Attachment 4

Wireless Telecommunications Master Plan

March 24, 2006

City of Olympia, Washington

City of OLYMPIA

Prepared for the
City of Olympia
P.O. Box 1967
Olympia, WA 98507-1967

Prepared by
CityScape Consultants, Inc.
7040 W Palmetto Park Rd.
Ste 4, PMB 652
Boca Raton, FL 33433
Tel 954.757.8668 Fax 954.757.9994
www.cityscapeconsultants.com

CityScape Consultants, Inc.

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City of Olympia, Washington
Thurston Regional Planning Council and
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City Council
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University of North Carolina at Greensboro
Department of Geography
Jeffrey C. Patton, Ph.D.
Roy S. Stein, Ph.D.
Rick Bunch, Ph.D.
Jason S. Marshall

CityScape Consultants, Inc.
Richard L. Edwards
Susan Rabold
Kay Miles
Anthony T. Lepore, Esq.
Bobby Hall

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Contact information for questions or information pertaining to this document is:

Pete Swensson, Senior Planner
Thurston Regional Planning Council and
Olympia Advance Planning and Historic Preservation
2424 Heritage Ct. SW
Olympia, WA 98502
Phone: 360.956.7575
Fax: 360.956.7815
E-mail:swenssp@trpc.org

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Preface

PURPOSE OF THIS PLAN

In recent years, the City of Olympia, Washington, (City) has experienced wireless telecommunication infrastructure growth. Such growth requires additional elevated wireless antennas and base station ground equipment. In accordance with Federal Communications Commission (FCC) guidelines, the City adopted a revised Wireless Telecommunications Facilities Ordinance regulating new antenna-support structure construction.

In conjunction with the Ordinance development process, the City developed a Wireless Telecommunications Master Plan (Master Plan) to analyze current demand for wireless telecommunications services within the City, and to establish guidelines for growth as it impacts the City and its citizens into the future.

The purpose and intent of the Master Plan (Plan) is similar to the goals and objectives of other long-range plans, such as roadway improvements and the extension of water and sewer lines. The Plan combines the land-use planning strategies with the industry-accepted radio frequency (RF) engineering standards to create an illustrative planning tool that complements the City's Zoning Code. The Plan offers strategies to reduce tower infrastructure by improving efforts to morph wireless deployments from various service providers, thereby minimizing tower proliferation by increasing shared sites.

The Master Plan includes the following:

- An inventory of existing antenna-supporting structures and buildings, upon which wireless antennas are currently mounted.
- Analysis of reasonably anticipated wireless facility growth over the next ten years.
- Engineering analysis of potential coverage based on City-regulated height restrictions and other locations and design criteria.
- Recommendations for managing the development of wireless structures for the next ten years.

CityScape Consultants, Inc.

CityScape Consultants, Inc. is a land-use planning, legal and radio frequency engineering consulting firm located in Boca Raton, Florida and Raleigh, North Carolina. CityScape specializes in developing land use strategies to control the proliferation of wireless infrastructure, affording the maximum continuing control of local governments, while maintaining compliance with the Telecommunications Act of 1996.

Many communities are concerned about the proliferation of telecommunications tower build-outs from the standpoint of aesthetics, time involved in the review and fair deployment of these facilities, public safety issues, and the legal implications of upholding both the public and private interests involved. Most communities are dealing with tower growth in an ad hoc manner, which is the most expensive and perilous way to deal with it.

Implementation of a Master Plan simplifies and economizes the process. No longer is it necessary to run each individual site approval through a lengthy process involving numerous submissions, hearings and delays, after sites are encompassed in a plan and considered together as a whole. The Master Plan offers numerous benefits to the local government and its citizens, as well as the carriers who participate.

A comprehensive Master Plan includes:

- Review and revision (if necessary) of existing ordinances and code to encourage all present and future wireless service providers to participate in a Master Plan by working with CityScape to ascertain their current and future service needs.

- Development of a comprehensive telecommunications grid for the local government. This exclusive benefit of CityScape is prepared in conjunction with CityScape's legal department. A comprehensive grid of all telecommunications providers is the only method to assure:

- Minimizing the total number of telecommunications towers and/or sites within the local government;

- Ensuring the local government's compliance with the Telecommunications Act of 1996 (as amended).

- Correlating of all of the provider-furnished data together with the local government's own sites, along with added weighting to municipal owned locations in mapping out a Master Plan for wireless telecommunications facilities to be sited in the local government.

- Facilitate the local government needs, including future public facilities (public safety, municipal dispatch, communications and information technology infrastructures).

Chapter 1 The Telecommunications Industry

INTRODUCTION

Telecommunications is the transmission, emission or reception of radio signals, digital images, sound bytes or other information, via wires and cables; or via space, through radio frequencies, satellites, microwaves, or other electromagnetic systems. Telecommunications includes the transmission of voice, video, data, broadband, wireless and satellite technologies and others.

One-way communication for radio and television utilizes an antenna to transmit signals from the broadcast station antenna to the receiving devices found in a radio or television.

Traditional landline telephone service utilizes an extensive network of copper interconnecting lines to transmit and receive a phone call between parties. Fiber optic and T-1 Data lines increases the capabilities by delivering not only traditional telephone, but also high-speed Internet and, in some situations cable television, and is capable of substantially more. The new technology involves an extensive network of fiber optic lines sited in above- and below-ground locations.

Wireless telephony, also known as wireless communications, includes mobile phones, pagers, and two-way enhanced radio systems and relies on the combination of land lines, cable and an extensive network of elevated antennas, typically found on communication towers, to transmit voice and data information. This technology is known as the first and second generation (1G and 2G) of wireless deployment.

Third, fourth and fifth generations (3G, 4G and 5G) of wireless communications will include the ability to provide instant access to e-mail, the Internet, radio, video, TV, mobile commerce, and Global Positioning Satellite (GPS), in one hand-held, palm pilot type wireless telephone unit. Successful use of this technology will require the deployment of a significant amount of infrastructure, i.e. elevated antennas on above-ground structures such as towers, water tanks, rooftops, signage platforms and light poles.

The recent evolution of telecommunications began in the 1800's and continues to evolve at a very fast pace. Figure 1 identifies some of the most significant telecommunication benchmarks over the past 160 years.

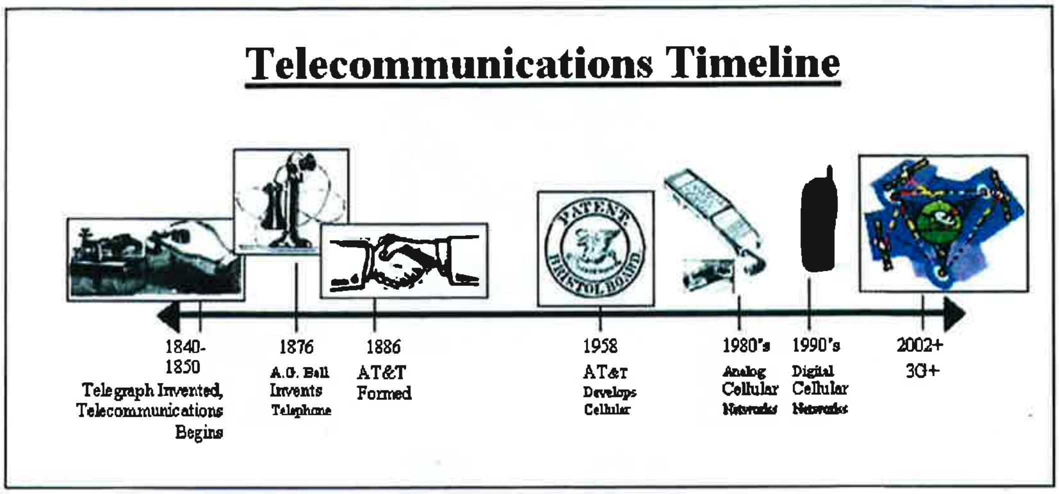


Figure 1: Telecommunication Timeline

Wired telephone networks

When the traditional wired, landline telephone networks were introduced in the United States, the first systems were built in largely populated cities where the financial return on the infrastructure investment could be quickly maximized. Telephone lines were installed alongside electrical power lines to maximize efficiency. As the technology improved the service was expanded from coast to coast. Figure 2 illustrates the wired, landline network system.

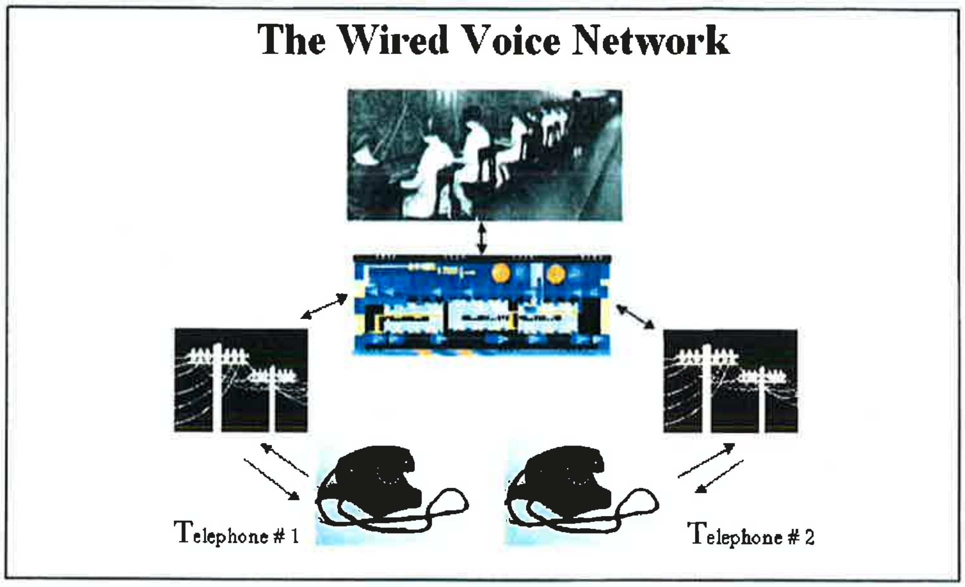


Figure 2: Wired Voice Network Systems

Wireless telephone networks

Wireless telephone networks operate utilizing wireless frequencies similar to radio and television stations. To design the wireless networks, radio frequency (RF) engineers overlay hexagonal cells representing circles on a map creating a grid system. These hexagons or circles represent an area equal to the proposed base station coverage area. The center of the hexagon pinpoints the theoretical "perfect location" for a base station. These grid systems are maintained by each individual wireless provider's engineering department, (resulting in up to seven different grid systems in each community).

During the 1980's, the first generation of 800 MHz band cellular systems was launched nationwide. Similar to the deployment strategy for the landlines, the 800 MHz systems were first constructed in largely populated areas. Some networks in rural areas are still underdeveloped. Originally, the 800 MHz band only supported an analog radio signal. Customers using a cell phone knew when they traveled outside of the service area because a static sound on the phone similar to the sound of a weak AM or FM radio station was heard through the handset. Recent technological advancements now allow 800 MHz systems to also support digital customers, which allowed the networks an increased number of transmissions per site.

The 1990's marked the deployment of the 1900 MHz band Personal Communication Systems (PCS). This second generation of wireless technology primarily supports a digital signal, which audibly can be clearer than the analog signal, but this comes with additional trade-offs. The technology of 2G includes a static free signal, yet has a higher rate of disconnects or dropped calls, yet it does allow for more services such as paging devices, and the ability to send text messaging through the handset unit. Deployment of 2G also targeted largely populated areas with secondary services to much of rural America resulting in limited or no PCS coverage.

In addition to 800 MHz cellular services and 1900 MHz PCS services, there are additional wireless providers utilizing services in the 800 MHz and 900 MHz frequency range. This service is called Enhanced Specialized Mobile Radio or ESMR. The largest ESMR band provider is Nextel Communications. All three of these "telephone" operations (800, 900 and 1900 MHz) are specifically covered, along with some other services, in the Telecommunications Act of 1996.

Both the 800, 900 and 1900 MHz bands all utilize a system of elevated antennas attached to a base station and either the preferred fiber optics links, microwave links or the traditional land lines to send and receive the voice and data signals between customers. Wireless systems must have a continuous trail of antennas to successfully send and receive the signals without interruptions, interference, or dropped calls. The antennas must be elevated to a height where a reasonably clear line of site is attained to avoid interference from obstruction caused by terrain, vegetation and buildings. The elevated base stations of choice have been telecommunication towers; but rooftops, water tanks and tall signage are also utilized as mounting platforms for wireless infrastructure. Rooftops are especially effective in downtown areas where buildings cause interference issues and ground space for new towers is usually unavailable. Figure 3 illustrates the wireless telephone network.

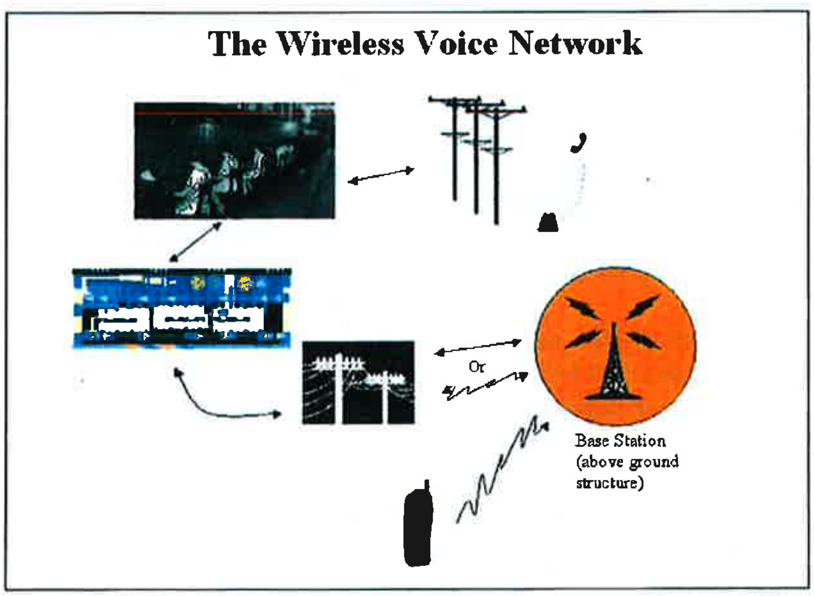


Figure 3: Wireless Voice Network

Wireless providers

In 1983, the Federal Communications Commission (FCC) granted licenses to two competing wireless providers to provide cellular coverage nationwide. The early stages primarily were served by the local telephone companies and on a national level by companies like Cellular One. There were many initial problems and growth was slow. Most wireless providers preferred tall towers in the range of three hundred to five hundred feet to service large areas. There was also a preference for analog services to reach farther, without much concern for static. Due to the difficulty of constructing new facilities, the expansion was costly and challenging.

