

To: City Council
From: Michael Stuhr, P.E., Portland Water Bureau Administrator
Date: August 1, 2017
Re: Probabilistic Benefits of Filtration over UV

BACKGROUND

In 2006, the U.S. Environmental Protection Agency (EPA) issued a federal drinking water rule called the Long Term 2 Enhanced Surface Water Treatment Rule (LT2) that required water utilities to treat for the pathogen *Cryptosporidium*.

In 2012, the City obtained a 10-year variance from the treatment requirement from the Oregon Health Authority (OHA) subject to a set of conditions that included maintaining an exceptionally low concentration of *Cryptosporidium* in ongoing raw water sampling.

Between January and March 2017, a total of 19 *Cryptosporidium* oocysts were found in 14 water samples from the Bull Run Watershed. On March 8, 2017, the Portland Water Bureau (PWB) notified the Oregon Health Authority (OHA) that due to the quantity of *Cryptosporidium* detected at that point, it was no longer feasible to achieve the concentration level of *Cryptosporidium* required to maintain the variance.

On May 19, 2017, OHA issued an order to PWB revoking Portland's treatment variance as of September 22, 2017, and requiring PWB to submit a plan to OHA by August 11, 2017, selecting a *Cryptosporidium* treatment technology and schedule.

ALTERNATIVES

The two treatment technologies being considered to provide compliance with LT2 are ultraviolet disinfection (UV) and filtration.

- UV (\$105 M)
- Filtration (\$350-\$500 M)

In December 2011, PWB completed a 100% Design for a UV treatment facility to be located at the Headworks site that would provide the necessary treatment for *Cryptosporidium*.

However, at the City Council's work session on this topic on June 27, 2017, PWB was requested to provide a probabilistic analysis of the additional benefits that could be realized with filtration instead of UV.

QUANTIFIABLE (KNOWN) BENEFITS

The only identified benefit for UV is treating for *Cryptosporidium* and meeting the regulatory requirements of the LT2 rule.

In addition to treating for *Cryptosporidium* and meeting regulatory requirements of the LT2 rule, PWB identified and quantified additional benefits that would be achieved with filtration. These benefits include scenarios such as turbidity events, which have a cost and identified likelihood, but would not likely drive construction of a filtration plant. These benefits are shown in Table 1.

Table 1: Identified Quantifiable/Known Benefits

Benefit	Explanation
Reduce disinfection by products (DBP's)	Reduces existing levels of DBP's which are carcinogenic compounds.
Increase supply reliability	Avoids loss of revenue due to offloading wholesale customers and impact to retail customers when turbidity levels with UV would require groundwater use rather than Bull Run.
Augment supply from Bull Run	Filtration would allow access to some additional Bull Run storage, likely only a benefit under unusual operating conditions.
Reduce conduit flushing	Removal of sediment in the water reduces yearly flushing.
Reduce violations of secondary MCL's	Reduce likelihood of manganese from Bull Run supply and reduce need to use groundwater with naturally higher manganese.
Increase public confidence in water quality	Filtration will provide more consistent water and more consistent water quality supporting increased public confidence.
Reduce water quality exceedances causing minor health issues	Improve treatment barrier and reduce likelihood of minor health issues.
Improve water quality beyond compliance	Provide more stable water for meeting lead and copper rule and reduce manganese.
Reduce need for GW due to an algae event	Algae events in the summer could cause higher turbidity and the need to switch to groundwater at a higher operating cost.
Reduce water quality impacts due to warmer water	Warmer water has multiple impacts to both water quality and operations, including contributing to algal events and increase in formation of DBP's due to the interaction of chlorine and organics.
Reduce discoloration complaints	Reducing organics would reduce complaints due to discoloration.
Improve ability to respond to changes in regulations	Filtration would provide a more robust barrier to pathogens and would be more adaptable to meeting future regulations.
Reduce need to expand groundwater	Increasing reliability of Bull Run decreases the need to expand groundwater.

Increase wholesale water contracts retention	Increased likelihood of retaining wholesale customers due to more reliable supply.
Reduce O&M costs by using Bull Run instead of GW	Reduced operating costs to be able to serve Bull Run during minor turbidity events vs. groundwater at a higher rate.
Increase ability to meet several critical service levels	Critical service levels such as reliability of customer supply, number of customer complaints, and compliance with regulations would be more easily met.
Reduce impact to groundwater system and resulting likelihood of failure of groundwater system	Groundwater infrastructure is aging and with more use would be more likely to require investment, or more likely to not perform as needed with additional consequences.
Increase flexibility to respond to future regional demands	Filtration would provide more flexibility to PWB and the region to meet future water needs
Reduce customer costs of water treatment	Removal of sediment would reduce additional treatment costs for sensitive users (hospitals, bottlers, tech facilities, etc.)

Based on likelihood of occurrence and the resulting consequence, these quantifiable benefits of filtration are equivalent to \$5.4 M annually, or \$99 M over 25 years.

