Technical Memorandum

Subject: Potential Impacts of Pesticide Use on Finished Water Quality

PWB Project #s: W02229

Stantec Project #: 2002006066

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Exhibit A.41

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List of Terms and Abbreviations

Bureau	Portland Water Bureau
CCL	Candidate Chemical List
DWSHA	Drinking Water Standards and Health Advisories
Facility	Bull Run Filtration Facility
ft	feet
gal	gallons
HA	Health Advisory
HHBP	Health Hazard Benchmark for Pesticides
HRL	Health Reference Level
Kg	kilogram
L	liter
lb	pound
lbs/day	pounds per day
m	meter
MCL	Maximum Concentration Level
MCLG	Maximum Concentration Level Goal
MDL	Method Detection Limit
mg	milligram
mgd	million gallons per day
mg/L	milligrams per liter
MRL	method reporting limit
µg/L	micrograms per liter
OHA	Oregon Health Authority
ppm	parts per million
PWB	Portland Water Bureau
USEPA	United States Environmental Protection Agency

1. Introduction

The Portland Water Bureau (PWB) is developing a new Filtration Facility (Facility) in southeastern Multnomah County where, as shown in Figure 1, farming is the predominant land use with adjacent areas also zoned for rural residential and commercial forestry uses. Water treatment facilities are often located in rural areas – of the 16 water treatment facilities that serve more than 40,000 people in Oregon, 10 are outside urban growth boundaries (Portland Water Bureau, 2022). As described in Felsot (2022), accepted agricultural and forest practices in the surrounding lands of the Facility site include periodic application of chemical pesticides (i.e., insecticides, herbicides, and fungicides). This memorandum evaluates the hypothetical drift of these chemicals onto the Facility site and into open process basins, directly or indirectly into the water being treated and ultimately distributed for consumption.

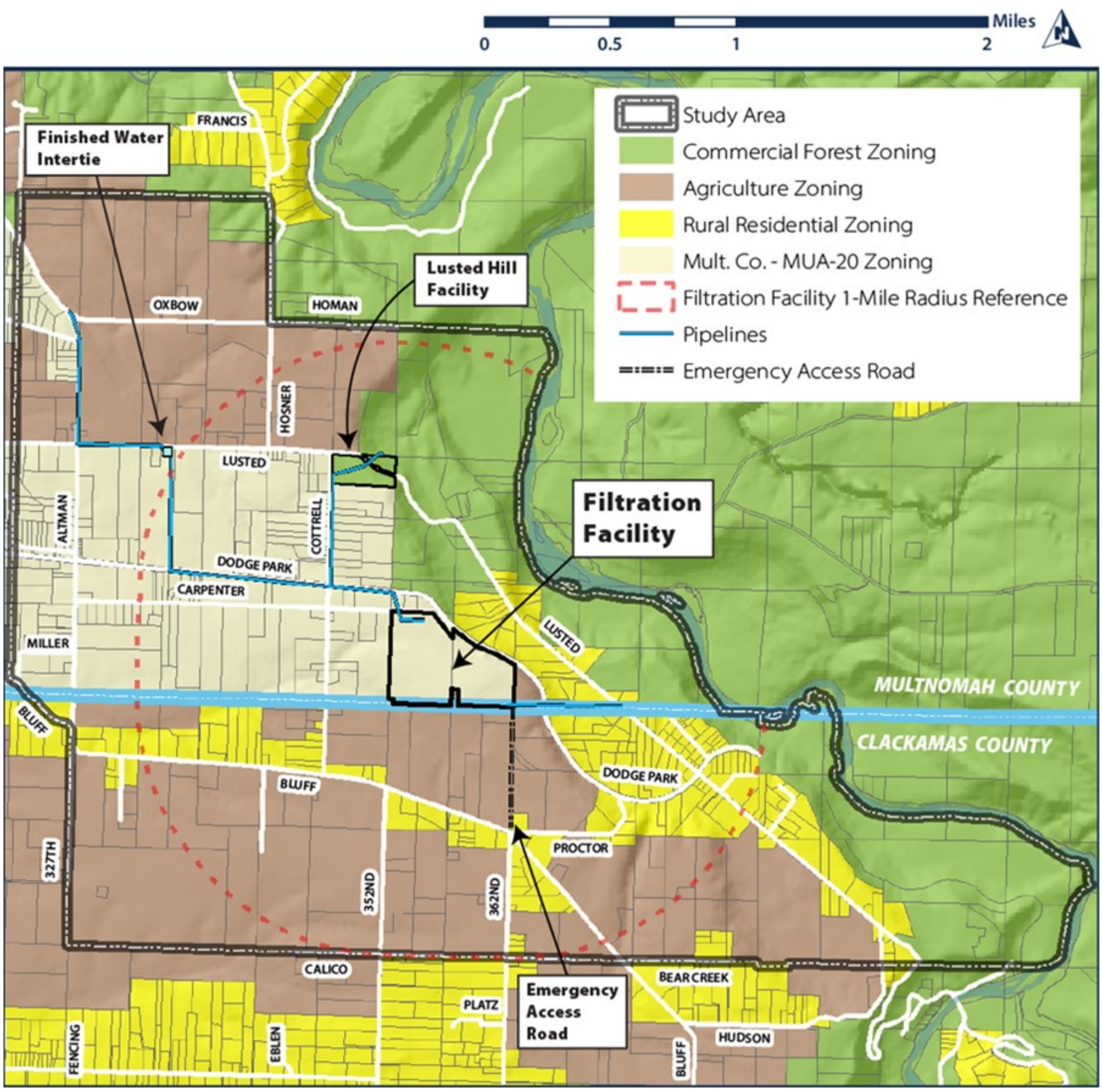


Figure 1. Land Currently in Farm Use near the Facility

This review evaluates the specific practices and pesticides currently used on land surrounding the Facility, and the treatment processes, site layout, and operational practices. The evaluation uses very conservative assumptions to represent the highest-risk scenarios. For example, the potential pesticide deposition rate was calculated using the process basin location closest to property line without considering design features that may limit potential introduction of pesticides into the process basins.

Even using the most conservative assumptions for pesticide application and Facility operation, this analysis shows that the levels of chemicals that could be introduced into the water sent into the distribution system are far below the levels which could exceed regulatory requirements, advisory levels, or benchmarks, or otherwise pose a human health risk. Production of drinking water at the Facility, therefore, does not conflict with continuation of accepted agricultural and forestry practices in the surrounding lands of the Facility, nor pose a risk to drinking water quality.

2. Methodology

2.1 Identification of Chemicals of Concern

As described in the report *Compatibility of Proposed Portland Water Bureau Filtration Facility & Pipeline Operations with Surrounding Agriculture* (Globalwise, Inc., 2022), pesticide application is an accepted farm practice, and spraying is the most common method of applying pesticides. While allowing drift and overspray of pesticides onto adjoining properties are not accepted farm practices, there is a risk that pesticides may drift onto the Facility site, so the potential consequences have been evaluated. The report *Use and Safety Characterization of Pesticides Used on Agricultural and Forestry Lands Surrounding the Proposed Site for the Portland Water Bureau's Bull Run Filtration Facility* (Felsot, 2022) describes how farm and forest experts surveyed pesticide use practices in the surrounding lands and developed a list of active ingredients and likely product formulations currently in use or likely to be used. This list was reviewed and 30 pesticides, shown in Table 1, were identified which are applied using methods that could cause them to drift onto the Facility site. Details of the process for selecting these pesticides (hereinafter called the "chemicals of concern"), their use in the surrounding lands of the Facility, and additional information on their chemical makeup and toxicity are provided in Felsot (2022), (Globalwise, Inc, 2022), and (Mason, Bruce & Girard, 2022).

