Site Survey and Onsite Analysis of Wireless Network Capabilities District 3 - Lake Lena.

Lake Lena, Minnesota
Aazhoomog

— Unincorporated community —

Coordinates: 46°03'41"N 92°27'40.2"W

Country	United States
State	Minnesota
County	Pine
Elevation	1,017 ft (310 m)
Time zone	Central (CST) (UTC-6)
• Summer (DST)	CDT (UTC-5)
Area code(s)	320
GNIS feature ID	1815033[1]

Genesis Wireless
Braham, Minnesota
September - 2012

- Lake Lena is an unincorporated village in Ogema Township, Pine County,
Minnesota, United States, along the Lower Tamarack River. Its name in the Ojibwe language is Aazhoomog, meaning "Crossroads" in reference to being at the former crossroad of the north-south trail
connecting Bikoganaagan (Danbury), via the former Agaming (Outflow/"Lower Tamarack River Village"), and the former Gibaak-wa'iganing (Tozer Camp/"lower Upper Tamarack River Village") with the east-west trail connecting Mooningwanekaaning (La Pointe), via Namekaawa'iganing (Gordon), with Gaa-zhiigwanaabikokaag (Hinckley). It currently is the administrative center for the Mille Lacs Band of Ojibwe, District III.

Overview

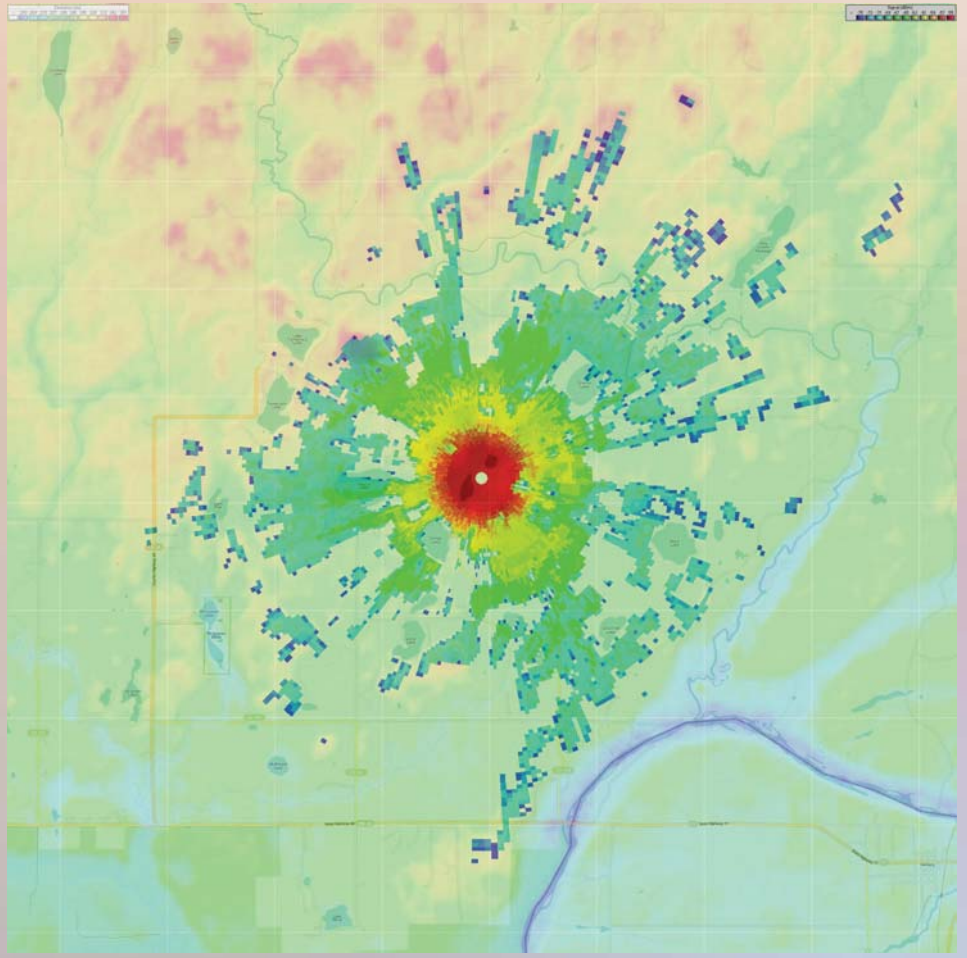
- In 2011 the Mille Lacs Band installed a 24 pair fiber optic cable from Hinckley to the remote community of Lake Lena. The fiber directly connects the clinic, school and gas station located in Lake Lena.
- In August of 2012 Genesis Wireless was enagaged by the Mille Lacs Band of Ojibwe to perform a site survey and onsite analysis of the wireless network capabilities at Lake Lena and prepare this feasibility report of using the fiber to bring high speed internet access to the Lake Lena community members.
- Genesis Wireless is a Minnesota Company founded in 1999, experienced in building and operating all aspects of outdoor wireless broadband networks.
- Genesis tested 5 different frequencies on location: 2.4 Ghz (WiFi), 5.2 Ghz, 5.8 Ghz, 3.65 Ghz (4G – WiMAX) and 900 Mhz.
- Genesis did contact PCS-Technologies, Inc., an experienced communications tower building company and equipment vendor, for a quote on a 180' tower, multi-carrier cell phone repeater option near the clinic at Lake Lena and a wireless point-to-point link.
- The following report will give the results of the signal surveys, costs analysis of equipment, and finally a recommendation of how to proceed to accomplish the ultimate goal of bringing high speed internet access to Lake Lena.

