PORTLAND WATER BUREAU
FROM FOREST TO FAUCET

Bull Run TREATMENT PROJECTS | Filtration

Memorandum

Subject: Filtration Facility Odor Considerations

PWB Project #s: W02229

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Exhibit A.53

1.0 Introduction

The purpose of this memo is to discuss the potential for odor to be generated from the Filtration Facility. In general, water treatment processes do not generate significant odors and no areas or processes of the Filtration Facility are expected to produce more than minor odors on Facility property or to emit any odors into off-site surrounding areas.

This memo will briefly discuss each of the major process areas relative to their potential odor generation. The sections include processes within the main process train and the residuals process train. The main process train discussion includes:

- Inlet Structure.
- Ozonation.
- Flash Mix.
- Flocculation and Sedimentation.
- Filtration.
- CT Basin and Clearwell.

The residuals process train discussion includes:

- Washwater equalization.
- Gravity thickeners.
- Mechanical dewatering.

NOTE: Other features, such as the overflow structure and the chemical building are discussed in the Additional Considerations section at the end of this memo.

These locations of these processes on the site are shown relative to one another in the process flow diagram in Figure 1. As described in the sections below, while these areas are not expected to generate more than minor odors, the Design Team has identified and mitigated possible sources of odor throughout the Facility.

