



Department of Natural Resources and Parks Wastewater Treatment Division

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West Point Treatment Plant Restoration Near-Field Effluent Mixing Water Quality Analysis

The following analysis addresses the effects of the West Point wastewater treatment effluent discharge of contaminants to concentrations in the near-field zone of initial mixing at the West Point outfall located in Puget Sound approximately 3,600 feet offshore at a depth of 240 feet below mean lower low water. The outfall pipe terminates in a diffuser section 600 feet long that releases effluent from 200 individual ports. Initial mixing of effluent with seawater occurs as a result of the pressurized discharge from the diffuser ports with substantial velocity and turbulence, buoyant rising of effluent upward through the water column due to the generally lower density and higher temperature of effluent compared to surrounding seawater, and transport away from the diffuser with tidal flow.

Modeling of the effluent discharge from the West Point outfall to determine the size of the initial zone of mixing was conducted by King County in 2013 using Ecology-specified procedures for renewal of the West Point NPDES permit. For protection of aquatic life from harm due to chronic contaminant exposure (i.e., long-term), the modeling is based on typical tidal flow and effluent discharge rates resulting in effluent dispersion throughout a volume of water with approximate dimensions of 1,460 feet along the axis of the diffuser pipeline, 860 feet in a north-south direction of tidal flow, and the full 240 feet depth of water. Mixing under the chronic flow conditions results in a 188:1 dilution ratio of seawater to effluent. For protection of aquatic life from harm due to acute contaminant exposure (short-term), the modeling of peak daily effluent discharge into minimal tidal flow conditions results in a smaller mixing volume that is 686 feet long, 86 feet wide, and the full 240 feet deep. Mixing under the acute flow conditions results in a 28:1 dilution ratio of seawater to effluent.

This near-field mixing water quality analysis provides estimates of contaminant concentrations in the mixture of effluent and background Puget Sound water upon mixing at the West Point acute and chronic dilution ratios, which is an estimated concentration at the edge of the zone of initial mixing. Previous updates of this analysis were conducted for potential worse-case effluent concentrations during the period when West Point repairs were underway. This update is conducted with the two most recent effluent samples collected (i.e., May 10th and May 22nd) that represent West Point operational conditions since repairs were completed to a level that is anticipated to ensure that all effluent limitations in the NPDES permit can be met. As with previous updates, the analysis uses historical 90th percentile background Puget Sound water concentration for the mixing analysis and compares predicted receiving water concentrations to Ecology's mixing analysis results presented in the West Point NPDES permit adopted in December 2014.

The analysis is conducted for those constituents historically detected in West Point effluent for which Washington has adopted marine water quality criteria for protection of aquatic life, consisting of the majority of the trace metals, cyanide, ammonia, and chlorine. The damage to West Point facilities (and effluent quality) was a temporary and short-term incident, and the duration of wastewater discharge with reduced quality was approximately three months. Therefore, this analysis does not consider the

effects of the reduced level of treatment at West Point on changes in water quality concentrations for constituents that are regulated for human health protection because human health criteria are established for lifetime (70 year) exposure assumptions. The analysis method, and all other variables used in the spreadsheet calculations, are consistent with Ecology protocols used for development of West Point's current NPDES permit.

Table 1 below shows the predicted receiving water concentrations for each constituent based on the effluent samples collected since May 10th in comparison to the equivalent concentrations developed for the NPDES permit renewal (see **Table 2**). Table 1 also shows the percentage change in predicted concentrations for the current level of treatment compared to the NPDES permit values, and evaluation of whether the receiving water concentrations are above the aquatic life criteria. The near-field mixing water quality analysis indicates:

- The undiluted (i.e., "end of pipe") maximum concentrations for arsenic, cadmium, chromium, nickel, and selenium measured in the West Point effluent are lower than the respective aquatic life water quality criteria, indicating that the discharge of effluent has no potential to harm aquatic life in Puget Sound.
- Concentrations in the initial zone of mixing for most of the contaminants are predicted to be higher than historical values, despite repairs being completed to West Point and the effluent being able to consistently meet effluent limitations in the NPDES permit. However, because there are only two effluent samples collected since May 10th, the predicted higher receiving water concentrations are mainly an artifact of the mixing analysis equations that attribute a greater level of uncertainty to the predicted maximum and average effluent concentration when there are only a few available sample values. Concentrations currently are predicted to range up to about 93% higher than historical conditions (i.e., for cyanide).
- The analysis indicates that the concentrations of all constituents that may exceed water quality criteria in the undiluted effluent are anticipated to all be lower than the applicable acute and chronic water quality criteria in the initial zone of mixing.

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Table 1. Analysis of Contaminant Concentrations in Initial Zone of Mixing and Comparison to Historical Conditions.

Constituent	Aquatic Life Criteria		Analysis of Constituent Concentrations in Initial Zone of Mixing									
			Current Conditions (worst-case historical or measured)				Historical (NPDES Permit)		% Difference (current compared to historical)		Criteria Exceeded at Edge of Mixing Zone	
	Acute Criteria (ug/L)	Chronic Criteria (ug/L)	95% Effluent Conc. (ug/L)	Ambient Puget Sound Conc. (ug/L)	Acute Conc. (ug/L)	Chronic Conc. (ug/L)	Acute Conc. (ug/L)	Chronic Conc. (ug/L)	Acute (%)	Chronic (%)	Acute	Chronic
Ammonia	8923	1340	13900	85	1365	276	1189	249	13%	10%	<u>N</u>	<u>N</u>
Arsenic	69	36	1.7	1.4	1.6	1.4	1.5	1.4	4%	1%	<u>N</u>	<u>N</u>
Cadmium	42	9.3	0.28	0.07	0.11	0.08	0.08	0.07	30%	6%	<u>N</u>	<u>N</u>
Chromium	1100	50	1.8	0.14	0.38	0.17	0.20	0.15	47%	15%	<u>N</u>	<u>N</u>
Copper	4.8	3.1	28.6	0.5	3.7	0.96	1.2	0.6	69%	39%	<u>N</u>	<u>N</u>
Lead	210	8.1	3.1	0.01	0.40	0.06	0.13	0.02	68%	63%	<u>N</u>	<u>N</u>
Mercury	1.8	0.025	0.0154	0.0002	0.0020	0.0005	0.0007	0.0003	66%	45%	<u>N</u>	<u>N</u>
Nickel	74	8.2	5.999	0.43	1.2	0.5	0.63	0.46	48%	16%	<u>N</u>	<u>N</u>
Selenium	290	71	0.78	0	0.10	0.02	0.03	0.01	68%	68%	<u>N</u>	<u>N</u>
Silver	1.9	n/a	0.18	0.03	0.05	0.03	0.03	0.03	29%	8%	<u>N</u>	<u>n/a</u>
Zinc	90	81	66.2	1.0	9.4	2.2	2.7	1.2	71%	47%	<u>N</u>	<u>N</u>
Cyanide	9.1	2.8	2	0	0.07	0.01	0.02	0.00	93%	93%	<u>N</u>	<u>N</u>
Chlorine	13	7.5	220	0	7.9	1.2	10.6	1.6	-35%	-37%	<u>N</u>	<u>N</u>

Note: color shaded columns show the results for the acute (blue) and chronic (green) conditions.