In 1995 and 1996, the FCC auctioned four additional licenses in regional areas to competing wireless providers for purposes of building a nationwide digital wireless communication system. This auction raised over twenty-three billion dollars for the US Treasury, which helped the Federal government pay off the annual deficit by 1998.

Wireless coverage

Wireless system providers attain service coverage via antennas located on elevated base stations. The height and location of the towers is critical to meeting the objectives of RF engineering. The systems need continuous coverage with minimal overlap to provide continuous service that the wireless subscribers desire.

In wireless system evolution, a wireless provider initially built fewer base stations with relatively tall antenna-supporting structures to maximize the network coverage footprint. These initial 1G 800 and 900 MHz systems sought to broadcast coverage to large geographic areas with minimal infrastructure. Typically, these tall towers were spaced four to eight miles apart.

By nature, the 1900 MHz frequency band is higher than the 800 MHz band and cannot transmit a signal an equal distance. For the same coverage, these base stations must be closer together; generally two to four miles apart. The mounting height of the antenna for 2G was not as critical as 1G, and these towers were shorter.

Figures 4 and 5 illustrate the ideal wireless network grid. In Figure 4, the yellow and blue hexagons represent 800 MHz and 1900 MHz coverage, respectively. As previously described, the yellow hexagons cover a larger geographic area because the 800 MHz frequencies can broadcast the cellular signal. The blue hexagons are closer together because the 1900 MHz frequency transmits a shorter range. Figure 5 illustrates the applied grid design to providing network coverage parallel to an interstate highway. The red triangles represent the base station and the circles represent the estimated wireless coverage to be operated from the base stations.

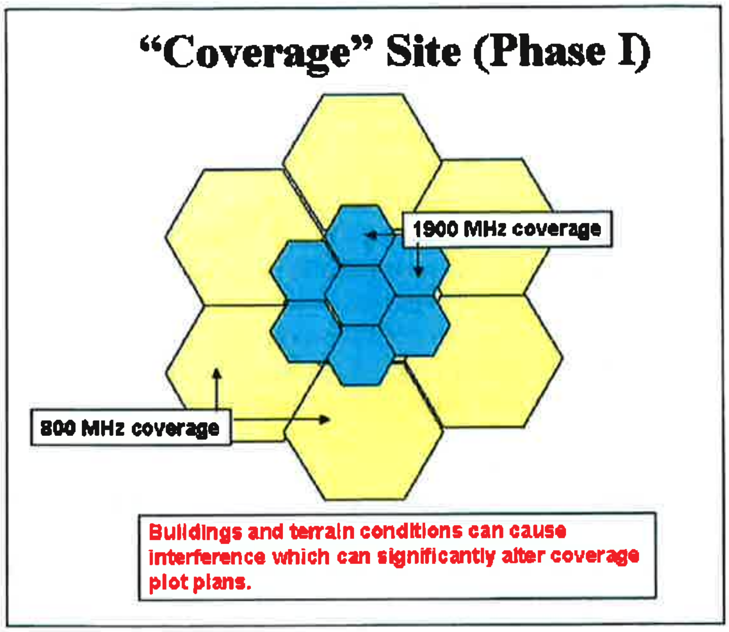


Figure 4: Coverage Grids

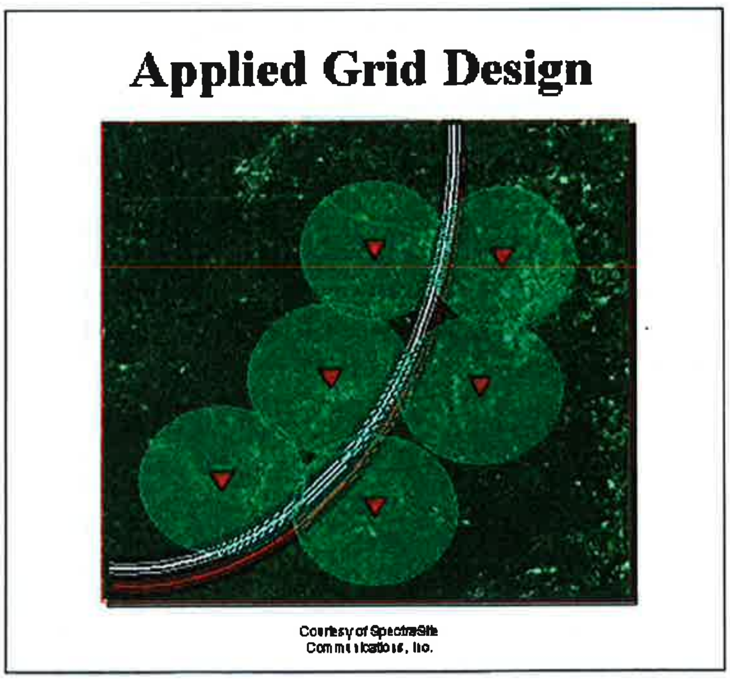


Figure 5: Applied Grid Design

Network capacity

The number of base station sites in a grid network not only determines the limits of geographic coverage, but the number of subscribers (customers) the system can support at any given time. Each base station can process as many as 1,000 subscribers per minute as subscribers' transverse through particular cell sites, yet at any time a single cell site can handle simultaneously no more than 240 calls (different providers prefer different numbers, 1,000 is an average). This process is referred to as network capacity. As population and wireless customers increase, excessive demand is put on the existing system's network capacity. When the network capacity reaches its limit, a customer will frequently hear a rapid busy signal, or get a message indicating all circuits are busy, or commonly be asked to leave a message without hearing the phone ring on the receiving end of the call.

As the wireless network reaches design network capacity, it causes the coverage area to shrink, further complicating coverage objectives. Network capacity can be increased several ways. The service provider can shift channels from an adjacent site, or the provider can add additional base stations with additional infrastructure.

A capacity base station has provisions for additional calling resources that enhance the network's ability to serve more wireless phone customers within a specific geographic area as its primary objective. An assumption behind the capacity base station concept is that an area already has plenty of radio signals from existing coverage base stations, and the signals are clear. But there are too many calls being sent through the existing base stations resulting in capacity blockages at the base stations and leading to no service indications for subscribers when they press the call send button on the wireless handset.

Figures 6 and 7 illustrate the complications and resolutions of network capacity issues. In Figure 6, the 1G networks covered specific areas. As more customers purchased wireless communication services, the coverage areas shrunk, creating gaps in the original coverage area. Figure 7 demonstrates the combination of options available for solving coverage gaps as networks reach maximum capacity.

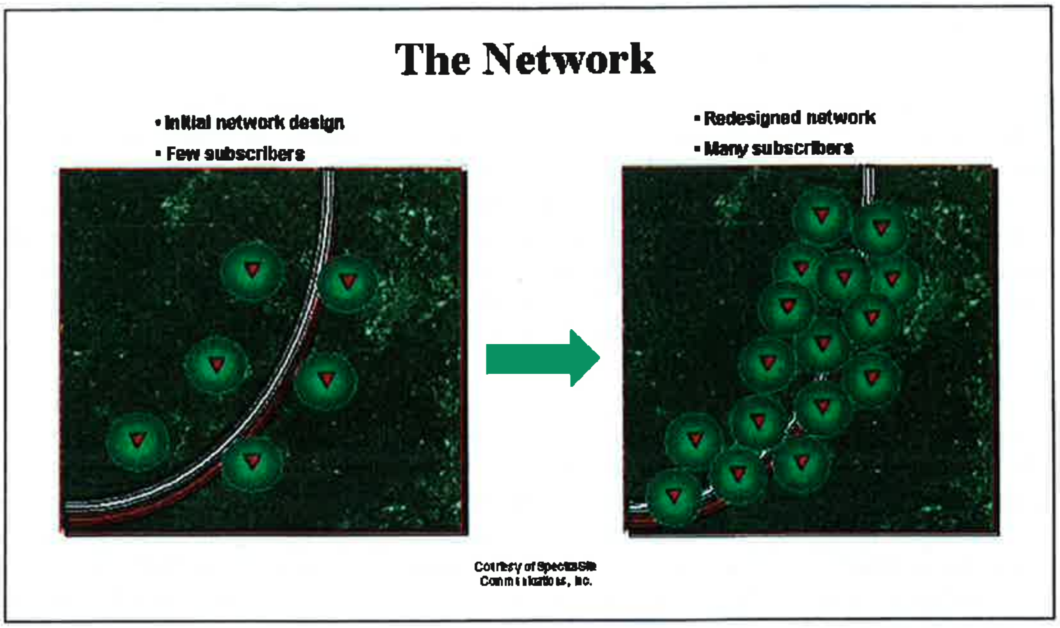


Figure 6: Network Capacity

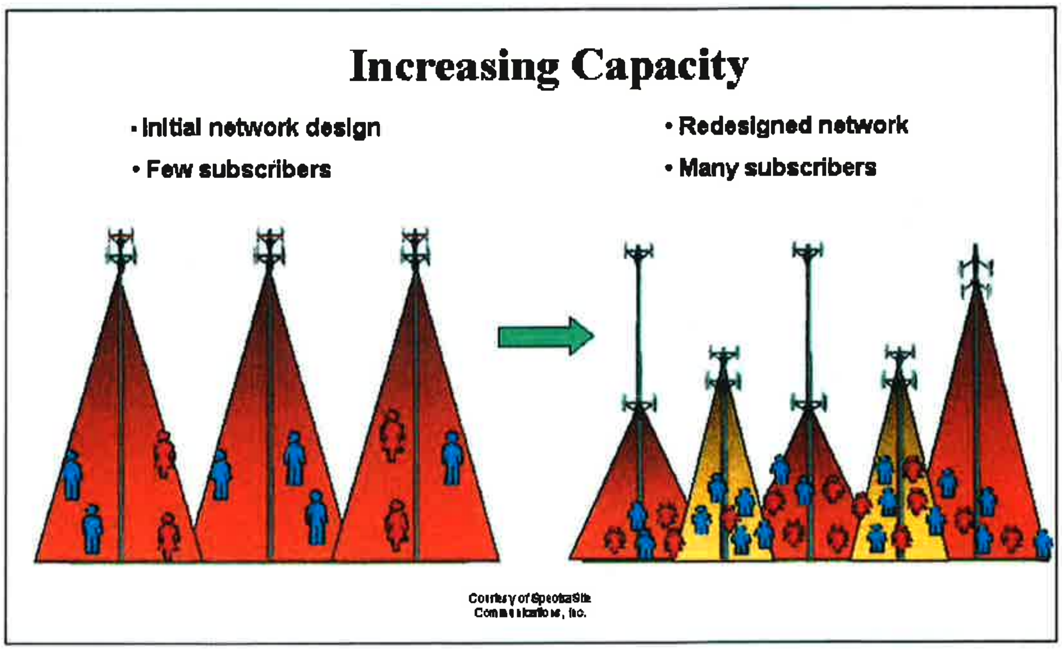


Figure 7: Increasing Network Capacities

Wireless infrastructure

Wireless base stations are facilities for mounting antenna arrays, for the purpose of meeting wireless telecommunication network deployment plans. A variety of structures can be used as base stations, such as towers, buildings, water tanks, existing emergency communications system tower facilities, tall signage and light poles; provided that: 1) the structure is structurally capable of supporting the antenna and the inter-connecting coaxial cables; and, 2) there is sufficient ground space to accommodate the accessory equipment cabinets used in running the network. Base stations can also be camouflaged in some circumstances to visually blend in with the surrounding area.

Figure 8 shows examples of some typical base stations. The monopole is a freestanding pole similar to an oversized utility pole. The lattice tower is also a freestanding, tripod shaped tower, with crisscrossing brackets. The guyed tower is not a freestanding tower and relies on the attached cables and anchors to support the facility. The flagpole is a camouflaged tower. The antennas are flush-mounted onto a monopole and a fiberglass cylinder is fitted over the antenna concealing them from view. The bell tower is a camouflaged lattice tower. The antennas are hidden above the bells and behind the artwork at the top of the structure.

Antenna Mounting Facilities

Monopole Tower

Lattice Tower

Guy Tower

Water Tank Mount

Rooftop Mount

Signage Mount (inside)

Camouflaged Tower

Camouflaged Tower

Camouflaged Tower

Figure 8: Examples of Base Stations

Wireless infrastructure and local zoning

The location of the antenna is critical to attaining an optimum functioning network. With the deployment of 1G, there were only two competing wireless cellular providers. But with the deployment of 2G the wireless market place became furiously competitive. "Speed to market" and "location, location, location" became the slogans for the competing 1G and 2G providers and remains today. The initial strategy was for service providers to operate a single base station only for their needs. The concept of sharing base stations was not part of the strategy as each provider sought to have the fastest deployment, so as to develop the largest customer base, resulting in a quick return on their cost of deployment. This resulted in an extraneous amount of new tower construction without the benefit of local land use management.

Coincidently, as local governments began to adopt development standards for the wireless communications industry, the industry strategy changed again. The cost associated with each provider developing an autonomous inventory of base stations put a financial strain on their ability to deploy their networks. As a result, most of the wireless providers divested their internal real estate departments and tower inventories. This change gave birth to a new industry, vertical real estate; and it includes a consortium of tower builders, tower owners, site acquisition and site management firms.

No longer was a tower being built for an individual wireless service provider, but for a multitude of potential new tenants who would share the facility without the individual cost of building, owning and maintaining the facility. Sharing antenna space on the tower between wireless providers is called co-location.

This industry change should have benefited local governments who adopted new tower ordinances requiring co-location as a way to reduce the number of new towers. But, it did not; because the vertical real estate business model for new towers was founded on tall tower structures intended to support as many wireless services as possible. As a result, local landscapes became dotted with all types of towers and communities began to adopt regulations to prohibit or have the effect of prohibiting wireless communication towers within their jurisdictional boundaries.

Wireless deployment came to a halt in many geographical areas as all involved in wireless deployment became equally frustrated with the situation. Second generation wireless providers had paid a large sum of money for the rights to provide wireless services, the license agreements between the wireless providers and the FCC mandated the networks be deployed within a specific time period and local government agencies were prohibiting the deployments through new zoning standards.

This perplexing situation prompted the adoption of Section 704 of the Federal Telecommunication Act of 1996.

Federal Telecommunications Act of 1996

Section 704 of the Federal Telecommunications Act of 1996 gives local governments zoning authority over the deployment of wireless telecommunication facilities subject to several specific guidelines.