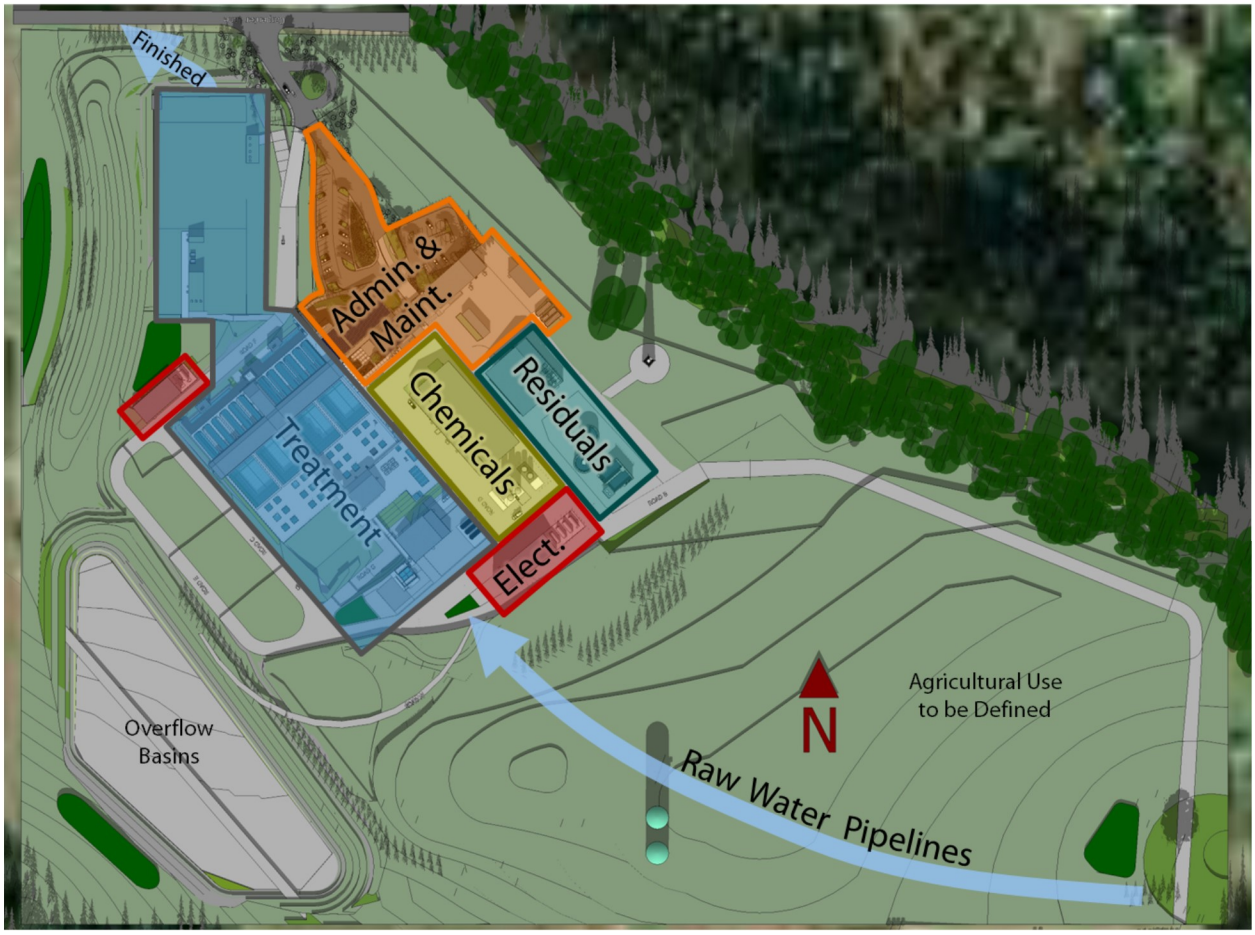

Figure 1: Site layout showing locations of functional zones.

2.0 Main Process Flow

Inlet Structure

At the Facility, the inlet structure will receive raw water from the Bull Run Reservoir via two new 72-inch raw water pipelines. The structure is divided into two chambers each with a gate to control influent flow. The basin is partially open to the atmosphere. This structure will not be a source of odors because the area open to the atmosphere is simply untreated water from the Bull Run reservoir. The inlet structure also receives flow from Recycle Return, which is flow from filter-to-waste and washwater clarifiers. This flow is not expected to be odorous and will only comprise less than 10 percent of overall facility flow. See below discussion on residuals stream for additional details.

Ozone

Flow is directed to the Ozone Contactor from the Inlet Structure. Gates at the contactor allow flow to enter or bypass the contactor. As water enters the contactor, a sidestream flow containing ozone is injected into the stream. Flow in the contactor travels in a serpentine stacked channel path before passing beneath an under baffle and over an outlet weir in the Flash Mix Inlet Channel.

While ozone gas has an odor, its generation and use at the Filtration Facility will not normally emit odors on the property or to the surrounding area as the gas is contained in a closed system. Ozone injection and the flow path after injection is all underwater within a sealed concrete basin. This sealed concrete basin is under negative pressure using a blower to prevent gas in the headspace from exiting. This blower directs the gas to a catalyst that converts any ozone into oxygen prior to discharge into the atmosphere.

Ozone generation is accomplished with liquid oxygen (LOX) and ozone generation units. LOX is delivered and stored onsite, then is vaporized from liquid to gaseous oxygen (GOX) and used as needed for ozone generation. Both LOX and GOX are odorless. LOX storage and transfer to the ozone generation units is a closed system and does not generate any odors. Ozone generation units will have several features to ensure excess ozone is not expelled into the surrounding environment. These features also minimize any potential for odor stemming from the ozone generators:

- Ozone and high purity oxygen analyzers in the enclosed areas around equipment.
- Ambient ozone analyzers to detect ozone-in-air in the room around the generators and the injection equipment.
- Ambient oxygen analyzers to monitor for leaks in the oxygen piping connecting to the ozone generators.

If alarm levels on these analyzers are exceeded, one or more of the following conditions will automatically be activated:

- Visual and audible alarms at the exterior, entry door, and interior and exterior to the structure until measurements go below the alarm setpoint.
- Alarm status at facility SCADA and would be maintained until acknowledged.
- Oxygen isolation valve would be closed at the LOX/vaporizer installation.
- Ozone production would be shut down until the leak is located and corrected.

Given the safety features in place within the design of the ozone system, this process will be a safe and odor-free area of the process train. For more information on ozone safety, please refer to the Hazardous Materials Management Plan (HMMP).

Flash Mix

The Flash Mix system serves to properly mix chemicals required to operate the flocculation and sedimentation process. The chemical addition and the flash mix pump connection are accomplished within closed pipes and are not open to the atmosphere. As a result, no odors are expected from the flash mix process.

Flocculation & Sedimentation Basins

Flocculation and sedimentation basins serve to remove sediment, debris, and other unwanted constituents from the water. Water enters the flocculation basins from the flash mix gallery and passes through several stages of mixing. During this mixing, particles begin to bind together and eventually settle to the bottom of the basins, where the settled solids are collected. While these basins are open to the atmosphere, the flow is not expected to produce odors as it is composed of water with small quantities of non-volatile chemicals. Contaminants (particles) in the water settle to the bottom and are not exposed to the atmosphere during removal.

