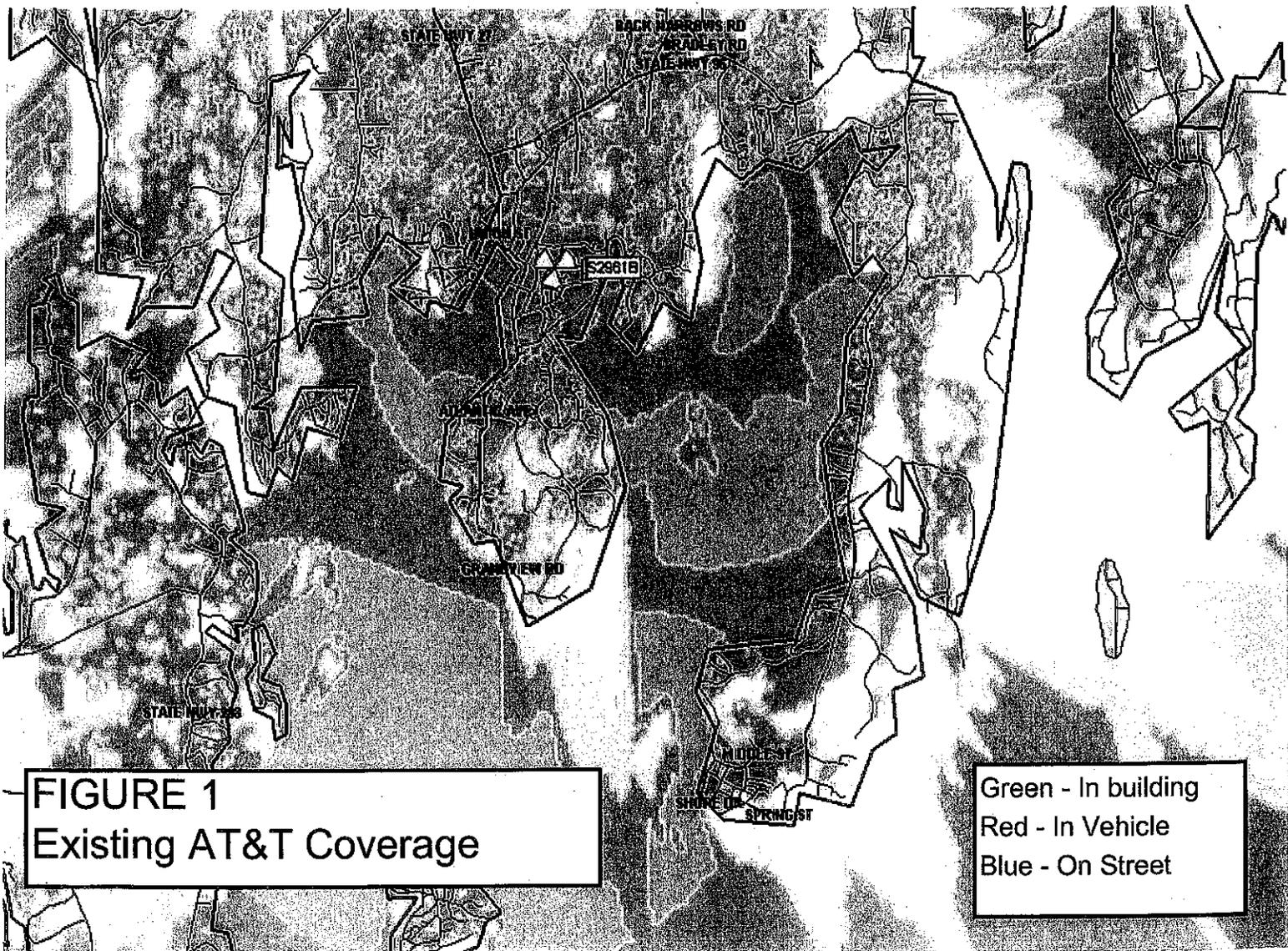


FIGURE 1
Existing AT&T Coverage

Green - In building
Red - In Vehicle
Blue - On Street

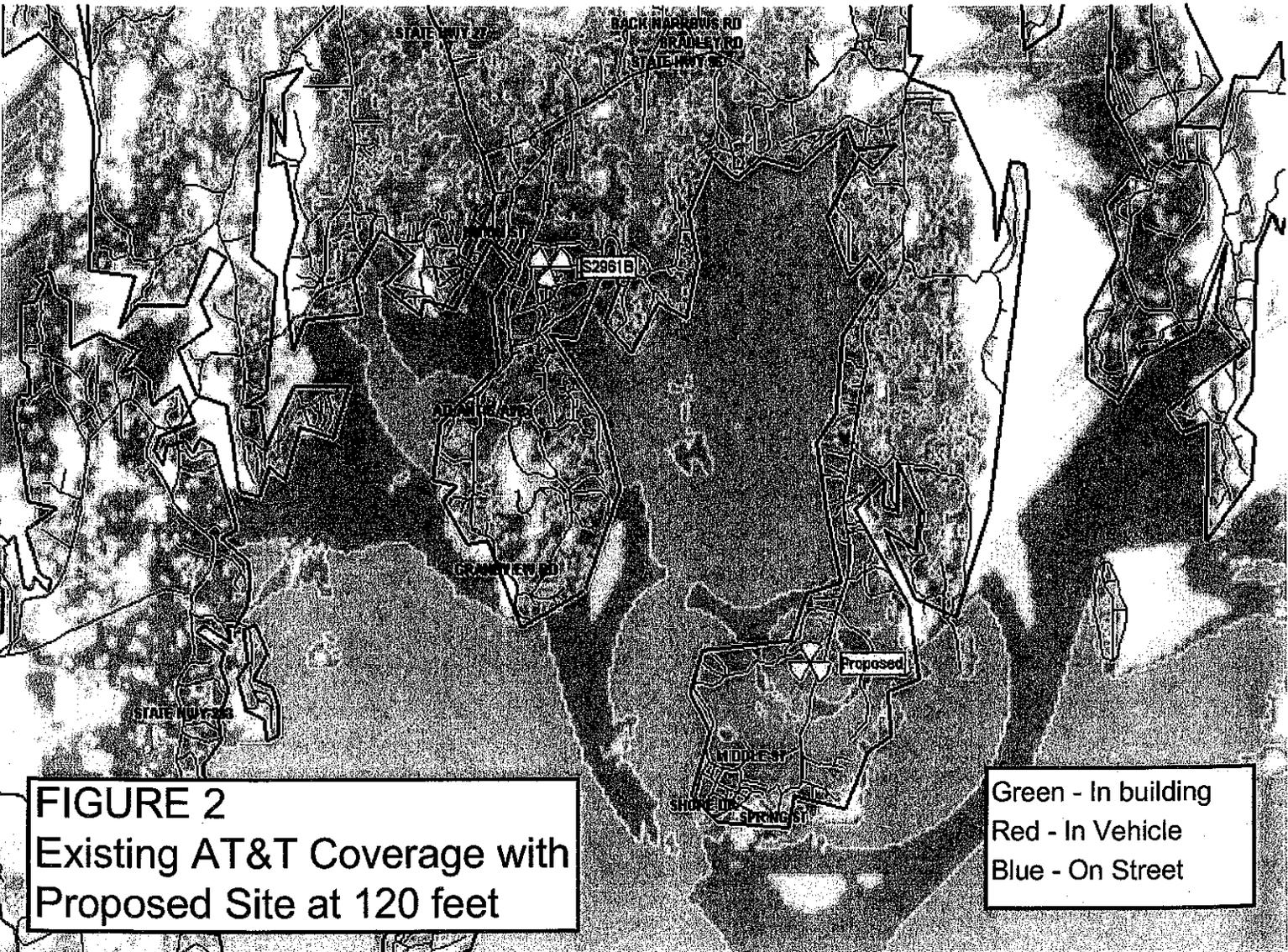


FIGURE 2
Existing AT&T Coverage with
Proposed Site at 120 feet

Green - In building
Red - In Vehicle
Blue - On Street

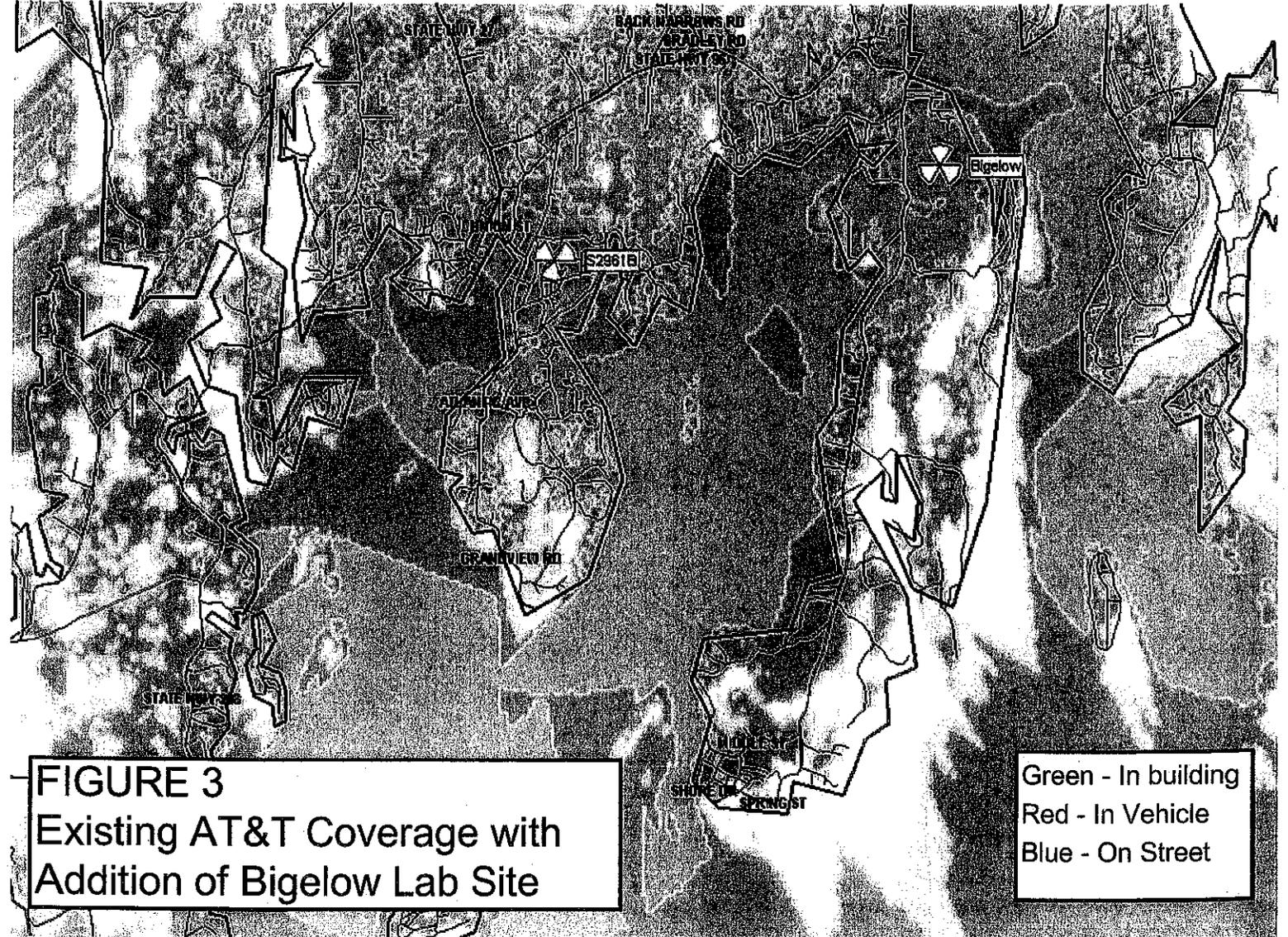


FIGURE 3
 Existing AT&T Coverage with
 Addition of Bigelow Lab Site

EXHIBIT 2
RF Data Input Table

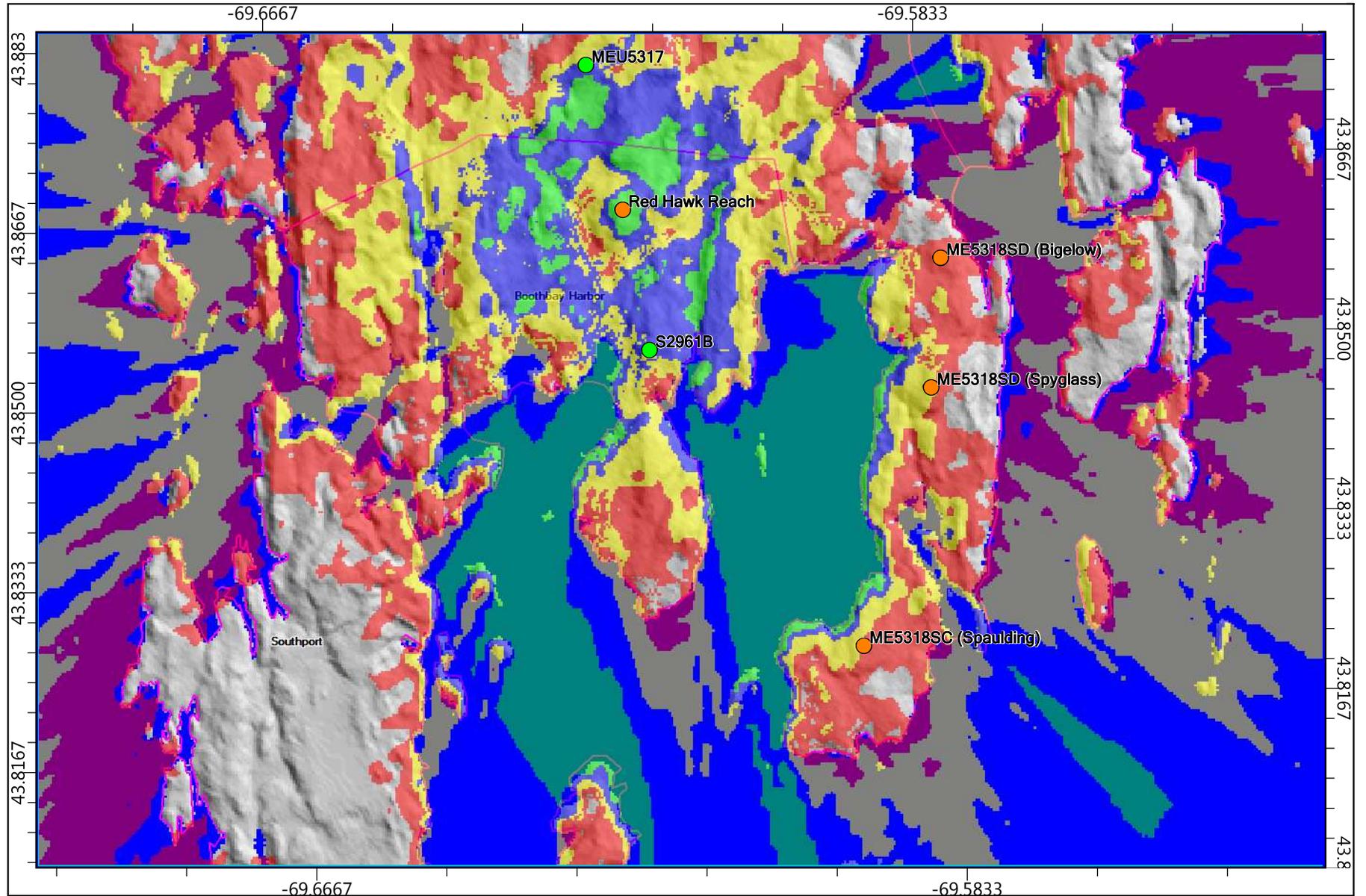