First, land use development standards may not unreasonably discriminate among the wireless providers, and may not prohibit or have the effect of prohibiting the deployment of wireless infrastructure. For example, some communities adopted development standards restricting the distance between towers to three miles. In some geographic locations with sparse populations this may have been adequate for the 1G deployment. But the laws of physics make it impossible for 2G wireless deployments to meet this spacing requirement. Without realizing it, some communities inadvertently prohibited the deployment of 2G technologies.

Second, local governments must act on applications for new wireless infrastructure within a reasonable amount of time. If a community adopts a moratorium on new wireless deployment, it must be for a limited amount of time, and the community must demonstrate a good-faith effort to resolve outstanding issues during the moratorium time period.

Third, incentives may be adopted to promote the location of telecommunications facilities in certain designated areas; and the Act encourages the use of third party professional review of site applications.

Fourth, provided Federal standards are met by the wireless provider, a local government cannot deny an application for a new wireless facility or the expansion of an existing facility on the grounds that radio frequency emissions are harmful to the environment or to human health.

Exposure to radio frequency emissions

The Federal Communications Commission (FCC) has rules for human exposure to electromagnetic radiation. Electromagnetic radiation should not be confused with ionizing radiation.

Ionizing radiation is radiation that has sufficient energy to remove electrons from atoms. This type of radiation can be found from many sources, including health care facilities, research institutions, nuclear reactors and their support facilities, nuclear weapon production facilities, and other various manufacturing settings, just to name a few. Some high-voltage beam-control devices, such as high-power transmitter tubes can emit ionizing radiation, but this is usually contained within the transmitter tube itself.

Overexposure to ionizing radiation can have serious effects, including cancers, birth deformities and mental illness.

Electromagnetic radiation is non-ionizing radiation, which ranges from extremely low frequency (ELF) radiation to ultraviolet light. Some typical sources of non-ionizing radiation include lasers, radio antennae, microwave ovens, and video display terminals (VDT). However, any electrical appliance or electrical wiring itself emits ELF radiation. Cellular and PCS installations must confirm Federal compliance with published standards on radio frequency exposure levels.

Radio frequency radiation attenuates very rapidly with distance from a wireless services antenna, and most wireless sites not accompanying broadcast facilities will easily comply.

The RF exposure rules adopted by the FCC are based on the potential for RF to heat human tissue. Basically, the level at which human tissue heating occurs has been studied, and rules are set such that humans are not to be exposed anywhere near the level that can cause measurable heating.

There have been extensive long-term studies and at best they are inconclusive as to any harmful effects. Debate continues and may never be concluded on whether or not there might be biological effects associated with "non-thermal" causes, such as magnetic fields. Based on these findings the Federal Government has maintained jurisdiction on such issues.

Base stations

For the cellular and PCS bands, human exposure limitations are given in terms of power density, with the unit's milliwatts per centimeter squared (mW/cm^2). The power density associated with a cellular/PCS installation may be easily calculated or measured with instruments.

Time averaging is used along with the level measured. This means that the level must not exceed the standard value over any period. For instance, if the standard calls for a limitation of 1.0 mW/cm^2 averaged over thirty minutes, the standard permits a level of 2.0 mW/cm^2 for up to fifteen minutes as long as this is followed by a fifteen minute period of no exposure.

In general, the FCC's general population/uncontrolled exposure limitation must be used in the service, unless it can be clearly demonstrated that unsuspecting persons can be radiated at standard levels from a site.

In many cases, no field evaluation is required, since the site is categorically excluded, based on the presumption that in its radio service there is no possibility of an excessive

RF level if the provider certifies such compliance. For example, facilities on towers with the antennas higher than ten meters (32.8 feet) and a power less than two thousand watts require no further consideration.

In general, single provider installations on towers will be categorically excluded. Multiple provider co-locations and very high power sites will require further consideration.

In consideration of how conservative the evaluation method is, an engineer may wish to make actual power density measurements. In almost all cases, those measurements have been far below the calculated values.

If the site truly does not comply, some alternatives include:

- Limit the site access such that only authorized personnel can reach the vicinity of the antennas. The applicable standard then becomes the occupational/controlled one.

- Raise the height of the antennas.

- Reduce the power.

- Re-position antennas such that people cannot get in close proximity to them.

In multi-transmitter facilities, it is necessary to evaluate each contributor individually. Its percent of standard figure is computed (or measured), and added together to sum all percentage figures to determine the total site exposure.

Phones

In July 2001, the Federal Drug Administration (FDA) issued a Consumer Update on Wireless Phones, which stated that "[t]he available scientific evidence does not show that any health problems are associated with using wireless phones," while noting that "[t]here is no proof, however, that wireless phones are absolutely safe."

The FCC issued a Consumer Information Bureau Publication in July 2001, which stated, "[t]here is no scientific evidence to date that proves that wireless phone usage can lead to cancer or other adverse health effects, like headaches, dizziness, elevated blood pressure, or memory loss."

Before a wireless phone model is available for sale to the public, it must be tested by the manufacturer and certified to the FCC that it does not exceed limits established by the FCC.

One of these limits is expressed as Specific Absorption Rate (SAR). SAR is a measure of the rate of absorption of RF energy in the body. Since 1996, the FCC has required that the SAR of handheld wireless phones not exceed 1.6 watts per kilogram, averaged over one gram of tissue.

Steps one can take to minimize RF exposure from cell phones:

- Reduce your talk time.
- Place more distance between your body and the source of the RF.
- And in a vehicle, use a phone with an antenna on the outside of the vehicle.

The FDA stated "[t]he scientific evidence does not show a danger to users of wireless phones, including children and teenagers." People who wish to reduce their RF exposure may choose to restrict their wireless phone use.

Emerging technologies

At the onset of this millennium economists and telecommunication forecasters debated the actuality of third, fourth and fifth generations of wireless coming to fruition in the United States. Skepticism that customers would have little demand for the emerging wireless services appeared in articles and newsrooms, while others recognized the infrastructure in the United States was significantly behind schedule as compared to the European and Asian deployments. It was predicted that consumers would demand the 3G products once theoretical plans were instituted through technological advancements. Third generation deployments have progressed slower when compared to the 1G and 2G deployments, but systems are being tested, designed, built and instituted.

For example Lucent Technologies announced the following on February 20, 2002:

> "...According to Lucent, its secure IP VPN mobility solution will help operators of 3G UMTS networks enter the emerging market for secure communications between enterprise data networks and end-users such as traveling employees or remote workers. The company said the secure IP VPN connections will enable mobile subscribers to use a service provider's wireless network as an extension of their corporate local area network (LAN) or intranet, allowing them to work from any location as if they were in the office... The end-user was authenticated and assigned an IP address, and then was able -- once the connection was established -- to successfully send and receive email, including messages with large attachments, in a fully encrypted mode, thus allowing even sensitive data to be accessed." (Intranet Journal, 02/20/02, "Lucent Demos 3G Mobile Service Connection to Corporate Intranet"). This technology is just beginning to be utilized in the United States.

In December of 2002, Sprint announced they were the first U.S. wireless provider to introduce the next generation of services nationwide known as PCS VisionSM. The 3G upgrades to infrastructure were done primarily through software improvements at the existing Sprint base stations. The wireless phone capable of accessing these services is the SPH-i330 manufactured by Samsung.

Figure 9 illustrates the Nokia 7250 handset and the SPH-i330 handset and the new services available by Sprint.

(www.samsung.com)

- An updated version of Samsung Electronics Co. Ltd.'s Palm OS-based cellular telephone has debuted in the U.S. market.
- Has a large 256 color LCD (liquid crystal display) with 160 by 240 pixel resolution. South Korea's Samsung has built 16M bytes of memory into the handset, which is double that of its predecessor.
- The phone's radio is a dual-band, tri-mode model offering compatibility with CDMA (Code Division Multiple Access) at both 800MHz and 1,900MHz and the analog AMPS network.
- The handset is available first in the U.S. though Sprint PCS Group and is compatible with the carrier's CDMA2000 1x data service, which offers packet-based data transmission at speeds of up to 144k bps (bits per second).
- Expected to be available through Sprint.

(ITworld.com, 12/26/02, "Samsung's i330 Palm OS cell phone debuts"
Martyn Williams, IDG News Service, Tokyo Bureau)

(www.nokia.com)

- The Nokia 7250 phone has an innovative keypad layout and a versatile scroll key that makes it easy to navigate the high-resolution color display.
- Take pictures with the built-in camera and then share them with your friends or family using multimedia messaging technology.
- Eight color schemes let you personalize some of the display elements like header lines or the battery and signal strength indicators.
- Extremely appealing audio features include a selection of pre-loaded ringing tones, a built-in stereo FM radio, and the possibility to receive new polyphonic sounds through MMS, WAP, or Nokia PC Suite.
- The Nokia 7250 tri-band phone operates in three networks - EGSM 900 and GSM 1800/1900 - providing coverage on five continents.
- The Nokia 7250 phone is one of the first to have a connector. It supports advanced functionalities, such as digital enhancement identification, stereo audio, and fast data connectivity.

Figure 9: 3G Wireless Phones and Related Services

Future wireless generations

While at last the United States is starting to experience the first deployments of 3G, other parts of the world are being introduced to 4G. Proving to early skeptics that while the deployment of wireless services in the United States have slowed down, the 3G services will continue to evolve and be sold here and abroad. The article below explains the type of wireless services now being promoted in Asia, which will eventually be promoted in the United States.

> "At a Telecom Asia exhibition in Hong Kong in 2004, Samsung showed for the first time its M400 handset. Based on Pocket PC 2002 Phone Edition, the device runs on CDMA 2000 1x EvDO (Evolution Data Only) networks, which are in commercial service in South Korea and offer data transmission at speeds of up to 2.4M bps. Features of the phone, which is based on an Intel Corp. XScale processor running at 400MHz, include a display capable of showing 65,000 colors, voice recognition and a text-to-speech engine, a TV tuner and GPS (Global Positioning System). Samsung also has a handset based on Microsoft's Windows Powered Smartphone platform under development. That operating system is targeted at handsets that are more like traditional cell phones and offers a limited number of PDA-like functions." (ITworld.com 12/26/02, "Samsung's i330 Palm OS cell phone debuts" Martyn Williams, IDG News Service, Tokyo Bureau). This same technology was introduced in the United States in January of 2006, at the Consumer Electronics Show in Las Vegas.

Satellite technologies

Satellite growth has surpassed the highest expectations of only a few years ago. The reason is simple…cost. Previously, relaying information, data, and other related materials were cumbersome and required many relay stations located in very specific locations and relatively close together. Initially satellite use was expensive because of the rarity and limited amount of available air time needed. With the deployment of more and more satellites, along with advancing technologies which allow more usage of the same amount of bandwidth, satellite air time has become more affordable. Competition always holds down cost, and that is what has occurred. In addition, satellite services are in the early stages of designing a more localized aspect. As this occurs there will be even more growth more rapidly.

But satellite technology has its limitations, which are all based on the Laws of Physics. Some licensee's of satellite services such as XM Radio and satellite telephone services have petitioned the Federal Communications Commission (FCC) to allow additional deployment of land based supplemental transmission relay stations for the ability to compete more aggressively with existing ground base services. Subscribers found the delay in talk times unacceptable along with fade and singal dropout. The FCC is looking favorably upon this request, even though the existing land based services are strongly objecting for various reasons. XM Radio was successful in getting ground base supplemental transmitters, and has become one of the largest users of ground base transmitters. If this is allowed there will be more demands placed on governmental agencies as another service begins to construct a land-based infrastructure.

EMSR

In addition ESMR systems and the technology used have been problematic to adjacent frequency channels used by other services, through no fault of the service provider in most situations. In order to reduce any potential for future interference issues, ESMR operators petitioned the FCC and the FCC concurred to shift frequencies from the 800 MHz and 900 MHz band to the 2,500 MHz band. Once again this frequency shift will cause the need for additional support structures and create additional impacts to local governments.

Preparations for 3G infrastructure

The FCC announced it would permit the phasing out of analog compatibility requirements for cellular phones by the year 2008. The Commission's action still allows providers the option to continue analog services as needed to meet customer needs. According to the Cellular Telecommunications & Internet Association (CTIA) about 85 percent of all wireless subscribers are already using digital technology, and wireless users generally replace their phones every eighteen months. Thus, the five-year phase out period is more than ample time to migrate the remaining analog users to digital, which also has the added benefit of increasing cell site capacity, as a single analogue channel can be converted to four digital channels.

The CTIA recently announced wireless carriers are now participating in a program that allows a customer of Carrier A to communicate through text messaging with a customer of Carrier B. One of its many benefits is as an electronic alternative to a postage stamp; you can send text messages from anywhere and they can be delivered anywhere at anytime.

Text messaging has been proven to very successful in other countries; in Australia, a recent Coca-Cola promotion resulted in over seven million text messages over a span of thirteen weeks. In Europe, one company quit issuing paychecks to its employees; instead it now sends them a text message confirming that the funds have been deposited.

The statistics are impressive. At the turn of the century there were one billion messages sent a day globally. Every digital phone that is sold today in the United States has messaging capability; in Europe last year, fifteen percent of the carriers' revenue came from text messaging.

The growth of text messaging in the United States will undoubtedly lead to a greater demand for wireless facilities because the additional spectrum use by text messages will create a system capacity demand for providers. Third, fourth and fifth generations of wireless deployment will bring the next phases of wireless technology and place great demands on network capacity. With voice, text and data all competing for spectrum space, providers will need to maximize their spectrum allocations by creating more compact base station facilities at closer intervals.

