Bull Run
TREATMENT
PROJECTS

Technical Memorandum

Subject: Communications Tower Design Report for Portland Water Bureau Bull Run Filtration Project

Project #s: **PWB:** W02229

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Portland Water Bureau

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Introduction

The Portland Water Bureau (Water Bureau) has been directed to construct a filtration facility to meet federal drinking water regulations. As shown in Figure 1, the project includes constructing a filtration facility as well as raw and finished water pipelines to connect the proposed facility to existing infrastructure for the Bull Run water supply. The proposed filtration facility will be critical to the delivery of drinking water to almost a quarter of the State of Oregon's population. Operation of the filtration facility will require the use of microwave communications and data infrastructure at the project site located in rural Multnomah County, near Gresham, Oregon.

Microwave communication is used by the City for multiple purposes. It serves as a data conduit, allowing the City to route phone calls, computer communication, and data from the Water Bureau's SCADA system, to other locations in the region. The microwave network also serves a critical role as the conduit for 800 MHz radio communications. The City has a series of towers throughout the region to carry this communication traffic. The proposed filtration facility will require similar communication to support its operation.

This Design Report addresses Multnomah County Code (MCC) requirements outlined in section 39.7560(C). Other elements included under section 39.7650 are listed in Section 1.C of the land use application.

Proposal & Narrative

The Bureau of Technology Services (BTS) provides technology services for the City of Portland; communication technology and equipment including that managed by BTS as well as that managed internally by the Water Bureau. BTS is working in collaboration with the Water Bureau to design and develop the project's technology infrastructure by creating scope and associated estimates for equipment, materials, and labor, and managing related buildout.

BTS has procured the services of communications and technology consultants to help develop and verify that the proposed communications tower and equipment design adequately meets facility needs and MCC.
Based on consultant/expert recommendations, the Water Bureau proposes to install a 180-foot high, self-supporting lattice microwave communications tower, antennas, and accessory communications equipment. The 180-foot tower is the minimum needed for the microwave dish to be above the existing tree line and have line-of-sight with Lookout Point tower as well as for SCADA (Supervisory Control and Data Acquisition) communications to have line-of-sight with repeaters at Mt Scott, Council Crest, Prune Hill, and Willalatin. Tower details are provided below, and in supporting documentation, where directed.