The Present Situation

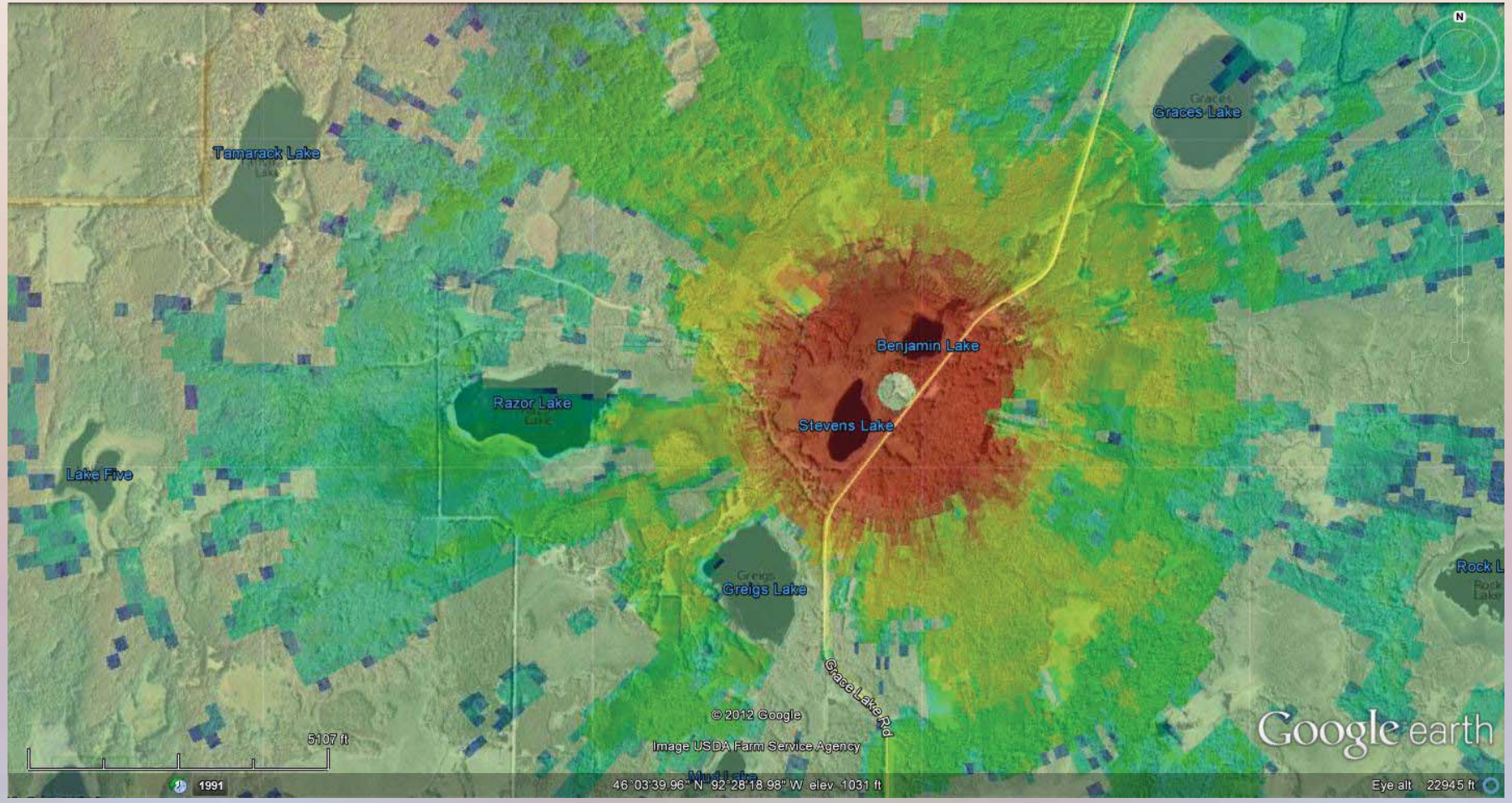
- Lake Lena is located in extreme eastern Pine County along the Minnesota – Wisconsin State Border formed by the St. Croix River. The area is extremely wooded with equal portions of Pine and Deciduous forests. This presents a difficult situation as far as signal propagation in delivering wireless services. The trees significantly reduce the amount of signal able to propagate from a broadcast location.
- Genesis was on location at the Lake Lena Clinic several times during the month of August and September conducting signal surveys. This involved temporarily mounting broadcast equipment on the roof of the clinic, then driving to various locations around the Lake Lena Community checking signal strength.

5.2 - 5.8 GHz Signal

- The first signal tested was 5.2 and 5.8 GHz. The following is an overview map of the signal coverage.
- The 5.2 – 5.8 had the poorest signal propagation through the forest therefore was unable to reach out at all. The Red areas indicate optimal signal.
- The photo image on the next page shows that the 5.8 GHz signal was unable to propagate much beyond the clinic and community center. It stops at the Ceremonial Center and doesn't reach residents near Razor Lake.

