



STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY

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Jamey Barker, P.E.
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Re: Ecology Opinion on Groundwater Cleanup Levels and Reporting for the following Contaminated Site:

- **Site Name:** Vashon Island Landfill
- **Site Address:** 18900 Westside Highway SW, Vashon, WA 98070
- **King County Parcel No.:** 3623-02-9009
- **Public Landfill Survey System:** SW/4 of Section 36, Township 23 North, Range 2 East, Willamette Meridian
- **Cleanup Site ID:** 1146
- **Facility/Site ID:** 2192

Dear Jamey:

King County Solid Waste Division (KCSWD) is the owner and operator of the Vashon Island Landfill. Public Health – Seattle & King County (Public Health) is the jurisdictional health department that permits the landfill under Chapter 173-351 of the Washington Administrative Code (WAC). The Washington State Department of Ecology's (Ecology) Solid Waste Management Program provides technical support to Public Health and oversight of landfill post-closure care under WAC 173-351. KCSWD performs post-closure monitoring in accordance with Vashon Island Closed Landfill Post-Closure Care and Maintenance Permit No. PR0015723 issued by Public Health. As stipulated in WAC 173-351-440(8), KCSWD must establish groundwater protection standards using the groundwater quality criteria in WAC 173-200. Groundwater monitoring is reported to Public Health and Ecology in quarterly and annual reports, as required in WAC 173-351-415.

Ecology has primacy when there is a release of hazardous substances from the landfill that is subject to the state's cleanup law, the Model Toxics Control Act (MTCA), Chapter 70A.305 of the Revised Code of Washington, and WAC 173-340. KCSWD is performing an independent cleanup of the landfill under MTCA. KCSWD completed the Final Remedial Investigation on November 6, 2020 and is initiating the feasibility study required under MTCA.

In this letter, Ecology is requesting KCSWD to:

- Revise the cleanup levels from those proposed in the Final Remedial Investigation. The cleanup levels should be revised based on the opinions and recommendations in this letter. Ecology notes that cleanup action plans are decision documents for formal MTCA sites that are subject to public comment, and thus not applicable to the independent cleanup of Vashon Island Landfill.
- Reevaluate the extent of contamination in all aquifers at the site using the revised cleanup levels.
- Prepare annual monitored natural attenuation reports under MTCA in addition to the annual post-closure care groundwater monitoring reports required under the solid waste regulations. The post-closure care reports evaluate detection and assessment monitoring, whereas the requested MTCA report evaluates the attenuation contamination that has been released from the landfill. The reports should utilize the same analytical data.

Landfill History

Solid waste disposal activities have occurred at Vashon Island Landfill since the early 1900s. KCSWD assumed operations during the late 1950s. In 1998, Phase I closure was performed for the northwest portion of the landfill in accordance with WAC 173-304, and landfill liner was placed across the central portion of the landfill. Solid waste was accepted at the landfill until 1999, when the Vashon Transfer & Recycling Station began operations. Phase II closure was completed for the remaining landfill in 2001 in accordance with WAC 173-351. Historical solid waste areas extend west of the Phase I area and south of the Phase II area.

Review of MTCA Cleanup Documents and Opinions

Vashon Island Landfill is regulated under both landfill and cleanup regulations (WAC 173-351 Criteria for Municipal Solid Waste Landfills and WAC 173-340 Model Toxics Control Act - Cleanup). Vashon Island Landfill entered into MTCA in 2010 because the concentrations of one or more WAC 173-351, Appendix III constituents were detected above the groundwater protection standard, in accordance with WAC 173-351-440(7). Ecology submitted a letter to KCSWD on August 27, 2010, which defines the roles of Public Health and Ecology in the permitting and cleanup of the landfill. On August 30, 2010, Ecology submitted a second letter to KCSWD, which references current citation WAC 173-351-440(7) for entering MTCA and WAC 173-351-465 to justify Ecology's lead under MTCA. The August 30, 2010, letter acknowledges KCSWD's intention to perform an independent cleanup under MTCA.

Ecology performed an initial investigation of the Vashon Landfill under MTCA on April 25, 2011, based on the fourth quarter 2010 environmental monitoring report, and following KCSWD's submittal of the Vashon Closed Landfill Western Hillslope Investigation on March 31, 2011. Ecology submitted an Early Notice Letter to KCSWD on September 26, 2011, which states that there is contamination on the property that is subject to MTCA.