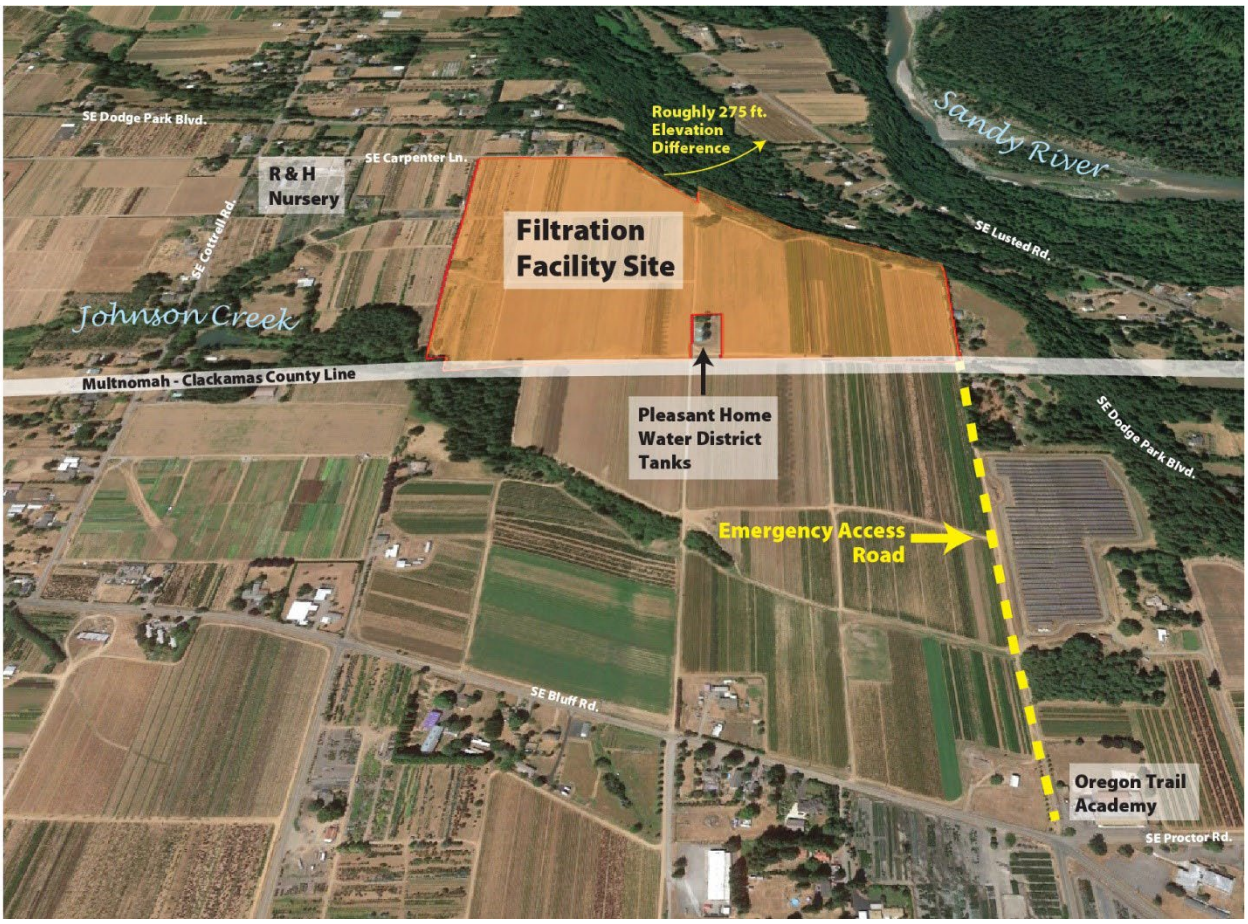

Figure 1. Bull Run Filtration Project Overview Map

The project, which includes a filtration facility and pipelines, will require communications and data infrastructure including a communications tower, which is subject to Conditional Use review by Multnomah County. This report addresses MCC 39.7560(C):

39.7560(C) Report from a professional engineer licensed in the State of Oregon, documenting the following:

Response: This Communications Tower Design Report contains the required documentation, compiled by Christopher Bowker, PE, licensed in Oregon. All technical elements have been designed by professional engineers licensed in the State of Oregon. The following appendices provide the details and necessary calculations to support this design report as referenced throughout this document.

- M.2: Bull Run Tower Design Drawing, Jeffrey E. Grassman, P.E.
- M.3: Bull Run Tower Foundation Drawing, Jeffrey E. Grassman, P.E.
- M.4: Communication Tower Design Calculations, Jeffrey E. Grassman, P.E.
- M.5: Design Criteria and Failure Modes, Jeffrey E. Grassman, P.E.
- M.9.a: Microwave Path Survey Interpretation Memo

- M.9.b: Microwave Path Survey Report
- M.10: Tower Ice Hazard and Mitigation Measures Letter, Adrian McJunkin, P.E.
- O.1 Jeffrey Grassman Resume

(1) Tower height and design, including technical, engineering, economic, and other pertinent factors governing selection of the proposed design. A cross-section of the tower structure shall be included.

Response: As shown in Figure 2, the communications tower will be located in the northeast portion of the facility, approximately 235 feet from the top of the Sandy River valley slope and approximately 330 feet from the east property line. The tower proposed as part of the new water filtration facility for the City of Portland was chosen to be a triangular shaped self-supporting lattice tower with three legs attached to the foundation elements. This type of tower provides a relatively strong tower with lower weight and wind resistance. Lattice towers are widely used in the communications industry and are considered an excellent economic choice for their strength as well as the cost of construction and materials. A lattice tower is much more versatile from an antenna mounting perspective as antennas can be mounted on any of the legs or on a face frame across a face of the tower.