Chapter 2 Wireless Technical Issues

INTRODUCTION

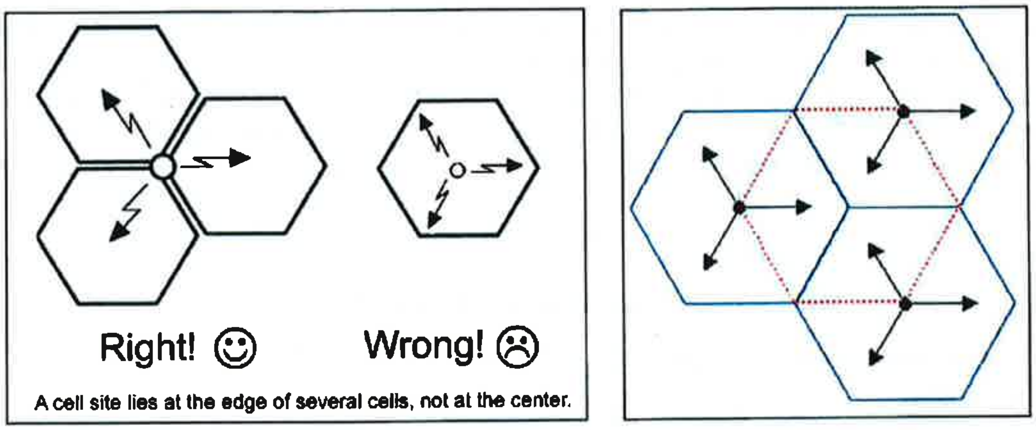
Cellular and PCS wireless providers attain service coverage through a network of ground equipment base stations and elevated antennas located on towers, water tanks, buildings or other similar elevated structures. The height and location of the elevated antenna platform on the elevated structure is critical to two aspects of radio frequency (RF) engineering, coverage and capacity. Generally, the higher the antenna is mounted on the support structure, the larger the geographic area that will be served by the wireless signal. However, each facility has network capacity limitations that are becoming more apparent in some of the older, 800 MHz cellular operators such as Cingular (formerly BellSouth Mobility and AT&T Wireless Services), Verizon, and Nextel. Base stations located in geographic areas where wireless subscribers are significant and the usage of airtime minutes is higher, operate at maximum capacity, and on some occasions are over-capacity, causing busy signals and direct-to-message incoming calls for many subscribers. To help remedy this situation, smaller antenna configurations and/or the antenna heights are mounted at lower elevations than would be necessary for coverage. This is defined as "capacity" planning.

As an example, when Cingular's system was initiated in 1984, the entire wireless network could provide coverage from Seattle to Olympia with about ten cell sites (towers). Today there are well over two hundred antenna locations covering that same area due to the increase in wireless subscribers and the effects that subscriber growth has on network capacity.

The second engineering issue concerns the relationship between tower location and frequency planning. Cellular and PCS wireless providers carefully choose the frequencies deployed at each base station to avoid mutual interference. Rules of frequency planning require a certain physical distance between base stations to minimize this interference. Slightly different considerations apply to some PCS providers using code division multiple access (CDMA) technology (Sprint PCS and Verizon). In a CDMA system, all base stations in a coverage area use the same, or a very limited set of several frequencies. However, wireless service customers experience interference from other subscribers and from signals from other base stations when subscriber usage increases. Avoidance of this interference requires precision of the antenna locations.

As demonstrated in Figure 10, base station network design is founded on the principles of a grid system that is maintained by each wireless provider's engineering department. The hexagonal cells on the grid represent the radius equal to the proposed cells' coverage areas. Common points of adjoining hexagons pinpoint the theoretical perfect location for a prospective new base station. For these reasons, deviation from these specified locations can significantly affect the wireless provider's deployment network.

"Most people see the cell as the blue hexagon, being defined by the tower in the center, with the antennas pointing in the directions indicated by the arrows. In reality, the cell is the red hexagon; with the towers at the corners...the confusion comes from not realizing that a cell is a geographic area, not a point."



(Courtesy of Tom Farley http://www.telecomwriting.com/index.html)

Figure 10: Network Grid

Search area within proposed coverage areas

The search area for new wireless infrastructure is ideally specified in a document provided to site search consultants in pursuit of a lease for property on which to place their facilities, whether a new tower, a rooftop or some other existing structure that could accommodate wireless antennas. From an engineering perspective, any location within the proposed search area is considered to be acceptable for the provider, with certain considerations based on terrain and sometimes population balance.

Search Area Radii

Search areas for the 800 MHz (cellular and ESMR) frequencies and 1900 MHz (PCS) frequencies are computed in the tables below. The tables utilize the "Okumura-Hata" propagation path loss formula for 800 MHz, and the "COST-231" formula for 1900 MHz. Maximum coverage radii for typical in-vehicle coverage is calculated for various tower heights, and is de-rated by twenty percent to account for a reasonable hand-off zone, then divided by four to obtain a search area radius for each tower height. Thus, for an 800 MHz antenna mounted at the 100-foot elevation, the search area would have a radius of 0.72 miles, and 0.36 miles for 1900 MHz, again sometimes more restrictive due to terrain.

Okumura-Hata Coverage Predictions for 800 MHz

Antenna mounting height	50'	80'	100'	115'	150'	180'
Radius, miles	2.53	3.20	3.60	3.88	4.50	5.00
Allow for hand-off	2.03	2.56	2.88	3.10	3.60	4.00
Search area, miles	0.51	0.64	0.72	0.78	0.90	1.00

COST 231 Coverage Predictions for 1900 MHz

Antenna mounting height	50'	80'	100'	115'	150'	180'
Radius, miles	1.33	1.64	1.82	1.95	2.23	2.45
Allow for hand-off	1.07	1.31	1.46	1.56	1.79	1.96
Search area, miles	0.27	0.33	0.36	0.39	0.45	0.49

Wireless telephone search areas are usually circles of approximately one-quarter the radius of the proposed cell. In practice it is fairly simple to determine whether the search area radius is reasonable. The distance from the closest existing site is determined, halved, and a hand-off overlap of about twenty percent is added. One fourth of this distance is the search area radius.

Height considerations

Higher structures (towers, rooftop, water tanks) may offer more opportunity for co-location, which could theoretically decrease the number of additional towers and antennas required in an area. The extent to which height may increase co-location opportunities must be verified by an RF engineering review on a case-by-case basis. Where there is high customer telephone usage or terrain concerns, and the build-out plans for some areas may require very low antenna location heights, especially in densely populated areas. Antennas located at a higher level on a facility are more attractive in some rural areas, but in many cases, the wireless providers seek to limit the height in more populous areas. Thus, wireless providers may need differing heights on a single tower, reducing the potential for interference, both between the same provider and a competing wireless provider.

Emerging technologies

Wireless providers are presently deploying new technology equipment in the United States to support data services over the wireless interface. One such example of this type of deployments has been a Global System for Mobile Communications (GSM) overlay on top of existing facilities, in recognition of GSM's data-handling capability. In certain cases, the GSM overlay is on 1900 MHz, where signals only cover about half the distance of the existing system, implying more wireless facility locations will be required to meet coverage and network capacity objectives.

Chapter 3 Master Plan Engineering Analysis

PLAN DESIGN PROCESS

This Master Plan evaluates the City of Olympia for future wireless facility build out, and is accomplished by:

- Researching the inventory of existing antenna-supporting structures and buildings, and evaluating designated public lands as potential sites for wireless facilities.
- Designing an engineered search radii template and applying it over the jurisdictional boundary of the City to evaluate existing build-out conditions.
- Providing an engineering analysis of existing coverage based on the inventory and regulatory height restrictions in the City.

The inventory

CityScape conducted a site assessment to view the existing antenna locations within the City and to locate publicly-owned properties as possible new antenna locations in an effort to: 1) identify telecommunications providers currently operating within the City; 2) locate telecommunications facilities currently existing in and around the City; 3) map existing structures that could potentially be used to locate and support wireless facilities; and 4) identify public property that is potentially developable for wireless communications facilities. This inventory was performed through actual site visits, aided by local jurisdictions' permit and inspections departments, and by research using the Thurston Regional Planning Council database and the FCC's antenna structure registration database. Mapping these types of land uses and properties creates a base map and a starting point from which observations and analysis are derived concerning current wireless deployment trends and projected future deployments for the City.

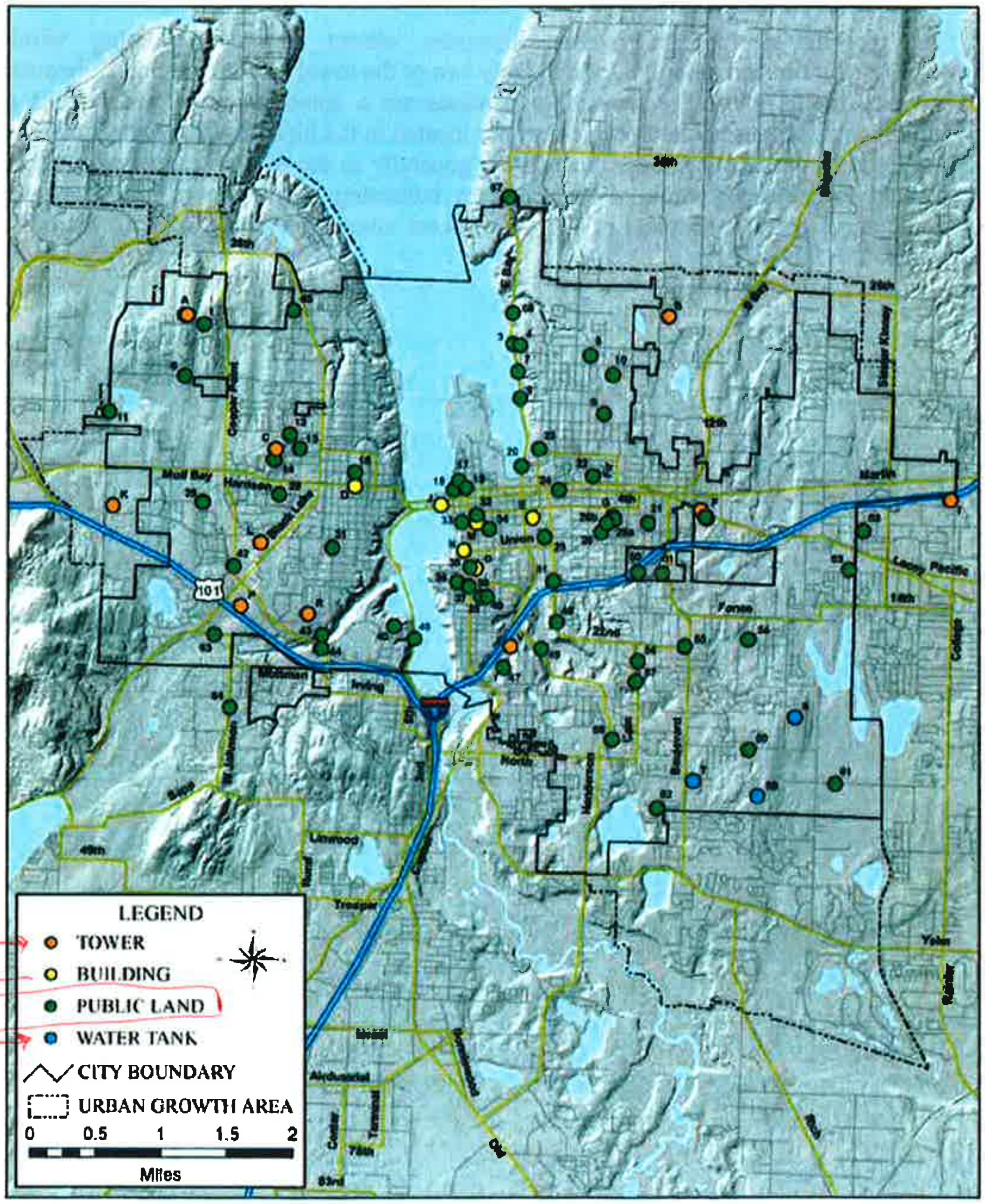
City-owned property and exisitng antenna locations

Olympia provided CityScape with the locations of existing antenna and certain City-owned lands where antenna exists and where new tower development could be permitted. These sites are illustrated in Figure 11. Orange dots represent eleven existing tower locations, yellow dots locate seven existing buildings, which could possibly accommodate an antenna attachment, blue dots identify the four water tanks, and all green dots indicate sixty-eight assessed parcels, mostly public property that we initially expect to qualify as potential sites for new wireless communication facilities.

The present deployment pattern illustrates eleven towers containing wireless infrastructure in and around the City. Only two of the tower facilities are actually outside the city limits, while the remaining locations are a combination of water tanks and buildings as support structures and they are located in the highest wireless traffic areas of the City. Most existing tower heights are generally in the 80-foot range with antennas affixed to the top portion of the facilities indicating a phase one, initial coverage, deployment pattern. Several of the more recent towers have been built in the 60-foot range.

EXISTING ANTENNA LOCATIONS AND PUBLIC LANDS

OLYMPIA, WASHINGTON



11 existing
7 existing
68 Qualified sites
4 existing

Figure 11: Existing Antenna Locations and Public Lands

Engineering analysis

The foundation for CityScape's engineering analysis is based on legally defensible wireless deployment guidelines that are consistent with accepted engineering practices, existing and estimated future population density, and the use of the 800 MHz and 1900 MHz band systems.

As explained in Chapter 2, generally accepted 800 MHz engineering principles establish a reasonable search area for a wireless base station as a circle with a radius about one-quarter that of the proposed cell, centered on the ideal location for the cell according to the wireless provider's deployment plan. CityScape has designed the engineering of this Master Plan based on an 80-foot and 60-foot deployment pattern to accommodate existing and anticipated coverage and network capacity objectives, respectively. CityScape has developed a series of root mean square (RMS) propogations maps, based on existing antenna locations, population density and frequency spectrum allocations. These maps illustrate a series of maps starting with no demographic or terrain variables for initial cellular, ESMR, and PCS coverage.

Basic coverage predictions and wireless coverage hand-off

Wireless telecommunication networks are comprised of elevated antenna arrays attached to a base station that transmit and receive radio signals allowing wireless telephone handsets to operate satisfactorily. The radio frequency of the wireless network system, height of the antenna and the location of the infrastructure are all important components to a complete network plan. One set of elevated antenna arrays does not provide service to a geographic area independently of other nearby elevated antennas, rather, each set of antenna arrays work in unison to provide complete wireless coverage. Complete coverage is only attained when the radio signal from one antenna array successfully relays or hands-off the radio signal to another antenna array without causing an interruption in service. Successful network hand-off is only possible when the geographic coverage areas from individual antenna arrays properly overlap and when the base station has available capacity. Geographic areas with good site hand-off and available capacity will also have good wireless coverage and generally uninterrupted services.

CityScape has been asked how many facilities would it take to provide coverage to Olympia. In an effort to answer this question, CityScape provides a series of theoretical root mean square (RMS) deployment maps to help visually answer this question. Initial coverage maps, Figures 12 and 13, illustrate wireless telecommunication signal coverage in a perfect radio frequency environment, without population or terrain concerns. These variables can significantly influence the effectiveness of the wireless signal between the antenna and a wireless telecommunication handset.