Table 1. Pesticides Used Near the Facility			
Pesticide Active Ingredient	**Representative Product Formulation**	**Pesticide Active Ingredient**	**Representative Product Formulation**
Aminopyralid	Milestone	Hexazinone	Velpar VU
Azoxystrobin	Heritage	Imidacloprid	Marathon II
Bifenthrin	Talstar S	Indaziflam	Marengo G
Carbaryl	Sevin	Isoxaben	Gallery 75DF
Chlorothalonil	Bravo Ultrex	Metconazole	Tournet
Clethodim	Envoy Plus	Myclobutanil	Eagle 20EW
Clopyralid	Transline	Oryzalin	Surflan AS
Cyfluthrin	Decathlon 20WP	Oxyflurofen	GoalTender
Dithiopyr	Dimension	Paraquat	Gramoxone SL2.0
Fludioxonil	Medallion	Permethrin	Perm-Up 3.2EC
Flumioxazin	SureGuard	Prodiamine	Barricade 4FL
Flutolanil	Prostar	Propiconazole	Tilt
Fluvalinate	Magvrik Aquaflow	Spinosad	Conserve SC
Glufosinate	Finale	Triclopyr	Garlon 4
Glyphosate	Roundup Pro	Trifluralin	Snapshot 2.5TG

2.2 Determination of Concentrations of Concern

The first step in the evaluation of these pesticides was to determine the concentration in drinking water which would raise a potential health or regulatory concern. Drinking water quality is regulated by the U.S. Environmental Protection Agency (USEPA) and the State of Oregon, with enforcement responsibility resting with the Oregon Health Authority (OHA). USEPA regulations include the Phase II/V Rules, commonly referred to as the Chemical Contaminant Rules. These rules regulate over 65 contaminants, including pesticides and other agricultural chemicals, but only seventeen pesticides in current use in the United States are included in current drinking water regulations. Other pesticides used on surrounding lands were evaluated against non-enforceable regulatory guidance or toxicological information published by USEPA.

Only one of the 30 pesticides (glyphosate) used in the surrounding lands is regulated under drinking water standards (United States Environmental Protection Agency, 2002a). The Maximum Contaminant Level Goal (MCLG), Maximum Contaminant Level (MCL), and Method Reporting Limit (MRL) for this chemical are shown in Table 2. MCLGs are the concentrations below which there is no known or expected risk to health, while MCLs are enforceable standards representing the highest level of a contaminant allowed in drinking water, and both are established based on the potential health effects of long-term consumption. MCLs are set as close to the MCLGs as feasible, considering the cost and practicality of treatment and monitoring. For glyphosate, the MCL and MGLG are the same, so for purposes of establishing a concentration of concern for these chemicals, the MCL will be used as it is both the regulatory limit and the limit below which there are no known or expected health risks. The MRL is the lowest concentration used for calibration using a method approved for reporting drinking water tests, so this is the lowest concentration that can be reliably quantified and reported to public utilities or regulators. The MRL varies by analytical method, and the information shown in Table 2 is for the method used by the lab providing regulatory compliance reporting for the PWB.

Concentrations are expressed in different units in different contexts, and the units used can have regulatory implications, so the units presented in this memorandum conform to those used in the relevant rules or guidance issued by regulatory agencies for that chemical. Use of this convention results in the presentation of comparisons that may use different units, or that may use many leading or trailing zeros, or exponential notation when expressing quantities. Units used for concentration include the following:

mg/L = milligrams per liter, equivalent to parts per million (ppm) for compounds in water

µg/L = micrograms per liter, equivalent to parts per billion for compounds in water

Table 2. Chemical of Concern Regulated under USEPA Drinking Water Standards

Chemical	MCLG[a] (mg/L)	MCL[b] (mg/L)	MRL[c] (µg/L)
Glyphosate	0.7	0.7	1.6

a. Maximum Contaminant Level Goal
b. Maximum Contaminant Level
c. Method Reporting Limit

In addition to current regulations, potential future regulations were considered. USEPA uses a three-step process for developing new drinking water regulations.

- Step 1 – Identification. Identify and prioritize unregulated chemicals based on the availability of health data, occurrence data, and analytical methods.
- Step 2 – Evaluation. Gather additional data to identify contaminants occurring at levels and frequencies of public health concern.
- Step 3 – Regulatory Determination. Determine if regulation is justified based on health effects, occurrence, and opportunity for health risk reduction.

As part of Step 1, USEPA publishes a list of contaminants, known as the Contaminant Candidate List (CCL) that are known or anticipated to occur in public water systems and are not currently subject to USEPA drinking water regulations (United States Environmnetal Protection Agency, 2022e). The first CCL was published in 1998, and updated lists were published in 2005, 2009, and 2016. A draft list was published in 2021 for public comment.

As shown in Table 3, four pesticides identified as chemicals of concern have appeared on previous CCLs or the current draft CCL, but none have yet advanced past Step 1 (United States Environmental Protection Agency, 2022b) It is therefore unlikely that regulation of these chemicals under drinking water statutes will occur in the near future, and no MCLG or MCL has been proposed.

Table 3. Chemicals of Concern Included in Current or Previous USEPA Contaminant Candidate Lists

Chemical	CCL	Regulatory Determination
Carbaryl	CCL 5 (Current Draft)	Pending
Clethodim	CCL 3 (2009), CCL 4 (2016)	CCL 4: Not proceeding from Phase 1 to Phase 2. Does not have nationally representative or other finished water data
Oxyfluorofen	CCL 3 (2009), CCL 4 (2016), CCL 5 (Current Draft)	Pending
Permethrin	CCL 3 (2009), CCL 4 (2016), CCL 5 (Current Draft)	CCL 4: Not proceeding from Phase 1 to Phase 2. Has available or in process health assessment and other finished drinking water data but no occurrence at levels >1/2 Health Reference Level (HRL)

Where no regulation under drinking water rules exists or is anticipated, the concentration of concern for this evaluation was based on the most conservative of the following:

- *Drinking Water Standards and Health Advisories* Tables
- Human Health Benchmarks for Pesticides

The *Drinking Water Standards and Health Advisories* (DWSHA) Tables compiles information on acute, life-time and cancer risks associated with chemicals in drinking water (United States Environmental Protection Agency, 2018). They are not enforceable standards, but are intended to be "informal technical guidance for unregulated drinking water contaminants to assist Federal, State and local officials, and managers of public or community water systems in protecting public health as needed." For purposes of this report, the lowest of the health advisory concentrations included in the tables was used in determining the concentration of concern.

Human Health Benchmarks for Pesticides (HHBPs) established by the USEPA are not legally enforceable federal standards, but were developed to help "better determine whether the detection of a pesticide in drinking water or source waters for drinking water may indicate a potential health risk" (United States Environmental Protection Agency, 2022c). Both acute and chronic risks were reviewed, and the lower value used as the concentration of concern. Where HHBP for a pesticide was not included in the published list, a HHBP was calculated for this evaluation using USEPA formulae and toxicology data shown in Attachment A. Using the lower of the MCL, Health Advisory Level, and HHBP value for each chemical, concentrations of concern were established for all chemicals used in the Facility surrounding lands, as shown in Table 4.