KCSWD submitted an Agency Draft Remedial Investigation Report on October 9, 2018, and Ecology provided opinion letters on the Agency Draft on December 6, 2018, and December 17, 2019. The December 17, 2019, opinion letter states that Ecology can accept a regional Puget Sound Basin background for arsenic and health-based criteria for manganese and iron, as opposed to secondary maximum contaminant levels (MCLs), but recommended that site-specific representative background concentrations of arsenic, manganese, and iron be used as groundwater protection standards under WAC 173-351.

KCSWD submitted the Final Agency Draft Remedial Investigation Report, dated May 2020, and then a Final Remedial Investigation Report on November 6, 2020, following an Ecology opinion letter on June 22, 2020, and subsequent clarification in July and September 2020. KCSWD's November 12, 2020, cover letter to Ecology states that the Remedial Investigation identifies potential soil exposure pathways, and that KCSWD intends to complete the assessment of soil cleanup levels, as necessary, in the Feasibility Study, and that they anticipate that compliance with the soil cleanup levels will be demonstrated empirically through groundwater compliance. The Final Remedial Investigation Report identifies two data gaps in Section 10.2, which includes identifying the source of seasonal water infiltration to gas extraction well GW-11 and the delineation of vinyl chloride in the Channel Cc2 aquifer south of the landfill.

The Final Remedial Investigation Report identifies the following potential exposure pathways for groundwater, including:

- Direct contact, ingestion, and inhalation by humans.
- Freshwater aquatic and terrestrial ecological surface water exposure.
- Direct contact and consumption of freshwater aquatic organisms by humans in surface water.

Preliminary cleanup levels were based on the following water quality standards:

- Method A groundwater cleanup levels.
- Method B groundwater cleanup levels for non-carcinogenic and carcinogenic exposure pathways (MTCA Equations 720-1 and 720-2).
- State primary MCLs in WAC 246-290-310.
- Method B surface water cleanup levels for non-carcinogenic and carcinogenic exposure pathways (MTCA Equations 730-1 and 730-2).
- Acute and chronic surface water criteria for freshwater aquatic life in WAC 173-201A.
- Acute and chronic surface water criteria for freshwater aquatic life in Section 304 of the Clean Water Act (CWA §304).
- Federal water quality standards for Washington state in 40 Code of Federal Regulations (CFR) 131.45.
- Human health surface water criteria in CWA §304.

The terrestrial ecological exposure pathway was evaluated for soil samples collected near the west hillside seepage area; however, groundwater cleanup levels were not developed from

partitioning equations using the ecological screening levels in Table 8.2a of the Final Remedial Investigation.

The preliminary groundwater cleanup levels did not evaluate secondary MCLs as an applicable or relevant and appropriate requirement (ARAR).

Ecology provides the following MTCA opinions and recommendations:

Cleanup Levels

Ecology recommends revising the cleanup levels in accordance with the following opinions and recommendations:

1. Cleanup Levels for Formal and Independent MTCA Sites

Preliminary cleanup levels are developed for the applicable exposure pathways during the remedial investigation.

For formal cleanup sites (e.g., Agreed Orders), Ecology designates the cleanup levels for the chemicals of concern in a Cleanup Action Plan in accordance with WAC 173-340-380(1), which is subject to public comment in accordance with WAC 173-340-380(2) and WAC 173-340-600(14). These cleanup levels are binding. Amendments to the Cleanup Action Plan and its cleanup levels are subject to public comment.

KCSWD has not entered into a formal cleanup agreement with Ecology. Rather, Ecology is providing opinions on the independent cleanup of the permitted landfill as part of its support to Public Health. For independent cleanups, Ecology can provide written opinions of whether the cleanup action meets the substantive requirements of MTCA, in accordance with WAC 173-340-515(5). In this letter, Ecology is providing opinions on the cleanup standards for the landfill. As opposed to a Cleanup Action Plan, the recommended cleanup standards in this letter are advisory in nature and non-binding.

Ecology is recommending revised cleanup levels for Vashon Island Landfill to those proposed in the Final Remedial Investigation Report (November 6, 2020).