RISK

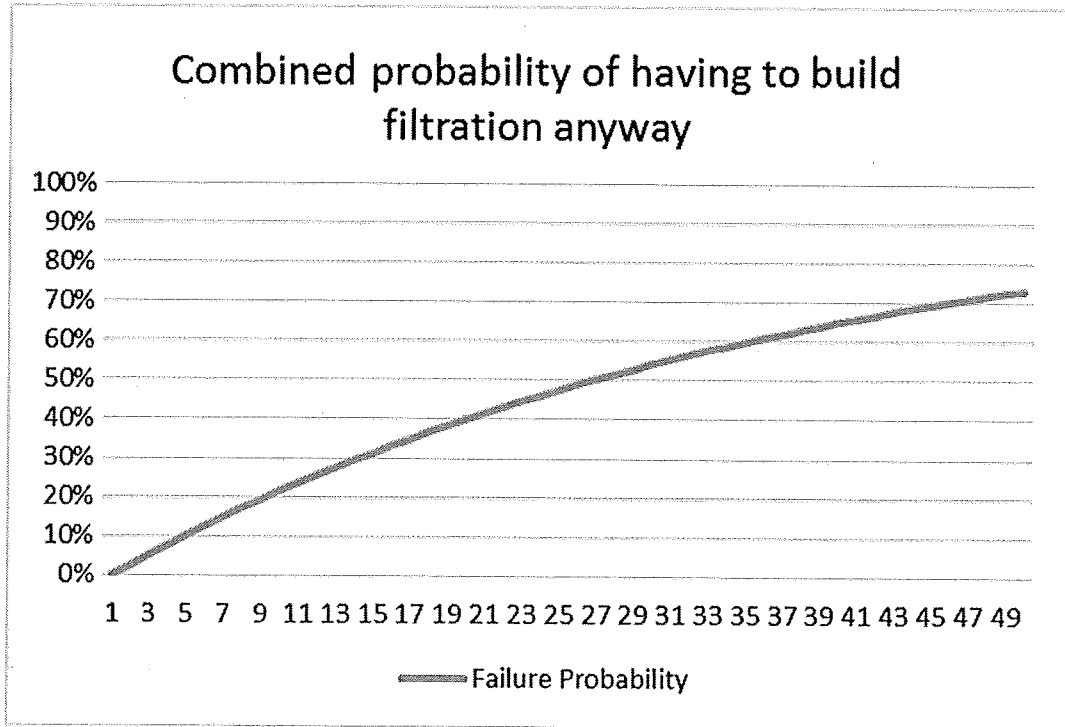
In addition to known benefits that filtration would provide over UV, PWB identified several risk factors that could drive the need to build filtration anyway within the UV facility expected useful life. That is, even if UV is the treatment technology chosen, there are certain circumstances outside of LT2 compliance which could trigger the need to build filtration. These risks, while singularly not of high likelihood, when combined can add up to a significant risk. The risks and their likelihoods are identified in Table 2.

Table 2: Identified Significant Risks

Driver	Risk	Likelihood
Water Quality	Increasing disinfection byproducts (DBPs) or changes in regulatory levels. These are known carcinogenic compounds which are currently within regulatory standards, but higher than desirable with occasional exceedances.	1/50 yrs
Water Quality	Increasing manganese levels in the Bull Run or changes in regulatory levels. Changes in operations of the Bull Run reservoir for temperature management has led to increasing manganese, typically during refill of the reservoir.	1/350 yrs
Regulatory	Emerging regulated compounds, such as pharmaceutical and personal care products (PPCPs), endocrine disrupting compounds (EDCs), perfluorooctanesulfonic acid (PFOS), perfluorooctanoic acid (PFOA), etc.	1/1000 yrs
Loss of Bull Run forest canopy	Major fire in the Bull Run.	1/350 yrs

The resulting combined probability curve for having to build filtration despite initially choosing UV treatment is shown in Figure 1.

Figure 1: Combined probability of having to build filtration anyway



These likelihoods of failure and the resulting probability curve equate to a 50% chance in 27 years of having to have built filtration anyway. The likelihoods continue to increase to a 73% chance in 50 years.

In addition to these risks, PWB recognizes that there are many other risks that have not been included. These risks are considered highly unlikely and are difficult to quantify. Therefore, they were not considered as likely triggers for filtration.

CONCLUSION

Both UV and filtration will allow PWB to treat for *Cryptosporidium* and comply with LT2. However, that is the only benefit that is achieved with UV. Filtration would provide additional quantifiable (known) benefits and would significantly address the identified risks.

A comparison of the alternatives is shown in Table 3.

Table 3: LT2 Compliance Comparison

Alternative Comparison		
	UV	Filtration
Treat for Crypto/Comply with LT2	Yes	Yes
Additional Benefits	None	\$5.4 M/yr. (\$99 M/25 years)
Risk Mitigation	None	Significantly addresses increasing risk probability, 50% chance in 27 years up to 73% chance in 50 years.