Table 4. Concentrations of Concern for Pesticides Used in the Region		
Chemical	Concentration of Concern	
	µg/L	Source[a]
Aminopyralid	3,000	Published HHBP
Azoxystrobin	1,070	Published HHBP
Bifenthrin	210	Published HHBP
Carbaryl	400	HA Level
Chlorothalonil	150	HA Level
Clethodim	2,000	Published HHBP
Clopyralid	850	Calc. HHBP
Cyfluthrin	78	Published HHBP
Dithiopyr	21	Published HHBP
Fludioxonil	2,000	Published HHBP
Flumioxazin	100	Published HHBP
Flutolanil	3,000	Published HHBP
Fluvalinate	56	Calc. HHBP
Glufosinate	40	Published HHBP
Glyphosate	700	MCL
Hexazinone	400	HA Level
Imidacloprid	500	Published HHBP
Indaziflam	100	Published HHBP
Isoxaben	300	Published HHBP
Metconazole	200	Published HHBP
Myclobutanil	150	Published HHBP
Oryzalin	1,100	Published HHBP
Oxyflurofen	230	Calc. HHBP
Paraquat	30	HA Level
Permethrin	2,900	Published HHBP
Prodiamine	830	Published HHBP
Propiconazole	600	Published HHBP
Spinosad	147	Published HHBP
Triclopyr	300	Published HHBP
Trifluralin	80	HA Level

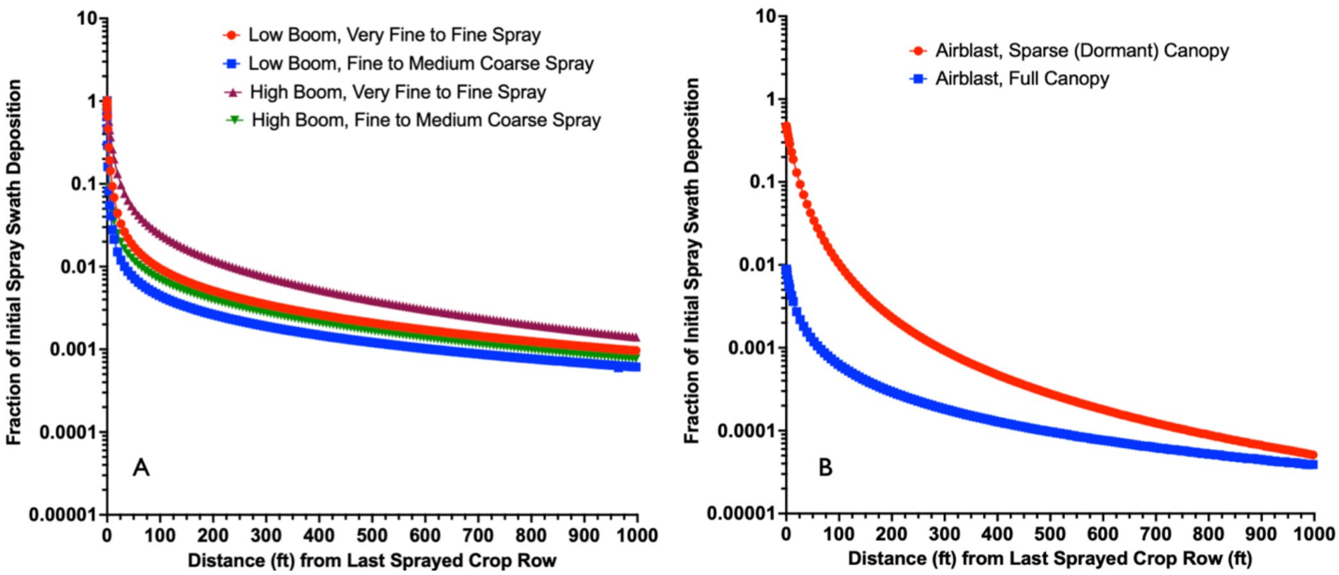
a. HA Level = 2018 Drinking Water Health Advisory Levels, Published HHBP = 2021 USEPA Health Hazard Baseline for Pesticides, Calc. HHBP = Calculated Health Hazard Baseline for Pesticides

2.3 Calculation of Potential Exposure

To estimate the hazard associated with the introduction of pesticides into drinking water, the methodology used by Felsot (2022) to evaluate dermal exposure was modified to evaluate the chemical concentration that could accumulate in a body of water relatively near a pesticide application.

As explained in Felsot (2022), pesticides in the surrounding lands are applied using ground – not aerial – methods such as air blast sprayers and ground boom sprayers. The drift of pesticides onto adjacent properties for ground application methods may be modeled using the AgDRIFT® computer simulation model, which can predict the chemical concentrations in water bodies between 0 and 1,000 feet downwind, perpendicular from the edge of the pesticide application area.

Pesticide drift characteristics are largely independent of the specific pesticide being applied, so a typical relationship between the distance away from the point of application and the amount of pesticide deposition, as a fraction of the application rate, can be modeled using AgDRIFT®. This relationship for boom and airblast application methods is illustrated in Figure 2, showing that while the deposition fraction varies among the different methods, the deposition drops significantly – by at least 97 percent – at a distance of 100 feet away from the spray swath, and continues to fall as the distance from the point of application increases.



Note: 'A' represents AgDrift modeling of fractional deposition from a ground sprayer boom at two heights above the ground or canopy and two spray qualities. 'B' represents the fractional deposition from an axial fan airblast sprayer operating in a dormant orchard without leaves and a full canopy orchard.

Figure 2. Fractional deposition of pesticide residues downwind of a spray swath.

For purposes of assessing pesticide drift into the Facility, the "High Boom, Fine to Medium Coarse Spray" method was assumed, as results using this method will be conservative (resulting in a higher predicted deposition rate) as compared to other ground application methods. Details of the relationship between the fraction of initial deposition and distance from the spray swath are provided in Table 5.

AgDRIFT® can be used to determine the concentration of a chemical in a body of water adjacent to a spray swath by entering the pesticide application rate, distance to the body of water, and depth of the water. The concentration can also be calculated using a distance factor (derived from the relationship between distance and fraction of initial deposition shown in Figure 2 and Table 5), and the formula shown in Equation 1.

$$Concentration\left(\frac{mg}{L}\right) = \frac{Pesticide\ Application\ Rate\left(\frac{lb}{acre}\right)}{Depth\ of\ Water\ Body\ (ft)} \times Distance\ Factor\ \times 0.3679 \qquad \text{Eq 1.}$$

To determine which pesticides would be evaluated in detail, all chemicals of concern were ranked for potential drinking water hazard by comparing the concentration of concern against the potential concentration that could result from pesticide drift into basins within the Facility. For this initial screening, a reference concentration was established for each pesticide, defined as the potential chemical concentration that could accumulate in a basin of water of 10 feet deep located 100 feet away from a pesticide swath being applied at the maximum application rate recommended by the product label. A diagram of this scenario is shown in Figure 3. This is not a condition that specifically exists at the Facility, but provides a basis for comparing and ranking pesticides to identify chemicals for further evaluation

Table 5. Pesticide Deposition for High Boom, Very Fine to Fine Spray Application

Distance from Swath (ft)	Fraction of Initial Spray Swath Deposition	Deposition Reduction
0	1.00	0.0%
50	0.0500	95.0%
100	0.0248	97.5%
200	0.0120	98.8%
300	0.00753	99.25%
400	0.00526	99.47%
500	0.00391	99.61%
750	0.00219	99.78%
1000	0.00141	99.86%

