

Appendix 7-5 Detailed Cumulative Risk Impact Assessment Results for Aquatic Life

Table 1 Cumulative Ecological Risk to Aquatic Life at edge of Mixing Zone due to Chlorination By-products and other Pollutants (Scenario 1)

Pollutants	Conc. in Effluent (mg/L)	Conc. in Seawater (mg/L)	Conc. at edge of Mixing Zone – Daily Max. (mg/L)	Conc. at edge of Mixing Zone – Annual Avg. (mg/L)	Conc. at edge of Mixing Zone – 4-day Avg. (mg/L)	Conc. at edge of Mixing Zone – Lowest Seasonal Avg. (mg/L)	Conc. at edge of Mixing Zone – 10%tile dilution factor (mg/L)	Toxicity Reference Value (mg/L)	Hazard Quotient (due to Effluent)	Hazard Quotient (due to Background)
Chlorination By-products (COCs)									2.80E-01	0
Aluminum	0.0159	0.0156	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.5	1.04E-02	1.04E-02
Antimony	0.000721	0.000258	2.65E-04	2.61E-04	2.60E-04	2.61E-04	2.62E-04	4.3	6.06E-05	6.00E-05
Barium	0.0232	0.00665	6.92E-03	6.74E-03	6.73E-03	6.75E-03	6.79E-03	5	1.35E-03	1.33E-03
Chromium III	0.00958	0.00028	4.30E-04	3.31E-04	3.27E-04	3.35E-04	3.61E-04	0.0274	1.21E-02	1.02E-02
Copper	0.00859	0.00002	1.58E-04	6.71E-05	6.35E-05	7.04E-05	9.45E-05	0.005	1.89E-02	4.00E-03
Lead	0.000128	0.000055	5.62E-05	5.54E-05	5.54E-05	5.54E-05	5.56E-05	0.0081	6.84E-03	6.79E-03
Nickel	0.0262	0.00077	1.18E-03	9.10E-04	8.99E-04	9.20E-04	9.91E-04	0.005	1.98E-01	1.54E-01
Selenium	0.00031	0.00007	7.39E-05	7.13E-05	7.12E-05	7.14E-05	7.21E-05	0.071	1.00E-03	9.86E-04
Silver	0.000182	0.000006	8.84E-06	6.97E-06	6.89E-06	7.04E-06	7.53E-06	0.0014	4.98E-03	4.29E-03
Tin	0.000844	0.00014	1.51E-04	1.44E-04	1.44E-04	1.44E-04	1.46E-04	0.0816	1.77E-03	1.72E-03
Vanadium	0.0295	0.00173	2.18E-03	1.88E-03	1.87E-03	1.89E-03	1.97E-03	0.1	1.88E-02	1.73E-02
Zinc	0.0141	0.00237	2.56E-03	2.43E-03	2.43E-03	2.44E-03	2.47E-03	0.02	1.24E-01	1.19E-01
Ammonia	22	0.23	5.81E-01	3.50E-01	3.41E-01	3.58E-01	4.19E-01	0.91	3.84E-01	2.53E-01
Sulphide	4.9	0.048	1.26E-01	7.47E-02	7.26E-02	7.65E-02	9.02E-02	0.1	7.65E-01	4.80E-01
TCDD	1E-10	3.9E-11	4.00E-11	3.93E-11	3.93E-11	3.94E-11	3.95E-11	3.8E-08	1.04E-03	1.03E-03
Toluene	0.012	0	1.94E-04	6.59E-05	6.09E-05	7.06E-05	1.04E-04	0.04	1.65E-03	0.00E+00
Diazinon	0.000048	0	7.74E-07	2.64E-07	2.44E-07	2.82E-07	4.17E-07	0.00001	2.64E-02	0.00E+00
Malathion	0.000031	0	5.00E-07	1.70E-07	1.57E-07	1.82E-07	2.70E-07	0.00002	8.52E-03	0.00E+00
								Hazard Index	1.87E+00	1.06E+00

Concentration adopted for Hazard Quotient calculation

Table 2 Cumulative Ecological Risk to Aquatic Life at edge of Mixing Zone due to Contaminants of Concern (Scenario 2)

