March 15, 2018

Shaun Martin Castle Rock

Town of Castle Rock Planning Commission

Dear Commissioners,

I represent a group of concerned citizens who reside in Castle Rock that are <u>opposed to</u> <u>the proposed location of a cell tower adjacent to Quarry Mesa</u>. To be clear, we do support improved cellular service for residence, but we do believe that there are alternatives that balance the need for adequate cellular service and the desire to preserve our Town identity, vision and values.

We've thoroughly researched the Town Municipal Code, the Town 20/20 and 20/30 Vision, various studies concerning impact to home values in proximity to cell towers, court cases supporting municipalities rejecting cell tower locations, and alternative solutions to bring improved cellular service to the Crystal Valley area. We've also attended all of the applicant's open forums where we, along with the vast majority of attendees voiced our clear opposition to the construction of a cell tower at this location.

Included with this letter is the summation of our research to date (PROPOSED CELL TOWER – ADVERSELY AFFECTING THE RESIDENTIAL & RECREATIONAL AREA OF:...). Please consider our research and efforts in making your decision regarding this application. Thank you.

Sincerely,

Shaun Martin

# **PROPOSED CELL TOWER**

ADVERSELY AFFECTING THE RESIDENTIAL & RECREATIONAL AREAS OF :

Quarry Mesa Madge Trail Rhyolite Park Crystal Valley Neighborhood Town of Castle Rock



# **Residents Supporting Cell Service** in Appropriate Town Locations

- We are a group of concerned Castle Rock residents who care about our Town and who *support* better cellular service for Crystal Valley Ranch.
- We are active members of the community who volunteer to serve our HOAs and our Town Board.
- We are invested in our community because Castle Rock is our home.
- We oppose the proposed location of a cell tower adjacent to Quarry Mesa, Madge Trail, Rhyolite Park, and Crystal Valley because of the unintended negative results to the neighborhood if a cell tower is built.
- We have attended all open forums hosted by the applicant.
- We have received comments and concerns from other residents who are not present tonight but who's views are represented in this summary.
- We have reviewed the Town Code, real estate publications, court rulings and news articles about cell tower placements, and new emerging technologies
- We have determined that <u>there are alternative solutions to this</u> <u>application that must be considered</u>.

# Why should this tower location be reconsidered for a different area?



# Map of the Proposed Location



# **Conflicts with Town Municipal Code**

1. 17.60.020 - ... (i) encourage the location of towers on public property and in <u>nonresidential areas</u> and to minimize the total number of towers throughout the Town (ii) encourage strongly the joint use of new and existing tower sites; (iii) encourage users of towers and antennas to locate them, to the extent possible, in areas where the adverse impact on the Town is minimal...

- 2. 17.60.030 Industry site selection criteria: H. <u>Compatibility</u> <u>with adjacent land uses</u>
- 17.60.040 C. Personal wireless service facilities should be located and designed to <u>minimize any impacts on</u> <u>residential property values</u>
- 4. 17.60.050 Priority No. 2: Place antennas on appropriate **existing structures**, such as buildings, towers, water towers and smokestacks in other zoned districts
- 5. 17.60.060 B. 2. The antennas or tower will have <u>no</u> <u>adverse impact on surrounding private property</u>.
- 17.60.080 B. 1. <u>Setback</u>: Tower setbacks shall be measured from the base of the tower to the property line of the parcel on which it is located.
- 17.60.140 In certain circumstances, there may be a need for expert review by a third party of the technical data submitted...The Town Council or the Planning Commission may require such a technical review, to be paid for by the applicant for the personal wireless services or facilities.

# Conflicts

- (i) Proposed location is <u>within a residential area</u> (closet home is 500 feet away); (ii) Verizon and Sprint have existing towers providing service in this neighborhood (*Attachment 2*), (iii) location is in neighborhood and recreational space.
- Adjacent land use is residential and recreational and incompatible for a cell tower site. <u>This site would</u> <u>be a commercial intrusion into a residential area</u>.
- 3. Real estate/appraisal data support the concern that cell towers near or in residential areas will diminish home values (*Attachment 3*). Applicant's home value impact/technical study was authored by a law firm that represents the cell tower company. The report is self-serving and was not conducted by an independent 3rd party.
- 4. The current application is for a new tower not for use of existing structure.
- 5. Numerous real estate and appraisal data reports support the concern that cell tows near or in residential areas will diminish home values.
- 6. Setback for the application is only 20 feet instead of the required 150 feet within a residential area.
- 7. Applicant's technical analysis is self-serving and lacking in-depth investigation of alternatives.

# Conflicts with Town's Vision 2020/2030

 Castle Rock's Vision 2020/2030 Statement lists under two different headings:

- <u>Town Identity</u>. "Preserve open space areas in and surrounding Castle Rock to protect the Town's natural beauty, ridge-lines, and scenic views ..."
- <u>Community Planning</u>. "Plan and provide for high-quality open space areas to accommodate community events, active and passive recreation, trail linkages, natural buffers, and environmental preservation."

# Conflicts

Quarry Mesa is a beautiful, open space enjoyed by hikers in the area and around Castle Rock.

Further, it is of great historic value to Castle Rock. The reality is that Castle Rock would have not survived if it were not for the rhyolite discovered and quarried at Quarry Mesa.

The proposed location of the Tower is directly adjacent to the main trail leading to the top of Quarry Mesa and Madge Trail.

This location would violate the intent of Vision 2020/2030.

# **Negative Impact on Property Values**

- In addition to being adjacent to Rhyolite Park, where there is a children's BMX park, sports fields, playgrounds and picnic areas, the proposed tower will be located directly across the road from two residential neighborhoods.
- Many studies show that close proximity to a cell tower <u>decreases a home's value</u> (Attachment 3)
  - In January 2011 the US District Court in Atlanta Georgia, Judge William S. Duffy Jr. found that Cobb County Georgia <u>was justified in denying a T-Mobile</u> <u>application</u> for a cell tower based on: the tower would <u>not be compatible with a</u> <u>residential area</u> and would be a commercial intrusion into a residential area, <u>property values would suffer</u>, and other reasons and contributing factors (see Attachment 3).
- Decreased home values of up to 20% could directly <u>impact one of the largest</u> <u>investments of residents</u> in the surrounding area of the tower - their property values.
- Decreased home values also could **impact tax revenue** collected by Douglas County, Schools, and the Town.
- The Town's ordinance governing the use of cell towers <u>discourages location in</u> <u>residential areas</u> and adjacent to public parks.
- The applicant's home value impact study was authored by a law firm that represents cellular service providers and **should not be relied upon as objective**.

# **Alternative Solutions**

- New cell service technologies are quickly eliminating the need for huge towers by **installing smaller and easy to conceal antennas within existing Town structures** like street lights, flag poles, etc.
  - Verizon Wireless Use By Special Review: Proposing 3 new small cells located at 3065 Foothills Drive (20' hut style), 1760 Meadows Blvd (20' hut style), and 1470 Clear Sky Way (in Bison Park in a light pole).
- Evolving technology (micro-cells, Wi-Fi calling, and choice of carriers) provide a way to eliminate any significant gaps in adequate cell service without the construction of another tower.
- Find an Alternate location



- Applicant has not conducted adequate research to identify alternatives to the proposed location.
- Applicant did not respond to request for data showing incremental increase of customers and quality of service for the proposed tower and comparable alternative/multiple tower locations
- Applicant will not explain their method of data gathering and claims their analysis is "proprietary."
- Applicant states the current Verizon tower serving this area is "not compatible" with their technology but no evidence has been provided.
- Applicant profits if it has its own cell tower to lease antenna space to carriers.





We ask for the Planning Commission and Town Council to reject this application for a cell tower located at Quarry Mesa. We believe that there are other legitimate and reasonable alternatives that provide balance to the need for cellular service and the need for preservation of our trails, open space, conservation areas, parks, and neighborhoods.

Castle Rock is attractive to families and businesses because of the quality of life provided here. We ask the Planning Commission and Town Council to consider the precedent this might set should this tower go forward at this location and to take the broader and longer term view of what is really important to the Town.

Thank you

# **Supporting Documents**

- Attachment 1 Detailed summary of conflicts with Town Code
- Attachment 2 Assessment of Verizon's cell coverage in the area
- Attachment 3 Real estate articles supporting the negative effect of cell towers on property values
- Attachment 4 Alternative technology solutions

17.60.020 - Policy statement:

The goals of this Chapter are to: (i) encourage the location of towers on public property and in <u>nonresidential areas and to minimize the total number of towers throughout the Town; (ii)</u> encourage strongly the joint use of new and existing tower sites; (iii) encourage users of towers and antennas to locate them, to the extent possible, in areas where the adverse impact on the Town is minimal; (iv) encourage users of towers and antennas to configure them in a way that minimizes the visual impact of the towers and antennas.

- (i) The proposed location is clearly within a residential area with the closest home being approximately 500 feet away. Public Open Space, Quarry Mesa and Madge Trail are immediately adjacent to the proposed location and a Town Park, Rhyolite Park are also adjacent to the proposed location. Further, a proposed school site is also adjacent to the this location. <u>No question, this is a very residential area</u>.
- (ii) Many residence in the Crystal Valley neighborhoods receive adequate cell service from Verizon and/or Sprint. The Municipal Code encourages the use of <u>existing cell</u> <u>towers and existing cell tower locations</u> for carriers to provide service. As Verizon and Sprint provide service to many areas that are under served by T- Mobile and other carriers, why aren't the existing towers and locations that are providing service being expanded and improved to provide T-Mobile with the service level they are striving for?
- (iii) This location does not seek to minimize the adverse impact on the Town as it is in a neighborhood and Open Space / recreational setting that is clearly visible to the residence and to the Town's people utilizing the trail and Open Space system.
- 17.60.030 Industry site selection criteria:
  - H. Compatibility with adjacent land uses.
    - A cell tower is clearly **not compatible** with contiguous and adjacent existing land uses of Quarry Mesa Open Space (a historic site), Madge Trail, Rhyolite Park, a future public school, and is a <u>commercial intrusion into a residential area</u>.

17.60.040 - Town site selection criteria:

C. Personal wireless service facilities should be <u>located and designed to minimize any</u> <u>impacts on residential property values</u>. Sites should be placed in locations where the <u>existing topography, vegetation, buildings or other structures provide the greatest amount of</u> <u>screening</u>.

 Numerous studies conducted by realtors and appraisers (references included) have found that cell towers located in existing neighborhoods diminish home values by approximately 20%. The topography, vegetation and building associated with the proposed site provide NO amount of screening. 17.60.050 - Priorities.

Priority No. 2: Place antennas on appropriate existing structures, such as buildings, towers, water towers and smokestacks in other zoned districts.

- The application proposes building a new cell tower which violates the second priority.

17.60.060 - Use of Town property.

B. Minimum requirements. 1. The antennas or tower will not interfere with the purpose for which the Town-owned property is intended; 2. The antennas or tower will have <u>no adverse</u> <u>impact on surrounding private property</u>.

 As mentioned above, the proposed location is not compatible with open space / trail system and would interfere with its use and enjoyment. Also mentioned above, the cell tower <u>would adversely impact surrounding residential property values</u>.

8. The applicant will cooperate with the Town's objective to promote co-locations and thus limit the number of separate antenna sites requested.

- This is a new site and does not meet this Town objective.

C. Special requirements. 2. Parks. "The presence of certain personal wireless service facilities, antennas or towers represents a <u>potential conflict with the purpose of some Town-owned parks</u>. In no case shall towers or antennas be allowed in designated conservation areas..."

 While the proposed location is not technically within a conservation area, it is adjacent to a conservation area and is immediately contiguous to the trail that accesses the conservation area. It would be adjacent to and visible from Rhyolite Park.

#### 17.60.080 - Design and review criteria.

B. 1. Setback: **Tower setbacks** shall be measured from the base of the tower to the property line of the parcel on which it is located.

- The municipal code requires that the set back for a cell tower <u>located in a</u> <u>residential area</u> be 3 times its height. That would be **150 feet for this tower.** The site plan provided in this application indicates a set back of only approximately 20 feet - a clear violation of this section of the Municipal Code.
- The applicant may argue that the proposed location is not zoned residential. While this is true, the Ordinance states residential area, not residential zone. The term of art "zone" was available to the authors of the municipal code, but the term "area" was used to indicate the general character of the location. The immediate adjacency of homes, hiking trails, open space and parks indicates that this is clearly a residential area.

17.60.140 - Third party review.

".... In certain instances there may be a need for expert review by a third party of the technical data submitted by the personal wireless services provider. The Town Council or the Planning Commission may require such a technical review, to be paid for by the applicant for the personal wireless services or facilities.

We believe that the technical analysis conducted by the applicant is self serving, and should this application go forward, we would ask that the Town exercise their prerogative to require an independent third party review – paid for by the applicant.

3/5/2018	TOTAL				
	HOMES/				
	LOTS IN	N	NO. OF RECEPTION BARS		
DEVELOPMENT	SAMPLE	1	Ш	Ш	<u>IIII</u>
OAK RIDGE	90		90		
PINE MEADOWS	69		69		
SKY VIEW	79	13	66		
TARAS RIDGE	58	2	8	48	
OLD LANTERN	94	4	82	8	
PAINTERS RIDGE	46		27	19	
CARRIAGE HILLS	135	40	93		2
KINGS RIDGE- SOUTH	56		56		
ANTELOPE RIDGE	210	6	78	103	23
WINDFLOWER	165	34	81	38	15
	1002	99	-	-	-
		9.9%	707 83.6%		
	415				
			50.4%		4%

**CVR CELL TOWER SIGNALS - VERIZON PROVIDER** 

#### 2.6 MILES ALONG LOOP ROAD



### Attachment 2 - Assessment of Verizon's cell coverage in the area

The table above contains the qualitative data gathered with a cell phone on the VERIZON reception quality in CVR. The sample includes all CVR communities but each homes/lots was not included. The method was to drive down the center of each street and record the number of reception bars indicated on a cell phone. This data collection method has some flaws: (1) cell phone reception in the center of each street does not necessarily indicate reception in each house, and (2) cell tower transmissions can be partially blocked by a car. Still, this study is indicative of the general VERIZON cell tower transmission reception quality in the overall CVR area.

#### What these rough data show is the following:

- Nowhere was VERIZON coverage measured at ZERO coverage!
- Less than 10% of those communities/areas surveyed only had a "single bar" of reception strength.
- 84% of those communities/areas surveyed had 2 or 3 bars of reception strength.
- 50% of those communities/areas surveyed had 3 or 4 bars of reception strength.
- 77% of the general open area inside of Loop Road between the back of Windflower and Opal Ridge has 2, 3 or 4 reception bars.

#### TENTATIVE CONCLUSIONS

- 1. There is NOT a general cell coverage problem in CVR -VERIZON's coverage is pretty good and other reports indicate that Sprint and AT&T probably have similar generally good coverage. Nowhere were there ZERO Bars of VERIZON reception.
- 2. There are spots in CVR where the VERIZON coverage could certainly be improved, so we will probably all agree that we support improved cell coverage in CVR. What we still oppose is the consistent 'single tower' solution proposed by the Applicant.
- 3. Those residents who live in weak coverage areas ought to explore doing business with another wireless provider OR going to their current provider and either buying or demanding a 'booster box' to improve their reception quality.
- 4. These few residents with poor or no coverage with their present wireless providers should NOT expect the entire CVR community to be penalized with the Applicant's 'single tower' solution when the Applicant could provide a two-tower solution that optimizes wireless reception quality on both sides of "the ridge" while keeping the open space ambiance intact.

- **The common sense approach**: Would you prefer to purchase a home adjacent to a cell tower or not adjacent to a cell tower?
- The data driven approach:
  - Many studies show that close proximity to a cell tower decreases a home's value. Homes constructed around pre-existing cell towers are likely effected little, but homes constructed in areas that when constructed did not have cell towers have negatively impacted home values. <u>Good analysis differentiates cellular service and cellular tower – these are two very different things</u>.
  - The applicant's home value impact study ("Cell Phone Towers Do Not Affect Property Values") was authored by the Saul Ewing law firm that represents the Telecommunications industry, specifically the interest of cellular service providers.

This study **should not be considered an independent report**. The study falls short for the following reasons:

- The article was authored by lawyers that have as clients cellular communications companies. The conclusions of the article are biased toward their clients and not a thorough objective evaluation of all the literature / studies available.
- 2. The AT&T study sited repeatedly finds that cellular towers just fade into the background of all the other exposed infrastructure such as "gas pumps, power lines, telephone poles, etc." Crystal Valley Ranch was purposely designed and constructed at great additional cost to conceal utility infrastructure. This is a false comparison to the Quarry Mesa situation.
- 3. In the sited AT&T vs. Sussex case the article notes over and over again that the location of the tower was in a heavily commercial area. Again, another false comparison to Crystal Valley Ranch and Quarry Mesa, a purely residential and recreational area.
- Independent studies by realtors and appraisers find that there is a negative impact.
- The 11<sup>th</sup> Circuit Court found that the negative impact on home values was in part good reason to support a municipalities decision to deny a T-Mobile application.
- Vast investment has been made in landscape and infrastructure to beautify the Crystal Valley corridor. Home owners in the Metro District will pay for these improvements. Shall we now allow a highly visible cell tower to be placed in plain site? <u>NO!</u>
- Studies
  - The Bond and Hue Proximate Impact Study
     The Bond and Hue study conducted in 2004 involved the analysis of 9,514 residential
     home sales in 10 suburbs. The study reflected that close proximity to a Cell Tower
     reduced price by 15% on average.
  - The Bond and Wang Transaction Based Market Study
     The Bond and Wang study involved the analysis of 4,283 residential home sales in 4
     suburbs between 1984 and 2002. The study reflected that close proximity to a Cell
     Tower reduced the price between 20.7% and 21%.

#### Impact to Neighborhood Image

Crystal Valley is a community with all utilities buried underground. We have invested, through our metro district, over a \$1,000,000 to sink our community water tank below grade (to the largest extend possible). Power, cable TV, internet and telephone are also buried.

Some in our community are also subject to the Ridgeline Ordinance requiring additional trees to help hide houses near the ridgeline from view and have invested many thousands of dollars per house to meet these requirements.

Residents have all, directly or indirectly, invested significantly to preserve the natural and clutter free appearance of the neighborhood.

The applicant should be held to the same high standard we have met and should not be allowed the sole exemption to build their water tank antenna 50 feet above grade to save a relatively small amount of money.

#### Example of "Windmill" Cell Tower Eventually Cluttered with Multiple Lease Add-ons



#### Attached Supporting Articles and Court Cases:

- 1. T-Mobile South LLC v. Cobb County, Georgia, No. 1:10-cv-00111-WSD (N.D. Ga. Jan., 31, 2011)
- Survey by the National Institute for Science, Law & Public Policy Indicates Cell Towers and Antennas Negatively Impact Interest in Real Estate Properties, *Business Wire*, July 3, 2014
- "A Pushback Against Cell Towers" by Marcelle S. Fischler, *The New York Times*, August 27, 2010
- 4. "The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods" by Sandy Bond, PhD, and Ko-Kang Wang, 2005
- 5. "Fact Sheet: Cell Towers Create Significant Decline in Property Value" by J. Baraberi

### IN THE UNITED STATES DISTRICT COURT FOR THE NORTHERN DISTRICT OF GEORGIA ATLANTA DIVISION

### **T-MOBILE SOUTH LLC,**

Plaintiff,

v.