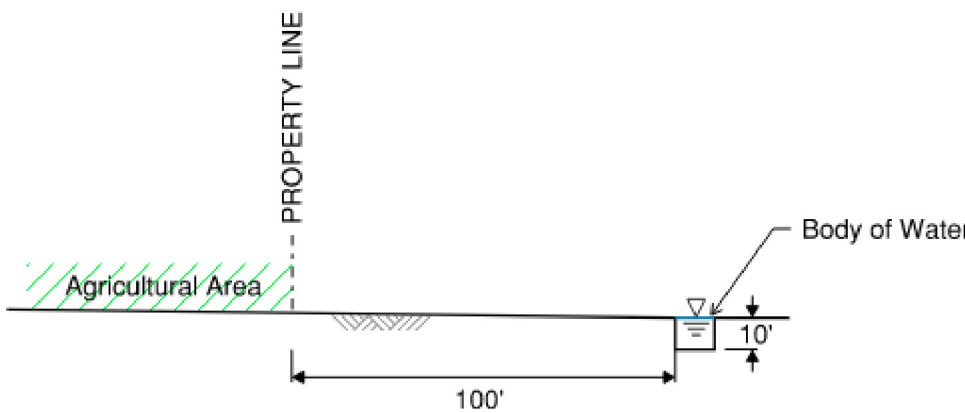


Figure 3. Diagram of scenario used to determine reference concentration (RC) for purposes of evaluating the relative hazard of pesticides.

A hazard rating was calculated, as shown in Equation 2, as the ratio of the potential chemical concentration in a completely mixed water body ten feet deep, 100 ft away from the pesticide application and the concentration of concern described above. The resulting hazard ratings are shown for all chemicals of concern in Table 6.

$$Hazard\ Rating = \frac{reference\ concentration\ (\frac{mg}{L})}{concentration\ of\ concern\ (\frac{mg}{L})} \qquad \text{Eq 2.}$$

The pesticides with the five highest hazard ratings are shown in Table 7. These chemicals are used for further quantitative evaluations, based on the logical premise that other chemicals, applied in the same location and using the same method, would be less likely to cause a regulatory concern or health impact. As Felsot (2022) describes, the hazard rankings cover a wide diversity of pesticide types with different application rates and potential hazards, which makes this analysis useful for predicting whether future uses of alternative or newly registered pesticides will cause regulatory concern or health impacts. Additionally, the trend in the pesticide market has been that new pesticides are applied at lower doses and have fewer health impacts, so new pesticides can be expected to have lower hazard ratings. Therefore, the conclusions reached in this analysis can be applied to alternative, future, and currently-used, pesticides.

Table 6. Chemical Application Rates and Calculated Hazard Rating

Chemical	Product Formulation	Maximum Application Rate (lbs/Acre)	Reference Concentration[a] (µg/L)	Concentration of Concern (µg/L)	Hazard Rating[b]	
					Value	Rank
Aminopyralid	Milestone	0.11	0.095	3,000	0.000032	30
Azoxystrobin	Heritage	0.25	0.22	1,070	0.00020	27
Bifenthrin	Talstar S	0.20	0.17	210	0.00082	21
Carbaryl	Sevin	2.0	1.7	400	0.0043	10
Chlorothalonil	Bravo Ultrex	3.1	2.7	150	0.018	5
Clethodim	Envoy Plus	0.24	0.21	2,000	0.00010	29
Clopyralid	Transline	0.50	0.43	850	0.00051	23
Cyfluthrin	Decathlon 20WP	0.11	0.095	78	0.00121	19
Dithiopyr	Dimension	0.50	0.43	21	0.021	4
Fludioxonil	Medallion	0.68	0.59	2,000	0.00029	26
Flumioxazin	SureGuard	0.38	0.33	100	0.0033	12
Flutolanil	Prostar	8.6	7.4	3,000	0.0025	15
Fluvalinate	Mavrik Aquaflow	0.34	0.29	56	0.0052	8
Glufosinate	Finale	1.5	1.3	40	0.032	2
Glyphosate	Roundup Pro	3.8	3.2	700	0.0046	9
Hexazinone	Velpar VU	4.0	3.4	2,000	0.0017	16
Imidacloprid	Marathon II	0.41	0.35	500	0.00071	22
Indaziflam	Marengo G	0.040	0.034	100	0.00034	24
Isoxaben	Gallery 75DF	1.0	0.86	300	0.0029	14
Metconazole	Tournet	0.27	0.23	200	0.0012	20
Myclobutanil	Eagle 20EW	0.25	0.22	150	0.0014	18
Oryzalin	Surflan AS	4.0	3.4	1,100	0.0031	13
Oxyflurofen	GoalTender	2.0	1.7	230	0.0075	7
Paraquat	Gramoxone SL2.0	1.0	0.86	100	0.009	6
Permethrin	Perm-Up 3.2EC	0.40	0.34	2,900	0.00012	28
Prodiamine	Barricade 4FL	1.5	1.3	830	0.0016	17
Propiconazole	Tilt	0.22	0.19	600	0.00032	25
Spinosad	Conserve SC	0.69	0.59	147	0.0040	11
Triclopyr	Garlon 4	8.0	6.9	300	0.023	3
Trifluralin	Snapshot 2.5TG	4.0	448	3.4	80	1

a. The reference concentration is equal to the concentration of chemical in a water body 10 ft deep 100 ft distant from the last sprayed crop row, as calculated by AgDrift using the most conservative application method (high boom, very fine to fine spray).

b. Hazard Ranking calculated as: reference concentration ÷ concentration of concern.

Table 7. Pesticides with Highest Hazard Rating				
Pesticide Active Ingredient	Reference Concentration (µg/L)	Concentration of Concern		Hazard Rating
Trifluralin	3.4	80	One-day HA, Ten-day HA	0.043
Glufosinate	1.3	40	Chronic HHBP	0.032
Triclopyr	6.9	300	Chronic HHBP	0.023
Dithiopyr	0.4	21	Chronic HHBP	0.021
Chlorothalonil	2.7	150	Cancer Risk HA	0.018

3. Evaluation

To evaluate the potential that pesticide drift into open process basins could create a risk to regulatory compliance or drinking water quality, three scenarios were evaluated:

1. Pesticide deposition into the process basins and evaluation of the resulting concentration within the basin.
2. Pesticide deposition into the overflow basins, return of water in the overflow basins to the head of the process, and evaluation of the resulting chemical concentration in water entering the Facility.
3. Pesticide deposition into process and overflow basins during Facility operation and evaluation of the concentration leaving the clearwell.

For all scenarios, potential exposure duration would be only for the hours immediately following the pesticide application before the concentration in the basins was diluted and eventually flushed out of the facility. Thus the comparison to concentrations of concern based on chronic health effects are very conservative.

All surface runoff from the site is captured by stormwater management facilities, so only direct deposition from drift into process or overflow basins is relevant to this analysis.

As shown in Figure 4, the open and semi-open process basins include the filters and the flocculation and sedimentation (floc/sed) basins. These are at least 375 feet from the western edge of the Facility property boundary, the closest possible location of a spray swath of chemicals. The two overflow basins are in the southwestern portion of the site, and are set back approximately 130 feet from both the southern and western property lines, similarly representing the closest possible location of a spray swath of chemicals.