Site	Longitude	Latitude	Transmitter	Frequency Band
ME5318SC(Spaulding)	-69.59472222	43.82333333	ME5318SC(Spaulding)7	1900 MHz Band
ME5318SC(Spaulding)	-69.59472222	43.82333333	ME5318SC(Spaulding)8	1900 MHz Band
ME5318SC(Spaulding)	-69.59472222	43.82333333	ME5318SC(Spaulding)9	1900 MHz Band
ME5318SD(Bigelow)	-69.58194444	43.85972222	ME5318SD(Bigelow)7	1900 MHz Band
ME5318SD(Bigelow)	-69.58194444	43.85972222	ME5318SD(Bigelow)8	1900 MHz Band
ME5318SD(Bigelow)	-69.58194444	43.85972222	ME5318SD(Bigelow)9	1900 MHz Band
ME5318SD(Spyglass)	-69.58388889	43.84694444	ME5318SD(Spyglass)7	1900 MHz Band
ME5318SD(Spyglass)	-69.58388889	43.84694444	ME5318SD(Spyglass)8	1900 MHz Band
ME5318SD(Spyglass)	-69.58388889	43.84694444	ME5318SD(Spyglass)9	1900 MHz Band

Antenna	Height (ft)	Azimuth (°)	Prop Model	Pilot Power (dBm)	Technology
HPA-65R-BUU-H8_1940MHz_02DT	120	30	MRM_RU_ME_NH_PCS_033112	34.5	UMTS
HPA-65R-BUU-H8_1940MHz_02DT	120	160	MRM_RU_ME_NH_PCS_033112	34.5	UMTS
HPA-65R-BUU-H8_1940MHz_02DT	120	260	MRM_RU_ME_NH_PCS_033112	34.5	UMTS
HPA-65R-BUU-H8_1940MHz_04DT	300	90	MRM_RU_ME_NH_PCS_033112	34.5	UMTS
HPA-65R-BUU-H8_1940MHz_02DT	300	200	MRM_RU_ME_NH_PCS_033112	34.5	UMTS
HPA-65R-BUU-H8_1940MHz_02DT	300	320	MRM_RU_ME_NH_PCS_033112	34.5	UMTS
HPA-65R-BUU-H8_1940MHz_04DT	300	90	MRM_RU_ME_NH_PCS_033112	34.5	UMTS
HPA-65R-BUU-H8_1940MHz_03DT	300	210	MRM_RU_ME_NH_PCS_033112	34.5	UMTS
HPA-65R-BUU-H8_1940MHz_05DT	300	340	MRM_RU_ME_NH_PCS_033112	34.5	UMTS

