LICENSE AGREEMENT

THIS LICENSE AGREEMENT ("Agreement") is made, effective as of the date set forth in section 2.01(a) below ("Effective Date"), by and between the **CITY AND COUNTY OF DENVER, a municipal corporation** ("City"), and **CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS,** a Delaware General Partnership authorized to conduct business in Colorado, whose principal office is located at One Verizon Way, Basking Ridge NJ 07920 ("Licensee").

DEFINITIONS

All capitalized terms or phrases in this Agreement, except for proper names, shall have the meanings as set forth below:

A. Agreement means this License Agreement during the Term or Term Extension of the Agreement.

B. ADA means federal Americans with Disabilities Act and any other federal or state laws requiring access for the disabled to public accommodations.

C. Applicable Law means all federal, state, and local laws applicable in the context of the specific matter addressed in this Agreement, including but not limited to: 1) the constitutions, laws, and rules and regulations of the United States of America and the State of Colorado; 2) the City Charter, the Denver Revised Municipal Code, and building, fire, electrical, plumbing and other applicable codes, as they may be amended from time to time; 3) rules and regulations, including any standards and specifications, promulgated or amended by the Denver Department of Safety and the Denver Fire Department; 4) any rules and regulations promulgated or amended by other City departments and agencies applicable to this Agreement; 5) executive orders issued by the Mayor; 6) any court order, judgment, or decree or any appellate decision applicable to this Agreement; 7) any federal, state, or local administrative decision or order applicable to this Agreement; 8) any anti-discrimination laws; and 9) the requirements of the ADA.

D. Cancellation means the revocation of the License and the termination or cancellation of the Agreement, including mutual termination by the parties, in the manner specified in this Agreement.

E. City means the City and County of Denver as represented by the Denver Fire Department and its Fire Chief.

F. City Representative means the Fire Chief's designee(s) who will oversee and direct all activities of Licensee under this Agreement. The City Representative(s) may be employees or contractors of the Denver Fire Department, Denver's Technology Services, the Electronic Engineering Bureau of the Department of Safety, and/or Denver's Division of Real Estate. Contact information for the City Representative and the assigned responsibilities, if there is more than one City Representative, shall be provided to Licensee upon execution of this Agreement. The City may identify, change, add or delete City Representative(s) by written notice to Licensee.

G. City System means all existing and future communication and other electronic facilities,

equipment and instrumentation and related infrastructure and utility connections that the City requires for the operation of the Fire Station or the provision of emergency services from the Fire Station, including, but not limited to, public safety channels, radio system or other electronic means of sending, receiving, processing and recording information and data for public safety purposes.

H. DRMC means the Denver Revised Municipal Code as it may be amended from time to time.

I. Effective Date means the date this Agreement goes into effect, as specified in section 2.01(a) below.

J. Emergency means an occurrence or incident that presents an imminent threat of widespread or severe damage, injury, or loss of life or property resulting from any natural cause or cause of human origin, including but not limited to fire, explosion, flood, earthquake, wind, storm, structural failure, hazardous substance, environmental contamination, civil disturbance, vandalism, or breach of security.

K. FCC means the Federal Communications Commission.

L. Fire Chief means the head of the Denver Fire Department.

M. Fire Station means the specific fire station operated by the Denver Fire Department to which this Agreement applies, as specified in section 1.01(a).

N. Interference Study means a site and technical interference study, **Exhibit D**, field tests or other activities or investigations related to the resolution of RF Interference that may be associated with the Licensed System as specified in section 5.02.

O. License means the license granted as specified in section 1.01(a) which is exclusive only to the extent specified in this Agreement and which is restricted and revocable as specified in this Agreement. No property or leasehold interest or right is granted by the License.

P. Licensed Area means the location at the Fire Station where Licensee is authorized to install and operate the Licensed System, as specified in section 1.01(a).

Q. Licensed System means the radio frequency equipment and wireless communication facility, and related equipment, infrastructure and utility communications authorized by the City and installed and operated by Licensee within the Licensed Area of the Fire Station, as specified in section 1.01(a).

R. Licensee means the legal entity to which the License is granted under and in accordance with this Agreement, as identified in opening paragraph of this Agreement. To the extent that Licensee retains contractors or consultants to perform any of Licensee's rights and obligations under the Agreement, Licensee shall also mean those contractors and consultants.

S. License Fee means the compensation to be paid by Licensee to the City for the use of the Licensed Area and the operation of the Licensed System at the Fire Station as specified in section 3.01.

T. Minimum Technical Standards mean those standards set forth in **Exhibit C-1** as these Minimum Technical Standards may be updated from time-to-time, as needed, to address the state-of-the-art.

U. Party means either the City or Licensee, as appropriate in the context, and Parties means both the City and Licensee.

V. Permitted Use means the uses (subject to restrictions) as specified in section 1.02, which Licensee may make of the Licensed Area in the installation and operation of the Licensed System.

W. RF (Radio Frequency) Interference means any emission, radiation or induction from or associated with the Licensed System that affects the functioning of or degrades, obstructs, or interrupts radio or other wireless communications being made by the City or other authorized parties to or from the Fire Station or the operation of any communication system located at the Fire Station.

X. Point of Contact means the Chief Deputy for the Technical Services Division of the Denver Fire Department, or the Chief Deputy's designated representative, during regular business hours of the Denver Fire Department and the Denver Fire Department's non-emergency Dispatch for Licensee's urgent need for access after regular business hours of the Denver Fire Department.

Y. Term means the duration of the Agreement running from the Effective Date of the Agreement, as specified in section 2.01(a).

Z. Term Extension means any approved amendment to the Agreement allowing the duration of the Agreement for another five-year period subject to any new or changed terms or conditions, as specified in section 2.02.

AA. Tower means the communication structure or structures authorized by the City on which the Licensed System and the City System are located, as specified in 1.01(b).

SECTION 1
LICENSE; PERMITTED USE; and ACCESS

1.01 Grant of License.

(a) City owns property located within the City and County of Denver, State of Colorado, known as Fire Station #21, which is located at 1580 E. Virginia Ave, Denver 80209 ("Fire Station"). City hereby grants a License to Licensee for the use of certain designated areas at the Fire Station as depicted on **Exhibit A** (the "Licensed Area") for the installation and operation by Licensee of the Licensed System, as the Licensed System is technically described in **Exhibit B**. The Licensed System shall be situated within the Licensed Area and shall be located in relation to the City System, if any, as depicted in **Exhibit A**. The Licensed Area shall not include the City System. Any proposed change to the Licensed Area depicted in **Exhibit A** shall require an amendment to this Agreement.

(b) Licensee was granted a license under a previous agreement, Contract Control #RC85006, dated February 18, 2009 and known by Licensee as contract number 79226 ("2009 License Agreement"). The Parties acknowledge and agree that this Agreement revokes the 2009 License Agreement upon the effective date of the Agreement.

(c) As a condition of the grant of the License, Licensee shall construct and install, at its sole cost and expense, the Licensed System, as described in the attached **Exhibit B** and at the location specified in **Exhibit A**, for shared use by the City and Licensee. The Licensed Area shall not include the City System.

1.02 Permitted Use/Restrictions.

(a) The Licensed Area at the Fire Station shall be used for the installation, maintenance, alteration, repair, replacement, operation, and removal of the Licensed System within the Licensed Area, in accordance with this Agreement ("Permitted Use"). The Licensed System shall be owned by Licensee. Except as expressly provided in this Agreement, the City may not disturb or modify the Licensed System without the prior written permission of Licensee.

(b) Licensee may access the Fire Station site, use the Licensed Area, and install and operate the Licensed System only as set forth in this Agreement. The Permitted Use does not authorize any activity that would conflict or interfere with the public health, safety or welfare purpose or operation of the Fire Station or City System. Such prohibited conflict or interference includes RF Interference as set forth in this Agreement and **Exhibit D**. Licensee shall likewise take every reasonable measure to promptly and effectively avoid or remedy any emergency situation within its control that could adversely impact the Fire Station, the City System, the Licensed Area, or the Licensed System. Licensee must also coordinate with the Denver Fire Department and gain Denver Fire Department approval prior to all concrete cuts.

(c) Licensee must acquire City Approval, prior to making any change to the Licensed System as shown in **Exhibit B** and may trigger a change in license fee and a license amendment. Notwithstanding the foregoing, Licensee may add base station equipment to the Licensed System within the Licensed Area and may also repair or replace any other equipment comprising the Licensed System with "like-for-like" equipment upon notice to Licensor.

1.03 Access.

(a) Provided that Licensee gives at least forty-eight (48) hours prior notice to the Point of Contact, Licensee has the reasonable right of access, ingress to and egress from the Licensed Area during regular business hours for Licensee's employees, contractors and agents, including suppliers of materials and furnishers of service (collectively "Licensee's Personnel").

(b) In the event of an urgent situation where Licensee needs prompt access to the Licensed System during or outside of regular business hours, which shall be deemed to include any failure of Licensed System or any portion thereof, Licensee shall communicate with the Point of Contact to arrange for access by Licensee's Personnel.

(c) With respect to all access to the Fire Station, Licensee's Personnel must present legally sufficient identification, preferably in the form of a badge with picture ID issued by Licensee; will be subject to escort by Fire Department staff and search and inspection of items brought onto the Fire Station site; and will comply with all restrictions and security protocols set by the Fire Chief and the direction of the City Representative. All equipment, vehicles, machinery and other materials brought onto the Fire Station site must be necessary for the work authorized to be performed.

(d) Should Licensee require access into a secure area of the Fire Station which may require prior approval or escort, then the permission of the City Representative must be obtained and any security protocols must be strictly observed by Licensee.

(e) The exercise of access by Licensee or Licensee's personnel shall not conflict or interfere with the operations of the Fire Station or the City System and may not block access at or the use of the Fire Station nor be in violation of the ADA. In addition, the exercise of access shall not conflict or interfere with the City System unless prior written permission is obtained from the City Representative.

(f) Any particular access on the Fire Station site may, at any time, temporarily or permanently, be closed, so long as an alternative means of access is made available to Licensee within a reasonable time. During the duration of any state of Emergency declared by the President of the United States, the Governor of the State of Colorado, or the Mayor of the City and County of Denver, access may be denied for security and public safety reasons. Licensee hereby releases and discharges the City from any and all claims, demands or causes of action which Licensee may now, or at any time hereafter, have against the City, arising or alleged to arise out of the closing of any point of access on the Fire Station site or the temporary unavailability of access to a Fire Station site.

SECTION 2
TERM and TERM EXTENSION

2.01 Term.

The Term of this Agreement shall be effective as of the first day of the month after the date of mutual execution of this Agreement (the "Effective Date"), and shall expire on ten years from that date, unless Licensee terminates the Agreement upon sixty (60) days written notice.

2.02 Term Extension.

Licensee may exercise one (1) options to renew the License for one additional ten-year period at the end of the term. Licensee shall provide written notice to the City of its intent to exercise the renewal option by no sooner than one hundred and eighty (180) days and no later than sixty (60) days before the end of the Term. All terms and conditions shall remain in effect in accordance with this Agreement during the renewal period, including the percentage fee increase under Section 3.01, unless otherwise modified by mutual written agreement. Modifications, if any, must be set forth in an amendment to this Agreement and processed for approval in the same manner as the Agreement.

SECTION 3
LICENSE FEE

3.01 License Fee.

(a) Licensee agrees to pay City a monthly License Fee of **Three Thousand Six Hundred Dollars and Zero Cents** (**$3,600.00**), payable in equal monthly installments beginning on the Effective Date, and continuing on the first day of each month thereafter for the Term of the Agreement and any Term renewal. The License Fee shall increase three percent (3%) each year, with the increased License Fee taking effect on the anniversary of the Effective Date of this Agreement each year.

(b) Any License Fee paid to the City shall not be refundable in the event of Cancellation, as provided in this Agreement.

3.02 Place and Manner of Payments.

All sums payable to City, including the License Fee and other costs and expenses incurred by the City and reimbursable by Licensee under this Agreement, shall be made payable, without notice, to the "Manager of Finance for the City and County of Denver" and delivered to:

City and County of Denver
Division of Real Estate
201 West Colfax Avenue, Dept. 1010
Denver, Colorado 80202

All payments shall be made in legal tender of the United States. Any payment not made to City accrues interest at the lesser of (i) 18% per annum, or (ii) the maximum interest rate allowed under law, commencing on the fifth (5^{th}) calendar day after the date such amount is due and owing until paid to City. Licensee agrees to pay any charges, fees, or costs incurred by the City for collection of unpaid License Fees or other unpaid costs and expenses of Licensee specified in this Agreement, including reasonable attorney's fees.

SECTION 4
DESIGN, CONSTRUCTION AND INSTALLATION

4.01 General.

(a) On or after the Effective Date of this Agreement, Licensee shall, at its sole cost and expense, install within the Licensed Area, the Licensed System in accordance with **Exhibit A** and **Exhibit B** (unless changes are authorized under section 4.02)**,** and in accordance with the terms and conditions of this Agreement.

(b) The Licensed System shall in all respects be designed and installed in accordance with Applicable Law, and pursuant to any required building permit and zoning permit to be obtained by Licensee from the City, and according to requirements or design guidelines of the Denver's Technology Services division, the Denver Department of Safety and the Denver Fire Department.

(c) The implementation of the design and installation of the Licensed System, as described and depicted in **Exhibit A** and **Exhibit B**, as well as any changes, elaborations or additions to the design, construction and installation of the Licensed System beyond those described and depicted in **Exhibit A** and **Exhibit B** shall be subject to the oversight and approval of the City Representative as well as any other approvals required in this Agreement.

4.02 Plans and Specifications.

(a) Prior to any installation of any portion of the Licensed System, four (4) copies of complete and accurate plans and specifications for the Licensed System must be submitted to the City Representative for review. These plans and specifications must include complete specifications of transmitter power, operating frequencies, filter passband and rejection characteristics, antenna model numbers and radiation patterns (both horizontal and vertical plane patterns), antenna height and location, and placement of utilities servicing the Licensed System.

(b) Licensee shall cooperate with the City Representative in the review of the plans and specifications and shall make any reasonable modifications required by the City Representative. Upon completion of the review and any required modifications, the City Representative, in consultation with the Fire Chief, will approve the plans and specifications.

(c) To the extent that the approved plans and specifications are different from the information contained in either the location in **Exhibit A** or the plans in **Exhibit B**, Licensee shall prepare, to the reasonable satisfaction of the City Representative, new exhibits reflecting such changes, and the changed exhibits will replace and supersede the corresponding exhibits attached to this Agreement.

(d) Installation work shall not commence, nor shall continue, until Licensee has established to the City Representative's reasonable satisfaction that the work will proceed in conformance with the approved plans and specifications and that all Applicable Law has been or will be fully and appropriately satisfied. Licensee also cannot commence any cutting of concrete without the express written permission from the Denver Fire Department.

4.03 Installation.

(a) Licensee is responsible for undertaking all measures necessary and appropriate under Applicable Law to protect the health and safety of the public, City employees, and Licensee's employees and contractors and to lawfully conduct the work associated with the installation. Prior to the commencement of installation, Licensee or its contractor shall obtain and pay for all required permits, licenses and approvals. Good and workmanlike standards of design, construction and installation shall be required in connection with all such work.

(b) To the extent that building codes or other City requirements mandate that modifications be made to the roof or other infrastructure of the Fire Station as part of the installation, Licensee shall be required to include those modifications in its **Exhibit B** plans (unless changes are authorized under section 4.02) and to make such modifications, at its sole cost and expense and subject to prior written approval of such modifications by the City Representative and the City

Representative's oversight of the modifications as they are being made. The City is not obligated to make any modifications to the Fire Station, including the Licensed Area, to support the installation.

(c) Licensee shall include in Licensee's contract(s) with its consultants and contractors provisions whereby such consultants and contractors shall defend and hold harmless the City from all costs, liens, damages and expenses related to the design, construction and installation work.

(d) Licensee shall be responsible for obtaining utility locates prior to starting any authorized digging on City property. If damage should occur to any existing underground utilities or other underground facilities on City property, whether or not a utility locate was obtained, Licensee shall immediately report the damage to the City Representative and shall take all actions and incur all costs and expenses necessary to repair the damage in a manner satisfactory to the City Representative.

(e) Upon completion of the installation, Licensee shall timely furnish to the City Representative with documented evidence of payment, contractor's affidavits and full and final waivers of all liens for labor, services, or materials.

(f) Equipment shall be located in designated locations as depicted on **Exhibit A** and **Exhibit B** within the Licensed Area. The temporary placement of any equipment or materials outside of the Licensed Area shall require the prior written approval of the City Representative. No equipment or materials shall be placed so as to block access at or use of the Fire Station or in violation of the ADA.

(g) Licensee is responsible for acquiring land lines required for the installation and operation of the Licensed System. The installation of land lines at the Fire Station shall be subject to the prior written approval of the City Representative. Licensee shall be solely responsible for paying any fees, charges, surcharges, taxes, assessments, and similar costs and expenses associated with the land lines.

(h) With respect to utilities, Licensee shall comply with section 5.07 and the installation requirements of this section 4.03.

(i) The City is not responsible for the Licensed System or Licensee's other authorized installations. Licensee shall be responsible for securing the Licensed System and Licensee's other authorized installations and keeping them in good working order.

SECTION 5
USE AND OPERATION

5.01 Authorized Frequencies.

In the operation of the Licensed System, Licensee is authorized to operate in the FCC-licensed radio bands and frequencies set forth in **Exhibit C-1.** Operation in any unlicensed radio band (as defined by the FCC) or any radio band used by a City System is prohibited.

5.02 RF (Radio Frequency) Interference.

(a) Licensee acknowledges that City's unimpeded use and operation of the Fire Station is critical to the health, safety and welfare of the City and County of Denver and its inhabitants. Licensee shall use its best efforts, at all times, to avoid any RF Interference or interference of any kind with the operation or use of the Fire Station and the City System as set forth in this Agreement and **Exhibit D**. Licensee shall diligently work to prevent and, in the event of failure to do so, immediately correct radio frequency interference to the City System and any component elements, including the City's WiFi system, and to cooperate with, and comply with the directions from, the City Representative assigned to deal with RF Interference matters. To help achieve this goal, Licensee shall comply with the following:

(a) Licensee agrees to comply with all federal, state, local, or other government regulations applicable to Licensee and its activities operating or using the Licensed System, including, but not limited to, regulations and standards published by the FCC.

(b) Upon written request by the City Representative, not to exceed once per five (5) year period, Licensee agrees to conduct an Interference Study prior to commencing operations and/or during the entire Term or Term Extension of this Agreement, and to furnish the City Representative with the results of the Site Study and to include it as part of Licensee's System Plans and Specifications. If Licensee should fail within a period specified by the City Representative to undertake or complete an Interference Study, the City may arrange for such an Interference Study and Licensee shall reimburse the City for the cost and expense of conducting and preparing the Interference Study. Notwithstanding any provision of this section, if Licensee requests equipment modification, the City may request a new interference study.

(c) Licensee agrees to comply with the most recent edition of the Minimum Technical Standards, with the current Minimum Technical Standards attached hereto as **Exhibit C-2**.

(d) In order to prevent interference, Licensee shall maintain and repair, at no cost to the City, the Licensed System, in order to comply with FCC rules and the reasonable requirements of the City Representative. If this maintenance should necessitate changing out or replacing existing antennas, the requirements of section 5.04 shall be applicable.

(e) If authorized to make changes, Licensee shall notify the City Representative of the specific changes to associated RF equipment, transmit and receive frequencies, transmitter output power, antenna configurations, and effective radiated power before making the changes. An Interference Study shall be conducted by Licensee, as directed by the City Representative and at Licensee's sole cost and expense, prior to any proposed frequency changes. The requirements of section 5.04 shall be applicable to the changes addressed herein.

(f) To extent there are more than one licensee operating at the Fire Station, Licensees are encouraged to resolve potential or real interference problems amongst themselves. Licensee agrees to cooperate fully with City and other licensees to diagnose and correct interference problems. Such cooperation may require Licensee to temporarily reduce or shut down transmit power to help diagnose problems.

(g) When the City Representative, based on inquiry and evaluation, becomes aware of a

potential or existing interference problem caused directly or indirectly, wholly or partially, by the Licensed System, the City may require Licensee to reimburse City for the cost of an Interference Study to include radio frequency measurements. The purpose of this Interference Study is to identify the problem and determine if the problem is caused directly or indirectly, wholly or partially, by the Licensed System. This Interference Study shall be conducted by a consulting engineer selected by the Fire Chief after consultation with Licensee and the City Representative. In the event there are additional licensees operating at the Fire Station, Licensee shall pay for a pro rata share of the costs of the Interference Study, unless Licensee is determined to be solely responsible for the interference, in which case Licensee shall pay all costs and expenses. Pro rata share shall be determined by dividing the costs by the number of non-City licensees operating at the Fire Station.

(h) When necessary to correct interference problems, as determined by the Chief in the Chief's reasonable discretion, Licensee agrees, at its sole cost and expense, to install cavity-type bandpass filters, notch filters, isolators, or other state-of-the-art equipment. These equipment items are in addition to the minimum equipment of the Minimum Technical Standards. The minimum equipment items shall be installed regardless.

(i) Licensee shall ensure that its frequencies used for the operation of the Licensed System do not interfere with any operation of the Fire Station, including without limitation interference with public safety or the City System. Licensee shall provide documentation of the frequencies that it is authorized to use and is using for the Licensed System. Licensee shall not occupy any frequencies that they are not using for the purposes of blocking other licensees from operating. Licensee shall be responsible for conducting an RF scan to verify there will be no interference with other systems. This shall occur prior to Licensee turning on the Licensed System and shall be documented by a third-party vendor and submitted to the City Representative. Once City Representative has reviewed this documentation, the City Representative will give notice to Licensee that it can turn on its Licensed System. If the City Representative is not satisfied with the details of the study, the City Representative will give notification to Licensee as to what needs to be remedied before notice to proceed will be given.

(j) If Licensee's equipment or operations cause RF Interference, as determined by the Fire Chief in the Fire Chief's reasonable discretion, including without limitation interference with the City System, and if the interference is not eliminated within ten (10) days after written notice from the Fire Chief, then City may, at Licensee's sole cost and expense, temporarily turn off the power to the Licensed System. The City Representative shall contact Licensee at the time the Licensed System needs to be deactivated so Licensee can facilitate the effort to deactivate the Licensed System, isolate any interference, and turn the Licensed System back on with minimal interruption. Licensee, at its sole cost and expense and subject to the requirements of section 5.06, shall (i) have the right to make such repairs, maintenance, replacements or adjustments to the Licensed System as may be reasonably necessary to prevent such interference, and (ii) have the right to conduct intermittent tests of the Licensed System at times mutually agreeable to the City Representative to determine if the Licensed System will continue to cause such interference.

(k) The City requires that Licensee operate its Licensed System with no interference to other licensees' systems. Any unresolved disputes regarding the cause or resolution of specific interference problems or complaints must be evaluated by an independent third party selected by the Fire Chief who is competent to evaluate the potential causes of the interference and the measures

required for its resolution. If it is determined that interference to the equipment, frequencies or channels of Licensee or other licensees operating at the Fire Station is a result of the non-compliance of those facilities with the Minimum Technical Standards, it shall be the responsibility of Licensee or other licensees to resolve the interference in accordance with the Minimum Technical Standards. If the interference continues when these facilities are brought into compliance with the Minimum Technical Standards, then it shall be Licensee's responsibility to take whatever measures are necessary to resolve the interference promptly and effectively or disengage the operation of the Licensed System until the interference is resolved to the satisfaction of the City Representative.

5.03 Operational Test Procedures.

The following test procedures shall be approved by City prior to or during, whichever is applicable, Licensee's operation of the Licensed System.

(a) Perform a desktop interference study to include all frequencies to be used by Licensee to ensure no interference is likely from intermodulation products or out-of-band emissions.

(b) Verify the results of the Interference Study by conducting appropriate measurements of the installed systems.

(c) If problems are found, make recommendations for additional filtering, channel changes, greater antenna separation, or other fixes, as necessary.

5.04 Changes to Licensed System.

(a) Licensee shall provide prior written notice to the Fire Chief of any proposed change that would require cutting through existing concrete. All reviews of proposed changes shall be subject to such process as prescribed by the Fire Chief and undertaken by the City Representative.

(b) Any proposed changes which are significant (as reasonably determined by the Fire Chief) will require a review of the current lease rate and may result in an additional License Fee being charged to Licensee and possible other changes to the terms and conditions of the Agreement. These changes, along with any addition, relocation or replacement of antennae or other equipment outside the Licensed Property, shall require an amendment to the Agreement which must be approved in the same manner as this Agreement. Notwithstanding the foregoing, Licensee's addition of ground/base station equipment to the Licensed System within the Licensed Area as well as any maintenance actions, repair or replacement any other equipment comprising the Licensed System with "like-for-like" equipment shall not be considered significant and thus requiring an amendment to this Agreement Changes or occupation or use of areas outside of the Licensed Property which are not authorized as provided herein will be considered to be in breach of this Agreement.

(c) All such changes shall be subject to the Minimum Technical Standards and the installation and operational conditions set forth in this Agreement. The approval form must be attached to the scope of work and stamped structural drawings sheets (not separate). All contractors, subcontractors and vendors must have a copy of the signed approval sheets to present to the officer in charge of the Fire Station, before any work may begin.

5.05 Repairs and Maintenance; Removal.

(a) The maintenance, care, repair, alteration, enhancement or replacement of the Licensed System or infrastructure within the Licensed Area shall be made by Licensee at its sole cost and expense. Licensee covenants and agrees during the Term or Term Extension of this Agreement, after the installation of the Licensed System and occupancy of the Licensed Area, that Licensee:

(1) shall keep the System in good order and condition, and will make all necessary and appropriate repairs or changes thereof if approved as required in section 5.04 above;

(2) shall not permit rubbish, debris, waste materials or anything unsightly or detrimental to health, or likely to create a fire or explosion hazard, or conducive to deterioration, to remain in any part of the Licensed Area or the Fire Station or to be disposed of improperly;

(3) shall at all times maintain the Licensed System in accordance with Applicable Law, the Minimum Technical Standards, FCC requirements, and manufacturer's specifications;

(4) shall promptly repair any and all damage to, among other things, the structures, equipment and surrounding property at the Fire Station which result from Licensee's installation and operation of its Licensed System including, but not limited to, any leaks or physical damage as a result of roof penetrations or other physical penetrations or structural damage to the building or structures, including the significant reduction in the useful life of buildings or structures or any parts thereof, caused by the Licensed System or its operation and/or other workmen and maintenance and repair activities involving the Licensed System;

(5) shall store tools, test equipment and work materials only in areas at the Fire Station approved by the City Representative; and

(6) shall restore any damage resulting from roof or other building penetrations and actions or omissions of the License in the Licensed Area or at the Fire Station so that the damaged property is restored to original condition.

(b) Removal of the Licensed System by Licensee may only occur only upon expiration of the Agreement or Cancellation, as provided by this Agreement or as part of the process of a replacement of the Licensed System as authorized under this Agreement.

(c) If Licensee should be of the opinion that repair, alteration or replacement of the tower is needed ("Alteration"), Licensee shall submit in writing a request to the Fire Chief explaining the perceived need for the Alteration. The Fire Chief shall determine whether such Alteration is warranted and, if so, who should make and pay for or the Alteration or how the cost of the Alteration is to be shared. Any obligation of the City to perform the work shall be strictly contingent upon approvals, including contracts, required by Applicable Law and obtaining all funding needed for the Alteration. If Licensee proposes to make and pay for the Alterations, it should provide plans and a budget with the request submitted to the Fire Chief.

5.06 Right to Enter, Inspect and Make Repairs and Improvements.

(a) The City and its authorized officers, employees, agents, contractors, subcontractors and other representatives shall have the right (at such times as may be reasonable under the circumstances and with as little interruption of Licensee's operations as is reasonably practicable) to access Licensee's equipment for the following purposes:

(1) to inspect such equipment at reasonable intervals during regular business hours (or at any time in case of Emergency or urgent need to protect the City System) to determine whether Licensee has complied and is complying with the terms and conditions of this Agreement;

(2) to perform maintenance and make repairs and replacements in cases where Licensee is obligated but has failed to do so, after the City has given Licensee reasonable notice so to do and an opportunity to cure. In the event that Licensee fails to cure within thirty (30) days of receipt of such notice (unless the nature of the cure is such that an extension of said period is necessary beyond thirty (30) days is necessary this period may be extended if Licensee diligently pursues completion of said cure) then City can proceed with repairs. In such event, event Licensee shall reimburse the City for the reasonable cost thereof within thirty (30) days of Licensee's receipt of City's invoice accompanied by reasonable substantiation of the costs incurred. The City shall have the right to seek recovery of the cost of the maintenance or repair by any judicial remedy available should Licensee fail to pay the cost of the repair. Under no circumstances will City attempt to repair or alter in any way Licensee's operational equipment such as base station radios, other electronic equipment, alarm systems, antennas, coaxial cable, DAS, UPS, etc.; however, this restriction shall not limit the City in performing inspections and repairs and protecting the City System and the Fire Station as provided in this Agreement.

(b) The City reserves the right at all times to take any action it deems necessary, in its sole discretion, to repair, maintain, alter, expand, or improve the City System and the Fire Station and the improvements thereon in connection with their use and operation. The City agrees to give reasonable advance notice of any such activities to Licensee and to reasonably cooperate with Licensee to carry out such activities with a minimum amount of interference to Licensee's use of the Licensed Area. Licensee agrees to cooperate with the City respect to such repairs, maintenance, alterations, expansions, or improvements and to accommodate such work to the extent the City deems necessary and at Licensee's sole expense.

5.07 Utilities.

(a) Licensee shall be responsible for arranging for all utility services needed for the Licensed System, including separately metered electrical service, and for paying for all service, connection, taxes, fees, surcharges and other charges associated with or resulting from the utility services for the Licensed System. Licensee shall be responsible to install all utility service locations in compliance with all applicable laws, codes and regulations and subject to the requirements of section 5.04 above and the installation requirements of section 4.03 above.

(b) Licensee shall be responsible for providing and properly maintaining and replacing, subject to the requirements of section 5.04 above and the installation requirements of section 4.03 above, an independent ventilation, heating and air conditioning system for those portions of the

Licensed System, if any, that are expressly required by the manufacturer of the System to maintain manufacturer's warranties based upon Licensee's installation of the Licensed System at the Fire Station.

5.08 Interruption of Utility Services.

(a) Licensee agrees that City shall not be liable for failure of any utility services to be supplied to the Licensed System or for any interruption of utility services to the Licensed System caused by third parties.

(b) The City reserves the right to temporarily interrupt utility services at such time as may be necessary by reason of accident, unavailability of employees, repairs, alterations or improvements or whenever by reason of *force majeure*, including any state of Emergency declared by the President of the United States, the Governor of the State of Colorado, or the Mayor of the City and County of Denver for which such interruption is reasonable for security and public safety reasons. The City shall not be liable for operational or business losses or for damages to persons or property due to such interruptions. Nor shall such interruptions in any way be construed as cause for abatement of the License Fee, unless caused by the demonstrated gross negligence or intentional misconduct of the City or its agents, contractors or employees.

(c) No backup power supplies shall be placed within the Licensed Area or elsewhere on City property without the prior, written approval of the City Representative and after obtaining any required permits, licenses or approvals for such backup power supplies.

SECTION 6
INSURANCE; INDEMNITY and DEFENSE; GOVERNMENTAL IMMUNITY; LIMITS ON LIABILITY; and TAXES, LICENSES, LIENS AND FEES

6.01 Insurance.

(a) (1) General Conditions: Licensee agrees to secure, at or before the time of execution of this Agreement, the following insurance covering all operations, goods or services provided pursuant to this Agreement. Lessee shall keep the required insurance coverage in force at all times during the term of the Agreement, including any extension thereof, and during any warranty period. The required insurance shall be underwritten by an insurer licensed or authorized to do business in Colorado and rated by A.M. Best Company as "A-VII" or better. Upon receipt of notice from its insurer(s), Licensee shall provide the City with thirty (30) days prior written notice of cancellation of any required coverage. Such notice shall be sent by first class mail and shall reference the City's contract number. Licensee shall be responsible for the payment of any deductible or self-insured retention. The insurance coverages specified in this Agreement and these requirements do not lessen or limit the liability of the Licensee. The Licensee shall maintain, at its own expense, any additional kinds or amounts of insurance that it may deem necessary to cover its obligations and liabilities under this Agreement.

(b) Proof of Insurance: Licensee shall provide a copy of this Agreement to its insurance agent or broker. Licensee may not commence work or uses relating to the Agreement prior to placement of coverage. Licensee certifies that the certificate of insurance attached as

Exhibit E, preferably an ACORD certificate, provided by Licensee complies with all insurance requirements of this Agreement. The City requests that the City's contract number be referenced on the certificate of insurance. The City's acceptance of a certificate of insurance or other proof of insurance that does not comply with all insurance requirements set forth in this Agreement shall not act as a waiver of Licensee's breach of this Agreement or of any of the City's rights or remedies under this Agreement. In the event of a claim arising out of this Agreement, the Denver Risk Management Office may require additional proof of insurance, including but not limited to policies and endorsements.

(c) Additional Insureds: For Commercial General Liability and Auto Liability, Licensee's insurer(s) shall include the City and County of Denver, its elected and appointed officials, employees and volunteers as additional insured as their interest may appear under this Agreement.

(d) Waiver of Subrogation: For all required coverages, Licensee's insurer shall waive subrogation rights against the City.

(e) Subcontractors: Licensee shall require all subcontractors and subconsultants (including independent contractors, suppliers or other entities providing goods or services under this Agreement) to obtain and maintain substantially the same coverages required of Licensee. Licensee agrees to provide proof of insurance for all such subcontractors and subconsultants upon request by City.

(f) Workers' Compensation/Employer's Liability Insurance: Licensee shall maintain the coverage as required by statute for each work location and shall maintain Employer's Liability insurance with limits of $100,000 per accident for bodily injury, $100,000 disease each employee, and $500,000 disease policy limit.

(g) Commercial General Liability: Licensee shall maintain a Commercial General Liability insurance policy with combined single limits of $1,000,000 per occurrence for bodily injury and property damage including contractual liability, $2,000,000 for each personal and advertising injury claim, $2,000,000 products and completed operations aggregate, and $2,000,000 general aggregate.

(h) Automobile Liability: Lessee shall maintain Automobile Liability in an amount of $1,000,000 combined single limit each accident for bodily injury and property damage covering all owned, hired and non-owned vehicles used at the Leased Premises.

(i) Property Insurance: Lessee shall provide 100% replacement cost for Lessee's tenant improvements and personal property. Business Interruption coverage shall be included with limits not less than the annual payments due to the City under the term of the agreement. Lessee understands and acknowledges that the City does not provide any insurance coverage for any property of the Lessee, its agents, employees or assignees located in the Leased Premises and Lessee acknowledges and agrees that the Lessee, its agents, employees and assignees have no claim against the City for any damage or loss of personal property and belongings of Lessee, its agents, employees or assignees in the Leased Premises

(j) Failure to comply with the requirements of this section 6.01 shall be legal grounds under this Agreement for work by Licensee at the Fire Station to be ordered to cease or to be restricted, as deemed appropriate by the Fire Chief or the Denver Risk Management Office, until compliance is achieved and any unpaid claims are resolved to the reasonable satisfaction of the City Representative and the Denver Risk Management Office. These insurance obligations shall survive the expiration of the Agreement and Cancellation.

6.02 Indemnification & Defense.

(a) Licensee hereby agrees to defend, indemnify, and hold harmless City, its appointed and elected officials, agents and employees against all liabilities, claims, judgments, suits or demands for damages to persons or property arising out of, resulting from, or relating to regarding the use and occupancy of, and activities and operations on, the Fire Station site by Licensee (including its officers, employees, representatives, suppliers, contractors, subcontractors and agents) under this Agreement ("Claims"), unless such Claims have been specifically determined by the trier of fact to be the sole negligence or willful misconduct of City. This indemnity shall be interpreted in the broadest possible manner to indemnify City for any acts or omissions of Licensee (including its officers, employees, representatives, suppliers, contractors, subcontractors and agents) either passive or active, irrespective of fault, including City's concurrent negligence whether active or passive, except for the sole negligence or willful misconduct of City.

(b) Licensee's duty to defend and indemnify City shall arise at the time written notice of the Claim is first provided to City regardless of whether an action has been filed in court on the Claim. Licensee's duty to defend and indemnify the City shall arise even if City is the only party sued and/or it is alleged that City's negligence or willful misconduct was the sole cause of the alleged damages.

(c) Licensee will defend any and all Claims which may be brought or threatened against City and will pay on behalf of City any expenses incurred by reason of such Claims including, but not limited to, court costs and attorney fees incurred in defending and investigating such Claims or seeking to enforce this indemnity obligation. Such payments on behalf of City shall be in addition to any other legal remedies available to City and shall not be considered City's exclusive remedy.

(d) Insurance coverage requirements specified in this Agreement shall in no way lessen or limit the liability of Licensee under the terms of this indemnification obligation. Licensee shall obtain, at its own expense, any additional insurance that it deems necessary for City's protection.

(e) This indemnification and defense obligation shall survive the expiration of this Agreement and Cancellation.

6.03 Colorado Governmental Immunity Act.

Licensee understands and agrees that City is relying upon, and has not waived, the monetary limitations and all other rights, immunities and protection provided by the Colorado Governmental Act, § 24-10-101 *et seq*., C.R.S., and any related statutory protections against liability.

6.04 Limitation on Liability.

Licensee agrees that no liability shall attach to the City for any damages or losses incurred or claimed by Licensee or any other person or party on account of the installation, construction or operation of the Licensed System by Licensee. Licensee agrees that it shall not in any way seek damages or make any claims against the City for any interference or delay caused by construction in adjacent areas, other businesses or operations, including without limitation damages or losses in the nature of delay damages, lost labor productivity, and impact damages.

6.05 Environmental Requirements.

(a) Licensee and its contractor(s) and subcontractor(s) shall obtain all federal, state, and local environmental permits necessary for the work to be performed and shall comply with all applicable federal, state, and local environmental permit requirements applicable to the work. Licensee and its contractor(s) and subcontractor(s) shall comply with all applicable local, state, and federal environmental guidelines, rules, regulations, statutes, laws, and orders applicable to the work (collectively, "Environmental Requirements"), including but not limited to Environmental Requirements regarding the storage, use, transportation, and disposal of Hazardous Materials and regarding releases or threatened releases of Hazardous Materials to the environment.

(b) The term "Hazardous Materials" shall mean asbestos, asbestos-contaminated soils, and asbestos-containing materials, special wastes, polychlorinated biphenyls (PCBs), any petroleum products, natural gas, radioactive source material, pesticides, any hazardous waste as defined at 42 U.S.C. § 6903(5) of the Solid Waste Disposal Act, any hazardous substance as defined at 42 U.S.C. § 9601(14) of the Comprehensive Environmental Response, Compensation and Liability Act, and chemical substance as defined at 15 U.S.C.§ 2602(2) of the Toxic Substances Control Act, and any guidelines issued and rules or regulations promulgated pursuant to such statutes, or any other applicable federal or state statute.

(c) No Hazardous Materials shall be brought onto, or stored on, the Fire Station site without the prior, written approval of the City Representative and, if required by the City Representative, the prior, written approval of the Denver Department of Environmental Health and/or the Colorado Department of Public Health and Environment.

(d) The obligations of Licensee set out in this section 6.04 shall survive the expiration of the Agreement and Cancellation. Licensor represents, warrants and agrees that Licensor will not, and will not permit any third party to use, generate, store or dispose of any Hazardous Material on, under, about or within the Fire Station in violation of any law or regulation.

6.05 Taxes, Licenses, Liens and Fees.

(a) Licensee agrees to promptly pay all taxes, excises, license fees and permit fees of whatever nature applicable to its operations hereunder and to take out and keep current all municipal, state or federal licenses required for the conduct of its business or operations under this Agreement and further agrees not to permit any of said taxes, excises, license fees or permit fees to become delinquent.

(b) Licensee also agrees not to permit any mechanic's or materialman's or any other lien to become attached or be foreclosed upon the Fire Station or the tower, or improvements thereto, or any part or parcel thereof, by reason of any work or labor performed or materials furnished by any mechanic or materialman for Licensee, as contractors or subcontractors.

(c) Licensee further agrees to promptly pay when due all bills, debts and obligations incurred by it in connection with its operations hereunder, and not to permit the same to become delinquent and to suffer no lien, mortgage, judgment or execution to be filed against the Fire Station, the tower, the City System, the Licensed System, or related improvements, which may in any way impair the rights of the City under this Agreement or to the City's property.

(d) The obligations of Licensee set out in this section 6.05 shall survive the expiration of the Agreement and Cancellation.

6.06 No Waiver.

No failure of the City to insist upon the strict performance of a term, covenant or agreement contained in this Agreement shall be deemed or taken to be a waiver by the City of any succeeding failure to perform or any breach or default.

SECTION 7
CITY RIGHTS

7.01 City's Rights.

(a) City shall retain all the rights to the use, occupancy and ownership of the tower; and such use, occupancy and ownership by the City shall be the primary use of the Fire Station and shall not be interfered with by the exercise of the rights granted hereunder during the Term or Term Extension of the Agreement, except to the extent interference shall be a result of Licensee's reasonable uses and actions in the installation, inspection, maintenance, alteration, repair, replacement, operation and removal of the Licensed System as authorized under this Agreement; provided, however, that Licensee shall be liable to the City for any damage to improvements that may result from such installation, inspection, maintenance, alteration, repair, replacement, operation and removal.

(b) If the City desires Licensee to leave in place any modifications made by Licensee to the tower and so states in a written notice to Licensee, then Licensee shall leave such modifications in place without compensation from or to the City. If Licensee is required to remove the modifications and does not restore damage resulting from said removal and thereby causing the City to have to undertake the restoration, then Licensee shall promptly reimburse the City for the work.

(c) The City specifically reserves for itself, other lessees, licensees and assignees of City, all rights which do not materially and adversely interfere with Licensee's exercise of its License under this Agreement; provided, however, the City will not materially and adversely interfere with, and

will not knowingly permit or allow other licensees to materially and adversely interfere with, the rights of Licensee under the terms of this Agreement except to the extent expressly provided in this Agreement.

(d) Upon expiration of the Agreement or Cancellation or on the date specified in any demand for possession by the City after any default by Licensee (after any applicable notice and cure periods), Licensee covenants and agrees to surrender possession of the Licensed Area and all other parts of the Fire Station site to the City in the same condition as when first occupied, ordinary wear and tear excepted but subject to the repair and restoration requirements provided in this Agreement.

(e) Licensee shall remove, at its sole cost, upon expiration of the Agreement or Cancellation, the Licensed System and all of Licensee's personal property within thirty (30) calendar days after expiration or Cancellation, as applicable. If such removal should damage the or Tower, Licensee agrees, at its sole cost, to immediately repair such damage in a good and workmanlike manner and to put the property in the same condition as it would have been if the Licensed System had not been installed, reasonable wear and tear excepted but subject to the repair and restoration requirements provided in this Agreement. If Licensee fails to remove the Licensed System and Licensee's personal property within thirty (30) calendar days after the expiration of this Agreement or Cancellation, as applicable, the City, at its option, may remove, store and/or dispose of same and retain any proceeds therefrom, and further is entitled to recover any cost incurred by the City in removing same and in restoring the Tower.

(f) If Licensee holds over after the expiration of this Agreement or Cancellation, and so long as the Licensed System is still situated on the Fire Station site (even if it has been disconnected), Licensee shall pay to City a holdover fee equal to 250% of the then total License Fee prorated from the effective expiration or Cancellation date, whichever is applicable, to the date the Licensed System is properly and completely removed from the property. Nothing herein shall be construed to give Licensee the right to hold over at any time, and the City may exercise any and all remedies at law or in equity to recover possession of the Property, as well as any damages caused by Licensee.

SECTION 8
LOSS OF AND LIABILITIES
PERTAINING TO THE LICENSED SYSTEM

8.01 Damage or Destruction and Restoration.

In case of damage or loss of all or any portion of the Licensed System or the Tower, Licensee will give prompt notice thereof to the City; and, except as otherwise provided herein, Licensee shall promptly commence and complete with due diligence (subject to delays beyond its control), the restoration of the Licensed System or the Tower as nearly as reasonably practicable to the value and condition thereof immediately prior to such damage or destruction. In the event of such damage or destruction, Licensee shall be entitled to use or receive reimbursement from the proceeds of all property insurance policy or policies held by Licensee for the Licensed System or by the City for the Tower and shall be obligated to provide any additional moneys necessary for such restoration. The License Fee payable under section 3.01 shall continue to be due and owing.

8.02 Licensee's Election Not to Restore Damaged Licensed System.

In case of the damage or destruction of all or any part of the Licensed System, Licensee, within ninety (90) days thereafter, may elect not to restore or replace the Licensed System, and this Agreement shall be terminated. Licensee must notify the City within said 90 days of the damage or destruction to all or any part of the Licensed System of its intentions not to restore or replace the Licensed System and shall pay the City, in full, six (6) months of payments for the License Fee under section 3.01 from the date that the notice not to restore or replace is provided to the City. Licensee shall promptly proceed to remove the Licensed System from the Licensed Property and to repair and restore the Tower in accordance with Section 4 and section 7.01 and as otherwise provided in this Agreement within thirty (30) days after Licensee elects not to restore or replace the Licensed System. If Licensee should fail to repair or restore the Tower as required, the City may restore the Tower, at Licensee's cost and expense, as nearly as reasonably practicable to the value and condition thereof prior to the damage or destruction, and Licensee shall be obligated to timely and fully reimburse the City for the costs and expenses of such repairs and restoration. The obligations of Licensee under this section 8.02 shall survive the expiration of this Agreement and Cancellation.

SECTION 9
DEFAULT; REMEDIES; and DISPUTES

9.01 Default.

Licensee shall be in substantial default under this Agreement if Licensee:

(a) Fails to timely pay to the City on the fifth (5^{th}) calendar day after the date License Fee or any other payments are due and owing under this Agreement; provided, however, default shall not occur until the fifth (5^{th}) calendar day after written notice is provided by the City to Licensee; or

(b) Becomes insolvent, or takes the benefit of any present or future insolvency or bankruptcy statute, or makes a general assignment for the benefit of creditors, or consents to the appointment of a receiver, trustee or liquidator of any or substantially all of its property; or

(c) Transfers its interest under this Agreement, unless such transfer is specifically authorized pursuant to section 10.01; or

(d) Fails to submit or fails to timely submit complete and accurate plans and specifications, bonds, proof of insurance and other submittals as required by the express terms of this Agreement, and such failure continues for a period of fifteen (15) calendar days after Licensee has received written notice from the City of such failure; or

(e) Abandons, deserts or vacates the Licensed System or Licensed Area; or

(f) Suffers any materialmen's or mechanic's lien or attachment to be filed against the Licensed System, the City System, the Tower, or the Fire Station because of any act or omission of

Licensee, and such lien or attachment is not discharged or contested by Licensee in good faith by proper legal proceedings within thirty (30) calendar days after Licensee's receipt of written notice thereof from City; or

(g) Fails to keep, perform and observe any other promise, covenant or agreement set forth in this Agreement and such failure continues for a period of more than thirty (30) calendar days after delivery by City of a written notice of such breach or default, except where a shorter period is specified herein, or where fulfillment of its obligation requires activity over a period of time and Licensee within thirty (30) days of Licensee notice Licensee commences in good faith to perform whatever may be required to correct its failure to perform and continues such performance without interruption except for causes beyond its control (which must be documented in a written notice to the City); or

(h) Gives its permission to any person to use for any illegal or unauthorized purpose any portion of the City's property made available to Licensee for its use under this Agreement.

(i) Or any of its officers or employees are convicted, plead nolo contendere, enter into a formal agreement in which they admit guilt, enter a plea of guilty, or otherwise admit culpability to criminal offenses of bribery, kickbacks, collusive bidding, bid-rigging, antitrust, fraud, undue influence, theft, racketeering, extortion or any offense of a similar nature, in connection with the Licensee's business or operations in the State of Colorado.

City shall be in substantial default under this Agreement if Licensor fails to keep, perform and observe any other promise, covenant or agreement set forth in this Agreement and such failure continues for a period of more than thirty (30) calendar days after delivery by Licensee of a written notice of such breach or default, except where a shorter period is specified herein, or where fulfillment of its obligation requires activity over a period of time and City within thirty (30) days of City's notice City commences in good faith to perform whatever may be required to correct its failure to perform and continues such performance without interruption except for causes beyond its control (which must be documented in a written notice to the Licensee).

9.02 Remedies.

If Licensee substantially defaults in any of the covenants, terms and conditions herein and such default is not cured within any applicable notice and cure periods, the City may exercise any one or more of the following remedies:

(a) The City may elect to allow this Agreement to continue in full force and effect and to enforce all of City's rights and remedies hereunder, including without limitation the right to collect compensation as it becomes due together with interest or recover any damages or losses resulting from the action or inaction of Licensee.

(b) The City may engage in Cancellation and repossess the Licensed Area, without liability for so doing and without having to comply with any eviction process under state law, upon giving thirty (30) calendar days written notice to Licensee of the intended Cancellation, at the end of which time all the rights hereunder of Licensee shall terminate, unless the default shall have been cured as prescribed in section 9.01 or elsewhere in this Agreement. Licensee shall be liable to the

City for all amounts owing to the City or any other party with respect to Licensee's operations at the Fire Station or under this Agreement.

(c) The remedies provided in this Agreement shall be cumulative and shall in no way affect any other remedy available to the City under law or equity. The obligations of Licensee under this section 9.02 shall survive the expiration of the Agreement and Cancellation.

(d) In the event of a Licensor default, Licensee may terminate the Agreement and/or pursue any remedy now or hereafter available to the it under the 1aws or judicial decisions of the state in which the Licensed Area is located.

9.03 Dispute Resolution.

The Parties agree to work diligently together and in good faith, using reasonable efforts to resolve any unforeseen issues and disputes and to expeditiously take such actions as are necessary and appropriate to perform the duties and obligations of this Agreement. Any dispute between the City and Licensee, including whether a default by Licensee is substantial or has been timely and effectively cured, shall be taken to administrative hearing, pursuant to the procedure established by Section 56-106, DRMC. For the purpose of that procedure, the City official rendering a final determination shall be the Executive Director of the Denver Department of Safety.

SECTION 10
MISCELLANEOUS PROVISIONS

10.01 Assignments.

(a) Licensee shall not assign or otherwise transfer its interest in this Agreement, in whole or in part, or otherwise transfer any rights or interest in or to the License granted under this Agreement, without the prior written consent of the Fire Chief, which consent can be given or denied in Fire Chief's sole discretion, and subject to approval, under section 10.16 below, of an amendment to this Agreement authorizing the assignment. The Fire Chief may require any proposed assignee to demonstrate that it is appropriately licensed and authorized to provide the same services as Licensee and has the ability to perform the terms and conditions of this Agreement including any financial obligations under this Agreement.

(b) Notwithstanding the foregoing, Licensee may assign this Agreement, and the License granted herein, in whole, to any business entity which is parent, subsidiary, affiliate of Licensee, or to any party that acquires all or substantially all of Licensee's radio spectrum assets in the Denver market area, by reason of a merger, acquisition or other business reorganization. The burden shall be on Licensee to demonstrate, to the satisfaction of the Fire Chief, that any proposed assignment qualifies under this sub-section 10.01(b).

(c) The License granted under this Agreement may not be sold under any circumstances. Any contract entered by Licensee to sell or convey the License granted herein shall not be binding on the City and shall be grounds for terminating the Agreement, at the discretion of the Fire Chief.

(d) Under no circumstances shall Licensee be authorized to allow any other licensee or sub-licensee to co-locate or operate any system at the Fire Station or the Tower.

10.02 Fair Dealing; Further Assurances.

(a) In all cases where the consent or approval of one Party is required before the other may act, or where the agreement or cooperation of the Parties is separately or mutually required as a legal or practical matter, then in that event the Parties agree that each will act in a fair and reasonable manner with a view to carrying out the intents and goals of this Agreement as the same are set forth herein, subject to the terms hereof.

(b) From time to time, upon the request of a Party, the other Party agrees to make, execute and deliver or cause to be made, executed and delivered to the requesting Party any and all further instruments, certificates and documents consistent with the provisions of this Agreement as may, in the reasonable opinion of the requesting Party, be necessary or desirable in order to effectuate, complete or perfect the rights of said Party under this Agreement, provided said requesting Party is currently in full compliance with the provisions of this Agreement and has tendered or offered to tender any reciprocal instruments, certificates and documents to which the other Party is entitled under the Agreement.

10.03 Bond Ordinance.

This Agreement and the rights granted or conveyed hereby are in all respects subject and subordinate to any and all City bond ordinances related to the Fire Station and to any other bond ordinances which should amend, supplement or replace such bond ordinances. The parties agree that, the bond ordinances permit the terms of this Agreement as written and that Licensee shall comply with all IRS regulations and take no action that would jeopardize the tax exempt status of the Bonds. This Agreement has been approved by the City's Bond Counsel, attached hereto as **Exhibit F**. This Agreement may not be executed and may not be amended in the future without prior written approval of the City's Bond Counsel.

10.04 Financial Interests.

Except for financial interests authorized by the City in accordance with the City Charter and ordinances, any financial interests created in, or used to secure financing and payment for the costs of, any work performed or improvements made under this Agreement, including but not limited to any bonds, certificates of participation, purchase agreements, and Uniform Commercial Code filings, shall expressly exclude from such debt or financial security contained in such financial instrument(s) any title, rights and interests held by the City in the property subject to this Agreement. The terms and conditions of this Agreement must be expressly recognized in any such financial instrument(s) created or entered by or on behalf of Licensee, which must specifically acknowledge and affirm that any financial interests created by the financial instrument(s) are subordinate to this Agreement and may not encumber the City's title, rights and interests in the subject property or under this Agreement.

10.05 Appropriation.

Notwithstanding any provision of this Agreement to the contrary, the rights and obligations of the City under this Agreement are contingent upon all funds necessary for work or expenditures contemplated under this Agreement being budgeted, appropriated and otherwise made available by the City. The Parties acknowledge that this Agreement is not intended to create a multiple-fiscal year direct or indirect debt or financial obligation of the City, except to the extent that capital improvement funds that are lawfully appropriated can be lawfully carried over to subsequent years.

10.06 Contracting or Subcontracting.

Any work that is allowed to be contracted or subcontracted under this Agreement shall be subject, by the terms of the contract or subcontract, to every provision of this Agreement. Compliance with this provision shall be the responsibility of the Party who arranged the contract or authorized the subcontract. Except as otherwise expressly stated in this Agreement, no Party shall be liable or have a financial obligation to or for any contractor, subcontractor, supplier, or other person or entity with which the other Party contracts or has a contractual arrangement.

10.07 Third Parties.

This Agreement does not, and shall not be deemed or construed to, confer upon or grant to any third party or parties any right to claim damages or to bring any suit, action or other proceeding against either the City or Licensee because of any breach hereof or because of any of the terms, covenants, agreements and conditions herein.

10.08 Force Majeure.

Neither Party hereto shall be liable to the other for any failure, delay or interruption in the performance of any of the terms, covenants or conditions of this Agreement due to causes beyond the reasonable control of that Party, including without limitation strikes, boycotts, labor disputes, embargoes, shortages of materials, acts of God, acts of the public enemy, acts of superior governmental authority, severe weather conditions, fire, floods, riots, rebellion, sabotage or any other circumstance for which such Party is not responsible or which is not in its power to control, but in no event shall this section be construed so as to allow Licensee to reduce or abate its obligation to pay the License Fee prescribed in this Agreement.