According to the Okumura-Hata for 800 MHz propagation path loss formula coverage tables in Chapter 2, a reasonable coverage area for an antenna mounted at 80-feet for cellular deployment on flat terrain is 3.2 miles. The engineering exercise in Figure 12 shows how the use of two locations within the City of Olympia could provide coverage to the entire City. These sites represent a theoretical build out for antennas mounted at the 80-foot elevation at equal dispersion and no consideration of adjacent community wireless deployment for a single cellular provider, assuming no suitable existing structures have been constructed and excluding population variables. The smaller circles shown within the larger circles represent the limits of the search area for locating the tower. Although two cells cover the vast majority of the City of Olympia for one provider, this does not include the concept of capacity or terrain concerns. Figure 12 illustrates the hand-off radius applicable to 800 MHz between two of the approximate eleven possible existing above ground antenna locations demonstrating that initial cellular coverage without considerations of population or topographic variables is reasonable. Population and terrain of specific geographical areas and the total number of minutes used by the wireless subscribers within that designated area can have significant affects on the circumference of the coverage area.

Referring to the "COST-231" formula for 1900 MHz coverage tables in Chapter 2, a reasonable coverage area for an antenna mounted at 80-feet for a PCS site on flat terrain is 1.64 miles. Figure 13 shows approximately five facilities located within the City of Olympia jurisdictional boundaries. These sites represent a theoretical build out of 80-foot antenna locations at equal dispersion for one cellular provider again with no consideration of adjacent community wireless deployment, no terrain considerations and assuming, no suitable existing structures have been constructed and excluding population.

Figure 13 illustrates the hand-off radius applicable to 1900 MHz from five of the approximate eleven possible existing above ground antenna locations existing towers and tower clusters within the City of Olympia, demonstrating that initial PCS coverage without considerations of population and topographic variables is almost one hundred percent complete. The hand-off radius for 1900 MHz is reduced because of the difference in PCS operating frequencies and technologies as compared to the 800 MHz frequency which is why a sixth antenna location is necessary to fill in the gaps in coverage area.

THEORETICAL COVERAGE FOR A SINGLE PROVIDER AT 800MHz

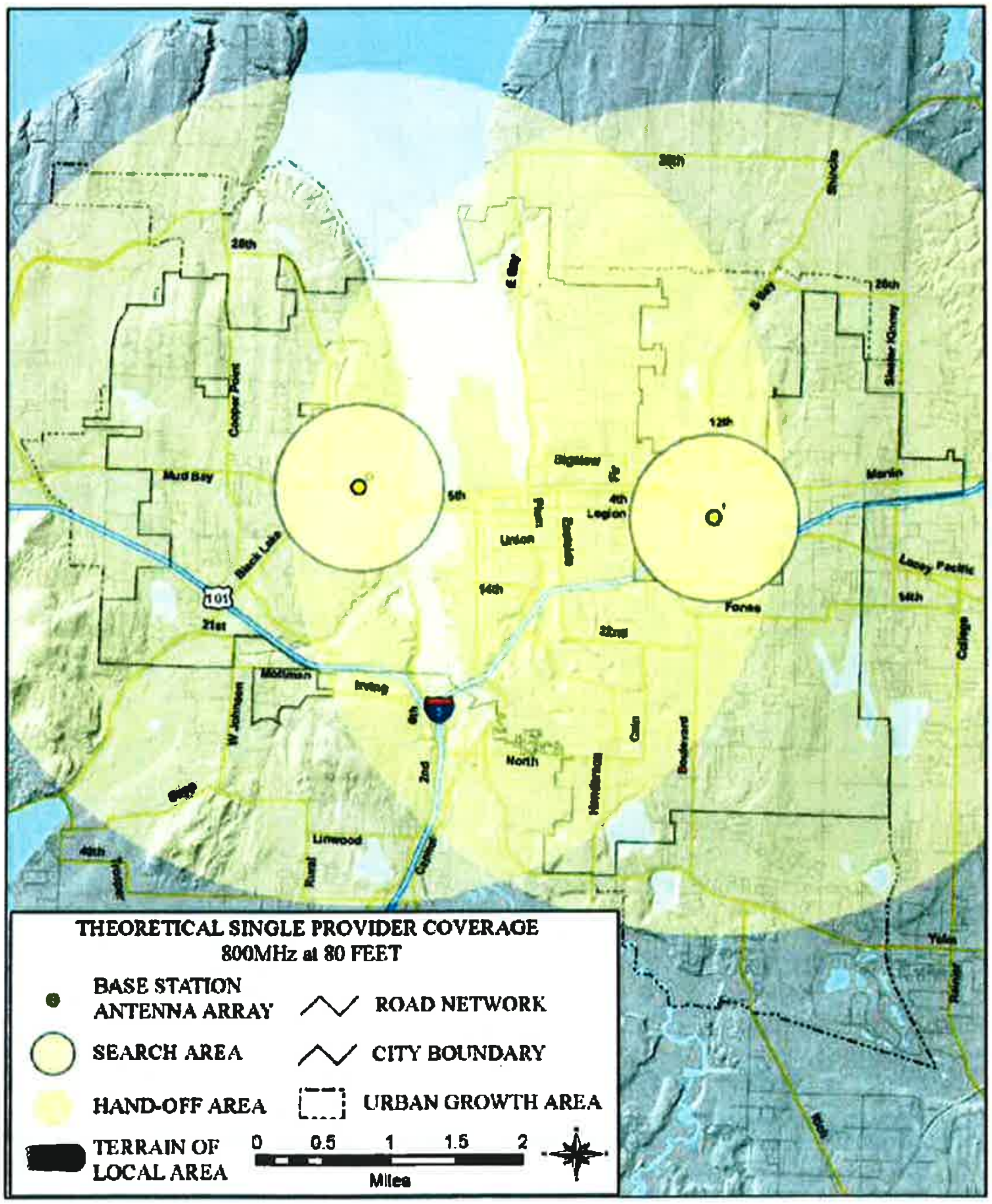


Figure 12: 800 MHz Hand-Off and Search Areas

THEORETICAL COVERAGE FOR A SINGLE PROVIDER AT 1900MHz

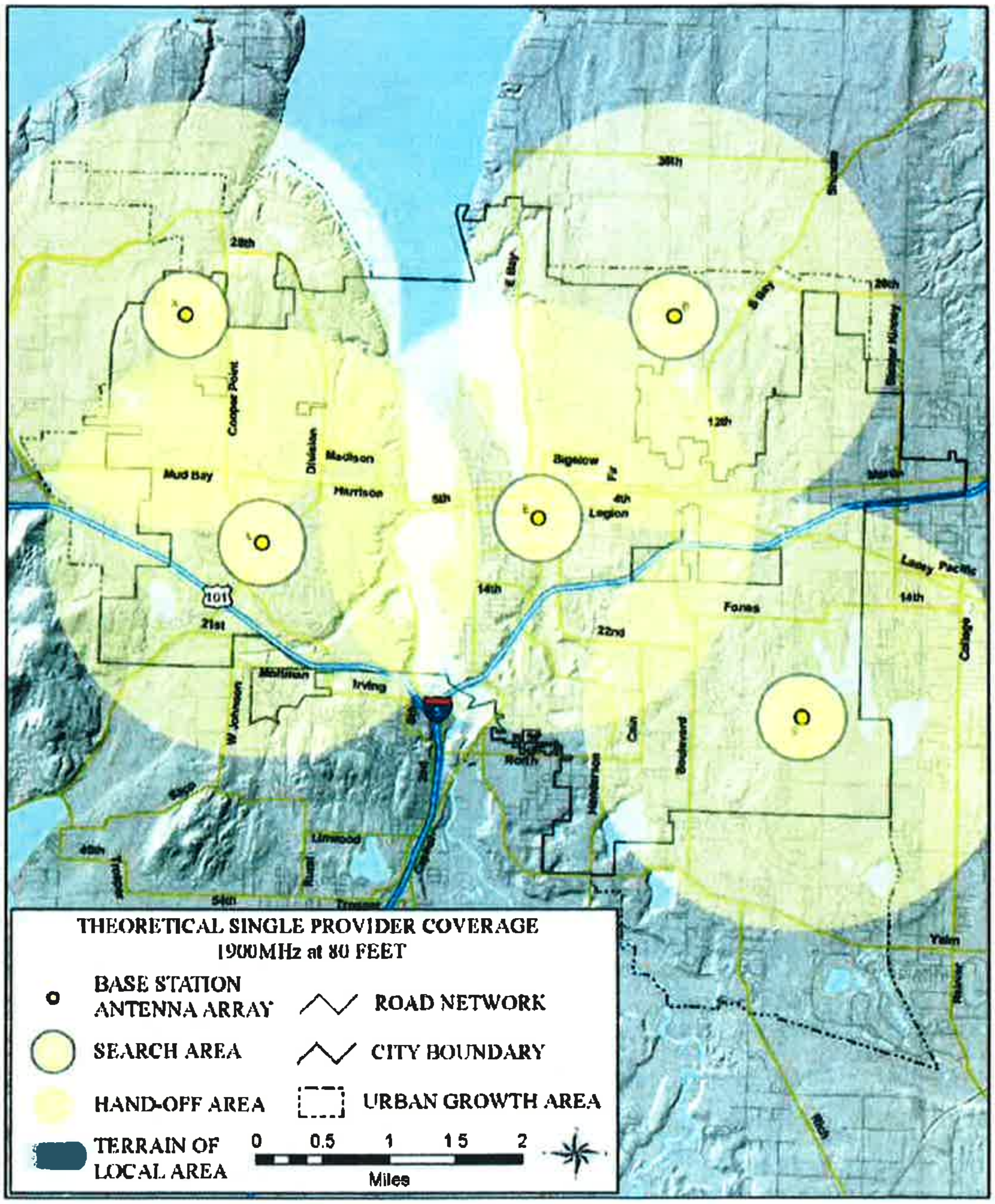


Figure 13: 1900 MHz Hand-Off and Search Areas

Coverage predictions including topographic variables

As previously described, in flat terrain and sparsely populated areas, base station prediction is an easier art. When wireless telephone usage increases both in minutes spent in use and higher customer penetration, service areas shrink in size. The impact terrain has on a service area is the most dramatic. Radio frequency propagation is similar to line-of-sight technology. Therefore on flat terrain service areas the coverage network forms an even circular pattern. In areas with varying terrain conditions, the line-of-sight coverage will be altered by higher and lower ground elevations. Olympia has enough topographical variation to provide sufficient gaps in coverage.

Using the same random antenna locations identified in Figures 12 and 13, Figures 14 and 15 illustrate how wireless service coverage areas become distorted when the topographic variables are added to the propogation formulas. The areas in gray illustrate service areas that could use immediate improvements, especially those located near the centerline north and south in Olympia.