1:10-cv-0111-WSD

**COBB COUNTY, GEORGIA,** 

Defendant.

### **OPINION AND ORDER**

This matter is before the Court on Cobb County, Georgia's (the "County") motion for summary judgment [16] and T-Mobile South LLC's ("T-Mobile") motion for summary judgment [17].

### I. BACKGROUND

This case involves the County's denial of T-Mobile's application for a Special Land Use Permit to construct a cell tower on a property owned and occupied by a local Episcopal church. T-Mobile is a cellular service provider. Cobb County is a political subdivision in the State of Georgia that acts through its authorized officials, including the Cobb County Board of Commissioners.

T-Mobile provides cellular service to customers in Cobb County and seeks to add a cell tower on the church property to meet its area coverage goals. Plaintiff considered collocating its telecommunications equipment on an existing tower in the area, but concluded that collocation did not meet its coverage goals and decided instead upon the construction of a new tower and contracted to build it on property owned by the church at 1673 Jamerson Road, Marietta, Georgia 30066 ("the property"). The property is zoned "R-30," which restricts development to single family homes on lots of at least 30,000 square feet and generally restricts structures to no more than thirty-five (35) feet in height. Because the property is zoned for residential uses, Cobb County's zoning ordinance required T-Mobile to apply for a special use permit to allow the tower to be constructed. Cobb County's decision not to issue the permit forms the basis for this action.

#### A. <u>T-Mobile's Application</u>

On September 3, 2009, T-Mobile applied for a Special Land Use Permit (the "Application") to build, on the property, a 135-foot-tall cell tower disguised as a church bell tower. The County's Planning and Zoning Staff reviewed the Application for compliance with the County's local zoning ordinance (the "Ordinance"). The Ordinance provides several design, location, and safety requirements for the construction of towers over 35 feet. Official Code of Cobb County, Georgia § 134-273. The Ordinance also lists fifteen factors to consider

when addressing whether to grant a Special Land Use Permit. Id. § 134-37(e).

The factors relevant in this case include:

(1) Whether or not there will be a significant adverse effect on the neighborhood or area in which the proposed use will be located.

(2) Whether or not the use is otherwise compatible with the neighborhood. . . .

(5) Whether or not property values of surrounding property will be adversely affected. . . .

(8) Whether or not special or unique conditions overcome the board of commissioners' general presumption that residential neighborhoods should not allow noncompatible business uses

(15) In all applications for a special land use permit the burden shall be on the applicant both to produce sufficient information to allow the county to fully consider all relevant factors and to demonstrate that the proposal complies with all applicable requirements and is otherwise consistent with the policies in the factors enumerated in this chapter for consideration by the county.

Id. The Planning and Zoning Staff concluded that the Application complied with

the requirements set out in the Ordinance and recommended approval of it.

On October 22, 2009, T-Mobile held a public information hearing to take

questions and hear suggestions from local residents about the Application. On

October 28, 2009, in response to comments made at the hearing, T-Mobile

amended its Application to provide that the tower be a "monopine"<sup>1</sup> rather than a bell tower.

On November 3, 2009, the Cobb County Planning Commission ("Commission") held a hearing to consider T-Mobile's amended Application. Representatives of T-Mobile presented remarks and offered additional documentation at the hearing to support its Application. T-Mobile highlighted a report ("T-Mobile report") suggesting that cell towers constructed close to residences did not negatively affect residential property values. The T-Mobile report's conclusion was based on purported property values in two subdivisions in other parts of Cobb County, which were adjacent to cell towers and where the homes sold for up to \$500,000. In both of these examples, the subdivisions were developed and the homes within them were constructed at or near cell towers that preexisted the developments and construction. The T-Mobile report was not prepared by a professional property appraiser. At the hearing, T-Mobile explained its need for the cell tower and its radio frequency engineer discussed how the proposed tower would help T-Mobile meet its coverage goals in the area. Several local residents spoke in opposition to the Application. After hearing evidence from

<sup>&</sup>lt;sup>1</sup> A "monopine" is a telecommunications tower disguised as a pine tree.

both T-Mobile and the opposition, the Commission voted to recommend that the Application be denied.

### B. Board of Commissioners

On November 17, 2009, Defendant Cobb County's Board of Commissioners ("Board") heard T-Mobile's Application. Representatives of T-Mobile and local residents opposing the Application both made presentations to the Board at the meeting.

T-Mobile stated that it preferred to collocate its equipment on an existing tower, but there were no towers in the area that suited T-Mobile's needs. <u>Id.</u> at 3. T-Mobile also presented photographs of a balloon test simulation,<sup>2</sup> which it argued showed that the tower would either not be visible or would be minimally visible to most residents in the neighborhoods in the area proposed for the tower construction. Id.

T-Mobile also presented evidence demonstrating why it needed the tower. <u>Id.</u> T-Mobile stated that while it currently provides cell coverage to the area in question, the coverage is not sufficient to allow customers to have service inside of buildings. <u>Id.</u> T-Mobile presented a computer-generated coverage map that sought

<sup>&</sup>lt;sup>2</sup> In the "balloon test" T-Mobile tethered a red balloon to the proposed tower location with a cord that is the as long as the proposed tower is high. T-Mobile took pictures of the tethered balloon from nearby streets to determine whether the proposed tower would be visible to area residents.

to show that areas near the proposed tower did not enjoy coverage that was satisfactory to T-Mobile. <u>Id.</u> T-Mobile claimed the computer-generated coverage map had been verified by an employee who conducted a drive test in the area. Plaintiff conceded that no testing was conducted to determine signal strength inside the homes or other buildings in the vicinity of the proposed tower. <u>Id.</u>

Opponents of the tower also presented evidence and their position on the tower. They argued that at least some of the balloon tests were conducted during windy conditions, which misrepresented the visual impact of the tower because the balloons were blown across the horizon. <u>Id.</u> at 4. The opponents also noted that the balloon tests were conducted when the trees in the impact area had full or nearly full leaf cover, misrepresenting the visual impact of the tower during the winter months. <u>Id.</u> T-Mobile admitted that the balloon test photographs do not depict the view of the proposed tower from the backyards of the closest homes, and did not depict the view of the proposed tower after the deciduous trees lost their leaves. <u>Id.</u>

Local resident testimony refuted the information offered by T-Mobile to support its need for the proposed tower. Local residents who had T-Mobile service testified that the service and signal strength was adequate and they were satisfied with the service they had in their neighborhood. T-Mobile did not present any

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evidence of dropped calls in the area of the proposed tower or complaints about signal strength or call quality. <u>Id.</u> at 4.

David Levtro, speaking on behalf of his neighborhood, also presented information opposing the Application. <u>Id.</u> at 4-5. Levtro introduced a screen shot from T-Mobile's website in which T-Mobile represented to current and potential customers T-Mobile's signal strength in the area of the proposed tower was rated "best" by T-mobile. <u>Id.</u> at 5; R. 565. Levtro also presented a survey of local residents, including many T-Mobile customers, who overwhelmingly indicated that they had adequate wireless service in the area. Board Decision at 5; <u>see</u> R. 645-60. Janice Owen, a local resident, testified that she discontinued her land line telephone service and now relies exclusively upon her T-Mobile wireless phone for all of her telecommunication needs. Board Decision at 5. She testified that she did not have any coverage issues with T-Mobile. <u>Id.</u>

The Board also reviewed a letter from Kacey Lewis, a local licensed realtor with nearly 29 years of real estate sales experience. Board Decision at 5; R. 530. Ms. Lewis wrote that in her opinion the proposed tower would lower the property values of nearby homes.<sup>3</sup> <u>Id.</u> Several local residents spoke to the Board and stated

<sup>&</sup>lt;sup>3</sup> The opponents submitted an unsigned draft letter, purportedly from Regions Bank, stating that the proposed tower would harm property values. R. 531. The Court does not consider this letter in its analysis.

their opinion that the proposed tower was an incompatible land use for the area.

Board Decision at 5-6.

After hearing the evidence submitted at the Board meeting and considering

the planning and zoning Ordinance and the Commission's recommendations, the

Board unanimously voted to deny the Application. In its written opinion, the

Board listed four reasons for denying Plaintiff's Application:

- (1) The proposed tower will have a significant adverse effect on the neighborhood and area surrounding it. Evidence showed the tower would be an incompatible commercial use in a residential area. The County Zoning Ordinance specifically discourages towers being located in residential areas. It is important to protect the quality of life and aesthetics of residential neighborhoods. Any concerns related to health hazards from radio waves or electromagnetic fields cannot and were not considered by the Board, as mandated by federal law.
- (2) The proposed tower is not compatible with the neighborhood, as the neighborhood is comprised of residential uses and is designated for low density uses by the Future Land Use Map.
- (3) There are no unique or special conditions that overcome the Board's general presumption that residential neighborhoods should not allow noncompatible business uses. Additionally, testimony revealed that T-Mobile customers in the area enjoyed satisfactory wireless service. It is the opinion of the Board that the testimony from various residents combined with the evidence submitted and the individual commissioners' experience and interpretation of the evidence and testimony, constitute substantial evidence that is competent, relevant, and adequate to support denial of the SLUP Application.
- (4) Allowing this commercial use on this property would be inappropriate. Although the Board of Commissioners has sometimes permitted cell towers at churches in residential areas, this site is not similar to those.

This is a very small church which has a structure similar to that of a house. It is not located on a major road. The nearest commercial zoning is at least one mile away, and most are considerably further than that. Over the years the Board of Commissioners, county staff, and nearby residents have expended considerable effort and expense in trying to improve the Canton Road corridor and eliminate commercial intrusion into this residential area. Allowing a cell tower at this location would undermine those longstanding efforts.

Id. at 7-8.

C. Procedural History

On January 14, 2010, T-Mobile filed this action for injunctive relief,

alleging that the Board's decision violated plaintiff's rights under the

Telecommunications Act of 1996 ("TCA") and the Constitution of the State of

Georgia.<sup>4</sup> Plaintiff claims it was entitled to injunctive relief compelling the County

to grant its Application for construction and operation of the cell tower on the

Property. On February 8, 2010, the County filed its Answer. On August 16, 2010,

T-Mobile and the County each moved for summary judgment.

## **II. DISCUSSION**

### A. <u>Summary Judgment Standard</u>

Summary judgment is appropriate where "the pleadings, depositions, answers to interrogatories, and admissions on file, together with the affidavits, if

<sup>&</sup>lt;sup>4</sup> T-Mobile later dismissed its claim under the Constitution of the State of Georgia [13], and the Court does not consider it here.

any, show that there is no genuine issue as to any material fact and that the moving party is entitled to a judgment as a matter of law." Fed. R. Civ. P. 56 (c). The party seeking summary judgment bears the burden of demonstrating the absence of a genuine dispute as to any material fact. <u>Herzog v. Castle Rock Entm't</u>, 193 F.3d 1241, 1246 (11th Cir. 1999). Once the moving party has met this burden, the non-movant must demonstrate that summary judgment is inappropriate by designating specific facts showing a genuine issue for trial. <u>Graham v. State Farm Mut. Ins.</u> <u>Co.</u>, 193 F.3d 1274, 1282 (11th Cir. 1999). The non-moving party "need not present evidence in a form necessary for admission at trial; however, he may not merely rest on his pleadings." <u>Id.</u>

The Court must view all evidence in the light most favorable to the party opposing the motion and must resolve all reasonable doubts in the non-movant's favor. <u>United of Omaha Life Ins. Co. v. Sun Life Ins. Co. of Am.</u>, 894 F.2d 1555, 1558 (11th Cir. 1990). "[C]redibility determinations, the weighing of evidence, and the drawing of inferences from the facts are the function of the jury . . . ." <u>Graham</u>, 193 F.3d at 1282. "If the record presents factual issues, the court must not decide them; it must deny the motion and proceed to trial." <u>Herzog</u>, 193 F.3d at 1246. But, "[w]here the record taken as a whole could not lead a rational trier of fact to find for the non-moving party," summary judgment for the moving party is

proper. <u>Matsushita Elec. Indus. Co., Ltd. v. Zenith Radio Corp.</u>, 475 U.S. 574, 587 (1986).

The filing of cross-motions for summary judgment "does not establish that there is no material fact in issue and that a trial is therefore unnecessary." <u>Donovan v. District Lodge No. 100, Int'l Ass'n of Machinists & Aerospace</u> <u>Workers</u>, 666 F.2d 883, 886 (11th Cir. 1982). "Nonetheless, cross-motions may be probative of the non-existence of a factual dispute when . . . they demonstrate a basic agreement concerning what legal theories and material facts are dispositive." <u>U.S. v. Oakley</u>, 744 F.2d 1553, 1555-56 (11th Cir. 1984) (citing <u>Bricklayers Int'l</u> <u>Union, Local 15 v. Stuart Plastering Co.</u>, 512 F.2d 1017 (5th Cir. 1975)).

#### B. <u>Cross-Motions for Summary Judgment</u>

The parties both move for summary judgment. Plaintiff claims the County's decision to deny the Application was not supported by substantial evidence. The County argues the substantial evidence supports its denial decision. In arguing whether the Board's decision was supported by substantial evidence, the parties focus on two findings by the Board: (1) that the proposed tower would not be compatible with the area as it is a commercial intrusion into a residential area; and (2) that T-Mobile has not demonstrated that its existing service is unsatisfactory or that a new tower is required. The parties agree the facts are not in dispute. Thus,

the issue here is whether there was substantial evidence to support the Board's decision.

### 1. Overview of the TCA

The Telecommunications Act ("TCA") was passed to address "zoning decisions by state and local governments [that] had created an inconsistent array of requirements, which inhibited both the deployment of personal communications services and the rebuilding of a digital technology-based cellular telecommunications network." Preferred Sites, LLC v. Troup County, 296 F.3d 1210, 1214 (11th Cir. 2002) (citing H.R. Rep. No. 104-204, at 94 (1995), reprinted in 1996 U.S.C.C.A.N. 10, 61). The TCA is intended "to promote competition and higher quality in American telecommunications services and 'to encourage the rapid deployment of new telecommunications technologies." Michael Linet, Inc. v. Vill. of Wellington, 408 F.3d 757, 761 (11th Cir. 2005) (citing City of Rancho Palos Verdes v. Abrams, 544 U.S. 113 (2005)). The TCA places several substantive and procedural limitations on the authority of state and local governments in the regulation and construction of facilities for telecommunications equipment. The TCA requires that a decision by a zoning board denying the construction of a cell tower to be both "in writing and supported by substantial

evidence contained in a written record." 47 U.S.C. § 332(c)(7)(B)(iii).<sup>5</sup> A party whose application for construction of a cell tower has been denied may challenge the zoning board's refusal in federal court. In evaluating refusals to grant cell tower construction applications, the courts acknowledge that "[1]and use decisions are basically the business of state and local governments."<sup>6</sup> <u>Am. Tower LP v. City of Huntsville</u>, 295 F.3d 1203, 1206 (11th Cir. 2002); <u>see also</u> 47 U.S.C. § 332(c)(7)(A); <u>Village of Wellington</u>, 408 F.3d at 761.

The "phrase 'substantial evidence contained in a written record' is the traditional standard used for judicial review of agency actions." <u>AT&T Wireless</u> <u>PCS, Inc. v. City of Chamblee</u>, 10 F. Supp. 2d 1326, 1329 (N.D. Ga. 1997). Courts typically define 'substantial evidence' as "such relevant evidence as a reasonable mind might accept as adequate to support a conclusion. <u>Am. Tower</u>, 295 F.3d at 1207. The "substantial evidence' standard is not as stringent as the preponderance of the evidence standard, [but] it requires courts to take a harder

<sup>&</sup>lt;sup>5</sup> T-Mobile does not challenge that the Board's decision satisfied the "in-writing" requirement of the TCA.

<sup>&</sup>lt;sup>6</sup> Plaintiff argues that "Congress determined that the federal interest in wireless communications should take priority over state zoning authority . . . ." Plaintiff's Opening Br. at 13. This is an overstatement of the law and conflicts with the text of the TCA. 47 U.S.C. § 332(c)(7)(A) ("Except as provided in this paragraph, nothing this chapter shall limit or affect the authority of a [local zoning authority] over decisions regarding the placement, construction, and modification of personal wireless service facilities.").

look than when reviewing under the arbitrary and capricious standard." <u>Preferred</u> <u>Sites</u>, 296 F.3d at 1218. "A court cannot substitute its own judgment for that of the local board, but it must overturn the board's if the decision is not supported by substantial evidence." <u>Id.</u> at 1218-19. The party challenging a local zoning board's decision has the burden to prove that the decision is not supported by substantial evidence. <u>Am. Tower</u>, 295 F.3d at 1207.

#### 2. Incompatible Use

T-Mobile contends that its Application met all of the objective criteria articulated in the Ordinance and the Board's decision to deny the Application was not supported by substantial evidence. T-Mobile argues that the Board's conclusion that the proposed tower would be incompatible with the existing neighborhood was based only on an aesthetic concern, and the Court of Appeals for the Eleventh Circuit has held that generalized aesthetic concerns are not substantial evidence. <u>Preferred Sites</u>, 296 F.3d at 1219-20.

The County contends that the evidence opposing the Application consisted of more than mere generalized aesthetic concerns. Defendant argues that the testimony from local residents substantially related not to mere aesthetic concerns but whether it is appropriate to construct a commercial cell tower in any configuration in an area zoned for residential use, particularly when the evidence in

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this case established that construction would reduce property values. Defendants argue that this inappropriate usage, coupled with the property value reduction shown, was substantial evidence supporting the Board's decision. The Court agrees.

The facts in this case are similar to those in Michael Linet, Inc. v. Village of Wellington, 408 F.3d 757 (11th Cir. 2005). In Village of Wellington, Linet, an agent for a wireless service provider, sought a permit to construct a cell tower on a golf course in a residential area. Id. at 760. The Village denied the application in response to strong opposition from local residents. Id. The residents expressed concern that the construction of the tower would adversely affect local property values. Linet sued the Village in federal court, alleging violations of the TCA. Id. The district court found the application denial was supported by substantial evidence. Id. On appeal, the Eleventh Circuit affirmed, concluding that while "[a] blanket aesthetic objection does not constitute substantial evidence under [the TCA, a]esthetic objections coupled with evidence of an adverse impact on property values or safety concerns can constitute substantial evidence." Id. at 761. Because the Village "heard objections from residents and a realtor concerning the cell site's negative impact on real estate values," and because the Village heard testimony regarding safety concerns, it had sufficient evidence to support its denial. Id. at

762. The court discounted testimony from Linet's expert stating that the tower would not impact home values because the expert considered the impact of "a different tower, [in a] different location  $\dots$ " <u>Id.</u>

The Eleventh Circuit in American Tower LP v. City of Huntsville reached a similar conclusion. 295 F.3d 1203 (11th Cir. 2002). In American Tower, a construction company requested a permit to construct a cell tower in a residentially zoned area located near two schools and several soccer fields. Id. at 1206. The city denied the permit, and American Tower brought an action in federal court under the TCA. Id. The district court found the denial was not supported by substantial evidence, and the city appealed to the Eleventh Circuit. Id. The Eleventh Circuit reversed, finding that substantial evidence supported the denial of the permit. The court concluded that the local zoning board was "authorized to consider . . . the proposed tower's negative aesthetic impact (as well as its effect on property values) and the proposed tower's effect on the health, safety, and welfare of the public." Id. at 1208. The zoning board heard testimony from several residents on the negative aesthetic affect of the proposed tower, as well as a local realtor who testified that the tower would make it harder to sell houses in the neighborhood and that she had already lost potential buyers because of the proposed tower. Id. The zoning board also relied on testimony regarding safety

questions concerning the proposed tower's close proximity to several soccer fields used by children. <u>Id.</u> at 1209. The court ultimately concluded that substantial evidence supported the zoning board's decision. <u>Id.</u>

T-Mobile argues that the Eleventh Circuit decision in Preferred Sites, LLC v. Troup County, 296 F.3d 1210 (11th Cir. 2002), supports that it is entitled to summary judgment. The Court disagrees. In Preferred Sites, the Eleventh Circuit affirmed the district court's decision that the local zoning board improperly denied Preferred Sites' application to construct a cell tower. In that case, unlike the matter before the Court, the only evidence opposing the application was an affidavit of a local citizen and five petitions from 58 local citizens. Id. at 1219. Of the five petitions, only two contained the individuals' signatures and addresses, and those petitions did not indicate the reason the individuals were signing the petitions. Id. The one affidavit submitted only described general concerns of citizens regarding the proposed tower's negative aesthetic affect. Id. This evidence did not constitute substantial evidence to support the zoning board's denial of the permit. Id. at 1220.