10.09 No Discrimination in Employment.

In connection with the performance of this Agreement, the Parties agree not to refuse to hire, discharge, promote or demote, or to discriminate in matters of compensation against any person otherwise qualified, solely because of race, color, religion, national origin, gender, gender identity or gender expression, age, military status, sexual orientation, gender variance, marital status, or physical or mental disability; and the Parties further agree to insert the foregoing provision in all approved contracts and subcontracts hereunder.

10.10 Conflict of Interest.

The Parties agree that no official, officer or employee of the City shall have any personal or

beneficial interest whatsoever in the services or property described herein, and Licensee further agrees not to hire or contract for services any official, officer or employee of the City or any other person which would be in violation of the Denver Revised Municipal Code Chapter 2, Article IV, Code of Ethics, or Denver City Charter provisions 1.2.9 and 1.2.12.

10.11 Applicable Law; Authority; Venue; Enforcement; and Claims.

(a) The Parties agree to comply with all Applicable Law in existence as of the Effective Date of this Agreement or as may be subsequently enacted or adopted and become applicable.

(b) This Agreement shall be construed and enforced in accordance with the laws of the United States, the State of Colorado, and the applicable provisions of the Charter and Revised Municipal Code of the City and County of Denver.

(c) Venue for any legal action relating to this Agreement shall lie in the District Court in and for the City and County of Denver.

(d) The Parties agree that this Agreement may be enforced in law or in equity for specific performance, injunctive, or other appropriate relief, including actual damages (notwithstanding Cancellation), as may be available according to the laws and statutes of the State of Colorado; provided, however, the Parties agree to and hereby release any claims for incidental, consequential, or punitive damages; provided, further, no provision of this Agreement may be enforced by the creation or recording of any type of lien against real property owned by the City, nor may any foreclosure process be utilized to recover any moneys owed by the City to Licensee. It is specifically understood that, by executing this Agreement, each Party commits itself to perform pursuant to these terms and conditions contained in this Agreement, and that any failure to comply which results in any recoverable damages shall not cause, by itself, the revocation or termination of any rights or obligations under this Agreement.

(e) Nothing in this section 10.11 shall be construed as a waiver, release, reduction or modification of any insurance, bond, indemnification or other liability obligations of Licensee or Licensee's design professional, contractor or sub-contractor expressly provided for in this Agreement.

(f) No official, officer, director, agent, or employee of either Party shall be charged personally or held contractually liable to the other Party or its officials, officers, directors, agents, or employees under any term or condition of this Agreement or for any breach, default, or violation under this Agreement.

(g) In the event that any claim, demand, suit, or action is made or brought in writing by any person or entity against one of the Parties related in any way to this Agreement, the Party in receipt of same shall promptly notify and provide a copy of said claim, demand, suit, or action to the other Party.

10.12 Use, Possession or Sale of Alcohol or Drugs; Smoking Policy.

(a) Licensee and its officers, agents, employees, and contractors shall cooperate and

comply with the provisions of the City and County of Denver's policy or order or any successor policy or order concerning the use, possession or sale of alcohol or drugs on City property.

(b) Licensee and its officers, agents, employees, and contractors shall cooperate and comply with the provisions of the City's policy or order prohibiting smoking in buildings and certain facilities, and Licensee agrees it will take reasonable action to prohibit smoking by its employees in the public areas of the Fire Station.

10.13 Notices.

All notices hereunder must be in writing and shall be deemed validly given if sent by certified mail, return receipt requested or by commercial courier, provided the courier's regular business is delivery service and provided further that it guarantees delivery to the addressee by the end of the next business day following the courier's receipt from the sender, addressed as follows (or any other address that the Party to be notified may have designated to the sender by like notice):

To the City:

Fire Chief of the Denver Fire Department
City and County of Denver
745 West Colfax Avenue
Denver, CO 80204

City Attorney's Office
City and County of Denver
1437 Bannock Street, Room 353
Denver, Colorado 80202

To Licensee:

Cellco Partnership d/b/a Verizon Wireless
d/b/a Verizon Wireless
180 Washington Valley Road
Bedminster, New Jersey 07921
Attention: Network Real Estate

Notice shall be effective upon actual receipt or refusal as shown on the receipt obtained pursuant to the foregoing. All proposed amendments to the Agreement, letter approvals for proposed actions by Licensee, proposed changes to the exhibits, and any document or affidavit seeking the signature of the Fire Chief or the Executive Director of Safety, shall be provided to both the Fire Chief and the City Attorney's Office. Licensee and City shall designate local contact personnel for operational and otherwise day-to-day business communications which may be made by telephone or email. Any changes to this contact information shall be provided immediately once known.

10.14 Examination of Records.

Licensee agrees that any duly authorized representative of the City, including the City Auditor or his representative, until the expiration of three (3) years after expiration of this Agreement or Cancellation, shall have access to and the right to examine any directly pertinent books, documents, papers and records of Licensee related to this Agreement, excluding Licensor's technical and proprietary information.

10.15 Parties' Obligation Regarding Confidential Information.

The Parties agree that issues governing the use and disclosure of Confidential Information, as defined below, provided to or made available to the City by Licensee will be governed by the following provisions:

(a) As used herein, the term "Confidential Information" means all information, of any nature and in any form, regardless of when given, that (i) is disclosed or provided by or through Licensee to the City pursuant to performance of this Agreement; and (ii) has been clearly marked or indicated in writing as being confidential by Licensee; provided, that no part of this Agreement or the exhibits attached to this Agreement shall be deemed to contain Confidential Information. Information falling within this definition shall be treated by the City as confidential proprietary information of Licensee pursuant to the provisions of the Colorado Open Records Act and under any rule of court. Information not so marked or indicated will not be so considered.

(b) Except as expressly provided in this Agreement or as otherwise mandated by the Colorado Open Records Act or other applicable law, the City will not disclose Confidential Information to anyone other than individuals designated by the Fire Chief, including the City Representative, without the prior written consent of Licensee. The City will not use, or permit others to use, Confidential Information for any purpose other than actions incidental to the performance and enforcement of this Agreement between the City and Licensee, including but not limited to auditing of records of Licensee by the City Auditor and/or other representatives of the City. The City will take all reasonable measures to avoid disclosure, dissemination or unauthorized use of Confidential Information, including, at a minimum, those measures that it takes to protect its own Confidential Information of a similar nature.

(c) The Parties recognize that the mere marking of a document as "Confidential" does not render it conclusively confidential under the Colorado Open Records Act. Consequently, in the event that the City is served with an Open Records Request or subpoena from any third party requesting all or part of any Confidential Information as defined herein, the City shall give timely notice to Licensee of such request or subpoena within the time parameters of the Colorado Open Records Act or of any applicable court rule. In that event, Licensee agrees upon receipt of actual notice from the City of such Open Records Request or subpoena to immediately undertake, at its own cost and expense, to defend such Confidential Information from disclosure pursuant to the Colorado Open Records Act or applicable court rule and shall defend, save and hold harmless and indemnify the City and its agents and employees with respect to such issues.

(d) Licensee shall not at any time or in any manner, either directly or indirectly, divulge, disclose or communicate to any person, firm or corporation in any manner whatsoever any information concerning any matters which are not subject to public disclosure, including without limitation the trade secrets of businesses or entities doing business with the City, security measures utilized by the City, and other privileged or confidential information.

10.16 Entire Agreement; Amendment.

The Parties acknowledge and agree that the provisions contained herein, including all exhibits attached hereto, constitute the entire agreement and that all representations made by any officer, agent or employee of the respective Parties unless included herein are null and void and of no effect. No alterations, amendments, changes or modifications, unless expressly reserved to the City herein, shall be valid unless executed by an instrument in writing by all the Parties with the same formality as this Agreement.

10.17 Severability.

If any term or provision of this Agreement is held by a court of law (following all legal rights of appeal or the expiration of time therefore) to be illegal or unenforceable or in conflict with any law of the State of Colorado or the City Charter or City ordinance, the validity of the remaining portions or provisions shall not be affected, and the rights and obligations of the Parties shall be construed and enforced as if the Agreement did not contain the particular term or provision held to be invalid; provided, however, if the invalidated term or provision was a critical or material consideration of either Party in entering this Agreement, the Parties shall work together, in good faith, to come up with an amendment to this Agreement that substantially satisfies the previously intended consideration while being in compliance with Applicable Law and the judgment of the court. Judicial invalidation of the License Fee, in whole or part, shall result in a failure of consideration and termination of this Agreement.

10.18 Time of Essence.

The Parties agree that in the performance of the terms and requirements of this Agreement by Licensee and the City, time is of the essence.

10.19 Section Headings.

The section headings herein are for convenience in reference only and are not intended to define or limit the scope of any provision of this Agreement.

10.20 Approval and Execution of Agreement.

This Agreement is expressly subject to and shall not be or become effective or binding on the City until City Council approval, if required by Charter, is obtained and the Agreement is fully executed by all required City signatories and all required Licensee signatories.

10.21 Authority.

Each Party represents and warrants that it has taken all actions that are necessary or that are required by its applicable law to legally authorize the undersigned signatories to execute this Agreement on behalf of the Party and to bind the Party to its terms. The person(s) executing this Agreement on behalf of each Party warrants that he/she/they have full authorization to execute this Agreement. The City shall have the right, in its discretion, to either temporarily suspend or permanently terminate the Agreement if there is any valid dispute as to the legal authority of Licensee or the person signing this Agreement on behalf of Licensee to enter into this Agreement.

10.22 Electronic Signatures and Electronic Records.

Licensee consents to the use of electronic signatures by the City. The Agreement, and any other documents requiring a signature hereunder, may be signed electronically by the City in the manner specified by the City. The Parties agree not to deny the legal effect or enforceability of the Agreement solely because it is in electronic form or because an electronic record was used in its formation. The Parties agree not to object to the admissibility of the Agreement in the form of an electronic record, or a paper copy of an electronic document, or a paper copy of a document bearing an electronic signature, on the ground that it is an electronic record or electronic signature or that it is not in its original form or is not an original.

Contract Control Number: FINAN-202366844-00
Contractor Name: CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS

IN WITNESS WHEREOF, the parties have set their hands and affixed their seals at Denver, Colorado as of:

SEAL

CITY AND COUNTY OF DENVER:

ATTEST:

By: _____

_____

APPROVED AS TO FORM:

Attorney for the City and County of Denver

By: _____

REGISTERED AND COUNTERSIGNED:

By: _____

By: _____

Contract Control Number: FINAN-202366844-00
Contractor Name: CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS

By: Please see attached signature page

Name: _____
(please print)

Title: _____
(please print)

ATTEST: [if required]

By: _____

Name: _____
(please print)

Title: _____
(please print)

Contract Control Number: FINAN-202366844-00
Contractor Name: CELLCO PARTNERSHIP D/B/A VERIZON WIRELESS

By: DocuSigned by: Mithun Thakur 0D560385CAE744C...

Name: Mithun Thakur
(please print)

Title: Executive Director Network Engineering
(please print)

ATTEST: [if required]

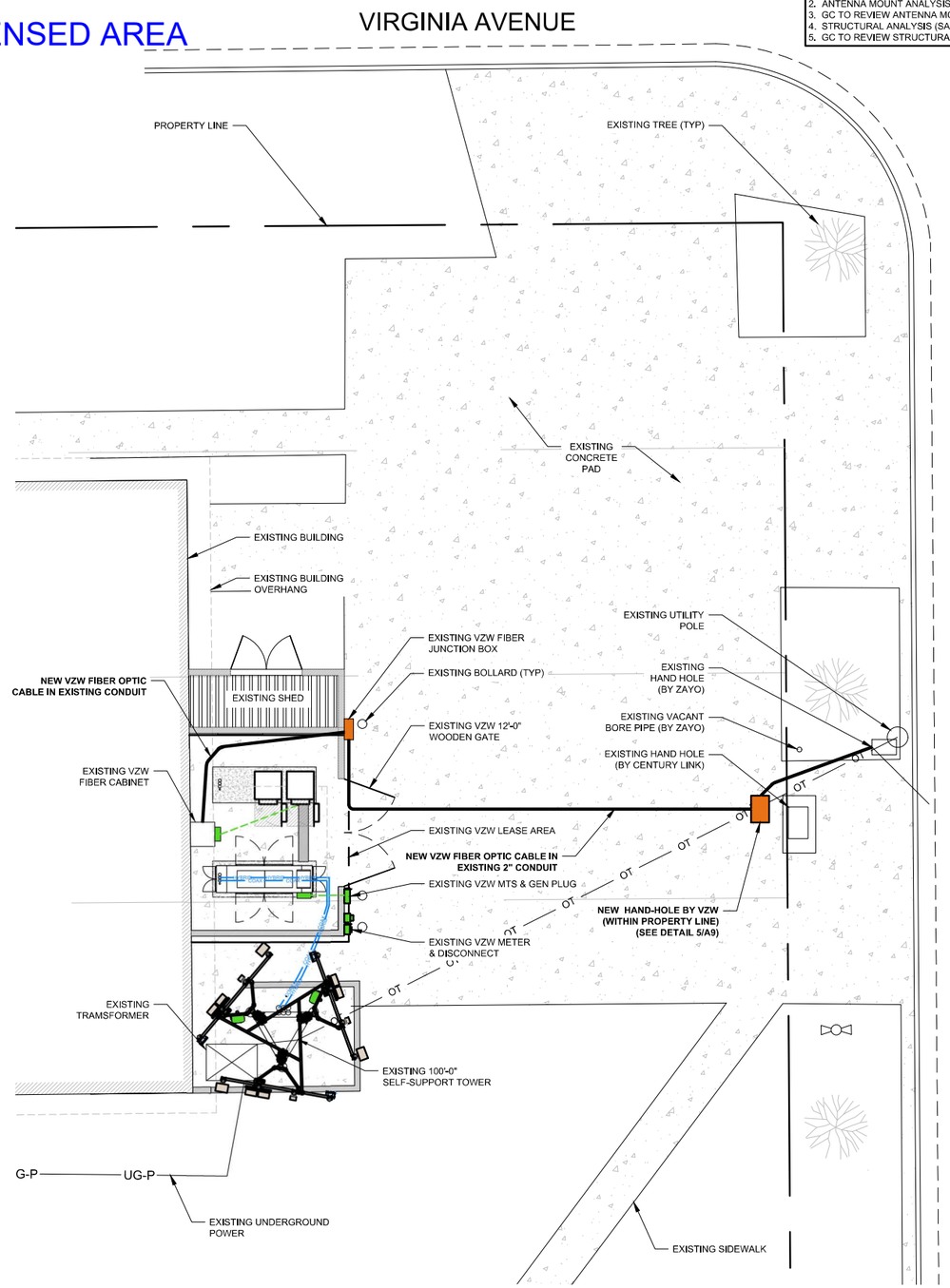
By: _____

Name: _____
(please print)

Title: _____
(please print)

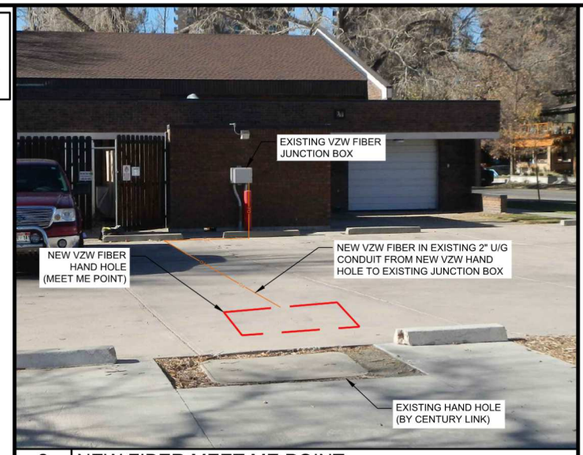
EXHIBIT A - LICENSED AREA

NOTES:
1. DRAWINGS CREATED BY INFORMATION FROM EXISTING DRAWINGS AND WITHOUT A SURVEY. VERIFY ALL DIMENSIONS, LENGTHS, MATERIALS & PROPERTY LINES.
2. ANTENNA MOUNT ANALYSIS (AMA) PROVIDED UNDER SEPARATE COVER.
3. GC TO REVIEW ANTENNA MOUNT ANALYSIS (AMA) PRIOR TO COMMENCING WORK.
4. STRUCTURAL ANALYSIS (SA) PROVIDED UNDER SEPARATE COVER.
5. GC TO REVIEW STRUCTURAL ANALYSIS (SA) PRIOR TO COMMENCING WORK.



1 SITE PLAN
SCALE: 1/16" = 1'-0"

1/16"=1'-0" (FULL SIZE)
16' 8' 0



2 NEW FIBER MEET ME POINT
NOT TO SCALE

3 NEW FIBER MEET ME POINT
NOT TO SCALE

4 NOT USED
NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:

verizon

VERIZON WIRELESS SERVICES
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124

PLANS PREPARED BY:

RLS
RELIANT LAND SERVICES
5335 W 48TH AVE, STE 301
DENVER, CO 80212

SITE INFORMATION:

SITE NAME:
DEN NORTH WASH PARK

SITE ADDRESS:
1580 E. VIRGINIA AVE
DENVER, CO 80204
DENVER COUNTY

ISSUED FOR:

DATE	DESCRIPTION	BY:
08/27/21	90% CONSTRUCTION DOCUMENTS DESIGN REVIEW	WSG
12/22/21	90% CONSTRUCTION DOCUMENTS REV A RF UPDATE	WSG
01/24/22	90% CONSTRUCTION DOCUMENTS REV B STRUCTURAL ANALYSIS UPDATE	WSG
04/21/22	90% CONSTRUCTION DOCUMENTS REV C DESIGN UPDATE	WSG
05/22/22	90% CONSTRUCTION DOCUMENTS REV D EME REPORT & SOW CM COMMENTS	WSG
06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:

COLORADO LICENSED CHRIS S. LEE PE 44498 PROFESSIONAL ENGINEER

Chris Lee, PE
Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:18:18 -07'00'

SHEET TITLE:
OVERALL UTILITY PLAN

SHEET NUMBER:
U1

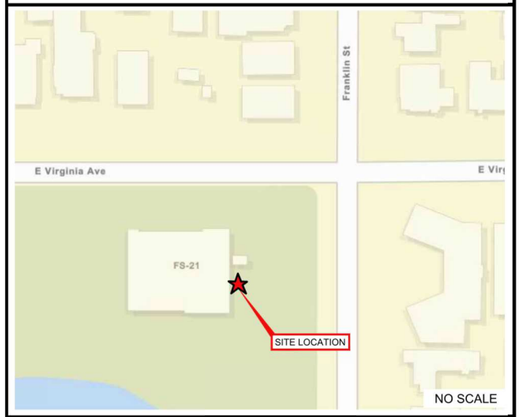
EXHIBIT B

verizon

SITE NAME: DEN NORTH WASH PARK
DENVER FIRE STATION #21
PROJECT: SITE MODIFICATION REQUEST
5G L-SUB6 - CARRIER ADD & DFTTC LIT-DARK TRANSPORT MOD
SITE ADDRESS: 1580 E. VIRGINIA AVE
DENVER, CO 80204
COUNTY: DENVER COUNTY
JURISDICTION: CITY AND COUNTY OF DENVER

SITE PHOTO

VICINITY MAP



FROM THE VZW WIRELESS OFFICE LOCATED AT 10000 PARK MEADOWS DR, LONE TREE, CO: TURN LEFT ONTO PARK MEADOWS DR, THEN RIGHT ON TO S YOSEMITE ST, THEN RIGHT ONTO CHESTER ST, THEN RIGHT ONTO E COUNTY LINE RD THEN RIGHT ONTO I-25 N. TAKE EXIT 206 FOR DOWNING ST, TURN RIGHT ONTO DOWNING ST, THEN RIGHT ONTO E VIRGINIA AVE. SITE IS ON RIGHT.

ISSUED FOR: BUILDING PERMIT

DRAWING INDEX

SHEET #	SHEET DESCRIPTION
T1	TITLE SHEET
CR1	CODE REVIEW
GN1	GENERAL NOTES & PHOTOS
U1	OVERALL UTILITY PLAN
U2	FIBER EQUIPMENT PLAN & ELEVATION
A1	OVERALL SITE PLAN
A2	EXISTING & NEW ENLARGED ANTENNA PLANS
A3	EXISTING & NEW EQUIPMENT ENCLOSURE PLANS
A3.1	EQUIPMENT ENCLOSURE SCOPE OF WORK
A4	NEW & EXISTING EAST ELEVATIONS
A5	RF INFORMATION & PLUMBING DIAGRAM
A6	OVERALL SITE SIGNAGE PLAN
A7	EQUIPMENT DETAILS
A8	EQUIPMENT DETAILS
A9	EQUIPMENT DETAILS
A10	EQUIPMENT DETAILS
S1	STRUCTURAL DETAILS & SPECIAL INPSECTIONS
S2	STRUCTURAL DETAILS
E1	BATTERY, PDF & PANEL DETAILS
E2	ONE-LINE DIAGRAM & NEW PANEL DETAILS

PROJECT DESCRIPTION

MODIFICATION OF EXISTING VERIZON WIRELESS (VZW) TELECOMMUNICATIONS SITE CONSISTING OF:

TOWER SCOPE OF WORK:
- INSTALL TOWER LEG REINFORCEMENTS
- MODIFY EXISTING ANTENNA MOUNTS
- INSTALL (3) NEW SECTOR FRAMES TO REPLACE (3) EXISTING TOWER LEG MOUNTS
- INSTALL (6) NEW PANEL ANTENNAS TO REPLACE (6) EXISTING ANTENNAS (LTE)
- INSTALL (3) NEW ACTIVE ANTENNA SYSTEMS (LS6)
- INSTALL (3) NEW ACTIVE ANTENNA SYSTEMS (UWB)
- RELOCATE (3) EXISTING PANEL ANTENNAS TO NEW CENTER LINE (CDMA)
- INSTALL (3) NEW 8843 RRHs TO REPLACE (3) GROUND MOUNTED RRHs (1900/2100 LTE)
- RELOCATE (3) 4449 RRHs FROM GROUND CABINETS TO TOWER (700/850 LTE)
- INSTALL (3) NEW RRHs (CBRS)
- REMOVE (12) UNUSED COAX CABLES FROM TOWER
- INSTALL (2) NEW 12-SPOT OVPs
- INSTALL (1) NEW 12x24 & (1) NEW 6X12 L.I. HYBRID CABLE

GROUND EQUIPMENT SCOPE OF WORK:
- RELOCATE EXISTING RF EQUIPMENT TO SOUTH SUNWEST CABINET
- REMOVE & REPLACE (1) EXISTING 2-BAY CABINET W/ (2) NEW VZW BATTERY CABINETS
- INSTALL (14) NEW 12V -48V BATTERY STRINGS (56 BATTERIES TOTAL) TO REPLACE (2) EXISTING 12V -48V BATTERY STRINGS (8 BATTERIES TOTAL)
- INSTALL (1) NEW DC UP-CONVERTER IN EXISTING CABINET
- INSTALL (2) NEW RACK MOUNT 12-SPOT OVPs TO REPLACE (2) EXISTING RACK MOUNT 6-SPOT OVPs
- INSTALL (1) NEW 6648 BBU
- REMOVE (1) EXISTING 6601 BBU
- RELOCATE (1) EXISTING ROUTER TO FIBER CABINET
- INSTALL NEW CABLE TRAY W/ DIAMOND PLATE COVER
- INSTALL (1) NEW FIBER HAND HOLE
- INSTALL NEW FIBER OPTIC CABLE IN EXISTING CONDUIT TO EXISTING FIBER CABINET
- RELOCATE FIBER CABINET CIRCUIT & BREAKER TO SOUTH ELECTRIC PANEL

SITE INFORMATION

JURISDICTION: CITY AND COUNTY OF DENVER
APN: 05142-00-001-000
ZONING DESIGNATION: OS-A (PARKS)

VZW GROUND EQUIPMENT:
OCCUPANCY GROUP: U (OUTDOOR EQUIPMENT)
CONSTRUCTION TYPE: NEMA 3R
FULLY SPRINKLERED: NO

TOWER ANTENNAS:
OCCUPANCY GROUP: U (OUTDOOR EQUIPMENT)
CONSTRUCTION TYPE: NEMA 3R
FULLY SPRINKLERED: N/A

ADA COMPLIANCE:
THIS COMMUNICATIONS FACILITY IS UNMANNED AND NOT FOR HUMAN HABITATION

APPLICABLE CODES

ALL WORK SHALL BE PERFORMED AND MATERIALS INSTALLED IN ACCORDANCE WITH THE CURRENT EDITIONS OF THE FOLLOWING CODES AS ADOPTED BY THE LOCAL GOVERNING AUTHORITIES. NOTHING IN THESE PLANS IS TO BE CONSTRUED TO PERMIT WORK NOT CONFORMING TO THESE CODES:

CODE TYPE	CODE
BUILDING	2018 IBC
ELECTRICAL	2020 NEC
FIRE	2018 IFC
DENVER BUILDING & FIRE CODE	2019

811 Know what's below. Call before you dig.

GENERAL CONTRACTOR NOTES

1. GENERAL CONTRACTORS & SUBCONTRACTORS SHALL VERIFY EXISTING CONDITIONS ON THE JOB SITE ALONG WITH ALL PLANS & DIMENSIONS. NOTIFY THE ENGINEER OF RECORD OF ANY DISCREPANCIES BEFORE PROCEEDING WITH THE WORK OR BE RESPONSIBLE FOR SAME.
2. **DRAWINGS ARE TO SCALE WHEN PLOTTED ON 11"x17" SHEET. USE DIMENSIONS SHOWN - DO NOT SCALE DRAWING. CONTACT RELIANT LAND SERVICES (RLS) FOR FURTHER INFORMATION.**
3. CALL BEFORE YOU DIG. COLORADO LAW REQUIRES 2 WORKING DAYS NOTICE FOR CONSTRUCTION PHASE. CALL 811 OR COLORADO811.ORG - SEE THE EXCAVATOR HANDBOOK FOR MORE INFORMATION.
4. THESE DRAWINGS MAY NOT SHOW ALL UNDERGROUND/BUILDING PIPING & UTILITIES. THE CONTRACTOR SHALL EXERCISE EXTREME CARE DURING ALL EXCAVATION & OTHER CONSTRUCTION ACTIVITIES.

REFERENCE DOCUMENTS

RF DATA SHEET: BY VERIZON WIRELESS DATED: 05-04-2022
STRUCTURAL ANALYSIS W/ STRUCTURAL MODIFICATION: BY AHOLA ENGINEERING, LLC DATED: 01-23-2022
NEW/REPLACEMENT ANTENNA MOUNT ANALYSIS REPORT AND PMI REQUIREMENTS: BY MASER CONSULTING DATED: 12-28-2021
PRE-INSTALLATION EME REPORT: BY WATERFORD CONSULTANTS, LLC. DATED: 05-13-2022

CONTRACTOR PMI REQUIREMENTS

PMI ACCESSED AT:	HTTPS://PMI.VZWSMART.COM
SMART TOOL VENDOR PROJECT NUMBER:	10086027
VZW LOCATION CODE (PSLC):	185057

***PMI AND REQUIREMENTS ALSO EMBEDDED IN MOUNT ANALYSIS REPORT

MOUNT MODIFICATION REQUIRED	YES	NO
	X	

VZW APPROVED SMART KIT VENDORS

REFER TO MOUNT MODIFICATION DRAWINGS PAGE FOR VZW SMART KIT APPROVED VENDORS

PROJECT TEAM

APPLICANT/CLIENT
VERIZON WIRELESS
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124

OWNER
CITY & COUNTY OF DENVER
745 W COLFAX AVE
DENVER, CO 80204
CONTACT: KATHRYN SPRITZER
PHONE: 720-865-2510

RF ENGINEER:
VERIZON WIRELESS
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124
CONTACT: DANG LE
PHONE: 720-589-9175

CONSTRUCTION MGR
VERIZON WIRELESS
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124
CONTACT: BRYAN WIDMAN
PHONE: 816-519-2202

SITE ACQUISITION
Q3 CONSULTING
CONTACT: HERB QUINTANA
PHONE: 720-925-5103

A&E FIRM:
RELIANT LAND SERVICES
5335 W 48TH AVE, SUITE 301
DENVER, CO 80212
CONTACT: KEVIN RATIGAN
PHONE: 303-518-6807

SOW CONSTRUCTION MGR:
HORROCKS ENGINEERS
5670 GREENWOOD PLAZA BLVD
GREENWOOD VILLAGE, CO 80111
CONTACT: CHAD WEBER
PHONE: 303-345-8242

ENGINEER OF RECORD:
RELIANT LAND SERVICES
550 PARKCENTER DR,STE 200
SANTA ANA, CA 92705
CONTACT: CHRIS LEE, PE
PHONE: 949-468-9702

STRUCTURAL ENGINEER:
AHOLA ENGINEERING
757 CAPEGLEN ROAD
COLORADO SPRINGS, CO 80906
CONTACT: MIKKO AHOLA, PE
PHONE: 719-640-2408

FIBER PROVIDER:
Zayo
CONTACT: DEANNA BROES

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:
verizon
VERIZON WIRELESS SERVICES
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124

PLANS PREPARED BY:
RLS
RELIANT LAND SERVICES
5335 W 48TH AVE, STE 301
DENVER, CO 80212

SITE INFORMATION:

SITE NAME:
DEN NORTH WASH PARK

SITE ADDRESS:
1580 E. VIRGINIA AVE
DENVER, CO 80204
DENVER COUNTY

ISSUED FOR:

DATE	DESCRIPTION	BY:
08/27/21	90% CONSTRUCTION DOCUMENTS DESIGN REVIEW	WSG
12/22/21	90% CONSTRUCTION DOCUMENTS REV A RF UPDATE	WSG
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05/22/22	90% CONSTRUCTION DOCUMENTS REV D EME REPORT & SOW CM COMMENTS	WSG
06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:

COLORADO LICENSED CHRIS S. LEE PE 44498 PROFESSIONAL ENGINEER

Chris Lee, PE
Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:16:42 -07'00'

SHEET TITLE:
TITLE SHEET

SHEET NUMBER:
T1

BATTERY COMPLIANCE NOTES:

BATTERY SCOPE OF WORK:
INSTALL (14) NEW 12V -48V BATTERY STRINGS (DEKA HT200ET) (56 BATTERIES TOTAL) TO REPLACE (2) EXISTING 12V -48V BATTERY STRINGS (DEKA HT170ET) (8 BATTERIES TOTAL)

DEKA HT200ET SPECIFICATIONS:
- VALVE REGULATED LEAD-ACID (VLRA)
- NON-SPILLABLE CLASSIFICATION
- VALVE REGULATED - LOW POSITIVE PRESSURE, SELF-SEALING W/ FLAME ARRESTOR
- EACH CELL HAS AN ELECTROLYTE CAPACITY OF **2.07** GALLONS. (56) TOTAL CELLS IN THIS OCCUPANCY RESULTING IN AN AGGREGATE ELECTROLYTE VOLUME OF **115.92** GALLONS

STATIONARY STORAGE BATTERY SYSTEMS HAVING CAPACITIES EXCEEDING THE VALUES SHOWN IN TABLE 1206.2 SHALL COMPLY WITH SECTION 1206.2.1 THROUGH 1206.2.12.6, AS APPLICABLE. (LEAD-ACID, ALL TYPES - 70kWh)
THIS INSTALLATION CONTAINS **127.68** kWh.

PROJECT CODE REVIEW

2018 INTERNATIONAL FIRE CODE

CODE #	CODE LANGUAGE	COMMENTS
1206.2.1	**PERMITS.** PERMITS SHALL BE OBTAINED FOR THE INSTALLATION AND OPERATION OF STATIONARY STORAGE BATTERY SYSTEMS IN ACCORDANCE WITH SECTION 105.7.2.	SECTION 105.7.2 REQUIRES A CONSTRUCTION PERMIT TO INSTALL AND OPERATE STATIONARY STORAGE BATTERY SYSTEMS. **VZW TO OBTAIN ALL PERMITS.**
1206.2.2	**CONSTRUCTION DOCUMENTS.** THE FOLLOWING INFORMATION SHALL BE PROVIDED WITH THE PERMIT APPLICATION: 1. LOCATION AND LAYOUT DIAGRAM OF THE ROOM IN WHICH THE STATIONARY STORAGE BATTERY SYSTEM IS TO BE INSTALLED. 2. DETAILS ON HOURLY FIRE-RESISTANCE-RATED ASSEMBLIES PROVIDED. 3. QUANTITIES AND TYPES OF STORAGE BATTERIES AND BATTERY SYSTEMS. 4. MANUFACTURE'S SPECIFICATIONS, RATINGS AND LISTINGS OF STORAGE BATTERIES AND BATTERY SYSTEMS. 5. DETAILS ON ENERGY MANAGEMENT SYSTEMS. 6. LOCATION AND CONTENT OF SIGNAGE. 7. DETAILS ON FIRE-EXTINGUISHING, SMOKE DETECTIONS AND VENTILATION SYSTEMS. 8. RACK STORAGE ARRANGEMENT, INCLUDING SEISMIC SUPPORT CRITERIA.	CONSTRUCTION DOCUMENTS ARE PROVIDED WITH REQUIRED INFORMATION
1206.2.4	**SEISMIC AND STRUCTURAL DESIGN.** STATIONARY STORAGE BATTERY SYSTEMS SHALL COMPLY WITH THE SEISMIC DESIGN REQUIREMENTS IN CHAPTER 16 OF THE INTERNATIONAL BUILDING CODE, AND SHALL NOT EXCEED THE FLOOR-LOADING LIMITATION OF THE BUILDING.	NEW BATTERY CABINETS RATING COMPLIES WITH SEISMIC RATINGS. SEE SHEET E1
1206.2.7	**TESTING, MAINTENANCE AND REPAIR.** STORAGE BATTERIES AND ASSOCIATED EQUIPMENT AND SYSTEMS SHALL BE TESTED AND MAINTAINED IN ACCORDANCE WITH THE MANUFACTURER'S INSTRUCTIONS. ANY STORAGE BATTERIES OR SYSTEM COMPONENTS USED TO REPLACE EXISTING UNITS SHALL BE COMPATIBLE WITH THE BATTERY CHARGE, ENERGY MANAGEMENT SYSTEMS, OTHER STORAGE BATTERIES AND OTHER SAFETY SYSTEMS, INTRODUCING OTHER TYPES OF STORAGE BATTERIES INTO THE STATIONARY STORAGE BATTERY SYSTEM OR OTHER TYPES OF ELECTROLYTES INTO FLOW BATTERY SYSTEMS SHALL BE TREATED AS A NEW INSTALLATION AND REQUIRE APPROVAL BY THE FIRE CODE OFFICIAL BEFORE THE REPLACEMENTS ARE INTRODUCED INTO SERVICE.	NEW STATIONARY STORAGE BATTERY SYSTEM TO BE INSTALLED. **VZW TO PROVIDE CONTINUOUS MAINTENANCE AND TESTING AS REQUIRED.**
1206.2.8.6	**SIGNAGE**. APPROVED SIGNS SHALL BE PROVIDED ON DOORS OR IN LOCATIONS NEAR ENTRANCES TO STATIONARY STORAGE BATTERY SYSTEM ROOMS AND SHALL INCLUDE THE FOLLOWING OR EQUIVALENT: 1. THE ROOM CONTAINS ENERGIZED BATTERY SYSTEMS. 2. THE ROOM CONTAINS ENERGIZED ELECTRICAL CIRCUITS. 3. THE ADDITIONAL MARKINGS REQUIRED IN SECTION 1206.2.12 FOR THE TYPES OF STORAGE BATTERIES CONTAINED WITHIN THE ROOM. EXCEPTION: EXISTING STATIONARY STORAGE BATTERY SYSTEMS SHALL BE PERMITTED TO INCLUDE THE SIGNAGE REQUIRED AT THE TIME IT WAS INSTALLED.	NEW SIGNAGE ON EQUIPMENT CABINET DOOR - NFPA HAZARD RATING DIAMOND - DANGER SIGN: -LEAD-ACID BATTERIES -CORROSIVE LIQUIDS (ELECTROLYTE) -ENERGIZED ELECTRICAL CIRCUITS -NO SMOKING
1206.2.8.7.1	**SEPARATION.** STATIONARY STORAGE BATTERY SYSTEMS LOCATED OUTDOORS SHALL BE SEPARATED BY A MINIMUM 5 FEET (1524MM) FROM THE FOLLOWING: 1. LOT LINES 2. PUBLIC WAYS 3. BUILDINGS 4. STORED COMBUSTIBLE MATERIALS 5. HAZARDOUS MATERIALS 6. HIGH-PILED STOCK 7. OTHER EXPOSURE HAZARDS EXCEPTION: THE FIRE CODE OFFICIAL IS AUTHORIZED TO APPROVE SMALLER SEPARATION DISTANCES IF LARGE-SCALE FIRE AND FAULT CONDITION TESTING CONDUCTED OR WITNESSED AND REPORTED BY AN APPROVED TESTING LABORATORY IS PROVIDED SHOWING THAT A FIRE INVOLVING THE SYSTEM WILL NOT ADVERSELY IMPACT OCCUPANT EGRESS FROM ADJACENT BUILDINGS OR ADVERSELY IMPACT ADJACENT STORED MATERIALS OR STRUCTURES.	NEW BATTERY STORAGE SYSTEMS TO MEET MINIMUM SEPARATIONS.

NOTES:
1. ONLY CODES THAT APPLY TO THIS INSTALLATION ARE INCLUDED IN THIS CHART

PROJECT CODE REVIEW (CONTINUED)

2018 INTERNATIONAL FIRE CODE

CODE #	CODE LANGUAGE	COMMENTS
1206.2.8.7.2	**MEANS OF EGRESS.** STATIONARY STORAGE BATTERY SYSTEMS LOCATED OUTDOORS SHALL BE SEPARATED FROM ANY MEANS OF EGRESS AS REQUIRED BY THE FIRE CODE OFFICIAL TO ENSURE SAFE EGRESS UNDER FIRE CONDITIONS BUT NOT LESS THAN 10 FEET (3048MM). EXCEPTION: THE FIRE CODE OFFICIAL IS AUTHORIZED TO APPROVE LESSER SEPARATION DISTANCES IF LARGE-SCALE FIRE AND FAULT CONDITION TESTING CONDUCTED OR WITNESSED AND REPORTED BY AN APPROVED TESTING LABORATORY IS PROVEDED SHOWING THAT A FIRE INVOLVING THE SYSTEM WILL NOT ADVERSELY IMPACT OCCUPANT EGRESS.	EXISTNG & NEW BATTERY INSTALLATIONS ARE NOT IN WAY OF EGRESS
1206.2.8.7.3	**SECURITY OF OUTDOOR AREAS.** OUTDOOR AREAS IN WHICH STATIONARY STORAGE BATTERY SYSTEMS ARE LOCATED SHALL BE SECURED AGAINST UNAUTHORIZED ENTRY AND SAFEGUARDED IN AN APPROVED MANNER.	EQUIPMENT COMPOUND IS ACCESSIBLE ONLY BY AUTHORIZED PERSONNEL.
1206.2.10.3	**ENERGY MANAGEMENT SYSTEM.** AN APPROVED ENERGY MANAGEMENT SYSTEM SHALL BE PROVIDED FOR BATTERY TECHNOLOGIES OTHER THAN LEAD-ACID AND NICKEL CADMIUM FOR MONITORING AND BALANCING CELL VOLTAGES, CURRENTS AND TEMPERATURES WITHIN THE MANUFACTURER'S SPECIFICATIONS. THE SYSTEM SHALL TRANSMIT AN ALARM SIGNAL TO AN APPROVED LOCATION IF POTENTIALLY HAZARDOUS TEMPERATURES OR OTHER CONDITIONS SUCH AS SHORT CIRCUITS, OVER VOLTAGE OR UNDER VOLTAGE ARE DETECTED.	AN EXISTING APPROVED ENERGY MANAGEMENT SYSTEM IS PROVIDED BY EXISTING GE INFINITY S PDF & GE GALAXY PULSAR CONTROLLER. ALARMS ARE SENT TO VERIZON WIRELESS.
1206.2.10.4	**BATTERY CHARGERS.** BATTERY CHARGERS SHALL BE COMPATIBLE WITH THE BATTER CHEMISTRY AND THE MANUFACTURER'S ELECTRICAL RATINGS AND CHARGING SPECIFICATIONS. BATTERY CHARGERS SHALL BE LISTED AND LABELED IN ACCORDANCE WITH THE UL 1564 OR PROVIDED AS PART OF A LISTED PREENGINEERED OR PREPACKAGED STATIONARY STORAGE BATTERY SYSTEM.	BATTERY CHARGING IS PROVIDED BY AN EXISTING GE INFINITY S PDF & GE GALAXY PULSAR CONTROLLER. SEE DETAIL 1/E1
1206.2.10.6	**SAFETY CAPS.** VENTED BATTERIES SHALL BE PROVIDED WITH FLAME ARRESTING SAFETY CAPS.	SEE DETAIL 3/E1 FOR DEKA HT170ET BATTERY SPECIFICATIONS
1206.2.10.7	**THERMAL RUNAWAY.** WHERE REQUIRED BY SECTION 1206.2.12, STORAGE BATTERIES SHALL BE PROVIDED WITH A LISTED DEVICE OR OTHER APPROVED METHOD TO PREVENT, DETECT AND CONTROL THERMAL RUNAWAY.	DC POWER IS PROVIDED BY A EXISTING GE INFINITY M PDF & GE GALAXY PULSAR CONTROLLER. SEE DETAIL 1/E1
1206.2.10.8	**TOXIC AND HIGHLY TOXIC GAS.** STATIONARY STORAGE BATTERY SYSTEMS THAT HAVE THE POTENTIAL TO RELEASE TOXIC AND HIGHLY TOXIC GAS DURING CHARGING, DISCHARGING AND NORMAL USE CONDITIONS SHALL COMPLY WITH CHAPTER 60.	CABINET IS LOCATED OUTSIDE
1206.2.11.3.2	**SUPERVISION.** REQUIRED MECHANICAL VENTILATION SYSTEMS FOR ROOMS AND CABINETS CONTAINING STORAGE BATTERIES SHALL BE SUPERVISED BY AN APPROVED CENTRAL STATION, PROPRIETARY OR REMOTE STATION SERVICE OR SHALL INITIATE AN AUDIBLE AND VISUAL SIGNAL AT AN APPROVED CONSTANTLY ATTENDED ON SITE LOCATION.	ALL ALARMS ARE SENT TO VERIZON WIRELESS
1206.2.11.5	**SPILL CONTROL AND NEUTRALIZATION.** WHERE REQUIRED BY SECTION 1206.2.12, APPROVED METHODS AND MATERIALS SHALL BE PROVIDED FOR THE CONTROL AND NEUTRALIZATION OF SPILLS OF ELECTROLYTE OR OTHER HAZARDOUS MATERIALS IN AREAS CONTAINING STATIONARY STORAGE BATTERIES AS FOLLOWS: 1. FOR BATTERIES WITH FREE-FLOWING ELECTROLYTE, THE METHOD AND MATERIALS SHALL BE CAPABLE OF NEUTRALIZING A SPILL OF THE TOTAL CAPACITY FROM THE LARGEST CELL OR BLOCK TO A pH BETWEEN 5.0 AND 9.0. 2. FOR BATTERIES WITH IMMOBILIZED ELECTROLYTE, THE METHOD AND MATERIAL SHALL BE CAPABLE OF NEUTRALIZING SPILL OF 3.0 PERCENT OF THE CAPACITY OF THE LARGEST CELL OR BLOCK IN THE ROOM TO A pH BETWEEN 5.0 AND 9.0.	TOTAL VOLUME OF ELECTROLYTE IS 115.92 GALLONS. 3% OF115.92 IS 3.4776 GALLONS, **VZW SHALL INSTALL A SAFETY KIT CAPABLE OF NEUTRALIZING A MINIMUM OF 5 GALLONS.** ENERSYS P/Ns: 853615 (8 GALLONS) OR EQUIVALENT
1206.2.12.1	**LEAD-ACID STORAGE BATTERIES.** STATIONARY STORAGE BATTERY SYSTEMS UTILIZING LEAD-ACID STORAGE BATTERIES SHALL COMPLY WITH THE FOLLOWING: 1. VENTILATION SHALL BE PROVIDED IN ACCORDANCE WITH SECTION 1206.2.11.3. 2. SPILL CONTROL AND NEUTRALIZATION SHALL BE IN ACCORDANCE WITH SECTION 1206.2.11.5. 3. THERMAL RUNAWAY PROTECTION SHALL BE PROVIDED FOR VALVE-REGULATED LEAD-ACID (VRLA) STORAGE BATTERIES IN ACCORDANCE WITH SECTION 1206.2.10.7. 4. THE SIGNAGE IN SECTION 1206.2.8.6 SHALL INDICATE THE ROOM CONTAINS LEAD-ACID BATTERIES.	1. VENTILATION IS PROVIDED IN ACCORDANCE WITH SECTION 1206.2.11.3. 2. NEW SPILL CONTROL AND NEUTRALIZATION SHALL BE IN ACCORDANCE WITH SECTION 1206.2.11.5. 3. THERMAL RUNAWAY PROTECTION IS PROVIDED FOR VALVE-REGULATED LEAD-ACID (VRLA) STORAGE BATTERIES IN ACCORDANCE WITH SECTION 1206.2.10.7. 4. SIGNAGE IN SECTION 1206.2.8.6 SHALL INDICATE THE ROOM CONTAINS LEAD-ACID BATTERIES IS PRESENT ON-SITE.

NOTES:
1. ONLY CODES THAT APPLY TO THIS INSTALLATION ARE INCLUDED IN THIS CHART

NFPA 76:
TELECOMMUNICATIONS FACILITIES WITH LESS THAN 500 SF OF SIGNAL PROCESSING EQUIPMENT ARE EXCLUDED FROM NFPA 76 REQUIREMENTS.

LOCAL JURISDICTION REGULATIONS AND PERMITTING:
CONTRACTOR TO PROVIDE HAZARDOUS MATERIALS REPORTING AND ANY ADDTIONAL PERMITS REQUIRED FOR BATTERY AND/OR GENERATOR SYSTEMS AT THIS INSTALLATION.

1 HAZMAT CODE REVIEW

NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:
verizon
VERIZON WIRELESS SERVICES
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124

PLANS PREPARED BY:
RLS
RELIANT LAND SERVICES
5335 W 48TH AVE, STE 301
DENVER, CO 80212

SITE INFORMATION:

SITE NAME:
DEN NORTH WASH PARK

SITE ADDRESS:
1580 E. VIRGINIA AVE
DENVER, CO 80204
DENVER COUNTY

ISSUED FOR:

DATE	DESCRIPTION	BY:
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06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:
COLORADO LICENSED
CHRIS S. LEE
PE 44498
PROFESSIONAL ENGINEER
Chris Lee, PE
Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:17:09 -07'00'

SHEET TITLE:
CODE REVIEW

SHEET NUMBER:
CR1

DESIGN NOTES

1.0 GENERAL CONDITIONS

1.1 DESIGN AND CONSTRUCTION OF ALL WORK SHALL CONFORM TO THE IBC 2018 EDITION AND ALL OTHER APPLICABLE STATE CODES, ORDINANCES, AND REGULATIONS. IN CASE OF CONFLICT BETWEEN THE CODES, STANDARDS, AND REGULATIONS, SPECIFICATIONS, GENERAL NOTES AND/OR MANUFACTURER'S REQUIREMENTS, USE THE MOST STRINGENT PROVISION.

1.2 IT IS THE EXPRESS INTENT OF THE PARTIES INVOLVED IN THIS PROJECT THAT THE CONTRACTOR OR SUBCONTRACTOR OR INDEPENDENT CONTRACTOR OR THEIR RESPECTIVE EMPLOYEES SHALL EXCULPATE THE ARCHITECT, THE ENGINEER, THE CONSTRUCTION MANAGER, THE OWNER, AND THEIR AGENTS, FROM ANY LIABILITY WHATSOEVER AND HOLD THEM HARMLESS AGAINST LOSS, DAMAGES, LIABILITY OR ANY EXPENSE ARISING IN ANY MATTER FROM THE WRONGFUL OR NEGLIGENT ACT, OR FAILURE TO CARRY OUT THE WORK IN ACCORDANCE WITH THE CONTRACT DOCUMENTS, OR THE CONSTRUCTION MEANS, METHODS, TECHNIQUES, SEQUENCES OR PROCEDURES OR FAILURE TO CONFORM TO THE STATE SCAFFOLDING ACT IN CONNECTION WITH THE WORK.

GENERAL CONSTRUCTION NOTES:

GENERAL CONSTRUCTION

1. FOR THE PURPOSE OF CONSTRUCTION DRAWINGS, THE FOLLOWING DEFINITIONS SHALL APPLY:
   GENERAL CONTRACTOR: T.B.D.
   CONTRACTOR: T.B.D.
   OWNER: VERIZON WIRELESS
2. ALL SITE WORK SHALL BE COMPLETED AS INDICATED ON THE DRAWINGS AND VERIZON WIRELESS (VZW) PROJECT SPECIFICATIONS.
3. GENERAL CONTRACTOR SHALL VISIT THE SITE AND SHALL FAMILIARIZE HIMSELF WITH ALL CONDITIONS AFFECTING THE PROPOSED WORK AND SHALL MAKE PROVISIONS. GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR FAMILIARIZING HIMSELF WITH ALL CONTRACT DOCUMENTS, FIELD CONDITIONS, DIMENSIONS, AND CONFIRMING THAT THE WORK MAY BE ACCOMPLISHED AS SHOWN PRIOR TO PROCEEDING WITH CONSTRUCTION. ANY DISCREPANCIES SHALL BE BROUGHT TO THE ATTENTION OF THE ENGINEER PRIOR TO THE COMMENCEMENT OF WORK.
4. ALL MATERIALS FURNISHED AND INSTALLED SHALL BE IN STRICT ACCORDANCE WITH ALL APPLICABLE CODES, REGULATIONS, AND ORDINANCES. GENERAL CONTRACTOR SHALL ISSUE ALL APPROPRIATE NOTICES AND COMPLY WITH ALL LAWS, ORDINANCES, RULES, REGULATIONS, AND LAWFUL ORDERS OF ANY PUBLIC AUTHORITY REGARDING THE PERFORMANCE OF WORK.
5. ALL WORK CARRIED OUT SHALL COMPLY WITH ALL APPLICABLE MUNICIPAL AND UTILITY COMPANY SPECIFICATIONS AND LOCAL JURISDICTIONAL CODES, ORDINANCES, AND APPLICABLE REGULATIONS.
6. UNLESS NOTED OTHERWISE, THE WORK SHALL INCLUDE FURNISHING MATERIALS, EQUIPMENT, APPURTENANCES, AND LABOR NECESSARY TO COMPLETE ALL INSTALLATIONS AS INDICATED ON THE DRAWINGS.
7. PLANS ARE NOT TO BE SCALED, THESE PLANS ARE INTENDED TO BE A DIAGRAMMATIC OUTLINE ONLY UNLESS OTHERWISE NOTED. DIMENSIONS SHOWN ARE TO FINISH SURFACES UNLESS OTHERWISE NOTED. SPACING BETWEEN EQUIPMENT IS THE MINIMUM REQUIRED CLEARANCE. THEREFORE, IT IS CRITICAL TO FIELD VERIFY DIMENSIONS, SHOULD THERE BE ANY QUESTIONS REGARDING THE CONTRACT DOCUMENTS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING A CLARIFICATION FROM THE ENGINEER PRIOR TO PROCEEDING WITH THE WORK. DETAILS ARE INTENDED TO SHOW DESIGN INTENT. MODIFICATIONS MAY BE REQUIRED TO SUIT JOB DIMENSIONS OR CONDITIONS AND SUCH MODIFICATIONS SHALL BE INCLUDED AS PART OF WORK AND PREPARED BY THE ENGINEER PRIOR TO PROCEEDING WITH WORK.
8. THE CONTRACTOR SHALL INSTALL ALL EQUIPMENT AND MATERIALS IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS UNLESS SPECIFICALLY STATED OTHERWISE.
9. IF THE SPECIFIED EQUIPMENT CANNOT BE INSTALLED AS SHOWN ON THESE DRAWINGS, THE CONTRACTOR SHALL PROPOSE AN ALTERNATIVE INSTALLATION SPACE FOR APPROVAL BY THE ENGINEER PRIOR TO PROCEEDING.
10. GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR THE SAFETY OF WORK AREA, ADJACENT AREAS AND BUILDING OCCUPANTS THAT ARE LIKELY TO BE AFFECTED BY THE WORK UNDER THIS CONTRACT. WORK SHALL CONFIRM TO ALL OSHA REQUIREMENTS AND THE LOCAL JURISDICTION.
11. GENERAL CONTRACTOR SHALL COORDINATE WORK AND SCHEDULE WORK ACTIVITIES WITH OTHER DISCIPLINES.
12. ERECTION SHALL BE DONE IN A WORKMANLIKE MANNER BY COMPETENT EXPERIENCED WORKMAN IN ACCORDANCE WITH APPLICABLE CODES AND THE BEST ACCEPTED PRACTICE. ALL MEMBERS SHALL BE LAID PLUMB AND TRUE AS INDICATED ON THE DRAWINGS.
13. SEAL PENETRATIONS THROUGH FIRE RATED AREAS WITH UL LISTED MATERIALS APPROVED BY LOCAL JURISDICTION. CONTRACTOR SHALL KEEP AREA CLEAN, HAZARD FREE, AND DISPOSE OF ALL DEBRIS.
14. WORK PREVIOUSLY COMPLETED IS REPRESENTED BY LIGHT SHADED LINES AND NOTES. THE SCOPE OF WORK FOR THIS PROJECT IS REPRESENTED BY DARK SHADED LINES AND NOTES. CONTRACTOR SHALL NOTIFY THE GENERAL CONTRACTOR OF ANY EXISTING CONDITIONS THAT DEVIATE FROM THE DRAWINGS PRIOR TO BEGINNING CONSTRUCTION.
15. CONTRACTOR SHALL PROVIDE WRITTEN NOTICE TO THE CONSTRUCTION MANAGER 48 HOURS PRIOR TO COMMENCEMENT OF WORK.
16. THE CONTRACTOR SHALL PROTECT EXISTING IMPROVEMENTS, PAVEMENTS, CURBS, LANDSCAPING AND STRUCTURES. ANY DAMAGED PART SHALL BE REPAIRED AT CONTRACTOR'S EXPENSE TO THE SATISFACTION OF THE OWNER.
17. THE CONTRACTOR SHALL CONTACT UTILITY LOCATING SERVICES PRIOR TO THE START OF CONSTRUCTION.
18. GENERAL CONTRACTOR SHALL COORDINATE AND MAINTAIN ACCESS FOR ALL TRADES AND CONTRACTORS TO THE SITE AND/OR BUILDING.
19. THE GENERAL CONTRACTOR SHALL BE RESPONSIBLE FOR SECURITY OF THE SITE FOR THE DURATION OF CONSTRUCTION UNTIL JOB COMPLETION.
20. THE GENERAL CONTRACTOR SHALL MAINTAIN IN GOOD CONDITION ONE COMPLETE SET OF PLANS WITH ALL REVISIONS, ADDENDA, AND CHANGE ORDERS ON THE PREMISES AT ALL TIMES.
21. THE GENERAL CONTRACTOR SHALL PROVIDE PORTABLE FIRE EXTINGUISHERS WITH A RATING OF NOT LESS THAN 2-A OT 2-A:10-B.C AND SHALL BE WITHIN 25 FEET OF TRAVEL DISTANCE TO ALL PORTIONS OF WHERE THE WORK IS BEING COMPLETED DURING CONSTRUCTION.
22. ALL EXISTING ACTIVE SEWER, WATER, GAS, ELECTRIC, AND OTHER UTILITIES SHALL BE PROTECTED AT ALL TIMES, AND WHERE REQUIRED FOR THE PROPER EXECUTION OF THE WORK, SHALL BE RELOCATED AS DIRECTED BY THE ENGINEER AND RF. EXTREME CAUTION SHOULD BE USED BY THE CONTRACTOR WHEN EXCAVATING OR DRILLING PIERS AROUND OR NEAR UTILITIES. CONTRACTOR SHALL PROVIDE SAFETY TRAINING FOR THE WORKING CREW. THIS SHALL INCLUDE BUT NOT BE LIMITED TO A) FALL PROTECTION, B) CONFINED SPACE, C) ELECTRICAL SAFETY, AND D) TRENCHING & EXCAVATION.
23. ALL EXISTING INACTIVE SEWER, WATER, GAS, ELECTRIC, AND OTHER UTILITIES, WHICH INTERFERE WITH THE EXECUTION OF THE WORK, SHALL BE REMOVED, CAPPED, PLUGGED OR OTHERWISE DISCONNECTED AT POINTS WHICH WILL NOT INTERFERE WITH THE EXECUTION OF THE WORK, AS DIRECTED BY THE RESPONSIBLE ENGINEER, AND SUBJECT TO THE APPROVAL OF THE OWNER AND/OR LOCAL UTILITIES.
24. THE AREAS OF THE OWNER'S PROPERTY DISTURBED BY THE WORK AND NOT COVERED BY THE TOWER, EQUIPMENT OR DRIVEWAY, SHALL BE GRADED TO A UNIFORM SLOPE, AND STABILIZED TO PREVENT EROSION.
25. CONTRACTOR SHALL MINIMIZE DISTURBANCE TO THE EXISTING SITE DURING CONSTRUCTION. EROSION CONTROL MEASURES, IF REQUIRED DURING CONSTRUCTION, SHALL BE IN CONFORMANCE WITH THE FEDERAL AND LOCAL JURISDICTION FOR EROSION AND SEDIMENT CONTROL.
26. NO FILL OR EMBANKMENT MATERIAL SHALL BE PLACED ON FROZEN GROUND, FROZEN MATERIALS, SNOW OR ICE SHALL NOT BE PLACED IN ANY FILL OR EMBANKMENT.
27. THE SUBGRADE SHALL BE BROUGHT TO A SMOOTH UNIFORM GRADE AND COMPACTED TO 95 PERCENT STANDARD PROCTOR DENSITY UNDER PAVEMENT AND STRUCTURES AND 80 PERCENT STANDARD PROCTOR DENSITY IN OPEN SPACE. ALL TRENCHES IN PUBLIC RIGHT OF WAY SHALL BE BACKFILLED WITH FLOWABLE FILL OR OTHER MATERIAL PRE-APPROVED BY THE LOCAL JURISDICTION.
28. ALL NECESSARY RUBBISH, STUMPS, DEBRIS, STICKS, STONES, AND OTHER REFUSE SHALL BE REMOVED FROM THE SITE AND DISPOSED OF IN A LAWFUL MANNER.
29. ALL BROCHURES, OPERATING AND MAINTENANCE MANUALS, CATALOGS, SHOP DRAWINGS, AND OTHER DOCUMENTS SHALL BE TURNED OVER TO THE GENERAL CONTRACTOR AT COMPLETION OF CONSTRUCTION AND PRIOR TO PAYMENT.
30. CONTRACTOR SHALL SUBMIT A COMPLETE SET OF AS-BUILT REDLINES TO THE GENERAL CONTRACTOR UPON COMPLETION OF PROJECT AND PRIOR TO FINAL PAYMENT.
31. CONTRACTOR SHALL LEAVE PREMISES IN A CLEAN CONDITION.
32. THE PROPOSED FACILITY WILL BE UNMANNED AND DOES NOT REQUIRE POTABLE WATER OR SEWER SERVICE, AND IS NOT FOR HUMAN HABITAT (NO HANDICAP ACCESS REQUIRED).
33. OCCUPANCY IS LIMITED TO PERIODIC MAINTENANCE AND INSPECTION, APPROXIMATELY 2 TIMES PER MONTH, BY VERIZON WIRELESS TECHNICIANS.
34. NO OUTDOOR STORAGE OR SOLID WASTE CONTAINERS ARE PROPOSED.
35. ALL MATERIAL SHALL BE FURNISHED AND WORK SHALL BE PERFORMED IN ACCORDANCE WITH THE CURRENT VERSION OF VERIZON WIRELESS NETWORK EQUIPMENT INSTALLATION STANDARDS. IN CASE OF A CONFLICT BETWEEN THE CONSTRUCTION SPECIFICATION AND THE DRAWINGS, THE DRAWINGS SHALL GOVERN
36. CONTRACTORS SHALL BE RESPONSIBLE FOR OBTAINING ALL PERMITS AND INSPECTIONS REQUIRED FOR CONSTRUCTION. IF CONTRACTOR CANNOT OBTAIN A PERMIT, THEY MUST NOTIFY THE GENERAL CONTRACTOR IMMEDIATELY.
37. CONTRACTOR SHALL REMOVE ALL TRASH AND DEBRIS FROM THE SITE ON A DAILY BASIS.
38. INFORMATION SHOWN ON THESE DRAWINGS WAS OBTAINED FROM SITE VISITS AND/OR DRAWINGS PROVIDED BY THE SITE OWNER. CONTRACTORS SHALL NOTIFY THE ENGINEER OF ANY DISCREPANCIES PRIOR TO ORDERING MATERIAL OR PROCEEDING WITH CONSTRUCTION.
39. NO WHITE STROBE LIGHTS ARE PERMITTED. LIGHTING IF REQUIRED, WILL MEET FAA STANDARDS AND REQUIREMENTS.
40. ALL COAXIAL CABLE INSTALLATIONS TO FOLLOW MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS.