EXHIBIT 3
Red Hawk Reach Coverage Map



Red Hawk Reach Only Coverage @ 165'



Scale: 1:58,095
0 0.5 1 1.5mi

- Red Hawk Coverage @ 165'
- >=-75 dBm
 - 85 dBm
 - 95 dBm
 - 105 dBm

EXHIBIT 4
Red Hawk Reach Tower Information

Registration 1022277

 [Map Registration](#)

Registration Detail

Reg Number	1022277	Status	Constructed
File Number	A0516074	Constructed	08/31/2006
EMI	No	Dismantled	
NEPA	No		

Antenna Structure

Structure Type TOWER - Free standing or Guyed Structure used for Commu

Location (in NAD83 Coordinates)

Lat/Long	43-51-55.0 N 069-37-19.0 W	Address	2 MI NW
City, State	LINEKIN , ME		
Zip	04538	County	LINCOLN
Center of AM Array		Position of Tower in Array	

Heights (meters)

Elevation of Site Above Mean Sea Level	Overall Height Above Ground (AGL)
61.3	61.0
Overall Height Above Mean Sea Level	Overall Height Above Ground w/o Appurtenances
122.3	57.9

Painting and Lighting Specifications

None

FAA Notification

FAA Study	2006-ANE-255-OE	FAA Issue Date	03/15/2006
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Owner & Contact Information

FRN	0004372322	Owner Entity Type
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Owner

United States Cellular Corporation	P: (773)399-8900
Attention To: Renee Mazur #444311	F:
8410 W. BRYN MAWR AVENUE, SUITE 700	E: renee.mazur@uscellular.com
CHICAGO , IL 60631	

Contact

Connolly , Peter M Esq	P: (202)862-5989
2099 Pennsylvania Avenue, N.W., Sui	F:
Washington , DC 20006	E: pconnoll@hklaw.com