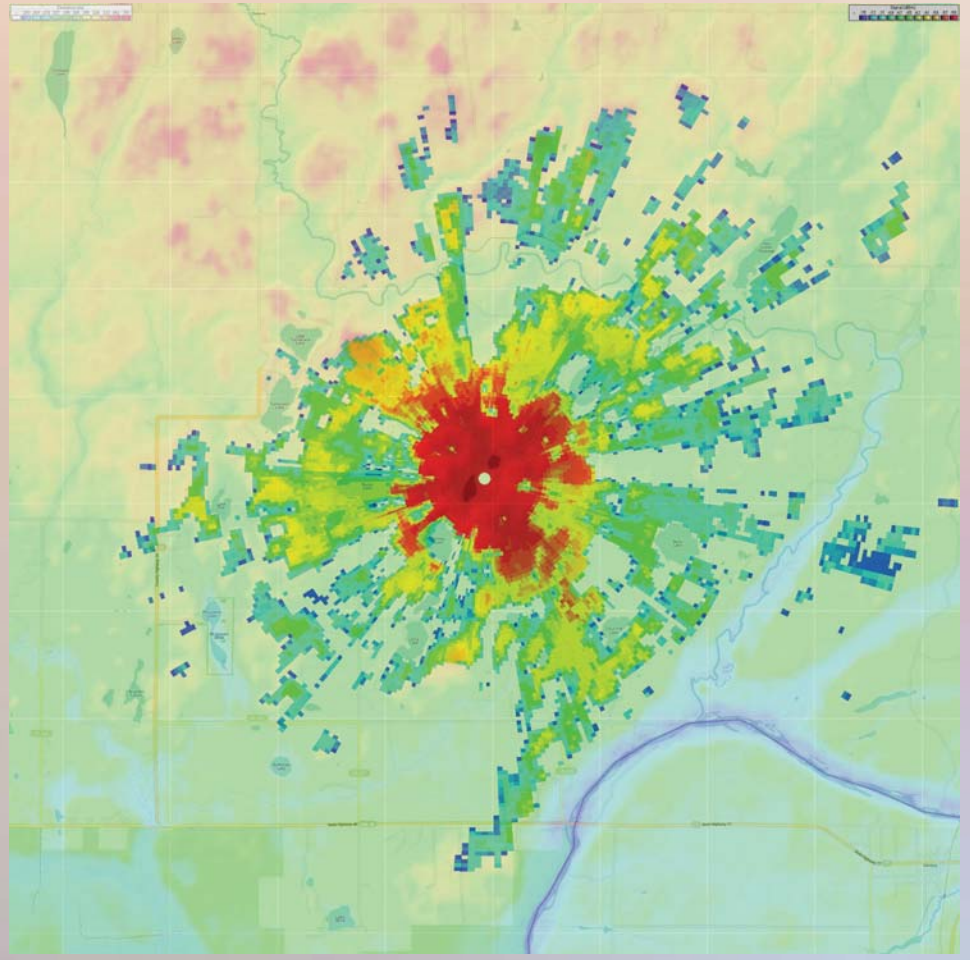


Google Earth Photo of 5.2 – 5.8 GHz Signal Propagation

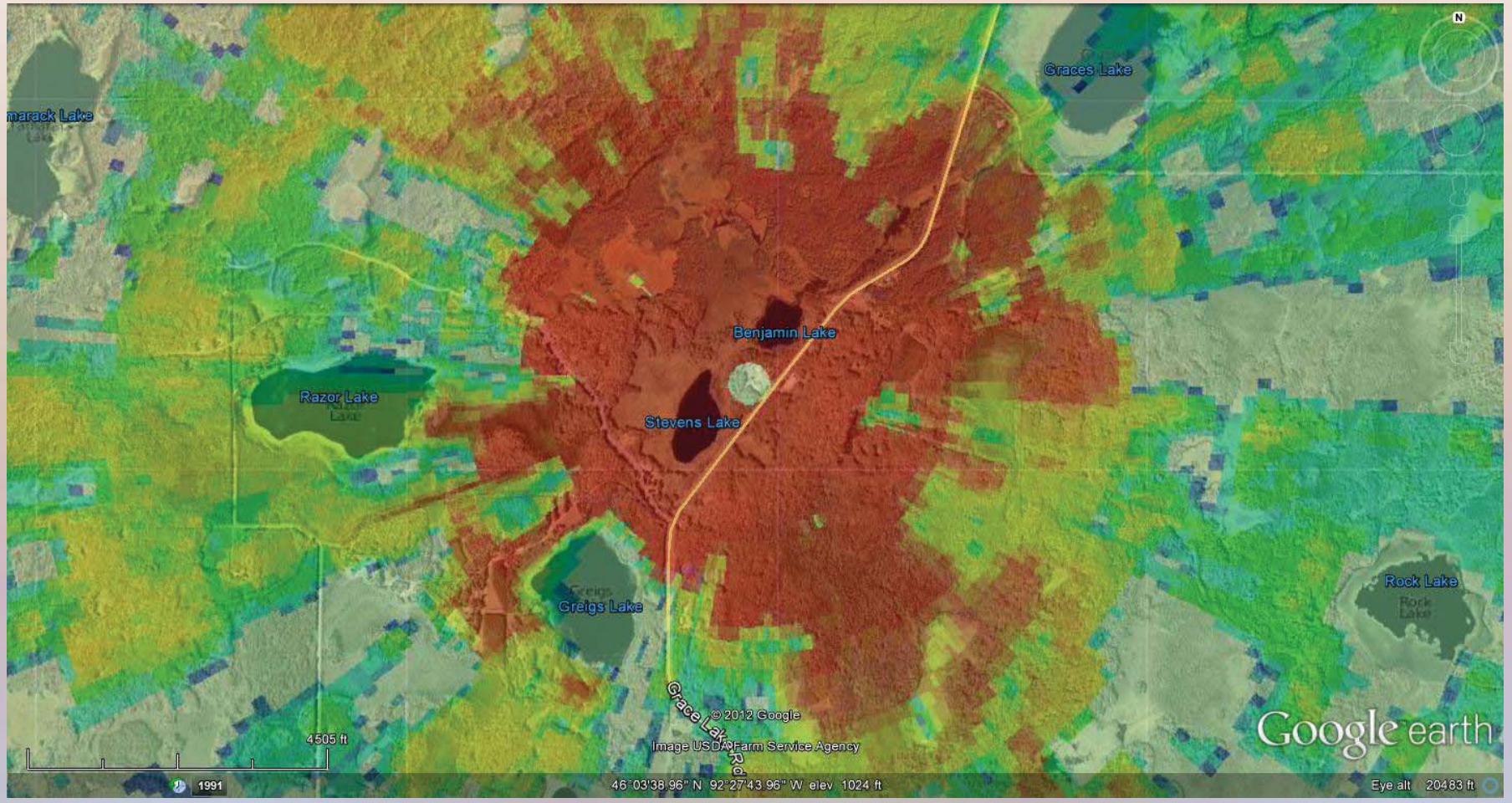


2.4 WiFi GHz Signal

- The second signal tested was 2.4 GHz WiFi. The following is an overview map of the signal coverage.
- The 2.4 WiFi had better signal propagation than 5.2 – 5.8 GHz, but still was unable to reach Razor Lake. The Red areas indicate optimal signal.
- The photo image on the next page shows that the 2.4 GHz signal was able to propagate beyond the clinic and community center. It stops just past the Ceremonial Center and doesn't reach residents near Razor Lake.