Here, the evidence of record goes well beyond general aesthetic objections. The opponents of the tower introduced evidence from a local realtor who indicated that the proposed tower would negatively affect local property values. R. 530. In

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contrast, T-Mobile's evidence of economic impact was based on the economic impact of different towers in very different kinds of neighborhoods. R. 352-53. These other neighborhoods are not a proper or credible comparison because the homes were constructed around pre-existing cell towers. <u>See id.</u> The T-Mobile report indicated only that the homes increased in value since they were constructed, it does not indicate what affect the tower had on home values in the area or what impact the construction of a tower would have on existing homes in the neighborhood in which a new tower is erected. The realtor's letter offered in opposition to the Application is the only credible evaluation of the proposed tower's impact on home values in the neighborhoods at and near the proposed tower construction and the opinion given was that values would be affected adversely.

T-Mobile meets some of the requirements contained in the Ordinance, but it fails to sufficiently address the Ordinance's requirement that towers be located outside of residential areas when possible. Official Code of Cobb County, Georgia \$ 134-273(3)(i) ("Nonresidential sites are encouraged for tower location where possible and use of platted lots in existing subdivisions is discouraged."). As the applicant, the Ordinance required T-Mobile to demonstrate its need for the permit. See id. \$ 134-37(e)(15). Several residents testified that the proposed tower was

incompatible with the surrounding residential area. Board Decision at 5-6. Plaintiff contends that its balloon tests show there is only a minimal, if any, impact on the local residents. The Board reasonably discounted the balloon tests because T-Mobile conducted at least some of the tests during conditions that "caused the balloon to be blown 'down horizon' which would make the photosimulations inaccurate," and because the balloon tests do not evaluate the view from the backyards of the closest homes or after deciduous trees lost their leaves. Board Decision at 4. It was the Board's prerogative to determine what weight if any to give to the test.

This is not a case where the only evidence offered were the opinion of mere aesthetic concerns. The aesthetic objections asserted here were substantially related to and supported by the residents' concerns about and the evidence showing an adverse impact on property values and other local impacts. <u>See Village of Wellington</u>, 408 F.3d at 761. Plaintiff's evidence to the contrary, including its report pertaining to property values in other areas and its balloon tests, are sufficiently flawed and did not discredit that there existed substantial evidence to suggest the Board's decision to deny the Application.<sup>7</sup>

<sup>&</sup>lt;sup>7</sup> The Board's decision crediting the opposition's evidence over T-Mobile's evidence when determining the economic affect of the proposed tower on home

### 3. Demonstrated Need

The parties dispute whether the Board's finding that T-Mobile failed to demonstrate a sufficient need for the proposed tower also was supported by substantial evidence. T-Mobile contends that the Board's conclusion that Plaintiff's current service was "satisfactory" misinterprets the TCA because the TCA requires "competition" among telecommunications providers. T-Mobile argues that "satisfactory" service is not sufficient to compete; "wireless providers must have the best possible coverage within their networks . . . . "<sup>8</sup> T-Mobile's Reply Br. at 12. Plaintiff points to its computer-generated coverage map, which shows that "there is an area of poor coverage in the area surrounding the proposed tower." T-Mobile's Opening Br. at 23. The County argues the Board was justified in denying Plaintiff's Application because substantial evidence shows that T-Mobile has adequate cellular coverage in the subject area and T-Mobile failed to meet its burden under the Ordinance of showing why it needs the new tower.

The evidence shows that T-Mobile represented to its customers in advertising materials that the area in question has T-Mobile's "best" signal

values "is not one the federal judges can just second-guess per the TCA." <u>Am.</u> <u>Tower</u>, 295 F.3d at 1208 n. 7.

<sup>&</sup>lt;sup>8</sup> The Court notes that T-Mobile's radio frequency engineer wrote in his report, upon which the Board relied, that "[i]n today's competitive marketplace, T-Mobile requires <u>adequate</u> coverage to be competitive and to fulfill our responsibilities under our FCC license." R. 462 (emphasis added).

strength. R. 565. Plaintiff now asserts that service in the area in question is "poor" and insufficient for customers to use their handsets in residential buildings. T-Mobile has not addressed and certainly has not resolved this important discrepancy in what it has represented about the quality of its service in the area. Plaintiff did not offer any evidence to show any change in circumstances causing its service to erode from "best" to "poor."

T-Mobile argues that its "expert technical evidence [showing the need for the tower] is essentially unrebutted except for 'lay person' drive test data purporting to show 'acceptable' coverage in the area." Plaintiff's Reply Br. at 13. T-Mobile criticizes the local resident's drive test as "junk science" cast as expert testimony. <u>See id.</u> at 13-14. To the extent Plaintiff contends that it somehow presented "expert testimony," the Court disagrees. T-Mobile did not establish that the evidence qualified as expert testimony or that the testimony was traditional expert testimony. McCorvey v. Baxter Healthcare Corp., 298 F.3d 1253, 1256 (11th Cir. 2002). In the end, the Board had the responsibility to evaluate the quality and credibility of the testimony offered by each party, including the engineer who testified for T-Mobile. The Court notes that T-Mobile's engineer did not evaluate in home signal strength – the strength T-Mobile argued was the problem sought to be addressed by the new tower.

The testimony of local residents about their existing T-Mobile service was equally credible evidence – and perhaps the better competitive measure – that Plaintiff's customers in the area at issue in this case are satisfied with their service. Plaintiff did not offer any evidence that any T-Mobile customer was or is dissatisfied with their wireless service. Indeed, the weight of the evidence is that they are satisfied. Board Decision at 5; R. 667. The Board even heard testimony from one local resident who discontinued her land line telephone service and now relies exclusively on her T-Mobile wireless phone for all her needs. Id. Finally, T-Mobile did not present any evidence that it had received complaints of dropped calls from its customers in the area near the proposed tower. Board Decision at 4; R. 666. This evidence, taken together with T-Mobile's representation that its signal strength in the area was the "best," supports the Board's conclusion that T-Mobile did not meet its burden of showing "[w]hether or not special or unique conditions overcome the board of commissioners' general presumption that residential neighborhoods should not allow noncompatible business uses." Official Code of Cobb County § 134-37(e)(8). This Court will not second guess the Board's credibility determination. Am. Tower, 295 F.3d at 1208 n.7. The Board's conclusion that T-Mobile failed to meet its burden of showing the need for the tower is supported by substantial evidence.

### **III. CONCLUSION**

The Court has carefully evaluated the undisputed evidence in this case and concludes that the Board's findings that (1) that the proposed tower would not be compatible with the area as it is a commercial intrusion into a residential area; and (2) that T-Mobile has not demonstrated why its existing service is not satisfactory are both supported by substantial evidence. The Court further finds that, on this evidence as a whole, T-Mobile has not shown that the Board's decision was not based on substantial evidence. Rather, the record here supports that the Board evaluated all of the evidence presented, weighed the credibility of and weight to be given to the evidence, and, based on substantial evidence, decided to deny the Application. Accordingly,

**IT IS HEREBY ORDERED** that the County's Motion for Summary Judgment [16] is **GRANTED**.

**IT IS FURTHER ORDERED** that T-Mobile's Motion for Summary Judgment [17] is **DENIED**.

SO ORDERED this 31st day of January, 2011.

IAM S. D UNITED STATES DISTRICT'JUDGE



## Survey by the National Institute for Science, Law & Public Policy Indicates Cell Towers and Antennas Negatively Impact Interest in Real Estate Properties

### 94% of respondents said a nearby cell tower or group of antennas would negatively impact interest in a property or the price they would be willing to pay for it

July 03, 2014 01:57 PM Eastern Daylight Time

WASHINGTON--(<u>BUSINESS WIRE</u>)--A survey conducted in June 2014 by the National Institute for Science, Law and Public Policy (NISLAPP) in Washington, D.C., <u>"Neighborhood Cell Towers & Antennas – Do They Impact a Property's Desirability?"</u>, shows home buyers and renters are less interested in properties located near cell towers and antennas, as well as in properties where a cell tower or group of antennas are placed on top of or attached to a building.

Of the 1,000 survey respondents, 94% reported that cell towers and antennas in a neighborhood or on a building would impact interest in a property and the price they would be willing to pay for it. And 79% said under no circumstances would they ever purchase or rent a property within a few blocks of a cell tower or antennas. And almost 90% of respondents said they were concerned about the increasing number of cell towers and antennas in their residential neighborhood, generally. See Full Results here: <u>http://electromagnetichealth.org/electromagnetichealth.o</u>

The NISLAPP survey reinforced the findings of a study by Sandy Bond, Ph.D. of the New Zealand Property Institute, and Past President of the Pacific Rim Real Estate Society (PRRES), published in *The Appraisal Journal* in 2006, <u>The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods</u>. That study found buyers would pay as much as 20% less, as determined at that time by an opinion survey in addition to a sales price analysis.

Jim Turner, Esq., Chairman of the National Institute for Science, Law and Public Policy, says, "The results of the 2014 NISLAPP survey suggest there is now high awareness about potential risks from cell towers and antennas, including among people who have never experienced cognitive or physical effects from the radiation." He adds, "A study of real estate sales prices would be beneficial at this time in the Unites States to determine what discounts homebuyers are currently placing on properties near cell towers and antennas."

#### Read More

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## The New York Times

**REAL ESTATE** | IN THE REGION | LONG ISLAND

# A Pushback Against Cell Towers

By MARCELLE S. FISCHLER AUG. 27, 2010 Wantagh

TINA CANARIS, an associate broker and a co-owner of RE/MAX Hearthstone in Merrick, has a \$999,000 listing for a high ranch on the water in South Merrick, one of a handful of homes on the block on the market. But her listing has what some consider a disadvantage: a cell antenna poking from the top of a telephone pole at the front of the 65-by-100-foot lot.

"Even houses where there are transformers in front" make "people shy away," Ms. Canaris said. "If they have the opportunity to buy another home, they do."

She said cell antennas and towers near homes affected property values, adding, "You can see a buyer's dismay over the sight of a cell tower near a home just by their expression, even if they don't say anything."

By blocking, or seeking to block, cell towers and antennas over the course of the last year, Island homeowners have given voice to concerns that proximity to a monopole or antenna may not be just aesthetically unpleasing but also harmful to property values. Many also perceive health risks in proximity to radio frequency radiation emissions, despite industry assertions and other evidence disputing that such emissions pose a hazard.

Emotions are running so high in areas like Wantagh, where an application for six cell antennas on the Farmingdale Wantagh Jewish Center is pending, that the Town of Hempstead imposed a moratorium on applications until Sept. 21. That is the date for a public hearing on a new town ordinance stiffening requirements. At a community meeting on Aug. 16 at Wantagh High School, Dave Denenberg, the Nassau county legislator for Bellmore, Wantagh and Merrick, told more than 200 residents that 160 cell antennas had been placed on telephone poles in the area in the last year by NextG, a wireless network provider.

"Everyone has a cellphone," Mr. Denenberg said, "but that doesn't mean you have to have cell installations right across the street from your house." Under the old town code, installations over 30 feet high required an exemption or a variance. But in New York, wireless providers have public utility status, like LIPA and Cablevision, and they can bypass zoning boards.

Earlier this month in South Huntington, T-Mobile was ordered to take down a new 100-foot monotower erected on property deemed environmentally sensitive (and thus requiring a variance). Andrew J. Campanelli, a civil rights lawyer in Garden City, said a group of residents had hired him to oppose the cellular company's application.

"They were worried about the property values," Mr. Campanelli said. "If your home is near a cell antenna, the value of your property is going down at least 4 percent. Depending on the size of the tower and the proximity, it is going down 10 percent."

In January, in an effort to dismantle 50 cell antennas on a water tower across from a school in the village of Bayville, Mr. Campanelli filed a federal lawsuit that cited health risks and private property rights.

In a statement, Dr. Anna F. Hunderfund, the Locust Valley superintendent, said that in February 2009 the district had engaged a firm to study the cellphone installations near the Bayville schools, finding that the tower "posed no significant health risks," and she noted that the emission levels fell well below amounts deemed unsafe by the Federal Communications Commission.

In June 2009, Sharon Curry, a psychologist in Merrick, woke up to find a cell antenna abutting her backyard, level to her 8-year-old son's bedroom window.

Puzzled by its presence, particularly because she lives next to an elementary school, she did research to see if there was cause for concern. What she learned

about possible health impacts, she said, led her to seek help from civic associations and to form a group, Moms of Merrick Speak Out, to keep new cell towers out. She said she was seeking the "responsible" placement of cell antennas, away from homes and schools.

The Federal Communications Act of 1996 says health concerns are not a valid reason for a municipality to deny zoning for a cell tower or antenna. Property values and aesthetics, however, do qualify, according to the act.

Frank Schilero, an associate broker with RE/MAX Innovations in Wantagh, has a listing on a \$629,000 home down the street from the Farmingdale Wantagh Jewish Center, where the application is pending to put six cell antennas on the roof.

"People don't like living next to cell towers, for medical reasons or aesthetics," Mr. Schilero said. "Or they don't want that eyesore sticking up in their backyards." There is an offer on his listing, he added, but since the buyer heard about the possible cell antennas she has sought more information from the wireless companies about their size and impact.

Charles Kovit, the Hempstead deputy town attorney, said that under the proposed code change any new towers or antennas would have to be 1,500 feet from residences, schools, houses of worship and libraries.

The town recently hired a consultant, Richard A. Comi of the Center for Municipal Solutions in Glenmont, to review antenna applications.

Under the new ordinance, applications for wireless facilities would require technical evidence that they had a "gap" in coverage necessitating a new tower.

"If not, they will get denied," Mr. Kovit said. The wireless companies would also have to prove that the selected location had "the least negative impact on area character and property values." If another location farther away from homes can solve the gap problem, "they are going to have to move."

A version of this article appears in print on August 29, 2010, on Page RE9 of the New York edition with the headline: A Pushback Against Cell Towers.

# features

# The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods

#### abstract

This article examines whether proximity to cellular phone towers has an impact on residential property values and the extent of any impact. First, a survey approach is used to examine how residents perceive living near cellular phone base stations (CPBSs) and how residents evaluate the impacts of CPBSs. Next, a market study attempts to confirm the perceived value impacts reported in the survey by analyzing actual property sales data. A multiple regression analysis in a hedonic pricing framework is used to measure the price impact of proximity to CPBSs. Both the survey and market sales analysis find that CPBSs have a negative impact on the prices of houses in the study areas.

by Sandy Bond, PhD, and Ko-Kang Wang

he introduction of cellular phone systems and the rapid increase in the number of users of cellular phones have increased exposure to electromagnetic fields (EMFs). Health consequences of long-term use of cellular phones are not known in detail, but available data indicates that development of nonspecific health symptoms is possible.<sup>1</sup> Conversely, it appears health effects from cellular phone equipment (antennas and base stations) pose few, if any, known health hazards.<sup>2</sup>

A concern associated with cellular phone usage is the siting of cellular phone transmitting antennas (CPTAs) and cellular phone base stations (CPBSs). In New Zealand, CPBS sites are increasingly in demand as the major cellular phone companies there, Telecom and Vodafone, upgrade and extend their network coverage. This demand could provide the owner of a well-located property a yearly income for the siting of a CPBS.<sup>3</sup> However, new technology that represents potential hazards to human health and safety may cause property values to diminish due to public perceptions of hazards. Media attention to the potential health hazards of CPBSs has spread concerns among the public, resulting in increased resistance to CPBS sites.

Some studies suggest a positive correlation between long-term exposure to the electromagnetic fields and certain types of cancer,<sup>4</sup> yet other studies report inconclusive results on health effects.<sup>5</sup> Notwithstanding the research results, media reports indicate that the extent of opposition from some property owners

Stanislaw Szmigielski and Elizbieta Sobiczewska, "Cellular Phone Systems and Human Health—Problems with Risk Perception and Communication," *Environmental Management and Health* 11, no. 4 (2000): 352–368.

<sup>2.</sup> Jerry R. Barnes, "Cellular Phones: Are They Safe?" Professional Safety 44, no. 12 (Dec. 1999): 20-23.

<sup>3.</sup> R. Williams, "Phone Zone—Renting Roof Space to Ma Bell," The Property Business 12 (April 2001): 6–7.

C. M. Krause et al., "Effects of Electromagnetic Field Emitted by Cellular Phones on the EEG During a Memory Task," Neuroreport 11, no. 4 (2000): 761–764.

Independent Expert Group on Mobile Phones, Mobile Phones and Health (Report to the United Kingdom Government, 2000), http://www.iegmp.org.uk.

affected by the siting of CPBSs remains strong.<sup>6</sup> However, the extent to which such attitudes are reflected in lower property values for homes located near CPBSs is not known.

Understanding the impact of CPBSs on property values is important to telecommunications companies both for planning the siting of CPBSs and for determining likely opposition from property owners. Similarly, property appraisers need to understand the valuation implications of CPBSs when valuing CPBS-affected property. The owners of affected property also want to understand the magnitude of any effects, particularly if compensation claims or an award for damages are to be made based on any negative effects on value.

The research here uses a case study approach to determine residents' perceptions towards living near CPBSs in Christchurch, New Zealand, and to quantify these effects in monetary terms according to an increasing or decreasing percentage of property value. The case study uses both an opinion survey and an econometric analysis of sales transaction data. A comparison of the results can be used to help appraisers value affected property as well as to resolve compensation issues and damage claims in a quantitative way. Further, the results provide a potential source of information for government agencies in assessing the necessity for increased information pertaining to CPBSs.

The following provides a brief review of the cellular phone technology and relevant literature. Then, the next section describes the research procedure used, including descriptions of the case study and control areas. The results are then discussed, and the final section provides a summary and conclusion.