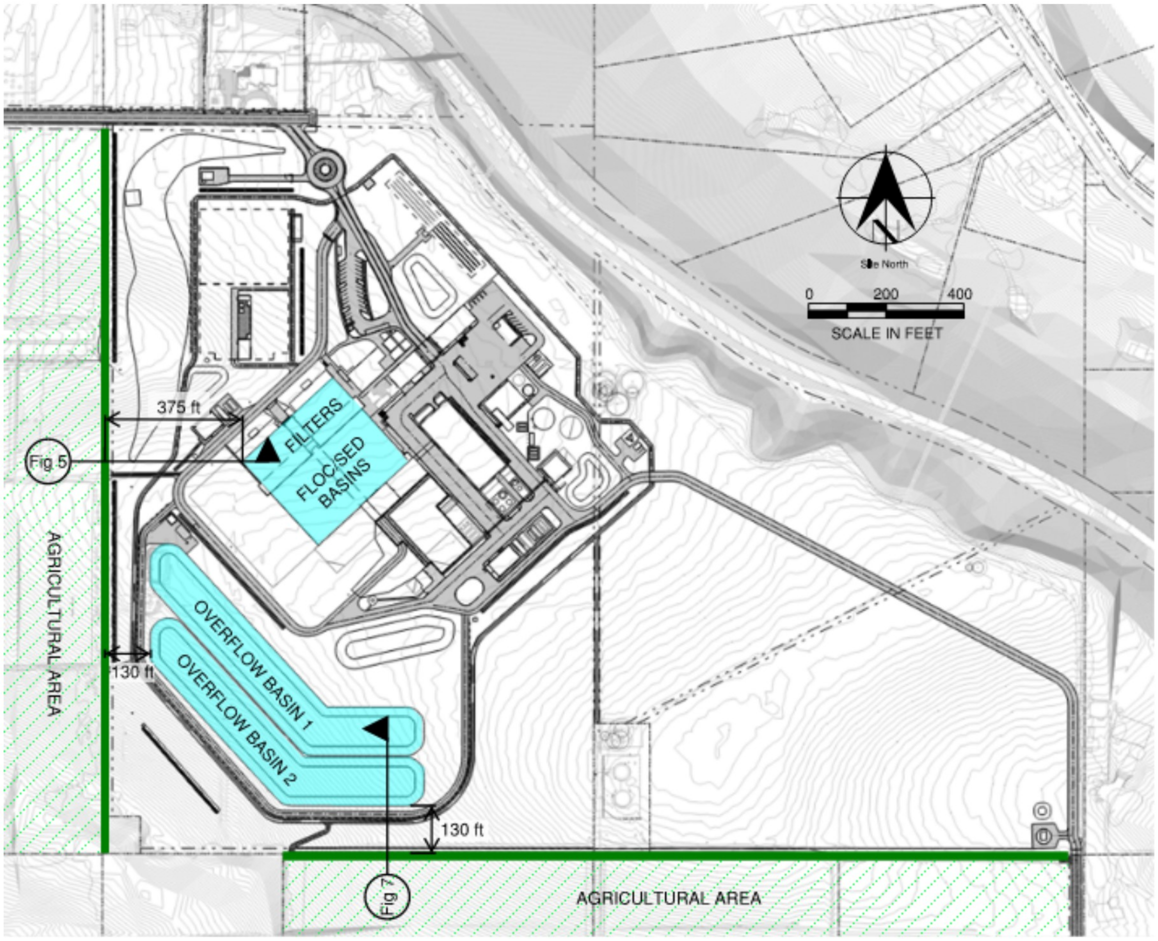


Figure 4. Proximity of Process and Overflow Basins to Agricultural Areas

3.0 Deposition in Process Basins

As shown in Figure 4 and Figure 5, the process basins, including the filters, sedimentation basins, and flocculation basins, are at a minimum 375 feet away from the closest property line of agricultural areas where pesticides may be applied. The space between the property line and the process basin includes screen plantings, and the deck of the process basins is approximately 10 feet above the ground surface where the pesticide application is performed. These factors will reduce pesticide drift, but are not modeled in AgDRIFT®, which assumes flat, level terrain between the pesticide application and the receiving water body. For these reasons, the AgDRIFT® results used in this analysis are extremely conservative and the actual potential for deposition of chemicals is much lower than modeled.

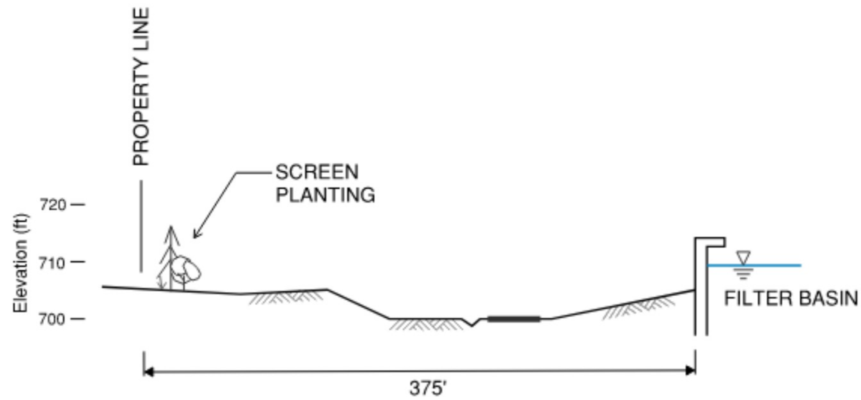


Figure 5. Site section showing the closest distance between the western property line and the Filter Structure.

The closest distance between the process basins and the property line is 375 feet, and at this distance from the point of application, the rate of chemical deposition is approximately 0.6 percent of the application rate. The far edge of the process basins is approximately 750 feet from the property line, and, at this distance, the rate of chemical deposition is approximately 0.2 percent of the application rate. To simplify the calculations and provide a more conservative estimate of chemical deposition, the rate of deposition at 375 feet will be used for all evaluations of the process basins.

As shown in Figure 6, there are openings in the concrete slabs above the flocculation, sedimentation, and filter basins through which pesticide drift could theoretically introduce chemicals into the water being treated. The opening area and basin volume for each basin are listed in Table 8, showing the total volume and open area for all three basins.