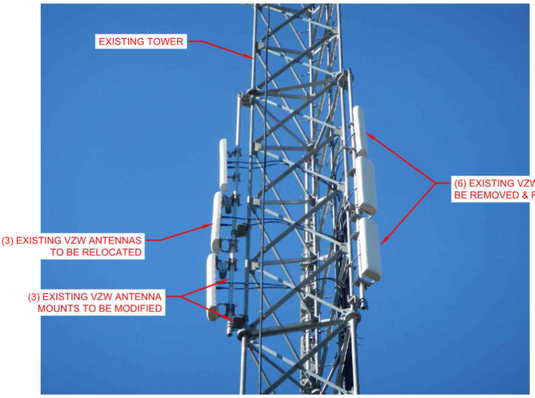
ANTENNA MOUNTING

41. DESIGN AND CONSTRUCTION OF ANTENNA SUPPORTS SHALL CONFORM TO CURRENT ANSI/TIA-222 OR APPLICABLE LOCAL CODES.
42. ALL STEEL MATERIALS SHALL BE GALVANIZED AFTER FABRICATION IN ACCORDANCE WITH ASTM A123 "ZINC (HOT-DIP GALVANIZED) COATINGS ON IRON AND STEEL PRODUCTS", UNLESS NOTED OTHERWISE.
43. ALL BOLTS, ANCHORS AND MISCELLANEOUS HARDWARE SHALL BE GALVANIZED IN ACCORDANCE WITH ASTM A153 "ZINC-COATING (HOT-DIP) ON IRON AND STEEL HARDWARE", UNLESS NOTED OTHERWISE.
44. DAMAGED GALVANIZED SURFACES SHALL BE REPAIRED BY COLD GALVANIZING IN ACCORDANCE WITH ASTM A780.
45. ALL ANTENNA MOUNTS SHALL BE INSTALLED WITH LOCK NUTS, DOUBLE NUTS AND SHALL BE TORQUED TO MANUFACTURER'S RECOMMENDATIONS.
46. CONTRACTOR SHALL INSTALL ANTENNA PER MANUFACTURER'S RECOMMENDATION FOR INSTALLATION AND GROUNDING.
47. ALL UNUSED PORTS ON ANY ANTENNA SHALL BE COVERED WITH CONCEALER CAP WITH PROPER WEATHER PROOFING OR BE TERMINATED WITH A 50 Ω LOAD.
48. PRIOR TO SETTING ANTENNA AZIMUTHS AND DOWNTILTS, ANTENNA CONTRACTOR SHALL CHECK THE ANTENNA MOUNT FOR TIGHTNESS AND ENSURE THAT THEY ARE PLUMB. ANTENNA AZIMUTHS SHALL BE SET FROM TRUE NORTH AND BE ORIENTED WITHIN +/- 5° AS DEFINED BY THE FINAL RF DESIGN. ANTENNA DOWNTILTS SHALL BE WITHIN +/- 0.5° AS DEFINED BY THE RFDS.
49. JUMPERS FROM THE TMA'S MUST TERMINATE TO OPPOSITE POLARIZATIONS IN EACH SECTOR, U.O.N.
50. CONTRACTOR SHALL RECORD THE SERIAL #, SECTOR, AND POSITION OF EACH ACTUATOR INSTALLED AT THE ANTENNAS AND PROVIDE THE INFORMATION TO VERIZON WIRELESS.
51. TMA'S SHALL BE MOUNTED ON PIPE DIRECTLY BEHIND ANTENNAS AS CLOSE TO ANTENNA AS FEASIBLE IN A VERTICAL POSITION, U.O.N.
52. ANTENNAS SHALL HAVE SEPARATION PER RF DESIGN, U.O.N.

TORQUE REQUIREMENTS

53. ALL RF CONNECTIONS SHALL BE TIGHTENED BY A TORQUE WRENCH.
54. ALL RF CONNECTIONS, GROUNDING HARDWARE AND ANTENNA HARDWARE SHALL HAVE A TORQUE MARK INSTALLED IN A CONTINUOUS STRAIGHT LINE FROM BOTH SIDES OF THE CONNECTION.
    A. RF CONNECTION BOTH SIDES OF THE CONNECTOR.
    B. GROUNDING AND ANTENNA HARDWARE ON THE NUT SIDE STARTING FROM THE THREADS TO THE SOLID SURFACE. EXAMPLE OF SOLID SURFACE: GROUND BAR, ANTENNA BRACKET METAL.
55. ALL 8M ANTENNA HARDWARE SHALL BE TIGHTENED TO 9 LB-FT (12 NM).
56. ALL 12M ANTENNA HARDWARE SHALL BE TIGHTENED TO 43 LB-FT (58 NM).
57. ALL GROUNDING HARDWARE SHALL BE TIGHTENED UNTIL THE LOCK WASHER COLLAPSES AND THE GROUNDING HARDWARE IS NO LONGER LOOSE.
58. ALL DIN TYPE CONNECTIONS SHALL BE TIGHTENED TO 18-22 LB-FT (24.4 - 29.8 NM).
59. ALL N TYPE CONNECTIONS SHALL BE TIGHTENED TO 15-20 LB-IN (1.7 - 2.3 NM).

1 GENERAL NOTES
SCALE: NOT TO SCALE



2 EXISTING TOWER PHOTO
NOT TO SCALE

3 EXISTING GROUND EQUIPMENT PHOTO
NOT TO SCALE

4 EXISTING GROUND CABINET PHOTO
SCALE: NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:
verizon
VERIZON WIRELESS SERVICES
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124

PLANS PREPARED BY:
RLS
RELIANT LAND SERVICES
5335 W 48TH AVE, STE 301
DENVER, CO 80212

SITE INFORMATION:

SITE NAME:
DEN NORTH WASH PARK

SITE ADDRESS:
1580 E. VIRGINIA AVE
DENVER, CO 80204
DENVER COUNTY

ISSUED FOR:

DATE	DESCRIPTION	BY:
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06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:

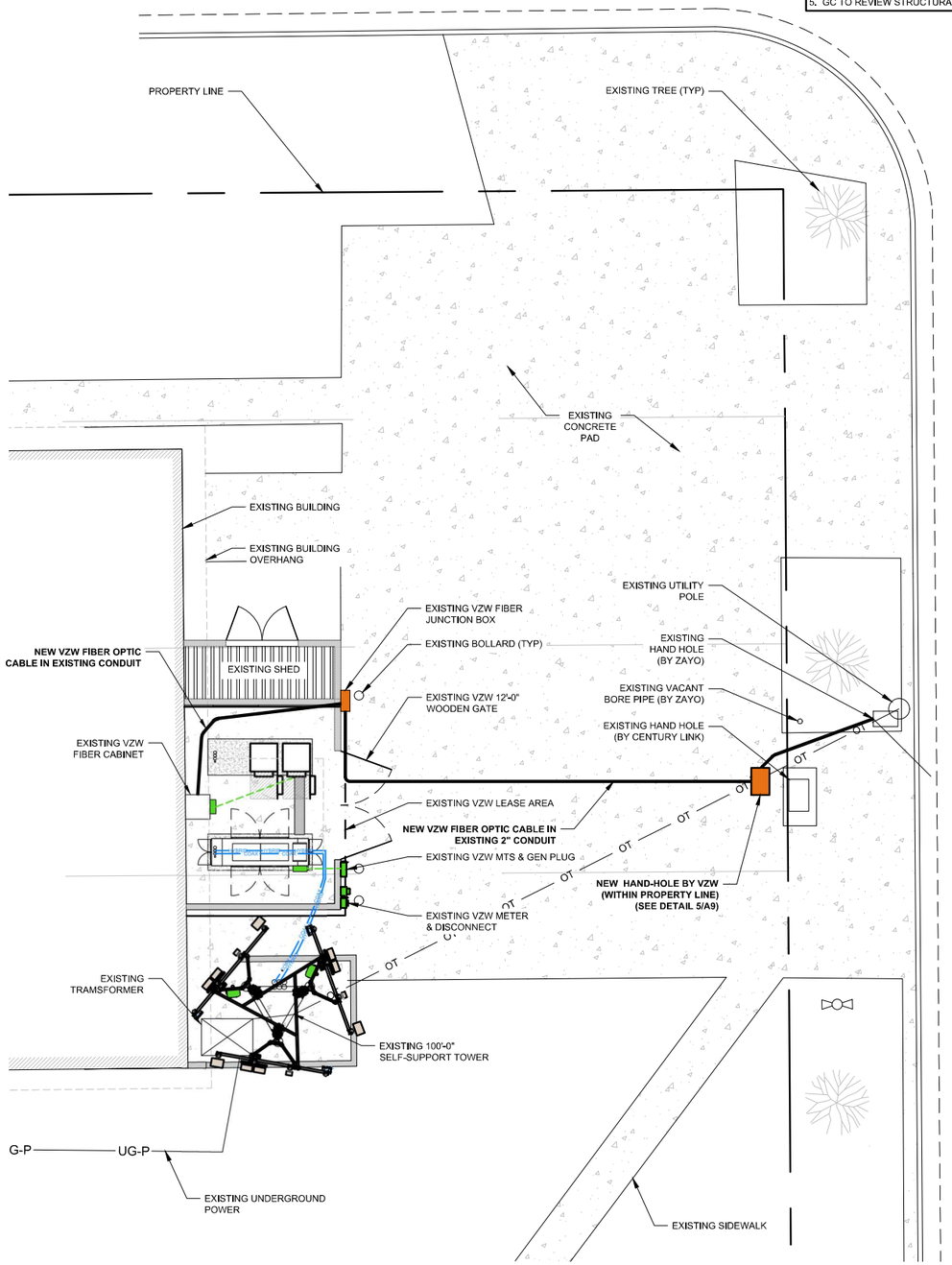
COLORADO LICENSED CHRIS S. LEE PE.44498 PROFESSIONAL ENGINEER

Chris Lee, PE Digitally signed by Chris Lee, PE Date: 2022.06.08 14:17:45 -07'00'

SHEET TITLE:
GENERAL NOTES & PHOTOS

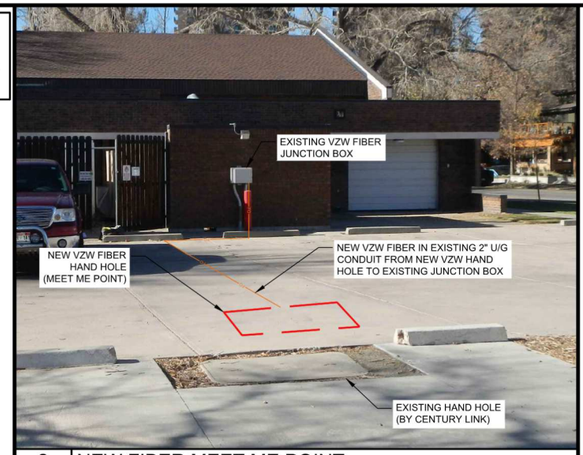
SHEET NUMBER:
GN1

NOTES:
1. DRAWINGS CREATED BY INFORMATION FROM EXISTING DRAWINGS AND WITHOUT A SURVEY. VERIFY ALL DIMENSIONS, LENGTHS, MATERIALS & PROPERTY LINES.
2. ANTENNA MOUNT ANALYSIS (AMA) PROVIDED UNDER SEPARATE COVER.
3. GC TO REVIEW ANTENNA MOUNT ANALYSIS (AMA) PRIOR TO COMMENCING WORK.
4. STRUCTURAL ANALYSIS (SA) PROVIDED UNDER SEPARATE COVER.
5. GC TO REVIEW STRUCTURAL ANALYSIS (SA) PRIOR TO COMMENCING WORK.



1 SITE PLAN
SCALE: 1/16" = 1'-0"

1/16"=1'-0" (FULL SIZE)
16' 8' 0



2 NEW FIBER MEET ME POINT
NOT TO SCALE

3 NEW FIBER MEET ME POINT
NOT TO SCALE

4 NOT USED
NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:

verizon

VERIZON WIRELESS SERVICES
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LONE TREE, CO 80124

PLANS PREPARED BY:

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COLORADO LICENSED CHRIS S. LEE PE.44498 PROFESSIONAL ENGINEER

Chris Lee, PE
Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:18:18 -07'00'

SHEET TITLE:
OVERALL UTILITY PLAN

SHEET NUMBER:
U1

NOTES:
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2. ANTENNA MOUNT ANALYSIS (AMA) PROVIDED UNDER SEPARATE COVER.
3. GC TO REVIEW ANTENNA MOUNT ANALYSIS (AMA) PRIOR TO COMMENCING WORK.
4. STRUCTURAL ANALYSIS (SA) PROVIDED UNDER SEPARATE COVER.
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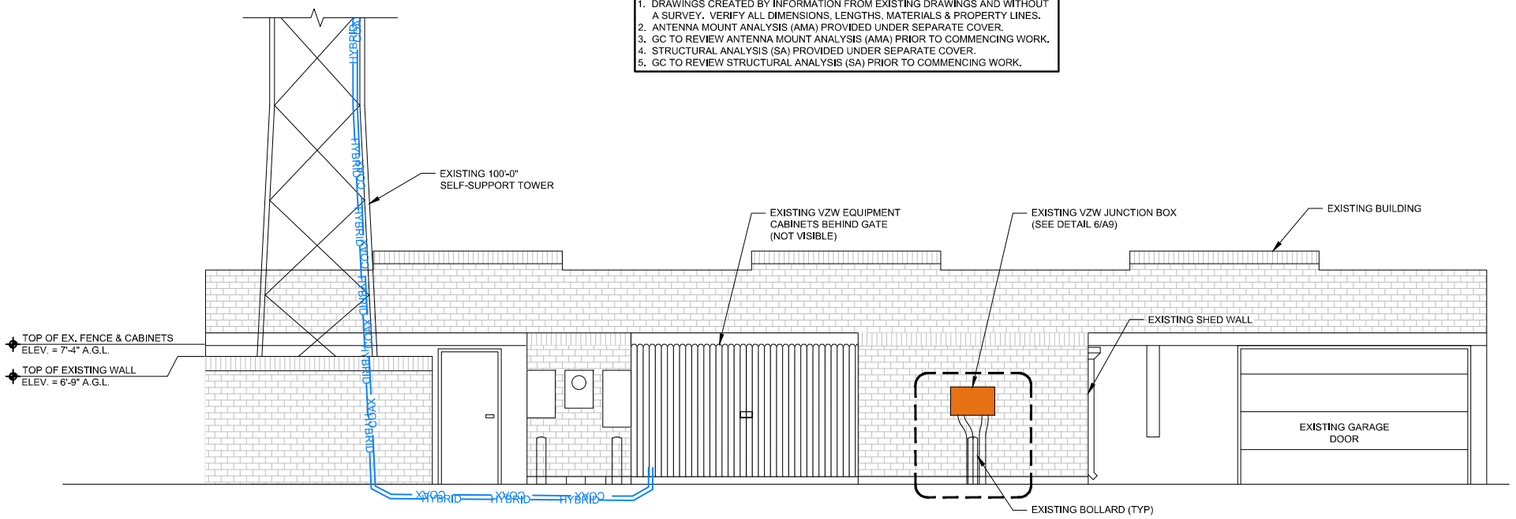
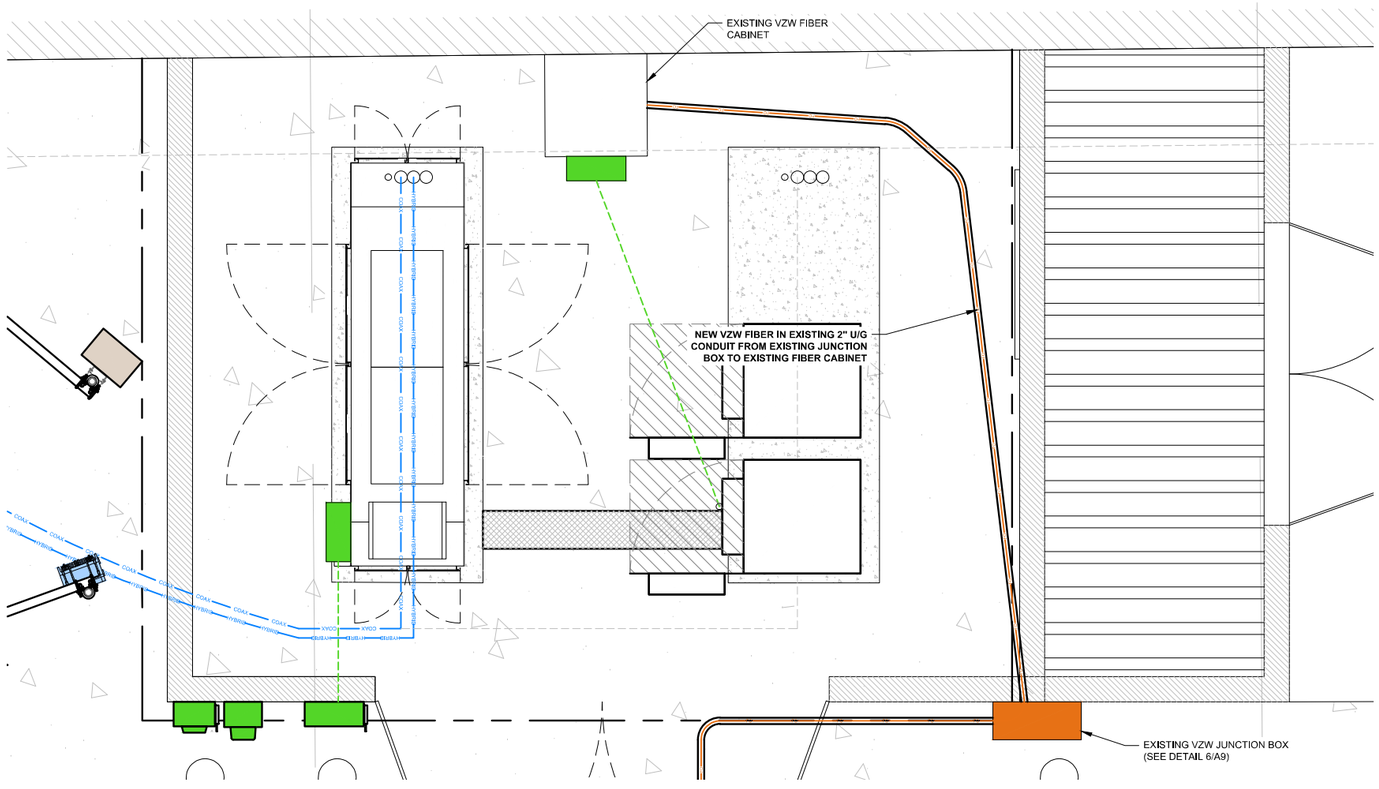


1 EXISTING SOUTHWEST ELEVATION - NEW
SCALE: 1/8" = 1'-0"

1/8"=1'-0" (FULL SIZE)
8' 4' 0

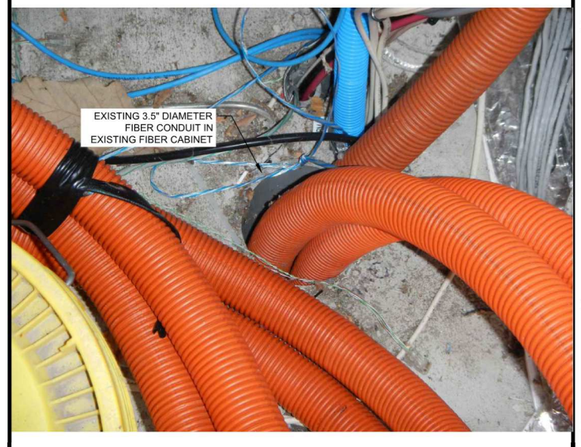


2 FIBER FROM JUNCTION BOX TO FIBER CABINET
SCALE: 1/4" = 1'-0"

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

3 EXISTING WALL TO U/G CONDUIT JUNCTION
NOT TO SCALE

4 EXISTING VZW FIBER CABINET
NOT TO SCALE



5 EXISTING FIBER CONDUIT
NOT TO SCALE

APPLICANT:
verizon
VERIZON WIRELESS SERVICES
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124

PLANS PREPARED BY:
RLS
RELIANT LAND SERVICES
5335 W 48TH AVE, STE 301
DENVER, CO 80212

SITE INFORMATION:

SITE NAME:
DEN NORTH WASH PARK

SITE ADDRESS:
1580 E. VIRGINIA AVE
DENVER, CO 80204
DENVER COUNTY

ISSUED FOR:

DATE	DESCRIPTION	BY:
08/27/21	90% CONSTRUCTION DOCUMENTS DESIGN REVIEW	WSG
12/22/21	90% CONSTRUCTION DOCUMENTS REV A RF UPDATE	WSG
01/24/22	90% CONSTRUCTION DOCUMENTS REV B STRUCTURAL ANALYSIS UPDATE	WSG
04/21/22	90% CONSTRUCTION DOCUMENTS REV C DESIGN UPDATE	WSG
05/22/22	90% CONSTRUCTION DOCUMENTS REV D EME REPORT & SOW CM COMMENTS	WSG
06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

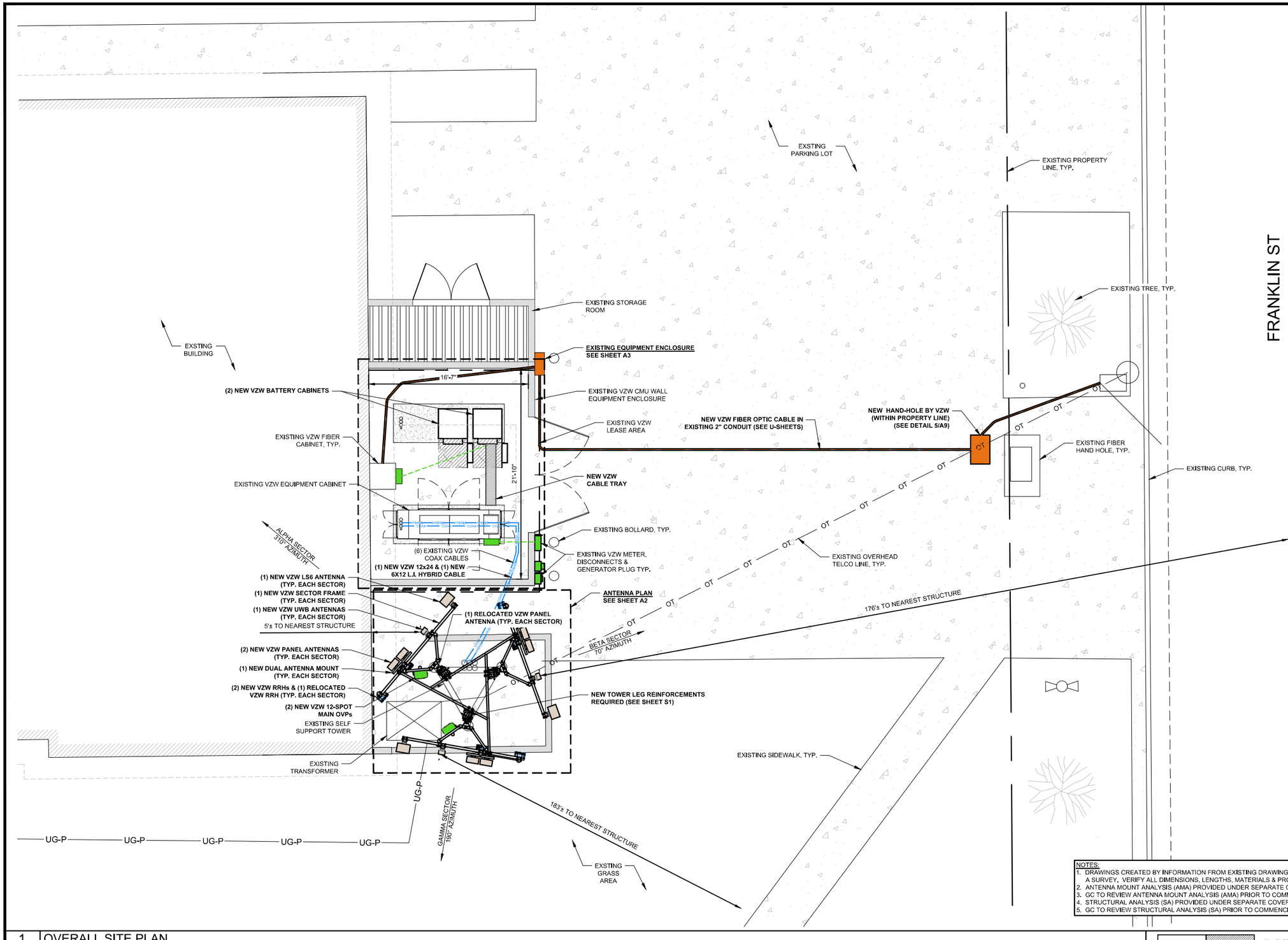
LICENSURE INFO:

COLORADO LICENSED CHRIS S. LEE PE 44498 PROFESSIONAL ENGINEER

Chris Lee, PE
Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:18:38 -07'00'

SHEET TITLE:
FIBER EQUIPMENT PLAN & ELEVATION

SHEET NUMBER:
U2



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5. GC TO REVIEW STRUCTURAL ANALYSIS (SA) PRIOR TO COMMENCING WORK.

1 OVERALL SITE PLAN

SCALE: 1" = 10'-0"

1"=10'-0" (FULL SIZE)

10' 5' 0

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

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verizon

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06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:

COLORADO LICENSED CHRIS S. LEE PE 44498 PROFESSIONAL ENGINEER

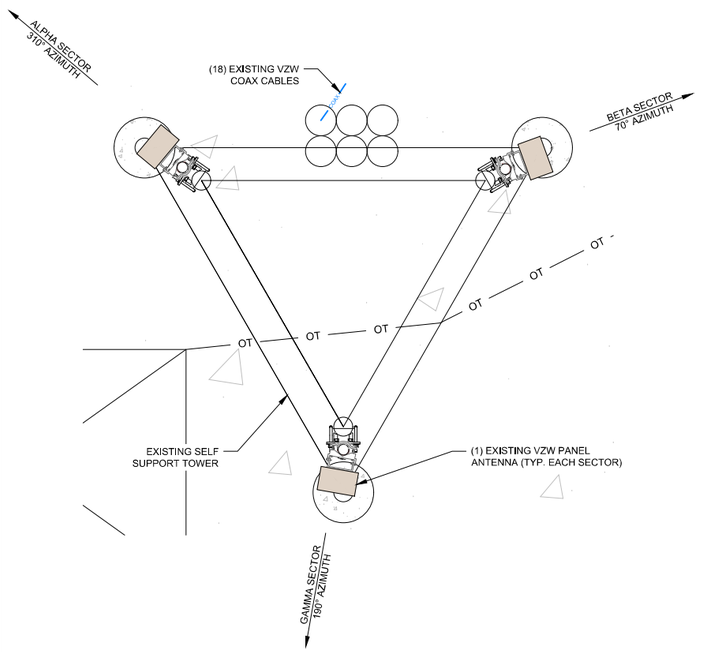
Chris Lee, PE Digitally signed by Chris Lee, PE Date: 2022.06.08 14:30:54 -07'00'

SHEET TITLE:

OVERALL SITE PLAN

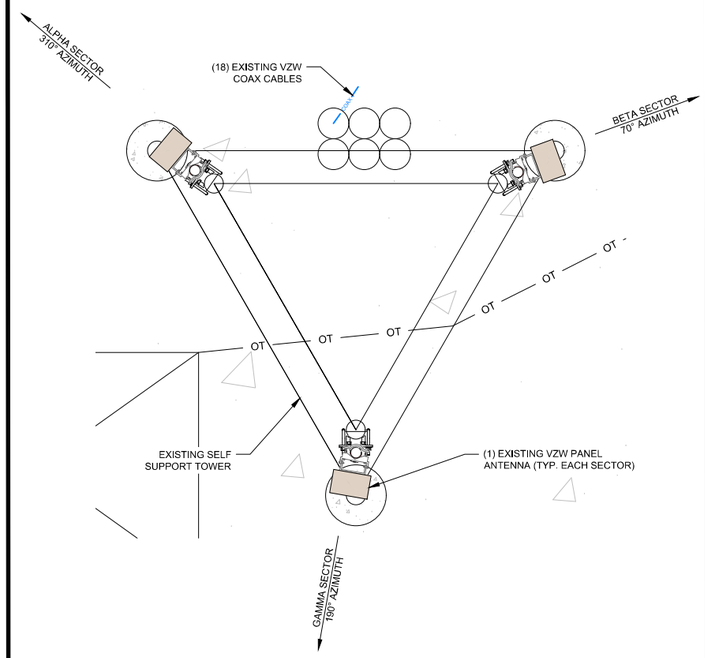
SHEET NUMBER:

A1



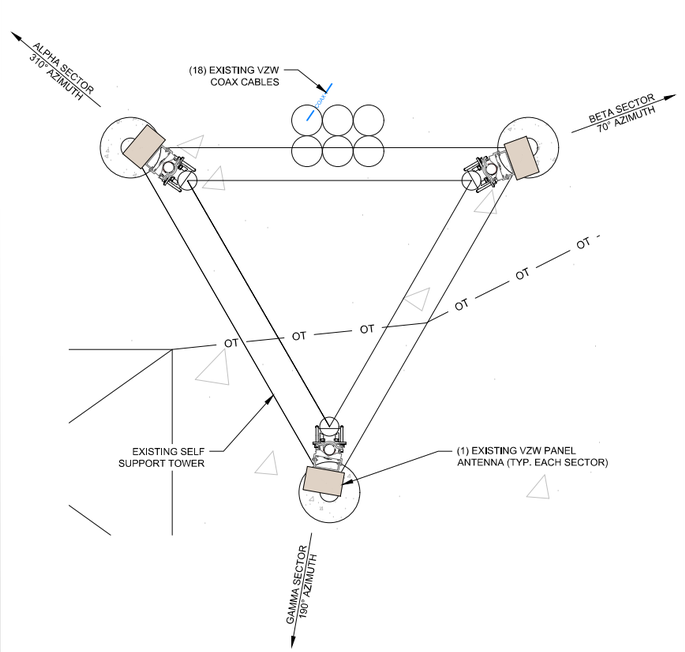
1 ENLARGED ANTENNA PLAN - EXISTING @ C.L. 53'-0"

SCALE: 3/8" = 1'-0"



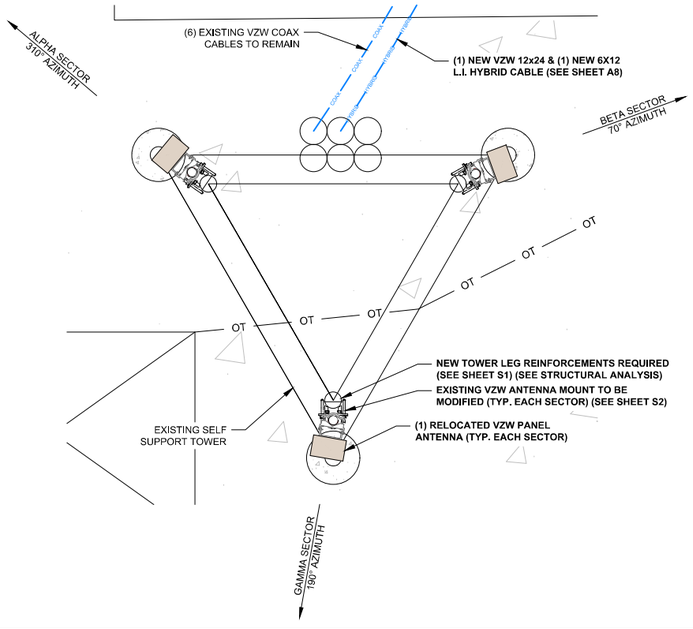
2 ENLARGED ANTENNA PLAN - EXISTING @ C.L. 68'-0"

SCALE: 3/8" = 1'-0"



3 ENLARGED ANTENNA PLAN - EXISTING @ C.L. 73'-0"

SCALE: 3/8" = 1'-0"

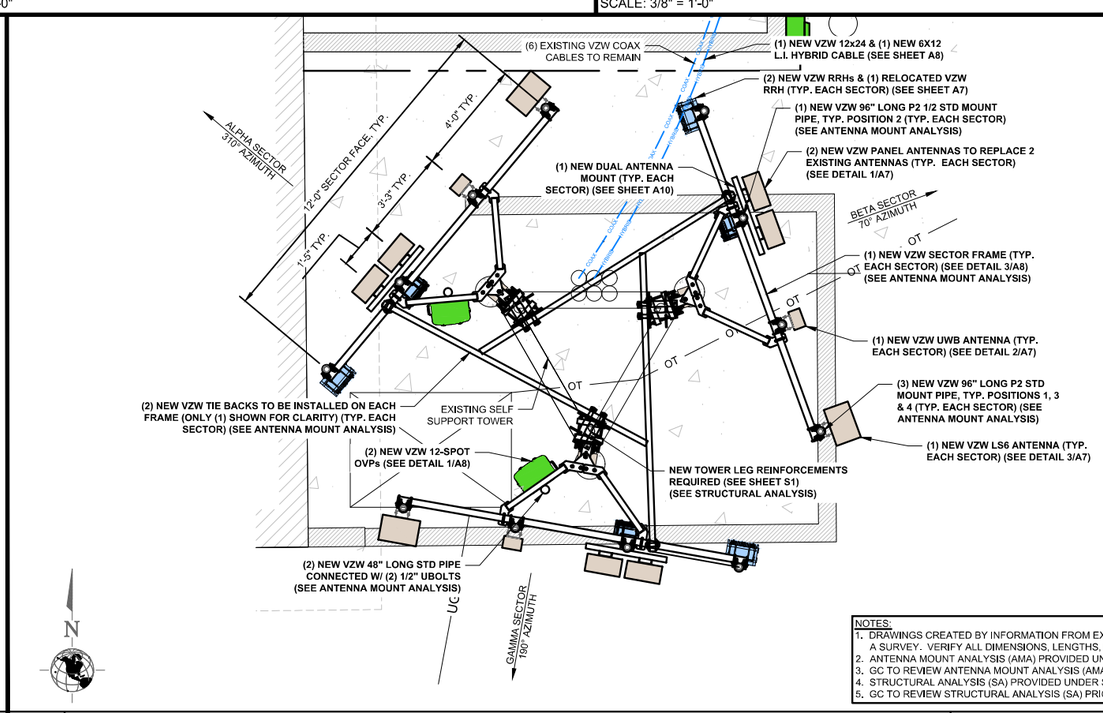


4 ENLARGED ANTENNA PLAN - NEW @ C.L. 65'-0"

SCALE: 3/8" = 1'-0"

3/8"=1'-0" (FULL SIZE)

3' 0



N

NOTES:
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5 ENLARGED ANTENNA PLAN - NEW C.L. @ 72'-0"

SCALE: 1/4" = 1'-0"

1/4"=1'-0" (FULL SIZE)

4' 2' 0

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:

verizon

VERIZON WIRELESS SERVICES
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06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:

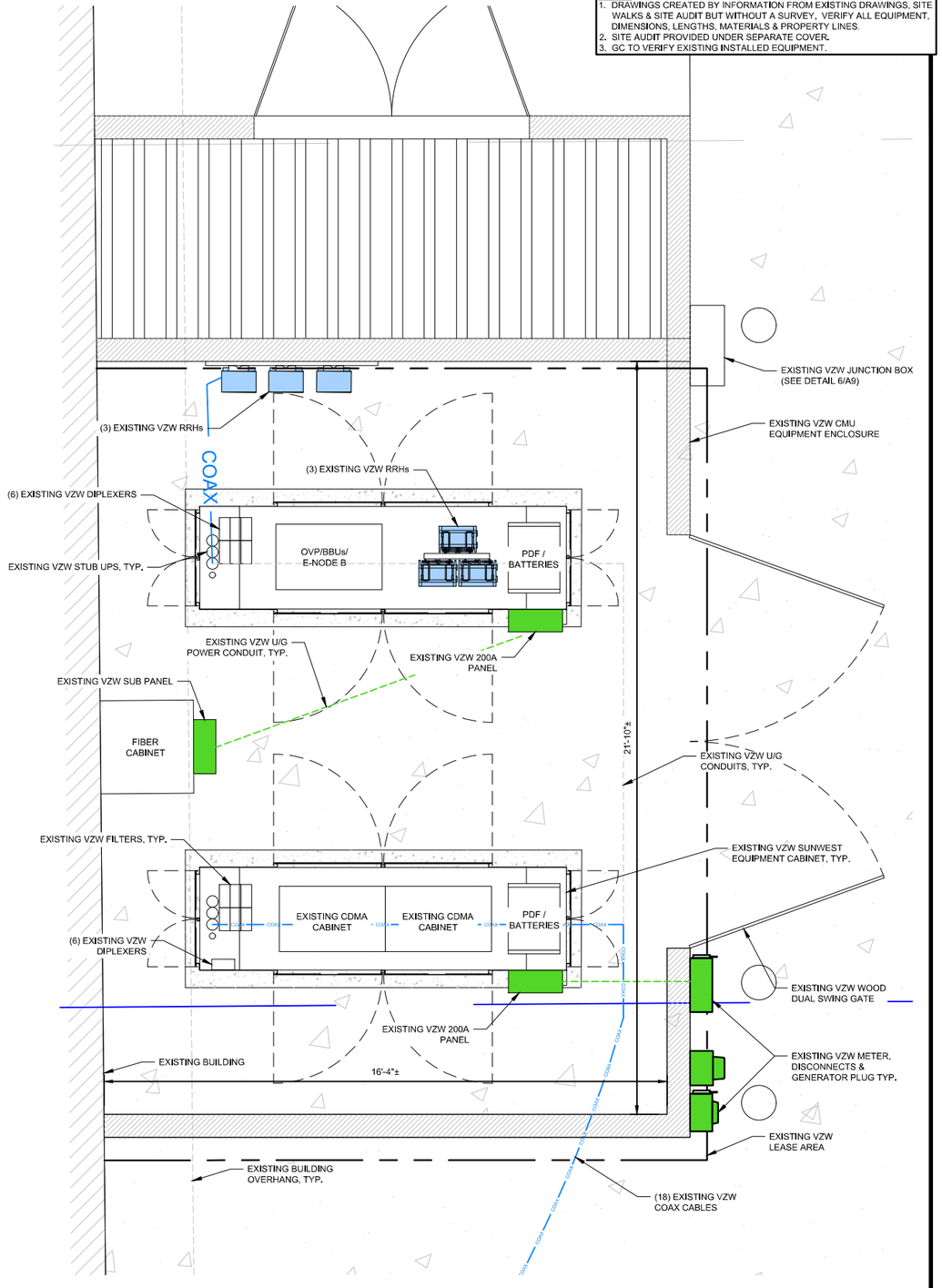
COLORADO LICENSED
CHRIS S. LEE
PE 44498
PROFESSIONAL ENGINEER

Chris Lee, PE Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:31:29 -07'00'

SHEET TITLE:
EXISTING & NEW ENLARGED ANTENNA PLANS

SHEET NUMBER:
A2

NOTES:
1. DRAWINGS CREATED BY INFORMATION FROM EXISTING DRAWINGS, SITE WALKS & SITE AUDIT BUT WITHOUT A SURVEY, VERIFY ALL EQUIPMENT, DIMENSIONS, LENGTHS, MATERIALS & PROPERTY LINES.
2. SITE AUDIT PROVIDED UNDER SEPARATE COVER.
3. GC TO VERIFY EXISTING INSTALLED EQUIPMENT.



1 EQUIPMENT ENLCOSURE PLAN - EXISTING
SCALE: 1/4" = 1'-0"
1/4"=1'-0" (FULL SIZE)
4' 2' 0

NOTES:
1. DRAWINGS CREATED BY INFORMATION FROM EXISTING DRAWINGS, SITE WALKS & SITE AUDIT BUT WITHOUT A SURVEY, VERIFY ALL EQUIPMENT, DIMENSIONS, LENGTHS, MATERIALS & PROPERTY LINES.
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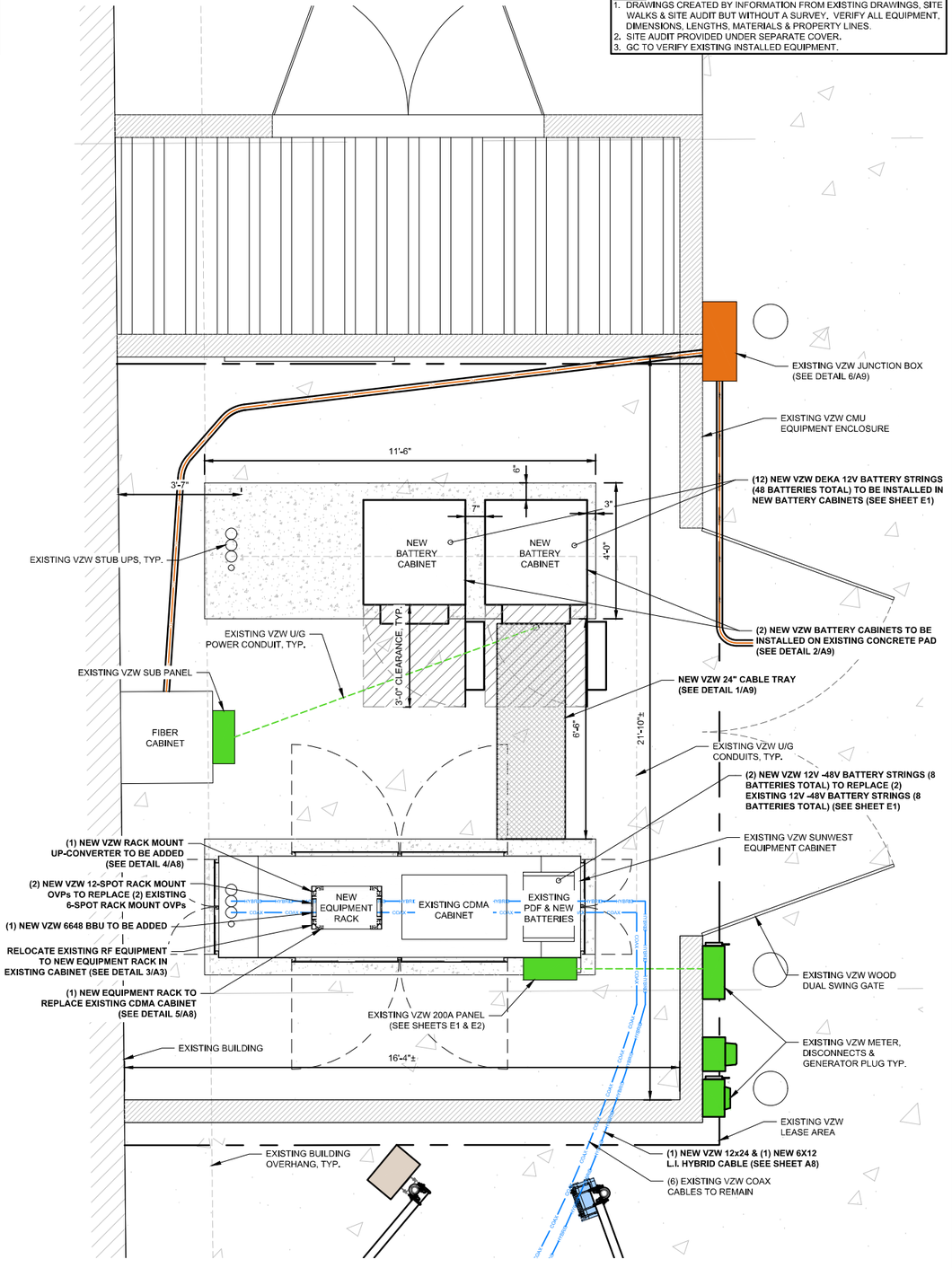
3. GC TO VERIFY EXISTING INSTALLED EQUIPMENT.