#### Cellular Telephone Technology<sup>7</sup>

Cellular (mobile) telephones are sophisticated twoway radios that use ultrahigh frequency (UHF) radio waves to communicate information. The information is passed between a mobile phone and a network of low-powered transceivers, called mobile phone sites or cell sites. As mobile sites are very low powered they serve only a limited geographic area (or "cell"), varying from a few hundred meters to several kilometers; they can handle only a limited number of calls at one time. When a mobile phone user on the move leaves one cell and enters another, the next site automatically takes over the call, allowing contact to be maintained.

When a mobile phone call is initiated, the phone connects to the network by using radio signals to communicate with the nearest mobile phone site. The mobile phone sites in a network are interlinked by cable or microwave beam, enabling phone calls to be passed from one cell to another automatically. A mobile phone site is typically made up of a mast with antennas connected to equipment stored in a cabinet. Power is fed into the cabinet by underground cable. The antennas are designed to transmit most of the signal away horizontally, or just below horizontal, rather than at steep angles to the ground.

Mobile phone sites can only accommodate a limited number of calls at any one time. When this limit is reached, the mobile phone signal is transferred to the next nearest site. If this site is full or is too far away, the call will fail.

Cell site capacity is a major issue for telecommunication companies. As the number of people using mobile phones grows, more and more cell sites are required to meet customer demand for reliable coverage. At the end of March 2002, Telecom had more than 1.3 million mobile phone customers and more than 750 mobile phone sites throughout New Zealand. Vodafone had over 1.1 million mobile phone customers.<sup>8</sup> In areas, such as Auckland (the largest city in New Zealand, with close to a third of the NZ population), where almost complete coverage has been achieved, the main issue is ensuring that there is the capacity to handle the ever-increasing number of mobile phones and calls.

#### **Locating Cellular Phone Sites**

For cellular phone service providers, the main goals when locating cell sites are (1) finding a site that provides the best possible coverage in the area without causing interference with other cells, and (2) finding a site that causes the least amount of environmental impact on the surrounding area. Service providers usually attempt to locate cell sites on existing structures such as buildings, where antennas can be mounted on the roof to minimize the environmental impact. If this is not possible, a mast will need to be erected to support the antennas for the new cell site.

<sup>6.</sup> S. Fox, "Cell Phone Antenna Worries Family," East & Bays Courier, November 8, 2002, 1.

The information in this section was sourced from Telecom, http://www.telecom.co.nz; New Zealand Ministry for the Environment, http://www.mfe.govt.nz; and New Zealand Ministry of Health, http://www.moh.govt.nz.

Vodafone, "Cell Sites and the Environment," http://www.vodafone.co.nz/aboutus/vdfn\_about\_cellsites.pdf (accessed December 19, 2002) and "Mobile Phones and Health," http://www.vodafone.co.nz/aboutus/vdfn\_about\_health\_and\_safety.pdf (accessed December 19, 2002); and Telecom, "Mobile Phone Sites and Safety," http://www.telecom.co.nz/content/0,3900,27116-1536,00.html (accessed December 19, 2002).

Service providers prefer to locate cell sites in commercial or industrial areas due to the "resource consent" procedure required by the Resource Management Act 1991<sup>9</sup> for towers located in residential areas.

Despite the high level of demand for better cell phone coverage, the location of cell sites continues to be a contentious issue. The majority of people want better cell phone coverage where they live and work, but they do not want a site in their neighborhood. Thus, cell sites in or near residential areas are of particular concern. Concerns expressed usually relate to health, property values, and visual impact.<sup>10</sup>

In general, uncertainties in the assessment of health risks from base stations are presented and distributed in reports by organized groups of residents who protest against siting of base stations. When the media publishes these reports it amplifies the negative bias and raises public concerns. According to Covello, this leads to incorrect assessment of risks and threats by the public, with a tendency to overestimate risks from base stations and neglect risks from the use of cell phones.<sup>11</sup>

#### **Assessment of Environmental Effects**

Under the Resource Management Act 1991 (RMA), an assessment of environmental effects is required every time an application for resource consent is made. Information that must be provided includes "an assessment of any actual or potential effects that the activity may have on the environment, and the ways in which any adverse effects may be mitigated."<sup>12</sup> An assessment of the environmental effects of cell sites would take into consideration such things as health and safety effects; visual effects; effects on the neighborhood; and interference with radio and television reception.

## Radio Frequency and Microwave Emissions from CPBSs

According to the Ministry for the Environment, the factors that affect exposure to radiation are as follows:

• Distance. Increasing the distance from the emitting source decreases the radiation's strength and decreases the exposure.

- Transmitter power. The stronger the transmitter, the higher the exposure.
- Directionality of the antenna. Increasing the amount of antennas pointing in a particular direction increases the transmitting power and increases the exposure.
- Height of the antenna above the ground. Increasing the height of an antenna increases the distance from the antenna and decreases the exposure.
- Local terrain. Increasing the intervening ridgelines decreases the exposure.<sup>15</sup>

The amount of radiofrequency power absorbed by the body (the dose) is measured in watts per kilogram, known as the specific absorption rate (SAR). The SAR depends on the power density in watts per square meter. The radio frequencies from cellular phone systems travel in a "line of sight." The antennas are designed to radiate energy horizontally so that only small amounts of radio frequencies are directed down to the ground. The greatest exposures are in front of the antenna so that near the base of these towers, exposure is minimal. Further, power density from the transmitter decreases rapidly as it moves away from the antenna. However, it should be noted that by initially walking away from the base, the exposure rises and then decreases again. The initial increase in exposure corresponds to the point where the lobe from the antenna beam intersects the ground.14

#### **Health Effects**

According to Szmigielski and Sobiczewska, the analogue phone system (using the 800–900 megahertz band) and digital phone system (using the 1850–1990 megahertz band) expose humans to electromagnetic field (EMF) emissions: radio frequency radiation (RF) and microwave radiation (MW), respectively. These two radiations are emitted from both cellular phones and CPBSs.<sup>15</sup>

For years cellular phone companies have assured the public that cell phones are safe. They state that the particular set of radiation parameters associated with cell phones is the same as any other ra-

<sup>9.</sup> The Resource Management Act 1991 is the core of the legislation intended to help achieve sustainability in New Zealand; see http://www.mfe.govt.nz/laws/rma.

<sup>10.</sup> Szmigielski and Sobiczewska; and Barnes.

<sup>11.</sup> Vincent T. Covello, "Risk Perception, Risk Communication, and EMF Exposure: Tools and Techniques for Communicating Risk Information," in Risk Perception, Risk Communication and Its Application to EMF Exposure: Proceedings of the World Health Organization and ICNIRP Conference, ed. R. Matthes, J. H. Bernhardt, M. H. Repucholi, 179–214 (Munich, Germany, May 1998).

<sup>12.</sup> Section 88(4), (b), Resource Management Act 1991.

<sup>13.</sup> Ministry for the Environment and Ministry of Health, National Guidelines for Managing the Effects of Radiofrequency Transmitters, available at http:// www.mfe.govt.nz and http://www.moh.govt.nz (accessed May 21, 2002).

<sup>14.</sup> lbid.; and Szmigielski and Sobiczewska.

<sup>15.</sup> Szmigielski and Sobiczewska.

dio signal. However, reported scientific evidence challenges this view and shows that cell phone radiation causes various effects, such as altered brain activity, memory loss, and fatigue.<sup>16</sup>

According to Cherry, there is also strong evidence to conclude that cell sites are risk factors for certain types of cancer, heart disease, neurological symptoms and other effects.<sup>17</sup> The main concerns related to EMF emissions from CPBSs are linked to the fact that radio frequency fields penetrate exposed tissues.

Public concern regarding both cell phones and CPBSs in many countries has led to establishment of independent expert groups to carry out detailed reviews of the research literature. Research on the health effects of exposures to RF are reviewed by, for instance, the NZ Radiation Laboratory, the World Health Organization, the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the Royal Society of Canada, and the UK Independent Expert Group on Mobile Phones. The reviews conclude that there are no clearly established health effects for low levels of exposure. Such exposures typically occur in publicly accessible areas around radio frequency transmitters. However, there are questions over the delayed effects of exposure.

While present medical and epidemiological studies reveal weak association between health effects and low-level exposures of RF/MW fields, controversy remains among scientists, producers, and the general public. Negative media attention has fuelled the perception of uncertainty over the health effects from cell phone systems. Further scientific or technological information is needed to allay fears of the public about cell phone systems.

#### **Radio Frequency Radiation Exposure Standards**

International Standards. The reviews of research on the health effects of exposures to RF have helped establish exposure standards that limit RF exposures to a safe level. Most standards—including those set by the ICNIRP, the American National Standards Institute (ANSI), and New Zealand—are based on the most-adverse potential effects. The 1998 ICNIRP guidelines have been accepted by the world's scientific and health communities; these guidelines are both consistent with other stated standards and published by a highly respected and independent scientific organization. The ICNIRP is responsible for providing guidance and advice on the health hazards of nonionizing radiation for the World Health Organization (WHO) and the International Labour Office.<sup>18</sup>

The New Zealand Standard. In New Zealand, when a mobile phone site is being planned, radio frequency engineers calculate the level of electromagnetic energy (EME) that will be emitted by the site. The level of EME is predicted by taking into account factors such as power output, cable loss, antenna gain, path loss, and height and distance from the antenna. These calculations allow engineers to determine the maximum possible emissions in a worst-case scenario, i.e., as if the site was operated at maximum power all the time. The aim is to ensure that EME levels are below international and NZ standards in areas where the general public has unrestricted access.

All mobile phone sites in New Zealand must comply in all respects with the NZ standard for radio frequency exposures.<sup>19</sup> This standard is the same as used in most European countries, and is more stringent than that used in the United States, Canada, and Japan. Some local communities in New Zealand have even lower exposure-level standards; however, in reality mobile phone sites only operate at a fraction of the level set by the NZ standard. The National Radiation Laboratory has measured exposures around many operating cell sites, and maximum exposures in publicly accessible areas around the great majority of sites are less than 1% of the exposure limit of the NZ standard. Exposures are rarely more than a few percent of the limit, and none have been above 10%.

#### **Court Decisions**

Two court cases in New Zealand have alleged adverse effects due to CPBSs: *McIntyre v. Christchurch City* 

<sup>16.</sup> K. Mann and J. Röschke, "Effects of Pulsed High-Frequency Electromagnetic Fields on Human Sleep," Neuropsychobiology 33, no. 1 (1996): 41–47; Krause et al.; Alexander Borbely et al., "Pulsed High-Frequency Electromagnetic Field Affects Human Sleep and Sleep Electroencephalogram," Neurosci Let, 275, no. 3 (1999): 207–210; L. Kellenyi et al., "Effects of Mobile GSM Radiotelephone Exposure on the Auditory Brainstem Response (ABR)," Neurobiology 7, no. 1 (1999): 79–81; B. Hocking, "Preliminary Report: Symptoms Associated with Mobile Phone Use," Occup Med 48, no. 6 (Sept. 1998): 357–360; and others as reported in Neil Cherry, Health Effects Associated with Mobil Base Stations in Communities: The Need for Health Studies, Environmental Management and Design Division, Lincoln University (June 8, 2000); http://pages.britishlibrary.net/orange/cherryonbasestations.htm.

<sup>17.</sup> Cherry.

<sup>18.</sup> Ministry for the Environment and Ministry of Health.

<sup>19.</sup> NZS 2772.1:1999, "Radiofrequency Fields Part I: Maximum Exposure Levels – 3kHz to 300GHz." This standard was based largely on the 1998 ICNIRP recommendations for maximum human exposure levels to radio frequency. The standard also includes a requirement for minimizing radio frequency exposure. See National Radiation Laboratory, *Cell Sites* (March 2001), 7; available at http://www.nrl.moh.govt.nz/CellsiteBooklet.pdf.

*Council*<sup>20</sup> and *Shirley Primary School v. Telecom Mobile Communications Ltd.*<sup>21</sup> Very few cell site cases have actually proceeded to Environment Court hearings. In these two cases the plaintiffs claimed that there was a risk of adverse health effects from radio frequency radiation emitted from cell phone base stations and that the CPBSs had adverse visual effects.

In *McIntyre*, Bell South applied for resource consent to erect a CPBS. The activity was a noncomplying activity under the Transitional District Plan. Residents objected to the application. Their objections were related to the harmful health effects from radio frequency radiation. In particular, they argued it would be an error of law to decide, based on the present state of scientific knowledge, that there are no harmful health effects from low-level radio frequency exposure. It was also argued that the Resource Management Act contains a precautionary policy and also requires a consent authority to consider potential effects of low probability but high impact in reviewing an application.

The Planning Tribunal considered residents' objections and heard experts' opinions as to the potential health effects, and granted the consent, subject to conditions. It was found that there would be no adverse health effects from low levels of radiation from the proposed transmitter, not even effects of low probability but high potential impact.

In *Shirley Primary School*, Telecom applied to the Christchurch City Council for resource consent to establish, operate, and maintain a CPBS on land adjacent to the Shirley Primary School. This activity was a noncomplying activity under the Transitional District Plan. Again, the city council granted the consent subject to conditions. However, the school appealed the decision, alleging the following four adverse effects:

- Risk of adverse health effects from the radio frequency radiation emitted from the cell site
- Adverse psychological effects on pupils and teachers because of the perceived health risks
- Adverse visual effects
- Reduced financial viability of the school if pupils withdraw because of the perceived adverse health effects

The court concluded that the risk of the children or teachers at the school developing leukemia or other cancers from radio frequency radiation emitted by

20. NZRMA 289 (1996).

the cell site is extremely low, and the risk to the pupils of developing sleep disorders or learning disabilities because of exposure to radio frequency radiation is higher, but still very small. Accordingly, the Telecom proposal was allowed to proceed.

In summary, the Environmental Court ruled that there are no established adverse health effects from the emission of radio waves from CPBSs and no epidemiological evidence to show this. The court was persuaded by the ICNIRP guidelines that risk of health effects from low-level exposure is very low and that the cell phone frequency imposed by the NZ standard is safe, being almost two and one-half times lower than that of the ICNIRP.

The court did concede that while there are no proven health effects, there was evidence of property values being affected by both of the health allegations. The court suggested that such a reduction in property values should not be counted as a separate adverse effect from, for example, adverse visual or amenities effects. That is, a reduction in property values is not an environmental effect in itself; it is merely evidence, in monetary terms, of the other adverse effects noted.

In a third case, *Goldfinch v. Auckland City Council*,<sup>22</sup> the Planning Tribunal considered evidence on potential losses in value of the properties of objectors to a proposal for the siting of a CPBS. The court concluded that the valuer's monetary assessments support and reflect the adverse effects of the CPBS. Further, it concluded that the effects are more than just minor as the CPBS stood upon the immediately neighboring property.

#### **Literature Review**

While experimental and epidemiological studies have focused on the adverse health effects of radiation from the use of cell phones and CPBSs, few studies have been conducted to ascertain the impact of CPBSs on property values. Further, little evidence of property value effects has been provided by the courts. Thus, the extent to which opposition from property owners affected by the siting of CPBSs is reflected in lower property values is not well known in New Zealand.

Two studies have been conducted to ascertain the adverse health and visual effects of CPBSs on property values. Telecom commissioned Knight Frank (NZ) Ltd to undertake a study in Auckland in 1998/

<sup>21.</sup> NZRMA 66 (1999).

<sup>22.</sup> NZRMA 97 (1996).

99 and commissioned Telfer Young (Canterbury) Ltd to undertake a similar study in Christchurch in 2001. Although the studies show that there is not a statistically significant effect on property prices where CPBSs are present,<sup>25</sup> the research in both cases involves only limited sales data analysis. Further, no surveys of residents' perceptions were undertaken, and the studies did not examine media attention to the sites and the impact this may have on saleability of properties in close proximity to CPBSs. Finally, as the sponsoring party to the research was a telecommunication company it is questionable whether the results are completely free from bias. Hence, the present study aims to help fill the research void on this contentious topic in an objective way.

CPBSs are very similar structures to high-voltage overhead transmission lines (HVOTLs); therefore it is worthwhile to review the body of literature on the property values effects of HVOTLs. The only recently published study in New Zealand on HVOTLs effects is by Bond and Hopkins.<sup>24</sup> Their research consists of both a regression analysis of residential property transaction data and an opinion survey to determine the attitudes and reactions of property owners in the study area toward living close to HVOTLs and pylons.

The results of the sales analysis indicate that having a pylon close to a particular property is statistically significant and has a negative effect of 20% at 10–15 meters from the pylon, decreasing to 5% at 50 meters. This effect diminishes to a negligible amount after 100 meters. However, the presence of a transmission line in the case study area has a minimal effect and is not a statistically significant factor in the sale prices.

The attitudinal study results indicate that nearly two-thirds of the respondents have negative feelings about the HVOTLs. Proximity to HVOTLs determines the degree of negativity: respondents living closer to the HVOTLs expressed more negative feelings towards them than those living farther away. It appears, however, from a comparison of the results, that the negative feelings expressed are often not reflected in the prices paid for such properties.

There have been a number of HVOTLs studies carried out in the United States and Canada. A major review and analysis of the literature by Kroll and Priestley indicates that in about half the studies, HVOTLs have not affected property values and in the rest of the studies there is a loss in property value between 2%-10%.25 Kroll and Priestley are generally critical of most valuer-type studies because of the small number of properties included and the failure to use econometric techniques such as multiple regression analysis. They identify the Colwell study as one of the more careful and systematic analyses of residential impacts.<sup>26</sup> That study, carried out in Illinois, finds that the strongest effect of HVOTLs is within the first 15 meters, but the effect dissipates quickly with distance, disappearing beyond 60 meters.

A Canadian study by Des Rosiers, using a sample of 507 single-family house sales, finds that severe visual encumbrance due to a direct view of either a pylon or lines exerts a significant, negative impact on property values; however location adjacent to a transmission corridor may increase value.<sup>27</sup> This was particularly evident where the transmission corridor was on a well-wooded, 90-meter right-of-way. The proximity advantages include enlarged visual field and increased privacy. The decrease in value from the visual impact of the HVOTLs and pylons (on average between 5% and 10% of mean house value) tends to be cancelled out by the increase in value from proximity to the easement.

A study by Wolverton and Bottemiller<sup>28</sup> uses a paired-sale analysis of home sales in 1989–1992 to ascertain any difference in sale price between properties abutting rights-of-way of transmission lines (subjects) in Portland, Oregon; Vancouver, Washington; and Seattle, Washington; and those located in the same cities but not abutting transmission line rights-of-way (comparisons). Subjects sold during the study period were selected first; then a matching comparison was selected that was as similar to the subject as possible. The study results did not support a finding of a price effect from abutting an HVTL right-of-way. In their conclusion, the authors

<sup>23.</sup> Mark Dunbar, Telfer Young research valuer, personal communication with Bond, 2002. The results of these studies have not been made publicly known. The study by Knight Frank of Auckland was conducted by Robert Albrecht.

<sup>24.</sup> S. G. Bond and J. Hopkins, "The Impact of Transmission Lines on Residential Property Values: Results of a Case Study in a Suburb of Wellington, New Zealand," Pacific Rim Property Research Journal 6, no. 2 (2000): 52–60.

<sup>25.</sup> C. Kroll and T. Priestley, "The Effects of Overhead Transmission Lines on Property Values: A Review and Analysis of the Literature," Edison Electric Institute (July 1992).