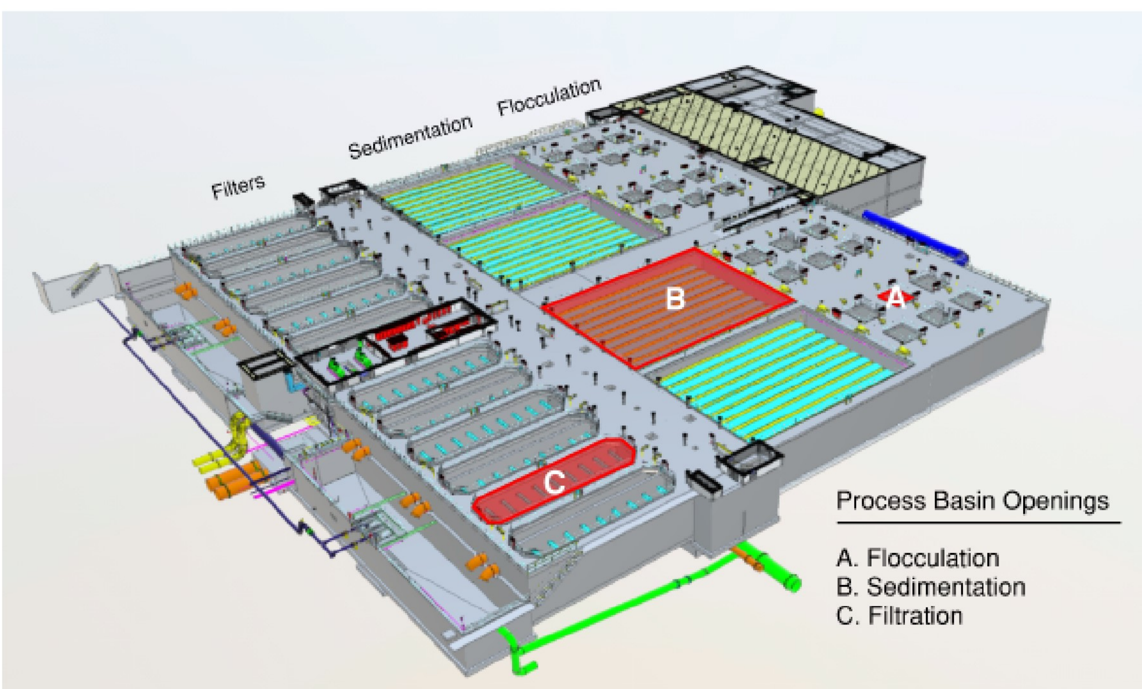


Figure 6. Open Areas on Process Basins

Table 8. Open Area and Volume for Process Basins						
Basin	**Opening Area (ft^2)**	**Openings (Number)**	**Total Open Area (ft^2)**	**Volume per Train or Cell (gal)**	**Trains or Cells (Number)**	**Total Basin Volume (gal)**
Flocculation	182	24	4,374	1,007,500	4	4,030,000
Sedimentation	6,929	4	27,716	1,190,000	4	4,760,000
Filtration	1,255	12	15,060	117,826	12	1,413,912
Total			**47,150**			**10,203,912**

To assess the maximum potential chemical concentration that could accumulate in a process basin, a single filter cell was evaluated, as the filters are closest to the property line and have the highest ratio of open area to basin volume. A highly conservative boundary condition was evaluated in which the Facility was not operating but the process basins were full. Under this condition, any pesticide drift into the process basins would be introduced into the volume of water held within the process basins. The chemical concentration within the basin can be calculated, as shown in Equation 3, as the mass of chemical introduced through the open area divided by the volume of the basin. As water moves through the process basins, however, it mixes within each basin and as it moves from one channel or basin to another, so the water in the filter basin would mix with water already in the Facility as well as with additional water brought into the Facility. Because of this, the chemical concentration calculated in this scenario is higher than what would occur when the Facility is operating.

$$chemical\ concentration\ (\mu g/L) = \frac{mass\ of\ chemical\ introduced\ (lb)}{basin\ volume\ (gal)} \times 1.20 \times 10^8 \qquad \text{Eq 3.}$$

Using the scenario and evaluation method described above, theoretical chemical concentrations in the filters for the pesticides with the five highest hazard ratings were calculated. The results, provided in Table 9, show that even in this highly conservative analysis, the chemical concentration within the filter basin is less than one percent of the concentration of concern. Even for trifluralin, the chemical of concern with the highest resulting potential concentration, the concentration of concern is approximately 120 times greater than the calculated basin concentration and for chlorothalonil the concentration of concern is approximately 290 times greater than the calculated basin concentration.

Table 9. Potential Pesticide Deposition into Single Filter Cell (No Flow Condition)						
Chemical	**Maximum Application Rate (lb/acre)**	**Pesticide Deposition @ 375 ft**		**Chemical Concentration in Basin (µg/L)**	**Concentration of Concern (µg/L)**	**Ratio of Concentration in Basin to Concentration of Concern**
		Rate (lb/ft^2)	**Mass (lbs)**			
Trifluralin	4.0	5.2×10^{-7}	6.6×10^{-4}	0.670	80	0.84%
Glufosinate	1.5	1.9×10^{-7}	2.5×10^{-4}	0.251	40	0.63%
Triclopyr	8.0	1.1×10^{-6}	1.32×10^{-3}	1.34	300	0.45%
Dithiopyr	0.5	6.6×10^{-8}	8.2×10^{-5}	0.0837	21	0.40%
Chlorothalonil	3.1	4.1×10^{-7}	5.1×10^{-4}	0.519	150	0.35%

Based on these results, the use of the five chemicals shown in Table 9, and by extension the other chemicals used in the surrounding area, will not cause affected water to exceed regulatory requirements or guidelines, or pose a risk to human health.

3.1 Deposition in Overflow Basins

The second scenario evaluated is the deposition of pesticides in the overflow basins. The overflow basins serve multiple functions for the maintenance and operation of the Facility, including providing storage capacity to contain overflows from multiple points in the treatment process, receiving the contents of a basin when it is drained for maintenance, and storing and equalizing recycle flows from filter-to-waste operation.

As shown in Figure 4 and Figure 7, the overflow basins are 130 feet away from both the southern and western property lines, the closest potential locations where pesticides may be applied. The space between the property line and the overflow basins includes screen plantings, and the top edge of the overflow basins are approximately 10 feet above the ground surface where the pesticide application could be performed. As discussed above, these factors will reduce pesticide drift, but are not modeled in AgDRIFT®, which assumes flat, level terrain between the pesticide application and the receiving water body. For these reasons, the AgDRIFT® RC results used in this analysis are extremely conservative and the actual potential for deposition of chemicals is much lower than modeled.

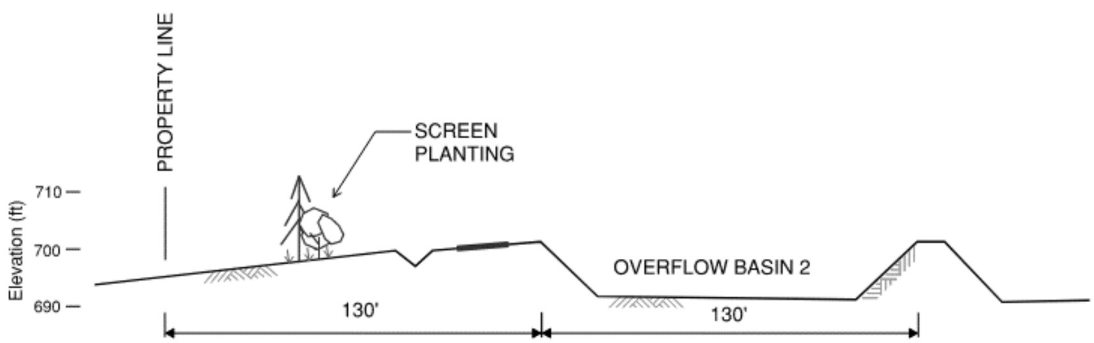


Figure 7. Site section showing the distance between the southern property line and the Overflow Basin.

The closest distance between the overflow basins and the nearest property line is 130 feet, and at this distance from the point of application, the rate of chemical deposition is approximately 1 percent of the application rate. The far edge of the overflow basins (as shown in Figure 4) is over 850 feet from the property line, and at this distance the rate of chemical deposition is approximately 0.12 percent of the application rate. To simplify the calculations and provide a more conservative estimate of chemical deposition, the rate of deposition at 130 feet will be used for all evaluations of the overflow basins.

Pesticide drift across the southern or western property lines could introduce small amounts of chemicals into the overflow basin (Felsot 2022). The basins will normally be operated at a water level of at least one foot, as water from filter-to-waste operation is sent to the overflow basins and then pumped back to the head of the Facility at a steady rate. This filter-to-waste recycle rate is typically less than one percent of the water being produced by the Facility, but recycle flows of up to 10 percent of production is allowed, so this conservative boundary condition was used in this analysis. Basin area and volume are shown in Table 11.