THEORETICAL COVERAGE FOR A SINGLE PROVIDER AT 800MHz, CONSIDERING TERRAIN

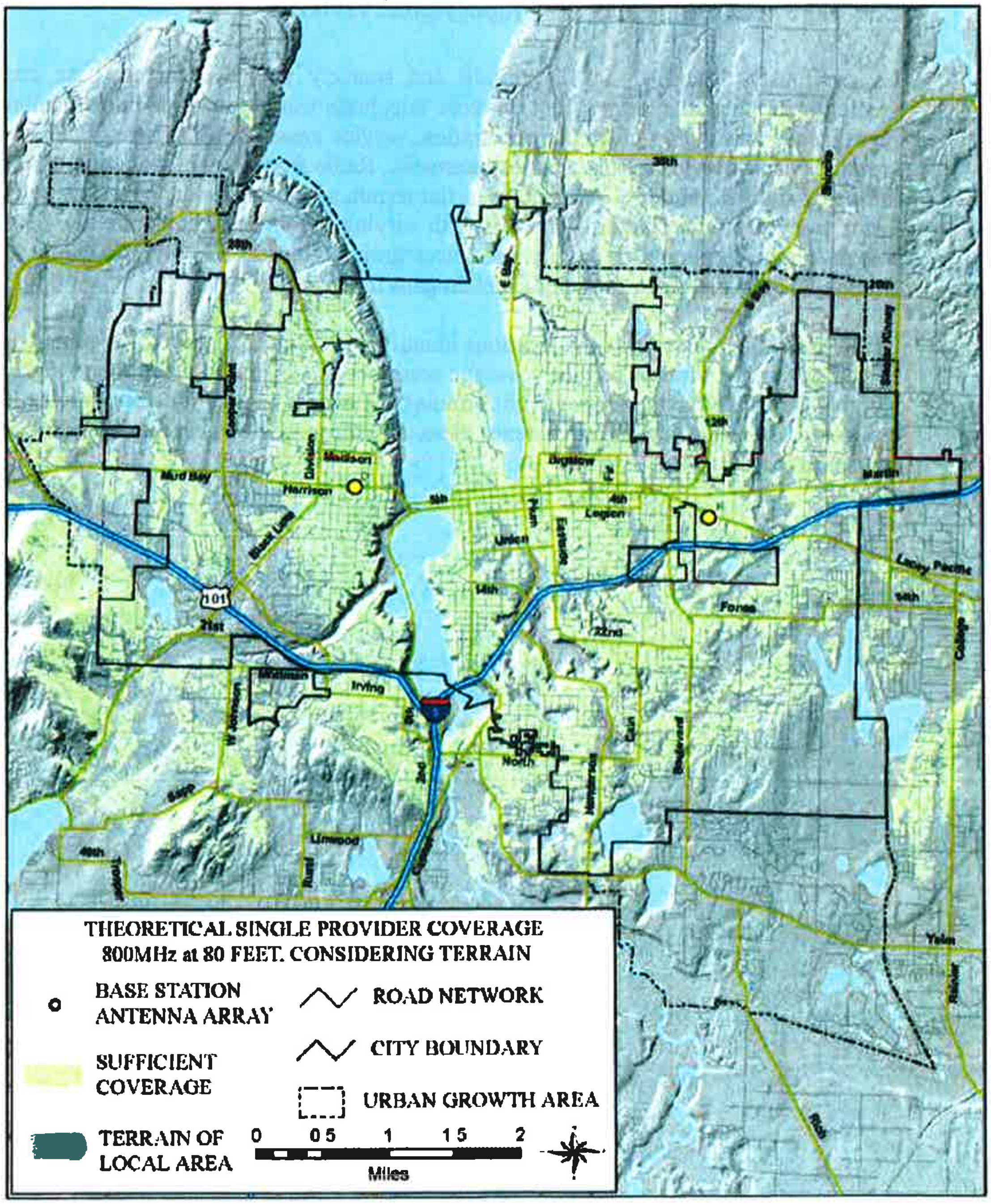


Figure 14: 800 MHz Theoretical Coverage from 80-foot antenna mounting elevations

THEORETICAL COVERAGE FOR A SINGLE PROVIDER AT 1900MHz, CONSIDERING TERRAIN

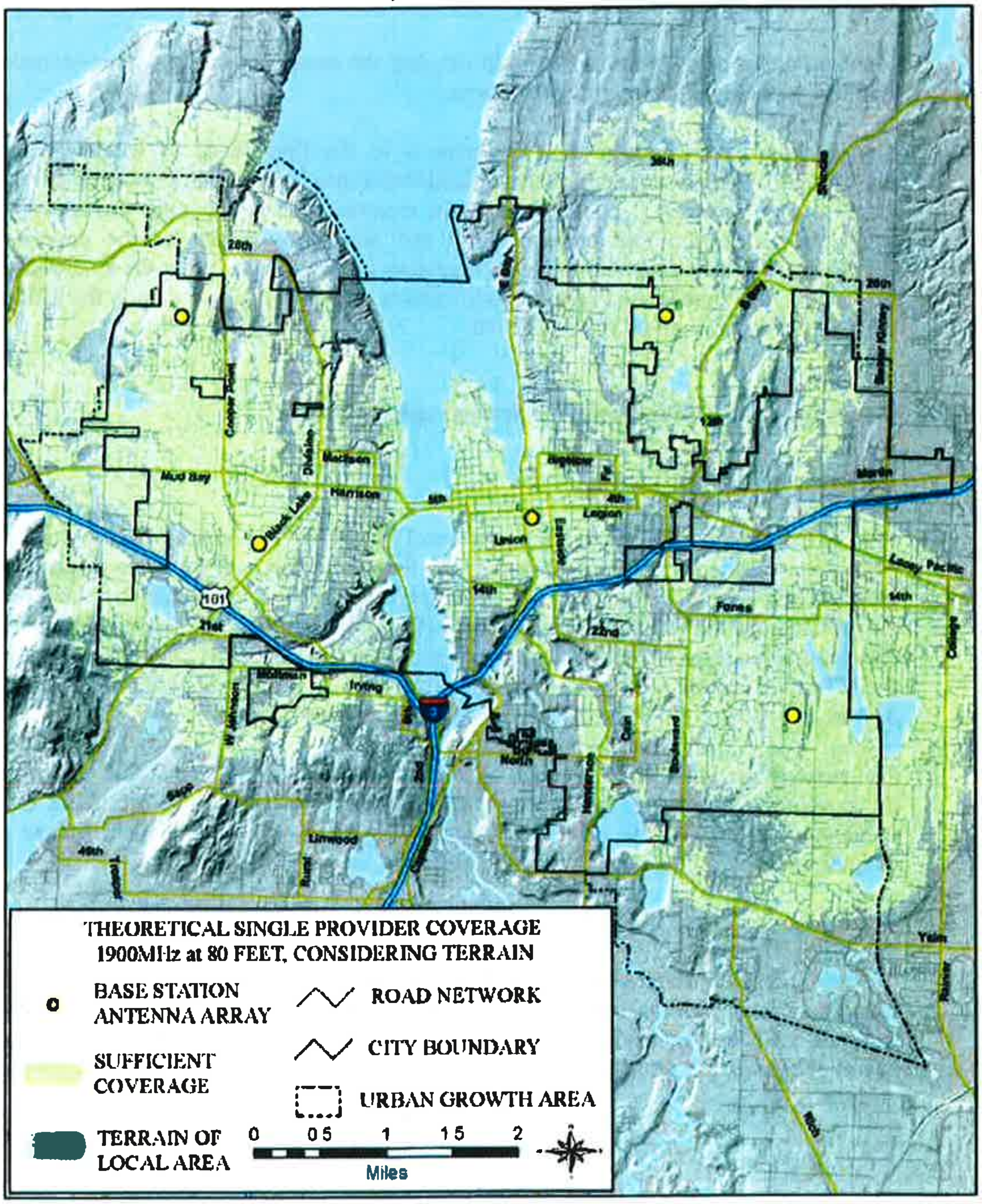


Figure 15: 1900 MHz Theoretical Coverage from 80-foot antenna mounting elevations

Engineering Analysis

The next phase of the Master Plan will develop the system out to ten years to include identifying potential City property locations.

The existing patterns reveal that Olympia is in the first phase of wireless service deployment. The present deployment consideration has been directed towards coverage more so than capacity. Local deployment records indicate Olympia has a wireless telephone penetration rate between sixty and sixty-two percent of the population. CityScape anticipates service providers operating in Olympia to begin the next phase of base station deployment and system modifications to increase capacity upon the lifting of the present Moratorium in March of 2006.

Coverage predictions based on demographics trends

The industry

Prior to the granting of the cellular licenses in 1980 for the first phase of deployment, the United States was divided into 51 regions by Rand McNally and Company described as Metropolitan Market Areas (MTA). The spectrum auction conducted by the Federal Government for the 1900 MHz bands for 2G (PCS), further divided the United States into 493 geographic areas call Basic Trading Areas (BTA). The City of Olympia is located in the MTA 024 and BTA 331. The list of holders of FCC licenses for MTA 024 and BTA 331 are as follows: Cingular, Sprint, T-Mobile, Verizon and Nextel.

The wireless growth of the 1990s has slowed considerably over the last few years due to the economy. However, the industry has begun a new phase of construction that is underway. Demand for new facilities will continue as populations increase and technology evolves and maximizes the capacity of the existing networks.

The industry is expected to mature in several important ways over the next decade. First, wireless providers will offer more service options to increase the number of airtime minutes that subscribers buy. Second, 3G, 4G and 5G enhanced phone services will require more network capacity. The resulting effect requires more base stations as network capacities exhaust and relief is required. Consequently, the City can expect to see applications for more wireless communication facilities continuing throughout the decade.

Wireless demographic analysis

Based on the 2000 Census, the City of Olympia's population was 42,514; an increase of 25.1 percent from 1990. For engineering analysis purposes, CityScape has chosen to use the demographic data provided in the 23rd Edition of The Profile, Table II-5, "Population Estimate and Forecast by Fire District, Thurston County 2000 - 2030" because the data in this table most closely matches the Census data. Table II-5 indicates the popluation for the City Fire Districts in 2005 was 43,290. Table II-5 shows an estimated popluation for Olympia Fire Districts in 2015 to be about 50,940; a population increase of 17.7 percent.

According to the 23rd Edition of The Profile, Table I-1, "Thurston County Land Area, 2005" the City of Olympia, including the Urban Growth Area (UGA) is 25 square miles. Using the population data above for 2005, this means there are presently about 43,290 people in Olympia, about 1,732 people per square miles. Based on today's penetration rate, 60 percent of the community has cell phones; meaning 1,038.96 subscribers per square mile. Presently, a base station can accommodate approximately 200 subscribers per site, so the City would need to have about 25 base stations strategically located throughout the City to accommodate the current subscriber rate.

Using the population data above for 2015, the population would be about 50,940, that equals about 2,038 people per square mile or 306 people per square mile increase. Based on the future anticipated penetration rate, 78 percent of the community would have cell phones; meaning 1,590 subscribers per square mile. Because of the necessity for increased broadband 2015 it is anticipated the average number of subscribers processed by the base stations will drop from 1,000 presently to about 750. Thus approximately 3 base stations per square mile or about 75 total should be necessary to accommodate a single wireless provider in the City of Olympia. It is the intent of the Master Plan to reduce that number to less than 60 in the expanded city limits of Olympia.

Using the same random locations in Figures 12 through 15, Figures 16 and 17 illustrate the diminishing coverage effects of lowering the antenna mounting elevation from 80-foot to 60-foot to accommodate the effects of future demographics in the City.

THEORETICAL COVERAGE FOR A SINGLE PROVIDER AT 800MHz, CONSIDERING TERRAIN

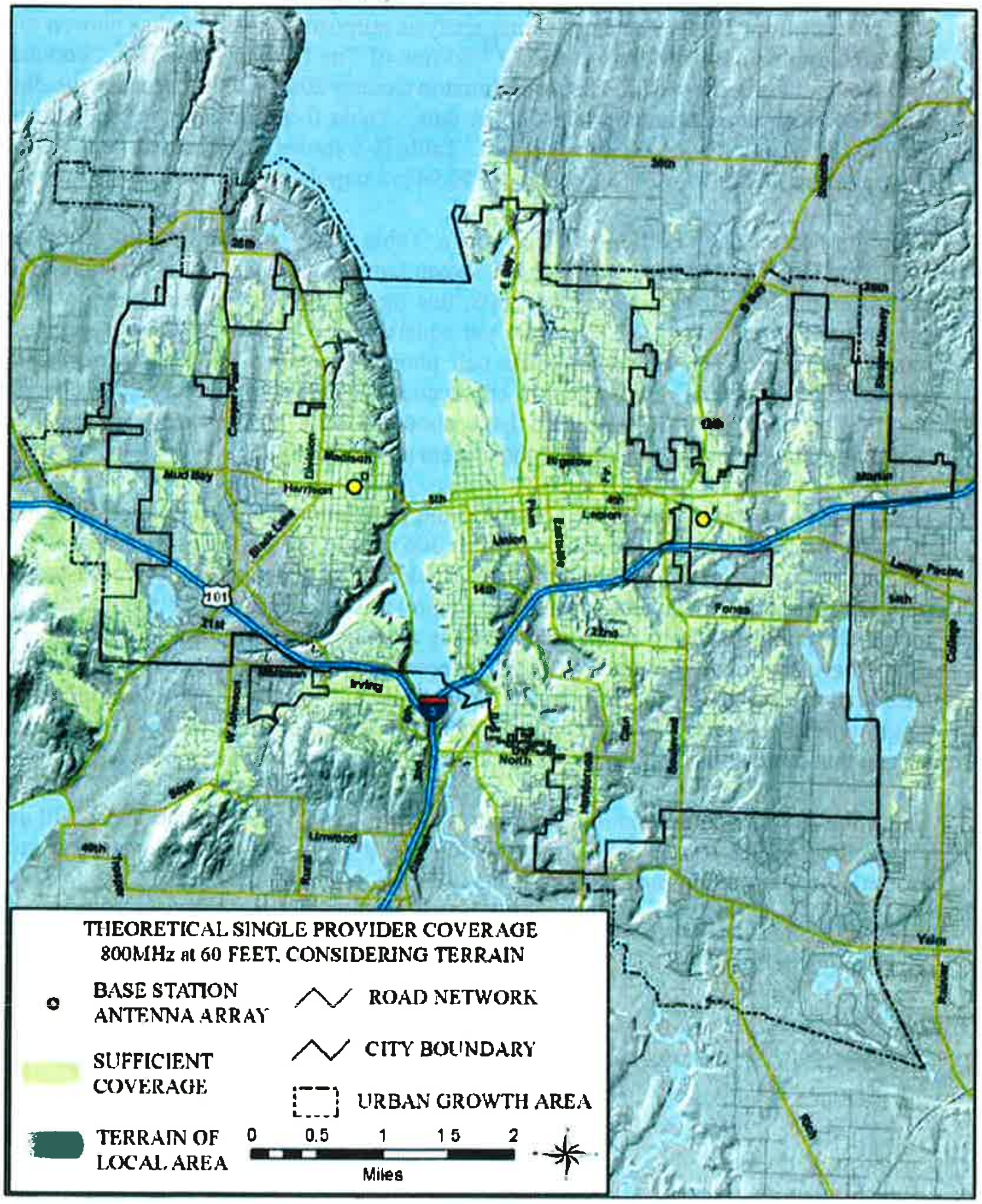


Figure 16: 800 MHz Theoretical Coverage from 60-foot antenna mounting elevations

THEORETICAL COVERAGE FOR A SINGLE PROVIDER AT 1900MHz, CONSIDERING TERRAIN

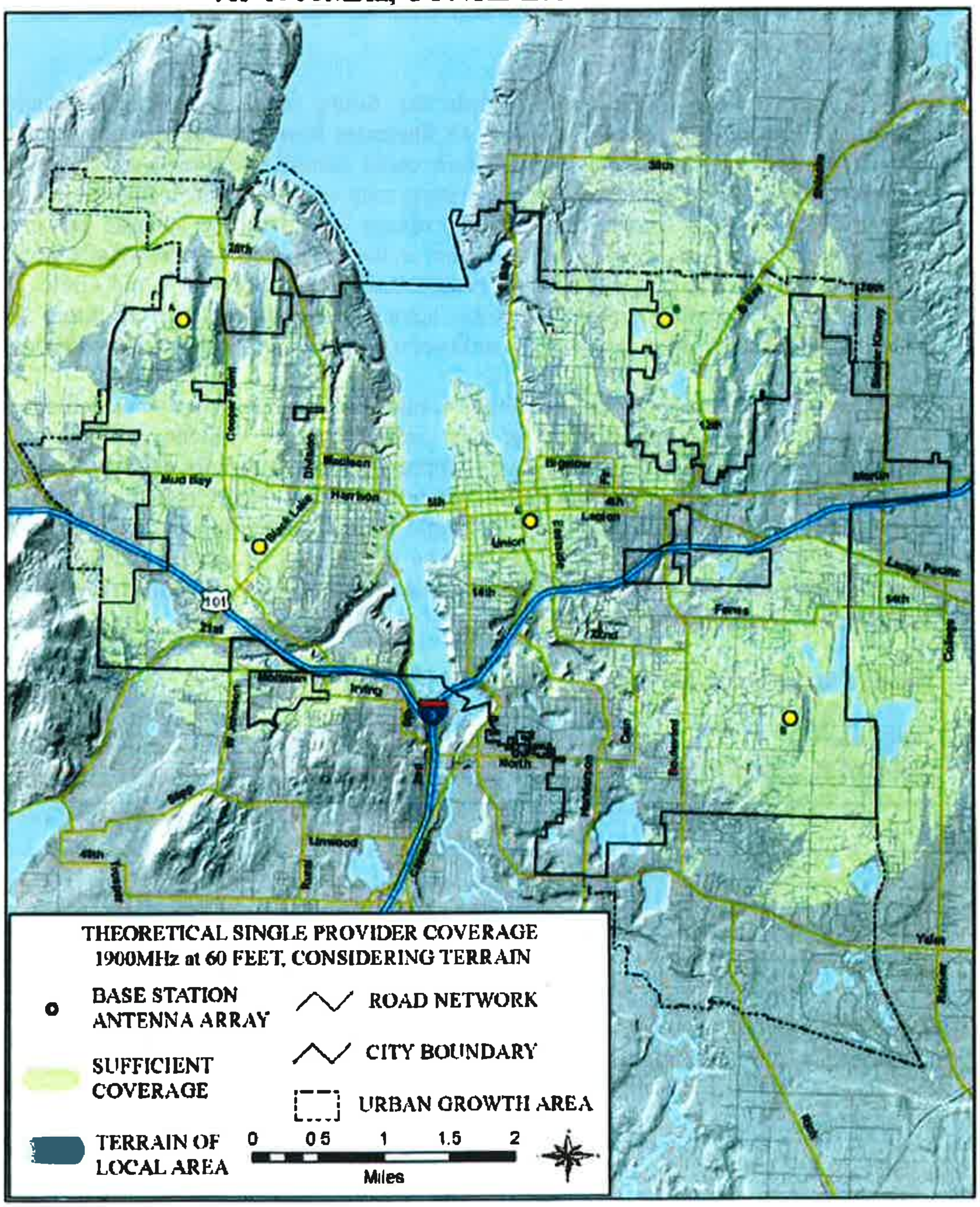


Figure 17: 1900 MHz Theoretical Coverage from 60-foot antenna mounting elevations

City Property

An objective of the Master Plan is to recognize the co-location possibilities of existing sites, minimize new tower construction, and maximize the use of City-owned lands for the use of new infrastructure.