<sup>26.</sup> Peter F. Colwell, "Power Lines and Land Value," Journal of Real Estate Research 5, no. 1 (Spring 1990): 117–127.

François Des Rosiers, "Power Lines, Visual Encumbrance and House Values: A Microspatial Approach to Impact Measurement," Journal of Real Estate Research 23, no. 3 (2002): 275–301.

<sup>28.</sup> Marvin L. Wolverton and Steven C. Bottemiller, "Further Analysis of Transmission Line Impact on Residential Property Values," *The Appraisal Journal* (July 2003): 244–252.

warn that the results cannot and should not be generalized outside of the data. They explain that

limits on generalizations are a universal problem for real property sale data because analysis is constrained to properties that sell and sold properties are never a randomly drawn representative sample. Hence, generalizations must rely on the weight of evidence from numerous studies, samples, and locations.<sup>29</sup>

Thus, despite the varying results reported in the literature on property value effects from HVOTLs, each study adds to the growing body of evidence and knowledge on this (and similar) valuation issue(s). The study reported here is one such study.

#### **Opinion Survey Research Objectives and Methodology**

Research by Abelson;<sup>50</sup> Chalmers and Roehr;<sup>51</sup> Kinnard, Geckler and Dickey;<sup>52</sup> Bond;<sup>53</sup> and Flynn et al.,<sup>54</sup> recommend the use of market sales analysis in tandem with opinion survey studies to measure the impact of environmental hazards on residential property values. The use of more than one approach provides the opportunity to compare the results from each and to derive a more informed conclusion than obtained from relying solely on one approach. Thus, the methods selected for this study include a public opinion survey and a hedonic house price approach (as proposed by Freeman<sup>55</sup> and Rosen<sup>56</sup>). A comparison of the results from both of these techniques will reveal the extent to which the market reacts to cell phone towers.

#### **Public Opinion Survey**

An opinion survey was conducted to investigate the current perceptions of residents towards living near CPBSs and how this proximity might affect property values. Case study areas in the city of Christchurch were selected for this study. The study included residents in ten suburbs: five case study areas (within 300 meters of a cell phone tower) and five control areas (over 1 kilometer from the cell phone tower). The five case study suburbs were

matched with five control suburbs that had similar living environments (in socioeconomic terms) except for the presence of a CPBS.

The number of respondents to be surveyed (800) and the nature of the data to be gathered (perceptions/personal feelings towards CPBSs) governed the choice of a self-administered questionnaire as the most appropriate collection technique. Questionnaires were mailed to residents living in the case study and control areas.

A self-administered survey helps to avoid interviewer bias and to increase the chances of an honest reply where the respondent is not influenced by the presence of an interviewer. Also, mail surveys provide the time for respondents to reflect on the questions and answer these at their leisure, without feeling pressured by the time constraints of an interview. In this way, there is a better chance of a thoughtful and accurate reply.

The greatest limitation of mail surveys is that a low response rate is typical. Various techniques were used to help overcome this limitation, including careful questionnaire design; inclusion of a free-post return envelope; an accompanying letter ensuring anonymity; and reminder letters. An overall response rate of 46% was achieved for this study.

The questionnaire contained 43 individual response items. The first question acted as an identifier to determine whether the respondent was a homeowner or tenant. While responses from both groups were of interest, the former was of greater importance, as they are the group of purchasers/sellers that primarily influence the value of property. However, it was considered relevant to survey both groups as both are affected by proximity to a CPBS to much the same extent from an occupiers' perspective, i.e., they both may perceive risks associated with a CPBS. It was hypothesized that tenants, being lesspermanent residents, would perceive the effects in a similar way, but to a much lesser degree.

Other survey questions related to overall neighborhood environmental desirability; the timing of

<sup>29.</sup> Ibid., 252.

<sup>30.</sup> P. W. Abelson, "Property Prices and Amenity Values," Journal of Environmental Economics and Management 6 (1979): 11–28.

<sup>31.</sup> James A. Chalmers and Scott Roehr, "Issues in the Valuation of Contaminated Property," The Appraisal Journal (January 1993): 28–41.

<sup>32.</sup> W. N., Kinnard, M. B. Geckler, and S. A. Dickey, "Fear (as a Measure of Damages) Strikes Out: Two Case Studies Comparisons of Actual Market Behaviour with Opinion Survey Research" (paper presented at the Tenth Annual American Real Estate Society Conference, Santa Barbara, California, April 1994).

S. G. Bond, "Do Market Perceptions Affect Market Prices? A Case of a Remediated Contaminated Site," in *Real Estate Valuation Theory*, ed. K. Wang and M. L. Wolverton, 285–321 (Boston: Kluwer Academic Publishers, 2002).

<sup>34.</sup> James Flynn et al., "Survey Approach for Demonstrating Stigma Effects in Property Value Litigation," The Appraisal Journal (Winter 2004): 35–45.

<sup>35.</sup> A. Myrick Freeman, The Benefits of Environmental Improvement: Theory and Practice (Baltimore: John Hopkins Press, 1979).

<sup>36.</sup> Sherwin Rosen, "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition," Journal of Political Economy 82, no. 1 (Jan/Feb 1974): 34–55.

the CPBS's construction and its proximity in relation to the respondent's home; the importance placed on the CPBS as a factor in relocation decisions and on the price/rent the respondent was prepared to pay for the house; how a CPBS might affect the price the respondent would be willing to pay for the property; and the degree of concern regarding the effects of CPBSs on health, stigma, aesthetics, and property values. The surveys were coded to identify the property address of the respondent. This enabled each respondent's property to be located on a map and to show this in relation to the cell site.

Eighty questionnaires<sup>37</sup> were distributed to each of the ten suburbs (five case study and five control areas) in Christchurch. Respondents were instructed to complete the survey and return it in the free-post, self-addressed envelope provided. The initial response rate was 31%. A month later, a further 575 questionnaires with reminder letters were sent out to residents who had not yet responded. A total response rate of 46% was achieved. Response rates from each suburb ranged from 33% (Linwood) to 61% (Bishopdale).

The questionnaire responses were coded and entered into a computerized database.<sup>58</sup> The analysis of responses included the calculation of means and percentage of responses to each question to allow for an overview of the response patterns in each area.

#### **Case Study and Control Areas**

The suburbs of Beckenham, Papanui, Upper Riccarton, Bishopdale, and St Albans were selected for the case study because there is at least one CPBS within each of these communities. Census data, providing demographic and socioeconomic characteristics of geographic areas, was used to select the control suburbs of Spreydon, Linwood, Bromley, Avonhead, and Ilam.<sup>59</sup> The control areas are located further away (over 1 kilometer) from the CPBS in their matched case study area. As well as matching demographic and socioeconomic characteristics, each suburb was selected based on its similarity to its matched case study area in terms of living environment and housing stock, distance to the central business district, and geographic size; the only dissimilarity is that there are no CPBSs in the control areas. (See Appendix I for a location map.)

Demographic statistics show that Bromley and Ilam comprise a younger population (median age about 33), with Bishopdale and Upper Riccarton having an older population (median age about 40). The ethnic breakdown of each suburb indicates that Papanui and Spreydon have the highest proportion of Europeans (about 90%), Bromley has the highest proportion of both Maoris and Pacific Islanders (13.9% and 8.5% respectively), while Ilam, Avonhead, and Upper Riccarton have the highest proportion of Asians (16.1% to 18.5%).<sup>40</sup>

Median household and median family incomes (MHI and MFI) are highest in Ilam and Avonhead (MHI: \$34,751NZ, \$53,405NZ; MFI: \$51,530NZ, \$65,804NZ, respectively) and lowest in Linwood and Beckenham (MHI: \$22,275NZ, \$26,398NZ; MFI: \$29,673NZ, \$33,847NZ respectively).<sup>41</sup> Residents of St Albans West have the highest levels of education (21.7% have a degree or a higher degree) followed by Upper Riccarton (18.7%), Ilam (16.7%), and Avonhead (16.2%). These same suburbs have the highest proportion of professionals by occupational class (20.3% to 27.3%). Residents of Bromley have the lowest education (40% have no qualification) and the lowest proportion of professionals (5.5%).<sup>42</sup>

In summary, the socioeconomic data shows that Ilam is the more superior suburb, followed by Avonhead, Upper Riccarton, St Albans West, and Papanui. The lower socioeconomic areas are, in decreasing order, Spreydon, Bishopdale, Bromley, Beckenham, and Linwood.

#### **Survey Results**

A summary of the main findings from the survey is presented in Appendix II, and the survey results are discussed in the following.

#### **Response Rates**

Of the 800 questionnaires mailed to homeowners and tenants in the case study and control areas (400 to each group), 50% from the case study area and 41%

<sup>37.</sup> Approved by the University of Auckland Human Subjects Ethics Committee (reference 2002/185).

<sup>38.</sup> The computer program SPSS was selected as the appropriate analytical tool for processing the data.

<sup>39.</sup> The census is conducted in New Zealand every five years, and the data used to define the control areas is from the latest census conducted in 2001, see Christchurch City Area Unit Profile, 2001 at http://www.ccc.govt.nz/Census/ChristchurchCityAreaUnitProfile.xls.

<sup>40.</sup> Christchurch City Area Unit Profile statistics.

<sup>41. \$1</sup>NZ = \$0.65US, thus, \$34,751NZ = \$22,588US.

<sup>42.</sup> The median house price for Christchurch city in August 2003 was \$185,000NZ/\$120,000US (New Zealand national median house price at this time was \$215,000NZ/\$140,000US), http://www.reinz.co.nz/files/HousingFacts-Sample-Pg1-5.pdf (accessed March 17, 2004). Median house prices in each individual suburb could not be obtained as the median sales data from the Real Estate Institute of NZ (REINZ) contains more than one suburb in each location grouping.

from the control area were completed and returned. Over three-quarters (78.5%) of the case study respondents were homeowners compared to 94% in the control area.

#### Desirability of the Suburb as a Place to Live

More than half (58.3%) the case study respondents have lived in their suburb for more than five years (compared to 65% in the control group) and a quarter (25%) have lived in their suburb between 1 and 4 years (compared to 28% in the control group).

Around two-thirds (65% of the case study respondents and 68% of the control group respondents) rated their neighborhoods as either above average or superior as a place to live when compared with other similar named suburbs. The reasons given for this include close proximity to amenities (shops, library, medical facilities, public transport, and recreational facilities) and good schools.

Reasons given for rating the case study neighborhoods inferior to other similar neighborhoods include lower house prices, older homes, more student housing and lower-income residents. The reasons given by the control group respondents for an inferior rating include distance from the central business district (Avonhead); smell from the sewerage oxidation ponds and composting ponds (Bromley); and lower socioeconomic area and noise from the airport (Linwood).

## Feelings About a CPBS as an Element of the Neighborhood

In the case study areas, a CPBS had already been constructed when only 39% of the respondents bought their houses or began renting in the neighborhood. Some responded that they were not notified that the CPBS was to be built, that they had no opportunity to object to it, and that they felt they should have been consulted about its construction. For the respondents who said that proximity to the tower was of concern to them, the most common reasons given for this were the impact of the CPBS on health, aesthetics, and property values. Nearly three-quarters (74%) of the respondents said they would have gone ahead with the purchase or rental of their property anyway if they had known that the CPBS was to be constructed.

In the control areas nearly three-quarters (72%) of the respondents indicated they would be opposed to construction of a CPBS nearby. The location of a CPBS would be taken into account by 83% of respondents if they were to consider moving. As with the case study respondents, the control group respondents who were concerned about proximity to a

CPBS were most often concerned about the effects of CPBSs on health, aesthetics, and property values.

#### Impact on Decision to Purchase or Rent

In the case study areas, the tower was visible from the houses of 46% of the respondents, yet two-thirds (66%) of these said it was barely noticeable, and one-quarter said it mildly obstructed their view. When asked in what way the CPBS impacts the enjoyment of living in their home, 37% responded that its impact was related to health concerns, 21% said it impacted neighborhood aesthetics, 20% said it impacted property value, and 12% said it impacted the view from their property.

When asked about the impact that the CPBS had on the price/rent they were prepared to pay for their property, over half the case study respondents (53.1%) said that the tower was not constructed at the time of purchase/rental, and 51.4% of the respondents said the proximity to the CPBS did not affect the price they were prepared to pay for the property. Nearly 3% said they were prepared to pay a little less, 2% said they were prepared to pay a little more. For the control group respondents, 45% of the respondents would pay substantially less for a property if a CPBS were located nearby, over one-third (38%) were prepared to pay just a little less for such a property, and 17% responded that a CPBS would not influence the price they would pay.

Only 10% of the case study respondents gave an indication of the impact that the CPBS had on the price/rent they were prepared to pay for the property; one-third of these felt it would decrease price/rent by 1% to 9%. For the control group, over one-third (38%) of the respondents felt that a CPBS would decrease price/rent by more than 20%, and a similar number (36%) said they would be prepared to pay 10% to 19% less for property located near a CPBS. The responses are outlined in Table 1.

# Table 1 Impact of a CPBS on Purchase/Rental Price Decision

Percent of Case Study Respondents
Responses)
5% (3%)
10% (2%)
14% (2%)
33% (19%)
24% (36%)
nt 14% (38%)

Interestingly, it would seem that those living farther away from the CPBSs (the control group) are far more concerned about proximity to CPBSs than those living near CPBSs (the case study group); they indicated that a CPBS would have a greater price/ rent effect. The possible explanations for this are discussed in the survey results section.

#### **Concerns About Proximity to the CPBS**

Most case study respondents were not worried about the effects of proximity to a CPBS related to health (50%), stigma (55%), future property value (61%), or aesthetics (63%). About one-quarter to one-third of these respondents were somewhat worried about the impact of proximity to a CPBS on health (38%), stigma (34%), future property value (25%), or aesthetics (25%). From the list of issues, respondents were most worried about future property value, but only 13.5% of the respondents responded this way.

Here again, control group respondents were much more concerned about the effects of proximity to a CPBS than their case study counterparts. Of the possible concerns about CPBSs on which respondents were asked to comment, control group respondents were most worried about the negative effects on future property values and aesthetics. Nearly half the respondents were worried a lot about these issues. Similar responses were recorded for the possibility of harmful health effects in the future from CPBSs (42% were worried a lot about this) and stigma associated with houses near CPBSs (34% were worried a lot). The responses regarding concerns about living near a CPBS are shown in Table 2.

In both the case study and control areas, the issue of greatest concern for respondents was the impact of proximity to CPBSs on future property values. The main concerns related to CPBSs were the unknown potential health effects, the possible socioeconomic implications of the siting of CPBSs, and how CPBSs affect property values. There also were concerns that the city council was not notifying the public about the possible construction of CPBSs.

#### **Discussion of the Survey Results**

The results were mixed, with responses from residents ranging from having no concerns to being very concerned about proximity to a CPBS. In general, those people living in areas farther from CPBSs were much more concerned about issues related to proximity to CPBSs than residents who lived near CPBSs.

Over 40% of the control group respondents were worried a lot about future health risks, aesthetics, and future property values compared with the case study areas, where only 13% of the respondents were worried a lot about these issues. However, in both the case study and control areas, the impact of proximity to CPBSs on future property values is the issue of greatest concern for respondents. If purchasing or renting a property near a CPBS, over a third (38%) of the control group respondents said a CPBS would reduce the price of their property by more than 20%. The perceptions of the case study respondents were again less negative, with a third saying they would reduce the price by only 1%–9%, and 24% saying they would reduce the price by 10%–19%.

The lack of concern shown by the case study respondents may be due to the CPBSs being either not visible or only barely visible from their homes. The CPBSs may be far enough away from respondents' properties (as was indicated by many respondents, particularly in St Albans West, Upper Riccarton, and Bishopdale) or hidden by trees and consequently not perceived as affecting the properties. The results may have been quite different had the CPBS being more visually prominent.

Alternatively, the apparent lower sensitivity to CPBSs of case study residents compared to the control group residents may be due to cognitive dissonance reduction. In this case, respondents may be unwilling to admit, due to the large amounts of money already paid, that they may have made a poor purchase or rental decision in buying or renting property located near a CPBS. Similarly, the homeowners may be unwilling to admit there are concerns about CPBSs when the CPBSs were built

#### Table 2 Concerns about Living Near a CPBS\*

Concern	Does not worry me	Worries me somewhat	Worries me a lot
Possibility of harmful health effects	50% (20%)	38% (38%)	12% (42%)
Stigma effect	55% (21%)	34% (45%)	12% (34%)
Effect on future property values	61% (15%)	25% (37%)	13% (47%)
Aesthetics	63% (18%)	25% (37%)	11% (45%)

\* Percent of case study respondents having that concern (control group respondents). All numbers are rounded.

after they had purchased their homes, because to do so might have a negative impact on property values.

Regardless of the reasons for the difference in responses from the case study and control groups, the overall results show that residents perceive CPBSs negatively. In both the case study and control areas, the impact of proximity to CPBSs on future property values was the issue of greatest concern for respondents. Overall, respondents felt that proximity to a CPBS would reduce value by from 10% to over 20%. The second part of the study outlined below, involving an econometric analysis of Christchurch property sales transaction data, helps to confirm these results.

Respondents' comments added at the end of the survey indicate that residents have ongoing concerns about CPBSs. Although some people accepted the need for CPBSs, they said that they did not want them built in their back yard, or they preferred that they be disguised to blend better with their environment.

#### Market Study Research Objectives and Methodology

A market study was undertaken to test the hypothesis that in suburbs where there is a CPBS it will be possible to observe discounts to the selling price of homes located near these structures. Such discounts would be observed where buyers of proximate homes view the CPBSs in negative terms due to a perceived risk of adverse effects on health, aesthetics, and property value.

The literature dealing specifically with the measurement of the impact of environmental hazards on residential sale prices (including proximity to transmission lines, landfill sites, and ground water contamination) indicates the popularity of hedonic pricing models, as introduced by Court<sup>45</sup> and later Griliches,<sup>44</sup> and further developed by Freeman<sup>45</sup> and Rosen.<sup>46</sup> The more recent studies, including those by Dotzour;<sup>47</sup> Simons and Sementelli;<sup>48</sup> and Reichert,<sup>49</sup> focus on proximity to an environmental hazard and demonstrate that this reduces residential house prices by varying amounts depending on the distance from the hazard.<sup>50</sup> However, there are no known published studies that use hedonic housing models to measure the impact of proximity to a CPBS on residential property values.

As in the previous residential house price studies, the standard hedonic methodology was used here to quantify the impact of a CPBS on sale prices of homes located near a CPBS. The results from this study in tandem with the opinion survey results will help test the hypothesis that proximity to a CPBS has a negative impact on property value and will reveal the extent to which the market reacts to CPBSs.

#### **Model Specification**

A hedonic price model is constructed by treating the price of a property as a function of its utility-bearing attributes. Independent variables used in the model to account for the property attributes are limited to those available in the data set and known, based on other well-tested models reported in the literature and from valuation theory, to be related to property price. The basic model used to analyze the impact on sale price of a house located near a CPBS, is as follows:

$$P_i = f(X_{1,i}, X_{2,i}, \dots, X_{n,i})$$
  
where:

 $P_i$  = property price at the *i* th location  $X_{i,i} \dots X_{n,i}$  = individual characteristics of each sold property (e.g., land area, age of house, floor area, sale date, construction materials, house condition, CPBS construction date, etc.)