Pollutants	Conc. in Effluent (mg/L)	Conc. in Seawater (mg/L)	Conc. at edge of Mixing Zone – Daily Max. (mg/L)	Conc. at edge of Mixing Zone – Annual Avg. (mg/L)	Conc. at edge of Mixing Zone – 4-day Avg. (mg/L)	Conc. at edge of Mixing Zone – Lowest Seasonal Avg. (mg/L)	Conc. at edge of Mixing Zone – 10%tile dilution factor (mg/L)	Toxicity Reference Value (mg/L)	Hazard Quotient (due to Effluent)	Hazard Quotient (due to Background)
Chlorination By-products (COCs)									2.93E-01	0
Aluminum	0.0159	0.0156	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.5	1.04E-02	1.04E-02
Antimony	0.000721	0.000258	2.66E-04	2.61E-04	2.60E-04	2.61E-04	2.62E-04	4.3	6.06E-05	6.00E-05
Barium	0.0232	0.00665	6.93E-03	6.75E-03	6.74E-03	6.75E-03	6.80E-03	5	1.35E-03	1.33E-03
Chromium III	0.00958	0.00028	4.35E-04	3.34E-04	3.29E-04	3.37E-04	3.65E-04	0.0274	1.22E-02	1.02E-02
Copper	0.00859	0.00002	1.63E-04	6.95E-05	6.56E-05	7.29E-05	9.79E-05	0.005	1.96E-02	4.00E-03
Lead	0.000128	0.000055	5.62E-05	5.54E-05	5.54E-05	5.55E-05	5.57E-05	0.0081	6.84E-03	6.79E-03
Nickel	0.0262	0.00077	1.19E-03	9.17E-04	9.05E-04	9.27E-04	1.00E-03	0.005	2.00E-01	1.54E-01
Selenium	0.00031	0.00007	7.40E-05	7.14E-05	7.13E-05	7.15E-05	7.22E-05	0.071	1.00E-03	9.86E-04
Silver	0.000182	0.000006	8.93E-06	7.02E-06	6.94E-06	7.09E-06	7.60E-06	0.0014	5.01E-03	4.29E-03
Tin	0.000844	0.00014	1.52E-04	1.44E-04	1.44E-04	1.44E-04	1.46E-04	0.0816	1.77E-03	1.72E-03
Vanadium	0.0295	0.00173	2.19E-03	1.89E-03	1.88E-03	1.90E-03	1.98E-03	0.1	1.89E-02	1.73E-02
Zinc	0.0141	0.00237	2.57E-03	2.44E-03	2.43E-03	2.44E-03	2.48E-03	0.02	1.24E-01	1.19E-01
Ammonia	22	0.23	5.93E-01	3.56E-01	3.46E-01	3.64E-01	4.28E-01	0.91	3.91E-01	2.53E-01
Sulphide	4.9	0.048	1.29E-01	7.60E-02	7.38E-02	7.80E-02	9.21E-02	0.1	7.80E-01	4.80E-01
TCDD	1E-10	3.9E-11	4.00E-11	3.94E-11	3.93E-11	3.94E-11	3.96E-11	3.8E-08	1.04E-03	1.03E-03
Toluene	0.012	0	2.00E-04	6.94E-05	6.38E-05	7.41E-05	1.09E-04	0.04	1.73E-03	0.00E+00
Diazinon	0.000048	0	8.00E-07	2.77E-07	2.55E-07	2.96E-07	4.36E-07	0.00001	2.77E-02	0.00E+00
Malathion	0.000031	0	5.17E-07	1.79E-07	1.65E-07	1.91E-07	2.82E-07	0.00002	8.96E-03	0.00E+00
								Hazard Index	1.90E+00	1.06E+00

Concentration adopted for Hazard Quotient calculation

Table 3 Cumulative Ecological Risk to Aquatic Life at edge of Mixing Zone due to Chlorination By-products and other Pollutants (Scenario 3)