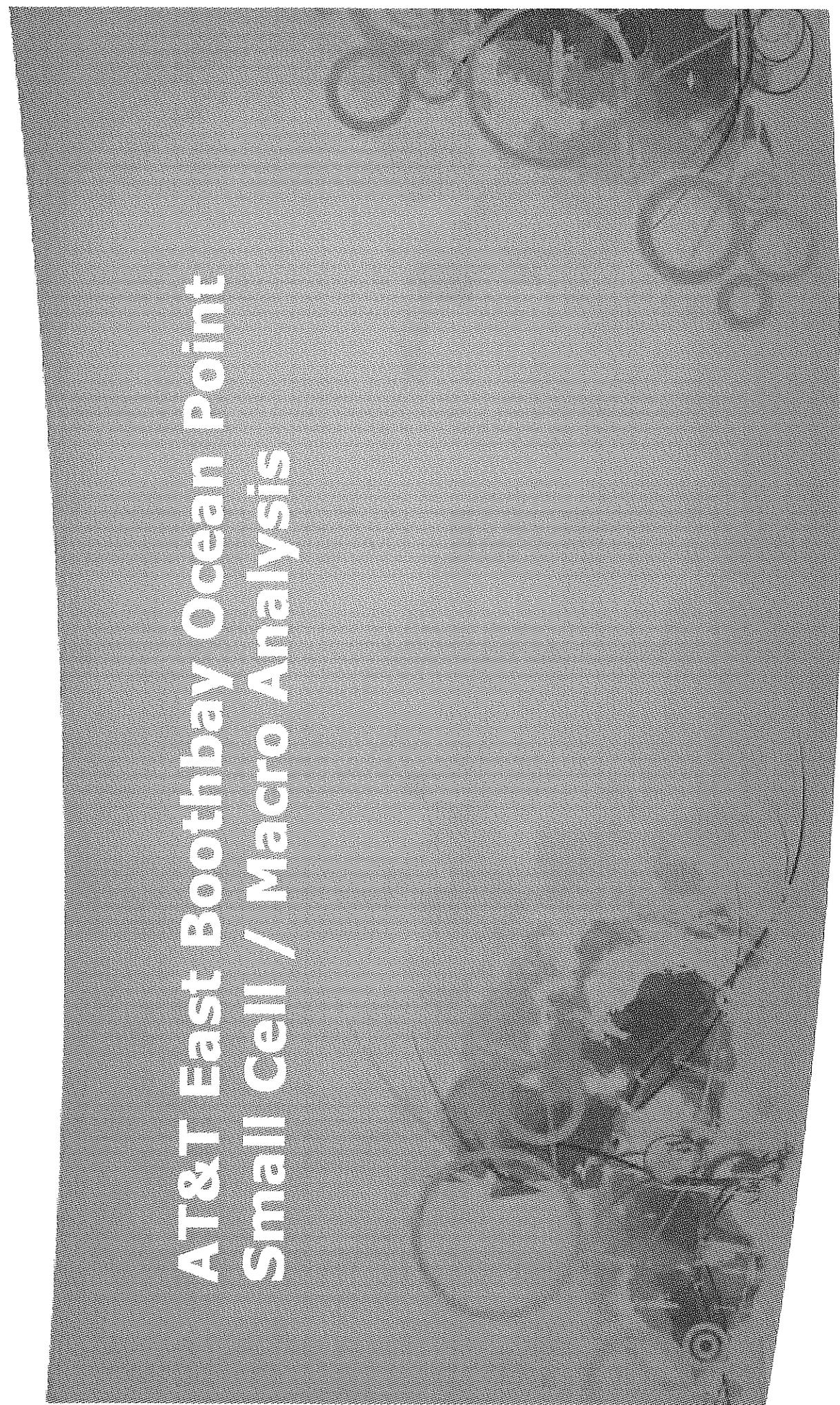
Last Action Status

Status	Constructed	Received	08/31/2006
Purpose	Notification	Entered	08/31/2006
Mode	Interactive		