2. Method A Cleanup Levels

The Final Remedial Investigation Report applies Method A cleanup levels for the groundwater ingestion exposure pathway (see Sections 5.5.1, Table 5.1, and Table 6.3). As stated in WAC 173-340-704(1), Method A cleanup levels are applicable for routine cleanup actions, as defined in WAC 173-340-200. Vashon Island Landfill does not meet the criteria for a routine cleanup action. Additionally, Method A and Method B cleanup levels should not be applied for the same media.¹

¹ Guidance on the Use of Method A, B, and C Cleanup Levels and Mixing Methods, December 2022, https://www.ezview.wa.gov/Portals/_1987/Documents/Documents/MixingMethodsABC.pdf

3. Secondary Maximum Contaminant Levels

Secondary MCLs are based on aesthetic drinking water criteria such as taste, color, and odor.² WAC 173-351-440(8) states the landfill owner or operator must establish a groundwater protection standard using the groundwater quality criteria in WAC 173-200. WAC 173-200-040(2)(b) states the groundwater quality criteria for the primary and secondary contaminants shall be the most stringent of the MCL, MCL goal, and State MCLs as currently published in WAC 246-290-310, and that these criteria shall be amended as federal and state rules are amended.

The Final Remedial Investigation Report does not identify secondary MCLs as potentially applicable regulatory requirements in Section 5.1. Secondary MCLs were added to Ecology's Cleanup Levels and Risk Calculation (CLARC) website³ in the July 2022 update⁴, which states:

“The Washington State Department of Health (DOH) has established secondary MCLs under WAC 246-290-310. Ecology clarified in its 2001 Concise Explanatory Statement⁵ (see Chapter 10.1.8)⁶ that secondary MCLs incorporated into the DOH regulations for public water supplies are an applicable state law and therefore an applicable standard under MTCA. Secondary MCLs established by DOH under WAC 246-290-310 may be considered as ARARs when setting cleanup levels. Federal secondary MCLs for drinking water are considered advisory and are not ARARs under MTCA.”

Secondary MCLs published by DOH are an applicable standard under both the landfill and cleanup regulations for the Vashon Island Landfill and must be considered when selecting cleanup levels.

4. Groundwater Quality Criteria

Ecology establishes groundwater quality standards in WAC 173-200. WAC 173-351-440(8) requires that the groundwater protection standards for the landfill be based on the groundwater quality criteria of WAC 173-200. The groundwater quality criteria in WAC 173-200 are applicable for detection and assessment monitoring for potential releases of contamination from the landfill. WAC 173-200-040, Table 1 provides groundwater quality criteria based on MCLs, as updated by current regulation WAC 246-290-310, and carcinogens based on a 1E-6 excess cancer risk. When no criterion is established for a contaminant, the groundwater enforcement level should be based on its practical quantitation limit (PQL) (WAC 173-200-050(4)).

² <https://www.epa.gov/sdwa/secondary-drinking-water-standards-guidance-nuisance-chemicals>

³ <https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Contamination-clean-up-tools/CLARC>

⁴ <https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Contamination-clean-up-tools/CLARC/Latest-news>

⁵ Concise Explanatory Statement for the Amendments to the Model Toxics Control Act (MTCA) Cleanup Regulation, Ecology Publication No. 01-09-043, February 2001, <https://apps.ecology.wa.gov/publications/summarypages/0109043.html>

⁶ The 2001 Concise Explanatory Statement notes that, with the exception of the federal odor standard, the secondary MCLs are incorporated into the State DOH regulations for public water supplies.

Although WAC 173-200 is the applicable regulation for Vashon Island Landfill under WAC 173-351-440(8), WAC 173-200 is not an applicable regulation under MTCA because it is not listed in WAC 173-340-720(3)(b)(ii).

5. Applicable Water Quality Standards for the Groundwater Cleanup Levels

The groundwater cleanup levels at Vashon Island Landfill should be protective of the groundwater ingestion pathway and protective of nearby surface waters, in accordance with WAC 173-340-720(1)(d)(v).

In accordance with WAC 173-340-705(2) and WAC 173-340-720(4)(b), the applicable water quality standards for the groundwater exposure pathway are:

- State primary and secondary MCLs in WAC 246-290-310 and Federal MCLs and MCLGs, adjusted if needed per WAC 173-340-720(7)(b) to achieve target cancer risk and noncancer hazard.
- For chemicals without MCLs, Method B groundwater cleanup levels for non-carcinogenic and carcinogenic exposure pathways (MTCA Equations 720-1 and 720-2).

In accordance with WAC 173-340-705(2) and WAC 173-340-730(3)(b), the applicable water quality standards for the surface water exposure are:

- Acute and chronic surface water criteria for freshwater aquatic life in WAC 173-201A.
- Acute and chronic surface water criteria for freshwater aquatic life in section 304 of the Clean Water Act (CWA §304).
- Federal water quality standards for Washington state in 40 CFR 131.45.
- Human health surface water criteria in CWA §304.
- For chemicals without surface water criteria, Method B surface water cleanup levels for non-carcinogenic and carcinogenic exposure pathways (MTCA Equations 730-1 and 730-2).