2 EQUIPMENT ENLCOSURE PLAN - NEW
SCALE: 1/4" = 1'-0"
1/4"=1'-0" (FULL SIZE)
4' 2' 0

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:
verizon
VERIZON WIRELESS SERVICES
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LICENSURE INFO:

COLORADO LICENSED CHRIS S. LEE PE 44498 PROFESSIONAL ENGINEER

Chris Lee, PE
Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:31:58 -07'00'

SHEET TITLE:
EXISTING & NEW EQUIPMENT ENCLOSURE PLANS

SHEET NUMBER:
A3

EQUIPMENT ENCLOSURE SCOPE OF WORK:

- RELOCATE EXISTING RF EQUIPMENT TO NEW EQUIPMENT RACK IN EXISTING SUNWEST CABINET
- REMOVE & REPLACE (1) EXISTING 2-BAY EQUIPMENT CABINET W/ (2) NEW VZW BATTERY CABINETS
- INSTALL (14) NEW 12V -48V BATTERY STRINGS (56 BATTERIES TOTAL) TO REPLACE (2) EXISTING 12V -48V BATTERY STRINGS (8 BATTERIES TOTAL)
- INSTALL (1) NEW 6648 BBU
- REMOVE (1) EXISTING 6601 BBU
- RELOCATE (1) EXISTING ROUTER TO FIBER CABINET
- INSTALL (2) NEW RACK MOUNT 12-SPOT OVPs TO REPLACE (2) EXISTING RACK MOUNT 6-SPOT OVPs
- INSTALL (1) NEW RACK MOUNT UP-CONVERTER
- INSTALL NEW CABLE TRAY W/ DIAMOND PLATE COVER
- RELOCATE FIBER CABINET CIRCUIT & BREAKER TO SOUTH ELECTRIC PANEL
- REMOVE UNUSED EQUIPMENT

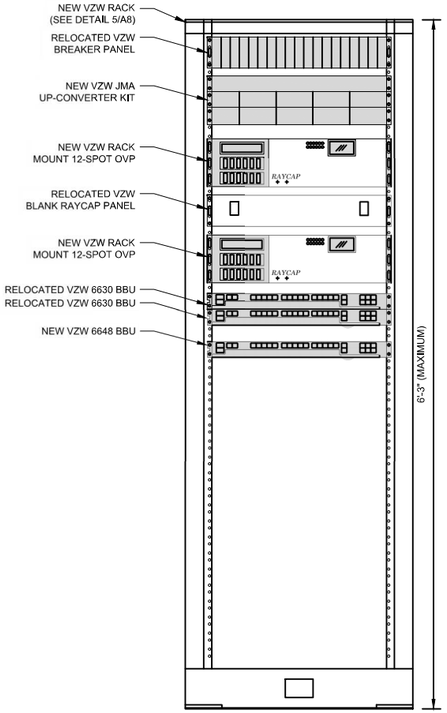
NOTES:

1. NEW SIGNS ON CABINET DOORS. SEE SHEET A6 FOR DETAILS.

2 POWER SCOPE OF WORK

NOT TO SCALE

EXISTING RF RACK PHOTO



NEW RACK ELEVATION

1 NOT USED

NOT TO SCALE

3 EXISTING & NEW RACK ELEVATION / PHOTO

NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:

verizon

VERIZON WIRELESS SERVICES
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124

PLANS PREPARED BY:

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06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:

COLORADO LICENSED
CHRIS S. LEE
PE 44498
PROFESSIONAL ENGINEER

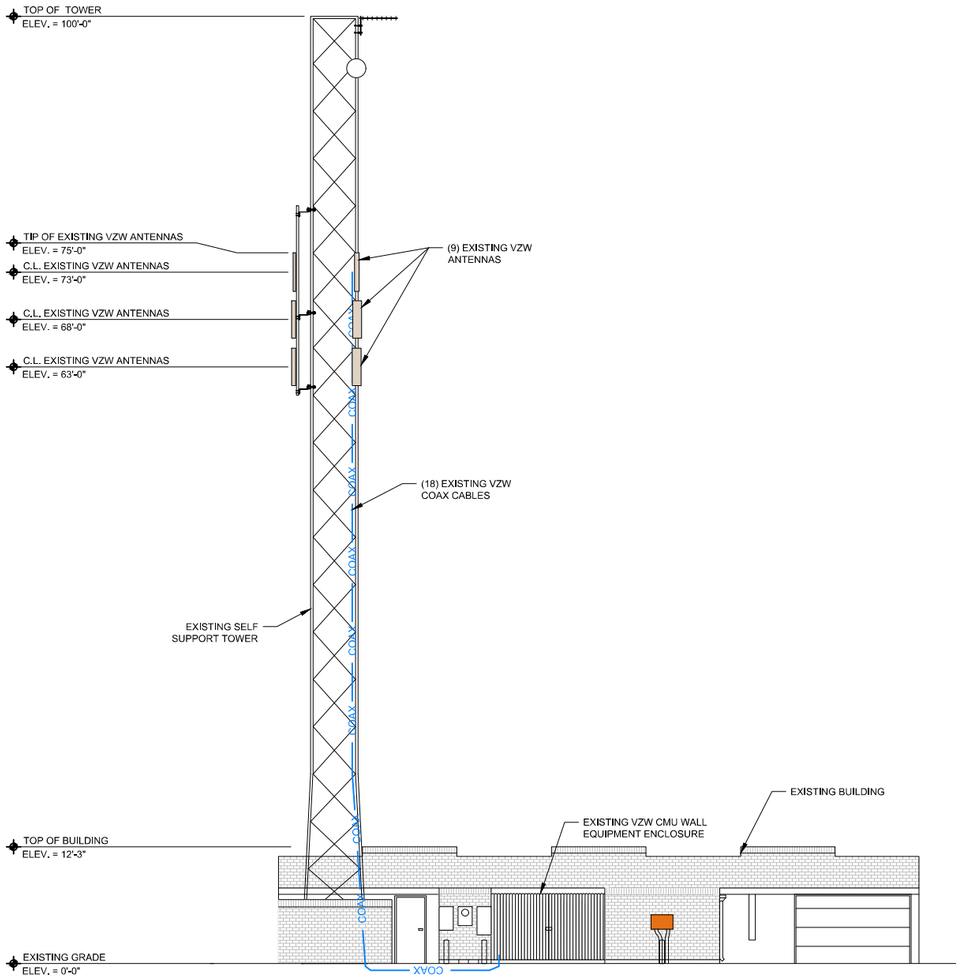
Chris Lee, PE
Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:32:24 -07'00'

SHEET TITLE:

EQUIPMENT ENCLOSURE SCOPE OF WORK

SHEET NUMBER:

A3.1



1 EAST ELEVATION - EXISTING

SCALE: 1/16" = 1'-0"

1/16"=1'-0" (FULL SIZE)

16' 8' 0

NOTES:
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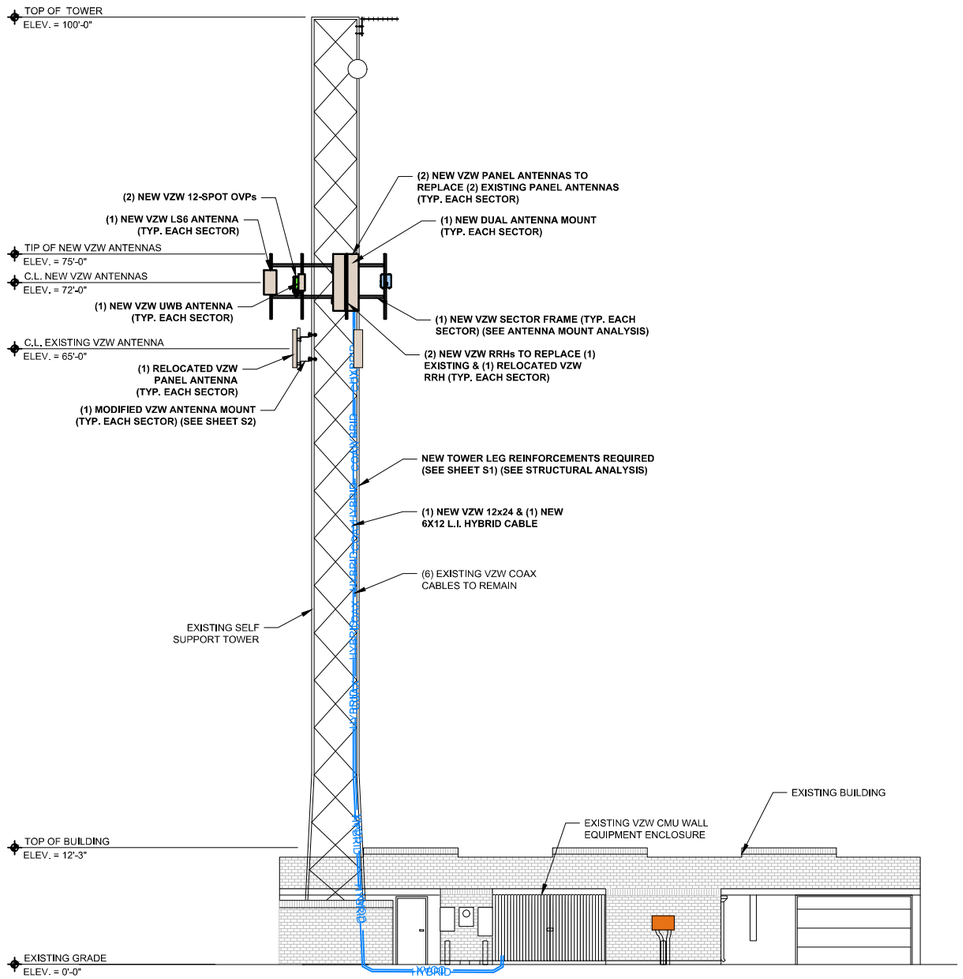

2 EAST ELEVATION - NEW

SCALE: 1/16" = 1'-0"

1/16"=1'-0" (FULL SIZE)

16' 8' 0

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:

verizon

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LICENSURE INFO:

COLORADO LICENSED
CHRIS S. LEE
PE 44498
PROFESSIONAL ENGINEER

Chris Lee, PE
Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:32:46 -07'00'

SHEET TITLE:

NEW & EXISTING
EAST ELEVATIONS

SHEET NUMBER:

A4

EXISTING RF EQUIPMENT SUMMARY

TYPE	STATUS	QTY.	AZ.	MFG	MODEL	DIMENSIONS	MOUNT LOCATION	TECHNOLOGY
ANTENNA	EXISTING	3	70°,190°,310°	ANTEL	BXA-70063-4CF	97"X11.2"X4.5"	63'-0" C.L.	LTE 2100
ANTENNA	EXISTING	3	70°,190°,310°	ANTEL	BXA-70063-4CF	94.7"X11.2"X5.2"	68'-0" C.L.	CDMA
ANTENNA	EXISTING	3	70°,190°,310°	ANTEL	BXA-185063-8CF	48.75"X6.06"X3.15"	73'-0" C.L.	LTE 700/850
RRH	EXISTING	3	N/A	ALCATEL-LUCENT	B4 RRH2X60-4R	36.61"X10.63"X5.75"	WALL	LTE 2100
RRH	EXISTING	3	N/A	ERICSSON	4449	15"X13.2"X11.1"	CABINET	LTE 700/850
DIPLEXER	EXISTING	6	N/A	N/A	N/A	N/A	CABINET	N/A
DIPLEXER	EXISTING	6	N/A	RFS	FDA3P5002-1C	N/A	CABINET	N/A
RACK OVP	EXISTING	2	N/A	RAYCAP	6-SPOT	RACK MOUNT	CABINET	N/A
COAX TRUNK	EXISTING	18	N/A	N/A	1 5/8" DIA.	110' +/-	CONDUIT / TOWER LEG	N/A
RET CABLE	EXISTING	3	N/A	N/A	.315" DIA.	110' +/-	CONDUIT / TOWER LEG	N/A

NEW RF EQUIPMENT SUMMARY

TYPE	STATUS	QTY.	AZ.	MFG	MODEL	DIMENSIONS	MOUNT LOCATION	TECHNOLOGY
ANTENNA	NEW	6	70°,190°,310°	JMA WIRELESS	MX10FRO660	70.9"X15"X7.4"	72'-0" C.L.	LTE 700/850/1900/2100/CBRS
ANTENNA	RELOCATED	3	70°,190°,310°	ANTEL	BXA-80063-4CF	47.4"X11.2"X4.5"	65'-0" C.L.	CDMA
ANTENNA	NEW	3	70°,190°,310°	ERICSSON	AIR6701	21"X8"X5"	72'-0" C.L.	UWB
ANTENNA	NEW	3	70°,190°,310°	ERICSSON	AIR6449	30.8"X16.1"X10.8"	72'-0" C.L.	LS6
RRH	NEW	3	N/A	ERICSSON	8843	15"X13.2"X11.1"	TOWER	LTE 1900/2100
RRH	RELOCATED	3	N/A	ERICSSON	4449	15"X13.2"X11.1"	TOWER	LTE 700/850
RRH	NEW	3	N/A	ERICSSON	4408 B48 DC	8.4"X7.9"X4.1"	TOWER	CBRS
RACK OVP	NEW	2	N/A	RAYCAP	RCMDC-4520-RM-48	RACK MOUNT	CABINET	12-SPOT
UP-CONVERTER	NEW	1	N/A	JMA WIRELESS	PB-19-KIT12	5.3"X19"X22"	CABINET	N/A
MAIN OVP	NEW	2	N/A	RAYCAP	RCMDC-6627-PF-48	19.2"x15.7"x10.3"	TOWER	12-SPOT
HYBRID TRUNK	NEW	1	N/A	COMMSCOPE	HFT2406-48SV3	110' +/-	CONDUIT / TOWER LEG	12X24
HYBRID TRUNK	NEW	1	N/A	COMMSCOPE	HFT1206-24SV2	110' +/-	CONDUIT / TOWER LEG	6X12 L.I.
COAX TRUNK	EXISTING	6	N/A	N/A	1 5/8" DIA.	110' +/-	CONDUIT / TOWER LEG	N/A
HYBRID JUMPER	NEW	9	N/A	N/A	1X2	10' +/-	N/A	N/A
HYBRID JUMPER	NEW	6	N/A	N/A	1X3	10' +/-	N/A	N/A
COAX JUMPER	NEW	12	N/A	N/A	FSJ1	10' +/-	N/A	N/A
COAX JUMPER	NEW	48	N/A	N/A	LDF4	10' +/-	N/A	N/A

NOTES:

1. REFER TO VZW FINAL RFDS FOR FINAL EQUIPMENT COUNT & DESIGN
2. DISTANCES LISTED ARE BASED ON EXISTING SITE DRAWINGS. INSTALLED ROUTES MAY VARY. VERIFY IN FIELD PRIOR TO INSTALLATION

1 RF EQUIPMENT SCHEDULE

NOT TO SCALE

RF SCOPE OF WORK:

- INSTALL (6) NEW PANEL ANTENNAS TO REPLACE (6) EXISTING ANTENNAS (LTE)
- INSTALL (3) NEW ACTIVE ANTENNA SYSTEMS (LS6)
- INSTALL (3) NEW ACTIVE ANTENNA SYSTEMS (UWB)
- INSTALL (3) NEW 8843 RRHs TO REPLACE (3) EXISTING GROUND MOUNTED RRHs (1900/2100 LTE)
- RELOCATE (3) EXISTING 4449 RRHs FROM GROUND CABINETS TO TOWER (700/850 LTE)
- INSTALL (2) NEW 12-SPOT OVPs
- INSTALL (1) NEW 12x24 & (1) NEW 6X12 L.I. HYBRID CABLE
- REMOVE (12) UNUSED COAX CABLES FROM TOWER

RF NOTE:

- INSTALL NEW LOW PIM DEVICES WITHIN 10' OF ANTENNAS AND REPLACE EXISTING PIM PRONE DEVICES AS REQUIRED BY VZW NETWORK STANDARDS

A&E SCOPE NOTES:

- INSTALL TOWER LEG REINFORCEMENTS (SEE STRUCTURAL ANALYSIS)
- MODIFY EXISTING ANTENNA MOUNTS
- INSTALL (3) NEW SECTOR FRAMES W/ MODIFICATIONS (SEE ANTENNA MOUNT ANALYSIS)

2 RF SCOPE OF WORK & NOTES

NOT TO SCALE

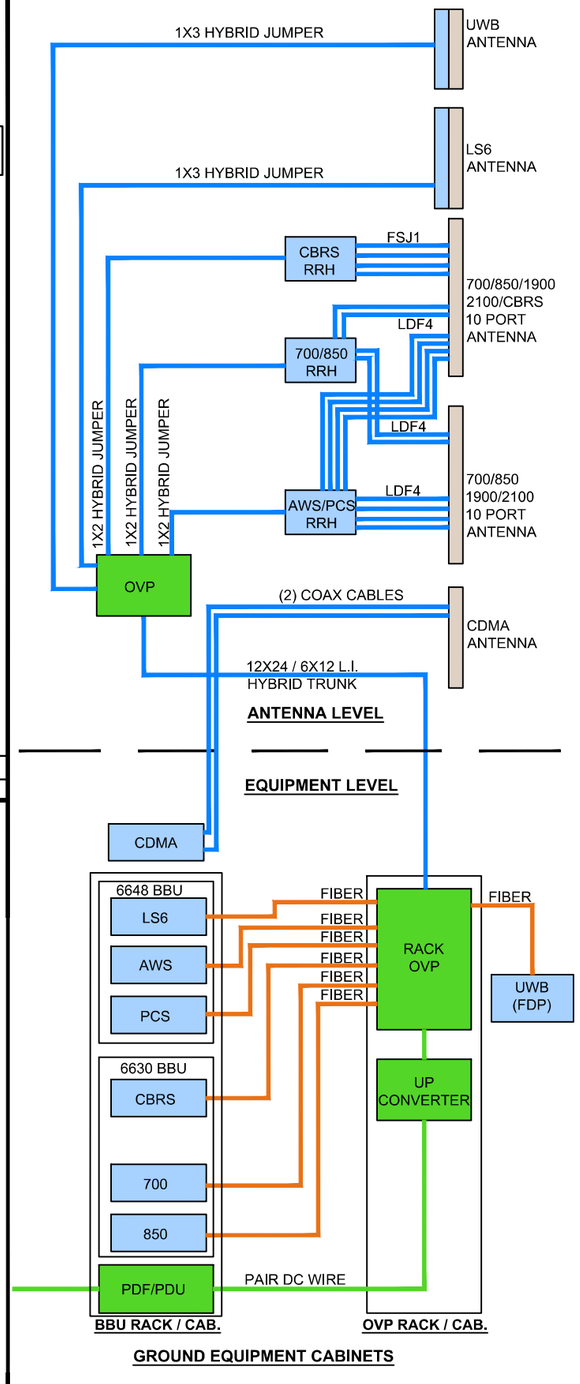
ALPHA SECTOR

BETA SECTOR

GAMMA SECTOR

3 EXISTING ANTENNA VIEWS

NOT TO SCALE



4 SECTOR PLUMBING DIAGRAM

NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:

verizon

VERIZON WIRELESS SERVICES
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124

PLANS PREPARED BY:

RLS
RELIANT LAND SERVICES
5335 W 48TH AVE, STE 301
DENVER, CO 80212

SITE INFORMATION:

SITE NAME:
DEN NORTH WASH PARK

SITE ADDRESS:
1580 E. VIRGINIA AVE
DENVER, CO 80204
DENVER COUNTY

ISSUED FOR:

DATE	DESCRIPTION	BY:
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05/22/22	90% CONSTRUCTION DOCUMENTS REV D EME REPORT & SOW CM COMMENTS	WSG
06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:

COLORADO LICENSED CHRIS S. LEE PE 44498 PROFESSIONAL ENGINEER

Chris Lee, PE Digitally signed by Chris Lee, PE Date: 2022.06.08 14:33:11 -07'00'

SHEET TITLE:
RF INFORMATION & PLUMBING DIAGRAM

SHEET NUMBER:
A5

TYPE A: NOC INFORMATION SIGN

1 GROUND EQUIPMENT GATE

TYPE B: RF GUIDELINES SIGN

N/A

TYPE C: RF CAUTION SIGN

N/A

TYPE D: RF WARNING SIGN

N/A

TYPE E: RF NOTICE SIGN

N/A

TYPE F: BATTERY CAUTION SIGN

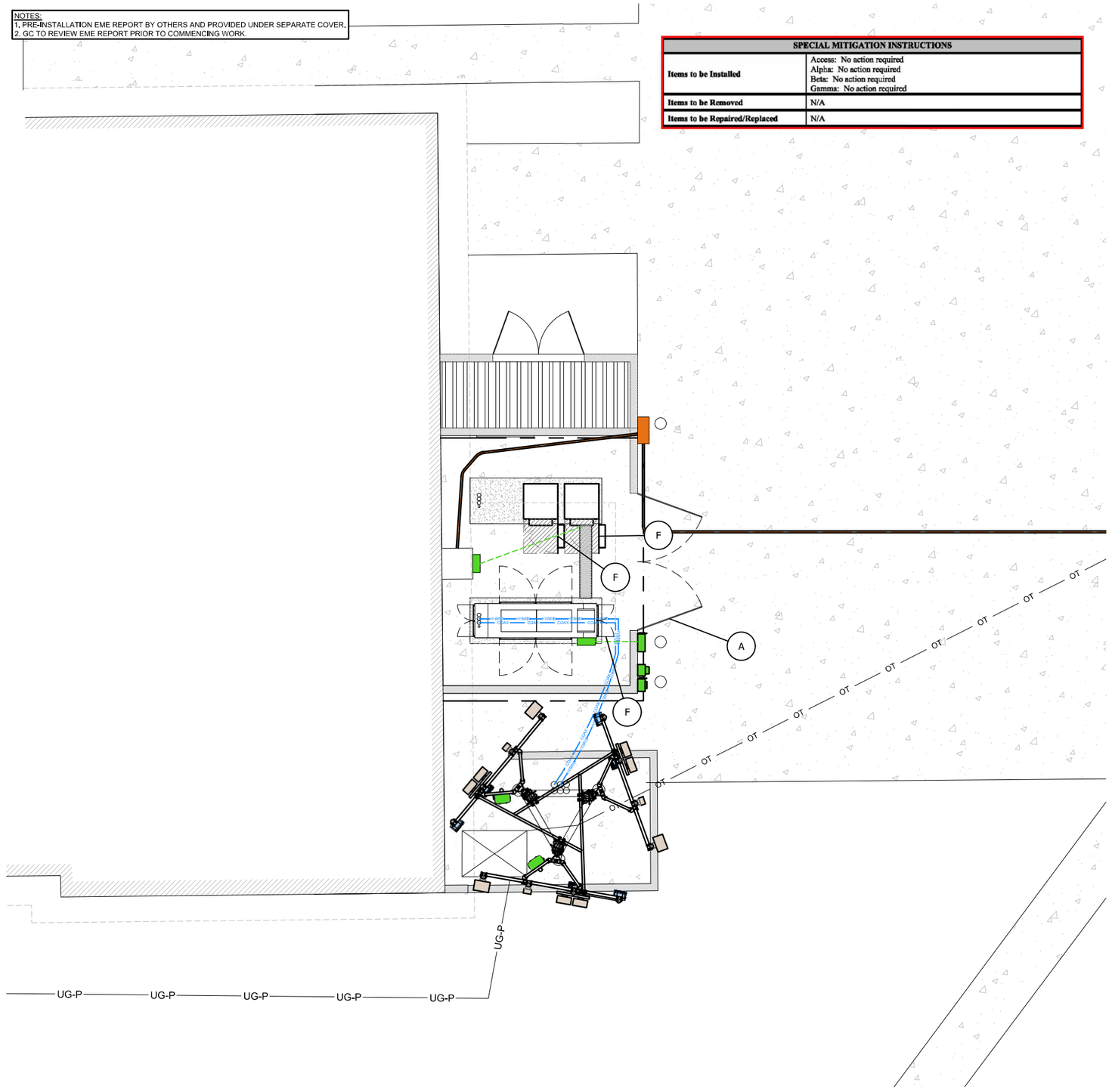
3 AT BATTERY CABINET DOORS

1 SIGNAGE DETAILS

NOT TO SCALE

NOTES:
1. PRE-INSTALLATION EME REPORT BY OTHERS AND PROVIDED UNDER SEPARATE COVER.
2. GC TO REVIEW EME REPORT PRIOR TO COMMENCING WORK.

SPECIAL MITIGATION INSTRUCTIONS	
Items to be Installed	Access: No action required Alpha: No action required Beta: No action required Gamma: No action required
Items to be Removed	N/A
Items to be Repaired/Replaced	N/A



2 OVERALL SITE SIGNAGE PLAN

SCALE: 1" = 10'-0"

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

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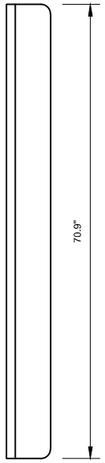
COLORADO LICENSED
CHRIS S. LEE
PE 44498
PROFESSIONAL ENGINEER

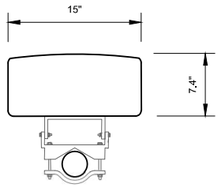
Chris Lee, PE
Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:33:54 -07'00'

SHEET TITLE:
OVERALL SITE SIGNAGE PLAN

SHEET NUMBER:
A6



SIDE



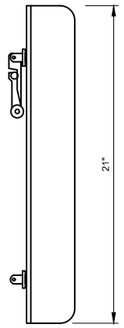
TOP

CONNECTIONS

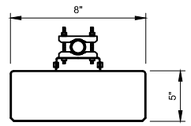
JMA MX10FRO660	
PROPERTY	VALUE
LENGTH	70.9"
WIDTH	15"
DEPTH	7.4"
WEIGHT	57.3 LBS

1 | 10 PORT ANTENNA DETAIL

NOT TO SCALE



SIDE

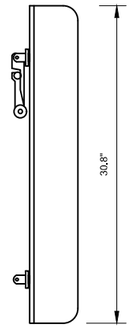


TOP

ERICSSON AIR 6701 UWB ANTENNA	
PROPERTY	VALUE
LENGTH	21"
WIDTH	8"
DEPTH	5"
WEIGHT	29 LBS

2 | ACTIVE ANTENNA SYSTEM DETAIL (UWB)

NOT TO SCALE



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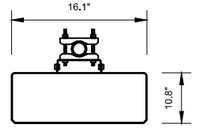


TOP

ERICSSON AIR6449 ANTENNA	
PROPERTY	VALUE
LENGTH	30.8"
WIDTH	16.1"
DEPTH	10.8"
WEIGHT	88 LBS

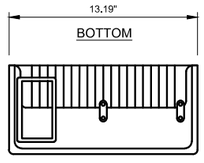
3 | ACTIVE ANTENNA SYSTEM DETAIL (LS6)

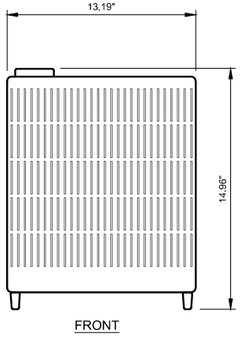
NOT TO SCALE

ERICSSON RRH-8843

DIMENSIONS, HxWxD: 14.96" x13.19" x11.1"

WEIGHT (EXCL. MOUNTING): 75 LBS





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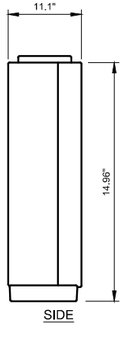


SIDE

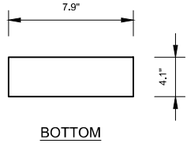
4 | RRH DETAIL

NOT TO SCALE

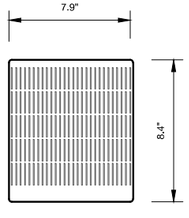
ERICSSON 4408 B48

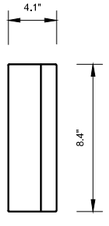
DIMENSIONS, HxWxD: 8.4" x7.9" x4.1"

WEIGHT (EXCL. MOUNTING): ~10 LBS



BOTTOM





SIDE

5 | RRH DETAIL

NOT TO SCALE

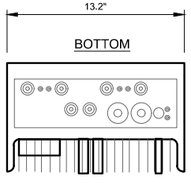
ERICSSON RRH-4449

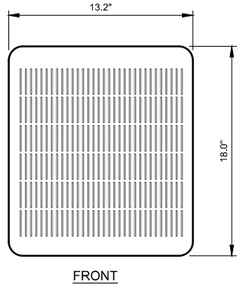
DIMENSIONS, HxWxD: 18.0" x13.2" x9.4"

DC POWER CONSUMPTION: 1439 WATTS

WEIGHT (EXCL. MOUNTING): 70.0 LBS

CONNECTORS: 4 X 4.3-10 FEMALE





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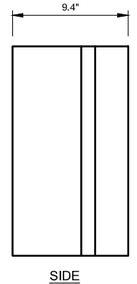

SIDE

6 | RRH DETAIL

NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

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CHRIS S. LEE
PE 44498
PROFESSIONAL ENGINEER

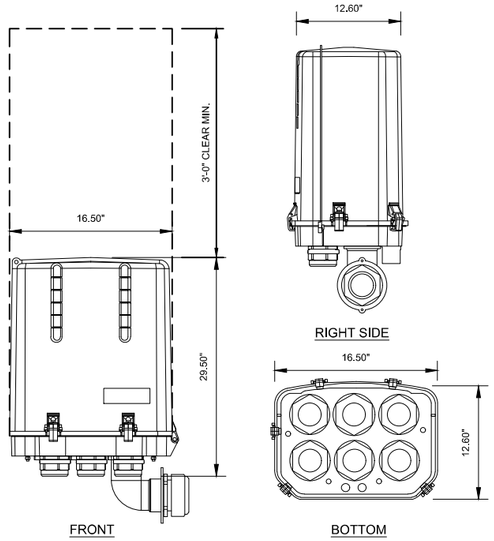
Chris Lee, PE Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:35:21 -07'00'

SHEET TITLE:

EQUIPMENT DETAILS

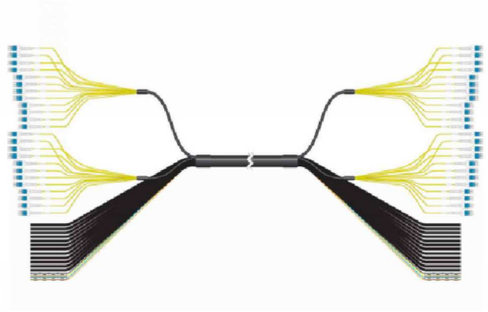
SHEET NUMBER:

A7



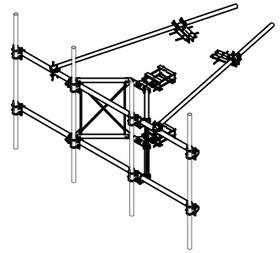
RAYCAP 12-OVP	
PROPERTY	VALUE
HEIGHT	29.50"
WIDTH	16.50"
DEPTH	12.60"
WEIGHT	32.00 LB

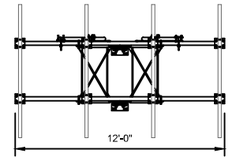
1 OVP DETAIL
NOT TO SCALE

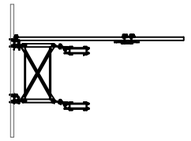


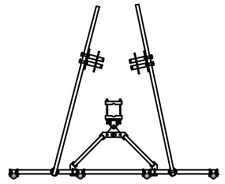
COMMSCOPE HFT2406-48SV3	
PROPERTY	VALUE
DIAMETER OVER JACKET	2"
WEIGHT	3.091 LB/FT
CONDUCTORS	24
FIBER QUANTITY	48

2 12x24 HYBRID CABLE DETAIL
NOT TO SCALE









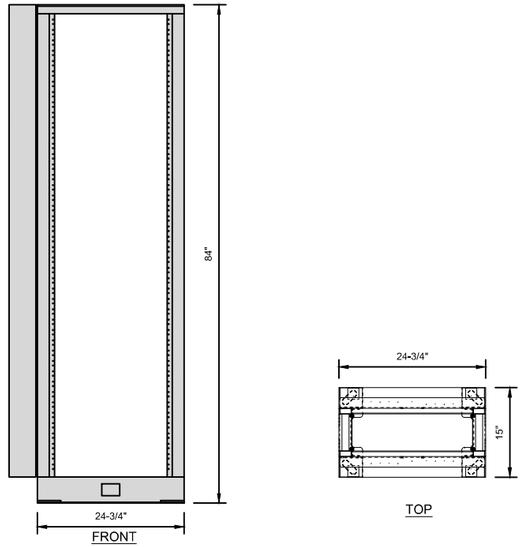
SITEPRO 1 VFA12-HD	
PROPERTY	VALUE
FACE WIDTH	12'-0"
WEIGHT	420 LBS
STIFF ARMS	YES

3 SECTOR MOUNT FRAME DETAIL
NOT TO SCALE

COMMSCOPE POWERSHIFT MODULE	
PROPERTY	*VALUE*
PART NUMBER:	PS-1-73
SUPPORTED CHANNELS	3 PER MODULE
HEIGHT	1.63"
WIDTH	4"
DEPTH	13.85"
POWER PER CHANNEL	1460W
RACK PART NUMBER	PS-R-1

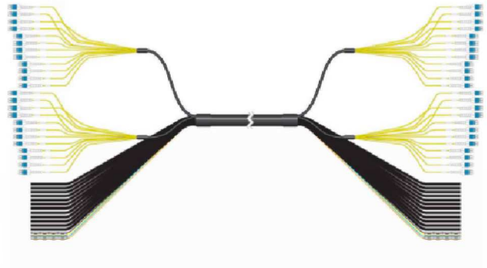
JMA POWERBOOST KITS			
PROPERTY	*VALUE*		
PART NUMBER:	PB-19-KIT6	PB-19-KIT9	PB-19-KIT12
SUPPORTED CHANNELS	6	9-10	12
HEIGHT	3.5"	5.3"	
WIDTH	19"		
DEPTH	18"	22"	22"
POWER PER CHANNEL	1600W		
RACK PART NUMBER	INCLUDED		

4 UP-CONVERTER DETAIL
NOT TO SCALE



EATON COOPER B-LINE P/N# SB85219084	
PROPERTY	VALUE
HEIGHT	84"
WIDTH	24-3/4"
MOUNTING SPACES	43
MOUNTING WIDTH	19"
WEIGHT	113 LBS

5 EQUIPMENT RACK DETAIL
NOT TO SCALE



COMMSCOPE HFT1206-24SV2	
PROPERTY	VALUE
DIAMETER OVER JACKET	1.551"
WEIGHT	1.882 LB/FT
CONDUCTORS	12
FIBER QUANTITY	24

6 6X12 L.I. HYBRID CABLE DETAIL
NOT TO SCALE

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CHRIS S. LEE
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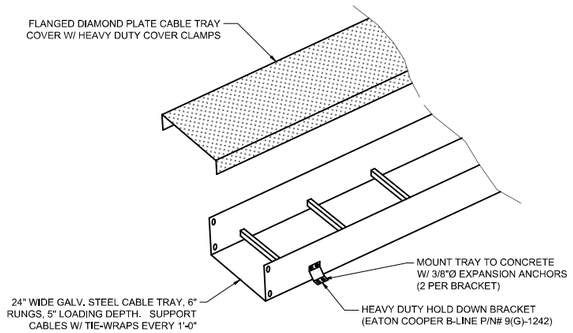
PROFESSIONAL ENGINEER
Chris Lee, PE
Digitally signed by Chris Lee, PE
Date: 2022.06.08 14:35:47 -07'00'

SHEET TITLE:
EQUIPMENT DETAILS

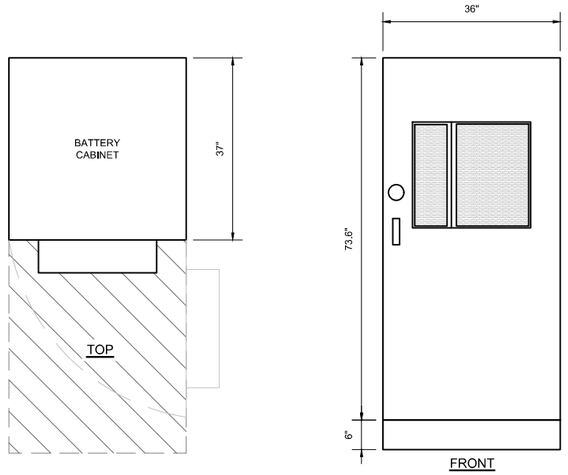
SHEET NUMBER:
A8

NOTES:
1. 1. CABLE TRAY SHALL BE FREE OF SHARP OBJECTS AND BURRS WHICH COULD DAMAGE CABLES.
2. COVERS SHALL BE FASTENED USING HOLD DOWN CLIPS. SHEET METAL SCREWS ARE NOT ACCEPTABLE.



EATON COOPER B-LINE CABLE TRAY - P/N# 356-P-06-24-144	
PROPERTY	VALUE
SIDE RAIL HEIGHT	5"
LOADING DEPTH	4"
WIDTH	24"
MATERIAL	GALVANIZED STEEL

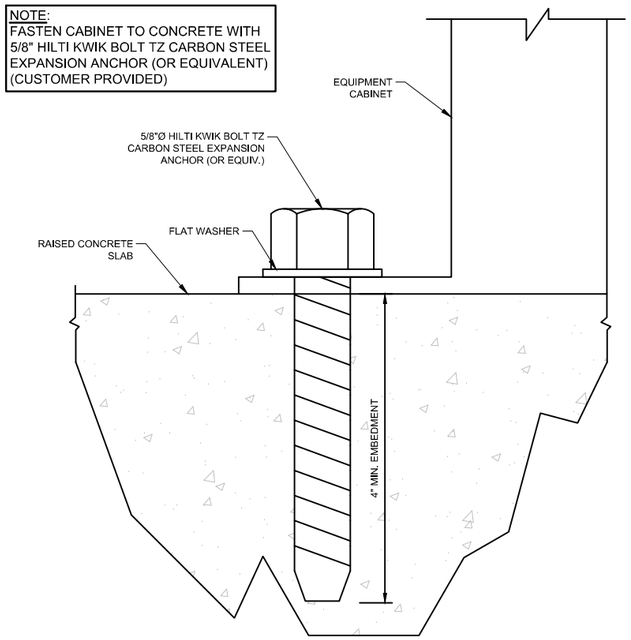
1 CABLE TRAY DETAIL
NOT TO SCALE



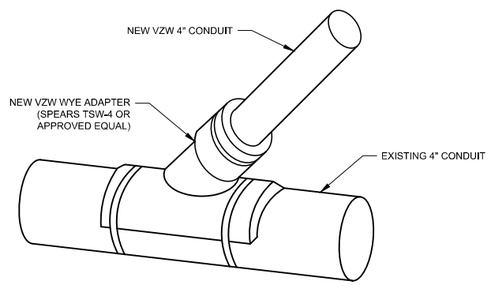
COMMSCOPE CMC74-36B CABINET	
PROPERTY	VALUE
HEIGHT	73.6"
WIDTH	36"
DEPTH	37"
WEIGHT (EMPTY)	650 LBS
WEIGHT (W/ BATTERIES)	4274 LBS

2 BATTERY CABINET DETAIL
NOT TO SCALE

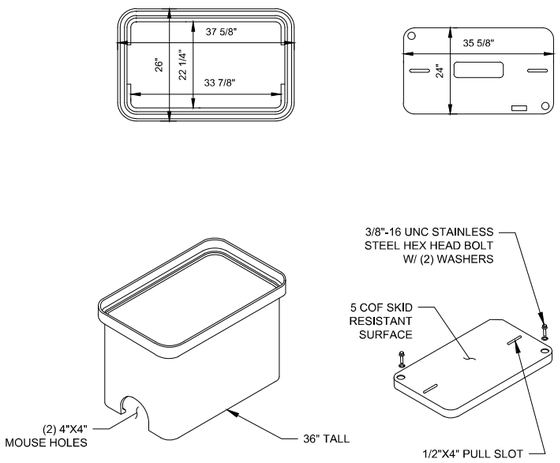
NOTE:
FASTEN CABINET TO CONCRETE WITH 5/8" HILTI KWIK BOLT TZ CARBON STEEL EXPANSION ANCHOR (OR EQUIVALENT) (CUSTOMER PROVIDED)



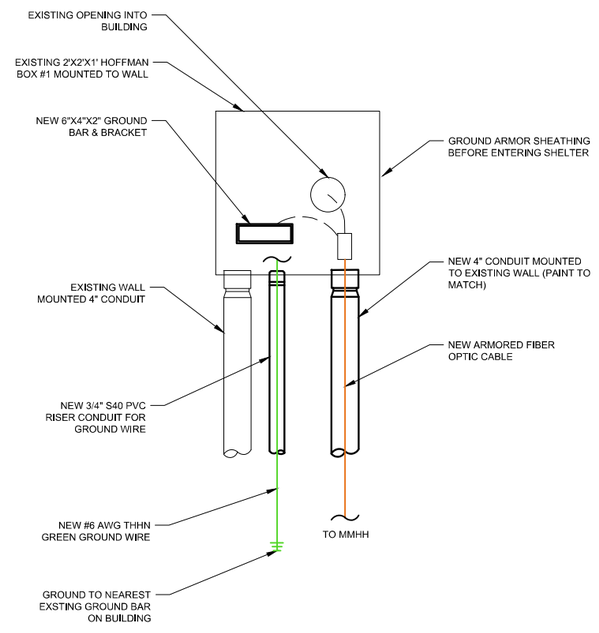
3 CABINET CONNECTION DETAIL
NOT TO SCALE



4 WYE DETAIL
NOT TO SCALE



5 HAND HOLE DETAIL
NOT TO SCALE



6 JUNCTION BOX GROUNDING DETAIL
NOT TO SCALE

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06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

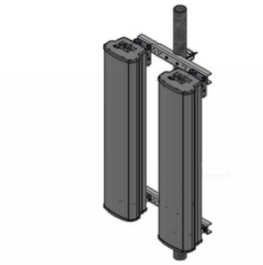
LICENSURE INFO:

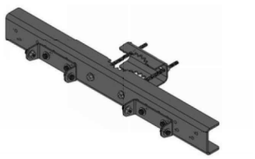
COLORADO LICENSED CHRIS S. LEE PE 44498 PROFESSIONAL ENGINEER

Chris Lee, PE Digitally signed by Chris Lee, PE Date: 2022.06.08 14:36:12 -07'00'

SHEET TITLE:
EQUIPMENT DETAILS

SHEET NUMBER:
A9

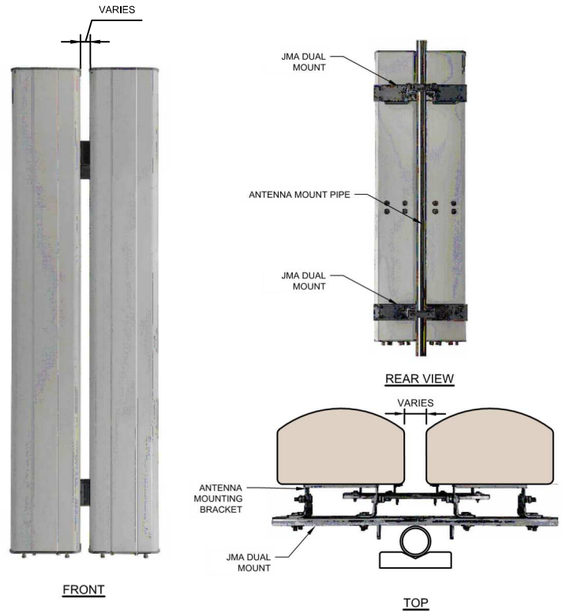




JMA 91900314 DUAL-MOUNT BRACKET	
PROPERTY	VALUE
MATERIAL	GALVANIZED STEEL
# OF BRACKETS FOR 4' ANTENNAS	2
# OF BRACKETS FOR 6'-8' ANTENNAS	3
WEIGHT	22.3 LBS/BRACKET

1 JMA DUAL ANTENNA MOUNT

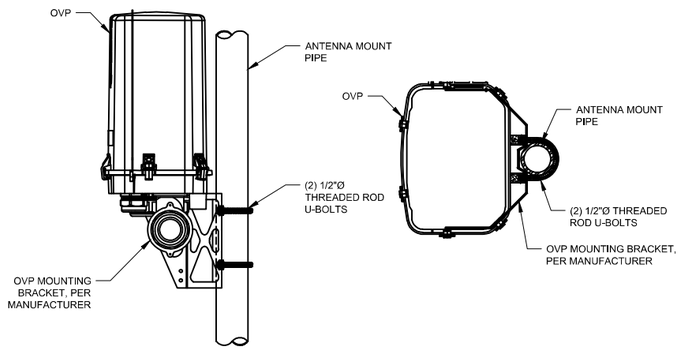
NOT TO SCALE



NOTE: CONFIGURATION MAY VARY. SEE MFG SPEC SHEETS FOR ANTENNA SPECIFIC DIMENSIONS.

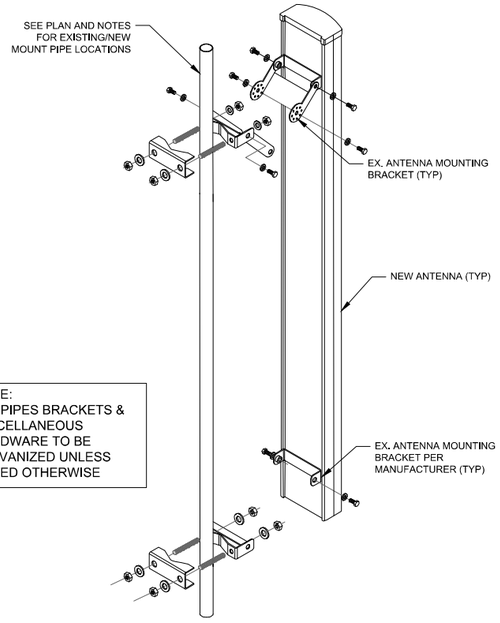
2 DUAL ANTENNA MOUNTING DETAIL

NOT TO SCALE



3 OVP MOUNTING DETAIL

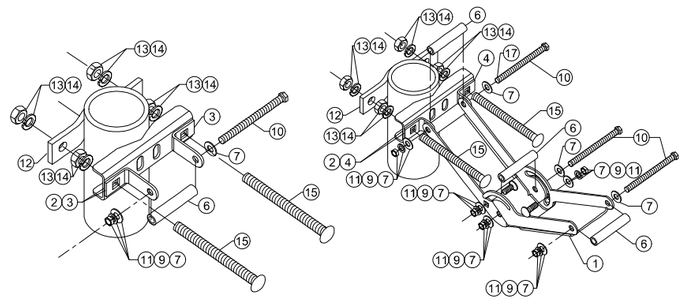
NOT TO SCALE



4 ANTENNA MOUNTING DETAIL

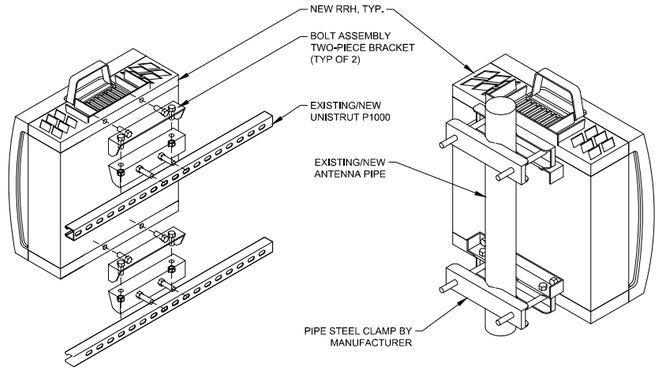
NOT TO SCALE

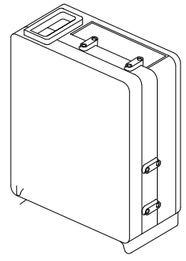
PARTS LIST			
ITEM #	QUANTITY	PART NUMBER	DESCRIPTION
1	2	601257	ANGLE ARM
2	2	601256	MOUNTING CLAMP
3	2	601235-1	BRACKET
4	2	601235-2	BRACKET
5	1	601258	LABEL, ANGLE
6	4	600679-3	SPACER TUBE
7	14	100525-24	ME FLAT WASHER (STAINLESS STEEL)
8	2	600419-8	M8x1.25x25mm LARGE CARRIAGE BOLT (STAINLESS STEEL)
9	6	6/1/7395	M8 LOCK WASHER (STAINLESS STEEL)
10	4	600419-10	M8x1.25x110mm LARGE HEX HEAD SCREW (STAINLESS STEEL)
11	6	204001-15	M81.25 HEX NUT (STAINLESS STEEL)
12	2	225244	CLAMP PLATE
13	8	600419-24	LARGE LOCK WASHER (STAINLESS STEEL)
14	8	204001-21	M12.x1.75 HEX NUT (STAINLESS STEEL)
15	4	600419-12	M12x1.75x150mm LARGE CARRIAGE BOLT (STAINLESS STEEL)
17	1	601584	MOLYBDENUM DISULFIDE GREASE



5 ANTENNA MOUNTING BRACKET DETAIL

NOT TO SCALE





6 RRH MOUNTING DETAIL

NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:

verizon

VERIZON WIRELESS SERVICES
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124

PLANS PREPARED BY:

RLS
RELIANT LAND SERVICES
5335 W 48TH AVE, STE 301
DENVER, CO 80212

SITE INFORMATION:

SITE NAME:
DEN NORTH WASH PARK

SITE ADDRESS:
1580 E. VIRGINIA AVE
DENVER, CO 80204
DENVER COUNTY

ISSUED FOR:

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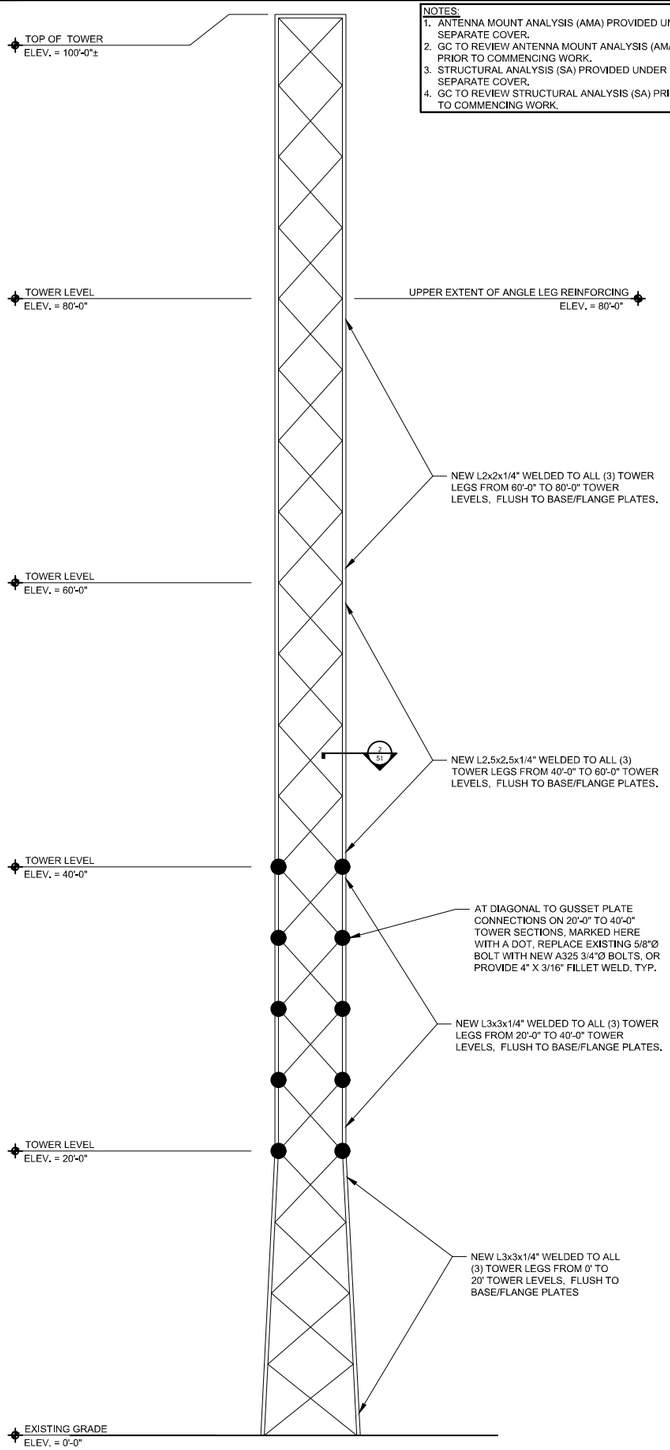
LICENSURE INFO:

COLORADO LICENSED CHRIS S. LEE PE 44498 PROFESSIONAL ENGINEER

Chris Lee, PE Digitally signed by Chris Lee, PE Date: 2022.06.08 14:36:35 -07'00'

SHEET TITLE:
EQUIPMENT DETAILS

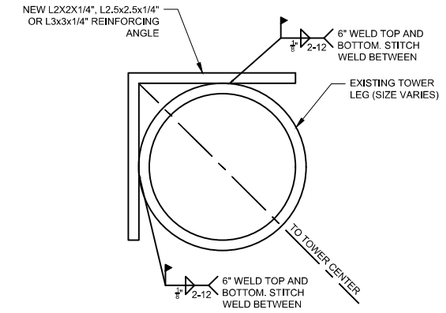
SHEET NUMBER:
A10



NOTES:
1. ANTENNA MOUNT ANALYSIS (AMA) PROVIDED UNDER SEPARATE COVER.
2. GC TO REVIEW ANTENNA MOUNT ANALYSIS (AMA) PRIOR TO COMMENCING WORK.
3. STRUCTURAL ANALYSIS (SA) PROVIDED UNDER SEPARATE COVER.
4. GC TO REVIEW STRUCTURAL ANALYSIS (SA) PRIOR TO COMMENCING WORK.

1 TOWER REINFORCEMENT ELEVATION
SCALE: 3/32" = 1'-0"

3/32"=1'-0" (FULL SIZE)
11' 6' 0



NOTES:
1. WELD ENDS OF REINFORCING ANGLES TO LEG FLANGES OVER FULL ANGLE EDGE.
2. PROVIDE WEEP HOLES AT BOTTOM ENDS FOR DRAINAGE.

2 TOWER LEG REINFORCEMENT SECTION
NOT TO SCALE

REQUIRED SPECIAL INSPECTIONS

STRUCTURAL STEEL	INSPECTIONS (YES/NO)
VISUAL INSPECTION OF MATERIAL AND MEMBER INSTALLATION	YES
VISUAL INSPECTION OF BOLTS	YES
VISUAL INSPECTION OF WELDS	YES

REQUIRED SPECIAL INSPECTIONS - TESTING

STRUCTURAL STEEL	TESTING (YES/NO)
NON-DESTRUCTIVE WELD TESTING	YES
BOLT PRE-TENSION TESTING	NO
SHEAR STUD HAMMER TEST	NO

3 SPECIAL INPECTIONS AND TESTING
NOT TO SCALE

DESIGN CRITERIA

BUILDING CODE	2018 INTERNATIONAL BUILDING CODE AND TIA/EIA 222-H		
WIND IN ACCORDANCE WITH ASCE 7 CHAPTER 6 AND TIA/EIA 222-H	OCCUPANCY/RISK CATEGORY	II	TABLE 1604.5
	DESIGN PROCEDURE	DIRECTIONAL METHOD	
	IMPORTANCE FACTOR (I)	1.0	
	EXPOSURE CATEGORY	C	
	BASIC WIND SPEED (3 SEC GUST) Vasd;Vult	90 MPH	115 MPH
	SERVICE WIND SPEED (3 SEC GUST)	60 MPH	
	TOPOGRAPHIC CATEGORY	1	
	CREST HEIGHT	0 FT	
	ICE THICKNESS	0.25"	
	STRUCTURE CLASS	II	
	SITE ELEVATION	5280 FT	
	SEISMIC Ss	0.182	
	SEISMIC S1	0.058	

STEEL

CODES	AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE MANUAL		
	LATEST EDITION		
STEEL SECTIONS	SECTION TYPE	MIN. YIELD STREGTH	ASTM DESIGNATION
	ANGLES & PLATES	50 KSI	A572
CONNECTIONS	USE STANDARD AISC FRAMED CONNECTIONS (U.N.O.)		
	TYPE	DESCRIPTION	
	BOLTS	A325 - 1/2"Ø (U.N.O.) OR WELDED EQUIVALENT	
		1. ALL BOLTED CONNECTIONS ARE TO BE "SNUG TIGHT" (U.N.O.) 2. USE WASHERS AT SHORT SLOTTED AND 5/16" WASHER PLATES AT LONG SLOTS	
	WELDS	1. MIN. OF 3/16" CONTINUOUS FILLET USING E70XX ELECTRODES (U.N.O.)	
GALVANIZED	ALL EXPOSED STEEL TO BE GALVANIZED. PROVIDE 2 COATS GALVANIZED TOUCH UP PAINT FOR ALL AREAS THAT ARE WELDED OR HAVE DAMAGED GALVANIZED AREAS.		

4 DESIGN CRITERIA & STEEL TABLES
NOT TO SCALE

BILL OF MATERIALS

ELEVATION (FT)	VERTICAL LEG ANGLE REINFORCEMENT (QTY)	NEW ANGLE MEMBER SIZE	NEW ANGLE MEMBER LENGTH[1] (FT)	NEW ANGLE MEMBER GRADE	DIAGONAL MEMBER BOLT REPLACEMENT SIZE	DIAGONAL BOLT GRADE	DIAGONAL BOLT QTY
0' - 20'	3	L3x3x1/4"	20'-6"	A572 Gr 50	-	-	-
20' - 40'	3	L3x3x1/4"	20'-6"	A572 Gr 50	3/4"	A325N	96
40' - 60'	3	L2.5x2.5x1/4"	20'-6"	A572 Gr 50	-	-	-
60' - 80'	3	L2x2x1/4"	20'-6"	A572 Gr 50	-	-	-

NOTES:
1. FIELD MEASURE REINFOREMENT ANGLES AND CUT TO LENGTH TO FIT FLUSH BETWEEN INSIDE FACE OF TOWER LEG FLANGES.
2. ALL REPLACEMENT STEEL TO BE HOT-DIPPED GALVANIZED.
3. ALL BOLTS GRADE A325N WITH LOCK WASHER AND HEAVY HEX NUT (GALVANIZED).
4. PROVIDE 2 COATS COLD GALVANIZING PAINT TO ALL FIELD CUT EDGES OF STEEL AND WELDS.