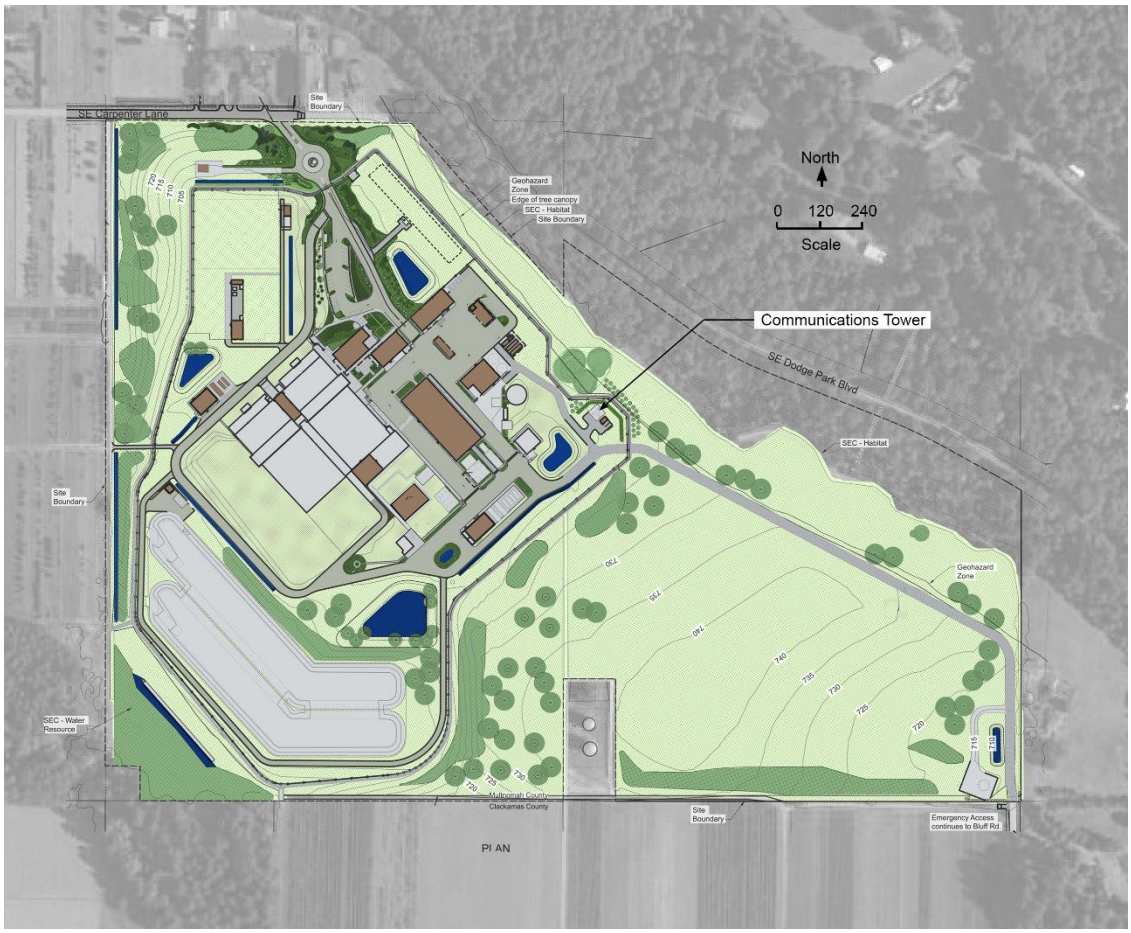

Figure 2: Bull Run Facility Site layout .

The proposed tower was designed to be of sufficient height to provide clear, unobstructed pathways for the microwave and SCADA communications which will use the tower. The SCADA communications are used to provide monitoring and control of the Portland Water system. The microwave communications are used to transport SCADA information as well as other LAN/WAN communications.

The minimum proposed tower height that meets all design objectives is 180 feet. This is BTS' recommendation to the Water Bureau (see Appendix M.9.a) which is based on a microwave path survey that BTS had performed by a consultant (see Appendix M.9.b). The microwave system will be installed at 165 feet to allow for 20 years of tree growth. 15 feet of clearance above that point is required to allow for microwave system installation and maintenance.

In accordance with MCC 39.7565, the tower shall be painted green from base to tree line, with the remainder painted silver or given a galvanized finish.