These criteria are provided on Ecology's CLARC⁷ website, as periodically amended.⁸

Ecology requires that groundwater concentrations be compared with both the most stringent groundwater quality standard and the most stringent surface water quality standard.

6. Chemicals of Concern and Monitored Natural Attenuation Parameters

The Final Remedial Investigation Report describes the release or mobilization of metals, volatile organic compounds (VOCs), and semi-volatile organic compounds (SVOCs) in the Channel Cc2 aquifer at the site. Section 6 and Table 6.3 identify the following chemicals of concern:

⁷ <https://ecology.wa.gov/Regulations-Permits/Guidance-technical-assistance/Contamination-clean-up-tools/CLARC>

⁸ The CLARC website was last updated in August 2023.

- Metals: Arsenic, iron, and manganese.
- VOCs: Trichloroethylene, vinyl chloride, 1,2-dichloropropane, benzene.
- SVOCs: Bis(2-chloroethyl) ether.

In the 2022 Annual Groundwater Data Evaluation Report for Vashon Island Landfill (March 2023), Table B-2 identifies the following exceedances in the Channel Cc2 aquifer:

- Metals: Arsenic, iron, and manganese.
- VOCs: Trichloroethylene, vinyl chloride, 1,1-dichloroethane, 1,2-dichloropropane, acetone, chloroethane, dichlorodifluoromethane, and trichlorofluoromethane.
- SVOCs: Bis(2-chloroethyl) ether, bis(2-ethylhexyl) phthalate.

The Final Remedial Investigation did not retain bis(2-ethylhexyl) phthalate as a chemical of concern based on its exceedance frequency.

Ecology recommends further evaluation of the following chemicals of concern:

- Metals: Arsenic, iron, and manganese.
- VOCs: Trichloroethylene, cis-1,2-dichloroethylene, trans-1,2, dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1-dichloroethane, 1,2-dichloroethane, 1,2-dichloropropane, benzene.
- SVOCs: Bis(2-chloroethyl) ether, bis(2-ethylhexyl) phthalate.

The three dichloroethylene isomers were retained because they biodegrade to vinyl chloride. Also, the concentrations of cis-1,2-dichloroethylene exceed the preliminary cleanup levels in MW-33. Two dichloroethane isomers are also retained.

Ecology does not recommend retaining the following non-carcinogenic compounds as chemicals of concern:

- Acetone: Detected in Cc2 wells MW-2, MW-20, and MW-33 in 2022. The maximum concentration of 8.46 µg/L is nearly three orders of magnitude below the 7,200 µg/L Method B cleanup level for non-carcinogens.
- Chloroethane: Detected in Cc2 well MW-33 in 2022 at a maximum estimated concentration of 0.196 µg/L. No cleanup levels have been established.
- Dichlorodifluoromethane: Detected in Cc2 wells MW-2, MW-20, MW-21, MW-33, MW-35, and MW-37 in 2022. The maximum concentration of 4.4 µg/L is more than two orders of magnitude below the 1,600 µg/L Method B cleanup level for non-carcinogens.
- Trichlorofluoromethane: Detected in Cc1 well MW-3 and in Cc2 wells MW-2, MW-21, and MW-37. The maximum detected concentration of 2.45 µg/L is about three orders of magnitude below the 2,400 µg/L Method B cleanup level for non-carcinogens.

Additionally, Ecology recommends further evaluation of the following monitored natural attenuation parameters:

- Nitrate, total and dissolved manganese, sulfate, total and dissolved iron.
- Field parameters: Dissolved oxygen and oxidation-reduction potential.

These parameters were selected to evaluate the favorability of reducing conditions and availability of terminal electron acceptors for the reductive dechlorination of chlorinated ethylenes.

7. Adjustment of Cleanup Levels for Risk

MTCA requires the groundwater cleanup levels and surface water cleanup levels to be adjusted in accordance with WAC 173-340-705(4), specifically WAC 173-340-708(5) and (6) and WAC 173-340-720(7)(a) and -730(5)(a). When multiple contaminants or exposure pathways are present, the cleanup levels need to be adjusted such that the total risk is not greater than a 1E-5 excess cancer risk and the hazard index (i.e., sum of hazard quotients) is not greater than one. The Final Remedial Investigation did not account for this. Final cleanup levels will need to address this requirement.