5 BILL OF MATERIALS
NOT TO SCALE

Mikko Ahola
Digitally signed by Mikko Ahola
DN: cn=Mikko Ahola, o=Ahola Engineering LLC, ou, email=mikko_ahola@email.com, c=US
Date: 2022.06.09 15:25:03 -06'00'

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:
verizon
VERIZON WIRELESS SERVICES
10000 PARK MEADOWS DR, STE 300
LONE TREE, CO 80124

PLANS PREPARED BY:
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RELIANT LAND SERVICES
5335 W 48TH AVE, STE 301
DENVER, CO 80212

SITE INFORMATION:

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DENVER COUNTY

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06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:
COLORADO LICENSED
MIKKO P AHOLA
PE-33495
06/09/22
PROFESSIONAL ENGINEER
DEN North Wash Park

SHEET TITLE:
STRUCTURAL DETAILS & SPECIAL INSPECTIONS

SHEET NUMBER:
S1

NOTES:
1. ANTENNA MOUNT ANALYSIS (AMA) PROVIDED UNDER SEPARATE COVER.
2. GC TO REVIEW ANTENNA MOUNT ANALYSIS (AMA) PRIOR TO COMMENCING WORK.
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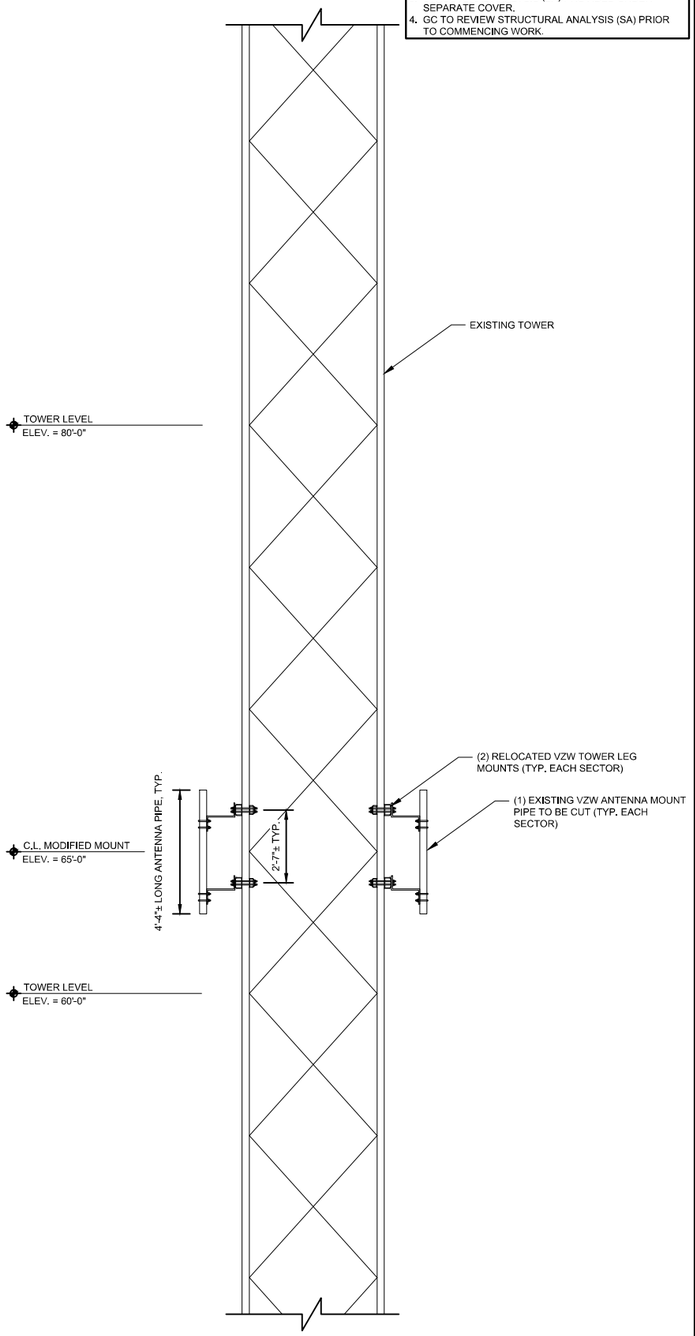

1 ANTENNA MOUNT MODIFICATION DETAIL
SCALE: 3/16" = 1'-0"

2 NOT USED
NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

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verizon

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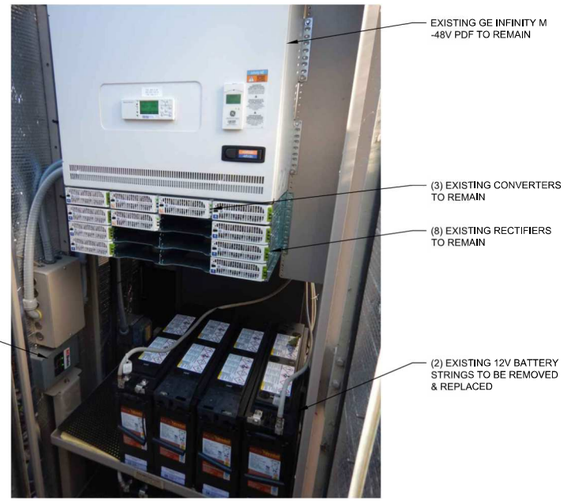
06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:

COLORADO LICENSED
MARCO P. AHUMADA
PE-33495
06/09/22
PROFESSIONAL ENGINEER
DEN North Wash Park

SHEET TITLE:
STRUCTURAL DETAILS

SHEET NUMBER:
S2



EXISTING PDF RACK

EXISTING RECTIFIER & CONVERTER INFORMATION			
CONVERTERS		RECTIFIERS	
QUANTITY	MODEL	QUANTITY	MODEL
3	NE075DC24A	8	NE050AC48ATEZ

1 EXISTING PDF RACK DETAIL

NOT TO SCALE

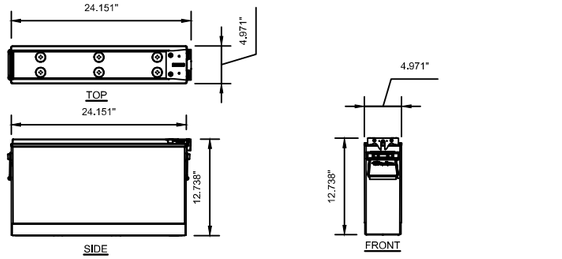
PANEL NAME	VZW - SOUTH PANEL				ENCL. TYPE	NEMA 3R			
VOLTAGE RATING	120/240	VAC			MOUNTING TYPE	SURFACE			
CONN. LINE VOLTAGE	240	VAC			LOCKABLE CABINET?	YES			
PHASE	1 WIRE	3			DOOR-IN-DOOR?	NO			
BUS TYPE	MAIN BREAKER				MFR.	SIEMENS			
BUS RATING	200	AMPS			MODEL	OUTDOOR LOAD CENTER			
MAIN BREAKER	200	AMPS			CAT. NO.	W3040B1200CU			
BREAKER TYPE	PLUG-IN				SERIES RATED BY MFR?	YES			
INTERRUPTING RATING	22	KAIC			FUSE TYPE	NA			

LOAD	POS	CB	PHASE	VA	VA	PHASE	CB	POS	LOAD
RECT 1	1	2P30	A	-	-	A	2P30	2	RECT 2
	3		B	-	-	B		4	
RECT 3	5	2P30	A	-	-	A	2P30	6	RECT 4
	7		B	-	-	B		8	
RECT 5	9	2P30	A	-	-	A	2P30	10	RECT 6
	11		B	-	-	B		12	
RECT 7	13	2P30	A	-	-	A	2P30	14	RECT 8
	15		B	-	-	B		16	
SPACE	17		A	-	-	A		18	SPACE
SPACE	19		B	-	-	B		20	SPACE
OUTLETS	21	1P20	A	-	-	A	1P20	22	LIGHTS
A/C-#2	23	2P40	B	-	-	B	2P20	24	A/C SHUT DOWN
	25		A	-		A		26	
A/C-#1	27	2P40	B	-		B	2P30	28	UNKNOWN
	29		A	-		A		30	

NOTES:
1. RE-LABEL RECTIFIER AND CONVERTER POSITIONS AS NEEDED FOR NEW INSTALLATION. SEE SHEET E2.

2 EXISTING PANEL SCHEDULE - SOUTH CABINET

NOT TO SCALE



DEKA HT200ET BATTERY	
PROPERTY	VALUE
NUMBER OF POSTS	2
RATING	190 AMPERE/HOURS @ 8 HR RATE TO 1.75 V.P.C.
DESIGN LIFE	10 YEARS IN FLOAT APPLICATIONS @ 95°F
LENGTH	24.15"
HEIGHT	12.73"
WIDTH	4.97"
WEIGHT	151 LBS

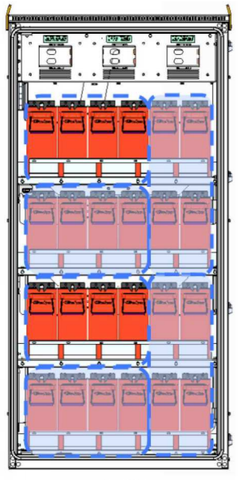
BATTERY TYPE	BATTERY WEIGHT (NOMINAL)		ELECTROLYTE (PER BATTERY)			
			VOLUME		WEIGHT	
	LBS	KG	GAL	LITER	LBS	KG
HT200ET	151	68.5	2.07	7.84	22.65	10.27

BATTERY SPECIFICATION:
- NON-SPILLABLE CLASSIFICATION
- VALVE REGULATED - LOW POSITIVE PRESSURE, SELF-SEALING W/ FLAME ARRESTOR

DEKA HT200ET - EACH CELL HAS AN ELECTROLYTE CAPACITY OF 2.07 GALLONS EACH. (56) CELLS IN THIS OCCUPANCY RESULTING IN AGGREGATE ELECTROLYTE VOLUME OF 115.92 GALLONS.
STATIONARY STORAGE BATTERY SYSTEMS HAVING CAPACITIES EXCEEDING THE VALUES SHOWN IN TABLE 1206.2 SHALL COMPLY WITH SECTION 1206.2.1 THROUGH 1206.2.12.6, AS APPLICABLE. (LEAD-ACID, ALL TYPES - 70 kWh)
THIS INSTALLATION CONTAINS 127.68 kWh.

3 DEKA HT200ET BATTERY DETAIL & CALCS

NOT TO SCALE



FRONT

NOTE: CABINETS ARE SEISMICALLY RATED WHEN INSTALLED PER MANUFACTURES SPECIFICATIONS.

COMMSCOPE CMC74-36B	
WEIGHT TOTAL EMPTY:	650 LBS
WEIGHT TOTAL W/ BATTERIES:	4,274 LBS

4 BATTERY CABINET DETAIL

NOT TO SCALE

5 NOT USED

NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

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COLORADO LICENSED CHRIS S. LEE PE 44498 PROFESSIONAL ENGINEER

Chris Lee, PE Digitally signed by Chris Lee, PE Date: 2022.06.08 14:36:58 -07'00'

SHEET TITLE:
BATTERY, PDF & PANEL DETAILS

SHEET NUMBER:
E1

SYMBOL LEGEND

PANEL A — PANELBOARD OR SWITCHGEAR

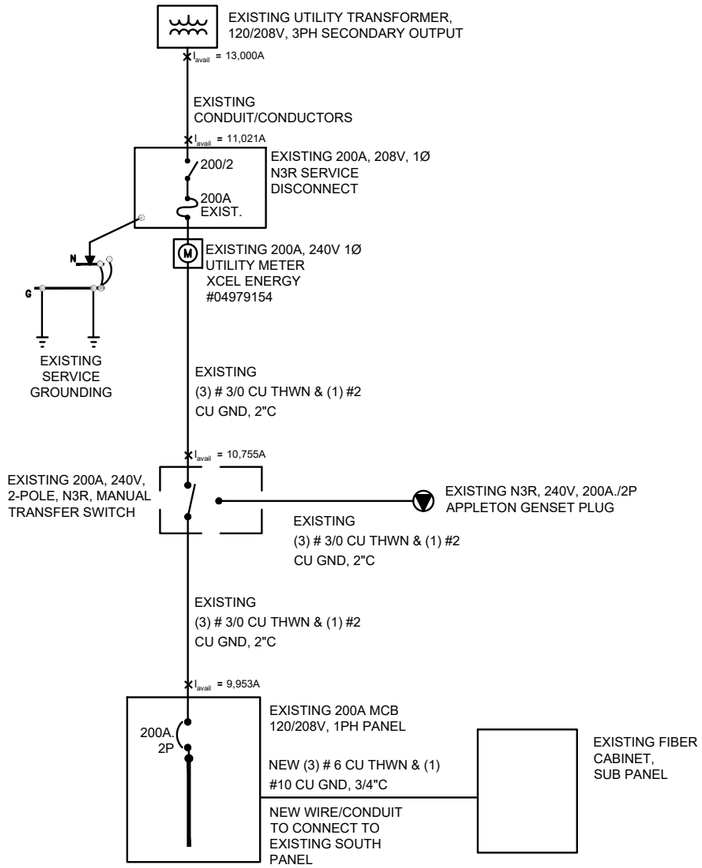
FUSED DISCONNECT

POTENTIAL TRANSFORMER

GROUND

EXTERIOR LIGHT FIXTURE

UTILITY METER



ONE-LINE DIAGRAM GENERAL NOTES:

1.	E.C. TO FIELD VERIFY SITE CONDITIONS.
2.	ALL EQUIPMENT IS NEW UNLESS NOTED AS EXISTING (E).
3.	ALL EXTERIOR EQUIPMENT TO BE WEATHERPROOF.
4.	PROVIDE GROUNDING PER NEC.

1 ONE LINE DIAGRAM

SCALE: NOT TO SCALE

PANEL NAME	200A PANEL			ENCL. TYPE	NEMA 3R		NOTES:
VOLTAGE RATING	120/240	VAC		MOUNTING TYPE	SURFACE		
CONN. LINE VOLTAGE	208	VAC		LOCKABLE CABINET?	YES		
PHASE	1 WIRE	3		DOOR-IN-DOOR?	NO		
BUS TYPE	MAIN BREAKER			MFR.	SIEMENS		
BUS RATING	200	AMPS		MODEL	OUTDOOR LOAD CENTER		
MAIN BREAKER	200	AMPS		CAT. NO.	W3040B1200CU		
BREAKER TYPE	PLUG-IN			SERIES RATED BY MFR?	-		
INTERRUPTING RATING	22	KAIC		FUSE TYPE	NA		

LOAD	POS	CB	PHASE	VA	VA	PHASE	CB	POS	LOAD
RECTIFIER 1	1	2P30	A	1800	1800	A	2P30	2	RECTIFIER 2
	3		B	1800	1800	B		4	
RECTIFIER 3	5	2P30	A	1800	1800	A	2P30	6	RECTIFIER 4
	7		B	1800	1800	B		8	
RECTIFIER 5	9	2P30	A	1800	1800	A	2P30	10	RECTIFIER 6
	11		B	1800	1800	B		12	
RECTIFIER 7	13	2P30	A	1800	1800	A	2P30	14	RECTIFIER 8
	15		B	1800	1800	B		16	
FIBER CABINET SUB PANEL	17	2P50	A	3150	-	A		18	BLANK
	19		B	3150	-	B		20	BLANK
OUTLETS (EXISTING)	21	1P20	A	180	250	A	1P20	22	LIGHTS (EXISTING)
A/C 2 (EXISTING)	23	2P40	B	1820	400	B	2P20	24	AC SHUT DOWN (EXISTING)
	25		A	1820	400	A		26	
A/C 1 (EXISTING)	27	2P40	B	1820	1260	B	2P30	28	NOT LABELED
	29		A	1820	1260	A		30	
			A TOTAL	23,280	B TOTAL	22,850			

LOAD TYPE	CONN. LOAD		NEC D.F.		NEC LOAD	TOTAL LOAD	
RECEPTACLES < 10 KVA	180	x	100%	=	180	44.6	KVA
LIGHTING	250	x	125%	=	313	93	%
LARGEST MOTOR	3640	x	125%	=	4550	185.8	AMPS
UNITARY HVAC EQUIPMENT	3640	x	100%	=	3640		
DC RECTIFIERS	28800	x	100%	=	28800		
OTHER	7100	x	100%	=	7100		
TOTAL	43,610	VA			44,593	VA	

2 NEW PANEL SCHEDULE

SCALE: NOT TO SCALE

FAULT CURRENT CALCULATION TABLE :

								AVAILABLE FAULT CURRENT (F):				F(L-L)	F(L-N)
(E) 75KVA UTILITY TRANSFORMER			V(L-L) 208	V(L-N) 120								13,000	39,063
LOCATION (n)	# of RUNS	CONDUCTOR	V(L-L)	V(L-N)	2=NON-MAG	L(ft)	C	f(L-L)	f(L-N)	M(L-L)	M(L-N)	F(L-L)	F(L-N)
(E) SERVICE DISC.	1	3/0	208	120	2	20	13,923	0.18	0.94	0.848	0.517	11,021	20,185
(E) MTS	1	3/0	208	120		3	12,844	0.025	0.08	0.976	0.927	10,755	18,715
(E) PANEL	1	3/0	208	120		10	12,844	0.081	0.24	0.925	0.805	9,953	15,058

NOTES:

1.	ALL CALCULATIONS UTILIZE BUSSMAN "POINT-TO-POINT" METHOD.			
2.	VARIABLES:	L=FEEDER LENGTH (LF) C=CONDUCTOR "C" VALUE	M(n)=(1/(1+F(n)) F(n)=F(n-1) x M(n)	f(n)(L-L)=(2 x L x F(L-L)(n-1)/(C x # of runs x VOLTAGE) in AMPERES f(n)(L-N)=(2 x L x F(L-L)(n-1)/(C X # of runs x VOLTAGE) in AMPERES
3.	THE E.C. SHALL FIELD REPORT ANY DISCREPANCIES TO THE ENGINEER.			
4.	CONDUCTOR LENGTHS SHALL BE LESS THAN THE VALUES LISTED. THE E.C. SHALL FIELD VERIFY CONDUCTOR LENGTHS AND CONTACT ENGINEER IMMEDIATELY IF CONDUCTOR LENGTHS ARE LESS THAN THE VALUE SHOWN.			
5.	CONDUCTOR LENGTHS LISTED IN THIS TABLE ARE FOR FAULT STUDY PURPOSES ONLY AND SHALL NOT BE USED FOR BIDDING OR OTHER CALCULATIONS.			
6.	ALL IN-LINE UTILITY METERS SHALL BE PROTECTED TO LIMIT THE FAULT CURRENT TO NO MORE THAN 10kA AT THE METER PER UTILITY COMPANY REQUIREMENTS.			
7.	LABEL AND DATE AVAILABLE FAULT CURRENT VALUE AT THE MAIN SERVICE DISCONNECT PER NEC 110.2(A).			
8.	PROVIDE ARC-FLASH HAZARD STUDY AND LABELING FOR PERSONNEL AND PROTECTIVE EQUIPMENT PRIOR TO ENERGIZING IN ACCORDANCE WITH NEC 110.16 AND NFPA 70E.			

3 FAULT CALCULATIONS

SCALE: NOT TO SCALE

COLOR LEGEND: HYBRID CABLES & COAX CABLES | RRH/BBU | POWER/GROUNDING | FIBER | ANTENNAS | PENETRATIONS | LEASE AREA | ACCESS/UTILITY EASEMENT | UTILITY EASEMENT

APPLICANT:

verizon

VERIZON WIRELESS SERVICES
8350 E CRESCENT PKWY STE #200
GREENWOOD VILLAGE, CO 80111

PLANS PREPARED BY:

RLS
RELIANT LAND SERVICES
5335 W 48TH AVE, STE 301
DENVER, CO 80212

SITE INFORMATION:

SITE NAME:
DEN NORTH WASH PARK

SITE ADDRESS:
1580 E. VIRGINIA AVE
DENVER, CO 80204
DENVER COUNTY

ISSUED FOR:

DATE	DESCRIPTION	BY:
08/27/21	90% CONSTRUCTION DOCUMENTS DESIGN REVIEW	WSG
12/22/21	90% CONSTRUCTION DOCUMENTS REV A RF UPDATE	WSG
01/24/22	90% CONSTRUCTION DOCUMENTS REV B STRUCTURAL ANALYSIS UPDATE	WSG
04/21/22	90% CONSTRUCTION DOCUMENTS REV C EME REPORT	WSG
06/07/22	100% CONSTRUCTION DOCUMENTS BUILDING PERMIT	WSG

LICENSURE INFO:

COLORADO LICENSED
JEREMY NEAL JOHNSON
55872
PROFESSIONAL ENGINEER
6/7/2022

SHEET TITLE:
ONE-LINE DIAGRAM & NEW PANEL DETAILS

SHEET NUMBER:
E2

Otegui Structural Services, LLC
8842 West Powers Place Littleton, CO 80123
Phone: 720-981-5333
e-mail: mikeo@oteguieng.com

January 23, 2020

Rex Crook
T-Rex Architex
5935 S. Zang St
Suite 280
Littleton, CO 80127

RE: DEN-North Wash Park
1580 E. Virginia Ave
Denver, CO
Site No.: Verizon Wireless

Dear Rex:
I am writing you this letter to response to your request for analysis of an existing 100'-0" Sabre self-supported tower with the intent to install new mounts, flat panel antennas, and RRH units.

Analysis was done using the following: TIA/EIA-222-G code/ International Building Code (1609.1.1 Exception 5, 3108), Vasd = 90 mph, Vult = 115 mph (3-sec gust), Exposure C, topographic category 1 for maximum stress calculations, and a 60-mph wind speed for deflection calculations.

Our analysis, based on the information in the attached report, finds that the tower will have a **rating of 72% or satisfactory after reinforcing.** Please refer to the attached report for more details.

Please feel free to call us with any questions or concerns.

Sincerely:

Michael A. Otegui, P.E.
Otegui Structural Services, LLC

GENERAL

The purpose of this report is to analyze an existing 100'-0" Sabre self-supported tower with the intent install new mounts, flat panel antennas, and RRH units after reinforcing. Analysis is to verify that the loading complies with the TIA/EIA-222-G code and the current International Building Code (1609.1.1 Exception 5, 3108).

The tower is 100ft tall, 3-sided, self-supported tower with steel pipe legs and steel angle diagonals. See attached output for a more detailed description of geometry, and sketches for reinforcing.

The existing tower is located in the Denver County, Colorado. Wind load requirement of Vult = 115 mph, Vasd = 90 mph (3-sec gust), exposure C is required for the location.

INFORMATION PROVIDED FOR ANALYSIS

Original tower drawings by Sabre dated 11/17/2006 were provided. Tower loading information was provided by T-Rex.

ASSUMPTIONS

All sizes and geometry from the Sabre drawings are assumed to be correct. It is assumed that the tower is in good condition, with no deterioration or damage. Also, tower reinforcing is assumed completed as shown on the attached drawings.

DESIGN CRITERIA

The following is the design criteria used for this report:

- Tower is located in Denver County, Colorado.
- Basic wind speed of Vult =115 mph, Vasd = 90 mph.
- Structure Class II.
- Exposure Category C.
- Topographic Category 1.
- Temperature drop of 50 °F.
- Deflections calculated using a wind speed of 60 mph.
- Stress ratio used in tower member design is 1.

APPURTENANCES

The following appurtenances attached to the tower were used in the analysis:

Description	Model	Owner	Dimensions	No.	Coax	Elev.	New/ Exist
Omni	4ft Omni	UK	48”x2”	1	(1) ½”	100’-0”	E
Yagi	4ft	UK	48”x2”	1	(1) ½”	100’-0”	E
Dish	2ft	UK	24”	1	(1) ½”	95’-0”	E
Flat Panel	MX06FRO660-02	VW	71”x15”x11”	6	6-12	73’-0”	N
Flat Panel	BXA-70063-6CF	VW	71”x11”x5”	3	(18) 7/8”	73’-0”	E
10ft Sector Frame	Valmont	--	10’-0”	3	--	73’-0”	N
OVP	DB-B1	VW	20"x16"x10"	1	--	73’-0”	N
RRH	Ericsson 4449	VW	15”x13"x9"	3	--	73’-0”	N
RRH	Ericsson 8843	VW	15"x13"x11"	3	--	73’-0”	N

Note: VW = Verizon Wireless, ATT = AT&T, SP = Sprint, UK = Unknown
** = All coax to run inside pole

RESULTS

The analysis finds that the tower will have a rating of 72%. That is, the highest stress on any one member is at 72% of its code allowed maximum.

Highest stressed members are as follows:

Elevation (ft)	Leg (%)	Diagonals (%)	Bolts (%)
100-80	10	8	12
80-60	69	35	56
60-40	60	45	72
40-20	65	55	72
20-0	59	26	31

Maximum deflections at service loading can be expected as follows:

Elevation	Deflection	Tilt	Twist
100ft	3.5”	0.1°	0.1°

FOUNDATIONS

The existing foundations are 2'-6" diameter piers drilled 30'-0" deep. The loading comparison is as follows:

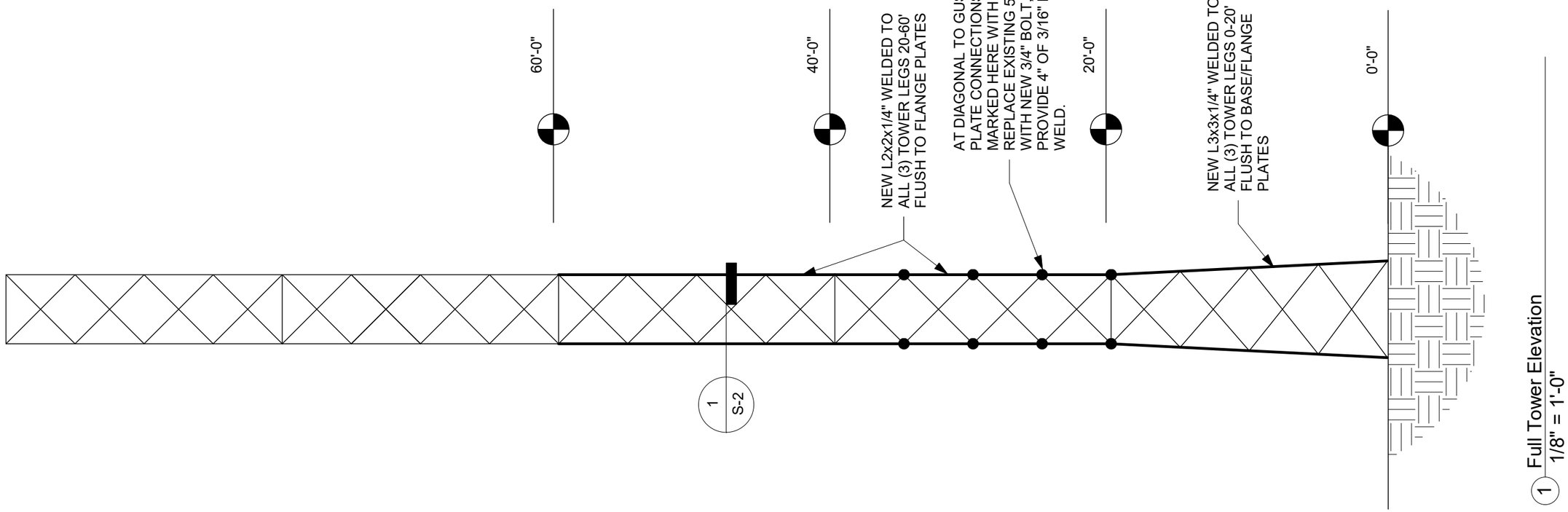
Loading	Original	Current
Vert. Dwn. (kips)	116	106
Vert Up (kips)	106	93
Shear (kips)	7.5	5.6

Therefore, it can be assumed that the existing foundations are adequate for the new loading

CONCLUSIONS

In our opinion the tower is **adequate** for the installation of equipment described above **after reinforcing**.

No attempt was made by Otegui Structural Services LLC to verify sizes, elevations or condition of the existing tower or framing. All framing information used in this report was provided by others. It is assumed that the tower is in good condition with no deterioration. Owner should verify that the tower is in good condition. This report does not imply a warranty for the tower.



Otegui Structural Services, LLC
8842 West Powers Place
Littleton, CO 80123
720-981-5333 mikeo@oteguieng.com

Verizon Wireless

DEN North Wash Park Tower Reinforcing

No.	Description	Date

Elevation

Project number	22014	S-1
Date	1-23-2020	
Drawn by	MAO	
Checked by	MAO	Scale 1/8" = 1'-0"

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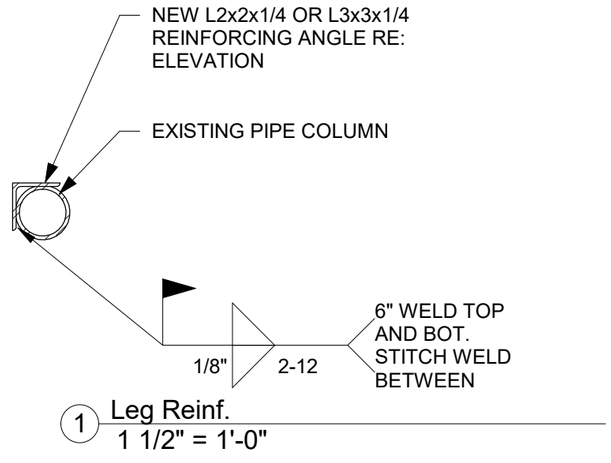
SPECIAL INSPECTION CHECKLIST			
INSPECTIONS		TESTING	
STRUCTURAL STEEL	Y/N	STRUCTURAL STEEL	Y/N
Visual insp. of material and member installation	Y	Non-Destructive Weld Testing	Y
Visual insp. of bolts	Y	Bolt Pre-Tension testing	NA
Visual insp. of welds	Y	Shear stud hammer test	NA



1 Leg Reinf.
1 1/2" = 1'-0"

DESIGN CRITERIA

BUILDING CODE	2015 INTERNATIONAL BUILDING CODE AND TIA/EIA 222-G		
	OCCUPANCY / RISK CATEGORY	II	TABLE 1604.5
WIND IN ACCORDANCE WITH ASCE 7 CHAPTER 6 AND TIA/EIA 222-G	DESIGN PROCEDURE	DIRECTIONAL METHOD	
	IMPORTANCE FACTOR (I)	1.0	
	EXPOSURE CATEGORY	C	
	BASIC WIND SPEED (3 SEC GUST) Vasd;Vult	90 MPH	115 MPH
	SERVICE WIND SPEED (3 SEC GUST)	60 MPH	
	TOPOGRAPHIC CATEGORY	1	
	CREST HEIGHT	0 FT	
	ICE THICKNESS	0.25"	
	STRUCTURE CLASS	II	
	SITE ELEVATION	5,280 ft	
	SEISMIC Ss	0.182	
	SEISMIC S1	0.058	

STEEL

CODES	AISC SPECIFICATIONS AND CODE OF STANDARD PRACTICE MANUAL		
	LATEST EDITION		
STEEL SECTIONS	SECTION TYPE	MIN. YIELD STRENGTH	ASTM DESIGNATION
	ANGLES & PLATES	50 KSI	A572
CONNECTIONS	USE STANDARD AISC FRAMED CONNECTIONS (U.N.O.)		
	TYPE	DESCRIPTION	
	BOLTS	A325-1/2 in.DIA.(U.N.O.) OR WELDED EQUIV.	
		1. ALL BOLTED CONNECTIONS ARE TO BE "SNUG-TIGHT" (U.N.O.) 2. USE WASHERS AT SHORT SLOTTED AND 5/16" WASHER PLATES AT LONG SLOTS.	
	WELDS	1. MIN. OF 3/16" CONT. FILLET USING E70XX ELECTRODES (U.N.O.)	
GALVANIZED	ALL EXPOSED STEEL TO BE GALVANIZED. PROVIDE GALVANIZED TOUCH UP PAINT FOR ALL AREAS THAT ARE WELDED OR HAVE DAMAGED GALVANIZED AREAS.		

EXISTING CONDITIONS

1. These Construction Documents were prepared with information about the existing conditions provided by others.
2. No investigation of existing conditions was undertaken. If the Contractor discovers existing conditions which vary from those shown on these documents, they shall notify structural engineer immediately for guidance on necessary changes to be made.
3. No openings or any changes or additions shall be made in any existing structural elements without written approval of the Structural Engineer.

Otegui Structural Services, LLC
8842 West Powers Place
Littleton, CO 80123
720-981-5333 mikeo@oteguieng.com

Verizon Wireless

DEN North Wash Park Tower Reinforcing

No.	Description	Date

Details-Notes

Project number	22014
Date	1-23-2020
Drawn by	MAO
Checked by	MAO

S-2

Scale As indicated

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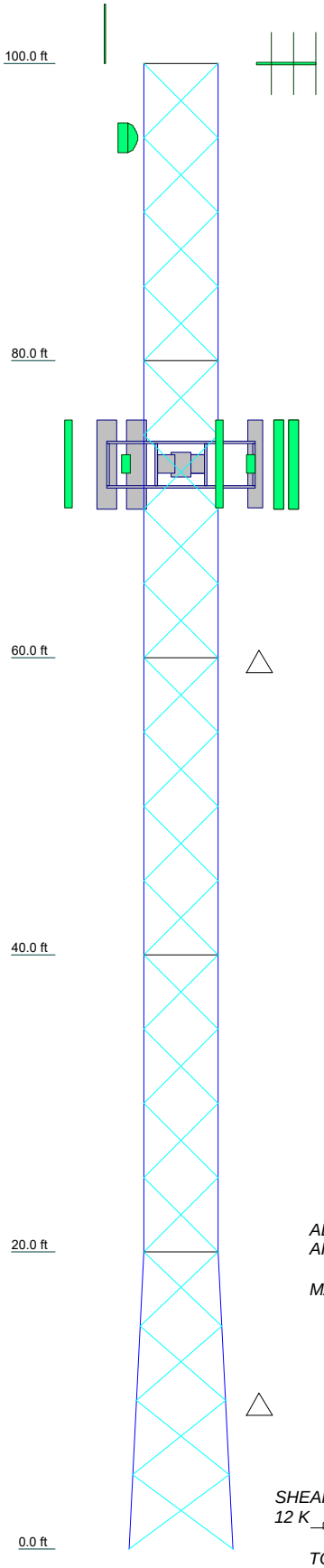
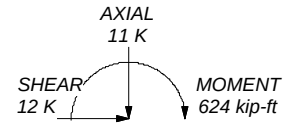
Section	Legs	Leg Grade	Diagonals	Diagonal Grade	Top Girts	Face Width (ft)	# Panels @ (ft)	Weight (K)
L1	HSS2.375x.154							0.5
L2								0.5
L3	HSS 2.87x0.203 w/ L2x2x1/4	A572-50	L2x2x1/8	A36	L2x2x1/8	5	16 @ 5	0.8
L4	HSS 3.5X0.3 w/ L2x2x1/4							1.1
T1	HSS 4X0.313 w/ L3x3x1/4					5	4 @ 5	1.3
						7		4.2



ALL REACTIONS ARE FACTORED

MAX. CORNER REACTIONS AT BASE:
DOWN: 106 K
SHEAR: 8 K

UPLIFT: -93 K
SHEAR: 7 K



TORQUE 4 kip-ft
REACTIONS - 90 mph WIND

DESIGNED APPURTENANCE LOADING

TYPE	ELEVATION	TYPE	ELEVATION
48"x2"	100	BXA-70063-6CF (VW)	73
48"x2"	100	BXA-70063-6CF (VW)	73
2ft w/ Shroud	95	BXA-70063-6CF (VW)	73
Dual Band Eric 4449 (VW)	73	MX06FRO660-02 (VW)	73
Dual Band Eric 8843 (VW)	73	MX06FRO660-02 (VW)	73
Dual Band Eric 8843 (VW)	73	MX06FRO660-02 (VW)	73
Dual Band Eric 8843 (VW)	73	MX06FRO660-02 (VW)	73
DB-B1 OVP (vw)	73	MX06FRO660-02 (VW)	73
(3) 10' Sector Frame (VW)	73	MX06FRO660-02 (VW)	73
Dual Band Eric 4449 (VW)	73	Dual Band Eric 4449 (VW)	73

MATERIAL STRENGTH

GRADE	Fy	Fu	GRADE	Fy	Fu
A572-50	50 ksi	65 ksi	A36	36 ksi	58 ksi

TOWER DESIGN NOTES

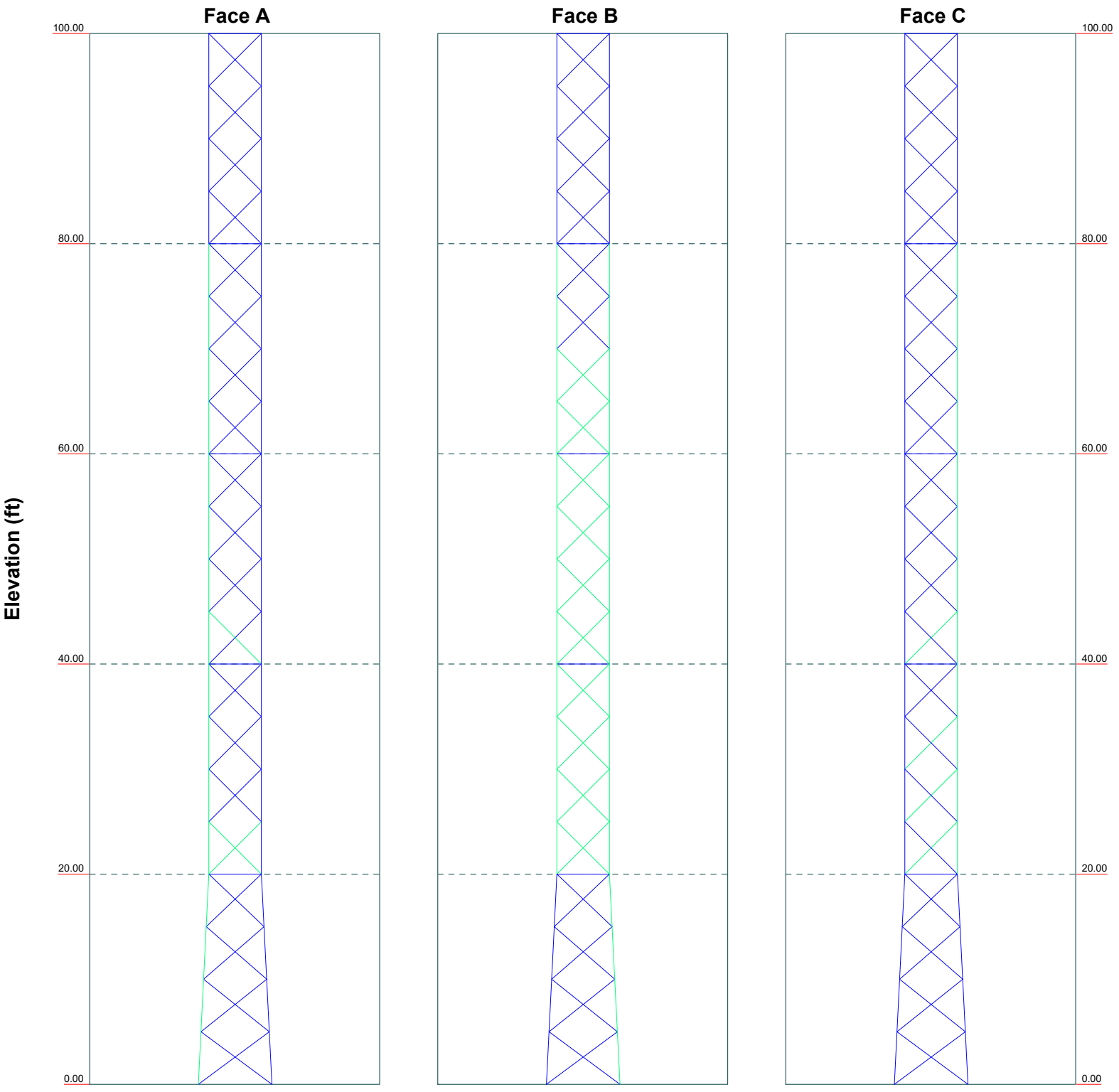
1. Tower is located in Denver County, Colorado.
2. Tower designed for Exposure C to the TIA-222-G Standard.
3. Tower designed for a 90 mph basic wind in accordance with the TIA-222-G Standard.
4. Deflections are based upon a 60 mph wind.
5. Tower Structure Class II.
6. Topographic Category 1 with Crest Height of 0.00 ft
7. TOWER RATING: 72.7%

Otegui Structural Services, LLC
8842 West Powers Place
Littleton, CO 80123
Phone: 720-981-5333
FAX:

Job:	***DEN North Wash Park***		
Project:	***220014***		
Client: Verizon Wireless	Drawn by: Mike Otegui		App'd:
Code: TIA-222-G	Date: 01/23/20		Scale: NTS
Path: H:\Otegui Structural Services\Job Files\220014-TRex-DEN North Wash Park SA\220014-DEN North Wash Park-REINFORCED.eri			Dwg No. E-1

Stress Distribution Chart
0' - 100'

> 100% | 90%-100% | 75%-90% | 50%-75% | < 50% Overstress



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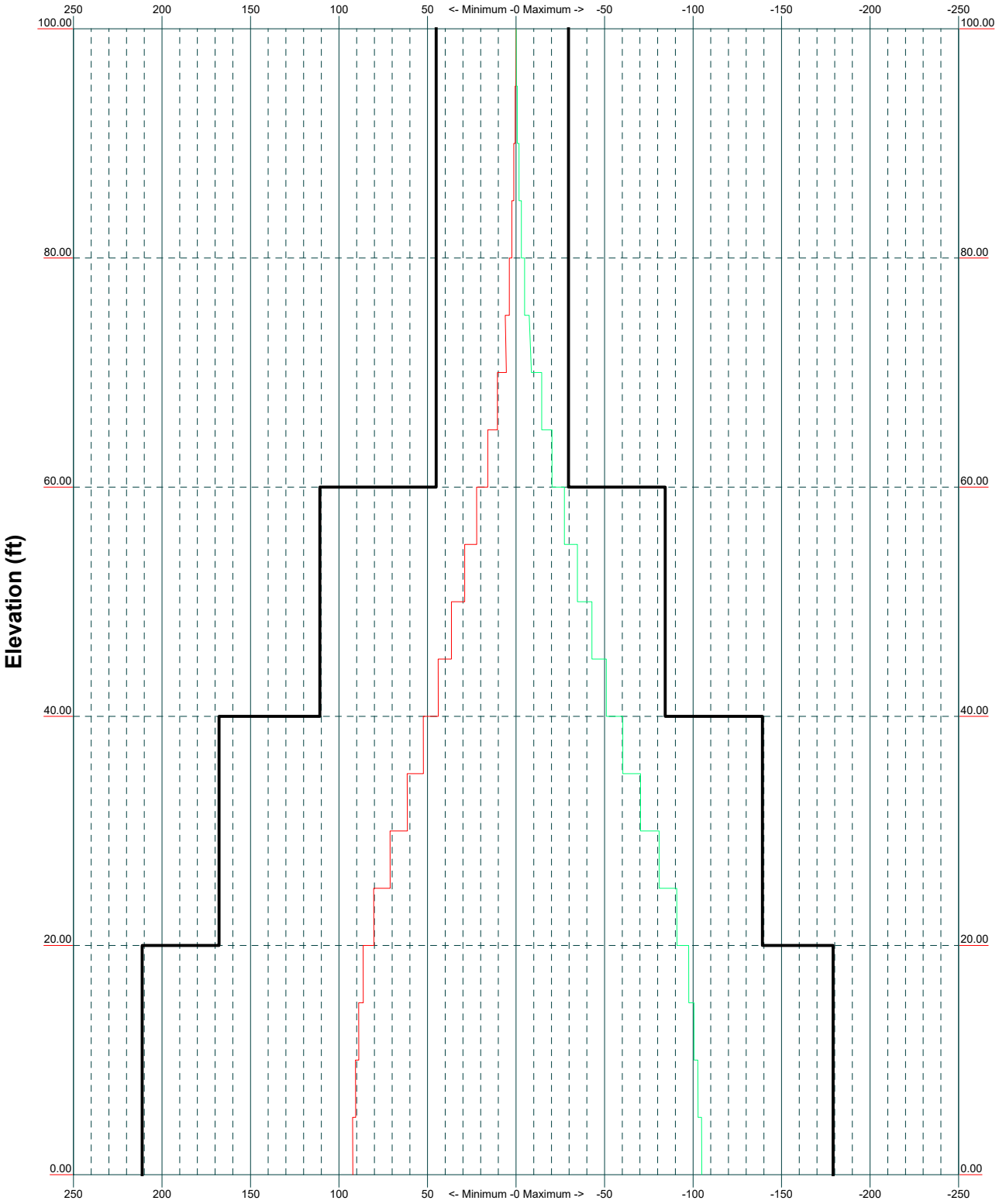
TIA-222-G - 90 mph Exposure C

Leg Capacity ——— **Leg Compression (K)**



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Client: Verizon Wireless	Drawn by: Mike Otegui		App'd:
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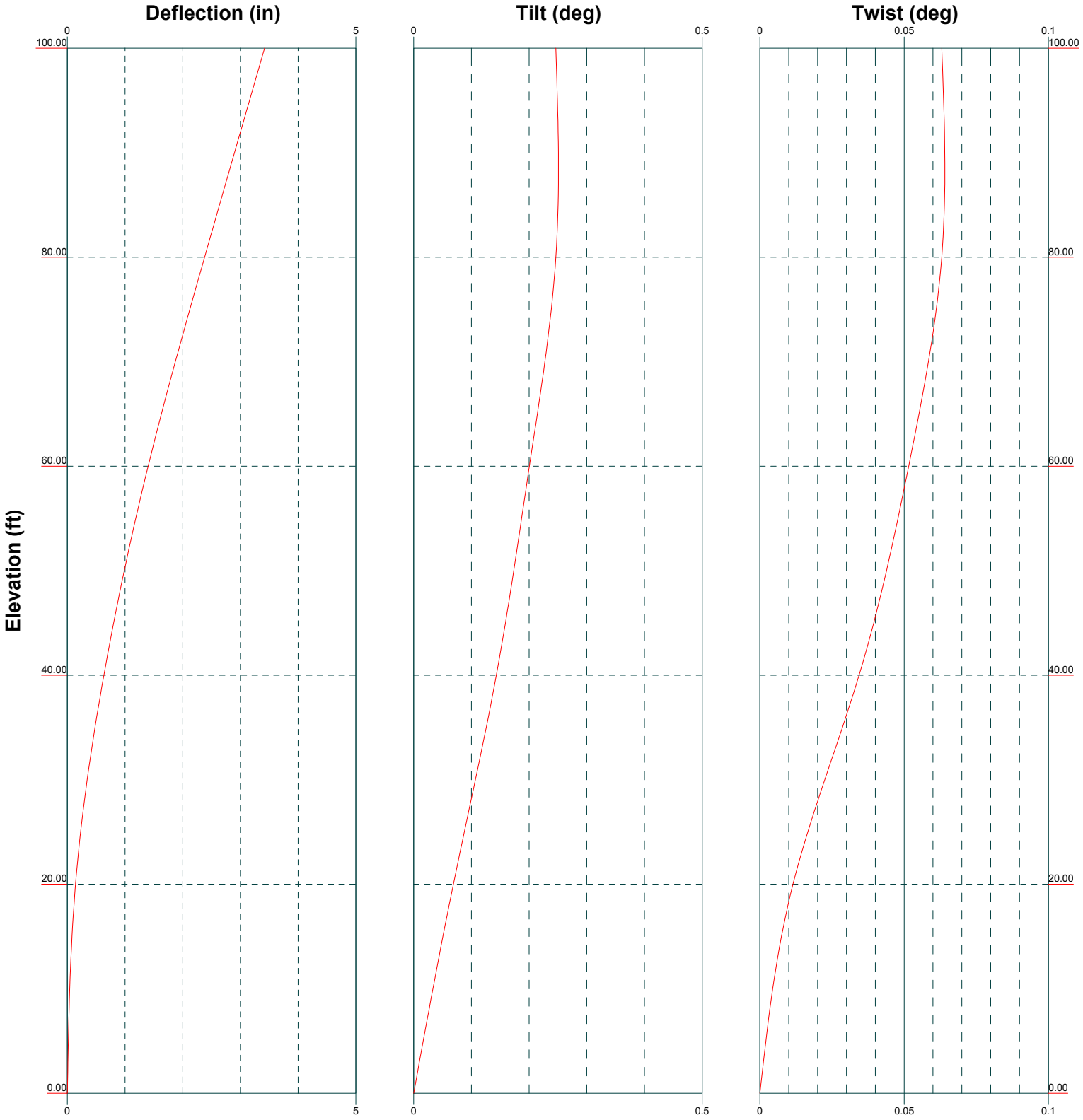
TIA-222-G - Service - 60 mph

Maximum Values



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Project: ***220014***			
Client: Verizon Wireless	Drawn by: Mike Otegui		App'd:
Code: TIA-222-G	Date: 01/23/20		Scale: NTS
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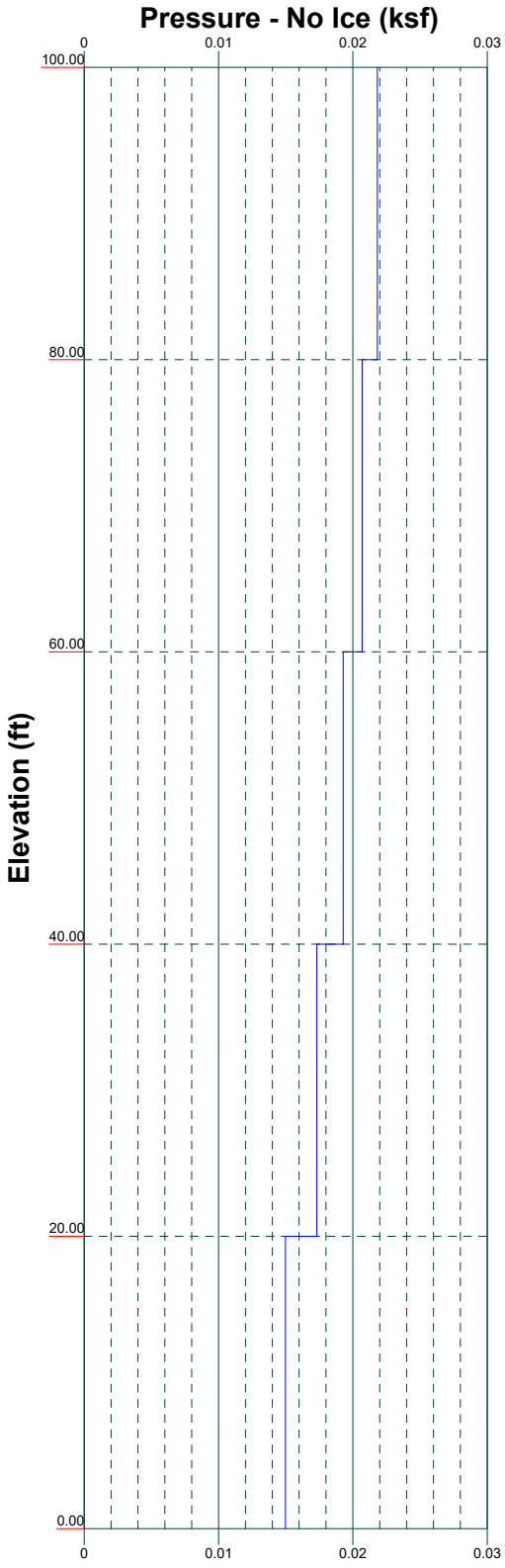
Wind Pressures
TIA-222-G - 90 mph Exposure C



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FAX:

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Project: ***220014***		
Client: Verizon Wireless	Drawn by: Mike Otegui	App'd:
Code: TIA-222-G	Date: 01/23/20	Scale: NTS
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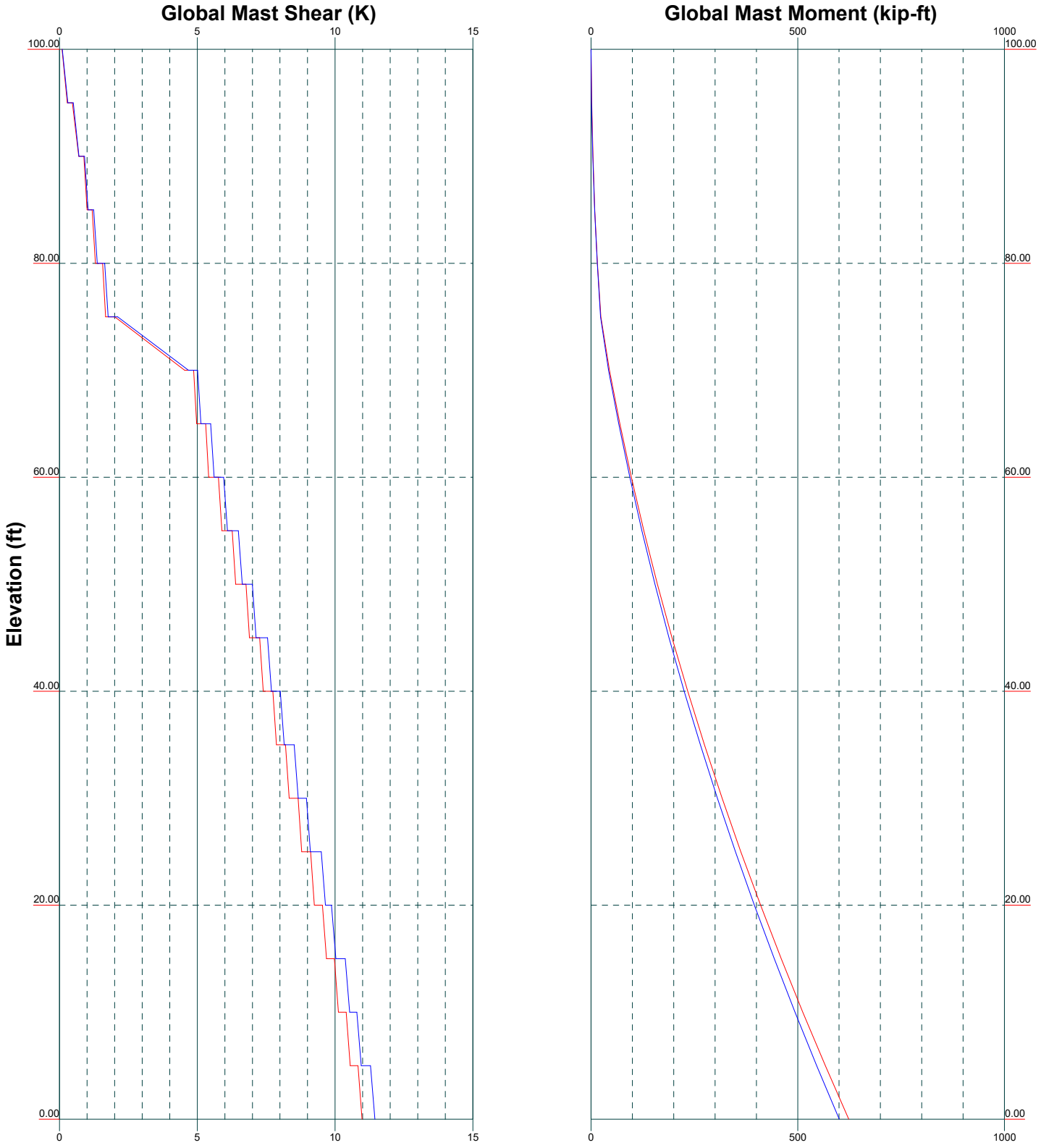
TIA-222-G - 90 mph Exposure C

Vx Vz

Maximum Values

Mx Mz



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Project: ***220014***			
Client: Verizon Wireless	Drawn by: Mike Otegui	App'd:	
Code: TIA-222-G	Date: 01/23/20	Scale: NTS	
Path: H:\Otegui Structural Services\Job Files\220014-TRex-DEN North Wash Park SA\220014-DEN North Wash Park-REINFORCED.eri		Dwg No. E-4	

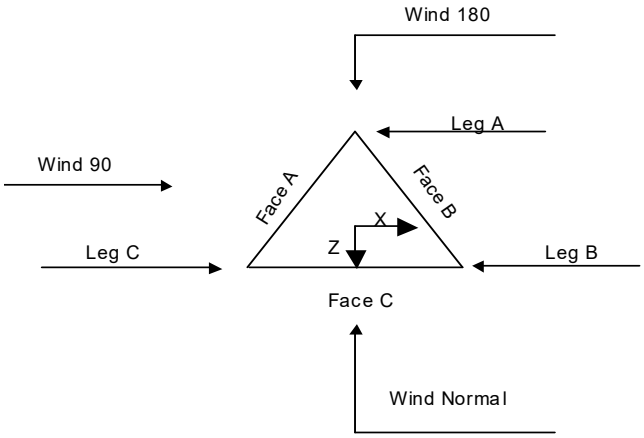
Tower Input Data

The main tower is a 3x free standing tower with an overall height of 100.00 ft above the ground line.
The base of the tower is set at an elevation of 0.00 ft above the ground line.
The face width of the tower is 5.00 ft at the top and 7.00 ft at the base.
There is a 3 sided latticed pole with a face width of 5.00 ft.
This tower is designed using the TIA-222-G standard.
The following design criteria apply:

Tower is located in Denver County, Colorado.
Basic wind speed of 90 mph.
Structure Class II.
Exposure Category C.
Topographic Category 1.
Crest Height 0.00 ft.
Deflections calculated using a wind speed of 60 mph.
A non-linear (P-delta) analysis was used.
Pressures are calculated at each section.
Stress ratio used in latticed pole member design is 1.
Stress ratio used in tower member design is 1.
Local bending stresses due to climbing loads, feed line supports, and appurtenance mounts are not considered.