The City desires using City-owned lands for future wireless telecommunications infrastructure, wherever possible. Figure 18 illustrates how utilizing certain properties for the installation of wireless infrastructure could benefit wireless network designs within the City. While each City-owned property may at some point fit into the network design objectives of a wireless provider, CityScape has identified specific properties, which if developed with wireless infrastructure in the near future, could benefit the City in several ways. The projected future locations are identified with a red circle. All existing towers and other support structures automatically are included as future sites, under the co-location requirement of the ordinance, although we do not circle each one.

First, maximizing the use of these properties would serve as a proactive management tool and prevent the over-proliferation of new infrastructure. Second, utilizing these designated properties would significantly improve network design objectives for the citizens of Olympia who subscribe for the wireless services. Third, managing the use of these City-owned properties provides additional control of the appearance and type of facility. Figure 18 demonstrates how the use of selected properties developed with wireless telecommunications infrastructure mounted at 60-feet could effectively provide complete coverage across the entire City.

A list of the potential properties is listed in the chart below.

Site Letters Of Figures	Site Names	Site Letters Of Figures	Site Names
G	Eastside Water Tower	50	1400 SE Edison
5	1910 NE Central St	53	Stormwater Site east of Crown Cork and Seal
6	Grass Lake Refuge	54	Park – 3111 SE 21 St
8	1320 NE East Bay Dr	55	Fire Station – 2525 SE 22 St
9	Park – 1200 Lybarger St	57	2700 Burnaby Park Loop
10	1707 McCormick St NE	58	1828 Arietta
22	1323 Olympic	59	Proposed Water Tank
31	Decatur Woods Park	61	4808 Herman Rd SE
41	1401 SE Eastside St	62	2428 SE Cedar Park Loop
45	1901 Lakeridge Dr	67	Right of Way on Boston Harbor Rd
47	Park – 2600 Hillside Dr SE		

COVERAGE FOR ALL PROVIDERS, INCLUDING FUTURE LOCATIONS

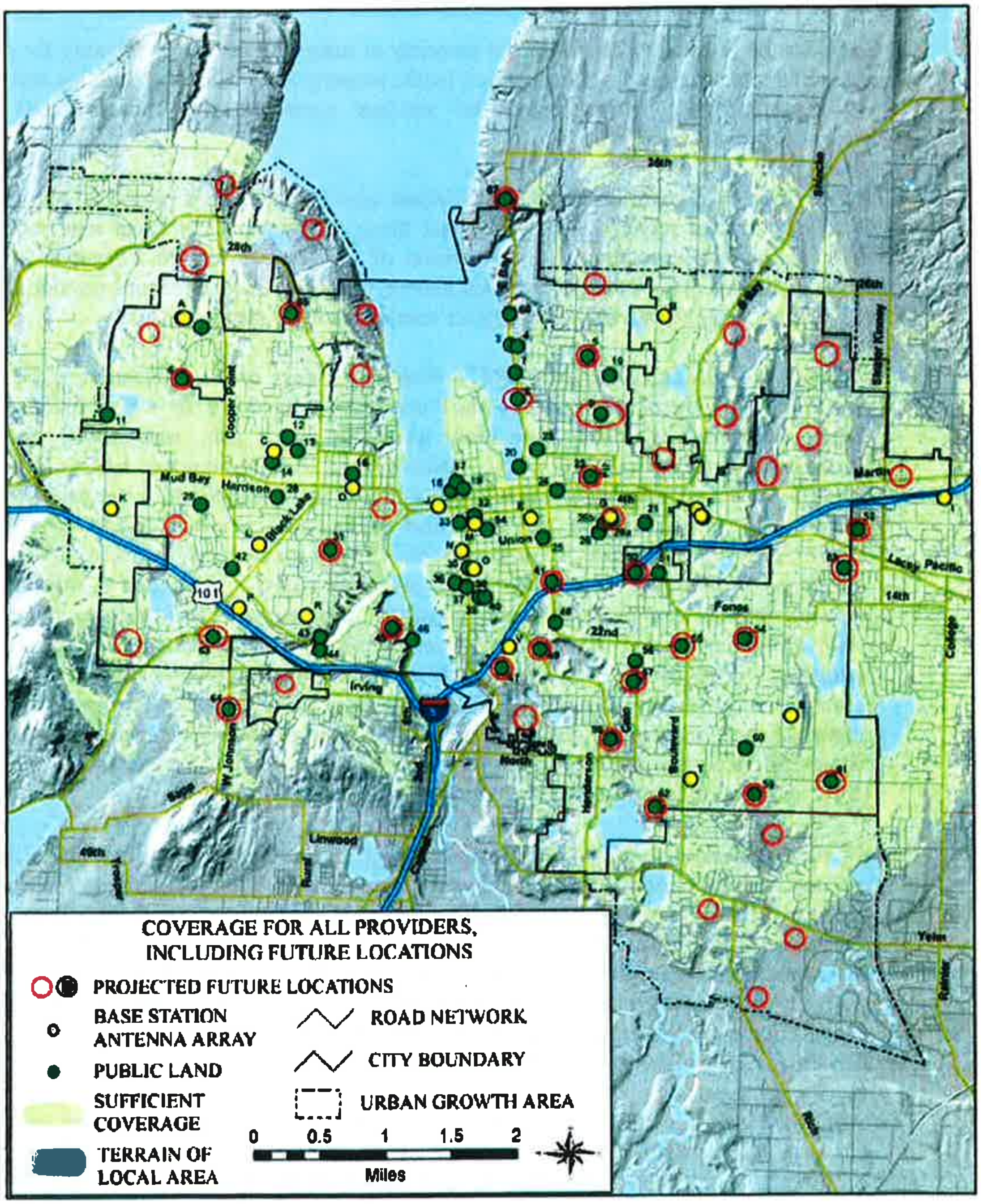


Figure 18: Coverage for All Providers, Including Future Locations Considering Terrain and Demographics.

Legal Opinion

CityScape has been asked to determine the propriety of using city or county property for private wireless telecommunications facilities. Use of public property is rooted in the enabling text of the Federal legislation that revolutionized the wireless communications industry, the 1996 Telecommunications Act (the Act).

The Act requires local governments to treat wireless telecommunications providers who provide functionally equivalent services equally and that those governments not enact regulations that hinder or prevent the development and provision of wireless services to consumers. Those provisions of Section 704 of the Act are well known, but lesser known sections provide that the federal government makes available property for wireless facilities stating in part:

> *"(c) AVAILABILITY OF PROPERTY- Within 180 days of the enactment of this Act, the President or his designee shall prescribe procedures by which Federal departments and agencies may make available on a fair, reasonable, and nondiscriminatory basis, property, rights-of-way, and easements under their control for the placement of new telecommunications services that are dependent, in whole or in part, upon the utilization of Federal spectrum rights for the transmission or reception of such services. These procedures may establish a presumption that requests for the use of property, rights-of-way, and easements by duly authorized providers should be granted absent unavoidable direct conflict with the department or agency's mission, or the current or planned use of the property, rights-of-way, and easements in question. Reasonable fees may be charged to providers of such telecommunications services for use of property, rights-of-way, and easements.* The Commission shall provide technical support to States to encourage them to make property, rights-of-way, and easements under their jurisdiction available for such purposes" *(emphasis added).*

Clearly, the congressional intent behind this language was to enable the utilization of Federal property for wireless services and to encourage state and local governments to make public property available for wireless purposes. The Federal Communications Commission (FCC) interpreted the language in its *Wireless Siting Fact Sheet #1* (April 23, 1996)[1] to mean: "Federal agencies and departments will work directly with licensees to make federal property available for this purpose, and the FCC is directed to work with the states to find ways for states to accommodate licensees who wish to erect towers on state property, or use state easements and rights-of-way" (see Appendix A).

However, there is no federal telecommunications regulation prohibiting the extent to which a city or county desires to regulate the placement of wireless communications facilities to *favor* public property over private property. Indeed, based on the foregoing language, it would appear that Congress' intent is to encourage siting on public property. Of course, if the effect of such a provision were to prevent the implementation of wireless services (for example, by mandating that a provider had to construct on public property and there was no public

[1] http://wireless.fcc.gov/siting/fact1.html

property available in the geographic search ring for the proposed facility), then such regulation would have the effect of prohibiting wireless services and that could be a violation of the Act.

The opinions provided herein relate solely to federal law and FCC decisions and regulations specifically and do not relate to any applicable state or local regulation. Anthony Lepore, Esq., CityScape's Vice President and a telecommunications specialist, is a member of the Florida and Massachusetts Bars and is admitted to practice before the Federal Communications Commission.

Chapter 4 Inventory

CityScape conducted an assessment of the existing antenna locations and certain city-owned lands available to the wireless industry for the placement of future wireless telecommunications infrastructure. The data for the assessment was obtained from a number of sources including actual permits obtained from the City for wireless infrastructure, site visits, research of governmental databases, research of registered site locations and direct information from existing wireless service providers active in Olympia.

Pictures of existing structures, parks and buildings correspond to the search area grid numbers identified on the map in Figure 11. Public land sites are outlined in green, water tanks are outlined in blue, existing structures are outlined in orange, and buildings are outlined in yellow.

Based on a visual inspection, CityScape made a judgement as to whether the support structure is likely to be a candidate for more antennas. The number of estimated co-locations will be referenced as future capacity. Prior to any co-locations, each existing structure must be examined and analyzed by a structural engineer for its ability to support the proposed weight bearing loads, and may be required to be replaced, as required by the City's Ordinance.

Figure 18 of this Plan shows the projected infrastructure over the next decade of wireless deployment. Also included in Figure 18 is the identification of the projected areas from which search rings will likely be located.

These areas have been determined by applying the siting requirements of the Olympia Municipal Code (Sections .080 Siting Alternatives Hierarchy, and .090 Permitted Wireless Communications Facilities by Zoning District, from Chapter 18.44 Antennas and Wireless Communications Facilities) to radio frequency engineering calculations of future facilities and locations required to serve customer needs in Olympia and its Growth Area.

Inventory-1

SITE LOCATION
Existing Antenna Location
3700 Elliott
Site Letter A
Lat:47.03.51.0
Lon:122.56.54.5

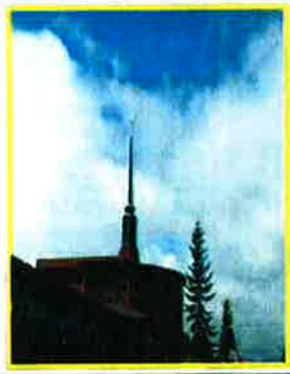
Type: Lattice/Water Tank
Future Capacity: 3

SITE LOCATION
Existing Antenna Location
2312 Friendly Grove Rd. NE
Site Letter B
Lat:47.03.56.16
Lon:122.52.12.0

Type: Monopole/Flagpole
Future Capacity: outside city limits, unknown

SITE LOCATION
Existing Antenna Location
505 Birch St
Site Letter C
Lat:47.02.58.6
Lon:122.55.57.4

Type: Lattice/Water Tank
Future Capacity: 3



SITE LOCATION
Gloria Dei Lutheran Church
1501 NW Harrison Ave
Site Letter D
Lat:47.02.44.5
Lon: 122.55.12.8

Type: Church Steeple
Future Capacity: restricted

SITE LOCATION
3 Story Building
712 Pear St
Site Letter E
Lat:47.02.34.1
Lon:122.53.27.4

Type: Rooftop
Future Capacity: unknown

SITE LOCATION
Existing Antenna Location
2703 Pacific
Site Letter F
Lat:47.02.39.2
Lon:122.51.51.6

Type: Lattice
Future Capacity: 4

SITE LOCATION
Existing Antenna Location
2711 Pacific
Site Letter F(a)
Lat:47.02.39.2
Lon:122.51.51.6

Type: Monopole/Land
Future Capacity: 2

SITE LOCATION
Eastside Water Tower
707 SE Fir Street
Site Letter G
Lat:47.02.35.5
Lon:122.52.40.8

Type: Water Tank
Future Capacity: 4

Inventory-2

LACEY

SITE LOCATION
Existing Antenna Location
4500 3rd Street
Site Letter I
Lat:47.02.46.2
Lon:122.49.27.5

Type: Lattice
Future Capacity: 3

SITE LOCATION
Rooftop 11 story building
410 SW 5th Avenue
Site Letter J
Lat:47.02.38.0
Lon:122.54.21.5

Type: Rooftop
Future Capacity: unknown

SITE LOCATION
Existing Antenna Location
548 Kaiser Road
Site Letter K
Lat:47.02.33.7
Lon: 122.57.31.9

Type: Monopole
Future Capacity: 3

SITE LOCATION
Existing Antenna Location
2627 9th Ave. SW
Site Letter L
Lat:47.02.21.0
Lon:122.56.06.2

Type: Monopole
Future Capacity: 2

SITE LOCATION
Rooftop
Evergreen Plaza
711 Capitol Way
Site Letter M
Lat:47.02.31.5
Lon:122.54.01.8

Type: 10 Story Building
Future Capacity: unknown

SITE LOCATION
Washington St Capitol
Campus--GA Building
210 11 St. SE
Site Letter N
Lat:47.02.20.4
Lon:122.54.08.8

Type: Building
Future Capacity: unknown

SITE LOCATION
Washington St Capitol
Campus– DOT
1125 SE Washington St.
Site Letter O
Lat:47.02.13.3
Lon:122.53.59.2

Type: 8 Story Building
Future Capacity: unknown

SITE LOCATION
Existing Antenna Location
1620 Black Lake Blvd.
Site Letter P
Lat:47.01.55.5
Lon:122.56.15.2