The total site risk should include arsenic carcinogenicity, which has a 1E-5 excess cancer risk at 0.58 µg/L.⁹ The site-specific natural background concentrations of arsenic are anticipated to exceed the 1E-5 excess cancer risk. Thus, the cleanup levels of the remaining carcinogenic chemicals of concern must be adjusted downward to achieve a 1E-5 excess cancer risk for multiple exposure pathways at the site. As described in WAC 173-340-708(6)(e), the cleanup levels for individual hazardous substances shall not be adjusted downward to less than the practical quantitation limit (PQL) or natural background.

8. Recommended Cleanup Levels

Ecology recommends revising the cleanup levels to dismiss the Method A cleanup levels, incorporate secondary MCLs (SMCLs), and adjust the total excess cancer risk for the site to 1E-5 for the recommended chemicals of concern.

Table 1 provides the recommended cleanup levels for the chemicals of concern based on the groundwater ingestion exposure pathway. Table 1 compares these cleanup levels with the groundwater quality criteria for the landfill (i.e., WAC 173-200) and the preliminary cleanup levels in the Final Remedial Investigation Report. The groundwater quality criteria and the

⁹ See the 2001 Concise Explanatory Statement for MTCA, Response to GQ 9.1.8. “Ecology acknowledges that at sites where arsenic is an indicator hazardous substance, this language [in WAC 173-720(7)(a) and -730(5)(a)] could result in the cleanup level for the other carcinogens being set at natural background or the PQL. However, we do not believe it is appropriate to make the suggested change [to address chemicals present only to human causes] without engaging in additional public dialogue on the implications of making this change. Such a change would be a significant policy shift from what is currently in the MTCA rule...”

groundwater cleanup levels incorporate the identical primary and secondary MCLs currently listed in WAC 246-290-310; however, MTCA requires that cleanup levels based on an MCL be adjusted downward such that the excess carcinogenic risk does not exceed 1E-5 and the non-carcinogenic risk does not exceed a hazard index of one (WAC 173-340-720(7)(b)). In the absence of MCLs, the groundwater cleanup levels should be protective of a 1E-6 total excess cancer risk and a hazard index of one.

Table 1: Preliminary Cleanup Levels for the Groundwater Ingestion Exposure Pathway				
Chemicals of Concern	Groundwater Quality Criteria (WAC 173-200) ¹⁰	Preliminary Cleanup Levels (Final Remedial Investigation, Table 6.3, Groundwater)	Recommended Preliminary Cleanup Levels	Basis of Cleanup Levels (Cleanup levels based on MCLs are reduced to a 1E-5 excess cancer risk or a hazard quotient of 1)
Metals (µg/L) (pending background adjustments)				
Arsenic	0.05	8	0.58	MCL (reduced to 1E-5 cancer risk)
Iron	300	11,000	300	SMCL
Manganese	50	750	50	SMCL
Volatile organic compounds (µg/L)				
Benzene	1.0	5	5	MCL
1,1-dichloroethane	1.0	-	7.7	Method B Cancer
1,2-dichloroethane	0.5	-	0.48	Method B Cancer
1,1-dichloroethylene	MCL	-	7	MCL
Cis-1,2-dichloroethylene	-	-	16	Method B Noncancer
Trans-1,2-dichloroethylene	MCL	-	100	MCL
1,2-dichloropropane	0.6	5	5	MCL
Trichloroethylene	3	5	4	MCL (reduced to HQ=1)
Vinyl chloride	0.02	0.29	0.29	MCL (reduced to 1E-5 cancer risk)
Semi-volatile organic compounds (µg/L)				
Bis(2-chloroethyl) ether	0.07	0.04	0.04	Method B Cancer
Bis(2-ethylhexyl) phthalate	6.0	-	6.0	MCL

Table 2 provides the recommended cleanup levels for the chemicals of concern based on surface water exposure pathways. With the exception of iron, the most stringent cleanup levels for surface water exposure are based on human health criteria in WAC 173-201A, 40 CFR 131.45, and/or CWA §304, as summarized on Ecology’s CLARC website.

¹⁰ The carcinogenic risk equations in WAC 173-200-040(2)(c) and WAC 173-340-720(4)(b)((iii)(B) (Equation 720-2) are equivalent and both express a 1E-6 cancer risk. The equations only differ in the lifetime exposure duration; 70 years in WAC 173-200 versus 75 years in MTCA. The cancer potency factors are periodically updated in CLARC for MTCA but have not been updated in WAC 173-200 since 1990.