The more recent hedonic pricing studies that demonstrate the effects of proximity to an environmental hazard use different functional forms to represent the relationship between price and various property characteristics.<sup>51</sup> In hedonic housing models the linear and log-linear models are most popular. The linear model implies constant partial effects between house prices and housing characteristics, while the log-linear model allows for nonlinear price effects and is shown in the following equation:

<sup>43.</sup> A. T. Court, "Hedonic Price Indexes with Automotive Examples," in The Dynamics of Automobile Demand (New York: General Motors, 1939).

<sup>44.</sup> Zvi Griliches, ed. Price Indexes and Quality Change (Cambridge, Mass.: Harvard University Press, 1971).

<sup>45.</sup> Freeman.

<sup>46.</sup> Rosen.

<sup>47.</sup> Mark Dotzour, "Groundwater Contamination and Residential Property Values," The Appraisal Journal (July 1997): 279–285.

<sup>48.</sup> Robert A. Simons and Arthur Sementelli, "Liquidity Loss and Delayed Transactions with Leaking Underground Storage Tanks," *The Appraisal Journal* (July 1997): 255–260.

<sup>49.</sup> Alan K. Reichert, "Impact of a Toxic Waste Superfund Site on Property Values," The Appraisal Journal (October 1997): 381–392.

<sup>50.</sup> Only Dotzour found no significant impact of the discovery of contaminated groundwater on residential house prices. This was likely due to the nonhazardous nature of the contamination where the groundwater was not used for drinking purposes.

<sup>51.</sup> See for example L. Dale et al., "Do Property Values Rebound from Environmental Stigmas? Evidence from Dallas," Land Economics 75, no. 2 (May 1999): 311–326; Dotzour; Simons and Sementelli; and Reichert.

$$\ln P_i = b_o + b_i \times X_{i,i} + b_2 \times X_{2i} + b_3 \times X_{3i}$$
  
... ... +  $b_n \times X_{n+1} + a_o \times D_o +$   
... ... +  $a_m \times D_m + e_o$ 

where:

 $\ln P_i$  = the natural logarithm of sale price

 $b_0 = the intercept$ 

$$b_1 \dots b_n$$
;  $\mathbf{a}_0 \dots a_m$  = the model parameters to be  
estimated, i.e., the implicit unit  
prices for increments in the  
property characteristics

$$X_1 \dots X_n$$
 = the continuous characteristics,  
such as land area

$$D_o \dots D_m$$
= the categorical (dummy)  
variables, such as whether the  
sale occurred before (0) or after  
(1) the CPBS was built

Sometimes the natural logarithm of land area and floor area is also used. The parameters are estimated by regressing property sales on the property characteristics and are interpreted as the households' implicit valuations of different property attributes. The null hypothesis states that the effect of being located near a CPBS does not explain any variation in property sale prices.

#### The Data

Part of the process for selecting appropriate case study areas was identifying areas where there had been a sufficient number of property sales to provide statistically reliable and valid results. Sales were required for the period before and after the CPBS had been built in order to study the impact of the CPBS on the surrounding properties' sale prices.

Further, due to the multitude of factors that combine to determine a neighborhood's character, such as proximity to the central business district, standard of schooling, recreational facilities provided, standard of housing, proximity to amenities, and the difficulty in allowing for these separately, sales located in areas with comparable neighborhood characteristics were preferred.

Four of the suburbs in the survey case study met the criteria for the market study: St Albans, Beckenham, Papanui, and Bishopdale. No sales data was available for Upper Riccarton after the CPBS was built in this suburb, hence this suburb was not included in the market analysis study. As each CPBS was built at a different date, the sales from each suburb were separately analyzed. The uniformity of locational and neighborhood characteristics in each of these suburbs allows the analysis to be simplified and to focus on the properties' physical attributes. The relative homogeneity of housing, locational, and neighborhood attributes was verified through field inspections.

The dependent variable is the property sale price. The data set includes 4283 property sales that occurred between 1986 and 2002 (approximately 1000 sales per suburb).<sup>52</sup>

The independent data set was limited to those variables that correspond to property attributes known and suspected to influence price. These variables are floor area  $(m^2)$ ; land area (ha); age of the house (the year the house was built); tower (a dummy variable indicating whether the sale occurred before or after the CPBS was built); sale date (month and year); time of sale based on the number of quarters before or after the CPBS was built (to help control for movements in house prices over time); category of residential property (stand-alone dwelling, dwelling converted into flats, ownership unit, etc); quality of the principal structure (as assessed by an appraiser); and roof and wall materials. The number of bedrooms was not available in the data set, but would not have been included as an independent variable since the number of bedrooms is highly correlated with floor area.

Since the GIS coordinates of properties for the initial analysis were not available, street name was included as an independent variable instead. To a limited extent, street name helped to control for the proximity effects of a CPBS. It was suspected that houses on a street close to a CPBS may, on average, sell for less than houses on a street farther away from the CPBS.

While views, particularly water views, have been shown in previous empirical studies to be an important attribute affecting sale price, in the present study the flat contour of the landscape where the homes are located, together with the suburban nature of the environment surrounding these, precluded any significant views. Thus, views were not included in the analysis. Further, due to the large number of sales included in the analysis, inspections of each individual property were not made to determine the view, if any, of a CPBS from each house. It was felt that it is not merely the view that may impact on price, but also proximity to a CPBS due to the potential effect this may have on health, cell phone coverage, and neighborhood aes-

<sup>52.</sup> These sales were obtained from Headway Systems Ltd, a data distribution and system development company. Headway is the major supplier of property market sales information to New Zealand's valuation profession; it is jointly owned by the NZ Institute of Valuers (NZIV) and PT Investments, a consortium of 28 shareholders from within the property industry.

thetics. Hence, view of a CPBS was not included as an independent variable. The variable descriptions are listed in Table 3. Variable codes are shown in Appendix III and basic descriptive statistics for selected quantitative variables are shown in Appendix IV.

#### Table 3 Variable Descriptions

Variable*	Definition
SLNETX	Sale price of the house (NZ\$)
SITSTX	Street name
CATGYX2	Category of dwelling: D, E, etc. <sup>†</sup>
CATGYX4	Quality of the structure: A, B, C <sup>+</sup>
TIMESOLD.Q	Using the time the cell phone tower was
	built as a baseline quarter, the number of
	quarters before (-) and after (+) it was built
AGE	Year the house was built
LANDAX	Land area (ha)
MATFAX	Total floor area (m <sup>2</sup> )
WALLCNX	Wall construction: W, B, C, etc. <sup>†</sup>
ROOFCNX	Roof construction: W, B, C, etc. <sup>†</sup>
TOWER	An indicator variable: 0 if before the cell phone tower was built, or 1 after it was built

\* Sale price is the dependent variable.

† See Appendix III for explanation of variable codes.

#### **Market Study Results**

An econometric analysis of Christchurch property transaction data helped to confirm the opinion survey results. In the analysis of selected suburbs, the sales data from sales that occurred before a CPBS was built was compared to sales data from after a CPBS was built to determine any variance in price, after accounting for all the relevant independent variables.

#### **Empirical Results**

The model of choice is one that best represents the relationships between the variables and has a small variance and unbiased parameters. Various models were tested and the results are described in the next section. The following statistics were used to help select the most appropriate model: the adjusted coefficient of determination (adjusted  $R^2$ ); the standard error of the regression equation; the AIC<sup>55</sup> and BIC<sup>54</sup> statistics; and *t*-test of significance of the coefficients and *F*-statistic.

# Significance of Variables and the Equation: St Albans

As hedonic prices can vary significantly across different functional forms, various commonly used functional forms were examined to determine the model specification that best describes the relationship between price and the independent variables. Also, to test the belief that the relationship between *Price* and *Land Area* is not a linear function of *Price*, the variable *LANDAX* (land area) was transformed to reflect the correct relationship. Several transformations were tested including: linear of *SLNETX* (sale price) and log of *LANDAX*; log of *SLNETX* and linear of *LANDAX*; and log of *SLNETX* and log of *LANDAX*. All dummy variables remained in their linear form in each model.

It was found that the best result was obtained from using the log of *SLNETX* and log of *LANDAX*, and the linear form of all the dummy variables. Taking the log of an independent variable implies diminishing marginal benefits. For example, an extra 50 square meters of land area on a 550-square-metersite would be worth less than the previous 50 square meters. The log-log model shows the percent change in price for a one-percent change in the independent variable, while all other independent variables are held constant (as explained in Hill, Griffiths, and Judge).<sup>55</sup>

In the semilogarithmic equation the interpretation of the dummy variable coefficients involves the use of the formula:  $100(e^{b_a} - 1)$ , where  $b_n$  is the dummy variable coefficient.<sup>56</sup> This formula derives the percentage effect on price of the presence of the factor represented by the dummy variable and is advocated over the alternative, and commonly misused, formula of 100. ( $b_n$ ). The resulting model included all the available variables as follows:

$$\begin{split} \log(SLNETX) &= \alpha + \beta_1 \times TOWER + \beta_2 \times SITSTX \\ &+ \beta_5 \times CATGYX2 + \beta_4 \times CATGYX4 \\ &+ \beta_5 \times TIMESOLD \times Q + \beta_6 \times AGE \\ &+ \beta_7 \times \log(LANDAX) \\ &+ \beta_8 \times MATFAX \\ &+ \beta_9 \times WALLCNX \\ &+ \beta_{10} \times ROOFCNX \end{split}$$

<sup>53.</sup> AIC is the Akaike Information Criterion, and is a "goodness of fit" measure involving the standard error of the regression adjusted by a penalty factor. The model selected is the one that minimizes this criterion (Microsoft SPSSPC Online Guide, 1997).

<sup>54.</sup> The BIC is the Bayesian Information Criterion. Like the AIC, BIC takes into account both how well the model fits the observed data, and the number of parameters used in the model. The model selected is the one that adequately describes the series and has the minimum SBC. The SBC is based on Bayesian (maximum-likelihood) considerations. (Microsoft SPSSPC Online Guide, 1997).

<sup>55.</sup> R. Carter Hill, William E. Griffiths, and George G. Judge, Undergraduate Econometrics (New York: John Wiley & Sons, 1997).

<sup>56.</sup> See Robert Halvorsen and Raymond Palmquist, "The Interpretation of Dummy Variables in Semi-Logarithmic Equations," American Economic Review 70, no. 3 (1980): 474–475.

From the regression output, the variables ROOFCNX and WALLCNX were found to be insignificant so these were removed from the model and the regression was rerun. The table in Appendix V summarizes these results. The *F*-statistic (123) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 4 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variables *ROOFCNX* and *WALLCNX* is superior to the regression that includes them (AIC and BIC are minimized). For this reason, the model excluding these variables was selected for analysis, and it is discussed next.

#### Table 4 Test Statistics — St Albans

	Adjusted R <sup>2</sup>	AIC	BIC
Full Model	0.82	-118.38	36.55
Sub Model	0.82	-121.64	5.95

Tests for normality, heteroskedasticity, and multicollinearity generally indicated that the model was adequately specified and that the data were not severely ill conditioned (heteroskedasticity and multicollinearity were diminished when the data were transformed).

The coefficient of determination ( $R^2$ ) indicates that approximately 82% of the variation in sale price is explained by the variation in the independent variable set. All variable coefficients had the expected signs,<sup>57</sup> except for *TOWER*, which was positive. The positive coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a CPBS in St Albans, the price of a house would increase by  $e^{0.1135} \approx 1.12$  (12%). A possible explanation is that cell phone technology was quite new at the time (1994), and as there had been little in the media about possible adverse health effects from CPBSs, people may have perceived it as a benefit as they were likely to get better cell phone coverage.

The most significant variables were *TIMESOLD.Q* (the quarter in which the sale occurred before or after the CPBS was built), *log(LANDAX)* (log of land area), and *MATFAX* (total floor area) and all have a positive influence on

price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built (1994), but only to a limited extent (1.38%). The positive log of land area and total floor area shows that prices increase with increasing size.

The regression coefficient on *log(LANDAX)* is 0.3285, which indicates that, on average, a 10% increase in *LANDAX* will generate a 3.285% increase in price. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, for each additional m<sup>2</sup> the price would increase by  $e^{0.0022514} \approx 1.0022314$  (0.22% increase).

# Significance of Variables and the Equation: Papanui

The same functional form used for St Albans was used for Papanui. From the regression output, the variable *CATGYX*2 was found to be insignificant so it was removed from the model and the regression was rerun; Appendix VI summarizes the results. The *F*-statistic (152) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 5 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *CATGYX*2 is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding this variable was selected for analysis, and is discussed next.

#### Table 5 Test Statistics — Papanui

Adjusted R <sup>2</sup>	AIC	BIC
0.87	-509.91	-371.99
0.87	-510.57	-381.56
	<b>Adjusted R<sup>2</sup></b> 0.87 0.87	Adjusted R <sup>2</sup> AIC           0.87         -509.91           0.87         -510.57

The coefficient of determination  $(R^2)$  indicates that approximately 87% of the variation in sale price is explained by the variation in the independent variable set. This would be considered high in comparison with the amount of explanation obtained in similar hedonic house studies reported in the literature.<sup>58</sup> All variable coefficients had the expected signs.

The most significant variables were *TIMESOLD.Q*, *MATFAX* (total floor area), and *TOWER*. The former two have a positive influence on price. The positive *TIMESOLD.Q* indicates that the

<sup>57.</sup> Note that the variable AGE is positive as this variable indicates the year the house was built; therefore, the higher the year, the younger the home. Newer houses have less wear and tear than older homes and sell, on average, for more than older homes.

<sup>58.</sup> For example, Reichert obtained an adjusted R<sup>2</sup> of 84%; Simons and Sementelli, 78%; Abelson, 68%; Dotzour, 56%–61%.

market was increasing over time since the CPBS was built (2000), but only by 1.4% per quarter. The positive coefficient for *MATEAX* indicates that, when all the other variables are held constant, the price would increase by  $e^{0.0042576} \approx 1.00427$  (0.43%), with increasing size. The negative coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a CPBS in Papanui, the price of a house would decrease by  $e^{0.2340} \approx 0.79$  (21% decrease).

# Significance of Variables and the Equation: Beckenham

The same functional form used for Papanui and St Albans was used for Beckenham. From the regression output, the variable *ROOFCNX* was found to be insignificant so it was removed from the model and the regression was rerun; Appendix VII summarizes these results. The *F*-statistic (214) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

Table 6 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *ROOFCNX* is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding this variable was selected for analysis.

#### Table 6 Test Statistics — Beckenham

Adjusted R <sup>2</sup>	AIC	BIC
0.89	-819.00	-641.39
0.89	-818.66	-650.66
	<b>Adjusted R<sup>2</sup></b> 0.89 0.89	Adjusted R <sup>2</sup> AIC           0.89         -819.00           0.89         -818.66

The coefficient of determination  $(R^2)$  indicates that approximately 89% of the variation in sale price is explained by the variation in the independent variable set. Again, as with the model for Papanui this amount of explanation would be considered high.

The most significant variables were *TIMESOLD.Q, MATFAX*, and *TOWER*. The former two have a positive influence on price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built in 2000, but only by 1.91% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by  $e^{0.0042054} \approx 1.00421$  (0.42%), with increasing size. The negative coefficient for *TOWER* shows that, when all the other variables are held constant, after the installation of a

CPBS in Beckenham, the price of a house would decrease by  $e^{-0.25019} \approx 0.793$  (20.7% decrease).

# Significance of Variables and the Equation: Bishopdale

The same functional form used for the other three suburbs was used for Bishopdale. From the regression output, the variables *ROOFCNX* and *CATGYX* were found to be insignificant so these were removed from the model and the regression was rerun; Appendix VIII summarizes these results. The *F*-statistic (122) shows that the estimated relationship in the model is statistically significant at the 95% confidence level and that at least one of the coefficients of the independent variables within the model is not zero.

#### Table 7 Test Statistics — Bishopdale

Adjusted R <sup>2</sup>	AIC	BIC
0.79	-927.48	-775.71
0.79	-929.32	-796.52
	<b>Adjusted R<sup>2</sup></b> 0.79 0.79	Adjusted R <sup>2</sup> AIC           0.79         -927.48           0.79         -929.32

Table 7 summarizes the model selection test statistics. Based on the AIC and BIC, the regression that excludes the variable *ROOFCNX* and *CATGYX* is superior to the regression that includes it (AIC and BIC are minimized). For this reason, the model excluding these variables was selected for analysis.

Again, the most significant variables were *TIMESOLD.Q* and *MATFAX*; the variable of interest, *TOWER*, was not a significant variable in the model so it is not discussed further. The former two variables have a positive influence on price. The positive *TIMESOLD.Q* indicates that the market was increasing over time since the CPBS was built in 1994, but only at 0.98% per quarter. The positive coefficient for *MATFAX* indicates that, when all the other variables are held constant, the price would increase by  $e^{0.0059665} \approx 1.004$  (0.40%), with increasing size.

#### **Summary of Results**

The above analysis shows that the most significant variables and their impact on price were similar between suburbs. This indicates the relative stability of the coefficients between each model. Interestingly, the impact of *TOWER* on price (a decrease of between 20.7% and 21%) was very similar in the two suburbs where the towers were built in the year 2000. This may be due to the much greater media publicity given to CPBSs after the two legal cases in Christchurch (*McIntryre* and *Shirley Primary School*  in 1996 and 1999, respectively). The two suburbs where *TOWER* was either insignificant or increased prices by around 12%, were suburbs where towers had been built in 1994, prior to the media publicity.

#### **Limitations of the Research**

The main limitation affecting this survey was in the selection of the case study areas. Specifically, the areas selected had CPBSs that were not highly visible to residents. If more-visible CPBSs had been selected, the results may have been quite different. Thus, caution must be used in making generalizations from this study or applying the results directly to other similar studies or valuation assignments. Factors that could affect results are the distance of homes from the CPBS, the style and appearance of the CPBS, how visible the CPBS is to residents, the type of home (single family, multifamily, rental, etc.), and the so-cioeconomic make-up of the resident population.

To help address the proximity factor, a study is in progress examining the role of distance to the CPBSs and price effects; that study uses GIS analysis to determine the impact this has on residential property prices. It is expected that this will provide a more precise estimation of the impact of a CPBS on price.

It must be kept in mind that these results are the product of only one case study carried out in a specific area (Christchurch) at a specific time (2003). The above results indicate that value effects from CPBSs may vary over time as market participants' perceptions change. Perceptions toward CPBSs can change either positively or negatively over time. For example, as the World Health Organization's ten-year study of the health effects from CPBSs is completed and becomes available, consumers' attitudes may become more positive or negative depending on the outcome of that study. Consequently, studies of the price effects of CPBSs need to be conducted over time.

#### **Areas for Further Study**

This research has focused on residents' perceptions of negative effects from proximity to CPBSs and how these impact property values, rather than the scientific or technological estimates of these risks. The technologists' objective view of risk is that risk is measurable solely in terms of probabilities and severity of consequences, whereas the public, while taking experts' assessments into account, view risk more subjectively, based on other factors. Further, the results of scientific studies about the health effects of radio frequency and microwave radiation from CPBSs are not consistent. Residents' perceptions and assessments of risk vary according to a wide range of psychological, social, institutional, and cultural processes, and this may explain why their assessments differ from those of the experts.