The tower selected for this project is designed and manufactured by Valmont Industries. The design characteristics are included in Appendix M.4. A cross section diagram of the tower is included in Appendix M.2. The tower's foundation elements are shown in

Appendix M.3. These documents are stamped by Jeffrey E. Grassman, a Professional Engineer licensed in the State of Oregon, whose resume is in Appendix O.1.

A 20' x 12' accessory communications equipment building is proposed immediately southeast and adjacent to the proposed tower that will house communications equipment as shown in Figure 2.

(2) *Total anticipated capacity of the structure, including number and types of antennas which can be accommodated.*

Response: BTS performed an assessment of antenna type, quantity, and mounting height. This information was then provided to Valmont Industries for inclusion in their load scenario evaluations to verify that the proposed tower has sufficient capacity.

For details regarding antenna type, quantity, and mounting height used in design calculations, please see Appendix M.4.

(3) *Evidence of structural integrity of the tower structure as required by the Building Official.*

Response: Structural performance calculations of the proposed tower are provided in Appendix M.4 for relevant loading scenarios and further discussed in the application narrative. The Telecommunications Industry Association (TIA)-222-G regulates the design requirements of this tower. Loading conditions account for factors, including but not limited to, the respective mounted height, tower leg, weight, and weight with ice of antennas.

All tower design documents showing the tower design, foundation design, and tower design calculations (Appendices M.2, M.3, and M.4), are stamped by Jeffrey E. Grassman, a Professional Engineer licensed in the State of Oregon.

(4) *Failure characteristics of the tower and demonstration that site and setbacks are of adequate size to contain debris.*

Response: Please see Appendix M.5 from the tower manufacturer, which addresses product failure characteristics.

Based on Appendix M.5, it is rare for a tower to fall in a radius larger than half its height, and that in most cases it will collapse in a small, confined area as it comes down upon itself. With a half-height radius of 90 feet, this distance is well within the 330-foot distance from the proposed tower location to the east property line as shown in Figure 2. A full discussion of the safety data is located in Appendix M.5.

(5) Ice hazards and mitigation measures which have been employed, including increased setbacks and/or deicing equipment.

Response: The proposed tower design accounts for icing. As mentioned above, the three loading scenarios were considered and include an ice and wind scenario, with 1.5 inches of ice on the tower. Scenario calculations also included ice and weight data for antennas, standoff brackets, and ladders. See Appendix M.4 for stamped design, loading scenarios, and calculations.

In addition, Western Utility Telecom, Inc was contracted to provide an assessment of the potential ice hazards that may be anticipated along with recommendations for mitigation measures which may be employed. Western Utility Telecom indicated (in Appendix M.10) "the best way to guard against risk to humans and damage to adjacent property is to restrict human traffic and land use in the icefall shadow of the tower" and goes on to indicate that mitigation measures may include fencing or barriers surrounding the base of the tower by approximately 100 to 130 feet. The Water Bureau will restrict access to the facility site and has located the tower away from other properties including public property, other private property not owned by the Water Bureau, and right-of-way. In addition to the tower area being inaccessible by the general public, the Water Bureau controls any visitor access and has the right to cancel any scheduled visits due to inclement weather. Finally, in an effort to increase on-site staff safety, the Water Bureau has located the tower towards the facility periphery and has increased the distance between the perimeter road and the base of the tower as much as possible while avoiding the geohazard area and while protecting the root zone of a small grove of trees. Additionally, Standard Operating Procedures will be developed to educate staff on tower ice hazard safety protocol.

See the document titled "Bull Run Filtration Facility – Ice Hazards Mitigation Measures Letter" in Appendix M.10 and the application narrative for further discussion of this issue.

Summary

The Water Bureau has collaborated with BTS and communication and data consultants to propose a communications tower, antennas, and accessory equipment that both meets the design objectives for the project and MCC requirements. As shown in the attached supporting documentation, the communications tower (with equipment) has been sized appropriately, considers areal context, has been designed in accordance with industry best practices (TIA-222-G), and is stamped by an Oregon licensed Professional Engineer.