Table 2: Preliminary Cleanup Levels for the Surface Water Exposure Pathway			
Chemicals of Concern	Preliminary Cleanup Levels (Final Remedial Investigation, Table 6.3, Surface water)	Recommended Preliminary Cleanup Levels	Basis of Cleanup Levels (Most stringent freshwater criteria listed in CLARC)
Metals (µg/L) (pending background adjustments)			
Arsenic	8	0.018	40 CFR 131.45, CWA §304
Iron	-	1,000	CWA §304
Manganese	50	50	CWA §304
Volatile organic compounds (µg/L)			
Benzene	0.44	0.44	WAC 173-201A
1,1-dichloroethane	-	-	-
1,2-dichloroethane	-	8.9	40 CFR 131.45
1,1-dichloroethylene	-	300	CWA §304
Cis-1,2-dichloroethylene	-	-	-
Trans-1,2-dichloroethylene	-	100	CWA §304
1,2-dichloropropane	0.71	0.71	WAC 173-201A
Trichloroethylene	0.3	0.3	40 CFR 131.45
Vinyl chloride	0.02	0.02	WAC 173-201A
Semi-volatile organic compounds (µg/L)			
Bis(2-chloroethyl) ether	0.02	0.02	WAC 173-201A
Bis(2-ethylhexyl) phthalate	-	0.045	40 CFR 131.45

Table 3 summarizes the recommended cleanup levels for groundwater and surface water at Vashon Island Landfill. Groundwater cleanup levels are the most stringent of the cleanup levels for the groundwater ingestion and surface water exposure pathways. Surface water cleanup levels are only protective of the surface water exposure pathways, which are more lenient than the groundwater ingestion exposure pathway for iron, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethylene, and cis-1,2-dichloroethylene. MTCA requires that the cleanup levels for multiple contaminants be adjusted such that the total site risk does not exceed an excess cancer risk of 1E-5. Because the anticipated background concentrations of arsenic exceed the 1E-5 excess cancer risk, the cleanup level of arsenic should be adjusted to natural background and the cleanup levels of the remaining carcinogens should be reduced to their PQL. Ecology recommends revisiting the total site risk adjustments once the concentrations of arsenic have attenuated to natural background concentrations.

Table 3: Recommended Cleanup Levels for the Groundwater and Surface Water Exposure Pathways				
Chemicals of Concern	Unadjusted Cleanup Levels		Adjusted Cleanup Levels (Total site risk of 1E-5) (Based on arsenic carcinogenicity)	
	Groundwater (including surface water)	Surface Water	Groundwater (including surface water)	Surface Water
Metals (µg/L) (pending background adjustments)				
Arsenic	0.018	0.018	0.58	0.018
Iron	300	1,000	300	1,000
Manganese	50	50	50	50
Volatile organic compounds (µg/L)				
Benzene	0.44	0.44	PQL	PQL
1,1-dichloroethane	7.7	-	PQL	PQL
1,2-dichloroethane	0.48	8.9	PQL	PQL
1,1-dichloroethylene	7	300	7	300
Cis-1,2-dichloroethylene	16	-	16	-
Trans-1,2-dichloroethylene	100	100	100	100
1,2-dichloropropane	0.71	0.71	PQL	PQL
Trichloroethylene	0.3	0.3	PQL	PQL
Vinyl chloride	0.02	0.02	PQL	PQL
Semi-volatile organic compounds (µg/L)				
Bis(2-chloroethyl) ether	0.02	0.02	PQL	PQL
Bis(2-ethylhexyl) phthalate	0.045	0.045	PQL	PQL

9. Adjustment of Cleanup Levels for Natural Background

Cleanup levels should not be established below natural background concentrations or the PQLs, in accordance with WAC 173-340-720(7)(c) and -730(5)(c). Similarly, groundwater enforcement limits should not be established below background groundwater quality or the PQL, in accordance with WAC 173-200-050(3)(b).

Background concentrations are developed differently under MTCA and WAC 173-200. Under MTCA, natural background is typically evaluated regionally, using groundwater that has not been influenced by localized human activities. WAC 173-200, however, applies an antidegradation standard. Ecology Publication No. 96-02¹¹ states:

¹¹ Implementation Guidance for the Ground Water Quality Standards, Ecology Publication No. 96-02, Revised October 2005.

- Background quality is measured hydraulically upgradient of the facility's point of discharge (Section 4.2.1.1.1).
- Regional water quality may also be used since it is indicative of water unimpacted by area activities (Section 6.3.2.2.2).
- Enforcement limits based on elevated background groundwater quality shall in no way be construed to allow continued pollution of the receiving groundwater (Section 6.3.7.2).

The basic premise of the antidegradation policy is that potential polluting facilities should not degrade the natural groundwater quality. However, once a facility has polluted a groundwater body, cleanup actions, including natural attenuation, are performed to restore groundwater quality to acceptable cleanup levels.