EXHIBIT 5
Small Cell Macro Analysis

Submitted 1/28/14

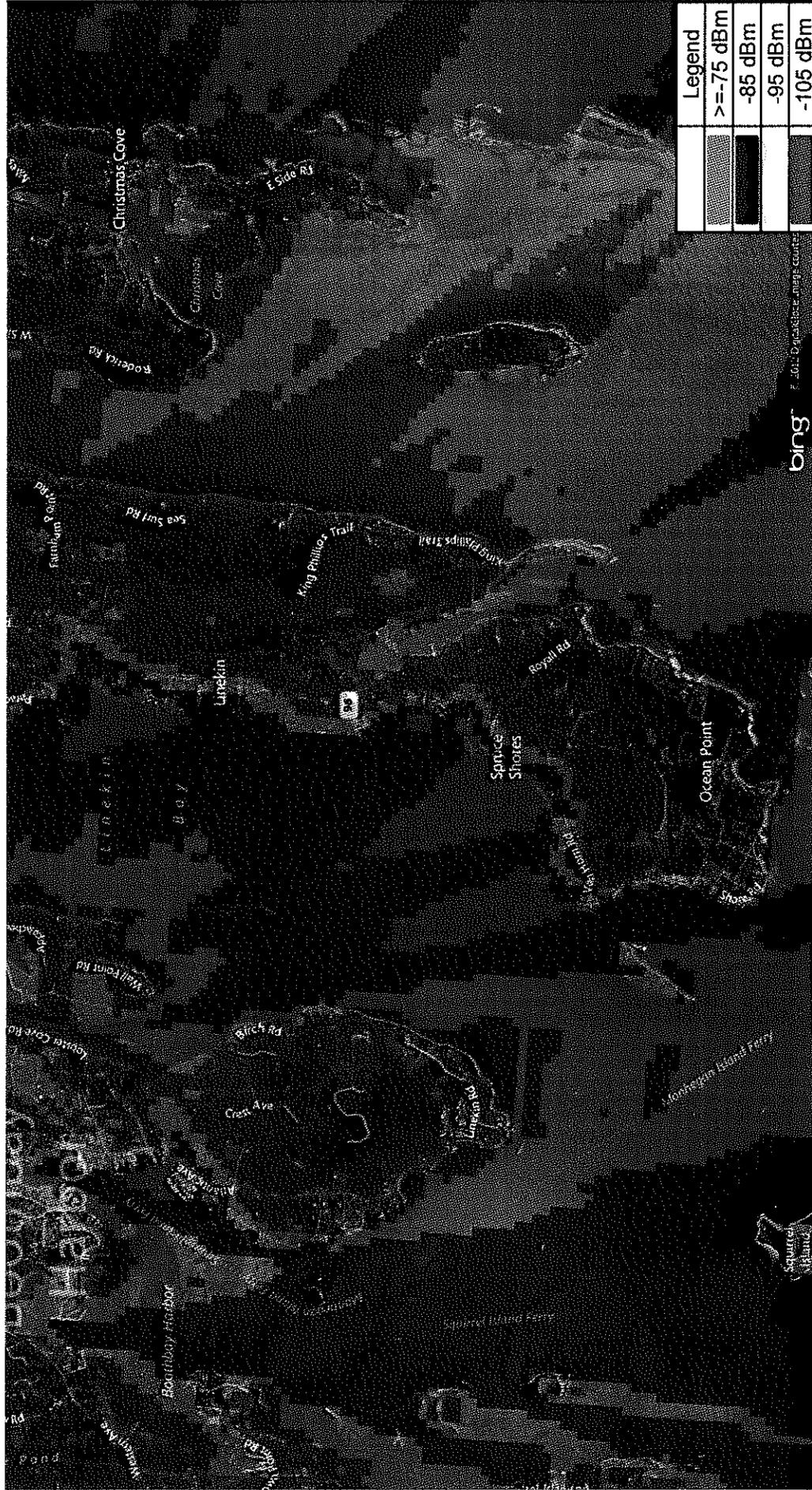
AT&T East Boothbay Ocean Point Small Cell / Macro Analysis