Google Earth Photo of 2.4 GHz Signal Propagation

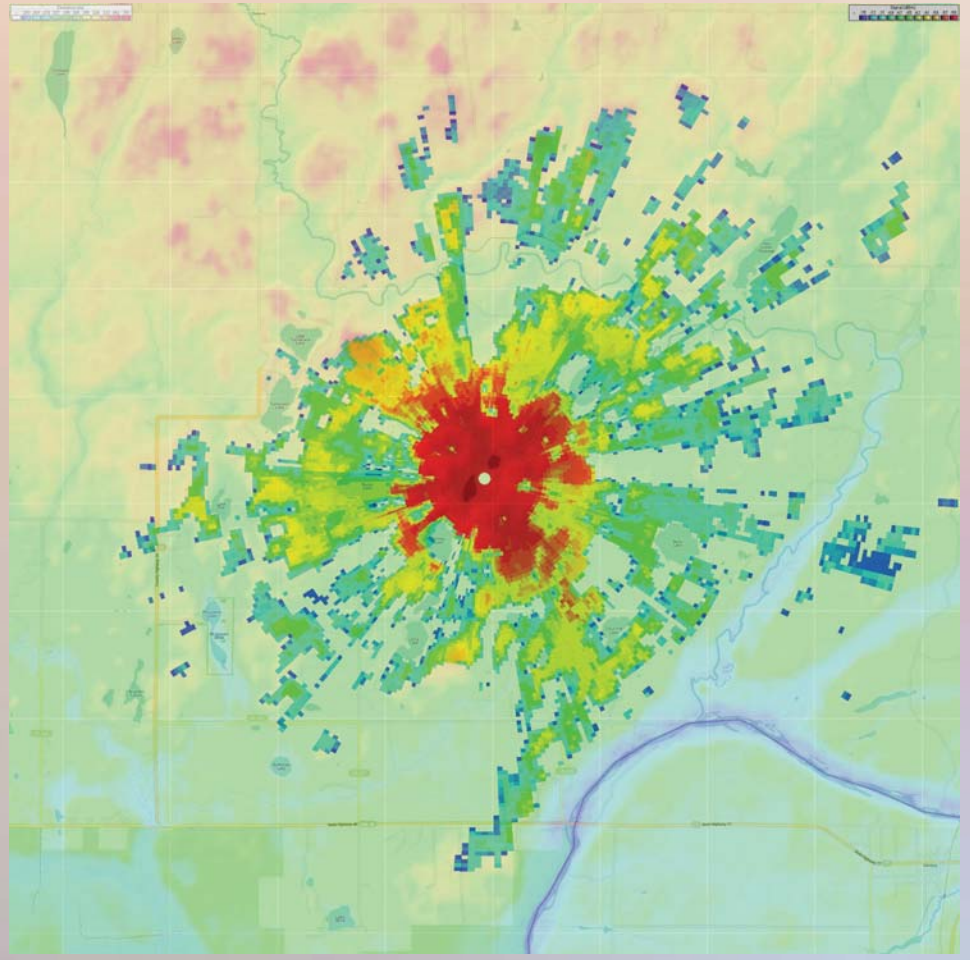


WiFi 2.4 GHz Signal - HotSpots

- WiFi, the universal frequency used by thousands of devices ranging from: lap-tops, cell phones, gaming devices, iPads, iPods, Iphones, etc.
- WiFi offers a very quick way for people to connect to the internet for many purposes including texting and cell phones connections.
- Lake Lena could utilize centralized locations to offer free access. Suggested locations: clinic, community center, school, ceremonial center, park & recreation area, ball diamond and hock-ey rink near Razor Lake

4G WiMAX 3.65 GHz Signal

- The next signal tested was 4G WiMAX 3.65 GHz. The following is an overview map of signal coverage.
- The 3.65 had the better signal propogation than 5.2 – 5.8 GHz and similar to the 2.4, but still was unable to reach Razor Lake. This is most likely due to the fact that 4G WiMAX needs to be mounted to a tower. The Red areas indicate optimal signal.