WAC 173-200 and WAC 173-340 have different methodologies for calculating and complying with the statistical background concentrations, as discussed in Ecology Publication No. 96-02 Appendix E and WAC 173-340-709(3) and -720(9).

Natural background concentrations developed under MTCA are more applicable for the Vashon Island Landfill contaminated areas than the background water quality developed under Ecology Publication No. 96-02. Releases have occurred from solid waste material placed before the construction of the Vashon Island Landfill liner in 1988. Groundwater monitoring has been performed in accordance with WAC 173-304 and -351 to detect and assess potential releases since the implementation WAC 173-304 in October 1985. KCSWD has evaluated the release of contamination under MTCA since 2010. Basically, groundwater quality is recovering from the release of contamination, as opposed to being monitored to observe a potential release.

The Final Remedial Investigation adjusted the preliminary cleanup level of arsenic up to the 8.0 µg/L Puget Sound Basin background concentration based on draft Ecology Publication No. 14-09-044 (Natural Background Groundwater Arsenic Concentrations in Washington State, June 2015). Ecology finalized Publication No. 14-09-044 in January 2022, which reports a calculated natural background concentration of 8.0 µg/L of arsenic for the Puget Sound Basin.

In the December 17, 2019 opinion letter for the Agency Draft Remedial Investigation, Ecology recommended that site-specific representative background concentrations of arsenic, manganese, and iron be used for post-closure care monitoring.

KCSWD currently uses interwell prediction limits from upgradient well MW-20 in the Channel Cc2 aquifer, and uses intrawell prediction limits for the underlying Unit D aquifer wells. The 2022 Annual Groundwater Data Evaluation Report (Section 4.4.4 and Table B-5) states that the interwell prediction limits from MW-20 are 4.39 µg/L total arsenic, 390 µg/L dissolved iron, and 548 µg/L dissolved manganese.

Ecology recommends that site-specific background concentrations of total arsenic, total manganese, and total iron be calculated using upgradient wells from multiple formations in accordance with WAC 173-340-709(3). The following upgradient wells should be considered as candidate wells for the site-specific background concentrations:

- Unit Cc1: MW-13
- Unit Cc2: MW-20
- Unit D: MW-7, MW-25, and MW-29

Nearby water wells identified in Remedial Investigation Figure 7.1 (Identified Beneficial Uses) may also be used candidate wells for background concentrations.

WAC 173-351, Appendix I requires the analysis of total arsenic, while WAC 173-351, Appendix II requires the analysis of dissolved iron and dissolved manganese as geochemical indicators. WAC 173-340-720(9)(b) states that “analysis shall be conducted on unfiltered groundwater samples, unless it can be demonstrated that a filtered sample provides a more representative measure of groundwater quality.” Unfiltered groundwater samples should be compared with the secondary MCLs because they are drinking water standards. Consistent with WAC 173-351, Appendix II, filtered groundwater samples are more appropriate for geochemical analysis.

Ecology requests KCSWD to revise the cleanup levels following the guidelines in this letter.

Contaminated Area Evaluation

The Final Remedial Investigation Report concludes that the release of the chemicals of concern is limited to the Channel Cc2 aquifer south and west of the landfill and the surface water seeps from this interval along the west hillside (see Sections 6 and 10 and Figures 6.1 to 6.8 and 10.1). In May 2022, KCSWD installed MW-37 along the southern property boundary to delineate the extent of vinyl chloride¹². The 2022 Annual Groundwater Data Evaluation Report identifies contamination in the Channel Cc1 and Cc2 aquifers (see Tables B-7 and B-8).

The Channel Cc1 aquifer has been historically impacted south and west of the landfill, as indicated by the detection of the chemicals of concern in MW-3 (south) and MW-4 (west). In MW-4, tetrachloroethylene was detected above the PQL four times between 2018 to 2020 (see Figure C-22B in the 2022 Annual Report) and cis-1,2-dichloroethylene was routinely detected below its recommended cleanup level between 2019 and 2022.

The main contamination area is within the underlying Channel Cc2 aquifer south and west of the landfill. The highest concentrations of the chemicals of concern are detected in MW-33, and the contaminant plumes extend to Cc2 wells MW-2, MW-21, MW-35, and MW-37 and surface seeps at SW-W1 and SW-W3.