Options

Consider Moments - Legs	Distribute Leg Loads As Uniform	Use ASCE 10 X-Brace Ly Rules
Consider Moments - Horizontals	Assume Legs Pinned	√ Calculate Redundant Bracing Forces
Consider Moments - Diagonals	√ Assume Rigid Index Plate	Ignore Redundant Members in FEA
Use Moment Magnification	√ Use Clear Spans For Wind Area	SR Leg Bolts Resist Compression
√ Use Code Stress Ratios	√ Use Clear Spans For KL/r	√ All Leg Panels Have Same Allowable
√ Use Code Safety Factors - Guys	√ Retension Guys To Initial Tension	Offset Girt At Foundation
Escalate Ice	Bypass Mast Stability Checks	Consider Feed Line Torque
Always Use Max Kz	√ Use Azimuth Dish Coefficients	Include Angle Block Shear Check
Use Special Wind Profile	√ Project Wind Area of Appurt.	Use TIA-222-G Bracing Resist. Exemption
√ Include Bolts In Member Capacity	√ Autocalc Torque Arm Areas	Use TIA-222-G Tension Splice Exemption
√ Leg Bolts Are At Top Of Section	Add IBC .6D+W Combination	Poles
√ Secondary Horizontal Braces Leg	Sort Capacity Reports By Component	Include Shear-Torsion Interaction
Use Diamond Inner Bracing (4 Sided)	√ Triangulate Diamond Inner Bracing	Always Use Sub-Critical Flow
SR Members Have Cut Ends	Treat Feed Line Bundles As Cylinder	Use Top Mounted Sockets
SR Members Are Concentric	Ignore KL/ry For 60 Deg. Angle Legs	Pole Without Linear Attachments
		Pole With Shroud Or No Appurtenances
		Outside and Inside Corner Radii Are Known



Triangular Tower

3 Sided Latticed Pole Section Geometry

Tower Section	Tower Elevation	Assembly Database	Description	Section Width	Number of Sections	Section Length
	ft			ft		ft
L1	100.00-80.00			5.00	1	20.00
L2	80.00-60.00			5.00	1	20.00
L3	60.00-40.00			5.00	1	20.00
L4	40.00-20.00			5.00	1	20.00

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Section	Tower Elevation	Diagonal Spacing	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset	Bottom Girt Offset
	ft	ft				in	in
L1	100.00-80.00	5.00	X Brace	No	No	0.000	0.000
L2	80.00-60.00	5.00	X Brace	No	No	0.000	0.000
L3	60.00-40.00	5.00	X Brace	No	No	0.000	0.000
L4	40.00-20.00	5.00	X Brace	No	No	0.000	0.000

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
L1 100.00-80.00	Pipe	HSS2.375x.154	A572-50 (50 ksi)	Equal Angle	L2x2x1/8	A36 (36 ksi)
L2 80.00-60.00	Pipe	HSS2.375x.154	A572-50 (50 ksi)	Equal Angle	L2x2x1/8	A36 (36 ksi)
L3 60.00-40.00	Arbitrary Shape	HSS 2.87x0.203 w/ L2x2x1/4	A572-50 (50 ksi)	Equal Angle	L2x2x1/8	A36 (36 ksi)
L4 40.00-20.00	Arbitrary Shape	HSS 3.5X0.3 w/ L2x2x1/4	A572-50 (50 ksi)	Equal Angle	L2x2x1/8	A36 (36 ksi)

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Elevation ft	Top Girt Type	Top Girt Size	Top Girt Grade	Bottom Girt Type	Bottom Girt Size	Bottom Girt Grade
L1 100.00-80.00	Equal Angle	L2x2x1/8	A36 (36 ksi)	Flat Bar		A36 (36 ksi)
L2 80.00-60.00	Equal Angle	L2x2x1/8	A36 (36 ksi)	Flat Bar		A36 (36 ksi)
L3 60.00-40.00	Equal Angle	L2x2x1/8	A36 (36 ksi)	Flat Bar		A36 (36 ksi)
L4 40.00-20.00	Equal Angle	L2x2x1/8	A36 (36 ksi)	Flat Bar		A36 (36 ksi)

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in	Double Angle Stitch Bolt Spacing Redundants in
L1 100.00-80.00	0.00	0.000	A36 (36 ksi)	1	1	1	36.000	36.000	36.000
L2 80.00-60.00	0.00	0.000	A36 (36 ksi)	1	1	1	36.000	36.000	36.000
L3 60.00-40.00	0.00	0.000	A36 (36 ksi)	1	1	1	36.000	36.000	36.000
L4 40.00-20.00	0.00	0.000	A36 (36 ksi)	1	1	1	36.000	36.000	36.000

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
L1	No	No	1	1	1	1	1	1	1	1

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	K Factors[1] Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
100.00-80.00				1	1	1	1	1	1	1
L2	No	No	1	1	1	1	1	1	1	1
80.00-60.00				1	1	1	1	1	1	1
L3	No	No	1	1	1	1	1	1	1	1
60.00-40.00				1	1	1	1	1	1	1
L4	No	No	1	1	1	1	1	1	1	1
40.00-20.00				1	1	1	1	1	1	1

[1]*Note: K factors are applied to member segment lengths. K-braces without inner supporting members will have the K factor in the out-of-plane direction applied to the overall length.*

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Elevation ft	Leg Net Width Deduct in	Leg U	Diagonal Net Width Deduct in	Diagonal U	Top Girt Net Width Deduct in	Top Girt U	Bottom Girt Net Width Deduct in	Bottom Girt U	Mid Girt Net Width Deduct in	Mid Girt U	Long Horizontal Net Width Deduct in	Long Horizontal U	Short Horizontal Net Width Deduct in	Short Horizontal U
L1 100.00-80.00	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
L2 80.00-60.00	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
L3 60.00-40.00	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75
L4 40.00-20.00	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75

3 Sided Latticed Pole Section Geometry *(cont'd)*

Tower Elevation ft	Leg Connection Type	Leg Bolt Size in	Leg No.	Diagonal Bolt Size in	Diagonal No.	Top Girt Bolt Size in	Top Girt No.	Bottom Girt Bolt Size in	Bottom Girt No.	Mid Girt Bolt Size in	Mid Girt No.	Long Horizontal Bolt Size in	Long Horizontal No.	Short Horizontal Bolt Size in	Short Horizontal No.
L1 100.00-80.00	Flange	0.750 A325N	0	0.625 A325N	1	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0
L2 80.00-60.00	Flange	0.750 A325N	0	0.625 A325N	1	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0
L3 60.00-40.00	Flange	0.750 A325N	0	0.625 A325N	1	0.750 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0
L4 40.00-20.00	Flange	0.750 A325N	0	0.750 A325N	1	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0

Tower Section Geometry

Tower Section	Tower Elevation ft	Assembly Database	Description	Section Width ft	Number of Sections	Section Length ft
T1	20.00-0.00			5.00	1	20.00

Tower Section Geometry *(cont'd)*

Tower Section	Tower Elevation ft	Diagonal Spacing ft	Bracing Type	Has K Brace End Panels	Has Horizontals	Top Girt Offset in	Bottom Girt Offset in
T1	20.00-0.00	5.00	X Brace	No	No	0.000	0.000

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Type	Leg Size	Leg Grade	Diagonal Type	Diagonal Size	Diagonal Grade
T1 20.00-0.00	Arbitrary Shape	HSS 4X0.313 w/ L3x3x1/4	A572-50 (50 ksi)	Equal Angle	L2x2x1/8	A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Top Girt Type	Top Girt Size	Top Girt Grade	Bottom Girt Type	Bottom Girt Size	Bottom Girt Grade
T1 20.00-0.00	Equal Angle	L2x2x1/8	A36 (36 ksi)	Solid Round		A36 (36 ksi)

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Gusset Area (per face) ft^2	Gusset Thickness in	Gusset Grade	Adjust. Factor A_f	Adjust. Factor A_r	Weight Mult.	Double Angle Stitch Bolt Spacing Diagonals in	Double Angle Stitch Bolt Spacing Horizontals in	Double Angle Stitch Bolt Spacing Redundants in
T1 20.00-0.00	0.00	0.000	A36 (36 ksi)	1	1	1	36.000	36.000	36.000

Tower Section Geometry *(cont'd)*

K Factors[1]

Tower Elevation ft	Calc K Single Angles	Calc K Solid Rounds	Legs	X Brace Diags X Y	K Brace Diags X Y	Single Diags X Y	Girts X Y	Horiz. X Y	Sec. Horiz. X Y	Inner Brace X Y
T1 20.00-0.00	No	No	1	1 1	1 1	1 1	1 1	1 1	1 1	1 1

[1]*Note: K factors are applied to member segment lengths. K-braces without inner supporting members will have the K factor in the out-of-plane direction applied to the overall length.*

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U	Net Width Deduct in	U
T1 20.00-0.00	0.000	1	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75	0.000	0.75

Tower Section Geometry *(cont'd)*

Tower Elevation ft	Leg Connection Type	Leg		Diagonal		Top Girt		Bottom Girt		Mid Girt		Long Horizontal		Short Horizontal	
		Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.	Bolt Size in	No.
T1 20.00-0.00	Flange	0.750 A325N	0	0.625 A325N	1	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0	0.625 A325N	0

Feed Line/Linear Appurtenances - Entered As Round Or Flat

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number	Number Per Row	Clear Spacing in	Width or Diameter in	Perimeter in	Weight klf
6-12 Hybrid (VW)	C	No	Yes	Ar (CaAa)	73.00 - 0.00	1	1	1.250	1.250		0.00
5/8 (VW)	A	No	Yes	Ar (CaAa)	100.00 - 0.00	3	3	0.625	0.625		0.00
Feedline ladder	C	No	Yes	Ar (CaAa)	100.00 - 0.00	1	1	3.000	3.000		0.00

Feed Line/Linear Appurtenances - Entered As Area

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number	C_AA_A ft^2/ft	Weight klf

Description	Face or Leg	Allow Shield	Exclude From Torque Calculation	Component Type	Placement ft	Total Number		C_AA_A ft^2/ft	Weight klf
7/8 (VW)	C	No	Yes	CaAa (Out Of Face)	73.00 - 0.00	18	No Ice	0.09	0.00

Feed Line/Linear Appurtenances Section Areas

Tower Section	Tower Elevation ft	Face	A_R ft^2	A_F ft^2	C_AA_A In Face ft^2	C_AA_A Out Face ft^2	Weight K
L1	100.00-80.00	A	0.000	0.000	3.750	0.000	0.09
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	6.000	0.000	0.04
L2	80.00-60.00	A	0.000	0.000	3.750	0.000	0.09
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	7.625	20.475	0.41
L3	60.00-40.00	A	0.000	0.000	3.750	0.000	0.09
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	8.500	31.500	0.61
L4	40.00-20.00	A	0.000	0.000	3.750	0.000	0.09
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	8.500	31.500	0.61
T1	20.00-0.00	A	0.000	0.000	3.750	0.000	0.09
		B	0.000	0.000	0.000	0.000	0.00
		C	0.000	0.000	8.500	31.500	0.61

Shielding Factor Ka

Tower Section	Feed Line Record No.	Description	Feed Line Segment Elev.	K_a No Ice	K_a Ice
L1	3	5/8	80.00 - 100.00	0.6000	0.6000
L1	4	Feedline ladder	80.00 - 100.00	0.6000	0.6000
L2	2	6-12 Hybrid	60.00 - 73.00	0.6000	0.6000
L2	3	5/8	60.00 - 80.00	0.6000	0.6000
L2	4	Feedline ladder	60.00 - 80.00	0.6000	0.6000
L3	2	6-12 Hybrid	40.00 - 60.00	0.6000	0.6000
L3	3	5/8	40.00 - 60.00	0.6000	0.6000
L3	4	Feedline ladder	40.00 - 60.00	0.6000	0.6000
L4	2	6-12 Hybrid	20.00 - 40.00	0.6000	0.6000
L4	3	5/8	20.00 - 40.00	0.6000	0.6000
L4	4	Feedline ladder	20.00 - 40.00	0.6000	0.6000
T1	2	6-12 Hybrid	0.00 - 20.00	0.6000	0.6000
T1	3	5/8	0.00 - 20.00	0.6000	0.6000
T1	4	Feedline ladder	0.00 - 20.00	0.6000	0.6000

Discrete Tower Loads

Description	Face or Leg	Offset Type	Offsets: Horz Lateral Vert ft ft ft	Azimuth Adjustment °	Placement ft		C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
(3) 10' Sector Frame (VW)	A	From Centroid-Leg	0.00 0.00 0.00	0.000	73.00	No Ice	23.00	23.00	0.70
Dual Band Eric 4449 (VW)	A	From Leg	2.00 -1.00 0.00	0.000	73.00	No Ice	1.78	1.51	0.08
Dual Band Eric 4449 (VW)	B	From Leg	2.00 -1.00 0.00	0.000	73.00	No Ice	1.78	1.51	0.08
Dual Band Eric 4449 (VW)	C	From Leg	2.00 -1.00 0.00	0.000	73.00	No Ice	1.78	1.51	0.08
Dual Band Eric 8843 (VW)	A	From Leg	2.00 1.00 0.00	0.000	73.00	No Ice	1.78	1.73	0.08
Dual Band Eric 8843 (VW)	A	From Leg	2.00 1.00 0.00	0.000	73.00	No Ice	1.78	1.73	0.08
Dual Band Eric 8843 (VW)	A	From Leg	2.00 1.00 0.00	0.000	73.00	No Ice	1.78	1.73	0.08
DB-B1 OVP (vw)	A	From Leg	0.00 0.00 0.00	0.000	73.00	No Ice	2.68	2.01	0.04
48"x2"	C	From Leg	3.00 0.00 2.00	0.000	100.00	No Ice	1.13	1.13	0.06
48"x2"	B	From Leg	3.00 0.00 0.00	0.000	100.00	No Ice	1.13	1.13	0.06
BXA-70063-6CF (VW)	A	From Leg	3.00 5.00 0.00	0.000	73.00	No Ice	7.57	4.16	0.02
BXA-70063-6CF (VW)	B	From Leg	3.00 5.00 0.00	0.000	73.00	No Ice	7.57	4.16	0.02
BXA-70063-6CF (VW)	C	From Leg	3.00 5.00 0.00	0.000	73.00	No Ice	7.57	4.16	0.02
MX06FRO660-02 (VW)	A	From Leg	3.00 -5.00 0.00	0.000	73.00	No Ice	9.87	8.20	0.06
MX06FRO660-02 (VW)	A	From Leg	3.00 -3.00 0.00	0.000	73.00	No Ice	9.87	8.20	0.06
MX06FRO660-02 (VW)	B	From Leg	3.00 -5.00 0.00	0.000	73.00	No Ice	9.87	8.20	0.06
MX06FRO660-02 (VW)	B	From Leg	3.00 -3.00 0.00	0.000	73.00	No Ice	9.87	8.20	0.06
MX06FRO660-02 (VW)	B	From Leg	3.00 -5.00 0.00	0.000	73.00	No Ice	9.87	8.20	0.06
MX06FRO660-02 (VW)	B	From Leg	3.00 -3.00	0.000	73.00	No Ice	9.87	8.20	0.06

Description	Face or Leg	Offset Type	Offsets: Horz Lateral ft Vert ft ft	Azimuth Adjustment °	Placement ft	C_AA_A Front ft^2	C_AA_A Side ft^2	Weight K
			0.00					

Dishes

Description	Face or Leg	Dish Type	Offset Type	Offsets: Horz Lateral ft Vert ft	Azimuth Adjustment °	3 dB Beam Width °	Elevation ft	Outside Diameter ft		Aperture Area ft^2	Weight K
2ft w/ Shroud	C	Paraboloid w/Shroud (HP)	From Leg	0.50 0.00 0.00	0.000		95.00	2.00	No Ice	3.14	0.10

Tower Pressures - No Ice

G_H = 0.850 (base tower), 0.850 (upper structure)

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft^2	Face	A_F ft^2	A_R ft^2	A_{leg} ft^2	Leg %	C_AA_A In Face ft^2	C_AA_A Out Face ft^2
L1	90.00	1.238	0.02	103.958	A	9.855	7.917	7.917	44.55	3.750	0.000
100.00-80.00					B	9.855	7.917		44.55	0.000	0.000
					C	9.855	7.917		44.55	6.000	0.000
L2 80.00-60.00	70.00	1.174	0.02	103.958	A	9.855	7.917	7.917	44.55	3.750	0.000
					B	9.855	7.917		44.55	0.000	0.000
					C	9.855	7.917		44.55	7.625	20.475
L3 60.00-40.00	50.00	1.094	0.02	106.049	A	9.760	10.220	10.220	51.15	3.750	0.000
					B	9.760	10.220		51.15	0.000	0.000
					C	9.760	10.220		51.15	8.500	31.500
L4 40.00-20.00	30.00	0.982	0.02	106.990	A	9.646	12.423	12.423	56.29	3.750	0.000
					B	9.646	12.423		56.29	0.000	0.000
					C	9.646	12.423		56.29	8.500	31.500
T1 20.00-0.00	10.00	0.85	0.01	127.081	A	10.607	16.694	16.694	61.15	3.750	0.000
					B	10.607	16.694		61.15	0.000	0.000
					C	10.607	16.694		61.15	8.500	31.500

Tower Pressure - Service

G_H = 0.850 (base tower), 0.850 (upper structure)

Section Elevation ft	z ft	K_Z	q_z ksf	A_G ft²	Face	A_F ft²	A_R ft²	A_{leg} ft²	Leg %	C_AA_A In Face ft²	C_AA_A Out Face ft²
L1	90.00	1.238	0.01	103.958	A	9.855	7.917	7.917	44.55	3.750	0.000
100.00-80.00					B	9.855	7.917		44.55	0.000	0.000
					C	9.855	7.917		44.55	6.000	0.000
L2 80.00-60.00	70.00	1.174	0.01	103.958	A	9.855	7.917	7.917	44.55	3.750	0.000
					B	9.855	7.917		44.55	0.000	0.000
					C	9.855	7.917		44.55	7.625	20.475
L3 60.00-40.00	50.00	1.094	0.01	106.049	A	9.760	10.220	10.220	51.15	3.750	0.000
					B	9.760	10.220		51.15	0.000	0.000
					C	9.760	10.220		51.15	8.500	31.500
L4 40.00-20.00	30.00	0.982	0.01	106.990	A	9.646	12.423	12.423	56.29	3.750	0.000
					B	9.646	12.423		56.29	0.000	0.000
					C	9.646	12.423		56.29	8.500	31.500
T1 20.00-0.00	10.00	0.85	0.01	127.081	A	10.607	16.694	16.694	61.15	3.750	0.000
					B	10.607	16.694		61.15	0.000	0.000
					C	10.607	16.694		61.15	8.500	31.500

Tower Forces - No Ice - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.13	0.51	A	0.171	2.696	0.02	1	1	14.368	0.83	0.04	A
100.00-80.00			B	0.171	2.696		1	1	14.368			
			C	0.171	2.696		1	1	14.368			
L2	0.50	0.51	A	0.171	2.696	0.02	1	1	14.368	1.16	0.06	A
80.00-60.00			B	0.171	2.696		1	1	14.368			
			C	0.171	2.696		1	1	14.368			
L3	0.70	0.81	A	0.188	2.635	0.02	1	1	15.612	1.31	0.07	A
60.00-40.00			B	0.188	2.635		1	1	15.612			
			C	0.188	2.635		1	1	15.612			
L4	0.70	1.07	A	0.206	2.575	0.02	1	1	16.797	1.21	0.06	A
40.00-20.00			B	0.206	2.575		1	1	16.797			
			C	0.206	2.575		1	1	16.797			
T1 20.00-0.00	0.70	1.29	A	0.215	2.547	0.01	1	1	20.079	1.15	0.06	A
			B	0.215	2.547		1	1	20.079			
			C	0.215	2.547		1	1	20.079			
Sum Weight:	2.73	4.19						OTM	268.97 kip-ft	5.65		

Tower Forces - No Ice - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft²	F K	w klf	Ctrl. Face
L1	0.13	0.51	A	0.171	2.696	0.02	0.8	1	12.397	0.73	0.04	B
100.00-80.00			B	0.171	2.696		0.8	1	12.397			
			C	0.171	2.696		0.8	1	12.397			
L2	0.50	0.51	A	0.171	2.696	0.02	0.8	1	12.397	1.07	0.05	B
80.00-60.00			B	0.171	2.696		0.8	1	12.397			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
			C	0.171	2.696		0.8	1	12.397			
L3	0.70	0.81	A	0.188	2.635	0.02	0.8	1	13.660	1.23	0.06	B
60.00-40.00			B	0.188	2.635		0.8	1	13.660			
			C	0.188	2.635		0.8	1	13.660			
L4	0.70	1.07	A	0.206	2.575	0.02	0.8	1	14.868	1.14	0.06	B
40.00-20.00			B	0.206	2.575		0.8	1	14.868			
			C	0.206	2.575		0.8	1	14.868			
T1 20.00-0.00	0.70	1.29	A	0.215	2.547	0.01	0.8	1	17.957	1.08	0.05	B
			B	0.215	2.547		0.8	1	17.957			
			C	0.215	2.547		0.8	1	17.957			
Sum Weight:	2.73	4.19						OTM	246.46 kip-ft	5.24		

Tower Forces - No Ice - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.13	0.51	A	0.171	2.696	0.02	0.85	1	12.889	0.75	0.04	C
100.00-80.00			B	0.171	2.696		0.85	1	12.889			
			C	0.171	2.696		0.85	1	12.889			
L2	0.50	0.51	A	0.171	2.696	0.02	0.85	1	12.889	1.09	0.05	C
80.00-60.00			B	0.171	2.696		0.85	1	12.889			
			C	0.171	2.696		0.85	1	12.889			
L3	0.70	0.81	A	0.188	2.635	0.02	0.85	1	14.148	1.25	0.06	C
60.00-40.00			B	0.188	2.635		0.85	1	14.148			
			C	0.188	2.635		0.85	1	14.148			
L4	0.70	1.07	A	0.206	2.575	0.02	0.85	1	15.350	1.15	0.06	C
40.00-20.00			B	0.206	2.575		0.85	1	15.350			
			C	0.206	2.575		0.85	1	15.350			
T1 20.00-0.00	0.70	1.29	A	0.215	2.547	0.01	0.85	1	18.487	1.09	0.05	C
			B	0.215	2.547		0.85	1	18.487			
			C	0.215	2.547		0.85	1	18.487			
Sum Weight:	2.73	4.19						OTM	252.08 kip-ft	5.34		

Tower Forces - Service - Wind Normal To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.13	0.51	A	0.171	2.696	0.01	1	1	14.368	0.37	0.02	A
100.00-80.00			B	0.171	2.696		1	1	14.368			
			C	0.171	2.696		1	1	14.368			
L2	0.50	0.51	A	0.171	2.696	0.01	1	1	14.368	0.52	0.03	A
80.00-60.00			B	0.171	2.696		1	1	14.368			
			C	0.171	2.696		1	1	14.368			

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L3	0.70	0.81	A	0.188	2.635	0.01	1	1	15.612	0.58	0.03	A
60.00-40.00			B	0.188	2.635		1	1	15.612			
			C	0.188	2.635		1	1	15.612			
L4	0.70	1.07	A	0.206	2.575	0.01	1	1	16.797	0.54	0.03	A
40.00-20.00			B	0.206	2.575		1	1	16.797			
			C	0.206	2.575		1	1	16.797			
T1 20.00-0.00	0.70	1.29	A	0.215	2.547	0.01	1	1	20.079	0.51	0.03	A
			B	0.215	2.547		1	1	20.079			
			C	0.215	2.547		1	1	20.079			
Sum Weight:	2.73	4.19						OTM	119.54 kip-ft	2.51		

Tower Forces - Service - Wind 60 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.13	0.51	A	0.171	2.696	0.01	0.8	1	12.397	0.32	0.02	B
100.00-80.00			B	0.171	2.696		0.8	1	12.397			
			C	0.171	2.696		0.8	1	12.397			
L2	0.50	0.51	A	0.171	2.696	0.01	0.8	1	12.397	0.47	0.02	B
80.00-60.00			B	0.171	2.696		0.8	1	12.397			
			C	0.171	2.696		0.8	1	12.397			
L3	0.70	0.81	A	0.188	2.635	0.01	0.8	1	13.660	0.55	0.03	B
60.00-40.00			B	0.188	2.635		0.8	1	13.660			
			C	0.188	2.635		0.8	1	13.660			
L4	0.70	1.07	A	0.206	2.575	0.01	0.8	1	14.868	0.50	0.03	B
40.00-20.00			B	0.206	2.575		0.8	1	14.868			
			C	0.206	2.575		0.8	1	14.868			
T1 20.00-0.00	0.70	1.29	A	0.215	2.547	0.01	0.8	1	17.957	0.48	0.02	B
			B	0.215	2.547		0.8	1	17.957			
			C	0.215	2.547		0.8	1	17.957			
Sum Weight:	2.73	4.19						OTM	109.54 kip-ft	2.33		

Tower Forces - Service - Wind 90 To Face

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
L1	0.13	0.51	A	0.171	2.696	0.01	0.85	1	12.889	0.33	0.02	C
100.00-80.00			B	0.171	2.696		0.85	1	12.889			
			C	0.171	2.696		0.85	1	12.889			
L2	0.50	0.51	A	0.171	2.696	0.01	0.85	1	12.889	0.49	0.02	C
80.00-60.00			B	0.171	2.696		0.85	1	12.889			
			C	0.171	2.696		0.85	1	12.889			
L3	0.70	0.81	A	0.188	2.635	0.01	0.85	1	14.148	0.55	0.03	C

Section Elevation ft	Add Weight K	Self Weight K	Face	e	C_F	q_z ksf	D_F	D_R	A_E ft^2	F K	w klf	Ctrl. Face
60.00-40.00			B	0.188	2.635		0.85	1	14.148			
			C	0.188	2.635		0.85	1	14.148			
L4	0.70	1.07	A	0.206	2.575	0.01	0.85	1	15.350	0.51	0.03	C
40.00-20.00			B	0.206	2.575		0.85	1	15.350			
			C	0.206	2.575		0.85	1	15.350			
T1 20.00-0.00	0.70	1.29	A	0.215	2.547	0.01	0.85	1	18.487	0.49	0.02	C
			B	0.215	2.547		0.85	1	18.487			
			C	0.215	2.547		0.85	1	18.487			
Sum Weight:	2.73	4.19						OTM	112.04 kip-ft	2.37		

Force Totals

Load Case	Vertical Forces K	Sum of Forces X K	Sum of Forces Z K	Sum of Overturning Moments, M_x kip-ft	Sum of Overturning Moments, M_z kip-ft	Sum of Torques kip-ft
Leg Weight	2.63					
Bracing Weight	1.55					
Total Member Self-Weight	4.19			-1.60	-1.17	
Total Weight	8.77			-1.60	-1.17	
Wind 0 deg - No Ice		-0.00	-7.22	-387.90	-1.73	2.38
Wind 90 deg - No Ice		6.95	0.02	-0.85	-373.46	-2.22
Wind 180 deg - No Ice		0.02	6.80	361.88	-1.94	-2.35
Total Weight	8.77			-1.60	-1.17	
Wind 0 deg - Service		-0.00	-3.21	-173.29	-1.42	1.06
Wind 90 deg - Service		3.09	0.01	-1.27	-166.63	-0.99
Wind 180 deg - Service		0.01	3.02	159.95	-1.51	-1.04

Load Combinations

Comb. No.	Description
1	Dead Only
2	1.2 Dead+1.6 Wind 0 deg - No Ice
3	1.2D+1.6W (pattern 1) 0 deg - No Ice
4	1.2D+1.6W (pattern 2) 0 deg - No Ice
5	0.9 Dead+1.6 Wind 0 deg - No Ice
6	1.2 Dead+1.6 Wind 90 deg - No Ice
7	1.2D+1.6W (pattern 1) 90 deg - No Ice
8	1.2D+1.6W (pattern 2) 90 deg - No Ice
9	0.9 Dead+1.6 Wind 90 deg - No Ice
10	1.2 Dead+1.6 Wind 180 deg - No Ice
11	1.2D+1.6W (pattern 1) 180 deg - No Ice
12	1.2D+1.6W (pattern 2) 180 deg - No Ice
13	0.9 Dead+1.6 Wind 180 deg - No Ice
14	Dead+Wind 0 deg - Service
15	Dead+Wind 90 deg - Service
16	Dead+Wind 180 deg - Service

Maximum Member Forces

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
L1	100 - 80	Latticed Pole Leg	Max Tension	13	2.42	-0.01	-0.04
			Max. Compression	2	-2.99	-0.05	-0.06
			Max. Mx	6	-0.28	0.13	0.00
			Max. My	4	0.95	0.03	-0.12
			Max. Vy	6	-0.06	-0.02	0.00
			Max. Vx	2	0.06	-0.00	0.02
		Latticed Pole Diagonal	Max Tension	6	0.65	0.00	0.00
			Max. Compression	6	-0.66	0.00	0.00
			Max. Mx	4	0.52	0.01	-0.00
			Max. My	6	-0.48	0.00	-0.00
			Max. Vy	4	-0.00	0.01	-0.00
			Max. Vx	6	-0.00	0.00	0.00
		Latticed Pole Top Girt	Max Tension	5	0.01	0.00	0.00
			Max. Compression	11	-0.02	0.00	0.00
			Max. Mx	11	-0.02	-0.01	0.00
			Max. My	6	-0.01	0.00	0.00
			Max. Vy	11	0.00	0.00	0.00
			Max. Vx	6	-0.00	0.00	0.00
L2	80 - 60	Latticed Pole Leg	Max Tension	13	16.02	0.04	0.06
			Max. Compression	2	-20.35	0.02	0.12
			Max. Mx	6	-0.51	1.03	-0.01
			Max. My	2	2.82	-0.10	-0.99
			Max. Vy	6	-0.81	-0.56	-0.01
			Max. Vx	2	0.77	-0.10	0.54
		Latticed Pole Diagonal	Max Tension	2	2.95	0.00	0.00
			Max. Compression	2	-3.08	0.00	0.00
			Max. Mx	4	2.64	0.03	0.00
			Max. My	2	-2.70	-0.02	-0.01
			Max. Vy	4	-0.01	0.03	0.00
			Max. Vx	2	-0.00	-0.02	-0.01
		Latticed Pole Top Girt	Max Tension	12	0.14	0.00	0.00
			Max. Compression	5	-0.14	0.00	0.00
			Max. Mx	11	0.08	-0.01	0.00
			Max. My	6	0.00	0.00	0.00
			Max. Vy	11	0.00	0.00	0.00
			Max. Vx	6	-0.00	0.00	0.00
L3	60 - 40	Latticed Pole Leg	Max Tension	13	43.95	-0.05	0.00
			Max. Compression	2	-51.03	0.26	-0.00
			Max. Mx	2	-51.03	0.26	-0.00
			Max. My	6	-2.37	-0.02	0.30
			Max. Vy	2	-0.07	0.26	-0.00
			Max. Vx	6	0.10	-0.02	0.30
		Latticed Pole Diagonal	Max Tension	10	3.77	0.00	0.00
			Max. Compression	2	-4.07	0.00	0.00
			Max. Mx	2	3.46	0.03	0.00
			Max. My	6	-2.94	-0.02	0.01
			Max. Vy	2	-0.01	0.03	0.00
			Max. Vx	6	-0.00	-0.02	0.01
		Latticed Pole Top Girt	Max Tension	8	0.27	0.00	0.00
			Max. Compression	5	-0.28	0.00	0.00

Section No.	Elevation ft	Component Type	Condition	Gov. Load Comb.	Axial K	Major Axis Moment kip-ft	Minor Axis Moment kip-ft
			Max. Mx	11	0.19	-0.01	0.00
			Max. My	6	0.02	0.00	0.00
			Max. Vy	11	0.00	0.00	0.00
			Max. Vx	6	-0.00	0.00	0.00
L4	40 - 20	Latticed Pole Leg	Max Tension	13	80.35	-0.07	-0.00
			Max. Compression	2	-90.86	0.83	-0.02
			Max. Mx	2	-90.86	0.83	-0.02
			Max. My	6	-2.96	-0.03	0.66
			Max. Vy	2	-0.18	0.83	-0.02
			Max. Vx	6	-0.16	-0.03	0.66
		Latticed Pole Diagonal	Max Tension	13	4.59	0.00	0.00
			Max. Compression	2	-5.04	0.00	0.00
			Max. Mx	2	4.01	0.03	0.00
			Max. My	6	-3.82	-0.02	0.01
			Max. Vy	2	-0.01	0.03	0.00
			Max. Vx	6	-0.00	-0.02	0.01
		Latticed Pole Top Girt	Max Tension	10	0.67	0.00	0.00
			Max. Compression	5	-0.72	0.00	0.00
			Max. Mx	11	0.48	-0.01	0.00
			Max. My	6	0.03	0.00	0.00
			Max. Vy	11	0.00	0.00	0.00
			Max. Vx	6	-0.00	0.00	0.00
T1	20 - 0	Leg	Max Tension	13	92.30	-0.27	0.00
			Max. Compression	2	-104.86	-0.00	0.00
			Max. Mx	2	-97.53	0.83	-0.02
			Max. My	6	-3.16	-0.04	0.92
			Max. Vy	2	0.17	0.83	-0.02
			Max. Vx	6	0.20	-0.04	0.92
		Diagonal	Max Tension	9	1.64	0.00	0.00
			Max. Compression	2	-1.80	0.00	0.00
			Max. Mx	2	0.38	0.02	-0.00
			Max. My	2	-1.79	-0.02	-0.01
			Max. Vy	2	-0.01	0.02	-0.00
			Max. Vx	2	0.00	0.00	0.00
		Top Girt	Max Tension	1	0.00	0.00	0.00
			Max. Compression	2	-0.08	0.00	0.00
			Max. Mx	4	-0.04	-0.01	0.00
			Max. My	6	-0.07	0.00	0.00
			Max. Vy	4	0.00	0.00	0.00
			Max. Vx	6	-0.00	0.00	0.00

Maximum Reactions

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Leg C	Max. Vert	10	51.20	3.45	-1.66
	Max. H_x	10	51.20	3.45	-1.66
	Max. H_z	9	-83.00	-5.26	3.38
	Min. Vert	9	-83.00	-5.26	3.38
	Min. H_x	9	-83.00	-5.26	3.38
	Min. H_z	10	51.20	3.45	-1.66
Leg B	Max. Vert	6	89.22	-5.61	-3.57
	Max. H_x	5	-48.40	3.04	2.13
	Max. H_z	5	-48.40	3.04	2.13

Location	Condition	Gov. Load Comb.	Vertical K	Horizontal, X K	Horizontal, Z K
Leg A	Min. Vert	5	-48.40	3.04	2.13
	Min. H_x	6	89.22	-5.61	-3.57
	Min. H_z	6	89.22	-5.61	-3.57
	Max. Vert	2	106.36	0.31	7.91
	Max. H_x	4	100.08	0.31	7.17
	Max. H_z	2	106.36	0.31	7.91
	Min. Vert	13	-93.47	-0.32	-7.07
	Min. H_x	13	-93.47	-0.32	-7.07
	Min. H_z	13	-93.47	-0.32	-7.07

Tower Mast Reaction Summary

Load Combination	Vertical K	$Shear_x$ K	$Shear_z$ K	Overturning Moment, M_x kip-ft	Overturning Moment, M_z kip-ft	Torque kip-ft
Dead Only	8.77	-0.00	0.00	-1.60	-1.17	0.00
1.2 Dead+1.6 Wind 0 deg - No Ice	10.53	-0.01	-11.56	-623.51	-2.34	3.83
1.2D+1.6W (pattern 1) 0 deg - No Ice	10.53	-0.00	-9.66	-477.33	-1.97	2.30
1.2D+1.6W (pattern 2) 0 deg - No Ice	10.53	-0.01	-10.30	-585.41	-2.34	3.82
0.9 Dead+1.6 Wind 0 deg - No Ice	7.89	-0.01	-11.56	-622.14	-1.98	3.82
1.2 Dead+1.6 Wind 90 deg - No Ice	10.53	11.12	0.03	-0.76	-600.45	-3.58
1.2D+1.6W (pattern 1) 90 deg - No Ice	10.53	9.31	0.02	-1.23	-460.90	-2.07
1.2D+1.6W (pattern 2) 90 deg - No Ice	10.53	9.97	0.03	-0.76	-565.77	-3.58
0.9 Dead+1.6 Wind 90 deg - No Ice	7.89	11.12	0.03	-0.27	-599.24	-3.57
1.2 Dead+1.6 Wind 180 deg - No Ice	10.53	0.03	10.88	582.94	-2.69	-3.78
1.2D+1.6W (pattern 1) 180 deg - No Ice	10.53	0.02	9.11	446.86	-2.18	-2.27
1.2D+1.6W (pattern 2) 180 deg - No Ice	10.53	0.03	9.77	549.40	-2.69	-3.78
0.9 Dead+1.6 Wind 180 deg - No Ice	7.89	0.03	10.88	582.57	-2.33	-3.78
Dead+Wind 0 deg - Service	8.77	-0.00	-3.21	-174.12	-1.44	1.06
Dead+Wind 90 deg - Service	8.77	3.09	0.01	-1.28	-167.43	-0.99
Dead+Wind 180 deg - Service	8.77	0.01	3.02	160.70	-1.53	-1.05

Solution Summary

	Sum of Applied Forces			Sum of Reactions			
Load Comb.	PX K	PY K	PZ K	PX K	PY K	PZ K	% Error
1	0.00	-8.77	0.00	0.00	8.77	-0.00	0.001%
2	-0.01	-10.53	-11.56	0.01	10.53	11.56	0.004%
3	-0.00	-10.53	-9.66	0.00	10.53	9.66	0.003%
4	-0.01	-10.53	-10.30	0.01	10.53	10.30	0.004%
5	-0.01	-7.89	-11.56	0.01	7.89	11.56	0.003%

Load Comb.	Sum of Applied Forces PX K	PY K	PZ K	Sum of Reactions PX K	PY K	PZ K	% Error
6	11.12	-10.53	0.03	-11.12	10.53	-0.03	0.004%
7	9.31	-10.53	0.02	-9.31	10.53	-0.02	0.003%
8	9.97	-10.53	0.03	-9.97	10.53	-0.03	0.004%
9	11.12	-7.89	0.03	-11.12	7.89	-0.03	0.003%
10	0.03	-10.53	10.88	-0.03	10.53	-10.88	0.002%
11	0.02	-10.53	9.11	-0.02	10.53	-9.11	0.003%
12	0.03	-10.53	9.77	-0.03	10.53	-9.77	0.002%
13	0.03	-7.89	10.88	-0.03	7.89	-10.88	0.004%
14	-0.00	-8.77	-3.21	0.00	8.77	3.21	0.002%
15	3.09	-8.77	0.01	-3.09	8.77	-0.01	0.002%
16	0.01	-8.77	3.02	-0.01	8.77	-3.02	0.001%

Non-Linear Convergence Results

Load Combination	Converged?	Number of Cycles	Displacement Tolerance	Force Tolerance
1	Yes	6	0.00000001	0.00013371
2	Yes	11	0.00000001	0.00012559
3	Yes	11	0.00000001	0.00012752
4	Yes	11	0.00000001	0.00012703
5	Yes	11	0.00000001	0.00008993
6	Yes	11	0.00000001	0.00014183
7	Yes	11	0.00000001	0.00013888
8	Yes	11	0.00000001	0.00014285
9	Yes	11	0.00000001	0.00010597
10	Yes	12	0.00000001	0.00006272
11	Yes	11	0.00000001	0.00014721
12	Yes	12	0.00000001	0.00006303
13	Yes	11	0.00000001	0.00011808
14	Yes	11	0.00000001	0.00011183
15	Yes	11	0.00000001	0.00011614
16	Yes	11	0.00000001	0.00011822

Maximum Tower Deflections - Service Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	100 - 80	3.419	14	0.248	0.064
L2	80 - 60	2.379	14	0.245	0.065
L3	60 - 40	1.400	14	0.201	0.052
L4	40 - 20	0.633	14	0.142	0.033
T1	20 - 0	0.142	14	0.067	0.013

Critical Deflections and Radius of Curvature - Service Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
100.00	48"x2"	14	3.419	0.248	0.064	548499
95.00	2ft w/ Shroud	14	3.158	0.250	0.065	548499
73.00	(3) 10' Sector Frame	14	2.021	0.233	0.062	44743

Maximum Tower Deflections - Design Wind

Section No.	Elevation ft	Horz. Deflection in	Gov. Load Comb.	Tilt °	Twist °
L1	100 - 80	12.142	2	0.881	0.232
L2	80 - 60	8.456	2	0.865	0.233
L3	60 - 40	4.992	2	0.715	0.189
L4	40 - 20	2.263	2	0.508	0.118
T1	20 - 0	0.509	2	0.239	0.048

Critical Deflections and Radius of Curvature - Design Wind

Elevation ft	Appurtenance	Gov. Load Comb.	Deflection in	Tilt °	Twist °	Radius of Curvature ft
100.00	48"x2"	2	12.142	0.881	0.232	161677
95.00	2ft w/ Shroud	2	11.216	0.885	0.235	161677
73.00	(3) 10' Sector Frame	2	7.192	0.826	0.223	12652

Bolt Design Data

Section No.	Elevation ft	Component Type	Bolt Grade	Bolt Size in	Number Of Bolts	Maximum Load per Bolt K	Allowable Load per Bolt K	Ratio Load / Allowable	Allowable Ratio	Criteria
L1	100	Latticed Pole Diagonal	A325N	0.625	1	0.65	5.22	0.124 ✔	1	Member Bearing
L2	80	Latticed Pole Diagonal	A325N	0.625	1	2.95	5.22	0.564 ✔	1	Member Bearing
L3	60	Latticed Pole Diagonal	A325N	0.625	1	3.77	5.22	0.722 ✔	1	Member Bearing
L4	40	Latticed Pole Diagonal	A325N	0.750	1	4.59	6.31	0.727 ✔	1	Member Bearing
T1	20	Diagonal	A325N	0.625	1	1.64	5.22	0.313 ✔	1	Member Bearing

Compression Checks

Leg Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	Mast Stability Index	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
L1	100 - 80	HSS2.375x.154	20.00	5.00	75.9 K=1.00	1.003	1.00	-2.99	29.62	0.101 [1] ✔
L2	80 - 60	HSS2.375x.154	20.00	5.00	75.9 K=1.00	1.003	1.00	-20.35	29.62	0.687 [1] ✔
L3	60 - 40	HSS 2.87x0.203 w/ L2x2x1/4	20.00	5.00	61.1 K=1.00	2.463	1.00	-51.03	84.33	0.605 [1] ✔
L4	40 - 20	HSS 3.5X0.3 w/ L2x2x1/4	20.00	5.00	50.5 K=1.00	3.729	1.00	-90.86	139.24	0.653 [1] ✔
T1	20 - 0	HSS 4X0.313 w/ L3x3x1/4	20.03	5.01	47.4 K=1.00	4.693	1.00	-104.86	179.15	0.585 [1] ✔

[1] P_u / ϕP_n controls

Diagonal Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
L1	100 - 80	L2x2x1/8	7.07	3.40	102.5 K=1.00	0.484	-0.66	8.89	0.075 [1] ✔
L2	80 - 60	L2x2x1/8	7.07	3.40	102.5 K=1.00	0.484	-3.08	8.89	0.347 [1] ✔
L3	60 - 40	L2x2x1/8	7.07	3.35	101.3 K=1.00	0.484	-4.07	9.00	0.452 [1] ✔
L4	40 - 20	L2x2x1/8	7.07	3.32	100.1 K=1.00	0.484	-5.04	9.11	0.553 [1] ✔
T1	20 - 0	L2x2x1/8	8.40	4.14	124.9 K=1.00	0.484	-1.79	6.86	0.261 [1] ✔

[1] P_u / ϕP_n controls

Top Girt Design Data (Compression)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
L1	100 - 80	L2x2x1/8	5.00	4.80	145.0 K=1.00	0.484	-0.02	5.21	0.005 [1] ✔
L2	80 - 60	L2x2x1/8	5.00	4.80	145.0 K=1.00	0.484	-0.14	5.21	0.027 [1] ✔
L3	60 - 40	L2x2x1/8	5.00	4.80	145.0 K=1.00	0.484	-0.28	5.21	0.055 [1] ✔
L4	40 - 20	L2x2x1/8	5.00	4.74	143.2	0.484	-0.72	5.34	0.135 [1]

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
T1	20 - 0	L2x2x1/8	5.00	4.69	K=1.00 141.6 K=1.00	0.484	-0.08	5.46	0.014 [1]

[1] P_u / ϕP_n controls

Tension Checks

Leg Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
L1	100 - 80	HSS2.375x.154	20.00	5.00	75.9	1.003	2.42	45.12	0.054 [1]
L2	80 - 60	HSS2.375x.154	20.00	5.00	75.9	1.003	16.02	45.12	0.355 [1]
L3	60 - 40	HSS 2.87x0.203 w/ L2x2x1/4	20.00	5.00	61.1	2.463	43.95	110.83	0.397 [1]
L4	40 - 20	HSS 3.5X0.3 w/ L2x2x1/4	20.00	5.00	50.5	3.729	80.35	167.81	0.479 [1]
T1	20 - 0	HSS 4X0.313 w/ L3x3x1/4	20.03	5.01	47.4	4.693	92.30	211.19	0.437 [1]

[1] P_u / ϕP_n controls

Diagonal Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
L1	100 - 80	L2x2x1/8	7.07	3.40	65.1	0.293	0.65	12.74	0.051 [1]
L2	80 - 60	L2x2x1/8	7.07	3.40	65.1	0.293	2.95	12.74	0.231 [1]
L3	60 - 40	L2x2x1/8	7.07	3.35	64.3	0.293	3.77	12.74	0.296 [1]
L4	40 - 20	L2x2x1/8	7.07	3.32	63.5	0.281	4.59	12.23	0.375 [1]
T1	20 - 0	L2x2x1/8	7.25	3.58	68.6	0.293	1.64	12.74	0.128 [1]

[1] P_u / ϕP_n controls

Top Girt Design Data (Tension)

Section No.	Elevation ft	Size	L ft	L_u ft	Kl/r	A in^2	P_u K	ϕP_n K	Ratio $\frac{P_u}{\phi P_n}$
L1	100 - 80	L2x2x1/8	5.00	4.80	92.0	0.484	0.01	15.69	0.001 [1] ✔
L2	80 - 60	L2x2x1/8	5.00	4.80	92.0	0.484	0.14	15.69	0.009 [1] ✔
L3	60 - 40	L2x2x1/8	5.00	4.80	92.0	0.484	0.27	15.69	0.017 [1] ✔
L4	40 - 20	L2x2x1/8	5.00	4.74	90.9	0.484	0.67	15.69	0.043 [1] ✔

[1] P_u / ϕP_n controls

Section Capacity Table

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass Fail
L1	100 - 80	Latticed Pole Leg	HSS2.375x.154	3	-2.99	29.62	10.1	Pass
		Latticed Pole Diagonal	L2x2x1/8	8	-0.66	8.89	7.5 12.4 (b)	Pass
		Latticed Pole Top Girt	L2x2x1/8	4	-0.02	5.21	0.5	Pass
L2	80 - 60	Latticed Pole Leg	HSS2.375x.154	33	-20.35	29.62	68.7	Pass
		Latticed Pole Diagonal	L2x2x1/8	40	-3.08	8.89	34.7 56.4 (b)	Pass
		Latticed Pole Top Girt	L2x2x1/8	34	-0.14	5.21	2.7	Pass
L3	60 - 40	Latticed Pole Leg	HSS 2.87x0.203 w/ L2x2x1/4	63	-51.03	84.33	60.5	Pass
		Latticed Pole Diagonal	L2x2x1/8	70	-4.07	9.00	45.2 72.2 (b)	Pass
		Latticed Pole Top Girt	L2x2x1/8	64	-0.28	5.21	5.5	Pass
L4	40 - 20	Latticed Pole Leg	HSS 3.5X0.3 w/ L2x2x1/4	93	-90.86	139.24	65.3	Pass
		Latticed Pole Diagonal	L2x2x1/8	100	-5.04	9.11	55.3 72.7 (b)	Pass
		Latticed Pole Top Girt	L2x2x1/8	94	-0.72	5.34	13.5	Pass
T1	20 - 0	Leg	HSS 4X0.313 w/ L3x3x1/4	123	-104.86	179.15	58.5	Pass
		Diagonal	L2x2x1/8	130	-1.79	6.86	26.1 31.3 (b)	Pass
		Top Girt	L2x2x1/8	126	-0.08	5.46	1.4	Pass
							Summary	
						Latticed Pole Leg (L2)	68.7	Pass
						Latticed Pole Diagonal (L4)	72.7	Pass
						Latticed Pole Top	13.5	Pass

Section No.	Elevation ft	Component Type	Size	Critical Element	P K	ϕP_{allow} K	% Capacity	Pass Fail
						Girt (L4)		
						Leg (T1)	58.5	Pass
						Diagonal (T1)	31.3	Pass
						Top Girt (T1)	1.4	Pass
						Bolt Checks	72.7	Pass
						RATING =	**72.7**	**Pass**

Exhibit C — City's Minimum Technical Standards

Note: Some standards may not apply to your facility due to frequency of operation or type of service.

1.0 General

1.1 Posting of Information. The following information shall be posted on or near your cabinet:

Copy of FCC license (if applicable)
Equipment Identification Card with the following information:

Transmit and receive frequencies (or frequency bands in case of wireless operators)
Type of service
Authorized output power & ERP
Antenna model number
Transmission line model number and type
Name of licensee
Contact information for responsible person (name, phone, email)

Unidentified equipment shall be considered unauthorized and may be red tagged and removed after 30 days.

1.2 Installations at City Fire Stations. The City may require that the Tenant (Licensee) upgrade City radio equipment to ensure interference-free coexistence. Specifically, there is a problem with installing an isolator on the existing 900 MHz Alligator Model 1888 MAS transceiver used at most City fire stations. The isolator must be installed only on the transmit line, but the transceiver uses a duplexed (switched) output whereby both the transmitter and the receiver share the same antenna line. Similarly, separate cavity filters are required for the receiver and transmitter, but it is not possible to install both on a single duplexed line. For this reason, the City usually directs that the Alligator Model 1888 be replaced with a Model 1800 Master unit with separate transmit and receive antenna ports. A duplexer cavity filter should be used to combine transmit and receive into the existing antenna. Contact the City's Technical Representative for recommended vendors for these components.

1.3 Changes. Notify the City's Technical Representative immediately of any changes to frequencies, antennas or other equipment configuration. Obtain City's approval prior to making those changes as required by the Lease (License). Approved changes shall be shown on an updated Equipment ID Card.

2.0 Mobile Wireless Services

2.1 Land Mobile Radio Filter and Isolator Requirements. For land mobile radio (LMR), as a minimum, each transmitter shall employ a dual stage isolator followed by a single cavity

bandpass filter. All transmitters shall have built-in or external harmonic (low pass) filters. The low pass filter must be a true low pass filter, not a notch filter tuned to just one or two harmonic frequencies. Harmonic rejection shall be at least 60 dB at the second harmonic and at least 50 dB at the third harmonic. The following minimum isolator and bandpass cavity filter specifications apply:

30-50 MHz
Isolators - None required.
TX cavity - minimum of 20 dB rejection at + 0.5 MHz

72-76 MHz
Isolators - Minimum of 25 dB
TX cavity - minimum of 20 dB rejection at + 0.5 MHz

138-174, 216-222 MHz
Dual Stage Isolators - minimum of 60 dB
TX cavity - minimum of 20 dB rejection at + 1.5 MHz

406-512 MHz
Dual Stage Isolators - minimum of 60 dB
TX cavity - minimum of 20 dB rejection at + 3.5 MHz

698-941 MHz (excluding airphone)
Dual Stage Isolators - minimum of 60 dB
Tx cavity - minimum of 20 dB rejection at + 6 MHz

Explanation. The bandpass filter and lowpass filter must follow the isolator because ferrite isolators are nonlinear and can create harmonics. Please note that most bandpass cavity filters will pass odd harmonics of the tuned frequency, so an external lowpass filter following the isolator is also required. Transmitter combiners will be considered on a case-by-case basis. Please provide all combiner technical information to the City's Technical Representative.

2.2 Airphone (849-851 MHz transmit, 894-896 MHz receive)
Transmitter out-of-band emissions shall not cause harmful interference to cellular base station receivers (824-849 MHz). Tenant (Licensee) shall submit plans, including bandpass filter response curves, to the City's Technical Representative for approval prior to installation. Tenant (Licensee) shall install adequate receiver bandpass filtering to preclude receiver desensitization or receiver intermodulation caused indirectly by cellular base stations on the site.

2.3 LMR Duplexers. Notch duplexers are not adequate. The duplexer must also have a bandpass characteristic to ensure other transmit signals do not enter the transmitter or over drive the receiver This is especially important for VHF repeaters which are vulnerable to FM broadcast signals and other closely-spaced VHF transmitters.

2.4 Personal Wireless Services. These services include, but are not limited to the 698-806, 806-

869, 1710-1755, 1850-2000, 2110-2155, 2500-2600 MHz bands (excluding 700 and 800 MHz public safety bands). Because the wireless provider is assumed to have exclusive use of a band of frequencies, out-of-band emissions are expected to be attenuated significantly by the manufacturer's standard combiners, duplexers and cross-band couplers. Ferrite isolators may not be required. Submit your plans to the City's Technical Representative for approval.

2.5 Unlicensed Band (License-Free) Radios. Unlicensed band radios and shared-band services, including, but not limited to those operating in the 902-928 MHz, 2.4-2.4835 GHz, 3.5 GHz, 4.9 GHz (public safety only) and 5 GHz bands are not allowed unless specifically authorized in the Tenant's (Licensee's) Lease (License). When authorized, Tenant (Licensee) shall not change operating frequencies without first getting approval from City. License-free radios are notorious for their poor quality in a harsh RF environment and specific make, model and technical specifications must be provided to the City's Technical Representative for approval. Additional protective devices, shielded CAT 6 cable and shielded NEMA cases may be required before such devices can be installed on the tower.

2.6 Receivers. The site may have relatively high radio frequency (RF) levels in all mobile radio bands. Your receiver amplifier must be robust to work in this environment. Ensure the receiver has good intermodulation (IM) rejection and high 1 dB compression point. If interference is encountered and we find the receiver is not performing up to the standards exhibited by state-of-the-art equipment, the City may require receiver improvements or upgrades before requiring changes to other tenant (licensee) equipment or configurations. This requirement applies to both new and existing tenants (licensees).

Filters are required for mobile radio receivers. Single receivers must employ a minimum of a single 7" diameter (or equivalent) cavity bandpass filter with a rejection curve corresponding to 1 dB insertion loss or better. Additional filter isolation may be required in special cases. Receiver multicouplers must use a bandpass filter (preselector) prior to the multicoupler amplifier.

2.7 Antennas. Select antennas designed to minimize passive intermodulation generation. Note that antennas that pass intermodulation tests at the factory may not provide good intermodulation rejection after years of exposure to heat, cold, vibration from wind, and humidity. Only new antennas are allowed for new installations. Select antennas specifically designed to reject intermodulation over the life of the antenna. Unless the antenna is a duplex configuration, transmit and receive antennas should be separated vertically on the tower. If the tower is owned by the City, the City will designate antenna locations. Antennas must be DC grounded to the tower for lightning protection.

2.8 Transmission Lines. Coaxial cable should be grounded at the top and the bottom of the run with an Andrew ground kit or equivalent. Ensure that ground conductors run straight down with no sharp bends because bends will increase the impedance of the grounding conductor. We also require that the line be marked so we can identify it later. We suggest bands of colored electrical tape at the bottom, middle and top of the run (similar to a resistor color code). Install a Huber-Suhner (or equivalent) coaxial surge arrestor at the bulkhead. All exterior transmission lines must be solid outer conductors. If possible, receive and transmit lines should be separated by at

least one foot from cabinet to antenna.

2.9 Connectors. Connectors are often sources of RF leakage and passive intermodulation. UHF connectors (PL259) are not allowed on connections external to the radio cabinet. Type "N" connectors are allowed below 512 MHz. 7/16 DIN connectors should be used at 698 MHz and above and are required above 1.7 GHz. Connectors using dissimilar metal contacts or ferrous materials (e.g., nickel plating) are not allowed. The preferred connector uses a silver plated body with gold plated inner conductor. Brass bodies and silver or brass inner conductors are also allowed.

2.10 Additional Protective Devices May Be Required. The specifications above are minimum requirements. Additional protective devices may be required based upon evaluation of the following information:

Theoretical TX mixes, particularly second and third order
Antenna location and type
Combiner/multicoupler configurations
Transmitter specifications
Receiver specifications
Historical problems
Transmitter to transmitter isolation
Transmitter to antenna isolation
Transmitter to receiver isolation
Calculated and measured level of IM products
Transmitter output power
Transmitter ERP
Spectrum analyzer measurements
VSWR measurements
Existing cavity selectivity
Antenna to antenna proximity

3.0 FM & IBOC Broadcast (Part 73, ERP > 1 kW)

3.1 FM Broadcast Transmitters. FM and IBOC Broadcast transmitters will be either combined with other stations into a common antenna or stand-alone. If combined, the combiner design shall be approved by the City's Technical Representative. If stand-alone, the transmitter shall employ a bandpass cavity filter with the following minimum performance specifications:

3.1.1. Rejection. The bandpass filter shall provide the following minimum rejection for Class C, C0 and C1 stations:

From Center +/-	Minimum Rejection
800 kHz	22 dB
1 MHz	28 dB
1.2 MHz	32 dB

1.4 MHz 38 dB
1.6 MHz 43 dB

Note that four cavities are required to meet this specification. Class C2 and C3 stations may use three-cavity filters. These filter requirements also apply to stations with FM & IBOC combined outputs. A stand alone IBOC transmitter and antenna shall comply with the following requirements: IBOC ERP greater than 5,000 Watts: 4 cavity filter (see rejection above), IBOC ERP less than or equal to 5,000 Watts: 3 cavity filter.