Pollutants	Conc. in Effluent (mg/L)	Conc. in Seawater (mg/L)	Conc. at edge of Mixing Zone – Daily Max. (mg/L)	Conc. at edge of Mixing Zone – Annual Avg. (mg/L)	Conc. at edge of Mixing Zone – 4-day Avg. (mg/L)	Conc. at edge of Mixing Zone – Lowest Seasonal Avg. (mg/L)	Conc. at edge of Mixing Zone – 10%tile dilution factor (mg/L)	Toxicity Reference Value (mg/L)	Hazard Quotient (due to Effluent)	Hazard Quotient (due to Background)
Chlorination By-products (COCs)									3.95E-01	0
Aluminum	0.0159	0.0156	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.5	1.04E-02	1.04E-02
Antimony	0.000721	0.000258	2.67E-04	2.62E-04	2.62E-04	2.62E-04	2.64E-04	4.3	6.09E-05	6.00E-05
Barium	0.0232	0.00665	6.98E-03	6.79E-03	6.78E-03	6.80E-03	6.87E-03	5	1.36E-03	1.33E-03
Chromium III	0.00958	0.00028	4.66E-04	3.59E-04	3.52E-04	3.64E-04	4.06E-04	0.0274	1.31E-02	1.02E-02
Copper	0.00859	0.00002	1.91E-04	9.26E-05	8.59E-05	9.72E-05	1.36E-04	0.005	2.72E-02	4.00E-03
Lead	0.000128	0.000055	5.65E-05	5.56E-05	5.56E-05	5.57E-05	5.60E-05	0.0081	6.86E-03	6.79E-03
Nickel	0.0262	0.00077	1.28E-03	9.86E-04	9.66E-04	9.99E-04	1.11E-03	0.005	2.23E-01	1.54E-01
Selenium	0.00031	0.00007	7.48E-05	7.20E-05	7.18E-05	7.22E-05	7.32E-05	0.071	1.01E-03	9.86E-04
Silver	0.000182	0.000006	9.52E-06	7.49E-06	7.35E-06	7.59E-06	8.38E-06	0.0014	5.35E-03	4.29E-03
Tin	0.000844	0.00014	1.54E-04	1.46E-04	1.45E-04	1.46E-04	1.50E-04	0.0816	1.79E-03	1.72E-03
Vanadium	0.0295	0.00173	2.29E-03	1.97E-03	1.94E-03	1.98E-03	2.11E-03	0.1	1.97E-02	1.73E-02
Zinc	0.0141	0.00237	2.60E-03	2.47E-03	2.46E-03	2.48E-03	2.53E-03	0.02	1.26E-01	1.19E-01
Ammonia	22	0.23	6.65E-01	4.14E-01	3.97E-01	4.26E-01	5.24E-01	0.91	4.55E-01	2.53E-01
Sulphide	4.9	0.048	1.45E-01	8.91E-02	8.53E-02	9.17E-02	1.14E-01	0.1	9.17E-01	4.80E-01
TCDD	1E-10	3.9E-11	4.02E-11	3.95E-11	3.95E-11	3.95E-11	3.98E-11	3.8E-08	1.04E-03	1.03E-03
Toluene	0.012	0	2.40E-04	1.02E-04	9.23E-05	1.08E-04	1.62E-04	0.04	2.54E-03	0.00E+00
Diazinon	0.000048	0	9.60E-07	4.07E-07	3.69E-07	4.32E-07	6.49E-07	0.00001	4.07E-02	0.00E+00
Malathion	0.000031	0	6.20E-07	2.63E-07	2.38E-07	2.79E-07	4.19E-07	0.00002	1.31E-02	0.00E+00
								Hazard Index	2.26E+00	1.06E+00

Concentration adopted for Hazard Quotient calculation

Table 4 Cumulative Ecological Risk to Aquatic Life at edge of Mixing Zone due to Chlorination By-products and other Pollutants (Scenario 4)

Pollutants	Conc. in Effluent (mg/L)	Conc. in Seawater (mg/L)	Conc. at edge of Mixing Zone – Daily Max. (mg/L)	Conc. at edge of Mixing Zone – Annual Avg. (mg/L)	Conc. at edge of Mixing Zone – 4-day Avg. (mg/L)	Conc. at edge of Mixing Zone – Lowest Seasonal Avg. (mg/L)	Conc. at edge of Mixing Zone – 10%tile dilution factor (mg/L)	Toxicity Reference Value (mg/L)	Hazard Quotient (due to Effluent)	Hazard Quotient (due to Background)
Chlorination By-products (COCs)									4.52E-01	0.00E+00
Aluminum	0.0159	0.0156	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.56E-02	1.5	1.04E-02	1.04E-02
Antimony	0.000721	0.000258	2.69E-04	2.62E-04	2.62E-04	2.62E-04	2.65E-04	4.3	6.10E-05	6.00E-05
Barium	0.0232	0.00665	7.03E-03	6.81E-03	6.78E-03	6.81E-03	6.91E-03	5	1.36E-03	1.33E-03
Chromium III	0.00958	0.00028	4.96E-04	3.69E-04	3.53E-04	3.69E-04	4.25E-04	0.0274	1.35E-02	1.02E-02
Copper	0.00859	0.00002	2.19E-04	1.02E-04	8.75E-05	1.02E-04	1.54E-04	0.005	3.08E-02	4.00E-03
Lead	0.000128	0.000055	5.67E-05	5.57E-05	5.56E-05	5.57E-05	5.61E-05	0.0081	6.86E-03	6.79E-03
Nickel	0.0262	0.00077	1.36E-03	1.01E-03	9.70E-04	1.01E-03	1.17E-03	0.005	2.33E-01	1.54E-01
Selenium	0.00031	0.00007	7.56E-05	7.23E-05	7.19E-05	7.23E-05	7.38E-05	0.071	1.01E-03	9.86E-04
Silver	0.000182	0.000006	1.01E-05	7.69E-06	7.39E-06	7.69E-06	8.75E-06	0.0014	5.49E-03	4.29E-03
Tin	0.000844	0.00014	1.56E-04	1.47E-04	1.46E-04	1.47E-04	1.51E-04	0.0816	1.80E-03	1.72E-03
Vanadium	0.0295	0.00173	2.38E-03	2.00E-03	1.95E-03	2.00E-03	2.16E-03	0.1	2.00E-02	1.73E-02
Zinc	0.0141	0.00237	2.64E-03	2.48E-03	2.46E-03	2.48E-03	2.55E-03	0.02	1.28E-01	1.19E-01
Ammonia	22	0.23	7.36E-01	4.39E-01	4.01E-01	4.39E-01	5.70E-01	0.91	4.83E-01	2.53E-01
Sulphide	4.9	0.048	1.61E-01	9.47E-02	8.62E-02	9.47E-02	1.24E-01	0.1	9.47E-01	4.80E-01
TCDD	1E-10	3.9E-11	4.04E-11	3.96E-11	3.95E-11	3.96E-11	4.00E-11	3.8E-08	1.04E-03	1.03E-03
Toluene	0.012	0	2.79E-04	1.15E-04	9.45E-05	1.15E-04	1.88E-04	0.04	2.88E-03	0.00E+00
Diazinon	0.000048	0	1.12E-06	4.62E-07	3.78E-07	4.62E-07	7.50E-07	0.00001	4.62E-02	0.00E+00
Malathion	0.000031	0	7.21E-07	2.98E-07	2.44E-07	2.98E-07	4.84E-07	0.00002	1.49E-02	0.00E+00
								Hazard Index	2.40E+00	1.06E+00