Table 10. Overflow Basin Area and Volume		
Basin	Area at Top of Basin (ft^2)	Volume at 1 ft. depth (gal)
Overflow Basin 1	117,800	516,000
Overflow Basin 2	114,400	519,000
Total	**232,200**	**1,035,000**

As described above for the process basins, chemical concentrations that could occur in the overflow basins were calculated for five pesticides (those with the highest hazard rating) used in the surrounding area. For these calculations, the total basin area was assumed to receive chemicals at the pesticide deposition rate determined by AgDRIFT® to occur at a distance 130 feet away from the point of application. It was then assumed that the water in the overflow basins would be recycled at a rate equal to 10 percent of the influent flow, so the resulting chemical concentration in water entering the treatment process would be approximately one-tenth of that in the overflow basins. As shown in Table 12, the concentration of concern for trifluralin is approximately 17 times greater than the calculated concentration in the Facility influent, and for chlorothalonil the concentration of concern is approximately 41 times greater.

Table 11. Potential Pesticide Deposition into Overflow Basins							
Chemical	Maximum Application Rate (lb/acre)	Pesticide Deposition @ 130 ft		Chemical Conc. in Basin (µg/L)	Facility Influent Conc.[a] (µg/L)	Conc. of Concern (µg/L)	Ratio of Concentration in Basin to Concentration of Concern
		Rate (lb/ft^2)	Mass (lb)				
Trifluralin	4.0	1.7×10^{-6}	0.405	46.9	4.69	80	5.9%
Glufosinate	1.5	6.5×10^{-7}	0.152	17.6	1.76	40	4.4%
Triclopyr	8.0	3.5×10^{-6}	0.810	93.9	9.39	300	3.1%
Dithiopyr	0.50	2.2×10^{-7}	0.0506	5.87	0.587	21	2.8%
Chlorothalonil	3.1	1.35E-06	0.314	36.4	3.64	150	2.4%

a. Assuming water in recycle basin is returned at a rate equal to ten percent of the influent flow.

3.2 Concentration Leaving Clearwell

To assess the potential pesticide concentration in finished water leaving the Facility, a simple spreadsheet-based, time series process model was developed to simulate the impact of pesticide deposition into open process basins while the Facility is operating. A block diagram of the process model is shown in Figure 8. The model included the following assumptions.

- Operation at 80 MGD
- Recycle is 5% of total flow
- Pesticide application at maximum rate
- Pesticide application occurs over 60 minutes

- Clearwell operated at constant volume equal to 75% of capacity
- Recycle/Overflow basin operated at a constant level of 3 ft

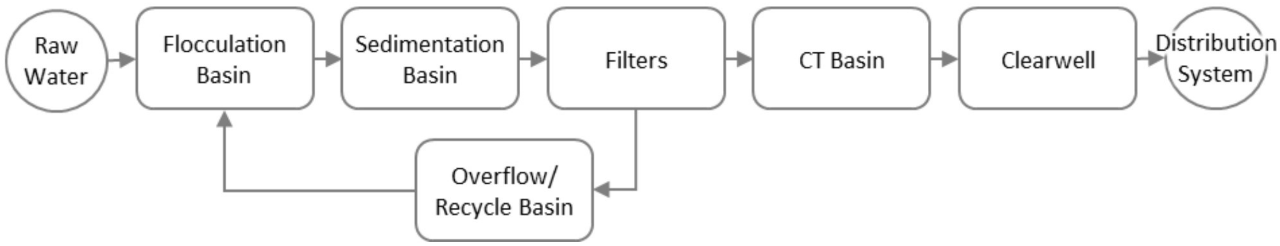


Figure 8. Block Diagram of Facility Process Model

Model results are summarized in Figure 9 for Trifluralin, the pesticide with the highest hazard rating. As shown in this figure, the large majority of the pesticide introduced into the treatment process comes through the overflow/recycle basin, resulting in the highest concentrations appearing in this basin. Direct deposition into the other process basins initially raises concentrations in the sedimentation and filter basins, but those initial concentrations fall after pesticide application ends. Concentrations in those basins rise again as water from the recycle basins is introduced into the main process.

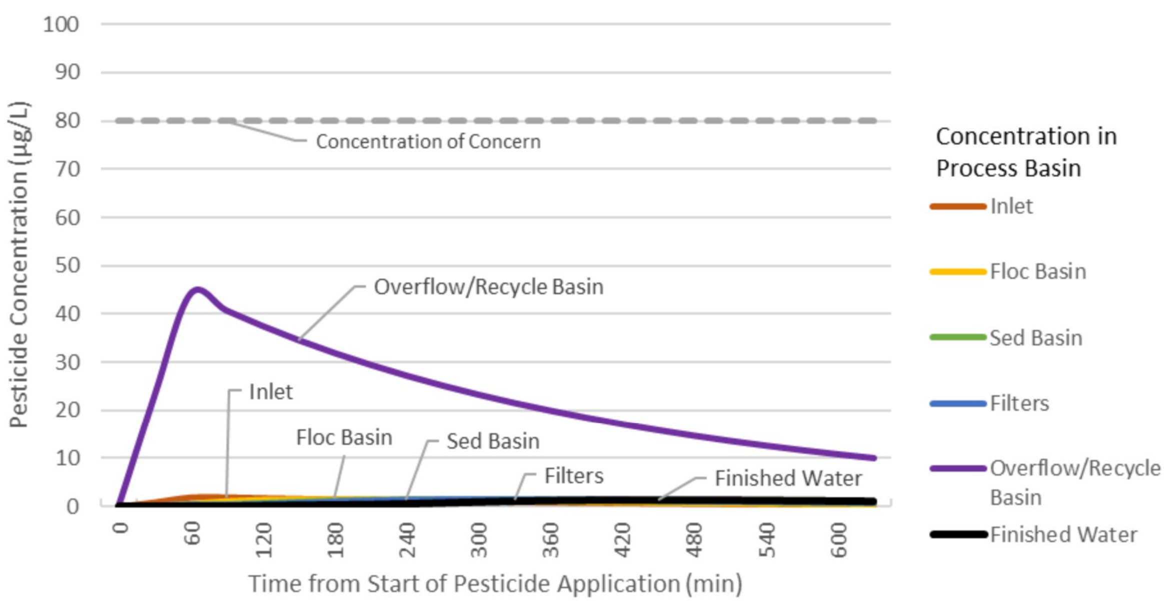


Figure 9. Theoretical pesticide concentration within the treatment process for Trifluralin.

Chemical concentrations in all basins, including the recycle basin, remain well below the concentration of concern of 80 µg/L at all times. The maximum concentration in the recycle basin is 44 µg/L, 55 percent of the concentration of concern. The maximum concentration in the finished water is 1.4 µg/L, 1.7 percent of the concentration of concern.

The model was run for the five pesticides with the highest hazard ratings, and similar results were achieved. As shown in Table 12, the model results predict that the maximum concentration of each pesticide in the finished water will be less than two percent of the concentration of concern.