Given the public concerns about the potential risks arising from being located nearby a CPBS, it is important for future studies to focus more attention on the kinds of risks the public associates with CPBSs and the level of risk perceived. How far away from the CPBS do people feel they have to be to be safe? What CPBS design, size, and surrounding landscape would help CPBSs to be more publicly acceptable? What social, economic, educational, and other demographic variables influence how people perceive the risks from CPBSs? Do residents that are heavy users of cell phones have a different perception of CPBSs than residents who make little use of this technology? Are these perceived risks reflected in property values and to what extent? Do these perceived risks vary over time and to what degree?

Answers to these questions, if shared among researchers and made public, could lead to the development of a global database to assist appraisers in determining the perceived level of risk associated with CPBSs and other similar structures.<sup>59</sup> Knowledge of the extent that these risks are incorporated into property prices and how they vary over time will lead to more accurate value assessments of properties in close proximity to CPBSs and other similar structures.

#### **Summary and Conclusions**

Focusing on four case study neighborhoods in Christchurch, New Zealand, this article presents the results from both an opinion survey and market sales analysis undertaken in 2003 to determine residents' perceptions towards living near a CPBS and how this may impact property prices. From the results, it appears that people who live close to CPBSs perceive the sites less negatively than those who live farther away.

The issue of greatest concern for survey respondents in both the case study and control areas is the impact of proximity to CPBSs on future property values. Overall, respondents would pay from 10%–19% less to over 20% less for a property if it were in close proximity to a CPBS.

The opinion survey results were generally confirmed by the market sales analysis using a hedonic house price approach. The results of the sales analysis show prices of properties were reduced by around 21% after a CPBS was built in the neighborhood. How-

<sup>59.</sup> For example, high-voltage overhead transmission lines.

ever, this result varies between neighborhoods, with a positive impact on price being recorded in one neighborhood, possibly due to the CPBS being built in that suburb before any adverse media publicity about CPBSs appeared in the local Christchurch press.

Research to date reports no clearly established health effects from radio frequency emissions of CPBSs operated at or below the current safety standards, yet recent media reports indicate that people still perceive that CPBSs have harmful effects. Thus, whether or not CPBSs are proven to be free from health risks is only relevant to the extent that buyers of properties near CPBSs perceive this to be true. Even buyers who believe that there are no adverse health effects from CPBSs, knowing that other potential buyers might think the reverse, will probably seek a price discount for a property located near a CPBS.

The comments of survey participants indicate the ongoing concerns that residents have about CPBSs. There is the need to increase the public's understanding of how radio frequency transmitting facilities operate and the strict exposure-limit standards imposed on the telecommunication industry. As more information is discovered that refutes concerns regarding adverse health effects from CPBSs, and as information about the NZ safety standards are made more publicly available, the perception of risk may gradually change, eliminating the discounts for neighboring properties.

#### Additional Reading

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#### Acknowledgements

The authors thank Mark Dunbar of Telfer Young and Robert Albrecht of DTZ for sharing the results of their cell phone research on valuation impacts from proximity to CPBSs, and Maya Marshall, Project Administrator at Telecom NZ, and Rapheal Hilbron, Community Relations Manager at Vodafone NZ, for information about CPBS locations and environmental impacts from these.

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Areas circled in white at the top are without a cell phone tower, while areas circled in the bottom three maps have a cell phone tower. Source: http://www.ccc.govt.nz/maps/Wises/

Variable	Responose	Valid Per	cent (%)
	nooponooo	Case Study	Control
Occupancy	Homeowner	78.5	94.2
	Tenant	21.5	5.8
How long have you lived there?	Less than 6 months	8.0	2.6
	6 months-1 year	8.6	4.5
	1–4 years	25.1	27.7
	More than 5 years	58.3	65.2
How would you rate the desirability of your neighborhood?	Superior	27.4	30.9
	Above Average	37.4	30.8
	Relow Average	28.5	27.0
	Inferior	1.1	0.7
Would you be opposed to construction of a cell phone tower pearby?	Ves		72.1
would you be opposed to construction of a cell phone tower nearby:	No		27.9
When you purchased/began renting was the cell phone	Yes	39.3	
tower already constructed?	No	60.7	
Was the proximity of the cell phone tower a concern to you?	Yes	20.0	
	No	80.0	
Would you have gone ahead with rental/purchase if you had known a	Yes	73.9	
cell phone site was to be constructed?	No	26.1	
Is location of a cell phone tower a factor you would consider	Yes		83.4
when moving?	No		16.6
Is the cell phone tower visible from your house?	Yes	45.7	
	No	54.3	
If yes, how much does it impact on your view?	Very obstructive	9.6	
	Mildly obstructive	24.5	
	Barely noticeable	66.0	
In what way does it impact on the enjoyment of living in your house?	Views	11.8	
	Aesthetics	20.6	
	Health concerns	36.8	
	Change in property value	19.9	
	Other	11.0	
Effect a nearby cell phone tower would have on the price/rent you	Tower wasn't constructed	53.1	
would pay for the property	Pay substantially more	0.0	0.0
	Pay a little more	2.3	0.0
	Pay a little less	2.8	37.6
	Not influence price	0.0 51 4	45.4 17.0
<sup>6</sup> / Effect a pearly call phone tower would have on the price/rent you	20% higher or more	5	20
would nav for the property	10-19% more	10	5.2
nould pay for the property	1–9% more	14	2.4
	1–9% less	33	19.2
	10–19% less	24	36.0
	20% or a greater reduction	14	37.6
Concern about the possibility of harmful health effects in the future	Does not worry me	50.3	19.9
	Worries me somewhat	38.0	38.4
	Worries me a lot	11.7	41.7
Concern about the stigma associated with houses near the cell	Does not worry me	54.6	20.8
phone sites	Worries me somewhat	33.9	45.0
	Worries me a lot	11.5	34.2
Concern about the affect on your properties value in the future	Does not worry me	61.3	15.4
	Worries me somewhat	25.4	37.2
	Worries me a lot	13.3	47.4
Concern about the aesthetic problems caused by the tower	Does not worry me	63.3	18.2
	Worries me somewhat	25.4	37.0
	Worries me a lot	11.3	44.8

#### **Appendix III Variable Codes**

#### **Category of Dwelling**

#### Code Definition

- D Dwelling houses are of a fully detached or semi-detached style situated on their own clearly defined piece of land.
- Converted dwelling houses that are now used as rental flat. Е
- F Ownership home units which may be single storey or multi-storey and which do not have the appearance of dwelling houses.
- Home and income. The dwelling is the predominant use, and there is an additional unit of use attached Н to or associated with the dwelling house that can be used to produce income.
- R Rental flats that have been purpose built.

#### **Quality of the Principal Structure**

#### Code Definition

- А Superior design and quality of fixtures and fittings is first class.
- В The design is typical of its era and the quality of the fixtures and fittings is average to good.
- С The design is below the level generally expected for the era, or the level of fixtures and fittings is barely adequate and possibly of below average quality.

#### **Building Materials: Walls and Roof**

Code	Definition
W	Wood
В	Brick
С	Concrete
S	Stone
R	Roughcast
F	Fibrolite

- Malthoid Μ
- Plastic
- Ρ
- L Iron Aluminium
- А G Glass
- Т Tiles
- Х \*

Appendix IV Descriptive Statistics						
Variable	Mean	Std. dev.	Median	Minimum	Maximum	Range
St Albans:						
Sale Price (\$)	221,957	110,761	200,000	42,000	839,000	797,000
Land Area (ha)	0.0658	0.0331	0.0579	0.0261*	0.3794	0.3533
Floor Area (m <sup>2</sup> )	161	70.40	150	50	450	400
Beckenham:						
Sale Price (\$)	116,012	50,037	111,000	21,500	385,000	363,500
Land Area (ha)	0.0601	0.0234	0.0553	0.0164*	0.2140	0.1976
Floor Area (m <sup>2</sup> )	115	32.50	110	40	340	300
Papanui:						
Sale Price (\$)	127,661	51,114	119,000	43,000	375,000	332,000
Land Area (ha)	0.0685	0.0289	0.0675	0.0310	0.3169	0.2859
Floor Area (m <sup>2</sup> )	122	34.60	110	56	290	234
Bishopdale:						
Sale Price (\$)	136,786	41,390	134,500	56,000	342,000	286,000
Land Area (ha)	0.0679	0.0163	0.0653	0.0400	0.2028	0.1628
Floor Area (m <sup>2</sup> )	125	31.20	118	64	290	226

\* These small land areas are related to apartments or units in a block of apartments/units that have the land area apportioned on a pro rata basis.

#### **Appendix V Regression Model: St Albans**

log(SLNETX) = TOWER + CATGYX2 + CATGYX4 + TIMESOLD.0 + AGE + log(LANDAX) + MATFAX + SITSTX

Poeidualeu	Min	10	Modian	20	Max
Residuais.	0 72955	0.15022	0.01502	0 14262	0 72047
	-0.72855	-0.10032	0.01595	0.14203	0.72047
Coefficients:		Estimate	Std. Error	t-value	Pr(>  t )
(Intercept)		9.1781868	0.6769096	13.559	< 2e-16 ***
TOWER		0.1133186	0.0318188	3.561	0.000395 ***
CATGYX2D		0.1846417	0.0702520	2.628	0.008776 **
CATGYX20		0.0334663	0.1008594	0.332	0.740134
CATGYX4B		-0.1551409	0.0245485	-6.320	4.75e-10 ***
CATGYX4C		-0.1483169	0.0722959	-2.052	0.040600 *
TIMESOLD.Q		0.0136663	0.0008208	16.650	< 2e-16 ***
AGE		0.0016408	0.0003521	4.660	3.81e-06 ***
log(LANDAX)		0.3285367	0.0283610	11.584	< 2e-16 ***
MATFAX		0.0022314	0.0001962	11.373	< 2e-16 ***
SITSTXAIKMANS RD		0.4029259	0.0533671	7.550	1.41e-13 ***
SITSTXBEVERLEY ST		0.2330787	0.0803137	2.902	0.003827 **
SITSTXBRISTOL ST		0.1706840	0.0521716	3.272	0.001124 **
SITSTXBROWNS RD		0.2492536	0.0720854	3.458	0.000579 ***
SITSTXCOX ST		0.3055798	0.0581672	5.253	2.00e-07 ***
SITSTXGORDON AVE		0.0823422	0.0679833	1.211	0.226236
SITSTXKNOWLES ST		0.1690979	0.0558911	3.025	0.002576 **
SITSTXMANSFIELD AVE		0.2954242	0.0652983	4.524	7.16e-06 ***
SITSTXMCDOUGALL AVE		0.3303105	0.0623720	5.296	1.60e-07 ***
SITSTXMURRAY PL		0.3613773	0.0629166	5.744	1.40e-08 ***
SITSTXOFFICE RD		0.3681146	0.0543368	6.775	2.71e-11 ***
SITSTX Other		0.0618491	0.0736629	0.840	0.401416
SITSTXPAPANUI RD		0.1940369	0.0560474	3.462	0.000570 ***
SITSTXRANFURLY ST		0.1701716	0.0617504	2.756	0.006012 **
SITSTXST ALBANS ST		0.1458665	0.0571172	2.554	0.010873 *
SITSTXWEBB ST		0.1895432	0.0725061	2.614	0.009143 **
SITSTXWESTON RD		0.2084419	0.0527555	3.951	8.60e-05 ***

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1 Residual standard error: 0.2175 on 677 degrees of freedom Multiple *R*-Squared: 0.8253, Adjusted *R*-squared: 0.8186 *F*-statistic: 123 on 26 and 677 DF, *p*-value: < 2.2e-16

Appendix	VI	Regression	Model:	Papanui
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In(formula = log(SLNETX) ~ TOWER + SITSTX + TIMESOLD.Q + AGE + log(LANDAX) + MATFAX + WALLCNX + ROOFCNX + CATGYX4, data = Papanui.final)

Residuals:	Min	1Q	Median	3Q	Max
	-0.484987	-0.098006	0.003859	0.106253	0.563126
Coefficients:		Estimate	Std. Error	t-value	Pr(>  t )
(Intercept)		5.9482316	0.6998186	8.500	< 2e-16 ***
TOWER		-0.2339640	0.0240908	-9.712	< 2e-16 ***
SITSTXHOANI ST		-0.1966982	0.0265429	-7.411	4.26e-13 ***
SITSTXLANGDONS RD		-0.1192547	0.0281242	-4.240	2.58e-05 ***
SITSTXLEANDER ST		0.0305555	0.0449437	0.680	0.496853
SITSTXMATSONS AVE		0.0949636	0.0292461	3.247	0.001231 **
SITSTXMORELAND AVE		-0.0892332	0.0397622	-2.244	0.025183 *
SITSTXMORRISON AVE		-0.1984492	0.0289772	-6.848	1.84e-11 ***
SITSTXOther		-0.1543194	0.0337436	-4.573	5.83e-06 ***
SITSTXSAILS ST		-0.0761412	0.0433455	-1.757	0.079490.
SITSTXSAWTELL PL		0.1840793	0.0393904	4.673	3.66e-06 ***
SITSTXSAWYERS ARMS R	2D	0.0872393	0.0201388	4.332	1.73e-05 ***
SITSTXST JAMES AVE		0.2497688	0.0289940	8.615	< 2e-16 ***
TIMESOLD.Q		0.0138914	0.0004137	33.575	< 2e-16 ***
AGE		0.0029307	0.0003512	8.345	4.85e-16 ***
log(LANDAX)		0.0904764	0.0270812	3.341	0.000886 ***
MATFAX		0.0042576	0.0002410	17.664	< 2e-16 ***
WALLCNXC		0.0054100	0.0200666	0.270	0.787558
WALLCNXF		-0.0980851	0.0464442	-2.112	0.035106 *
WALLCNXO		-0.1158407	0.0468334	-2.473	0.013655 *
WALLCNXR		-0.0670051	0.0244382	-2.742	0.006291 **
WALLCNXW		-0.0679166	0.0192628	-3.526	0.000454 ***
WALLCNXX		-0.0571365	0.0358369	-1.594	0.111381
ROOFCNXI		0.1502973	0.1139845	1.319	0.187810
ROOFCNXO		0.0870092	0.1164152	0.747	0.455111
ROOFCNXT		0.0954874	0.1138506	0.839	0.401965
CATGYX4B		-0.0623758	0.0343487	-1.816	0.069872.
CATGYX4C		-0.3669901	0.0905659	-4.052	5.74e-05 ***

Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1 Residual standard error: 0.1579 on 604 degrees of freedom Multiple *R*-Squared: 0.8718, Adjusted *R*-squared: 0.8661 *F*-statistic: 152.2 on 27 and 604 DF, *p*-value: < 2.2e-16

### **Appendix VII Regression Model: Beckenham**

Residuals:	<b>Min</b> -0.64490	<b>1Q</b> -0.09026	<b>Median</b> 0.01142	<b>3Q</b> 0.10112	<b>Max</b> 0.40993
Coefficients:		Estimate	Std. Error	t-value	Pr(> t )
Intercept)		9.2062865	0.4725194	19.483	< 2e-16 **
OWER1		-0.2301918	0.0182774	-12.594	< 2e-16 ***
ITSTXBECKENHAM ST		0.1648069	0.0515406	3.198	0.001436 **
ITSTXBOON ST		-0.0616738	0.0484966	-1.272	0.203817
SITSTXBRADFORD AVE		0.0923843	0.0494942	1.867	0.062300.
ITSTXCOLOMBO ST		0.0623765	0.0467234	1.335	0.182223
ITSTXDEVON ST		-0.0959430	0.0457562	-2.097	0.036299 *
ITSTXDUNN ST		-0.0207886	0.0427676	-0.486	0.627031
ITSTXFISHER AVE		0.2271245	0.0400288	5.674	1.90e-08 **
ITSTXLONGFELLOW ST		-0.0186953	0.0451597	-0.414	0.678990
ITSTXOTHER		-0.0222126	0.0467607	-0.475	0.634888
ITSTXPERCIVAL ST		-0.0347190	0.0517740	-0.671	0.502663
ITSTXROXBURGH ST		0.1029109	0.0466753	2.205	0.027729 *
ITSTXSOMERFIELD ST		0.0186495	0.0428968	0.435	0.663851
ITSTXSOUTHAMPTON S	ST	-0.0243265	0.0402926	-0.604	0.546171
ITSTXSOUTHEY ST		-0.0324513	0.0429880	-0.755	0.450520
ITSTXSTRICKI AND ST		-0.0819418	0.0407196	-2.012	0.044494 *
ITSTXTENNYSON ST		0.1165007	0.0393410	2.961	0.003147 **
ITSTXWEMBLEY ST		0.0648226	0.0458033	1.415	0.157359
ATGYX4B		0.0275481	0.0373405	0.738	0.460864
CATGYX4C		-0.1168640	0.0469787	-2.488	0.013049 *
IMESOLD.0		0.0189904	0.0003396	55,928	< 2e-16 **
GF		0.0010988	0.0002426	4.530	6.74e-06 **
og(LANDAX)		0.1546535	0.0195655	7.904	8.19e-15 **
ATFAX		0.0042054	0.0002138	19.674	< 2e-16 **
ALLENXC		-0.0208433	0.0378338	-0.551	0.581833
ALLONXE		-0 1171637	0.0394091	-2 973	0.003031 **
ALLENXO		-0.0445073	0.0399745	-1 113	0 265849
VALLENXR		-0 1119164	0.0235736	-4 748	2 41e-06 ***
ALLONXW		-0.0629968	0.0222366	-2 833	0.004718 **
ALLONXX		-0.0992564	0.0398493	-2.491	0.012933 *
ATGYX2D		0 1445276	0.0399650	3 616	0.000316 **
ATGYX2F		0.3069113	0.0744524	4 122	4 11e-05 **
ATCVYOD		0 2927391	0 1222453	2 395	0.016847 *

Residual standard error: 0.1515 on 864 degrees of freedom Multiple *R*-Squared: 0.8911, Adjusted *R*-squared: 0.8869 *F*-statistic: 214.2 on 33 and 864 DF, *p*-value: < 2.2e-16

### **Appendix VIII Regression Model: Bishopdale**

In(formula = log(SLNETX) ~ TOWER + TIMESOLD.Q + AGE + log(LANDAX) + MATFAX + WALLCNX + SITSTX, data = Bishopdale.final)						
Residuals:	Min	10	Median	3Q	Max	
	-0.53633	-0.08893	0.01446	0.08850	0.49048	
Coefficients:		Estimate	Std. Error	t-value	Pr(>  t )	
(Intercept)		9.0005033	0.6988891	12.878	< 2e-16 ***	
TOWER		0.0262575	0.0182796	1.436	0.151259	
TIMESOLD.Q		0.0097887	0.0004834	20.251	< 2e-16 ***	
AGE		0.0013236	0.0003598	3.679	0.000249 ***	
log(LANDAX)		0.1357753	0.0333622	4.070	5.16e-05 ***	
MATFAX		0.0039665	0.0001855	21.389	< 2e-16 ***	
WALLCNXC		-0.0169935	0.0108641	-1.564	0.118160	
WALLCNXO		0.0785660	0.0336688	2.333	0.019863 *	
WALLCNXR		-0.0693225	0.0300511	-2.307	0.021313 *	
WALLCNXW		-0.0815023	0.0230110	-3.542	0.000420 ***	
SITSTXCARDOME ST		0.0610536	0.0314227	1.943	0.052360.	
SITSTXCHEDWORTH AVE		0.0330487	0.0317738	1.040	0.298589	
SITSTXCLOTILDA PL		0.2252988	0.0420078	5.363	1.06e-07 ***	
SITSTXCOLESBURY ST		0.0528749	0.0302668	1.747	0.081018.	
SITSTXCOTSWOLD AVE		0.0604953	0.0286474	2.112	0.035012 *	
SITSTXEASTLING ST		0.0551537	0.0319833	1.724	0.085003.	
SITSTXFARRINGTON AVE		-0.0001768	0.0238544	-0.007	0.994087	
SITSTXHAREWOOD RD		0.0204412	0.0252674	0.809	0.418753	
SITSTXHIGHSTED RD		0.0391760	0.0253953	1.543	0.123302	
SITSTXKILBURN ST		-0.0176756	0.0366951	-0.482	0.630155	
SITSTXKINGROVE ST		-0.0052772	0.0375965	-0.140	0.888406	
SITSTXLEACROFT ST		0.1058243	0.0333633	3.172	0.001571 **	
SITSTXMURMONT ST		0.1825316	0.0365287	4.997	7.12e-07 ***	
SITSTXNEWMARK ST		-0.0342136	0.0272490	-1.256	0.209621	
SITSTXOTHER		0.0525437	0.0253634	2.072	0.038612 *	
SITSTXRALEIGH ST		0.0470151	0.0314032	1.497	0.134740	
SITSTXSTACKHOUSE AVE		0.0235719	0.0278844	-0.845	0.398165	
Signif. codes:0 '***' 0.0	01 '**' 0.01 '*'	0.05 '.' 0.1 ' ' 1				

Residual standard error: 0.137 on 821 degrees of freedom Multiple *R*-Squared: 0.7946, Adjusted *R*-squared: 0.7881 *F*-statistic: 122.1 on 26 and 821 DF, *p*-value: < 2.2e-16

# Fact Sheet: Cell Towers Create Significant Decline in Property Value

Arrowbee residents are justifiably concerned that the proposed Verizon cell tower will reduce the value of our homes and properties. Peer reviewed studies and experienced real estate and appraisal professionals agree that cell towers impact property value significantly. The ripple effect of negative property values in Arrowbee will also impact the value of property in the surrounding area.