In 2009, KCSWD installed three hand-augered monitoring wells on the west hillside to evaluate the extent of contamination, including MW-30 and MW-32 in the Cc2 aquifer and MW-31 in the Cc3 aquifer. MW-30 and MW-32 intersect the Cc2 aquifer upgradient of the contaminated seepage area. The Final Remedial Investigation (Table F.1) reports that MW-30 to MW-32 were sampled quarterly between January and November 2010, and no further sampling is reported.

¹² Vashon Island Closed Landfill Well Installation and Well Decommissioning Memorandum, Jacobs, July 29, 2022.

Cis-1,2-dichloroethylene was detected at 2.29 µg/L in MW-32 and vinyl chloride was detected at 0.026 µg/L in MW-30 and 0.138 µg/L in MW-32. The 2022 Groundwater Data Evaluation Report reports groundwater gauging in MW-30 only.

Ecology requests KCSWD to reevaluate the extent of contamination in all aquifers using the revised cleanup levels.

Recommended MTCA Reporting

KCSWD performs quarterly groundwater detection monitoring at the Vashon Island Landfill in accordance with WAC 173-351-430 and the 2016 Sampling and Analysis Plan and Quality Assurance Project Plan, as amended with a revised Table 5-1 on December 23, 2022. Quarterly and annual groundwater monitoring reports are submitted to Public Health and Ecology in accordance with WAC 173-351-415. The groundwater monitoring reports compare the analytical results with the groundwater quality criteria of WAC 173-200, as required by WAC 173-351-440(8). The annual groundwater monitoring reports evaluate WAC 173-351, Appendix I, Appendix II, and limited Appendix III (in Cc2 aquifer) parameters and provide statistical analyses with the intention of identifying potential releases of contamination. The annual groundwater monitoring reports do not evaluate the natural attenuation of contamination, the sequential degradation of the chlorinated ethylenes, the favorability of the reducing conditions for reductive dechlorination reactions, the recovery of the natural reducing conditions, or compare the concentrations of the chemicals of concern with the cleanup levels.

Ecology recommends that KCSWD provide an annual monitored natural attenuation report using the same analytical data collected for post-closure care. The purpose of the monitored natural attenuation report is to:

- Summarize or report the natural background concentrations of total arsenic, total iron, and total manganese, and summarize the recommended cleanup levels of the chemicals of concern.
- Identify the extent of contamination and the groundwater potentiometric gradients, as reported in the post-closure care annual report.
- Compare the concentrations of the chemicals of concern with the groundwater cleanup levels and surface water cleanup levels for wells and seeps within the extent of contamination.
- Evaluate the sequential degradation of chlorinated ethylenes in monitoring wells where trichloroethylene and dichloroethylene isomers are present.
- Evaluate reducing conditions necessary for the anaerobic biodegradation of trichloroethylene and the anaerobic or aerobic reducing conditions necessary for the biodegradation of dichloroethylene isomers and vinyl chloride.
- Evaluate the enhanced reducing conditions and recovery of natural reducing conditions based on the concentrations of dissolved oxygen, nitrate, total and dissolved manganese, sulfate, total and dissolved iron, and the oxidation-reduction potential.
- Provide trend lines of the concentrations of the chemicals of concern for wells and seeps within the contamination area and compare these with the cleanup levels.

- Identify whether each chemical of concern meets compliance requirements in WAC 173-340-720(9) for the wells within the contamination area.

Ecology requests KCSWD to prepare and submit annual monitored natural attenuation reports to Ecology and Public Health. The annual monitored natural attenuation report may be submitted as an appendix to the Annual Groundwater Data Evaluation Report required under WAC 173-351. We recognize that KCSWD might utilize different personnel for the reports and may request that the monitored natural attenuation report lag the post-closure care annual report.

Summary

In summary, Ecology recommends that KCSWD:

- Calculate the natural background concentrations of total arsenic, total iron, and total manganese for Vashon Island Landfill. KCSWD should coordinate with Ecology and Public Health to discuss wells proposed in this letter for background groundwater monitoring and data sets. The background evaluation should be completed by the end of 2024.
- Submit a technical memorandum with the preliminary cleanup levels by the end of 2024. KCSWD should follow the guidelines in this opinion letter, adjust the cleanup levels of total arsenic, total iron, and total manganese based on their natural background concentration, and adjust the cleanup levels of the remaining carcinogens to their PQLs.
- Submit annual monitored natural attenuation reports beginning in 2025 using the groundwater analytical data required by the landfill post-closure care and maintenance permit.

Please contact Tim O'Connor, at 425-389-2695 or tim.oconnor@ecy.wa.gov or Alan Noell, at 425-213-4803 or alan.noell@ecy.wa.gov with questions.

Sincerely,



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