Filters

Granular media filters are the final particle removal step in the treatment process. As particles pass through the filter media, they adhere to the grains of anthracite and sand and are thus captured in the filter bed. Solids are periodically removed from the filter bed with air and water backwash systems. Neither the filters themselves nor the flow into the filters are expected to generate any odors.

The backwash process gathers filtered solids in the filter wash water (FWW) and conveys the dilute solids to the filter's integrated waste washwater (WWW) equalization basins. While these flows do contain more concentrated particulates, they are not expected to generate odors, as they are very dilute. The solids are further concentrated in the residuals process, which is discussed in later sections.

After a backwash, the newly backwashed filter will operate in Filter-to-waste (FTW) mode for a short period of time. This flow is sent to the overflow basin via a dedicated FTW pipeline and is further discussed in the Additional Considerations portion of this memo.

CT Basin & Clearwell

The disinfection and storage facilities include:

- Pumps to supply water for backwashing filters,
- Chlorine contact basins where the filtered water is dosed with sodium hypochlorite for disinfection,
- Chemical injection systems for chloramine formation (with liquid ammonia sulfate) and pH and alkalinity adjustment (with soda ash and carbon dioxide), and
- Storage of finished water for delivery to the distribution system and for the on-site fire protection system.

These areas will be located mostly below grade to facilitate the hydraulic grade requirements, with the exception of the backwash pump station and stair wells to provide access to the clearwell gallery. Though vented to the atmosphere, these areas will not generate odors as the flow at this stage is closest to being considered finished water for potable use.

3.0 Residuals Flow

Strong undesirable odors are not typically associated with water treatment facility residuals, as the residual stream is often dilute and, even where concentrated, the solids are generally inert organic material. The odors generated from the water treatment facility residual solids are generally an earthy, organic smell, similar in character to common smells from forested or earthen areas in the Facility surrounding area. The residual solids at the Filtration Facility are simply the concentrated sediments and organics that were previously in the Bull Run source water. This is distinctly different from the typical odors at a wastewater treatment plant, which can generate more foul odors containing ammonia, hydrogen sulfides, and other unpleasant compounds associated with material from sanitary sewers.

Washwater Equalization Basins & Clarifiers

Washwater equalization basins and clarifiers remove solids from waste backwash water before it is returned to the inlet structure. Settled solids from the washwater clarifiers are sent to the thickeners. These basins are open to the atmosphere but are not expected to generate more than minor odors, as the solids are concentrated at the bottom of the basins.

Filter waste washwater (FWW) as well as other flow sources that discharge into the waste washwater equalization basins is pumped to the washwater clarifiers for solids removal. The pumped flow splits between two washwater clarifiers and enters the clarifier basins via flow diffuser piping. Solids are settled using a plate settler and sludge collection system, similar to that used in the main process train sedimentation basins. Clarified water flows over the top of the launders into a stainless-steel trough, which then flows by gravity to the inlet structure. Settled solids are pumped to the gravity thickener flow distribution structure via the washwater clarifier sludge pump station.

This process is not expected to generate more than minor odors. While the flow contains higher solids and other constituents relative to the main process flow, it is still very dilute relative to concentrated solids that could generate odors. Any minor odors would be expected to have the earthy, organic character discussed above and not to leave the Facility property.

Gravity Thickeners

Gravity thickeners concentrate the solids received from the sedimentation basins and washwater clarifiers, producing a thicker sludge suitable for further processing by the mechanical dewatering system.

Sludge is pumped from several locations throughout the facility to the gravity thickener flow distribution structure, where two weirs split flow to the two 40-foot diameter gravity thickeners for processing. The flow distribution structure, and consequentially gravity thickeners, receive sludge from the following locations:

- Sedimentation basin sludge pumps
- Washwater clarifier sludge pumps
- Thickened sludge transfer pumps (re-circulating sludge from the gravity thickener or sludge storage tank for additional processing)
- Overflow basin pump station

The gravity thickeners concentrate the sludge streams listed above. The concentrated solids settle to the bottom of the thickeners and are sent to the sludge storage tanks. Because only the clarified water is exposed to the air, odors are typically not produced by this treatment process.

Sludge Storage Tank

The thickened sludge tank stores and mixes thickened sludge from the gravity thickener, providing a more homogenous sludge quality to mechanical dewatering system.