Type: Monopole
Future Capacity: 2

Inventory-4

SITE LOCATION
Land
2700 20 Ave NW
Site Number 1
Lat:47.03.47.5
Lon:122.56.43.1

Type: Land
Future Capacity: unknown

SITE LOCATION
Building/St. Peter Hospital
413 NE Lilly Rd
Site Number 2
Lat:47.03.09.4
Lon: 122.50.47.0

Type: Rooftop—Potential co-location
Future Capacity: unknown

SITE LOCATION
Land
2002 East Bay Dr.
Site Number 3
Lat:47.03.43.5
Lon:122.53.42.0

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
1821 Berry
Site Number 4
Lat:47.03.43.0
Lon:122.53.37.9

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
1910 NE Central St.
Site Number 5
Lat:47.03.39.7
Lon:122.52.56.6

Type: Land
Future Capacity: unknown

SITE LOCATION
Land/Grass Lake Refuge
3133 14 Ave. NW
Site Number 6
Lat:47.03.26.6
Lon:122.56.53.2

Type: Park
Future Capacity: unknown

SITE LOCATION
Land
1702 NE East Bay Dr.
Site Number 7
Lat:47.03.32.5
Lon:122.53.38.6

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
1320 NE East Bay Dr.
Site Number 8
Lat:47.03.21.9
Lon:122.53.37.0

Type: Land
Future Capacity: unknown

Inventory-3

SITE LOCATION
Existing Antenna Location
2106 Carriage Drive SW
Site Letter R
Lat:47.01.53.04
Lon:122.53.37.2

Type: Monopole
Future Capacity: unknown

SITE LOCATION
Watershed
3920 Hoffman Ct. SE
Site Letter S
Lat:47.01.17.7
Lon: 122.50.51.2

Type: Water Tank
Future Capacity: 4

SITE LOCATION
Water Tank
2711 Log Cabin Rd. SE
Site Letter T
Lat:47.00.51.0
Lon:122.51.48.7

Type: Water Tank
Future Capacity: 4

SITE LOCATION
Approved Antenna Location
SW Quadrant I-5 Henderson Blvd. Interchange
Site Letter V
Lat: 47.01.42.6
Lon:122.53.38.4

Type: Monopole
Future Capacity: unknown

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Inventory-5

SITE LOCATION
Park Property
1200 Lybarger St NE
Site Number 9
Lat:47.3.16.5
Lon:122.52.47.7

Type: Park
Future Capacity: unknown

SITE LOCATION
Land
1707 McCormick St NE
Site Number 10
Lat:47.03.32.2
Lon:122.52.43.3

Type: Land
Future Capacity: unknown

SITE LOCATION
Park/Grass Lake Refuge
700 & 812 Kaiser Rd NW
Site Number 11
Lat:47.3.11.2
Lon:122.57.36.6

Type: Land/Park
Future Capacity: unknown

SITE LOCATION
Park Property
601 West Bay Dr
Site Number 12
Lat:47.03.04.4
Lon:122.55.51.0

Type: Park
Future Capacity: unknown

SITE LOCATION
Sunrise Park
505 NW Bing St
Site Number 13
Lat:47.02.59.0
Lon:122.55.44.9

Type: Park
Future Capacity: unknown

SITE LOCATION
Fire Station #2
330 Kenyon St NW
Site Number 14
Lat:47.02.54.2
Lon:122.55.59.6

Type: Fire Station
Future Capacity: 3

SITE LOCATION
Land (Crowne Pointe Apts)
2800 Limited L NW
Site Number 15
Lat:47.02.49.2
Lon:122.56.05.9

Type: Dwelling–Potential co-location
Future Capacity: 4

SITE LOCATION
Police (Park)
221 Perry NW St
Site Number 16
Lat:47.02.50.1
Lon:122.55.12.5

Type: Park
Future Capacity: unknown

Inventory-6

SITE LOCATION
Percival Landing Park
225 NW Columbia St
Site Number 17
Lat:47.02.48.0
Lon:122.54.11.6

Type: Park
Future Capacity: unknown

SITE LOCATION
Percival Landing Park
301 NW Columbia St
Site Number 18
Lat:47.02.44.5
Lon:122.54.14.4

Type: Park
Future Capacity: unknown

SITE LOCATION
Old Olympia City Hall
108 NW State Ave
Site Number 19
Lat:47.07.45.2
Lon:122.54.06.2

Type: Rooftop/Land
Future Capacity: 4

SITE LOCATION
Park Property
301 East Bay Dr
Site Number 20
Lat:47.02.54.6
Lon:122.53.35.2

Type: Park
Future Capacity: unknown

SITE LOCATION
Lion's Park
800 SE Wilson St
Site Number 21
Lat:47.02.33.4
Lon:122.52.20.7

Type: Park
Future Capacity: unknown

SITE LOCATION
Land
1323 Olympic
Site Number 22
Lat:47.02.51.1
Lon:122.52.53.4

Type: Park
Future Capacity: unknown

SITE LOCATION
Park Property
930 NE Bigelow Ave
Site Number 23
Lat:47.03.01.7
Lon:122.52.25.1

Type: Park
Future Capacity: unknown

SITE LOCATION
Fire Dept Headquarters
100 NE East Side St
Site Number 24
Lat:47.02.45.5
Lon:122.53.12.8

Type: Fire Station
Future Capacity: 3

Inventory-7

SITE LOCATION
Olympia City Hall
900 SE Plum St
Site Number 25
Lat:47.02.26.6
Lon:122.53.20.3

Type: Land
Future Capacity: unknown

SITE LOCATION
Madison Scenic Park
1600 10th Ave SE
Site Number 26
Lat:47.02.29.1
Lon:122.52.47.4

Type: Park
Future Capacity: unknown

SITE LOCATION
Madison Scenic Park
700 McCormick St
Site Number 26(a)
Lat:47.02.34.5
Lon:122.52.40.1

Type: Land
Future Capacity: unknown

SITE LOCATION
Madison Scenic Park
812 Central St SE
Site Number 26(b)
Lat:47.02.32.6
Lon:122.52.44.7

Type: Park
Future Capacity: unknown

SITE LOCATION
Land/Plaza
4230 Martin Way E
Site Number 27
Lat:47.02.54.6
Lon:122.49.53.3

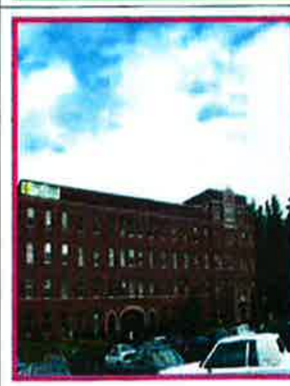
Type: Land—Potential co-location
Future Capacity: unknown

SITE LOCATION
Land
3401 4 Ave SW
Site Number 28
Lat:47.02.40.3
Lon:122.55.56.2

Type: Land
Future Capacity: unknown

SITE LOCATION
Yauger Park
3100 SW Capital Mall Dr
Site Number 29
Lat:47.02.36.4
Lon:122.56.40.7

Type: Park
Future Capacity: unknown



SITE LOCATION
(Capitol House Apts)
420 S Sherman
Site Number 30
Lat:47.02.37.1
Lon:122.54.53.1

Type: Rooftop/Dwelling—Potential co-location
Future Capacity: unknown

SITE LOCATION
Decatur Woods Park
1015 Decatur St
Site Number 31
Lat:47.02.19.8
Lon:122.55.24.3

Type: Park
Future Capacity: unknown

SITE LOCATION
Sylvester Park
400 Capitol Way
Site Number 32
Lat:47.02.34.6
Lon:122.54.00.6

Type: Park
Future Capacity: unknown

SITE LOCATION
Capitol Lake Park
213 Water St SW
Site Number 33
Lat:47.02.31.6
Lon:122.54.08.9

Type: Park
Future Capacity: unknown

SITE LOCATION
Land/Olympia Public Library
313 SE 8 Avenue
Site Number 34
Lat:47.02.29.2
Lon:122.53.52.8

Type: Building
Future Capacity: unknown

SITE LOCATION
Wash St Capitol Campus
1225 S Capitol Way
Site Number 35
Lat:47.02.13.7
Lon:122.54.03.3

Type: L:and
Future Capacity: unknown

SITE LOCATION
Land/Capitol
14 St
Site Number 36
Lat:47.02.07.7
Lon:122.54.11.1

Type: Land
Future Capacity: restricted

SITE LOCATION
Wash St Capitol Campus
1400 S Capitol Way
Site Number 37
Lat:47.02.06.4
Lon:122.54.04.2

Type: Land/Building
Future Capacity: unknown

SITE LOCATION
Wash St Capitol Campus
1500 Capitol Way
Site Number 38
Lat:47.02.06.0
Lon:122.54.04.5

Type: Land/Building
Future Capacity: unknown

SITE LOCATION
Wash St Capitol Campus
212 Maple Park Ave SE
Site Number 39
Lat:47.02.02.1
Lon:122.53.56.4

Type: Land/Building
Future Capacity: unknown

SITE LOCATION
Wash St Capitol Campus
310 Maple Park Ave SE
Site Number 40
Lat:47.02.02.2
Lon:122.53.51.5

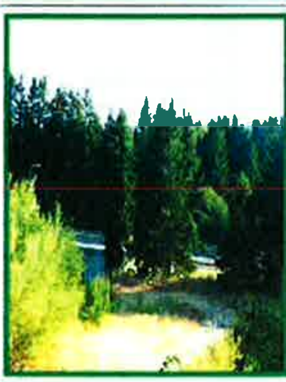
Type: Land/Building (DOT)
Future Capacity: restricted

SITE LOCATION
Land (Maintenance Center)
1401 SE Eastside St
Site Number 41
Lat:47.02.09.0
Lon:122.53.14.6

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
1305 SW Cooper Pt Rd
Site Number 42
Lat:47.02.11.1
Lon:122.56.21.3

Type: Land
Future Capacity: unknown



SITE LOCATION
Land
1935 Cooper Pt Rd
Site Number 43
Lat:47.01.44.9
Lon:122.55.48.9

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
2200 Cooper Pt Dr SW
Site Number 44
Lat:47.01.39.5
Lon:122.55.28.7

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
1901 Lakeridge Dr
Site Number 45
Lat:47.01.49.3
Lon:122.54.47.0

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
Deschutes Parkway
Site Number 46
Lat:47.01.44.5
Lon:122.54.34.6

Type: Land
Future Capacity: unknown

SITE LOCATION
Park Property
2600 Hillside Dr SE
Site Number 47
Lat:47.01.34.1
Lon:122.53.42.3

Type: Park
Future Capacity: unknown

SITE LOCATION
Harry Fain's Legion Park
2020 SE Eastside St
Site Number 48
Lat:47.01.52.7
Lon:122.53.11.8

Type: Park
Future Capacity: unknown

SITE LOCATION
Watershed Park
2500 SE Henderson Blvd
Site Number 49
Lat:47.01.42.0
Lon:122.53.20.6

Type: Park
Future Capacity: unknown

SITE LOCATION
Land
1400 SE Edison
Site Number 50
Lat:47.02.13.6
Lon:122.52.25.5

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
3014 Boulevard SE
Site Number 51
Lat:47.02.13.6
Lon:122.52.11.8

Type: Land
Future Capacity: unknown

SITE LOCATION
Land (Shopping Center)
South Center Pacific Ave
Site Number 52
Lat:47.02.32.8
Lon:122.50.16.0

Type: Land/Shopping Ctr.
Future Capacity: unknown

SITE LOCATION
Land
Stormwater Site east of
Crown Cork and Seal
Site Number 53
Lat:47.02.17.2
Lon:122.50.23.8

Type: Land
Future Capacity: unknown

SITE LOCATION
Park Property
3111 SE 21 St
Site Number 54
Lat:47.01.48.0
Lon:122.51.20.8

Type: Park
Future Capacity: unknown

Inventory-11

SITE LOCATION
Fire Station
2525 SE 22 St
Site Number 55
Lat:47.01.44.5
Lon:122.51.57.3

Type: Fire Station
Future Capacity: 3

SITE LOCATION
Land
2300 Cain Rd
Site Number 56
Lat:47.01.38.2
Lon:122.52.24.4

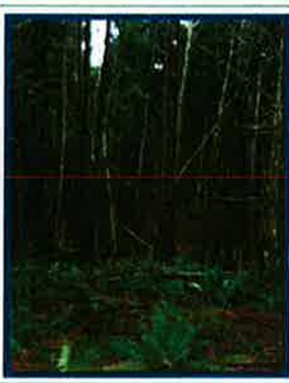
Type: Land
Future Capacity: unknown

SITE LOCATION
Land
2700 Burnaby Park Loop
Site Number 57
Lat:47.01.30.1
Lon:122.52.25.1

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
1828 Arietta
Site Number 58
Lat:47.01.06.6
Lon:122.52.37.9

Type: Land
Future Capacity: unknown



SITE LOCATION
Proposed New Build
Water Tank
Site Number 59
Lat:47.00.45.8
Lon:122.51.12.9

Type: Water Tank
Future Capacity: unknown

SITE LOCATION
LBA Park
3333 SE Morse Merriman
Site Number 60
Lat:47.01.04.1
Lon:122.51.19.0

Type: Park
Future Capacity: unknown

SITE LOCATION
Land
4808 Herman Rd SE
Site Number 61
Lat:47.00.51.6
Lon:122.50.28.3

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
2428 SE Cedar Park Loop
Site Number 62
Lat:47.00.39.8
Lon:122.52.10.9

Type: Land
Future Capacity: unknown

WIRELESS TELECOMMUNICATIONS MASTER PLAN
City of Olympia, Washington • March 24, 2006

Inventory-12

SITE LOCATION
Black Lake Meadows
Stormwater Facility
Site Number 63
Lat:47.01.43.8
Lon:122.56.31.5

Type: Land
Future Capacity: unknown

SITE LOCATION
School Dist #11 Transp. Center—2945 RW Johnson
Site Number 64
Lat:47.01.14.8
Lon:122.56.20.9

Type: Land
Future Capacity: unknown

SITE LOCATION
Land
2421 Burbank
Site Number 65
Lat:47.03.54.2
Lon:122.55.51.0

Type: Land
Future Capacity: unknown

SITE LOCATION
Land—2100 block East Bay Drive NE
Site Letter 66
Lat:47.03.55.8
Lon:122.53.42.7

Type: Land
Future Capacity: unknown

SITE LOCATION
Right of Way—3200 block Boston Harbor Rd NE
Site Letter 67
Lat:47.04.42.17
Lon:122.53.46.92

Type: ROW
Future Capacity: unknown