Concentration adopted for Hazard Quotient calculation

Table 5 Cumulative Ecological Risk to Aquatic Life at edge of Mixing Zone due to Chlorination By-products and other Pollutants (Scenario 5)

Pollutants	Conc. in Effluent (mg/L)	Conc. in Seawater (mg/L)	Conc. at edge of ZID – Daily Max. (mg/L)	Conc. at edge of ZID – Annual Avg. (mg/L)	Conc. at edge of ZID – 4-day Avg. (mg/L)	Conc. at edge of ZID – Lowest Seasonal Avg. (mg/L)	Conc. at edge of ZID – 10%tile dilution factor (mg/L)	Toxicity Reference Value (mg/L)	Hazard Quotient (due to Effluent)	Hazard Quotient (due to Background)
Chlorination By-products (COCs)									2.83E-01	0
Antimony	0.000782	0.000258	2.70E-04	2.63E-04	2.62E-04	2.63E-04	2.66E-04	4.3	6.12E-05	6.00E-05
Barium	0.0237	0.00665	7.05E-03	6.81E-03	6.78E-03	6.81E-03	6.92E-03	5	1.36E-03	1.33E-03
Chromium III	0.00844	0.00028	4.70E-04	3.58E-04	3.44E-04	3.58E-04	4.08E-04	0.0274	1.31E-02	1.02E-02
Copper	0.00663	0.00002	1.74E-04	8.36E-05	7.20E-05	8.36E-05	1.23E-04	0.005	2.47E-02	4.00E-03
Nickel	0.0223	0.00077	1.27E-03	9.77E-04	9.40E-04	9.77E-04	1.11E-03	0.005	2.21E-01	1.54E-01
Selenium	0.00013	0.00007	7.14E-05	7.06E-05	7.05E-05	7.06E-05	7.09E-05	0.071	9.93E-04	9.86E-04
Silver	0.000099	0.000006	8.16E-06	6.89E-06	6.73E-06	6.89E-06	7.45E-06	0.0014	4.92E-03	4.29E-03
Tin	0.000457	0.00014	1.47E-04	1.43E-04	1.42E-04	1.43E-04	1.45E-04	0.0816	1.75E-03	1.72E-03
Vanadium	0.0313	0.00173	2.42E-03	2.01E-03	1.96E-03	2.01E-03	2.19E-03	0.1	2.01E-02	1.73E-02
Zinc	0.00979	0.00237	2.54E-03	2.44E-03	2.43E-03	2.44E-03	2.49E-03	0.02	1.24E-01	1.19E-01
Ammonia	4.2	0.23	3.22E-01	2.68E-01	2.61E-01	2.68E-01	2.92E-01	0.91	2.95E-01	2.53E-01
Sulphide	0.053	0.048	4.81E-02	4.80E-02	4.80E-02	4.80E-02	4.81E-02	0.1	4.80E-01	4.80E-01
TCDD	6.2E-11	3.9E-11	3.95E-11	3.92E-11	3.92E-11	3.92E-11	3.94E-11	3.8E-08	1.03E-03	1.03E-03
Diazinon	0.000058	0	1.35E-06	5.58E-07	4.57E-07	5.58E-07	9.06E-07	0.00001	5.58E-02	0.00E+00
Malathion	0.000015	0	3.49E-07	1.44E-07	1.18E-07	1.44E-07	2.34E-07	0.00002	7.21E-03	0.00E+00
								Hazard Index	1.53E+00	1.06E+00

Concentration adopted for Hazard Quotient calculation