The tank is open to the atmosphere and has a vertically mounted mixer to homogenize sludge before the dewatering feed pumps feed sludge to the centrifuges. The previously described earthy odor may be generated from these tanks but would not be expected to be detectable outside of the tank area or off the Facility property. The tanks have been designed with access platforms so that personnel can washdown the tanks on a regular schedule in order to prevent any generation of more significant odors.

Mechanical Dewatering

The mechanical dewatering system concentrates the solids removed from the raw water and produced during the treatment process into a dry cake that can be loaded into trucks or bins for off-site disposal. Onsite mechanical dewatering allows solids to be concentrated and removed from the process in an efficient manner.

The process equipment in the building functions to remove as much water as possible from residual sludge collected from all other processes around the facility before it is hauled off site for disposal. In the main process area, dedicated rotary lobe pumps feed sludge from the thickened sludge storage tanks to one of two centrifuges, where the liquid and solids phases are separated with the help of an emulsion polymer solution. A series of shaftless screw conveyors then transfer the dewatered sludge to a truck loading bay. The remaining liquid removed from the sludge is returned to the waste washwater equalization basin to be retreated in the washwater clarifiers.

The mechanical dewatering process is located within a building, minimizing any ambient odor to the surrounding environment. The truck loading bay may hold dewatered solids for disposal, but the truck turnover will be regularly scheduled, minimizing the potential for solids to be sitting for long periods of time. Similar to the sludge storage tanks, an earthy odor may be generated from the truck loading area but is not expected to leave the area of the building or the Facility property more generally.

4.0 Additional Considerations

The treatment process has been designed as a closed system, with all waste streams recycled, to create a zero-liquid-discharge facility. There are no flows from the treatment process discharged to the environment. Solids removed from the water by sedimentation and filtration are dewatered to produce a mostly dry, solid cake that is then trucked off-site for disposal. While there are some areas within the residuals process that may generate small-scale, localized earthy odors, it is all within a system designed to mitigate these fugitive odors.

Overflow Basins

Two large overflow basins (totaling 13.5 million gallons) serve both the main treatment process and residuals handling processes and will be an active component of the treatment process during normal operations. As discussed above, in addition to receiving emergency overflows, filtered water from the filter-to-waste line will

be routed to the overflow basin, providing a constant inflow of waste washwater to the basin. Depending on the source, the water in the overflow basin is pumped to the inlet structure or the residuals treatment process. Similar to other open treatment basins, stormwater that enters this basin will be treated and returned to the head of the treatment facility with the other residuals flow streams. By design, this constant fill-and-drain cycle results in relatively low detention times within the overflow basin, preventing algae growth and consequentially preventing the creation of odiferous compounds during normal operations.

Emergency operations resulting in unexpected valve closures, or other similar events, could cause overflows of untreated, partially treated, or fully treated water into the overflow basins. This capacity is sufficient to contain over two hours of the maximum potential inflow (135 MGD) to the Facility, allowing sufficient time to detect and correct the cause of the overflow under scenarios identified as reasonably possible by design and operations staff. In these circumstances, this stored volume would be recycled back to the head of the facility, directly, or via the residuals treatment stream, as quickly as reasonable, avoiding longer detention times and stagnation of the stored water, and eliminating the formation of odiferous compounds.

Chemical Building & Chemical Injection

The chemical building houses nearly all chemicals used onsite and features yard piping from chemical storage tanks to their respective injection locations within the process train. All chemical handling and storage facilities include secondary containment, with provisions to safely remove spilled chemicals by pumping them into a truck for off-site disposal. Chemical storage tanks feature vents that are routed through the roof of the chemical building to prevent any tank pressurization. Only two chemicals used (sodium bisulfite and sodium hypochlorite) have the potential to off-gas or generate odors at low levels. Sodium hypochlorite is generated at a low concentration of 0.8 percent solution, so potential for off-gassing is especially low. These tanks vent to the roof, so there may be a slight odor at the roof of the chemical building. However, this odor is expected to be minimal and would disperse quickly. As a result, it is unlikely that any odor would be noticeable except on the roof of the chemical building.

5.0 Conclusion

By their nature, drinking water treatment plants generally do not emit more than minor odors. Nonetheless, the Filtration Facility design minimizes possible odor generation from all possible minor odor sources. As a result, the Filtration Facility is not expected to generate any off-site odors under normal or emergency operation. In addition to the presence of minimal odors and effective mitigation measures, the large setbacks from any potential odor sources to the property line mean that no odors would be detectable off-site.