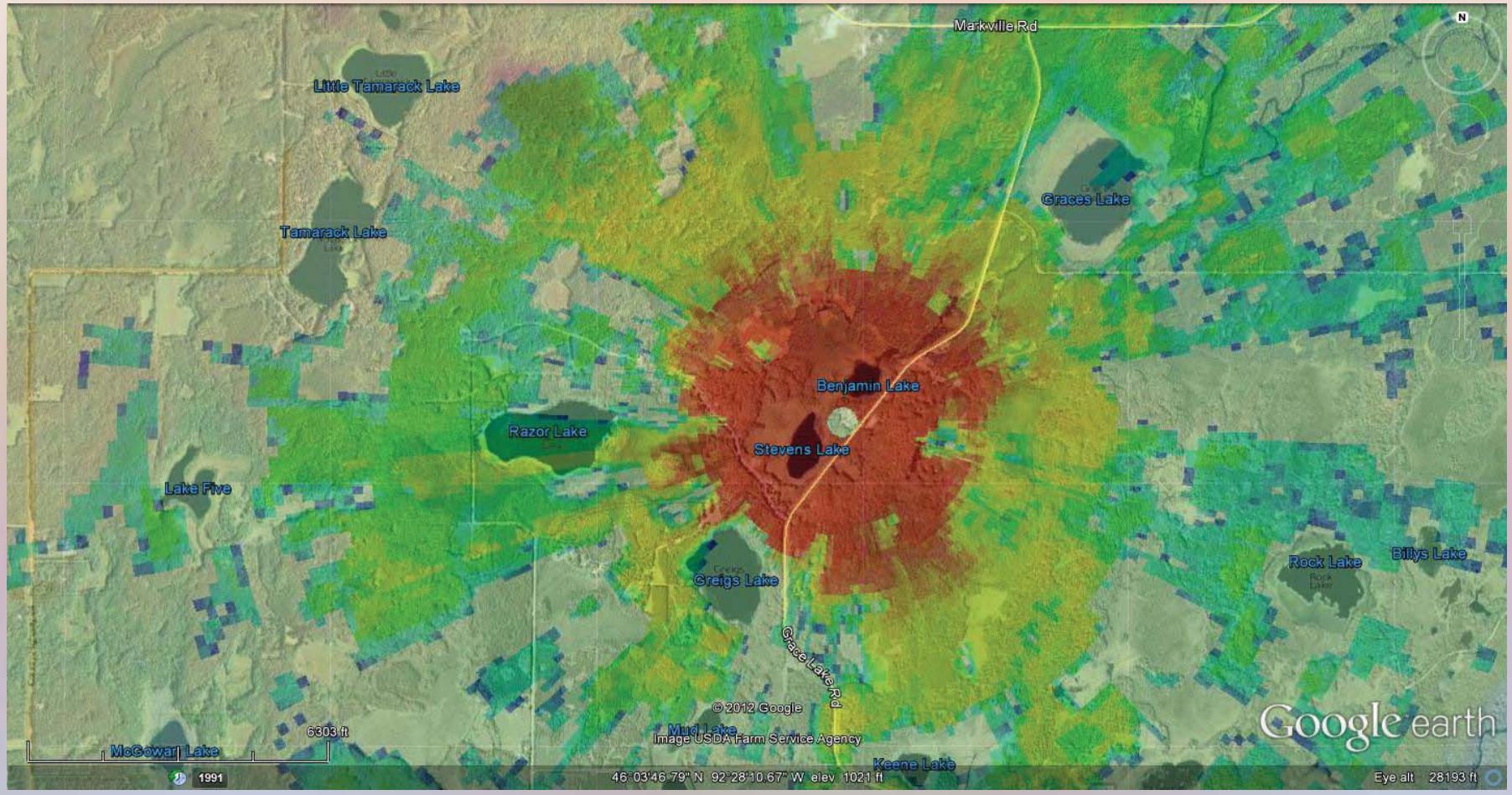


4G WiMAX 3.65 GHz Signal Continued

- 4G WiMAX is the latest technology in wireless that offers greatly increased speeds. It's very much like cellular service.
- WiMAX has built-in service flows for offering internet-based telephone (VoIP), video, and mobile services.
- The Google Earth image on the following page shows the 3.65 GHz signal from the roof of the clinic. This signal footprint would improve greatly with equipment mounted on a proper tower.