# **POTENTIAL BUYERS ARE TURNED OFF BY CELL TOWERS FOR THREE PRIMARY REASONS:**

- Aesthetics Cell towers, even those that look like fake pine trees, are aesthetically unpleasing. They are not compatible with the nature of the neighborhood. They change the character of a neighborhood, especially those in rural areas. They create a visual blight. Potential buyers aren't interested in spending their money on visual blight.
- Health Concerns Despite industry assertions about the safety of cell towers, there has been widespread media attention about persistent health concerns for cell towers and for wireless technology in general. Regardless of the validity of these concerns, the *perception* is what influences a potential buyer. With widespread concern comes widespread negative perception.
- **Property Value** Potential buyers are not interested in a property that has the baggage of a cell tower that may affect the future value of the property. Buyers see the risk of the investment as too great.

### STUDIES HAVE DOCUMENTED THE DETRIMENTAL EFFECTS OF CELL TOWERS ON PROPERTY VALUES:

- 1. A study by the National Institute for Science, Law & Public Policy published in June 2014 titled "Neighborhood Cell Towers & Antennas-Do They Impact a Property's Desirability?" found that:
  - 94% of home buyers and renters are less interested and would pay less for a property located near a cell tower or antenna
  - **79%** said that **under no circumstances would they ever purchase** or rent a property within a few blocks of a cell tower or antennas
  - 90% said they were concerned about the increasing number of cell towers and antennas in residential neighborhoods.

- Betsy Lehrfeld, an attorney and Executive Director of NISLAPP says: "The proliferation of this irradiating infrastructure throughout our country would never have occurred in the first place had Section 704 of the Telecommunications Act of 1996 not prohibited state and local governments from regulating the placement of wireless facilities on health or environmental grounds. The federal preemption leaves us in a situation today where Americans are clearly concerned about risks from antennas and towers, some face cognitive and physical health consequences, yet they and their families increasingly have no choice but to endure these exposures, while watching their real property valuations decline." Link here.
- 2. A study published in The Appraisal Journal in the Fall of 2007 titled "The Effect of Distance to Cell Phone Towers on House Prices in Florida" found that:
  - In terms of the effect that proximity to a tower has on price, the overall results indicate that this is statistically significant and negative. Generally, the closer a property is to the tower, the greater the decrease in price. The effect of proximity to a tower **reduces price by 15%** on average. Link here.
- 3. A study published in The Appraisal Journal in the Summer of 2005 titled "The Impact of Cell Phone Towers on House Prices in Residential Neighborhoods," found that:
  - People generally expect to pay 10% to over 20% less for a home located near a cell tower, and
  - Actual prices were reduced by 21% after a cell tower was built in a neighborhood.
  - "Even buyers who believe that there are no adverse health affects from cell phone base stations, knowing that other potential buyers might think the reverse, will probably seek a price discount for a property located near a cell phone base station." Link here.

### THERE IS WIDESPREAD AGREEMENT AMONG REAL ESTATE PROFESSIONALS ACROSS THE COUNTRY ABOUT THE NEGATIVE IMPACT OF CELL TOWERS ON PROPERTY VALUE

By California Statue, real estate agents representing a seller of residential property..."have the duty to conduct a reasonably competent and diligent visual inspection of the property and to disclose to a prospective buyer all material facts affecting value, desirability, and implicitly intended use." Link here.

• Tina Canaris, an associate broker and a co-owner of RE/MAX Hearthstone in Merrick, said: "Even houses where there are transformers in front" make "people shy away," "If they have the opportunity to buy another home, they do." She said cell antennas and towers near homes affected property values, adding, "You can see a buyer's dismay over the sight of a cell tower near a home just by their expression, even if they don't say anything." From: "A Pushback Against Cell Towers," New York Times, 8-27-10. Link here.

Data compiled by J. Barbieri November 2015

- Addora Beal, Broker Associate with Hall Chambers Real Estate testified to the Glendale City Council in January 2009 that: "Perception is everything. If the public perceives it to be a problem, then it is a problem. It really does affect property values." <u>Link here</u> at the 2:35:24 mark.
- Donna Bohanna, President/Realtor of Solstice International Reality said to the Los Angeles Board of Supervisors in 2009 that: "As a realtor, I must disclose to potential buyers where there are any cell towers nearby. I have found in my own experience that there is a very real stigma and cellular facilities near homes are perceived as undesirable." Link here.
- Twenty-seven real estate professionals signed a letter to the Burbank City Council ini 2009 stating that cell towers negatively impact the property value of surrounding homes and properties. The letter said in part: "It is our professional opinion that cell towers decrease the value of homes in the area tremendously." Link here.
- Real estate appraiser Robert Heffernan presented a report to the Bridgewater New Jersey zoning board in 2012, stating that: "I believe the tower will have an adverse impact to surrounding properties." He continued, saying that price differentials "are based on a negative externality, which causes the house closest to the structure to be lower in the value that ones farther away." He noted that structures that are unlike what is typically seen in a neighborhood create an anomaly and that in his experience, people do not choose to live near these types of structures. Link here.

### **TWO IMPORTANT NOTES**

- 1. The U.S. Ninth Circuit Court of Appeals in October 2009 affirmed residents' right to oppose a wireless tower based on aesthetics, saying in part that: "The experience of traveling along a picturesque street is different from the experience of traveling through the shadows of a WCF [wireless communications facility], and we see nothing exceptional in the city's determination that the former is less discomforting, less troubling, less annoying and less distressing than the latter." Link here.
- 2. Also note that El Dorado County's rules about Special Use Permits (which Verizon is seeking) require that the special use "would not be...injurious to the neighborhood." A decline in property value is an extraordinary burden to place on residents, particularly when Verizon already has coverage in the area, and that a rural county surely has non-residential areas better suited for industrial blight.
#### <u>Alternatives – "Advancements in cellular service technology may render cell towers</u> obsolete"

- <u>**Technology**</u> does provide a way to eliminate any "significant gap" in the "user-oriented" approach for adequate cell service without the construction of another tower.
  - Micro-cells currently provide good cell service to many in Castle Rock and Crystal Valley. This in home equipment is typically provided free of charge from a cell service provider.
  - Wi-Fi calling is nothing new. Apps such as Viber, Skype, Facebook Messenger and WhatsApp. Carrier Wi-Fi Calling does not require any apps. Just switch your phone to Wi-Fi calling and you will experience seamless transition from cellular calling to Wi-Fi calling when the cellular signal is week.
  - Choice of carriers. Verizon and Sprint currently provide adequate service to many areas that may have inadequate T-Mobile or AT&T service.
  - New cell service technologies are quickly eliminating the need for huge towers. Installing much smaller and easy to conceal antennas within existing structures, and utilizing town owned street light standards, etc.
    - Outdoor Small Cell Technology / DAS (Distributive Antenna System) typically includes small, unobtrusive, low power antennas which can be placed exactly and only where needed on buildings or selected utility poles. The FCC is focusing on the benefits of DAS and DAS-related technologies. And the wireless industry is running with DAS. Even "tower" companies across America are getting in on DAS. To improve wireless service while preserving natural and historic character, DAS is being used in communities across the country.
    - <u>Verizon Wireless Use By Special Review</u>: Proposing 3 new small cells (as shown below) located at 3065 Foothills Drive (20' hut style), 1760 Meadows Blvd (20' hut style), and 1470 Clear Sky Way (in Bison Park in a light pole).



Foothills Drive

- Alternate cell tower location(s)
  - The applicant states that the current Verizon facility that provides service to these areas is "not compatible" with T-Mobil technology. No data has been provided to support that claim. The applicant only profits if it has its own cell tower to lease antenna space to carriers.
- Inadequate research of alternatives to placing a cell tower at this proposed location.
  - When asked for data showing the incremental increase of served customers and incremental increase in quality of service that would be provided at this location vs. alternative tower locations, the applicant could not or would not provide.
  - When the veracity of the T-Mobile presented data was questioned in an open forum, the applicant responded in part that their method of analysis is "proprietary." Does this mean that their method of analysis can not be scrutinized by others?
  - This may well be the most cost effective location for the applicant to place their cell tower, but that equation does not consider the impact to Town trails, open space, conservation areas, parks, schools, and neighborhoods.

#### Research on wireless/cellular technology in response to the T-Mobile/Powder River/Eco-Site Cell Tower application

- The cellular (wireless) technology market is vast, complex and fast growing one in which we consumers are at a serious disadvantage due to the technologies involved, their rapid rates of change and the general complicity of governments at all levels to support the rapid deployment of wireless networks
- As cellular networks have rapidly developed, several characteristics of that development are of interest:
  - a) A new wireless technology is fielded approximately every 10 years
    - i. Each new broadcast technology is NOT backward compatible
    - ii. This creates a business need to "sunset" (ALA" NOT support) older networks
      - 1. AT&T sunset its' 2G network on Jan 2017
      - 2. Verizon to sunset its' 2G network EOY 2019
      - 3. Verizon may sunset its' 3G network by 2021
      - 4. T-Mobile to sunset its' 2G network in 2020
  - b) Technology advances feature:
    - i. Increased mobility
    - ii. Voice to voice+ data to voice+data+video signals (Higher data content-B/W)
    - iii. High connectivity speeds/data rates
    - iv. Analog signals to digital signals
    - v. Digital narrow bandwidth (BW) progression to digital broadband
    - vi. Merging of telephony with Internet (IP)
    - vii. Higher transmission frequencies/shorter ranges
    - viii. Decreasing time lags (latency)
    - ix. Increasing needs for "network" and spectrum efficiencies
    - x. Shrinking cellular coverage areas/increasing "cell count' densities
    - xi. New cell phones launched every 2.5 years
  - c) The approximate chronology of the Wireless Mobile Network Generation introductions is as follows:

Name	0G	1G	2G	3G	4G	5G
Year Intro	1973	1980 's	1993	2001	2009	2013
Country 1 <sup>st</sup> Commercialized	USA	USA	Finland	Japan	South Korea	South Korea

### Attachment 4 - Alternative technology/solutions

Technology	Analog	Digit al	Digital	Digital	Digital	Digital
Data Rates		2Kbp s	14-64 Kps	2Mbps	200 Kbps-1 Gbps	1 Gbps - 60 Gbps
Special Characteristic		1 <sup>st</sup> Wirel ess Com m.	Digital version of 1G	Digital Broadban d	Very high speeds	Even higher speeds, IoT

### • Cell Tower Industry Trends

- *a) RCR Wireless News* (7/15/2015) reported 155,000 cell towers in the USA and predicted more than 200,000 towers in use by 2025, for a CAGR of 3.9%. This growth will be (is being) driven by the buildout of the 4G LTE networks and expansion into 5G.
- b) Steel In The Air (6/10/2016) predicted AT&T's network growth between 2017 2022 as follows: Macro-cells 67,000 to 73,700; Micro-cells 5,000 to 55,000. There are only so many (expensive!) macro-cells that can be installed for millimeter wave bands the micro-cells are much cheaper to install. Network densification is on the way w/ 5G.
- *c)* **The New York Times** (3/2/2018) reports over 300,000 cell towers now exist in the USA, and that 5G may add perhaps millions more towers.
  - This prospect has many communities/their elected officials insisting that their local governments control the placement and look of this new equipment. Their collective concerns are that this plethora of new cell stations could clutter neighborhoods with eyesores and could cost the communities a lot of potential revenues (through lost property taxes due to real estate devaluations) caused by the cell stations and by proposed state legislative actions that decrease the annual charge per pole that a city can charge.
  - AT&T has complained to the FCC that California municipal officials delayed deployment of small cells by over 800 days while they scrutinized antenna designs, RF exposure and cell station effects on property values.
  - Montgomery County, MD officials are fighting state and federal plans to shorten environmental and historic reviews because they believe expedited reviews risk small-cell facilities becoming unsightly and unsafe.
- d) An overall review of current cell tower literature reveals the industry's dedicated push to extend broadband coverage to rural America while saturating urban America with more and more cell towers, all with government support at all levels, while generally ignoring environmental and historic

#### Attachment 4 - Alternative technology/solutions

concerns of citizens and municipalities. 5G is very much still evolving with no final standards set yet for the technology or for its' deployment.

- Wireless providers
  - a) Top 10 Reviews (11/17/2017) ranked the wireless competitors overall as follows:
    - 1. VERIZON
    - 2. T-Mobile
    - 3. AT&T
    - 4. Metro PCS
    - 5. Sprint
  - b) VERIZON conducted extensive residential broadband 5G trials during 2017 in Ann Arbor, MI, Arlington, VA, New York, NY, and Denver, CO. Their first commercial 5G launch will be in Sacramento, CA in the 2<sup>nd</sup> half of 2018. 3-4 additional launches are expected by EOY 2018. VERIZON's 4G LTE network will remain in place with 98% of the US population having access to this network. VERIZON's 5G network will probably be the mm bands.
  - c) AT&T plans limited 5G cellular services rollout sometime during 2018. Many details unknown but AT&T seems to be focused on the mm band equipment like VERIZON. Both AT&T and VERIZON are American companies and have extensively used Lucent-provided technologies and equipment. Lucent is the former Bell Laboratories.
  - d) T-Mobile will rollout its' 5G network during 2019 as a strengthened 4G LTE network, using the low-band 600 MHz spectrum and will apparently add mm band technology only at some later unannounced time. They plan full national coverage in 2020. T-Mobile is a subsidiary of Deutsch Telecom and is thus 21% owned by the German government.
  - e) **Samsung** ran an impressive 5G trial at he recent Winter Olympics in Seoul, South Korea.
  - f) Japan will conduct a 5G trial at the 2018 Summer Olympics in Tokyo.
  - g) Russia will conduct a 5G trial at the 2018 World Cup in Moscow.
  - h) The recent successful SPACE-X launch of 2 broadband communications satellites opens satellite-based technology to directly communicate with individual cell phones as a replacement for terrestrial based cell towers. This is a long-term evolution, with 700 to 1500 satellites required for global coverage, BUT Elon Musk is an aggressive entrepreneur who may surprise the telecom industry with how fast he will move.
  - i) Qualcomm continues to work on LTE Direct which will offer device-to-device technology that **does NOT use cell towers!**
  - j) Current cell tower literature has many references of the early obsolescence of cell towers.

### Attachment 4 - Alternative technology/solutions

### Examples of New Technology Solutions



Example of Old Technology: "Windmill" Tower with Clutter of Multiple Lease Add-ons





### Will Your Cell Tower Be Needed In The Future?

By <u>Nick Foster</u> | Nov 12, 2014



Are you wondering how long you will receive rent from your cell tower? When will the industry no longer need cell towers (due to a replacement technology)? It's a lot like looking into a crystal ball. No one can predict the future however here are four things worth considering.

# 1. Prior To The 1980's, Cell Towers Didn't Really Exist

The first cell phone was invented in 1973. What we know of today as the small less expensive cell phone used by the general population didn't really come into use until the mid <u>1980</u>s. The majority of the cell tower network that we all see when driving down the road wasn't actually constructed until the 1990's or later. So, the rent that you are receiving from your cell tower, is payment for from a unique land or building use that didn't really exist 30 years ago.

# 2. Satellites As A Replacement Technology Is A Long Shot (But Elon Musk Could Do It)

The thought was once that terrestrial based cell towers would likely never be replaced with satellite technology due to high costs and the need to access the satellites for upgrades. It simply costs too much to deliver hundreds of satellites into space via rockets, and then there is the problem with servicing broken satellites or upgrading the satellites with the quick advancement of technology.

The <u>Wall Street Journal</u> reported that Elon Musk is discussing with industry executives the idea of launching 700 internet satellites into space. While Elon's project would cost an estimated \$1 billion and would be 10 times larger than any satellite fleet in existence, if anyone can do it – it's Elon Musk. Yes, his focus is solely on the internet at this time, however if anyone can disrupt an industry such as telecommunications it's Elon (think Tesla, SpaceX, Paypal, etc.).

What does this have to do with your cell tower? Technology is rapidly evolving and while it is unlikely satellite technology would replace cell towers, it is not without the realm of possibility in the future.

# 3. Direct-To-Direct Cellular Communications Is A Possibility

The technology giant Qualcomm has been working on <u>LTE direct</u> technology which may offer a window into our future. LTE Direct is a device-to-device technology that does not use cell towers. Your device would discover thousands of other devices and services within 500 meters of your proximity. This would be useful, for example, to find your friend or a sale in a nearby store that may interest you. At this time, it is not a replacement technology for voice and data traffic, but if anyone can phase out the cell tower it's the multi-billion dollar giant Qualcomm.

# 4. Industry Consolidation Will Continue

In recent years, <u>AT&T purchased Cricket</u>, <u>T-Mobile purchased Metro PCS</u>, and <u>Sprint purchased</u> <u>Nextel</u>. With each of these acquisitions cell towers were decommissioned due to overlap. Industry consolidations are not yet over and will continue as carriers strengthen financially and other carriers become prime business opportunities for acquisition.