3.1.2 Gain Flatness. +/-0.5 dB from +/-200 kHz from center frequency.

3.1.3. Group Delay Flatness. No greater than +/- 150 nanoseconds (symmetrical) in +/- 200 kHz (I.e., minimum to maximum delay difference shall be no greater than 300 nanoseconds in the band f_c - 200 kHz to f_c + 200 kHz.

3.1.4. VSWR. No greater than 1.1:1 in +/- 200 kHz (assuming filter is terminated in perfect 50 ohm load).

3.1.5. Insertion Loss. No greater than 0.3 dB in +/- 200 kHz.

The transmitter should comply with current FCC rules regarding out-of-band emissions at transmitter output (before the bandpass cavity filter). The external filter is required to provide further rejection of out-of-band emissions to ensure electromagnetic compatibility with other users on the site.

3.2 FM Broadcast Antennas. FM Broadcast antennas mounted below 250' AGL (center of radiation) shall employ short element spacing to reduce downward radiation and ensure compliance with CFR 47, Parts 1.1307-1.1310. This requirement does not apply to stations that employ a single element antenna. Examples of short element spacing are a 6 bay antenna with half-wavelength spacing or an 8 bay antenna with 3/4 wavelength spacing. Submit a plot of predicted power density versus distance at ground level for City's Technical Representative approval.

4.0 Full-Power Television

4.1 Full-power television transmitters shall include band pass and low pass filters.

4.2 For television transmitters, measured out-of-band emissions (including harmonics) greater than 3 MHz from the respective channel edge shall be more than 80 dB below the measured power over the entire channel. Both measurements shall use a 6 MHz measurement bandwidth.

5.0 Low Power Television (analog and digital)

5.1 Low Power Television (LPTV) transmitters and television translators must have low pass filters that attenuate all harmonics and spurious products at least 80 dB below the power

measured at the carrier frequency. To facilitate measurements of spurious products, each LPTV and translator transmitter shall have installed a line section and appropriate directional coupler element. For routine use, the line section may employ a standard DC element and be connected to a wattmeter capable of measuring forward and reflected power. In addition, the Tenant (Licensee) shall own or have access to an RF load capable of dissipating the full power of the transmitter for troubleshooting purposes.

6.0 Grounding, Bonding and Shielding

6.1 Shielding. RF interference can get directly into the electronics of a receiver or transmitter. Cabinet shielding must be in place and maintained to the manufacturer's specifications. Do not leave cabinet doors open because open cabinet doors defeat the shielding.

6.2 Grounding. Equipment grounding and bonding should be accomplished in accordance with Mil Std 188-124, Military Handbook 419 and Motorola R56. Contact the City's Technical Representative for guidance on grounding and bonding at your particular facility.

7.0 Site Work

7.1 Tower Work Insurance and Experience Requirements. All tower riggers or installers of antennas, transmission lines, cabinets, wiring or similar hardware or apparatus must meet the minimum basic requirements of the City. These will include, but not be limited to, the following:

- The rigging company must have a current Certificate of Insurance on file with the City. The certificate will include, but not be limited to the following:

    1. General Comprehensive & Liability: $5,000,000
    2. Vehicle Liability: $1,000,000
    3. Workman's Compensation Insurance (By Statute)

- Demonstrated experience on similar tower types and similar work activity on similar towers within the past two years with a list of at least two recent clients or professional references with actual knowledge of experience and necessary qualifications, or in lieu thereof; previous working relationship with the City and known by the City's personnel.

City reserves the right, at its sole discretion, to reject the use of any person or tower rigging company on City-owned towers or properties.

7.2 Work Standards. The installation of any and all materials on the tower and in the accompanying shelter must be pre-authorized and approved by the City's Technical Representative. The following guidelines will be strictly enforced:

7.2.1 Equipment or cabinets mounted on platforms will be constructed of galvanized or stainless steel and will be securely attached to the tower members or platforms with J-bolts, U-

bolts or similar clamping devices which do not penetrate tower members or any part of the galvanized coating. All mounting hardware must be hot-dipped galvanized or stainless steel (NOT PLATED). All mounting nuts, bolts, washers or similar must be Grade 5 or better.

7.2.2 Antennas and the mounting thereof must be approved in advance of installation. Data in reference to antenna type, weight, wind loading, gain, bandwidth and mounting details must be provided to the City's Technical Representative and may not be modified or replaced without expressed written permission of City. Installation of antennas on City-owned towers may require a new structural study at the Tenant (Licensee)‘s expense.

7.2.3 Transmission lines and hardware must be approved in advance of installation by the City's Technical Representative and must be specified as to manufacturer, size and type and shown on the City’s New Tenant Questionnaire. All the mounting hardware must be of appropriate type and design to support the transmission lines with strain-reliefs installed at the manufacturer’s recommended intervals. Under no circumstances will stainless steel automotive-type hose clamps be used to secure transmission lines or cables to tower members. Where not previously designated, all lines will be positioned on the tower to minimize wind loading and provide a minimum of obstruction to climbing or removal/replacement of other lines. Each line will be mounted independently of other lines on the tower. Cable trays, waveguide entrances, tower ladders, elevator rails and other similar members are to be kept clear of all cables on the tower. Stainless steel lashing ties are acceptable for use on the tower but are not to be used as strain reliefs.

7.2.4 Antenna jumper cables or cables to/from crossband couplers or similar devices on the tower will be kept to minimum required lengths and will be made of solid shield outer conductor cables with outer jackets capable of withstanding severe weather and ultraviolet rays. All such cable types must be pre-approved by the City.

7.2.5 UNDER NO CIRCUMSTANCES –

- will welding or drilling of tower members be allowed;
- will modifications to the tower, bridge, building entrance fittings or similar be permitted;
- will transmission line splices (a pair of connectors at other than the top or bottom of the run on the tower) be permitted except by prior approval or necessitated by damage only repairable by splicing;
- will any tampering, retuning, rerouting or other modifications be permitted to equipment owned by City or other tenants.

7.2.6 All installations will be performed in accordance with good engineering practice and within the guidelines of this document. Any deviation from these minimum requirements and technical standards must be approved in writing prior to installation or modification.

7.3 Removal of Unused Antennas and Lines. Tenant (Licensee) shall remove all unused antennas, transmission lines and associated mounting hardware from City's tower within 90 days of the date an antenna is no longer in service.

7.4 NO PRESENT INSTALLATION WILL BE "GRANDFATHERED" and must conform to these work standards within a reasonable time period to be determined by the City's Technical Representative. Periodic inspections may be performed to ensure that all installations meet technical standards.

8.0 Shelters

8.1 Cable Dressing Inside Building or Shelter. All wiring and cables within a given rack will be properly dressed and/or bundled with cable ties with excess cut close to the barbs. Twisted wire, tape, rope, twine, phone wire and similar bits of debris usually available on site ARE NOT ACCEPTABLE substitutes for proper securing hardware. All inter-rack cables and wiring must be properly routed and utilize the cable trays provided even if between adjacent racks. Overhead cables and RF lines must be easily removed or reworked within the cable trays. Proper care must be taken to ensure that new cables added to the trays are not stressed or intertwined with existing cables. OVERHEAD CABLES MAY NOT CROSS PERPENDICULARS OR BE SUSPENDED IN MID AIR WITHOUT SUPPORTS. NO SUPPORTS MAY BE INSTALLED WITHOUT PRIOR APPROVAL. All long cable runs must be properly identified at each end indicating the opposite cable end address. All cabling within the building must be cut to proper length except phasing harnesses, where required.

9.0 Towers

9.1 Tenant (Licensee) may not erect new towers without the City's prior written consent, which may be granted or denied in City's sole discretion, and towers that are approved may only be constructed after plans for the tower have been approved by the City and by the zoning authority.

9.2 New towers shall comply with TIA-222-G or the most recent edition adopted by the local zoning authority. Changes to an existing tower, including addition or replacement of antennas requires that TIA-222-G or the most recent edition be used. Tenant (Licensee)-owned towers that present an immediate safety hazard shall be corrected by Tenant (Licensee) regardless of the status of the current lease or the particular edition of TIA-222 in use at the time of tower construction. Installation of antennas on City-owned towers may require a new structural study at the Tenant (Licensee)'s expense.

10.0 Permits

10.1 Tenant (Licensee) shall comply with all local and Federal regulations. Tenant (Licensee) is responsible for acquiring all applicable permits, including, but not limited to FCC construction permits and building permits. Tenant (Licensee) is also responsible for performing any required studies, including RF exposure and RF interference studies required by the FCC, local government, and City. Tenant (Licensee) shall furnish all applicable permits, studies, and

approvals to the City for approval before starting any construction, including antenna installation.

11.0 Radio Frequency Safety

11.1 The engineering, design, configuration, installation, and maintenance of high power (> 1 kW ERP) radio facilities on the site shall be accomplished in a manner that minimizes downward radiation. Changes to proposed systems may be directed by City to comply with this objective.

11.2 Everyone on the site shall follow these guidelines:

- All personnel entering the site must be authorized
- Obey all posted signs
- Assume all antennas are active unless proven otherwise
- Before working on an antenna, notify the owner and disable the transmitter
- Use a radio frequency (RF) personal monitor when working near antennas
- Never operate transmitters without shields

11.3 Power densities on towers can be much higher than at ground level. For this reason, tower climbers should request power reductions from high-power tenants and carry RF personal monitors when climbing towers. The City's Technical Representative can tell you which transmitters should be turned down before climbing the tower.

11.4 Federal Government guidelines regarding human exposure to radio frequency energy are found in the Code of Federal Regulations (CFR) Title 47, Parts 1.1307-1.1310.

Figure 1 - Warning Sign to be Posted at Base of Tower
(Available from Tessco, Holaday, Narda and other Sources)

EXHIBIT D – INTERFERENCE STUDY

RADIO FREQUENCY INTERFERENCE ANALYSIS REPORT

North Wash Park

May 25, 2022

No harmful interference to existing radio systems is predicted as a result of Verizon Wireless' proposed operations at this site.

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2022.05.25 10:55:11 -04'00'

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1.0 Executive Summary

This report presents a radio frequency interference (RFI) analysis which was performed on the DEN-North Wash Park site. The RFI analysis consists of transmitter noise, receiver desensitization, intermodulation, harmonic and transmitter spurious output interference. The report consists of Sections that provide details of the communications site, antenna systems, operational frequencies and each interference analysis mode.

A summary of the interference analysis results is depicted in the following Table.

Interference Analysis Mode	Type Mix	Status	Summary	Worst-Case Margin (dB)
Transmitter Noise	N/A	Passed	No Interference was predicted	17.3
Receiver Desensitization	N/A	Passed	No Interference was predicted	41.1
Transmitter Intermodulation	1 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	2 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	3 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	4 Tx	Passed	No Interference was predicted	N/A
Transmitter Intermodulation	5 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	1 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	2 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	3 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	4 Tx	Passed	No Interference was predicted	N/A
Receiver Intermodulation	5 Tx	Passed	No Interference was predicted	N/A
Transmitter Harmonics	N/A	Passed	No Interference was predicted	N/A
Transmitter Spurious Output	N/A	Passed	No Interference was predicted	N/A
Interference Level Summing - C/(I+N)	N/A	Passed	No Interference was predicted	N/A
Wideband IM Spectral Analysis	N/A	N/A	No Analysis performed	N/A

The analysis was performed with the setup options depicted in the Table below.

Analysis	Description
Receiver Performance	Receiver Sensitivity Threshold
Receiver Bandwidth	Receiver Dependent
Antenna Patterns Considered	Yes
Measured Antenna Isolation Data	No
Filters/Multicouplers Considered	Yes
Number of Simultaneous Transmitters Mixed	5
Highest Intermodulation Order Tested	7
Condense Intermodulation Hit Quantity	Yes - 100000/Order
TX IM Bandwidth Multiplication	Yes
Tx/Rx Systems Excluded	None
Site File Name	North Wash Park.dta
Report File Name	North Wash Park.docx
WirelessSiteRFI Software Version	10.0.9

2.0 Site Description

The communication systems located at this site are described in this section as well as the configuration of the antenna systems.

The site parameters are:

Site Name: DEN-North Wash Park
Owner: City of Denver
Site Description: SST
Address: 1580 E Virginia Ave Denver CO 80209
Latitude: 39:42:25.8N
Longitude: 104:58:08.5W
Notes: This analysis is based on Verizon Wireless' proposed installation and existing wireless operations in the vicinity of this site.

2.1 Communications Systems

System	Provider	Technology	Frequency Band
1	Verizon Wireless Cellular B CDMA	CDMA	806 - 896 MHz - Land Mobile
2	Verizon Wireless Cellular B LTE High	LTE	806 - 896 MHz - Land Mobile
3	Verizon Wireless 700 MHz Upper C LTE	LTE	746 - 806 MHz - 700 MHz Band
4	Verizon Wireless PCS E LTE	LTE	1710 - 1990 MHz - PCS
5	Verizon Wireless PCS F LTE	LTE	1710 - 1990 MHz - PCS
6	Verizon Wireless AWS B LTE	LTE	1710 - 2155 MHz - AWS
7	Verizon Wireless AWS J LTE	LTE	1695 - 2180 MHz - AWS
8	Verizon Wireless CBRS	LTE	3550 – 3700 MHz - CBRS
9	Verizon C-Band Ericsson	5G	3700 MHz
10	Verizon 28 GHz	5G	28 GHz 5G
11	Denver 150 MHz Receive Only Land Mobile Radio	FM Land Mobile	150 - 174 MHz - Land Mobile
12	Denver 930 MHz Trunked	FM Land Mobile	896 - 940 MHz - Land Mobile
13	Denver WRCE950 Public Safety 4000 MHz	Public Safety 4000 MHz	4000 MHz - Land Mobile
14	Denver RMS 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
15	Denver MM 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
16	Denver STN 2 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
17	Denver STN 26 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
18	Denver STN 28 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
19	Denver DHA 850 MHz Trunked	800 MHz Trunking	806 - 896 MHz - Land Mobile
20	Denver BRDWY 700 MHz Trunked	700 MHz Trunked	769 - 805 MHz - Land Mobile

21	Denver 8CALL90 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
22	Denver 8TAC91 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
23	Denver 8TAC92 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
24	Denver 8TAC93 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
25	Denver 8TAC94 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
26	Denver STAC Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
27	Denver 450 MHz Land Mobile Radio	FM Land Mobile	420 - 470 MHz - Land Mobile
28	Denver VLAW31(NLEEC) Conventional	FM Land Mobile	150 - 174 MHz - Land Mobile
29	Denver VMED28(HEAR) Conventional	FM Land Mobile	150 - 174 MHz - Land Mobile
30	Denver R.A.C.E.S. Conventional	FM Land Mobile	150 - 174 MHz - Land Mobile
31	Denver METRO RPTR 1 Conventional	800 MHz Trunking	806 - 896 MHz - Land Mobile
32	Denver 850 MHz Trunked P25	Project 25	806 - 896 MHz - Land Mobile
33	Denver Jail Control	FM Land Mobile	420 - 470 MHz - Land Mobile
34	Denver Jail Tactical	FM Land Mobile	420 - 470 MHz - Land Mobile
35	Denver P25 ASR 850 MHz Trunked P25	Project 25	806 - 896 MHz - Land Mobile
36	Denver P25 Simulcast 850 MHz Trunked P25	Project 25	806 - 896 MHz - Land Mobile
37	Denver Fire Repeaters 700 MHz Trunked	700 MHz Trunked	769 - 805 MHz - Land Mobile

2.2 Antenna Systems

Ant #	Mfg	Antenna Model	Gain (dBd)	Hgt (ft)	Orient (deg)	Sec-tor	Ant Use	Transmission Line Type	Line Loss (/100')	Line Length (ft)
1	Antel	BXA-80063-4CF-EDIN-4 850	13	65	310	A	Dplx	1-5/8 in. Foam	0.82	100
2	Antel	BXA-80063-4CF-EDIN-4 850	13	65	70	B	Dplx	1-5/8 in. Foam	0.82	100
3	Antel	BXA-80063-4CF-EDIN-4 850	13	65	190	C	Dplx	1-5/8 in. Foam	0.82	100
4	JMA	MX10FRO660-xx 06DT 850	13	72	310	A	Dplx	1/2 in. Foam	0.5	10
5	JMA	MX10FRO660-xx 06DT 850	13	72	70	B	Dplx	1/2 in. Foam	0.5	10
6	JMA	MX10FRO660-xx 06DT 850	13	72	190	C	Dplx	1/2 in. Foam	0.5	10
7	JMA	MX10FRO660-xx 06DT 700	12.05	72	310	A	Dplx	1/2 in. Foam	0.5	10
8	JMA	MX10FRO660-xx 06DT 700	12.05	72	70	B	Dplx	1/2 in. Foam	0.5	10
9	JMA	MX10FRO660-xx 06DT 700	12.05	72	190	C	Dplx	1/2 in. Foam	0.5	10
10	CSS	MX10FRO660-xx 03DT 1900	15.4	72	310	A	Dplx	1/2 in. Foam	0.5	10
11	CSS	MX10FRO660-xx 03DT 1900	15.4	72	70	B	Dplx	1/2 in. Foam	0.5	10
12	CSS	MX10FRO660-xx 03DT 1900	15.4	72	190	C	Dplx	1/2 in. Foam	0.5	10

13	CSS	MX10FRO660-xx 03DT 1900	15.4	72	310	A	Dplx	1/2 in. Foam	0.5	10
14	CSS	MX10FRO660-xx 03DT 1900	15.4	72	70	B	Dplx	1/2 in. Foam	0.5	10
15	CSS	MX10FRO660-xx 03DT 1900	15.4	72	190	C	Dplx	1/2 in. Foam	0.5	10
16	JMA	MX10FRO660-xx 03DT 2100	15.3	72	310	A	Dplx	1/2 in. Foam	0.5	10
17	JMA	MX10FRO660-xx 03DT 2100	15.3	72	70	B	Dplx	1/2 in. Foam	0.5	10
18	JMA	MX10FRO660-xx 03DT 2100	15.3	72	190	C	Dplx	1/2 in. Foam	0.5	10
19	JMA	MX10FRO660-xx 03DT 2100	15.3	72	310	A	Dplx	1/2 in. Foam	0.5	10
20	JMA	MX10FRO660-xx 03DT 2100	15.3	72	70	B	Dplx	1/2 in. Foam	0.5	10
21	JMA	MX10FRO660-xx 03DT 2100	15.3	72	190	C	Dplx	1/2 in. Foam	0.5	10
22	JMA	MX10FRO660-03 03DT 3600	12.2	72	0	A	Dplx	1/2 in. Foam	0.5	10
23	Ericsson	AIR6449 (as omni)	21.35	72	0	A	Tx/Rx	Integrated	0.1	0.1
24	Ericsson	SM6701 half array (as omni)	25.96	72	0	A	Dplx	Integrated	0.1	0.1
25	Other	Generic Omni	9	100	0		Rx	7/8 in. Foam	0.5	150
26	Other	Generic Omni	10	100	0		Dplx	7/8 in. Foam	0.5	150
27	Other	Microwave Dish	42.5	100	0		Tx/Rx	7/8 in. Foam	0.5	150
28	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
29	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
30	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
31	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
32	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
33	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
34	Other	Generic Omni	9	303	0		Dplx	7/8 in. Foam	1	250
35	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
36	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
37	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
38	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
39	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
40	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
41	Other	Generic Omni	9	150	0		Dplx	7/8 in. Foam	0.5	150
42	Other	Generic Omni	9	100	0		Tx/Rx	7/8 in. Foam	0.5	150
43	Other	Generic Omni	9	100	0		Tx/Rx	7/8 in. Foam	0.5	150
44	Other	Generic Omni	9	100	0		Tx/Rx	7/8 in. Foam	0.5	150
45	Other	Generic Omni	9	200	0		Dplx	7/8 in. Foam	1	250
46	Other	Generic Omni	9	200	0		Dplx	1-1/4 in. Foam	1	250
47	Other	Generic Omni	9	100	0		Dplx	7/8 in. Foam	0.5	150
48	Other	Generic Omni	9	100	0		Tx/Rx	7/8 in. Foam	0.5	150
49	Other	Generic Omni	9	200	0		Dplx	1-1/4 in. Foam	1	250
50	Other	Generic Omni	9	200	0		Dplx	1-1/4 in. Foam	1	250
51	Other	Generic Omni	3	3	0		Dplx	7/8 in. Foam	0.5	10

3.0 Transmitter Frequencies

Freq #	Ant #	Provider	Model	Technology	Channel Label	ID	Frequency	Power (Watts)	BW (KHz)
1	1	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-384	A	881.52000	20	1230
2	1	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-425	B	882.75000	20	1230
3	2	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-384	C	881.52000	20	1230
4	2	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-425	D	882.75000	20	1230
5	3	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-384	E	881.52000	20	1230
6	3	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-425	F	882.75000	20	1230
7	4	Verizon Wireless Cellular B LTE High	Generic	Land Mobile	VZW-1	G	887.50000	40	5000
8	5	Verizon Wireless Cellular B LTE High	Generic	Land Mobile	VZW-1	H	887.50000	40	5000
9	6	Verizon Wireless Cellular B LTE High	Generic	Land Mobile	VZW-1	I	887.50000	40	5000
10	7	Verizon Wireless 700 MHz Upper C LTE	Generic	Land Mobile	VZW-2	J	751.00000	40	10000
11	8	Verizon Wireless 700 MHz Upper C LTE	Generic	Land Mobile	VZW-2	K	751.00000	40	10000
12	9	Verizon Wireless 700 MHz Upper C LTE	Generic	Land Mobile	VZW-2	L	751.00000	40	10000
13	10	Verizon Wireless PCS E LTE	Generic	Land Mobile	VZW-3	M	1967.5000	40	5000
14	11	Verizon Wireless PCS E LTE	Generic	Land Mobile	VZW-3	N	1967.5000	40	5000
15	12	Verizon Wireless PCS E LTE	Generic	Land Mobile	VZW-3	O	1967.5000	40	5000
16	13	Verizon Wireless PCS F LTE	Generic	Land Mobile	VZW-4	P	1972.5000	40	5000
17	14	Verizon Wireless PCS F LTE	Generic	Land Mobile	VZW-4	Q	1972.5000	40	5000
18	15	Verizon Wireless PCS F LTE	Generic	Land Mobile	VZW-4	R	1972.5000	40	5000
19	16	Verizon Wireless AWS B LTE	Generic	Land Mobile	VZW-5	S	2125.0000	40	10000
20	17	Verizon Wireless AWS B LTE	Generic	Land Mobile	VZW-5	T	2125.0000	40	10000
21	18	Verizon Wireless AWS B LTE	Generic	Land Mobile	VZW-5	U	2125.0000	40	10000
22	19	Verizon Wireless AWS J LTE	Generic	Land Mobile	VZW-6	V	2175.0000	40	10000
23	20	Verizon Wireless AWS J LTE	Generic	Land Mobile	VZW-6	W	2175.0000	40	10000
24	21	Verizon Wireless AWS J LTE	Generic	Land Mobile	VZW-6	X	2175.0000	40	10000
25	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-7	Y	3515.0000	5	10000
26	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-8	Z	3525.0000	5	10000
27	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-9	AA	3535.0000	5	10000
28	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-10	AB	3545.0000	5	10000
29	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-11	AC	3555.0000	5	10000
30	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-12	AD	3565.0000	5	10000

31	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-13	AE	3575.0000	5	10000
32	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-14	AF	3585.0000	5	10000
33	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-15	AG	3710.0000	200	20000
34	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-16	AH	3730.0000	200	20000
35	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-17	AI	3750.0000	200	20000
36	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-18	AJ	3770.0000	200	20000
37	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-19	AK	3790.0000	200	20000
38	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-20	AL	3810.0000	200	20000
39	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-21	AM	3830.0000	200	20000
40	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-22	AN	3850.0000	200	20000
41	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-23	AO	3870.0000	200	20000
42	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-24	AP	3890.0000	200	20000
43	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-25	AQ	3910.0000	200	20000
44	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-26	AR	3930.0000	200	20000
45	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-27	AS	3950.0000	200	20000
46	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-28	AT	3970.0000	200	20000
47	24	Verizon 28 GHz	Generic	Land Mobile	VZW-29	AU	27562.5000	1.6	25000
48	24	Verizon 28 GHz	Generic	Land Mobile	VZW-30	AV	27587.5000	1.6	25000
49	24	Verizon 28 GHz	Generic	Land Mobile	VZW-31	AW	27612.5000	1.6	25000
50	24	Verizon 28 GHz	Generic	Land Mobile	VZW-32	AX	27637.5000	1.6	25000
51	24	Verizon 28 GHz	Generic	Land Mobile	VZW-33	AY	27662.5000	1.6	25000
52	24	Verizon 28 GHz	Generic	Land Mobile	VZW-34	AZ	27687.5000	1.6	25000
53	24	Verizon 28 GHz	Generic	Land Mobile	VZW-35	BA	27712.5000	1.6	25000
54	24	Verizon 28 GHz	Generic	Land Mobile	VZW-36	BB	27737.5000	1.6	25000
55	24	Verizon 28 GHz	Generic	Land Mobile	VZW-37	BC	27762.5000	1.6	25000
56	24	Verizon 28 GHz	Generic	Land Mobile	VZW-38	BD	27787.5000	1.6	25000
57	24	Verizon 28 GHz	Generic	Land Mobile	VZW-39	BE	27812.5000	1.6	25000
58	24	Verizon 28 GHz	Generic	Land Mobile	VZW-40	BF	27837.5000	1.6	25000
59	24	Verizon 28 GHz	Generic	Land Mobile	VZW-41	BG	27862.5000	1.6	25000
60	24	Verizon 28 GHz	Generic	Land Mobile	VZW-42	BH	27887.5000	1.6	25000
61	24	Verizon 28 GHz	Generic	Land Mobile	VZW-43	BI	27912.5000	1.6	25000
62	26	Denver 930 MHz Trunked	Generic	FM Land Mobile	DEN-2	BK	928.75625	50	13
63	27	Denver WRCE950 Public Safety 4000 MHz	Generic	FM Land Mobile	DEN-3	BL	4950.0000	0.25	20000
64	27	Denver WRCE950 Public Safety 4000 MHz	Generic	FM Land Mobile	DEN-4	BM	4980.0000	0.25	20000
65	28	Denver RMS 850 MHz Trunked	Generic	FM Land Mobile	DEN-5	BN	858.08750	100	20
66	28	Denver RMS 850 MHz Trunked	Generic	FM Land Mobile	DEN-6	BO	858.33750	100	20
67	28	Denver RMS 850 MHz Trunked	Generic	FM Land Mobile	DEN-7	BP	859.08750	100	20
68	28	Denver RMS 850 MHz Trunked	Generic	FM Land Mobile	DEN-8	BQ	859.63750	100	20
69	29	Denver MM 850 MHz Trunked	Generic	FM Land Mobile	DEN-9	BR	855.91250	100	20
70	30	Denver STN 2 850 MHz Trunked	Generic	FM Land Mobile	DEN-10	BS	856.78750	100	20
71	31	Denver STN 26 850	Generic	FM Land Mobile	DEN-11	BT	855.68750	100	20

		MHz Trunked							
72	32	Denver STN 28 850 MHz Trunked	Generic	FM Land Mobile	DEN-12	BU	851.18750	100	20
73	33	Denver DHA 850 MHz Trunked	Generic	FM Land Mobile	DEN-13	BV	854.23750	100	20
74	34	Denver BRDWY 700 MHz Trunked	Generic	FM Land Mobile	DEN-14	BW	771.80000	100	20
75	35	Denver 8CALL90 Conventional	Generic	FM Land Mobile	DEN-15	BX	854.23750	100	20
76	36	Denver 8TAC91 Conventional	Generic	FM Land Mobile	DEN-16	BY	854.23750	100	20
77	37	Denver 8TAC92 Conventional	Generic	FM Land Mobile	DEN-17	BZ	854.23750	100	20
78	38	Denver 8TAC93 Conventional	Generic	FM Land Mobile	DEN-18	CA	854.23750	100	20
79	39	Denver 8TAC94 Conventional	Generic	FM Land Mobile	DEN-19	CB	854.23750	100	20
80	40	Denver STAC Conventional	Generic	FM Land Mobile	DEN-20	CC	854.23750	100	20
81	41	Denver 450 MHz Land Mobile Radio	Generic	FM Land Mobile	DEN-21	CD	460.42500	100	20
82	42	Denver VLAW31(NLEEC) Conventional	Generic	FM Land Mobile	DEN-22	CE	155.47500	100	20
83	43	Denver VMED28(HEAR) Conventional	Generic	FM Land Mobile	DEN-23	CF	155.34000	100	20
84	44	Denver R.A.C.E.S. Conventional	Generic	FM Land Mobile	DEN-24	CG	147.30000	100	20
85	45	Denver METRO RPTR 1 Conventional	Generic	FM Land Mobile	DEN-25	CH	851.88750	100	20
86	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-1	CI	852.37500	100	20
87	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-3	CJ	853.27500	100	20
88	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-4	CK	853.72500	100	20
89	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-5	CL	851.56250	100	20
90	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-6	CM	853.15000	100	20
91	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-7	CN	853.42500	100	20
92	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-12	CO	852.12500	100	20
93	47	Denver Jail Control	Generic	FM Land Mobile	Jail-1	CP	460.03750	100	20
94	48	Denver Jail Tactical	Generic	FM Land Mobile	Jail-2	CQ	453.41250	100	20
95	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-1	CR	859.26250	100	20
96	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-2	CS	858.71250	100	20
97	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-3	CT	857.13750	100	20
98	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-4	CU	856.73750	100	20
99	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-5	CV	856.21250	100	20
100	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-6	CW	855.98750	100	20
101	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-7	CX	855.48750	100	20
102	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-8	CY	855.23750	100	20
103	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-9	CZ	854.43750	100	20
104	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-10	DA	853.86250	100	20
105	49	Denver P25 ASR 850	Generic	FM Land Mobile	DASR-11	DB	853.32500	100	20

		MHz Trunked P25							
106	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-12	DC	852.77500	100	20
107	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-1	DD	859.71250	100	20
108	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-2	DE	859.61250	100	20
109	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-3	DF	859.21250	100	20
110	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-4	DG	856.13750	100	20
111	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-5	DH	858.21250	100	20
112	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-6	DI	857.73750	100	20
113	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-7	DJ	858.13750	100	20
114	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-8	DK	857.46250	100	20
115	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-9	DL	857.06250	100	20
116	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-10	DM	856.71250	100	20
117	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-11	DN	856.63750	100	20
118	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-12	DO	856.23750	100	20
119	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-13	DP	858.73750	100	20
120	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-14	DQ	855.73750	100	20
121	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-15	DR	855.46250	100	20
122	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-16	DS	854.56250	100	20
123	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-17	DT	854.06250	100	20
124	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-1	DU	799.31875	100	20
125	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-2	DV	799.85625	100	20
126	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-3	DW	800.50625	100	20
127	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-4	DX	800.75625	100	20
128	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-5	DY	801.18125	100	20
129	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-6	DZ	801.43125	100	20
130	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-7	EA	802.43125	100	20
131	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-8	EB	802.68125	100	20

4.0 Receiver Frequencies

Freq #	Ant #	Provider	Model	Technology	Channel Label	ID	Frequency	Sen (dBm)	BW (KHz)
1	1	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-384	A	836.52000	-113	1230
2	1	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-425	B	837.75000	-113	1230
3	2	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-384	C	836.52000	-113	1230
4	2	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-425	D	837.75000	-113	1230
5	3	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-384	E	836.52000	-113	1230
6	3	Verizon Wireless Cellular B CDMA	Generic	Land Mobile	VZW-425	F	837.75000	-113	1230
7	4	Verizon Wireless Cellular B LTE High	Generic	Land Mobile	VZW-1	G	842.50000	-123	5000
8	5	Verizon Wireless Cellular B LTE High	Generic	Land Mobile	VZW-1	H	842.50000	-123	5000
9	6	Verizon Wireless Cellular B LTE High	Generic	Land Mobile	VZW-1	I	842.50000	-123	5000
10	7	Verizon Wireless 700 MHz Upper C LTE	Generic	Land Mobile	VZW-2	J	781.00000	-123	10000
11	8	Verizon Wireless 700 MHz Upper C LTE	Generic	Land Mobile	VZW-2	K	781.00000	-123	10000
12	9	Verizon Wireless 700 MHz Upper C LTE	Generic	Land Mobile	VZW-2	L	781.00000	-123	10000
13	10	Verizon Wireless PCS E LTE	Generic	Land Mobile	VZW-3	M	1887.5000	-123	5000
14	11	Verizon Wireless PCS E LTE	Generic	Land Mobile	VZW-3	N	1887.5000	-123	5000
15	12	Verizon Wireless PCS E LTE	Generic	Land Mobile	VZW-3	O	1887.5000	-123	5000
16	13	Verizon Wireless PCS F LTE	Generic	Land Mobile	VZW-4	P	1892.5000	-123	5000
17	14	Verizon Wireless PCS F LTE	Generic	Land Mobile	VZW-4	Q	1892.5000	-123	5000
18	15	Verizon Wireless PCS F LTE	Generic	Land Mobile	VZW-4	R	1892.5000	-123	5000
19	16	Verizon Wireless AWS B LTE	Generic	Land Mobile	VZW-5	S	1725.0000	-123	10000
20	17	Verizon Wireless AWS B LTE	Generic	Land Mobile	VZW-5	T	1725.0000	-123	10000
21	18	Verizon Wireless AWS B LTE	Generic	Land Mobile	VZW-5	U	1725.0000	-123	10000
22	19	Verizon Wireless AWS J LTE	Generic	Land Mobile	VZW-6	V	1775.0000	-123	10000
23	20	Verizon Wireless AWS J LTE	Generic	Land Mobile	VZW-6	W	1775.0000	-123	10000
24	21	Verizon Wireless AWS J LTE	Generic	Land Mobile	VZW-6	X	1775.0000	-123	10000
25	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-7	Y	3415.0000	-123	10000
26	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-8	Z	3425.0000	-123	10000
27	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-9	AA	3435.0000	-123	10000
28	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-10	AB	3445.0000	-123	10000
29	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-11	AC	3455.0000	-123	10000
30	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-12	AD	3465.0000	-123	10000
31	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-13	AE	3475.0000	-123	10000

32	22	Verizon Wireless CBRS	Generic	Land Mobile	VZW-14	AF	3485.0000	-123	10000
33	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-14	AG	3710.0000	-123	20000
34	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-15	AH	3730.0000	-123	20000
35	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-16	AI	3750.0000	-123	20000
36	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-17	AJ	3770.0000	-123	20000
37	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-18	AK	3790.0000	-123	20000
38	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-19	AL	3810.0000	-123	20000
39	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-20	AM	3830.0000	-123	20000
40	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-21	AN	3850.0000	-123	20000
41	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-22	AO	3870.0000	-123	20000
42	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-23	AP	3890.0000	-123	20000
43	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-24	AQ	3910.0000	-123	20000
44	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-25	AR	3930.0000	-123	20000
45	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-26	AS	3950.0000	-123	20000
46	23	Verizon C-Band Ericsson	Generic	Land Mobile	VZW-27	AT	3970.0000	-123	20000
47	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-28	AU	27937.5000	-100	25000
48	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-29	AV	28012.5000	-100	25000
49	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-30	AW	28037.5000	-100	25000
50	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-31	AX	28062.5000	-100	25000
51	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-32	AY	28087.5000	-100	25000
52	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-33	AZ	28112.5000	-100	25000
53	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-34	BA	28137.5000	-100	25000
54	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-35	BB	28162.5000	-100	25000
55	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-36	BC	28187.5000	-100	25000
56	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-37	BD	28212.5000	-100	25000
57	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-38	BE	28237.5000	-100	25000
58	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-39	BF	28262.5000	-100	25000
59	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-40	BG	28287.5000	-100	25000
60	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-41	BH	28312.5000	-100	25000
61	24	Verizon 28 GHz	Generic	FM Land Mobile	VZW-42	BI	28337.5000	-100	25000
62	25	Denver 150 MHz Receive Only Land Mobile Radio	Generic	FM Land Mobile	VZW-43	BJ	154.70700	-116	11
63	26	Denver 930 MHz Trunked	Generic	FM Land Mobile	DEN-2	BK	952.72625	-119	13
64	27	Denver WRCE950 Public Safety 4000 MHz	Generic	FM Land Mobile	DEN-3	BL	4950.0000	-116	20000
65	27	Denver WRCE950 Public Safety 4000 MHz	Generic	FM Land Mobile	DEN-4	BM	4980.0000	-116	20000
66	28	Denver RMS 850 MHz Trunked	Generic	FM Land Mobile	DEN-5	BN	813.08750	-116	20
67	28	Denver RMS 850 MHz Trunked	Generic	FM Land Mobile	DEN-6	BO	813.33750	-116	20
68	28	Denver RMS 850 MHz Trunked	Generic	FM Land Mobile	DEN-7	BP	814.08750	-116	20
69	28	Denver RMS 850 MHz Trunked	Generic	FM Land Mobile	DEN-8	BQ	814.63750	-116	20
70	29	Denver MM 850 MHz Trunked	Generic	FM Land Mobile	DEN-9	BR	810.91250	-116	20
71	30	Denver STN 2 850 MHz Trunked	Generic	FM Land Mobile	DEN-10	BS	811.78750	-116	20

72	31	Denver STN 26 850 MHz Trunked	Generic	FM Land Mobile	DEN-11	BT	810.68750	-116	20
73	32	Denver STN 28 850 MHz Trunked	Generic	FM Land Mobile	DEN-12	BU	806.18750	-116	20
74	33	Denver DHA 850 MHz Trunked	Generic	FM Land Mobile	DEN-13	BV	809.23750	-116	20
75	34	Denver BRDWY 700 MHz Trunked	Generic	FM Land Mobile	DEN-14	BW	801.80000	-116	20
76	35	Denver 8CALL90 Conventional	Generic	FM Land Mobile	DEN-15	BX	809.23750	-116	20
77	36	Denver 8TAC91 Conventional	Generic	FM Land Mobile	DEN-16	BY	809.23750	-116	20
78	37	Denver 8TAC92 Conventional	Generic	FM Land Mobile	DEN-17	BZ	809.23750	-116	20
79	38	Denver 8TAC93 Conventional	Generic	FM Land Mobile	DEN-18	CA	809.23750	-116	20
80	39	Denver 8TAC94 Conventional	Generic	FM Land Mobile	DEN-19	CB	809.23750	-116	20
81	40	Denver STAC Conventional	Generic	FM Land Mobile	DEN-20	CC	809.23750	-116	20
82	41	Denver 450 MHz Land Mobile Radio	Generic	FM Land Mobile	DEN-21	CD	465.42500	-116	20
83	42	Denver VLAW31(NLEEC) Conventional	Generic	FM Land Mobile	DEN-22	CE	155.47500	-116	20
84	43	Denver VMED28(HEAR) Conventional	Generic	FM Land Mobile	DEN-23	CF	155.34000	-116	20
85	44	Denver R.A.C.E.S. Conventional	Generic	FM Land Mobile	DEN-24	CG	147.30000	-116	20
86	45	Denver METRO RPTR 1 Conventional	Generic	FM Land Mobile	DEN-25	CH	806.88750	-116	20
87	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-1	CI	807.37500	-119	20
88	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-3	CJ	808.27500	-119	20
89	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-4	CK	808.72500	-119	20
90	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-5	CL	806.56250	-119	20
91	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-6	CM	808.15000	-119	20
92	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-7	CN	808.42500	-119	20
93	46	Denver 850 MHz Trunked P25	Generic	FM Land Mobile	DP25-12	CO	807.12500	-119	20
94	47	Denver Jail Control	Generic	FM Land Mobile	Jail-1	CP	465.03750	-116	20
95	48	Denver Jail Tactical	Generic	FM Land Mobile	Jail-2	CQ	453.41250	-116	20
96	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-1	CR	814.26250	-119	20
97	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-2	CS	813.71250	-119	20
98	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-3	CT	812.13750	-119	20
99	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-4	CU	811.73750	-119	20
100	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-5	CV	811.21250	-119	20
101	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-6	CW	810.98750	-119	20
102	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-7	CX	810.48750	-119	20
103	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-8	CY	810.23750	-119	20
104	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-9	CZ	809.43750	-119	20
105	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-10	DA	808.86250	-119	20

106	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-11	DB	808.32500	-119	20
107	49	Denver P25 ASR 850 MHz Trunked P25	Generic	FM Land Mobile	DASR-12	DC	807.77500	-119	20
108	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-1	DD	814.71250	-119	20
109	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-2	DE	814.61250	-119	20
110	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-3	DF	814.21250	-119	20
111	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-4	DG	811.13750	-119	20
112	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-5	DH	813.21250	-119	20
113	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-6	DI	812.73750	-119	20
114	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-7	DJ	813.13750	-119	20
115	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-8	DK	812.46250	-119	20
116	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-9	DL	812.06250	-119	20
117	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-10	DM	811.71250	-119	20
118	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-11	DN	811.63750	-119	20
119	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-12	DO	811.23750	-119	20
120	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-13	DP	813.73750	-119	20
121	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-14	DQ	810.73750	-119	20
122	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-15	DR	810.46250	-119	20
123	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-16	DS	809.56250	-119	20
124	50	Denver P25 Simulcast 850 MHz Trunked P25	Generic	FM Land Mobile	DSIM-17	DT	809.06250	-119	20
125	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-1	DU	769.31875	-116	20
126	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-2	DV	769.85625	-116	20
127	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-3	DW	770.50625	-116	20
128	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-4	DX	770.75625	-116	20
129	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-5	DY	771.18125	-116	20
130	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-6	DZ	771.43125	-116	20
131	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-7	EA	772.43125	-116	20
132	51	Denver Fire Repeaters 700 MHz Trunked	Generic	FM Land Mobile	DFR-8	EB	772.68125	-116	20

5.0 Transmitter Noise Analysis

Transmitter noise interference occurs because a transmitter radiates energy on its operating frequency as well as frequencies above and below the assigned frequency. The energy that is radiated above and below the assigned frequency is known as sideband noise energy and extends for several megahertz on either side of the operating frequency. This undesired noise energy can fall within the passband of a nearby receiver even if the receiver's operating frequency is several megahertz away. The transmitter noise appears as "on-channel" noise interference and cannot be filtered out at the receiver. It is on the receiver's operating frequency and competes with the desired signal, which in effect, degrades the operational performance.

The analysis predicts each transmitter's noise signal level present at the input of each receiver. It takes into account the transmitter's noise characteristics, frequency separation, power output, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in both systems. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required, if any, to prevent receiver performance degradation caused by transmitter noise interference. The Table below depicts the results of this analysis. For each receiver, the transmitter that has the worst-case impact is displayed. The Signal Margin represents the margin in dB, before the receiver's performance is degraded. A negative number indicates that the performance is degraded and the value indicates how much additional isolation is required to prevent receiver performance degradation.

Receiver Provider	Receive Channel	Receive Frequency (MHz)	Transmitter Provider	Transmit Channel	Transmit Frequency (MHz)	Attn Required (dB)	Attn Provided (dB)	Signal Margin (dB)
Verizon Wireless Cellular B CDMA	VZW-384	836.52000	Verizon Wireless Cellular B CDMA	VZW-384	881.52000	45.6	198.7	153.1
Verizon Wireless Cellular B CDMA	VZW-425	837.75000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	63.6	202.4	138.8
Verizon Wireless Cellular B CDMA	VZW-384	836.52000	Verizon Wireless Cellular B CDMA	VZW-384	881.52000	45.6	198.7	153.1
Verizon Wireless Cellular B CDMA	VZW-425	837.75000	Verizon Wireless Cellular B CDMA	VZW-384	881.52000	46	185.5	139.5
Verizon Wireless Cellular B CDMA	VZW-384	836.52000	Verizon Wireless Cellular B CDMA	VZW-384	881.52000	45.6	198.7	153.1
Verizon Wireless Cellular B CDMA	VZW-425	837.75000	Verizon Wireless Cellular B CDMA	VZW-384	881.52000	46	185.5	139.5

Verizon Wireless Cellular B LTE High	VZW-1	842.50000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	73.6	160.1	86.5
Verizon Wireless Cellular B LTE High	VZW-1	842.50000	Verizon Wireless Cellular B LTE High	VZW-1	887.50000	58.6	181.3	122.7
Verizon Wireless Cellular B LTE High	VZW-1	842.50000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	73.6	194.1	120.5
Verizon Wireless 700 MHz Upper C LTE	VZW-2	781.00000	Verizon Wireless 700 MHz Upper C LTE	VZW-2	751.00000	65.3	140.3	75
Verizon Wireless 700 MHz Upper C LTE	VZW-2	781.00000	Verizon Wireless 700 MHz Upper C LTE	VZW-2	751.00000	65.3	140.3	75
Verizon Wireless 700 MHz Upper C LTE	VZW-2	781.00000	Verizon Wireless 700 MHz Upper C LTE	VZW-2	751.00000	65.3	140.3	75
Verizon Wireless PCS E LTE	VZW-3	1887.5000	Verizon Wireless PCS E LTE	VZW-3	1967.5000	61.6	137.1	75.5
Verizon Wireless PCS E LTE	VZW-3	1887.5000	Verizon Wireless PCS E LTE	VZW-3	1967.5000	61.6	137.1	75.5
Verizon Wireless PCS E LTE	VZW-3	1887.5000	Verizon Wireless PCS E LTE	VZW-3	1967.5000	61.6	137.1	75.5
Verizon Wireless PCS F LTE	VZW-4	1892.5000	Verizon Wireless PCS F LTE	VZW-4	1972.5000	61.6	133.6	71.9
Verizon Wireless PCS F LTE	VZW-4	1892.5000	Verizon Wireless PCS F LTE	VZW-4	1972.5000	61.6	133.6	71.9
Verizon Wireless PCS F LTE	VZW-4	1892.5000	Verizon Wireless PCS F LTE	VZW-4	1972.5000	61.6	133.6	71.9
Verizon Wireless AWS B LTE	VZW-5	1725.0000	Verizon Wireless AWS B LTE	VZW-5	2125.0000	61.6	169	107.4
Verizon Wireless AWS B LTE	VZW-5	1725.0000	Verizon Wireless AWS B LTE	VZW-5	2125.0000	61.6	169	107.4
Verizon Wireless AWS B LTE	VZW-5	1725.0000	Verizon Wireless AWS B LTE	VZW-5	2125.0000	61.6	169	107.4
Verizon Wireless AWS J LTE	VZW-6	1775.0000	Verizon Wireless AWS J LTE	VZW-6	2175.0000	61.6	172	110.4
Verizon Wireless AWS J LTE	VZW-6	1775.0000	Verizon Wireless AWS J LTE	VZW-6	2175.0000	61.6	172	110.4
Verizon Wireless AWS J LTE	VZW-6	1775.0000	Verizon Wireless AWS J LTE	VZW-6	2175.0000	61.6	172	110.4
Verizon Wireless CBRS	VZW-7	3415.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	159.3	106.7
Verizon Wireless CBRS	VZW-8	3425.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	68.6	220.8	152.2
Verizon Wireless CBRS	VZW-9	3435.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	68.6	220.8	152.2
Verizon Wireless CBRS	VZW-10	3445.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	68.6	220.8	152.2

Verizon Wireless CBRS	VZW-11	3455.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	68.6	220.8	152.2
Verizon Wireless CBRS	VZW-12	3465.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	68.6	220.8	152.2
Verizon Wireless CBRS	VZW-13	3475.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	68.6	220.8	152.2
Verizon Wireless CBRS	VZW-14	3485.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	68.6	220.8	152.2
Verizon C-Band Ericsson	VZW-14	3710.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-15	3730.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-16	3750.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-17	3770.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-18	3790.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-19	3810.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-20	3830.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-21	3850.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-22	3870.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-23	3890.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-24	3910.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-25	3930.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-26	3950.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon C-Band Ericsson	VZW-27	3970.0000	Verizon Wireless CBRS	VZW-7	3515.0000	52.6	182.2	129.6
Verizon 28 GHz	VZW-28	27937.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	61.5	36.9
Verizon 28 GHz	VZW-29	28012.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	61.5	36.9
Verizon 28 GHz	VZW-30	28037.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	72.2	47.5
Verizon 28 GHz	VZW-31	28062.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	99	74.3
Verizon 28 GHz	VZW-32	28087.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Verizon 28 GHz	VZW-33	28112.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Verizon 28 GHz	VZW-34	28137.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Verizon 28 GHz	VZW-35	28162.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Verizon 28 GHz	VZW-36	28187.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Verizon 28 GHz	VZW-37	28212.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Verizon 28 GHz	VZW-38	28237.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Verizon 28 GHz	VZW-39	28262.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Verizon 28 GHz	VZW-40	28287.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Verizon 28 GHz	VZW-41	28312.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Verizon 28 GHz	VZW-42	28337.5000	Verizon 28 GHz	VZW-42	27887.5000	24.6	120	95.4
Denver 150 MHz Receive Only Land Mobile Radio	VZW-43	154.70700	Denver VMED28(HEAR) Conventional	DEN-23	155.34000	79.4	112.7	33.2
Denver 930 MHz Trunked	DEN-2	952.72625	Denver 930 MHz Trunked	DEN-2	928.75625	65.2	127.8	62.6
Denver WRCE950 Public Safety 4000 MHz	DEN-3	4950.0000	Denver WRCE950 Public Safety 4000 MHz	DEN-4	4980.0000	36.2	209.2	173
Denver WRCE950 Public Safety 4000 MHz	DEN-4	4980.0000	Denver WRCE950 Public Safety 4000 MHz	DEN-3	4950.0000	36.2	209.2	173
Denver RMS 850 MHz Trunked	DEN-5	813.08750	Denver RMS 850 MHz Trunked	DEN-5	858.08750	55.6	202.1	146.5

Denver RMS 850 MHz Trunked	DEN-6	813.33750	Denver RMS 850 MHz Trunked	DEN-5	858.08750	55.6	204.6	148.9
Denver RMS 850 MHz Trunked	DEN-7	814.08750	Denver RMS 850 MHz Trunked	DEN-5	858.08750	55.9	208.2	152.3
Denver RMS 850 MHz Trunked	DEN-8	814.63750	Denver RMS 850 MHz Trunked	DEN-5	858.08750	56	212.2	156.1
Denver MM 850 MHz Trunked	DEN-9	810.91250	Denver MM 850 MHz Trunked	DEN-9	855.91250	55.6	166.7	111.1
Denver STN 2 850 MHz Trunked	DEN-10	811.78750	Denver STN 2 850 MHz Trunked	DEN-10	856.78750	55.6	179.5	123.9
Denver STN 26 850 MHz Trunked	DEN-11	810.68750	Denver STN 26 850 MHz Trunked	DEN-11	855.68750	55.6	162.6	107
Denver STN 28 850 MHz Trunked	DEN-12	806.18750	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	55.6	158.2	102.6
Denver DHA 850 MHz Trunked	DEN-13	809.23750	Denver DHA 850 MHz Trunked	DEN-13	854.23750	55.6	160.9	105.3
Denver BRDWY 700 MHz Trunked	DEN-14	801.80000	Denver Fire Repeaters 700 MHz Trunked	DFR-6	801.43125	69.6	89.7	20.1
Denver 8CALL90 Conventional	DEN-15	809.23750	Denver 8CALL90 Conventional	DEN-15	854.23750	55.6	160.9	105.3
Denver 8TAC91 Conventional	DEN-16	809.23750	Denver 8TAC91 Conventional	DEN-16	854.23750	55.6	160.9	105.3
Denver 8TAC92 Conventional	DEN-17	809.23750	Denver 8TAC92 Conventional	DEN-17	854.23750	55.6	160.9	105.3
Denver 8TAC93 Conventional	DEN-18	809.23750	Denver 8TAC93 Conventional	DEN-18	854.23750	55.6	160.9	105.3
Denver 8TAC94 Conventional	DEN-19	809.23750	Denver 8TAC94 Conventional	DEN-19	854.23750	55.6	160.9	105.3
Denver STAC Conventional	DEN-20	809.23750	Denver STAC Conventional	DEN-20	854.23750	55.6	160.9	105.3
Denver 450 MHz Land Mobile Radio	DEN-21	465.42500	Denver 450 MHz Land Mobile Radio	DEN-21	460.42500	57.4	138.8	81.4
Denver VLAW31(NLEEC) Conventional	DEN-22	155.47500	Denver R.A.C.E.S. Conventional	DEN-24	147.30000	45.4	158.5	113.1
Denver VMED28(HEAR) Conventional	DEN-23	155.34000	Denver R.A.C.E.S. Conventional	DEN-24	147.30000	45.4	158.5	113.1
Denver R.A.C.E.S. Conventional	DEN-24	147.30000	Denver VLAW31(NLEEC) Conventional	DEN-22	155.47500	45.4	158.5	113.1
Denver METRO RPTR 1 Conventional	DEN-25	806.88750	Denver METRO RPTR 1 Conventional	DEN-25	851.88750	55.6	155.3	99.7
Denver 850 MHz Trunked P25	DP25-1	807.37500	Denver 850 MHz Trunked P25	DP25-5	851.56250	58.9	156.4	97.5
Denver 850 MHz Trunked P25	DP25-3	808.27500	Denver 850 MHz Trunked P25	DP25-5	851.56250	59.1	155.7	96.6
Denver 850 MHz Trunked P25	DP25-4	808.72500	Denver 850 MHz Trunked P25	DP25-5	851.56250	59.1	158.2	99
Denver 850 MHz Trunked P25	DP25-5	806.56250	Denver 850 MHz Trunked P25	DP25-1	852.37500	58.6	156.3	97.7
Denver 850 MHz Trunked P25	DP25-6	808.15000	Denver 850 MHz Trunked P25	DP25-5	851.56250	59	155.3	96.3

Denver 850 MHz Trunked P25	DP25-7	808.42500	Denver 850 MHz Trunked P25	DP25-5	851.56250	59.1	156.5	97.4
Denver 850 MHz Trunked P25	DP25-12	807.12500	Denver 850 MHz Trunked P25	DP25-5	851.56250	58.8	156	97.2
Denver Jail Control	Jail-1	465.03750	Denver Jail Tactical	Jail-2	453.41250	52	110.6	58.6
Denver Jail Tactical	Jail-2	453.41250	Denver Jail Control	Jail-1	460.03750	54.6	89.8	35.2
Denver P25 ASR 850 MHz Trunked P25	DASR-1	814.26250	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	59.6	209.1	149.5
Denver P25 ASR 850 MHz Trunked P25	DASR-2	813.71250	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	59.5	206.7	147.1
Denver P25 ASR 850 MHz Trunked P25	DASR-3	812.13750	Denver P25 ASR 850 MHz Trunked P25	DASR-11	853.32500	59.4	184	124.6
Denver P25 ASR 850 MHz Trunked P25	DASR-4	811.73750	Denver P25 ASR 850 MHz Trunked P25	DASR-11	853.32500	59.3	178.9	119.6
Denver P25 ASR 850 MHz Trunked P25	DASR-5	811.21250	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	59.3	172.4	113
Denver P25 ASR 850 MHz Trunked P25	DASR-6	810.98750	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	59.3	168.2	108.9
Denver P25 ASR 850 MHz Trunked P25	DASR-7	810.48750	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	59.2	160.9	101.7
Denver P25 ASR 850 MHz Trunked P25	DASR-8	810.23750	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	59.2	162.2	103
Denver P25 ASR 850 MHz Trunked P25	DASR-9	809.43750	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	59.1	161.7	102.6
Denver P25 ASR 850 MHz Trunked P25	DASR-10	808.86250	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	59	158.9	100
Denver P25 ASR 850 MHz Trunked P25	DASR-11	808.32500	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	58.8	156	97.2
Denver P25 ASR 850 MHz Trunked P25	DASR-12	807.77500	Denver P25 ASR 850 MHz Trunked P25	DASR-1	859.26250	58.6	156.2	97.6
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-1	814.71250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	59.5	212.9	153.3
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-2	814.61250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-16	854.56250	59.5	212	152.5
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-3	814.21250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-16	854.56250	59.4	208.8	149.4
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-4	811.13750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	59.1	171	111.9
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-5	813.21250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-16	854.56250	59.3	203.5	144.1

Denver P25 Simulcast 850 MHz Trunked P25	DSIM-6	812.73750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	59.3	196.4	137
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-7	813.13750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-16	854.56250	59.3	202.7	143.3
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-8	812.46250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	59.3	190.5	131.2
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-9	812.06250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	59.3	182.8	123.6
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-10	811.71250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	59.2	178.7	119.5
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-11	811.63750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	59.2	177.9	118.7
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-12	811.23750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-16	854.56250	59.1	172.8	113.7
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-13	813.73750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-16	854.56250	59.4	206.8	147.4
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-14	810.73750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	59.1	163.4	104.4
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-15	810.46250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	59	161.1	102.1
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-16	809.56250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	58.7	162.1	103.4
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	809.06250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-1	859.71250	58.6	160	101.4
Denver Fire Repeaters 700 MHz Trunked	DFR-1	769.31875	Denver Fire Repeaters 700 MHz Trunked	DFR-1	799.31875	62.2	80	17.8
Denver Fire Repeaters 700 MHz Trunked	DFR-2	769.85625	Denver Fire Repeaters 700 MHz Trunked	DFR-1	799.31875	62.5	81.4	18.9
Denver Fire Repeaters 700 MHz Trunked	DFR-3	770.50625	Denver Fire Repeaters 700 MHz Trunked	DFR-1	799.31875	62.8	80.6	17.8
Denver Fire Repeaters 700 MHz Trunked	DFR-4	770.75625	Denver Fire Repeaters 700 MHz Trunked	DFR-1	799.31875	63	80.3	17.3
Denver Fire Repeaters 700 MHz Trunked	DFR-5	771.18125	Denver Fire Repeaters 700 MHz Trunked	DFR-1	799.31875	63.2	82.1	19
Denver Fire Repeaters 700 MHz Trunked	DFR-6	771.43125	Denver Fire Repeaters 700 MHz Trunked	DFR-1	799.31875	63.3	83.2	19.9
Denver Fire Repeaters 700 MHz Trunked	DFR-7	772.43125	Denver Fire Repeaters 700 MHz Trunked	DFR-1	799.31875	63.8	84.3	20.5

Denver Fire Repeaters 700 MHz Trunked	DFR-8	772.68125	Denver Fire Repeaters 700 MHz Trunked	DFR-1	799.31875	63.9	83.2	19.3

No transmitter noise interference problems were predicted.