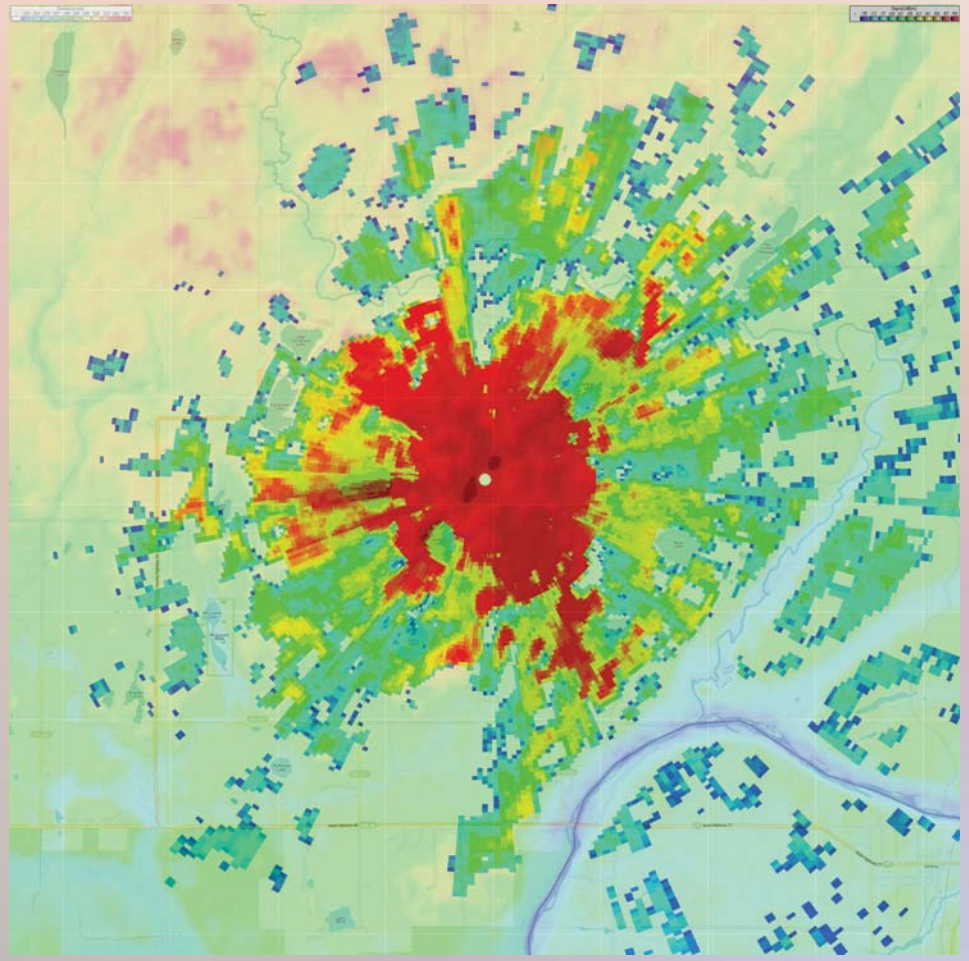
alvarion
Your Open WiMAX Choice

Google Earth Photo of WiMAX 3.65 GHz Signal Propagation



900 MHz Signal

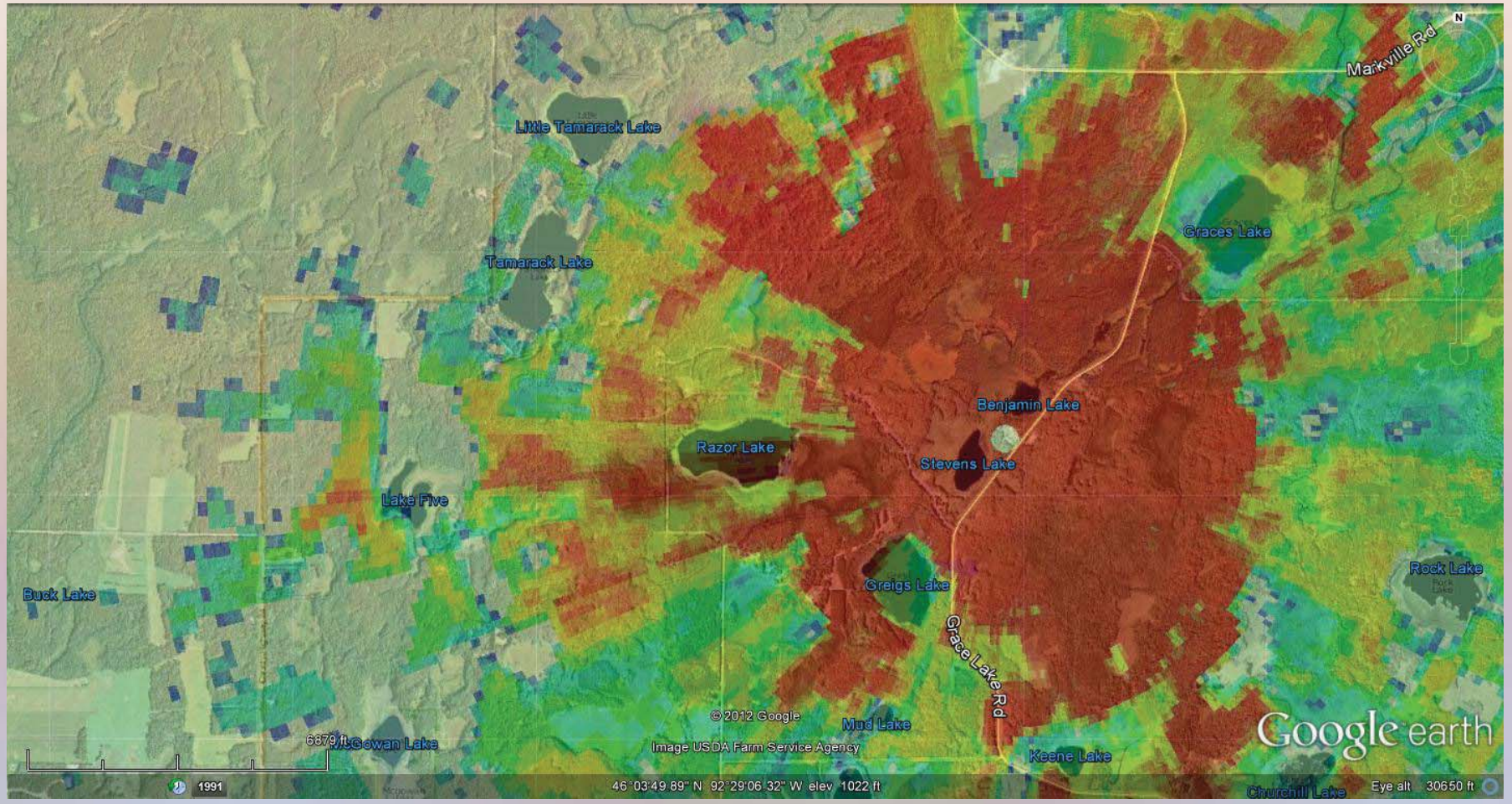
- The best performing signal tested was 900 MHz. The following is an overview map of signal coverage.
- The 900 MHz had the best signal propagation and was able to reach the farthest. It almost made it to Razor Lake. The Red areas indicate optimal signal.
- A tower would optimize signal coverage, but would not be necessary to get high speed internet service operating. Antennas could be mounted to the rooftop of the clinic and plug directly into the fiber network (photo on next page).



900 MHz Signal Continued

- Customer equipment for 900 MHZ would be a grid dish mounted on the roof of a home.
- There would need to be a repeater at the school and at the recreation area near Razor Lake to ensure that every resident wanting service would be able to get it. These could easily include 2.4 GHz WiFi Hotspots.
- The Google Earth image on the next page shows that the 900 MHz signal was able to propagate beyond the clinic and community center. It went past the Ceremonial Center and gets out near residents on Razor Lake.

Google Earth Photo of 900 MHz Signal Propogation



Communications Tower

To Build or Not to Build...

There are some distinct advantages to building a 180' communications tower:

1. It would allow for optimal signal coverage for Lake Lena residents to receive high speed internet. It would allow use of more technically advanced equipment like the 4G WiMAX, including mobile vehicle connections and also offer highest speeds of all equipment tested.

2. It would allow for a backup wireless point-to-point link for everyone on the the fiber, connecting directly from the rooftop of the Grand Casino Hotel in Hinckley.

Communications Tower: Pros and Cons

`QUOTE-3786

PCS Technologies, Inc.
30 W. Water St.
St. Paul, MN 55107
PHONE: (651) 222-5881 FAX: (651) 228-2645
SHIP TO: Same Address

Mille Lacs Band (956)
777 Lady Luck Drive
Hinckley, MN 55037

ATTN: Jay Manke
800-472-6321

CUSTOMER QUOTE

QUOTE NUMBER : 3786 REQUESTED ON : 09-25-12
TERMS : Net 30 EXPIRES ON : 10-25-12
TAKEN BY : Dick SHIP VIA : Deliver to Site
REQUESTED BY : Jay Mankie SALES REP. : John
SITE NAME : Lena DESCRIPTION : 180' twr. & link

PART#	DESCRIPTION	UNIT.PRICE	UOM	QTY	TOT.PRICE
4246	180' Sabre SS Tower S3TL	29050.00	Each	1	29050.00
4248	Footing for 180' S3TL tower based on normal soils	18880.00	Each	1	18880.00
1012	Soils testing for self support tower	2500.00	1	1	2500.00
1664	Off load & Inventory Tower	420.00	per	1	420.00
4251	Assemble & erect 180' SS Sabre S3TL SS tower	10800.00	Each	1	10800.00
611	Site Grounding #2 ring around Twr. & cab.	2800.00	Each	1	2800.00
407	Site Survey	2900.00	Each	1	2900.00
2205	Site Engineering	1600.00	Each	1	1600.00
4336	Two Carrier Repeater	18700.00	each	1	18700.00
4337	6 GHz link w/6' dishes	39560.70	each	1	39560.70
357	Travel and Living Expense	2400.00	Each	1	2400.00
1548	FCC Licensing	1500.00	Each	1	1500.00
TOTAL					

QUOTE TOTAL $ 131110.70

SPECIAL REQUESTS / NOTES:

Quote is budgetary for the installation of a 180' self support tower at the Lena site. Also included is a 6 GHz link from the Casino to the Lena tower and a two carrier repeater that would be installed on the Lena tower. Customer is responsible for all permitting, tree clearing and landscaping.

3. It allows for rebroadcast of cellular providers services, greatly increasing cell phone coverage for residents.

4. It would allow mounting of civil defense sirens for weather emergencies.

Genesis obtained a quote from PCS for building a turnkey tower application for the Lake Lena Community. It includes a 180' tower and FCC licensing permits, a wireless point-to-point link for backing up the fiber, and it also includes a price on multi-carrier repeaters to be installed on the tower. It does not include the cost of high speed internet equipment. A path study was done on the wireless link to ensure it would be effective 99.999%. The next page shows the 6 GHz path study.