Table 12. Potential Pesticide Concentration in Finished Water

Chemical	Maximum Chemical Concentration in Finished Water (µg/L)	Concentration of Concern (µg/L)	Maximum Concentration in Finished Water : Conc. of Concern
Trifluralin	1.35	80	1.69%
Glufosinate	0.51	40	1.27%
Triclopyr	2.70	300	0.90%
Dithiopyr	0.169	21	0.80%
Chlorothalonil	1.05	150	0.70%

4. Conclusion

The objective of this evaluation was to determine if the application of pesticides in the surrounding lands of the Facility poses a risk to operation of the Facility, specifically a risk that the drinking water produced would have chemicals at a level that pose a risk to public health if, contrary to accepted farm practices, pesticides drift onto the Facility site. For each of the pesticides identified as used in the land surrounding the Facility, a "concentration of concern" was determined. This concentration was based on current or anticipated regulations, health advisories, and benchmarks published by USEPA or calculated from toxicological data following USEPA methodologies. Where multiple advisory levels or benchmarks were published, the concentration most protective of public health was used in this analysis.

The list of pesticides used in the surrounding lands was screened based on the maximum recommended application rate and the concentration of concern. This analysis identified the five pesticides that posed the largest risk to water quality. Detailed analysis of pesticide drift scenarios evaluated these five pesticides, under the logical assumption that analysis of any of the other chemicals would show lower risks to water quality and public health.

Three pesticide deposition scenarios were evaluated for each of the five highest-hazard pesticides:

1. Pesticide deposition into the process basins and evaluation of the resulting concentration within the basin.
2. Pesticide deposition into the overflow basins, return of water in the overflow basins to the head of the process, and evaluation of the resulting chemical concentration in water entering the Facility.
3. Pesticide deposition into process and overflow basins during Facility operation and evaluation of the concentration leaving the clearwell.

The results of these analyses are summarized in Table 14 and show that the levels of chemicals that could result from the nearest possible pesticide application are far below the levels which pose potential regulatory compliance or human health risks, particularly when considering the potential concentration in the finished water. For all chemicals evaluated, the predicted concentration in finished water is less than two percent of the concentration of concern. Furthermore, potential exposure duration would be only for the hours immediately following the pesticide application, so the comparison to concentrations of concern based on chronic health effects are very conservative.

The potential introduction of chemicals will be further mitigated by the construction of berms and plantings between the property line and the basin, as well as the elevation of open water basins above the level of agricultural fields. These features will disperse or capture pesticide drifting from adjacent properties.

Because the scenarios evaluated used conservative assumptions to represent the highest-risk scenarios, this evaluation concludes that pesticide application in the surrounding lands of the Facility does not pose a human health risk or risk of violating drinking water regulations or exceeding advisory levels or benchmarks.

Table 13. Comparison of Concentrations of Concern to Potential Treatment Process Concentrations

Chemical	Concentration of Concern (µg/L)	Calculated Chemical Concentration in Treatment Process (µg/L)			
		Deposition into Inactive Basin		Finished Water Simulation	
		Filter Cell Concentration (µg/L)	Overflow Basin Concentration (µg/L	Concentration (µg/L)	% of Concentration of Concern
Trifluralin	80	0.67	47	1.35	1.69%
Glufosinate	40	0.25	18	0.51	1.27%
Triclopyr	300	1.3	94	2.70	0.90%
Dithiopyr	21	0.084	5.9	0.169	0.80%
Chlorothalonil	150	0.52	36	1.05	0.70%

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Attachment A. Regulations, Guidance, Toxicological Information, and Concentrations of Concern for Chemicals Used in the Surrounding Area

Chemical	National Primary Drinking Water Standards		2018 Drinking Water Health Advisory Levels		2021 EPA HHBP		Calculated HHBP				Concentration of Concern	
	MCLG[a] (mg/L)	MCL[b] (mg/L)	Concentration (mg/L)	Type[d]	Acute or One Day HHBP (µg/L)	Chronic or Lifetime HHBP (µg/L)	aPAD (mg/kg/day)	Acute or One Day HHBP[e] (µg/L)	cPAD (mg/kg/day)	Chronic or Lifetime HHBP[f] (µg/L)	(µg/L)	Source
Aminopyralid	-	-	N/A		--	3,000					3,000	2021 HHBP
Azoxystrobin	-	-	N/A		4,500	1,070					1,070	2021 HHBP
Bifenthrin	-	-	N/A		210	--					210	2021 HHBP
Carbaryl	-	-	0.4	DWEL	N/A	N/A					400	HA Level
Chlorothalonil	-	-	0.15	10^{-4} Cancer Risk	N/A	N/A					150	HA Level
Clethodim	-	-	N/A		7,000	2,000					2,000	2021 HHBP
Clopyralid	-	-	N/A		N/A	N/A	0.15	1,000	0.15	847	850	Calc. HHBP
Cyfluthrin	-	-	N/A		78	--					78	2021 HHBP
Dithiopyr	-	-	N/A		--	21					21	2021 HHBP
Fludioxonil	-	-	N/A		--	2,000					2,000	2021 HHBP
Flumioxazin	-	-	N/A		800	100					100	2021 HHBP
Flutolanil	-	-	N/A		--	3,000					3,000	2021 HHBP
Fluvalinate	-	-	N/A		N/A	N/A	0.010	67	0.010	56	56	Calc. HHBP
Glufosinate			N/A		1,800	40					40	2021 HHBP
Glyphosate	0.7	0.7	20	One-day HA, Ten-day HA	N/A	N/A					700	MCL
Hexazinone	-	-	2	Life-time HA, DWEL	N/A	N/A					2,000	HA Level
Imidacloprid	-	-	N/A		500	500					500	2021 HHBP
Indaziflam	-	-	N/A		500	100					100	2021 HHBP
Isoxaben	-	-	N/A		--	300					300	2021 HHBP
Metconazole	-	-	N/A		8,000	200					200	2021 HHBP
Myclobutanil	-	-	N/A		20,000	150					150	2021 HHBP
Oryzalin	-	-	N/A		7,100	1,100					1,100	2021 HHBP
Oxyflurofen	-	-	N/A		N/A	N/A	1.8	12,200	0.040	226	230	Calc. HHBP
Paraquat	-	-	0.1	One-day HA, Ten-day HA	N/A	N/A					100	HA Level
Permethrin	-	-	N/A		2,900	--					2,900	2021 HHBP
Prodiamine	-	-	N/A		--	830					830	2021 HHBP
Propiconazole	-	-	N/A		2,000	600					600	2021 HHBP
Spinosad	-	-	N/A		--	147					147	2021 HHBP
Triclopyr	-	-	N/A		1,000	300					300	2021 HHBP
Trifluralin	-	-	0.08	One-day HA, Ten-day HA	N/A	N/A					80	HA Level

a. Maximum Contaminant Level Goal

b. Maximum Contaminant Level

c. Human Health Benchmark for Pesticides

d. Health Advisory Types:

DWEL: Drinking Water Equivalent Level. A DWEL is a drinking water lifetime exposure level at which adverse, noncarcinogenic health effects would not be expected to occur.

One-Day HA: The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for up to one day of exposure for a 10-kg child.

Ten-Day HA: The concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for up to ten days of exposure for a 10-kg child.

10^{-4} Cancer Risk: The concentration of a chemical in drinking water corresponding to an excess estimated lifetime cancer risk of 1 in 10,000.

e. Cacluated using formula for deriving Acute HHBP for Children = [aPAD (mg/kg/day) x 1000 (µg/mg)] / [0.15 (L/kg-day)]

f. Calculated using formula for deriving Chronic HHBP for Females 13-49 Years = [cPAD (mg/kg bw/day) x 1000 (µg/mg) x 0.2 RSC] / 0.0354 (L/kg/day) DWI-BW ratio, and RSC= Relative Source Contribution assumed as 20%