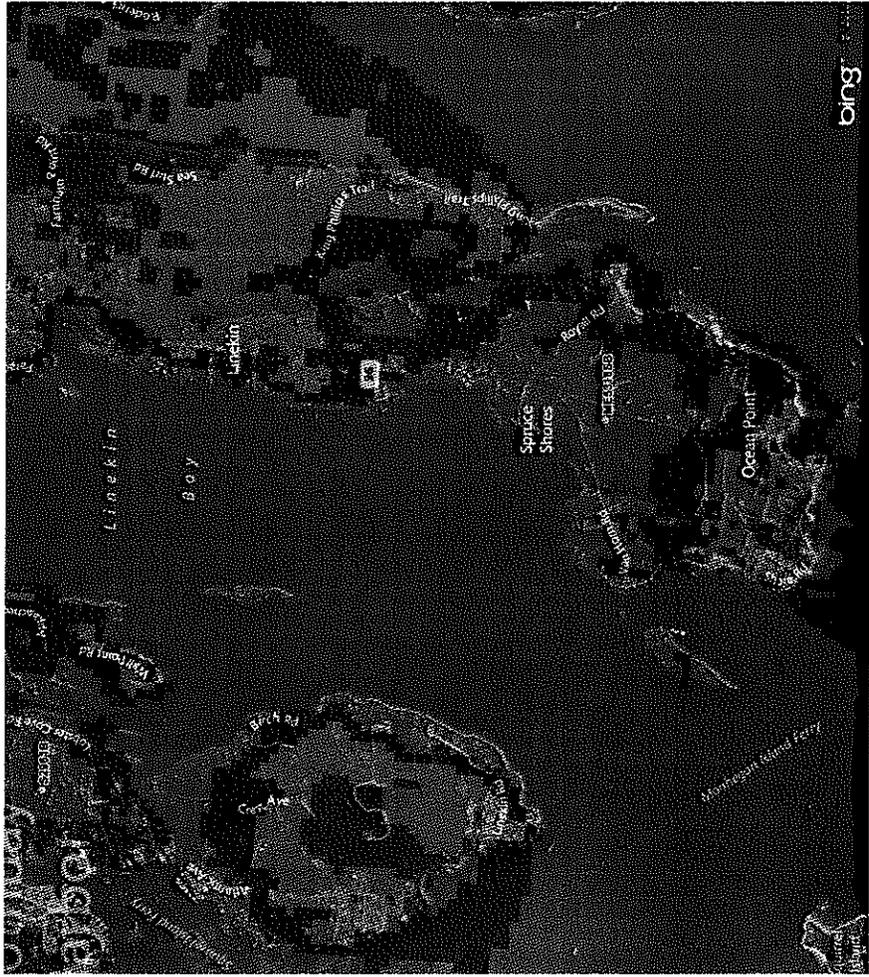
Boothbay/Ocean Point Satellite Map



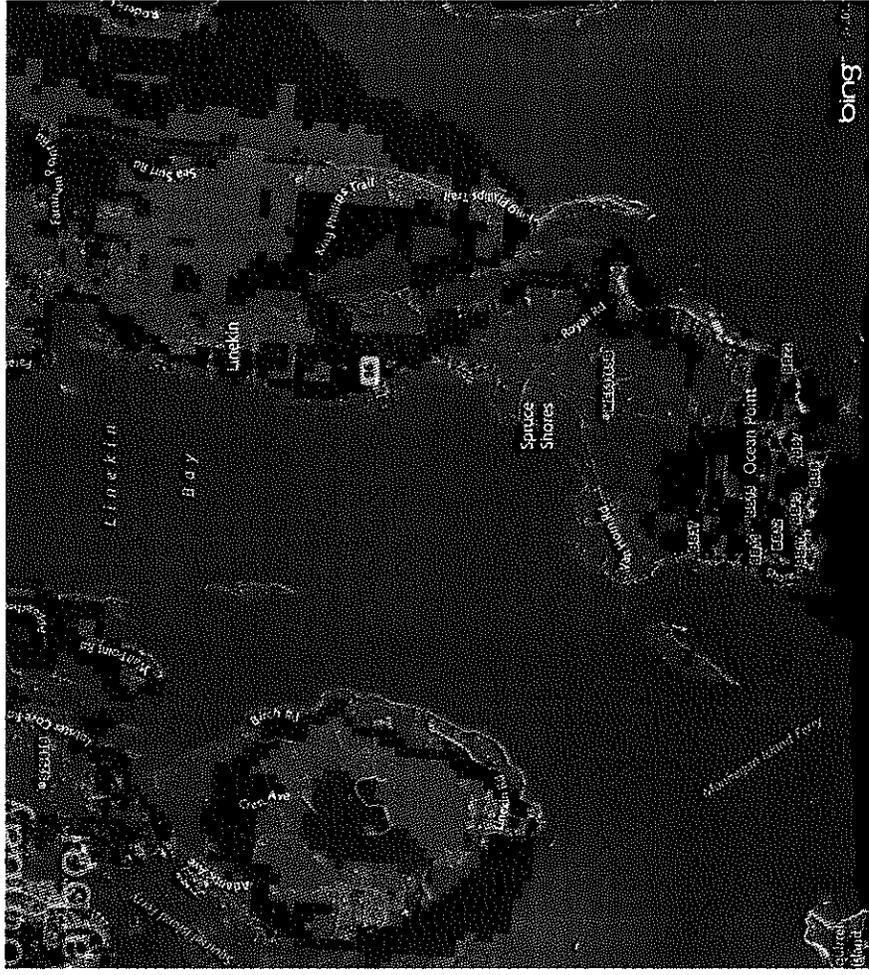
Boothbay/Ocean Point Current Coverage



Future Coverage - with S2961B (In Progress Watertank) & ME5318SB



Future Coverage - with S2961B, ME5318SB & Ocean Point Small Cells



Small Cell Application

Small Cells

The small cell product is a small, low power device that is typically mounted at low height(street poles) and is designed to improve coverage in small areas.

The Small Cell solution is well suited to suburban and light urban environments where there is slow moving traffic and low amounts of dense blocking clutter. Close proximity foliage(trees) to the Small Cell antennas greatly diminish its coverage footprint.

The Small Cell product is not suited to medium to high speed roadways.

Applying the constraints detailed above Small Cells are well suited towards shoreline coverage gaps and should be used to supplement macro coverage in these areas.

Boothbay/Ocean Point Design

The proposed tower will provide coverage along Rte96, interior residences, Eastern and Western coastal residences and surrounding waterways.

Small Cell alone is not a viable solution for the following reasons:

- The majority of the coverage area of Ocean Point is comprised of heavy foliage/rural mix with the utility poles at or below the surrounding tree line.
- Rte96 carries medium speed traffic where Small Cells are not suitable.
- The limited footprint of the Small Cell will not provide the desired coverage to the surrounding waterways to cover the offshore boating traffic.

A combination of Small Cell along the coastal areas, and the proposed macro will result in an ideal solution.

Conclusions and Recommendations

Conclusions:

- The macro is the only solution for providing coverage within the targeted footprint but small cells outside the macro footprint are an opportunity to further improve specific, targeted areas which align with small cell capabilities.
- A design objective for this area is improved coverage along Rte96 and Small Cells are not a viable option to handle the vehicular mobility along this route nor do they provide similar levels of signal for in-building or waterway coverage beyond Rte96.