6.0 Receiver Desensitization Analysis

Receiver desensitization interference occurs when an undesired signal from a nearby "off-frequency" transmitter is sufficiently close to a receiver's operating frequency. The signal may get through the RF selectivity of the receiver. If this undesired signal is of sufficient amplitude, the receiver's critical voltage and current levels are altered and the performance of the receiver is degraded at its operating frequency. The gain of the receiver is reduced, thereby reducing the performance of the receiver.

A transmitter can be operating several megahertz away from the receiver frequency and/or its antenna can be located several thousand feet from the receiver's antenna and still cause interference.

The analysis predicts each transmitter's signal level present at the input of each receiver. It takes into account the transmitter's power output, frequency separation, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in both systems. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required, if any, to prevent receiver performance degradation caused by receiver desensitization interference. The Table below depicts the results of this analysis. For each receiver, the transmitter that has the worst-case impact is displayed. The Signal Margin represents the margin in dB, before the receiver's performance is degraded. A negative number indicates that the performance is degraded and the value indicates how much additional isolation is required to prevent receiver performance degradation.

Receiver Provider	Receive Channel	Receive Frequency (MHz)	Transmitter Provider	Transmit Channel	Transmit Frequency (MHz)	Attn Required (dB)	Attn Provided (dB)	Signal Margin (dB)
Verizon Wireless Cellular B CDMA	VZW-384	836.52000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	38.6	158.5	119.9
Verizon Wireless Cellular B CDMA	VZW-425	837.75000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	38.6	158.5	119.9
Verizon Wireless Cellular B CDMA	VZW-384	836.52000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	38.6	198.7	160.1
Verizon Wireless Cellular B CDMA	VZW-425	837.75000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	38.6	198.7	160.1
Verizon Wireless Cellular B CDMA	VZW-384	836.52000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	38.6	200.5	161.9
Verizon Wireless Cellular B CDMA	VZW-425	837.75000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	38.6	200.5	161.9

Verizon Wireless Cellular B LTE High	VZW-1	842.50000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	48.6	179.2	130.6
Verizon Wireless Cellular B LTE High	VZW-1	842.50000	Verizon Wireless Cellular B LTE High	VZW-1	887.50000	30.6	195.2	164.6
Verizon Wireless Cellular B LTE High	VZW-1	842.50000	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	48.6	213.1	164.5
Verizon Wireless 700 MHz Upper C LTE	VZW-2	781.00000	Verizon Wireless 700 MHz Upper C LTE	VZW-2	751.00000	29.3	159.3	130
Verizon Wireless 700 MHz Upper C LTE	VZW-2	781.00000	Verizon Wireless 700 MHz Upper C LTE	VZW-2	751.00000	29.3	159.3	130
Verizon Wireless 700 MHz Upper C LTE	VZW-2	781.00000	Verizon Wireless 700 MHz Upper C LTE	VZW-2	751.00000	29.3	159.3	130
Verizon Wireless PCS E LTE	VZW-3	1887.5000	Verizon Wireless PCS E LTE	VZW-3	1967.5000	26	154.1	128.1
Verizon Wireless PCS E LTE	VZW-3	1887.5000	Verizon Wireless PCS E LTE	VZW-3	1967.5000	26	154.1	128.1
Verizon Wireless PCS E LTE	VZW-3	1887.5000	Verizon Wireless PCS E LTE	VZW-3	1967.5000	26	154.1	128.1
Verizon Wireless PCS F LTE	VZW-4	1892.5000	Verizon Wireless PCS F LTE	VZW-4	1972.5000	26	155.6	129.6
Verizon Wireless PCS F LTE	VZW-4	1892.5000	Verizon Wireless PCS F LTE	VZW-4	1972.5000	26	155.6	129.6
Verizon Wireless PCS F LTE	VZW-4	1892.5000	Verizon Wireless PCS F LTE	VZW-4	1972.5000	26	155.6	129.6
Verizon Wireless AWS B LTE	VZW-5	1725.0000	Verizon Wireless AWS B LTE	VZW-5	2125.0000	26	160.2	134.2
Verizon Wireless AWS B LTE	VZW-5	1725.0000	Verizon Wireless AWS B LTE	VZW-5	2125.0000	26	160.2	134.2
Verizon Wireless AWS B LTE	VZW-5	1725.0000	Verizon Wireless AWS B LTE	VZW-5	2125.0000	26	160.2	134.2
Verizon Wireless AWS J LTE	VZW-6	1775.0000	Verizon Wireless AWS J LTE	VZW-6	2175.0000	26	164.2	138.2
Verizon Wireless AWS J LTE	VZW-6	1775.0000	Verizon Wireless AWS J LTE	VZW-6	2175.0000	26	164.2	138.2
Verizon Wireless AWS J LTE	VZW-6	1775.0000	Verizon Wireless AWS J LTE	VZW-6	2175.0000	26	164.2	138.2
Verizon Wireless CBRS	VZW-7	3415.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	140.3	123.3
Verizon Wireless CBRS	VZW-8	3425.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	33	182.2	149.2
Verizon Wireless CBRS	VZW-9	3435.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	33	182.2	149.2
Verizon Wireless CBRS	VZW-10	3445.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	33	182.2	149.2

Verizon Wireless CBRS	VZW-11	3455.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	33	182.2	149.2
Verizon Wireless CBRS	VZW-12	3465.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	33	182.2	149.2
Verizon Wireless CBRS	VZW-13	3475.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	33	182.2	149.2
Verizon Wireless CBRS	VZW-14	3485.0000	Verizon C-Band Ericsson	VZW-15	3710.0000	33	182.2	149.2
Verizon C-Band Ericsson	VZW-14	3710.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-15	3730.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-16	3750.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-17	3770.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-18	3790.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-19	3810.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-20	3830.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-21	3850.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-22	3870.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-23	3890.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-24	3910.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-25	3930.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-26	3950.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon C-Band Ericsson	VZW-27	3970.0000	Verizon Wireless CBRS	VZW-7	3515.0000	17	220.8	203.8
Verizon 28 GHz	VZW-28	27937.5000	Verizon 28 GHz	VZW-42	27887.5000	11	99	88
Verizon 28 GHz	VZW-29	28012.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-30	28037.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-31	28062.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-32	28087.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-33	28112.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-34	28137.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-35	28162.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-36	28187.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-37	28212.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-38	28237.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-39	28262.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-40	28287.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-41	28312.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Verizon 28 GHz	VZW-42	28337.5000	Verizon 28 GHz	VZW-42	27887.5000	11	120	109
Denver 150 MHz Receive Only Land Mobile Radio	VZW-43	154.70700	Denver VMED28(HEAR) Conventional	DEN-23	155.34000	65.8	110.7	44.9
Denver 930 MHz Trunked	DEN-2	952.72625	Denver 930 MHz Trunked	DEN-2	928.75625	29.6	153.2	123.7
Denver WRCE950 Public Safety 4000 MHz	DEN-3	4950.0000	Denver WRCE950 Public Safety 4000 MHz	DEN-4	4980.0000	0.2	209.2	208.9
Denver WRCE950 Public Safety 4000 MHz	DEN-4	4980.0000	Denver WRCE950 Public Safety 4000 MHz	DEN-3	4950.0000	0.2	209.2	208.9
Denver RMS 850 MHz Trunked	DEN-5	813.08750	Denver RMS 850 MHz Trunked	DEN-5	858.08750	27.6	201.9	174.3

Denver RMS 850 MHz Trunked	DEN-6	813.33750	Denver RMS 850 MHz Trunked	DEN-5	858.08750	27.6	201.9	174.3
Denver RMS 850 MHz Trunked	DEN-7	814.08750	Denver RMS 850 MHz Trunked	DEN-5	858.08750	27.7	201.9	174.2
Denver RMS 850 MHz Trunked	DEN-8	814.63750	Denver RMS 850 MHz Trunked	DEN-5	858.08750	27.8	201.9	174.2
Denver MM 850 MHz Trunked	DEN-9	810.91250	Denver MM 850 MHz Trunked	DEN-9	855.91250	27.6	198.2	170.6
Denver STN 2 850 MHz Trunked	DEN-10	811.78750	Denver STN 2 850 MHz Trunked	DEN-10	856.78750	27.6	198.9	171.3
Denver STN 26 850 MHz Trunked	DEN-11	810.68750	Denver STN 26 850 MHz Trunked	DEN-11	855.68750	27.6	198.2	170.6
Denver STN 28 850 MHz Trunked	DEN-12	806.18750	Denver STN 28 850 MHz Trunked	DEN-12	851.18750	27.6	193.6	166
Denver DHA 850 MHz Trunked	DEN-13	809.23750	Denver DHA 850 MHz Trunked	DEN-13	854.23750	27.6	197.7	170.1
Denver BRDWY 700 MHz Trunked	DEN-14	801.80000	Denver Fire Repeaters 700 MHz Trunked	DFR-8	802.68125	37	78.1	41.1
Denver 8CALL90 Conventional	DEN-15	809.23750	Denver 8CALL90 Conventional	DEN-15	854.23750	27.6	197.7	170.1
Denver 8TAC91 Conventional	DEN-16	809.23750	Denver 8TAC91 Conventional	DEN-16	854.23750	27.6	197.7	170.1
Denver 8TAC92 Conventional	DEN-17	809.23750	Denver 8TAC92 Conventional	DEN-17	854.23750	27.6	197.7	170.1
Denver 8TAC93 Conventional	DEN-18	809.23750	Denver 8TAC93 Conventional	DEN-18	854.23750	27.6	197.7	170.1
Denver 8TAC94 Conventional	DEN-19	809.23750	Denver 8TAC94 Conventional	DEN-19	854.23750	27.6	197.7	170.1
Denver STAC Conventional	DEN-20	809.23750	Denver STAC Conventional	DEN-20	854.23750	27.6	197.7	170.1
Denver 450 MHz Land Mobile Radio	DEN-21	465.42500	Denver 450 MHz Land Mobile Radio	DEN-21	460.42500	20	130	110
Denver VLAW31(NLEEC) Conventional	DEN-22	155.47500	Denver R.A.C.E.S. Conventional	DEN-24	147.30000	10.5	98	87.5
Denver VMED28(HEAR) Conventional	DEN-23	155.34000	Denver R.A.C.E.S. Conventional	DEN-24	147.30000	10.5	98	87.5
Denver R.A.C.E.S. Conventional	DEN-24	147.30000	Denver VLAW31(NLEEC) Conventional	DEN-22	155.47500	10.5	98	87.5
Denver METRO RPTR 1 Conventional	DEN-25	806.88750	Denver METRO RPTR 1 Conventional	DEN-25	851.88750	27.6	195	167.4
Denver 850 MHz Trunked P25	DP25-1	807.37500	Denver 850 MHz Trunked P25	DP25-5	851.56250	30.7	194.4	163.7
Denver 850 MHz Trunked P25	DP25-3	808.27500	Denver 850 MHz Trunked P25	DP25-5	851.56250	30.8	194.4	163.6
Denver 850 MHz Trunked P25	DP25-4	808.72500	Denver 850 MHz Trunked P25	DP25-5	851.56250	30.8	194.4	163.6
Denver 850 MHz Trunked P25	DP25-5	806.56250	Denver 850 MHz Trunked P25	DP25-5	851.56250	30.6	194.4	163.8
Denver 850 MHz Trunked P25	DP25-6	808.15000	Denver 850 MHz Trunked P25	DP25-5	851.56250	30.8	194.4	163.6

Denver 850 MHz Trunked P25	DP25-7	808.42500	Denver 850 MHz Trunked P25	DP25-5	851.56250	30.8	194.4	163.6
Denver 850 MHz Trunked P25	DP25-12	807.12500	Denver 850 MHz Trunked P25	DP25-5	851.56250	30.7	194.4	163.7
Denver Jail Control	Jail-1	465.03750	Denver Jail Control	Jail-1	460.03750	20	130	110
Denver Jail Tactical	Jail-2	453.41250	Denver Jail Control	Jail-1	460.03750	20	96.3	76.3
Denver P25 ASR 850 MHz Trunked P25	DASR-1	814.26250	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	31.1	196.4	165.3
Denver P25 ASR 850 MHz Trunked P25	DASR-2	813.71250	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	31.1	196.4	165.3
Denver P25 ASR 850 MHz Trunked P25	DASR-3	812.13750	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	31	196.4	165.4
Denver P25 ASR 850 MHz Trunked P25	DASR-4	811.73750	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	31	196.4	165.4
Denver P25 ASR 850 MHz Trunked P25	DASR-5	811.21250	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	30.9	196.4	165.5
Denver P25 ASR 850 MHz Trunked P25	DASR-6	810.98750	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	30.9	196.4	165.5
Denver P25 ASR 850 MHz Trunked P25	DASR-7	810.48750	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	30.8	196.4	165.5
Denver P25 ASR 850 MHz Trunked P25	DASR-8	810.23750	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	30.8	196.4	165.6
Denver P25 ASR 850 MHz Trunked P25	DASR-9	809.43750	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	30.8	196.4	165.6
Denver P25 ASR 850 MHz Trunked P25	DASR-10	808.86250	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	30.7	196.4	165.7
Denver P25 ASR 850 MHz Trunked P25	DASR-11	808.32500	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	30.7	196.4	165.7
Denver P25 ASR 850 MHz Trunked P25	DASR-12	807.77500	Denver P25 ASR 850 MHz Trunked P25	DASR-12	852.77500	30.6	196.4	165.8
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-1	814.71250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	31.1	197.6	166.5
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-2	814.61250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	31.1	197.6	166.5
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-3	814.21250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	31.1	197.6	166.5
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-4	811.13750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.8	197.6	166.8
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-5	813.21250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	31	197.6	166.6

Denver P25 Simulcast 850 MHz Trunked P25	DSIM-6	812.73750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.9	197.6	166.7
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-7	813.13750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	31	197.6	166.6
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-8	812.46250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.9	197.6	166.7
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-9	812.06250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.9	197.6	166.7
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-10	811.71250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.8	197.6	166.8
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-11	811.63750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.8	197.6	166.8
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-12	811.23750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.8	197.6	166.8
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-13	813.73750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	31	197.6	166.6
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-14	810.73750	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.8	197.6	166.8
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-15	810.46250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.8	197.6	166.8
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-16	809.56250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.6	197.6	167
Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	809.06250	Denver P25 Simulcast 850 MHz Trunked P25	DSIM-17	854.06250	30.6	197.6	167
Denver Fire Repeaters 700 MHz Trunked	DFR-1	769.31875	Denver BRDWY 700 MHz Trunked	DEN-14	771.80000	37	82.4	45.4
Denver Fire Repeaters 700 MHz Trunked	DFR-2	769.85625	Denver BRDWY 700 MHz Trunked	DEN-14	771.80000	37	82.4	45.4
Denver Fire Repeaters 700 MHz Trunked	DFR-3	770.50625	Denver BRDWY 700 MHz Trunked	DEN-14	771.80000	37	82.4	45.4
Denver Fire Repeaters 700 MHz Trunked	DFR-4	770.75625	Denver BRDWY 700 MHz Trunked	DEN-14	771.80000	37	82.4	45.4
Denver Fire Repeaters 700 MHz Trunked	DFR-5	771.18125	Denver BRDWY 700 MHz Trunked	DEN-14	771.80000	37	82.4	45.4
Denver Fire Repeaters 700 MHz Trunked	DFR-6	771.43125	Denver BRDWY 700 MHz Trunked	DEN-14	771.80000	37	82.4	45.4
Denver Fire Repeaters 700 MHz Trunked	DFR-7	772.43125	Denver BRDWY 700 MHz Trunked	DEN-14	771.80000	37	82.4	45.4

Denver Fire Repeaters 700 MHz Trunked	DFR-8	772.68125	Denver BRDWY 700 MHz Trunked	DEN-14	771.80000	37	82.4	45.4

No receiver desensitization interference problems were predicted.

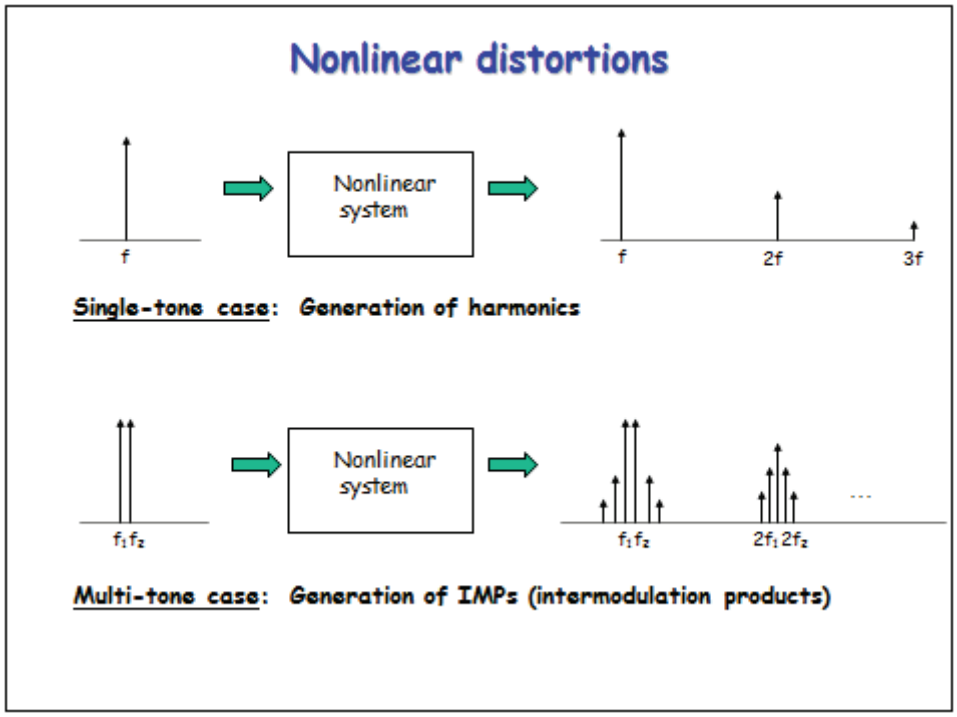
7.0 Intermodulation Interference Analysis

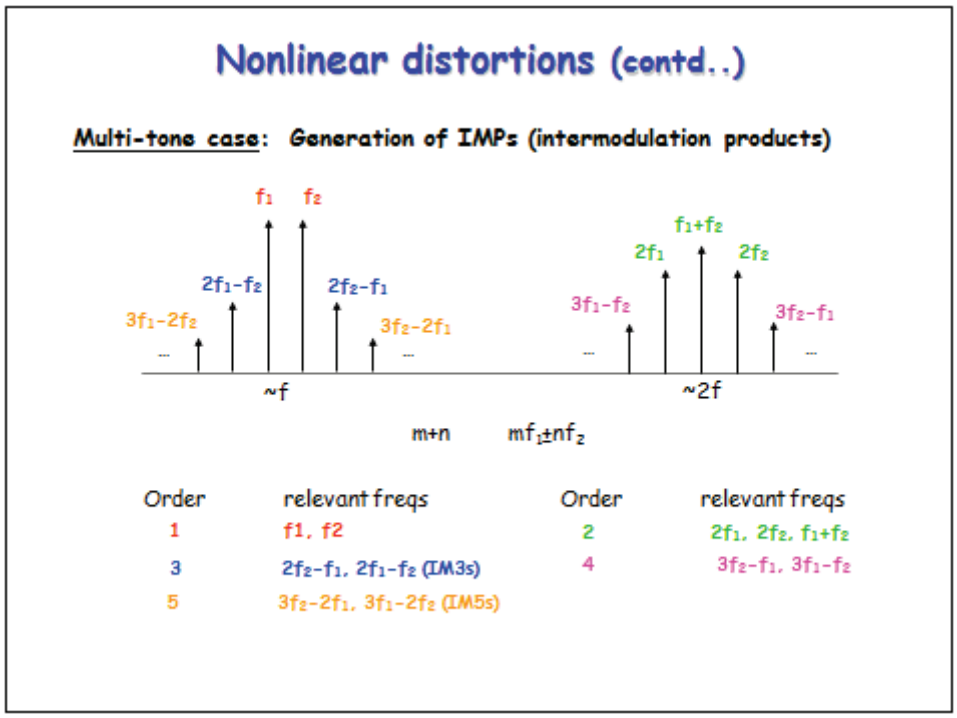
There are three basic categories of Intermodulation (IM) interference. They are receiver produced, transmitter produced, and "other" radiated IM. Transmitter produced IM is the result of one or more transmitters impressing a signal in the non-linear final output stage circuitry of another transmitter, usually via antenna coupling. The IM product frequency is then re-radiated from the transmitter's antenna. Receiver produced IM is the result of two or more transmitter signals mixing in a receiver RF amplifier or mixer stage when operating in a non-linear range.

"Other" radiated IM is the result of transmitter signals mixing in other non-linear junctions. These junctions are usually metallic, such as rusty bolts on a tower, dissimilar metallic junctions, or other non-linear metallic junctions in the area. IM products can also be caused by non-linearity in the transmission system such as antenna, transmission line, or connectors.

Communication sites with co-located transmitters, usually have RF coupling between each transmitter and antenna system. This results in the signals of each transmitter entering the nonlinear final output (PA) circuitry of the other transmitters. When intermodulation (IM) products are created in the output circuitry and they fall within the passband of the final amplifier, the IM products are re-radiated and may interfere with receivers at the same site or at other nearby sites. Additionally, these strong transmitter signals may directly enter a receiver and drive the RF amplifier into a nonlinear operation, or if not filtered effectively by the receiver input circuitry, these signals could mix in the nonlinear circuitry of the receiver front-end or mixer, creating IM products directly in the receiver.

The frequencies of IM mixing are known as nonlinear distortions. The images below depict how these IM products are derived when passing through a nonlinear junction/system.





Not all of the mixing possibilities are significant in creating interference signals. Some fall “out-of-band” of the receiver and the higher order IM products are usually weaker in signal strength.

7.1 Transmitter Generated Intermodulation Analysis

Intermodulation in transmitters occurs when a signal from another transmitter is impressed on the nonlinear final output stage circuitry, usually via antenna coupling. The power level of the IM product is determined by the power level of the incoming extraneous signal from another transmitter and by a conversion loss factor. The conversion loss factor takes into account the mixing efficiency of the transmitter's final output stage. Conversion loss differs with transmitter design, adjustment, frequency separation of the source signals, and with the order of the IM product.

The analysis calculates all possible IM product frequencies that could potentially interfere with receivers at the communications site based on each receiver’s individual bandwidth. It then predicts each IM signal level present at the input of each affected receiver. For each IM frequency, the analysis considers all possible sources of IM generation in the transmitters. For example, if there are four transmitters involve, the analysis will calculate the IM signal level that would be generated in each transmitter. For this example, that would be four possible mixing conditions.

The analysis takes into account the transmitter’s power output, modulation bandwidth, conversion losses, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna

separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for each IM interference signal that occurs. Receivers experiencing transmitter generated intermodulation interference are depicted in the following Table.

Tx 1 Source Mix Tx		Tx 2 Source		TX 3 Source		Tx 4 Source		Tx 5 Source		Intermod Hit		Affected Receiver		Attn Need
ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	Freq (MHz)	Ord	ID	Freq (MHz)	
None														

No transmitter generated intermodulation interference problems were predicted.

7.2 Receiver Generated Intermodulation Analysis

Within a receiver, when two or more strong off-channel signals enter and mix in the receiver and one of the IM product frequencies created coincides with the receiver operating frequency, potential interference results. This internal IM mixing process takes place in the receiver's RF amplifier when it operates in a nonlinear range and/or in the first mixer, which, of course, has been designed to operate as a nonlinear device.

Receivers have a similar conversion loss type factor and receiver performance is commonly described in terms of conversion loss with respect to the 2A - B type products. Here, conversion loss is the ratio of a specified level of A and B to the level of the resulting IM product, when the product is viewed as an equivalent on-channel signal. Receiver conversion loss varies with input levels, AGC action, and product order.

The analysis calculates all possible IM product frequencies that could potentially interfere with receivers at the communications site based on each receiver's individual bandwidth. It then predicts each IM signal level present at the input of each affected receiver. For each IM frequency, the analysis considers that the IM signal is generated directly in the receiver.

The analysis takes into account the transmitter's power output, modulation bandwidth, conversion losses, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for each IM interference signal that occurs. Receivers experiencing receiver generated intermodulation interference are depicted in the following Table.

Tx 1 Source		Tx 2 Source		TX 3 Source		Tx 4 Source		Tx 5 Source		Intermod Hit		Affected Receiver		Attn Need
ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	ID	Freq (MHz)	Freq (MHz)	Ord	ID	Freq (MHz)	
None														

No receiver generated intermodulation interference problems were predicted.

8.0 Transmitter Harmonic Output Interference Analysis

Transmitter harmonic interference is due to non-linear characteristics in a transmitter. The harmonics are typically created due to frequency multiplers and the non-linear design of the final output stage of the transmitter. If the harmonic signal falls within the passband of a nearby receiver and the signal level is of sufficient amplitude, it can degrade the performance of the receiver.

The analysis takes into account the transmitter's harmonic characteristics, output level, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for any harmonics that fall within a receiver's passband. Receivers experiencing transmitter harmonic interference are depicted in the following Table.

Transmitter		Harmonic		Affected Receiver		Attn Needed
ID	Frequency (MHz)	Frequency (MHz)	Order	ID	Frequency (MHz)	
None						

No transmitter generated harmonic interference problems were predicted.

9.0 Transmitter Spurious Output Interference Analysis

Transmitter spurious output interference can be attributed to many different factors in a transmitter. The generation of spurious frequencies could be due to non-linear characteristics in a transmitter or possibly the physical placement of components and unwanted coupling. If a spurious signal falls within the passband of a nearby receiver and the signal level is of sufficient amplitude, it can degrade the performance of the receiver.

The analysis takes into account a transmitter's spurious output specification, output levels, transmission line losses, filters, duplexers, combiners, isolators, multi-couplers and other RF devices that are present in each system. Additionally, the analysis considers the antenna separation space loss, horizontal and vertical gain components of the antennas as well as how they are mounted on the structure. The gain components are derived from antenna pattern data published by each manufacturer.

The analysis determines how much isolation is required to prevent receiver performance degradation for any transmitter spurious signals that fall within a receiver's passband. Receivers experiencing transmitter spurious output interference are depicted in the following Table.

Transmitter		Affected Receiver		Attn Needed
ID	Frequency (MHz)	ID	Frequency (MHz)	
None				

No transmitter generated spurious interference problems were predicted.

10.0 Interference Power Level Summing Analysis

This section of the report provides a simulation of Intermodulation (IM) interference, transmitter wideband noise and receiver desensitization interference occurring on each individual receiver when all transmitters at the site are active at the same instance in time. Even though individual interference modes may not be reported in other report sections, this summing analysis represents a worst-case interference scenario.

However, the probability of this interference occurrence for an individual receiver could be low since it depends on the utilization of the transmitters involved in the interference generation.

The carrier-to-noise C/(I + N) ratio for each receiver is based on the aggregate of interference power levels. A negative C/(I + N) ratio indicates that the performance of the receiver could possibly be degraded by the value shown.

The following Table presents this data:

Receiver		Interference Power Level (dBm)				
Channel Label	Freq (MHz)	Tx Noise	Rx Desense	IM Power	Aggregate	C / (I+N)
VZW-384	836.52000	-252.6937	-231.1292	-180.9357	-180.9	67.9
VZW-425	837.75000	-236.1361	-230.8695	-178.8952	-178.9	65.9
VZW-384	836.52000	-263.0685	-269.9343	-198.7386	-198.7	85.7
VZW-425	837.75000	-249.6297	-269.7303	-188.7087	-188.7	75.7
VZW-384	836.52000	-263.0699	-271.1602	-202.8477	-202.8	89.8
VZW-425	837.75000	-249.6327	-270.9745	-206.515	-206.5	93.5
VZW-1	842.50000	-194.9128	-251.265	-186.4365	-185.9	62.9
VZW-1	842.50000	-235.8961	-286.4327	-211.2502	-211.2	88.2
VZW-1	842.50000	-228.7217	-283.2155	-209.4897	-209.4	86.4
VZW-2	781.00000	-197.9914	-253.009	-183.187	-183	60
VZW-2	781.00000	-197.9978	-253.0359	-183.1937	-183.1	60.1
VZW-2	781.00000	-197.9978	-253.0359	-191.6669	-190.8	67.8
VZW-3	1887.5000	-198.5176	-251.0904	-309.5516	-198.5	75.5
VZW-3	1887.5000	-198.5176	-251.0904	-318.4763	-198.5	75.5
VZW-3	1887.5000	-198.5176	-251.0904	-314.3079	-198.5	75.5
VZW-4	1892.5000	-194.9416	-252.6127	-297.6727	-194.9	71.9
VZW-4	1892.5000	-194.9416	-252.6127	-298.1053	-194.9	71.9
VZW-4	1892.5000	-194.9416	-252.6127	-297.3205	-194.9	71.9
VZW-5	1725.0000	-230.3822	-257.2007	-289.2644	-230.4	107.4
VZW-5	1725.0000	-230.3822	-257.2007	-293.2282	-230.4	107.4
VZW-5	1725.0000	-230.3822	-257.2007	-290.139	-230.4	107.4
VZW-6	1775.0000	-233.3878	-261.2003	-199.0393	-199	76
VZW-6	1775.0000	-233.3878	-261.2003	-198.205	-198.2	75.2
VZW-6	1775.0000	-233.3878	-261.2003	-198.0535	-198.1	75.1
VZW-7	3415.0000	-220.6982	-237.2191	-224.8823	-219.2	96.2
VZW-8	3425.0000	-263.6975	-260.7385	-225.8898	-225.9	102.9
VZW-9	3435.0000	-263.6975	-260.7385	-227.1216	-227.1	104.1
VZW-10	3445.0000	-263.6975	-260.7385	-297.0981	-259	136
VZW-11	3455.0000	-263.6975	-260.7385	-302.8479	-259	136

VZW-12	3465.0000	-263.6975	-260.7385	-301.6489	-259	136
VZW-13	3475.0000	-263.6975	-260.7385	-294.801	-259	136
VZW-14	3485.0000	-263.6975	-260.7385	-301.2949	-259	136
VZW-14	3710.0000	-243.5895	-317.7485	-246.4608	-241.8	118.8
VZW-15	3730.0000	-243.5895	-317.7485	-284.8569	-243.6	120.6
VZW-16	3750.0000	-243.5895	-317.7485	-221.8159	-221.8	98.8
VZW-17	3770.0000	-243.5895	-317.7485	-219.0116	-219	96
VZW-18	3790.0000	-243.5895	-317.7485	-290.7842	-243.6	120.6
VZW-19	3810.0000	-243.5895	-317.7485	-285.7601	-243.6	120.6
VZW-20	3830.0000	-243.5895	-317.7485	-284.9446	-243.6	120.6
VZW-21	3850.0000	-243.5895	-317.7485	-182.5774	-182.6	59.6
VZW-22	3870.0000	-243.5895	-317.7485	-284.197	-243.6	120.6
VZW-23	3890.0000	-243.5895	-317.7485	-290.4777	-243.6	120.6
VZW-24	3910.0000	-243.5895	-317.7485	-287.3308	-243.6	120.6
VZW-25	3930.0000	-243.5895	-317.7485	-211.5434	-211.5	88.5
VZW-26	3950.0000	-243.5895	-317.7485	-214.1617	-214.2	91.2
VZW-27	3970.0000	-243.5895	-317.7485	-287.195	-243.6	120.6
VZW-28	27937.5000	-136.8588	-188.0292	-432.2148	-136.9	36.9
VZW-29	28012.5000	-136.8588	-209.0412	-448.0059	-136.9	36.9
VZW-30	28037.5000	-147.5132	-209.0412	-448.2161	-147.5	47.5
VZW-31	28062.5000	-174.3442	-209.0412	-462.7463	-174.3	74.3
VZW-32	28087.5000	-195.3588	-209.0412	-462.7451	-195.2	95.2
VZW-33	28112.5000	-195.3588	-209.0412	-463.7103	-195.2	95.2
VZW-34	28137.5000	-195.3588	-209.0412	-489.1323	-195.2	95.2
VZW-35	28162.5000	-195.3588	-209.0412	-489.7473	-195.2	95.2
VZW-36	28187.5000	-195.3588	-209.0412	-489.4437	-195.2	95.2
VZW-37	28212.5000	-195.3588	-209.0412	-488.5847	-195.2	95.2
VZW-38	28237.5000	-195.3588	-209.0412	-488.0318	-195.2	95.2
VZW-39	28262.5000	-195.3588	-209.0412	-487.5264	-195.2	95.2
VZW-40	28287.5000	-195.3588	-209.0412	-487.7391	-195.2	95.2
VZW-41	28312.5000	-195.3588	-209.0412	-235.1263	-195.2	95.2
VZW-42	28337.5000	-195.3588	-209.0412	-487.6985	-195.2	95.2
VZW-43	154.70700	-148.4222	-158.7233	-344.7924	-148	32
DEN-2	952.72625	-181.5916	-242.6523	-301.9168	-181.6	62.6
DEN-3	4950.0000	-288.9601	-324.9381	-346.6735	-289	173
DEN-4	4980.0000	-288.9601	-324.9381	-346.6734	-289	173
DEN-5	813.08750	-256.3783	-286.5768	-241.85	-241.7	125.7
DEN-6	813.33750	-258.8889	-286.5701	-242.0609	-242	126
DEN-7	814.08750	-262.3658	-286.5	-242.8887	-242.8	126.8
DEN-8	814.63750	-266.2563	-286.4493	-243.5355	-243.5	127.5
DEN-9	810.91250	-226.9068	-286.3836	-246.2309	-226.9	110.9
DEN-10	811.78750	-239.6378	-287.0217	-245.7607	-238.7	122.7
DEN-11	810.68750	-222.7471	-286.3484	-246.2644	-222.7	106.7
DEN-12	806.18750	-218.383	-281.8969	-240.6523	-218.4	102.4
DEN-13	809.23750	-221.0421	-285.911	-245.6378	-221	105
DEN-14	801.80000	-133.1927	-149.6695	-121.1904	-120.9	4.9
DEN-15	809.23750	-221.0421	-285.911	-245.6378	-221	105
DEN-16	809.23750	-221.0421	-285.911	-245.6378	-221	105
DEN-17	809.23750	-221.0421	-285.911	-245.6378	-221	105

DEN-18	809.23750	-221.0421	-285.911	-245.6378	-221	105
DEN-19	809.23750	-221.0421	-285.911	-245.6378	-221	105
DEN-20	809.23750	-221.0421	-285.911	-245.6378	-221	105
DEN-21	465.42500	-197.3505	-225.9529	-322.4601	-197.3	81.3
DEN-22	155.47500	-229.1113	-203.5	-316.2169	-203.5	87.5
DEN-23	155.34000	-229.0725	-203.5	-337.7262	-203.5	87.5
DEN-24	147.30000	-226.0815	-200.4897	-365.1289	-200.5	84.5
DEN-25	806.88750	-215.4707	-283.3163	-241.7418	-215.5	99.5
DP25-1	807.37500	-208.2566	-276.0579	-235.0045	-208.2	89.2
DP25-3	808.27500	-207.4622	-276.0039	-235.7205	-207.5	88.5
DP25-4	808.72500	-209.8266	-275.9713	-235.9849	-209.8	90.8
DP25-5	806.56250	-208.2035	-276.0793	-234.4739	-208.2	89.2
DP25-6	808.15000	-207.1015	-276.0113	-235.5579	-207.1	88.1
DP25-7	808.42500	-208.2157	-275.9944	-235.8058	-208.2	89.2
DP25-12	807.12500	-207.8529	-276.0681	-234.8879	-207.8	88.8
Jail-1	465.03750	-174.623	-225.9292	-319.2167	-174.6	58.6
Jail-2	453.41250	-151.1637	-192.284	-348.522	-151.2	35.2
DASR-1	814.26250	-258.0721	-275.7608	-238.187	-238.1	119.1
DASR-2	813.71250	-255.6859	-275.7957	-238.8538	-238.8	119.8
DASR-3	812.13750	-233.1733	-275.9276	-237.558	-231.8	112.8
DASR-4	811.73750	-228.2085	-275.9623	-236.9212	-227.7	108.7
DASR-5	811.21250	-221.6923	-276.0042	-236.3539	-221.5	102.5
DASR-6	810.98750	-217.5605	-276.0197	-236.0471	-217.5	98.5
DASR-7	810.48750	-210.3532	-276.0487	-235.2534	-210.3	91.3
DASR-8	810.23750	-211.5997	-276.0602	-234.8704	-211.6	92.6
DASR-9	809.43750	-211.1978	-276.0946	-234.0255	-211.2	92.2
DASR-10	808.86250	-208.4757	-276.1164	-233.4305	-208.5	89.5
DASR-11	808.32500	-205.5397	-276.1322	-232.7483	-205.5	86.5
DASR-12	807.77500	-205.8237	-276.1392	-232.3325	-205.8	86.8
DSIM-1	814.71250	-260.4018	-275.7525	-237.2031	-237.2	118.2
DSIM-2	814.61250	-259.5225	-275.7607	-237.4061	-237.4	118.4
DSIM-3	814.21250	-256.4527	-275.7945	-237.3513	-237.3	118.3
DSIM-4	811.13750	-219.0383	-276.0271	-234.0123	-218.9	99.9
DSIM-5	813.21250	-251.2354	-275.8813	-236.5817	-236.4	117.4
DSIM-6	812.73750	-244.2006	-275.9196	-235.9813	-235.4	116.4
DSIM-7	813.13750	-250.4378	-275.8875	-236.5392	-236.4	117.4
DSIM-8	812.46250	-238.3793	-275.9413	-235.7116	-233.8	114.8
DSIM-9	812.06250	-230.7318	-275.9722	-235.3175	-229.4	110.4
DSIM-10	811.71250	-226.6429	-275.9968	-234.8688	-226	107
DSIM-11	811.63750	-225.8697	-276.0014	-234.7648	-225.3	106.3
DSIM-12	811.23750	-220.7753	-276.0229	-234.1237	-220.6	101.6
DSIM-13	813.73750	-254.4739	-275.8362	-237.1166	-237	118
DSIM-14	810.73750	-211.48	-276.0407	-233.5624	-211.5	92.5
DSIM-15	810.46250	-209.1306	-276.0474	-233.2128	-209.1	90.1
DSIM-16	809.56250	-210.1742	-276.0685	-232.3589	-210.1	91.1
DSIM-17	809.06250	-208.0915	-276.0731	-232.0103	-208.1	89.1
DFR-1	769.31875	-125.5499	-161.1958	-133.5949	-124.9	8.9
DFR-2	769.85625	-126.7017	-161.1812	-133.5949	-125.9	9.9
DFR-3	770.50625	-125.5713	-161.1608	-133.5949	-124.9	8.9

DFR-4	770.75625	-125.1427	-161.1527	-133.5949	-124.6	8.6
DFR-5	771.18125	-126.7104	-161.1385	-133.5949	-125.9	9.9
DFR-6	771.43125	-127.3376	-161.1298	-133.5949	-126.4	10.4
DFR-7	772.43125	-128.2	-161.0948	-133.5949	-127.1	11.1
DFR-8	772.68125	-127.0199	-161.0856	-133.5949	-126.2	10.2

11.0 Discussion and Recommendations

Information regarding existing and proposed equipment, cabling and antennas has been provided by Verizon Wireless' representatives. Waterford Consultants, LLC has considered specific frequency information as well as spectrum blocks licensed to licensees listed herein based on FCC database query results. For wireless service providers, Waterford Consultants, LLC has assumed band and technology deployment based on available consumer sources that monitor wireless voice and data providers in specific markets. Typical channel plans have been assumed for this study and these results are limited to the information contained within this report.

No site visit was performed for this analysis and the condition of the structure and installed appurtenances as well as nearby environmental factors that could be potential sources of passive intermodulation interference have not been considered.

12.0 Professional Certification

Engineering Statement Re:

Potential for Interference to Existing Services

At

North Wash Park

My signature on the cover of this study hereby certifies and affirms:

That I am a registered as a Professional Engineer in the jurisdiction indicated; and

That I am employed by Waterford Consultants, which provides engineering services to clients in the Radio Communications field; and

That I am familiar with the Rules and Regulations and the policies of the Federal Communications Commission both in general and specifically as they apply to the treatment of interference to other services such as may be created by Commission licenses; and

That I have examined the technical information supplied by Verizon Wireless and their representatives relating to their intention to install antennas, transmitters and associated technical equipment on an existing communication site, on an existing tower, currently identified as the North Wash Park Co-location Study site; and

That the technical equipment to be installed by Verizon Wireless represents the state of the art and that it has been carefully designed to preclude the possibility of interference to other services, including the transmission and reception of broadcast AM, FM, and Television and other communications services, such as police, fire, utility and other public safety and public service facilities as well as private communications installations, such as cordless telephones, and Citizen's Band and Radio Amateur stations; and

That the equipment to be installed by Verizon Wireless, meets or exceeds all Federal Communications Commission emission requirements to avoid interfering with other services and home/business equipment; and

That frequency information provided by Verizon Wireless concerning existing installations on this structure has been examined to estimate the potential for interference to existing and proposed operations, resulting from the introduction of the Verizon Wireless' operation; and

That this examination involved the computation of intermodulation products, transmitter harmonics, receiver desensitization, and transmitter spurious emissions produced by the combination of frequencies associated with existing services known to currently operate at the

North Wash Park Co-location Study site, and these frequencies, which could be used by others at the North Wash Park Co-location Study site; and

That intermodulation products were computed (as a minimum) for the fundamental (f0), second (2 f0) thru seventh (7 f0) harmonic components of frequencies at this site; and

That predicted products were not found to potentially cause intermodulation to Verizon Wireless' proposed operations or to the other licenses currently operating at the North Wash Park Co-location Study site; and

That no additional isolation needs to be provided between antennas in the horizontal and vertical planes, and the attenuation along the nadir and zenith associated with vertical plane radiation patterns; and

That after examination the levels of RF energy present at the North Wash Park Co-location Study site, receiver sensitivity will not be degraded by either the existing or Verizon Wireless' proposed operations; and

That, if interference were to occur as a result of Verizon Wireless' operations, Verizon Wireless would be expected to recognize its responsibility to act promptly to take steps necessary to correct the interference, including, but not limited to, filtering and frequency coordination; and

In summary, it is stated here that there is not an indication that the installation being proposed by Verizon Wireless will create interference to their own operations, or the operations of any of the services currently operating at the North Wash Park Co-location Study site. In the event that interference is identified after installation and is attributable to Verizon Wireless' equipment, frequency coordination and filtering would be Verizon Wireless' primary corrective course of action to resolve the problem.

EXHIBIT E

CERTIFICATE OF LIABILITY INSURANCE

DATE(MM/DD/YYYY)
06/29/2022

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER
Aon Risk Services Northeast, Inc.
New York NY Office
One Liberty Plaza
165 Broadway, Suite 3201
New York NY 10006 USA

CONTACT NAME:
PHONE (A/C. No. Ext): (866) 283-7122
FAX (A/C. No.): (800) 363-0105
E-MAIL ADDRESS:

INSURER(S) AFFORDING COVERAGE		NAIC #
INSURER A:	Liberty Mutual Fire Ins Co	23035
INSURER B:	LM Insurance Corporation	33600
INSURER C:	Liberty Insurance Corporation	42404
INSURER D:		
INSURER E:		
INSURER F:		

INSURED
Verizon Wireless, LLC
1095 Avenue of the Americas
New York NY 10036 USA

COVERAGES **CERTIFICATE NUMBER:** 570094184968 **REVISION NUMBER:**

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

Limits shown are as requested

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
A	X COMMERCIAL GENERAL LIABILITY			TB2691550588142	06/30/2022	06/30/2023	EACH OCCURRENCE	$1,000,000
	CLAIMS-MADE X OCCUR						DAMAGE TO RENTED PREMISES (Ea occurrence)	$2,000,000
	X XCU Coverage is Included						MED EXP (Any one person)	$10,000
	GEN'L AGGREGATE LIMIT APPLIES PER:						PERSONAL & ADV INJURY	$1,000,000
	X POLICY PRO-JECT LOC						GENERAL AGGREGATE	$2,000,000
	OTHER:						PRODUCTS - COMP/OP AGG	$2,000,000
A	AUTOMOBILE LIABILITY			AS2-691-550588-122 AOS	06/30/2022	06/30/2023	COMBINED SINGLE LIMIT (Ea accident)	$1,000,000
A	X ANY AUTO			AS2-691-550588-132 NH - Primary	06/30/2022	06/30/2023	BODILY INJURY (Per person)	
A	OWNED AUTOS ONLY / HIRED AUTOS ONLY / SCHEDULED AUTOS / NON-OWNED AUTOS ONLY			TL2-691-550588-182 NH - Excess	06/30/2022	06/30/2023	BODILY INJURY (Per accident)	
							PROPERTY DAMAGE (Per accident)	
	UMBRELLA LIAB OCCUR						EACH OCCURRENCE	
	EXCESS LIAB CLAIMS-MADE						AGGREGATE	
	DED RETENTION							
B	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY			WA569D550588092 AOS	06/30/2022	06/30/2023	X PER STATUTE OTH-	
B	ANY PROPRIETOR / PARTNER / EXECUTIVE OFFICER/MEMBER EXCLUDED? Y/N: N (Mandatory in NH)	N/A		WC5691550588082 WI, MN	06/30/2022	06/30/2023	E.L. EACH ACCIDENT	$1,000,000
	If yes, describe under DESCRIPTION OF OPERATIONS below						E.L. DISEASE-EA EMPLOYEE	$1,000,000
							E.L. DISEASE-POLICY LIMIT	$1,000,000

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

RE: Site Location: 1580 E. Virginia Ave., Denver, City Reference: DFD 21, VZW Site Name: DEN North Wash Park, Location Code: 185057. The City and County of Denver, its elected and appointed officials, employees and volunteers are included as Additional Insured with respect to the General Liability policy. Where permitted by law, the Named Insured parties listed herein waive all rights against The City and County of Denver, its elected and appointed officials, employees and volunteers listed herein for recovery of damages to the extent these damages are covered by the above-referenced General Liability, Automobile Liability and Workers' Compensation policies and, as further limited by written contract between the parties.

CERTIFICATE HOLDER

City and County of Denver
Attn: Real Estate
201 W. Colfax Ave., Dept. 1010
Denver CO 80202 USA

CANCELLATION

SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.

AUTHORIZED REPRESENTATIVE

Aon Risk Services Northeast, Inc.

Holder Identifier :

Certificate No : 570094184968

AGENCY CUSTOMER ID: 570000027366

LOC #:

ADDITIONAL REMARKS SCHEDULE

AGENCY	NAMED INSURED
Aon Risk Services Northeast, Inc.	Verizon Wireless, LLC
POLICY NUMBER	
See Certificate Number: 570094184968	
CARRIER / NAIC CODE	EFFECTIVE DATE:
See Certificate Number: 570094184968	

ADDITIONAL REMARKS

THIS ADDITIONAL REMARKS FORM IS A SCHEDULE TO ACORD FORM,

FORM NUMBER: ACORD 25 **FORM TITLE:** Certificate of Liability Insurance

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER	
INSURER	
INSURER	
INSURER	

ADDITIONAL POLICIES If a policy below does not include limit information, refer to the corresponding policy on the ACORD certificate form for policy limits.

INSR LTR	TYPE OF INSURANCE	ADDL INSD	SUBR WVD	POLICY NUMBER	POLICY EFFECTIVE DATE (MM/DD/YYYY)	POLICY EXPIRATION DATE (MM/DD/YYYY)	LIMITS	
	WORKERS COMPENSATION							
C		N/A		WA769D550588072 MA	06/30/2022	06/30/2023		

EXHIBIT F

Spritzer, Kathryn - DOF Administrator II

From: Edrich, Matthias M. <Matthias.Edrich@KutakRock.com>
Sent: Friday, December 2, 2022 9:15 AM
To: Spritzer, Kathryn - DOF Administrator II; Varty, Johna - CAO CL0357 Assistant City Attorney Senior
Cc: Heydman, Laurie J. - CAO Asst City Attorney - Sr
Subject: Re: [EXTERNAL] Re: Review for bond compliance-DFD

Thank you very much for your clarification, Kathryn. I am sorry I missed that and now see that on the picture that was part of the original agreement!

Johna, based on where the tower is installed, the new license agreement will not result in private business use of the Elevate Denver bonds. Please let me know if you have any questions.

Sincerely,

Matthias

Matthias M. Edrich
Tax Partner

Kutak Rock LLP
1801 California Street, Suite 3000, Denver, CO 80202
matthias.edrich@kutakrock.com
office: 303.297.2400 **direct:** 303.292.7887 **cell:** 720.253.2466

From: Spritzer, Kathryn - DOF Administrator II <Kathryn.Spritzer@denvergov.org>
Sent: Thursday, December 1, 2022 8:00 AM
To: Edrich, Matthias M. <Matthias.Edrich@KutakRock.com>
Cc: Heydman, Laurie J. - CAO Asst City Attorney - Sr <Laurie.Heydman@denvergov.org>; Varty, Johna - CAO CL0357 Assistant City Attorney Senior <Johna.Varty@denvergov.org>
Subject: Re: [EXTERNAL] Re: Review for bond compliance-DFD

[CAUTION - EXTERNAL SENDER]

For clarification, the tower is located adjacent to, not on the roof of, the fire station building.

Kathryn Spritzer
Asset Manager, Division of Real Estate
City and County of Denver
720-865-2505 office
303-638-6806 cell
Kathryn.spritzer@denvergov.org

On Dec 1, 2022, at 5:58 AM, Edrich, Matthias M. <Matthias.Edrich@kutakrock.com> wrote:

Good morning, Laurie and Johna,

I hope you had a good Thanksgiving holiday. I am sorry for not responding sooner regarding Fire Station 21.

On the project tracking site for the Elevate Denver bond program, I noted the following description for improvements at fire stations throughout the city: "Fire Station Restrooms and Kitchen Upgrades. This project will repair and improve 19 fire stations (half of Denver's 38 fire stations) with updated equipment, bathrooms and living spaces to ensure better functionality, safety and gender equity. It will update equipment, restrooms, kitchens and living spaces to create functionality and comfort for employees and visitors." If this description accurately summarizes the bond-financed improvements at Fire Station 21, then no private business use arises from the cell tower lease. The thought is that these improvements do not contribute in any meaningful way to ensuring the cell tower can continue to be installed on the roof.

If the bond proceeds, however, were used for real structural improvements to the building to maintain the integrity of the building itself, we could conservatively allocate private business use to the cell tower lease. The thought is that some part of the structural improvements contributes at least indirectly to making sure the cell tower can continue to stay installed on the roof. One way to estimate private business use in this case would be to divide the annual tower lease payment by the annuitized value of the building itself (after taking into account the added value provided by the bond financing). (The annuitized value is roughly the value of the building (perhaps the original insured value) spread out over the expected life of the building and taking into account the time value of money.) The resulting percentage would be multiplied by the bond proceeds used at this fire station. The product would then be divided by the issue price of the bond issue that financed the improvement to arrive at the actual private business use percentage. I am imagining that this final percentage might be very small in comparison to the 10% allowance the city has for each bond issuance.

It would be best if we could confirm that the bond proceeds were used as described in the first paragraph above. That way, we don't need to worry about trying to figure out a conservative estimate of private business use.

If you have any questions after you have reviewed the above, please call me any time!

Sincerely,

Matthias

Matthias M. Edrich
Tax Partner

Kutak Rock LLP
1801 California Street, Suite 3000, Denver, CO 80202
matthias.edrich@kutakrock.com
office: 303.297.2400 **direct:** 303.292.7887 **cell:** 720.253.2466

From: Heydman, Laurie J. - CAO Asst City Attorney - Sr <Laurie.Heydman@denvergov.org>
Sent: Wednesday, November 16, 2022 1:44 PM
To: Edrich, Matthias M. <Matthias.Edrich@KutakRock.com>
Cc: Varty, Johna - CAO CL0357 Assistant City Attorney Senior <Johna.Varty@denvergov.org>; Spritzer, Kathryn - DOF Administrator II <Kathryn.Spritzer@denvergov.org>
Subject: Review for bond compliance-DFD

[CAUTION - EXTERNAL SENDER]

Good afternoon Mathias- I am attaching 2 consecutive cell tower leases that we have at Fire Station 21 that appears to have been the recipient of bond funds from the Elevate program. I am not sure the initial one was ever reviewed by Darren though it does have bond related boilerplate at section 11.02. I am copying Johna Varty in my office who is drafting these agreements and Katie Spritzer from the real estate division so you can discuss directly with them the square footage involved and any other technical information you would need to be able to confirm that the private business use is within allowed limits.

Thank you as always!

Laurie J. Heydman | Senior Assistant City Attorney
Municipal Operations Section, City Attorney's Office | City and County of Denver
Pronouns | She/Her/Hers
p: (720) 913-3278 | cell: (720) 785-4911
laurie.heydman@denvergov.org