6 GHz Point to Point Path Study

6GHz 1500HP 32QAM 134Mbps 8ft Dish

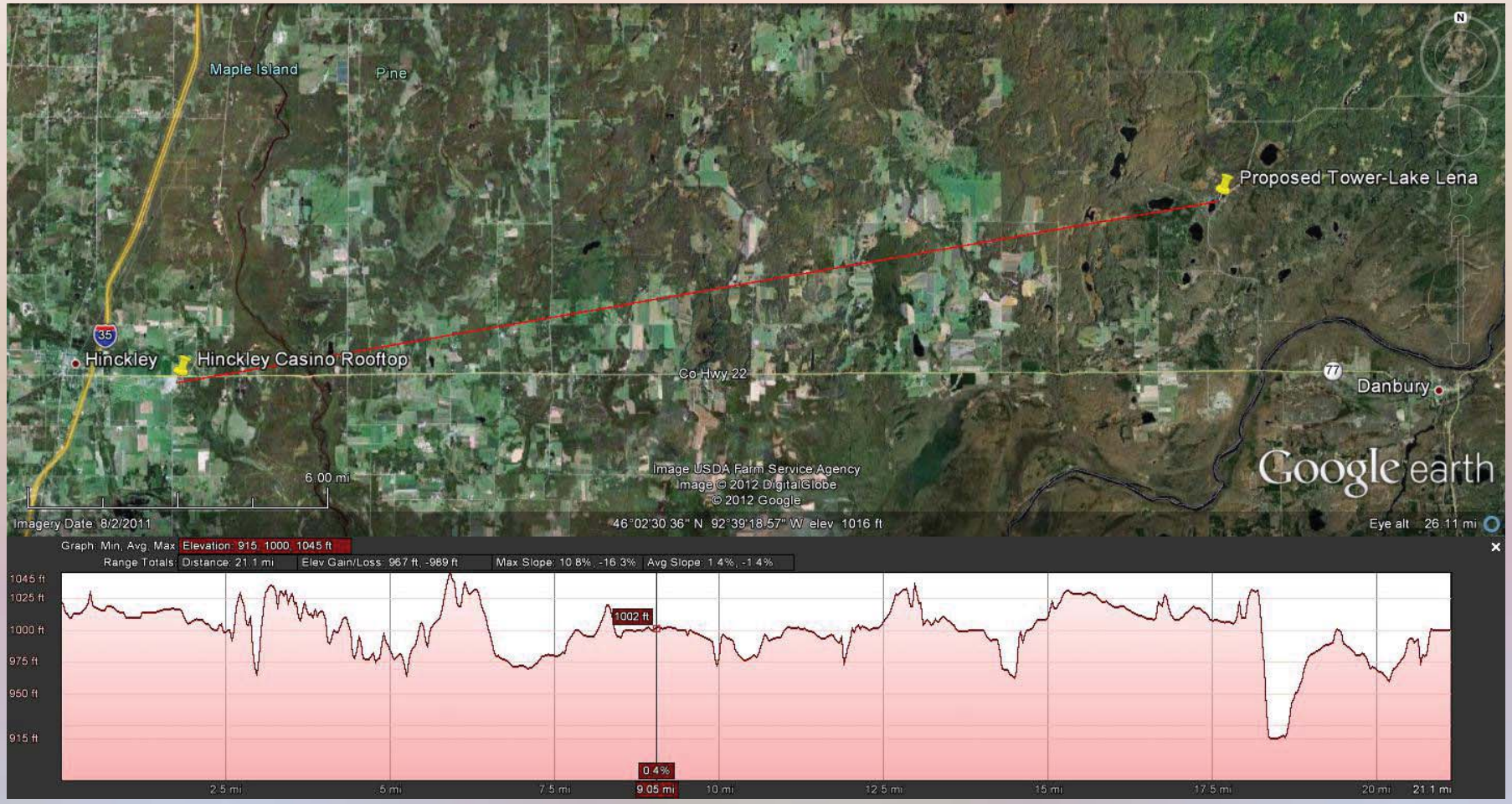
Grand Casino Hotel - Lake Lena

Elevation (ft) 997.38 1020.34
Latitude 46 00 32.97 N 46 03 41.58 N
Longitude 092 53 46.13 W 092 27 45.33 W
True azimuth (0) 80.00 260.31
Vertical angle (0) -0.07 -0.16
Antenna model HP8-59 HP8-59
Antenna height (ft) 120.00 180.00
Antenna gain (dBi) 41.50 41.50
TX line type FT6GHZ6FT FT6GHZ6FT
TX line length (ft) 6.00 6.00
TX line unit loss (dB /100 ft) 9.00 9.00
TX line loss (dB) 0.54 0.54
Connector loss (dB) 0.25 0.25
Other TX loss (dB) 0.50 0.50
Other RX loss (dB) 0.50 0.50
Frequency (MHz) 6000.00
Polarization Vertical
Path length (mi) 21.17
Free space loss (dB) 138.68
Atmospheric absorption loss (dB) 0.29
Net path loss (dB) 58.55 58.55
Code IP10-6-HP30-3 IP10-6-HP30-3
Traffic code 134Mbps-32QAM 134Mbps-32QAM
Radio model FibeAir IP10 HP 6GHz FibeAir IP10 HP 6GHz
TX power (dBm) 30.00 30.00

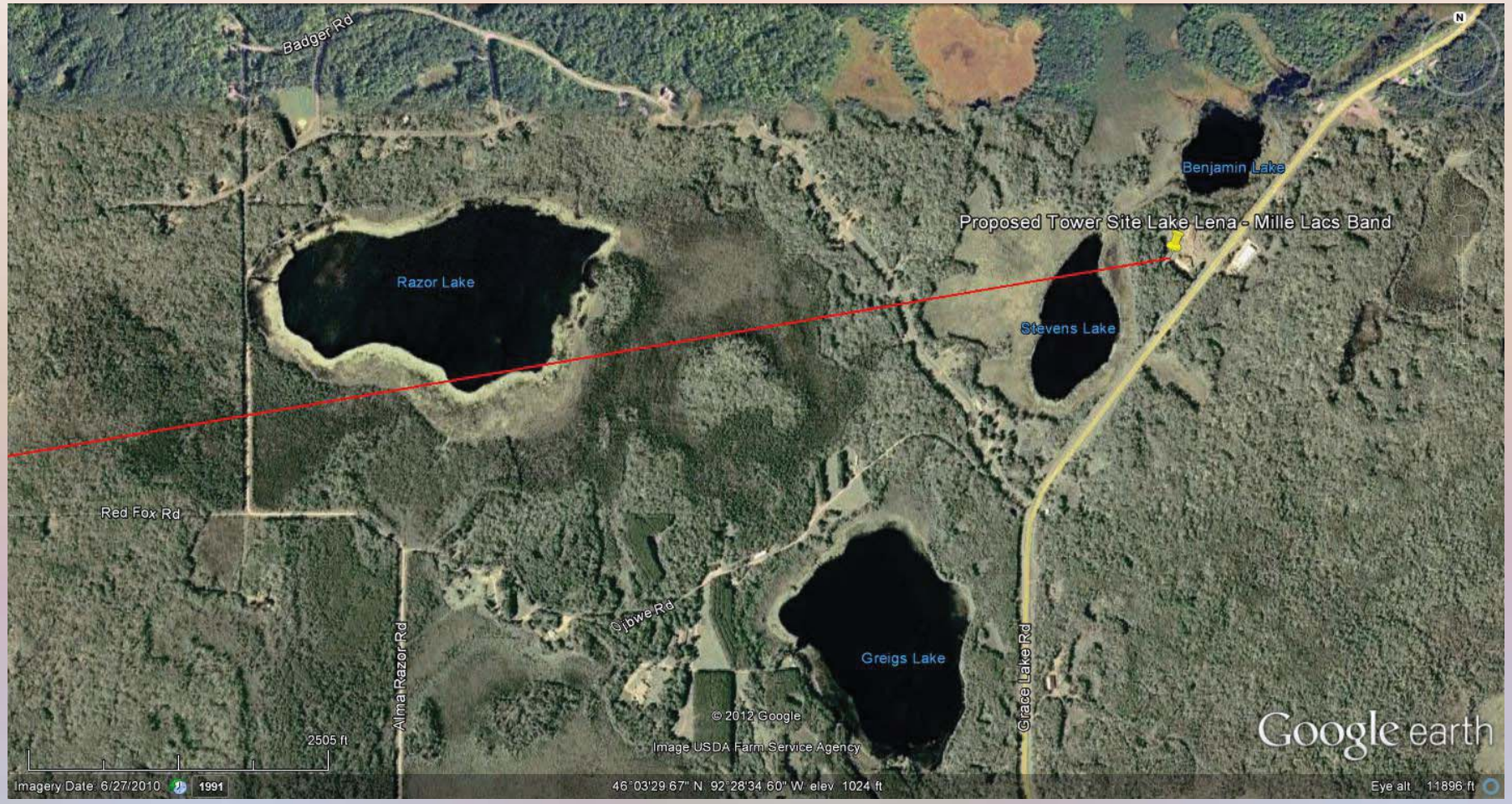
EIRP (dBm) 70.21 70.21
Emission designator 30M0D7WT 30M0D7WT
RX threshold criteria BER 10-6 BER 10-6
RX threshold level (dBm) -74.50 -74.50
RX signal (dBm) -28.55 -28.55
Thermal fade margin (dB) 45.95 45.95
Dispersive fade margin (dB) 56.60 56.60
Dispersive fade occurrence factor 1.00
Effective fade margin (dB) 45.60 45.60
Climatic factor 1.00
Terrain roughness (ft) 20.00
C factor 3.29
Fade occurrence factor (Po) 4.68E-01
Average annual temperature (0F) 68.00
Rain region D1-96 Temp. Cont inent
Annual multipath + rain (%-sec) 99.99912 – 276.82

*This document represents a preliminary design which is subject to a final path/site survey.
The design represents a best effort, and is not guaranteed.

Google Earth Photo of 6 GHz Point-to-Point Wireless Link



Google Earth Photo of Lake Lena Side of 6 GHz Point-to-Point Wireless Link



Recommendations

- Ultimately, building a tower would best serve the Lake Lena community. It would serve multiple purposes such as: local high speed internet, backup data link for the existing fiber network, cellular repeaters, civil defense sirens, and could also be used to boost local FM signal vehicle-to-vehicle transmission.
- The best signal coverage without a tower was obtained by the 900 MHz frequency. It also offers the least expensive route to offer high speed internet services. It is priced at $2900 installed per Broadcast site with WiFi repeater, complete with heavy-duty mounting kit, and all necessary copper grounding wire by code. All of the main broadcasts at the school and clinic could be plugged into fiber, allowing optimum internet speed.

Recommendations - Continued

- All installations would be performed by qualified, licensed and ensured Genesis personnel. Customer equipment costs $399 complete with heavy-duty mounting kit and all necessary copper grounding wire by code. Installation at each residence is $199 per site and would need to be installed by Genesis personnel to ensure a good quality connection. Installation take approximately 2-3 hours.
- Genesis would need to decide with the Mille Lacs Band on what would be appropriate monthly charges the Mille Lacs Band would like to see for the Lake Lena residents who use the service.
- There is an opportunity to offer service to non Lake Lena residents. The gas station would be an excellent place for a 900 MHz system with WiFi. There are several potential customers nearby. Their revenue from services could be used to offset the cost of service for Lake Lena residents.

Summary

- The cost to install turnkey Genesis WiMAX/LTE TELRAD systems with WiFi is $29,000 per location. There are 4 spots to start with:

Clinic	$29000
School	$29000
Gas Station	$29000
Razor Lake Rec Area	$29000
TOTAL	$116,000

- The Cost for PCS-TECH to install a tower turnkey with cellular repeater and point-to-point backup wireless link for the fiber network:

$131,110.70

Thank You

Genesis Wireless wants to thank the Mille Lacs Band for the consideration to assist the Lake Lena Community, and I look forward to the opportunity of a continued working relationship.

Please call me with any questions regarding this wireless study. I can be reached at:

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Braham, MN 55006

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