STEADY STATE ANALYSIS

ERM conducted a literature review to support selection of an accepted statistical method for evaluating temporal trends of chemical concentrations in groundwater systems. Based on this literature review, ERM selected the Mann-Kendall analysis as the most appropriate to evaluate temporal trends in Site chlorinated volatile organic compound (CVOC) groundwater concentration data. The following data plots were generated and interpreted to evaluate temporal data trends:

• a molar trend plot and Mann-Kendall analysis (acceptable 80% confidence level) for MW-268M; and

• a total-plume-mass molar trend plot and Mann-Kendall analysis (acceptable 80% confidence level) using plume-centerline wells.

A time-series evaluation of CVOC concentrations was performed for the most downgradient plume-centerline monitoring well (MW-268M). The molar concentrations of CVOCs were summed for each monitoring event, and then plotted over time (i.e., each subsequent sampling event). The molar trend chart is attached. A Mann-Kendall analysis (attached) confirmed the visual decline in CVOC concentrations to an acceptable 80 percent confidence level. This analysis indicates that total CVOC concentrations at this key location are decreasing over time.
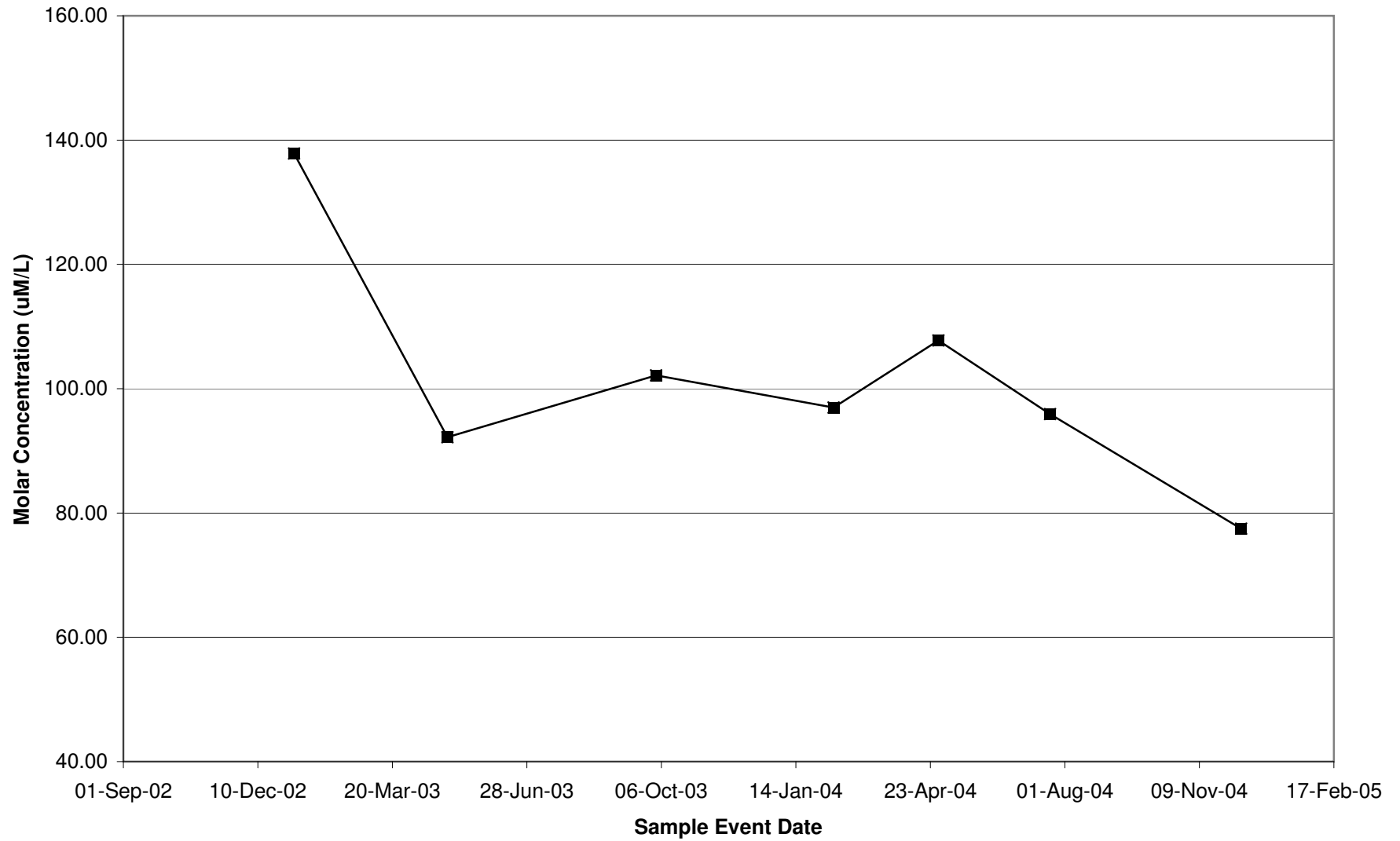
A similar analysis was performed to evaluate changes in total molar CVOC concentrations for wells located along the plume centerline. Plume centerline monitoring wells that were sampled during every Northern Area sampling event were selected for this analysis. The molar concentrations from this subset of wells was summed for each monitoring event, and then plotted over time. The total molar trend chart is attached. A Mann-Kendall analysis (attached) confirmed the visual decline in CVOC concentrations to an acceptable 80 percent confidence level. This analysis indicates that total CVOC concentrations along the plume centerline are decreasing over time.

CVOC concentrations are decreasing along the plume center line, including the most downgradient well, over time. Application of the statistically proven Mann-Kendall analysis indicates that the plume is attenuating.

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Summed CVOC Molar Concentration Trend at MW-268M

Notice: This form is the DNR supplied spreadsheet referenced in Appendices A of Comm 46 and NR 746, Wis. Adm. Code. It is provided to consultants as an optional tool for groundwater contaminant trend analysis to support site closure requests under s. Comm 46.07, Comm 46.08, NR 746.07, NR 746.08, Wis. Adm. Code. Use this form or a manual method when seeking case closure under those rules. Earlier versions of this form should not be used.

Instructions: Do not change formulas or other information in cells with a blue background, only cells with a yellow background are used for data entry. To use the spreadsheet, provide at least four rounds and not more than ten rounds of data that is not seasonally affected. Use consistent units. The spreadsheet contains several error checks, and a data entry error may cause "DATA ERR" or "DATE ERR" to be displayed. Dates that are not consecutive will show an error message and will not display the test results. The spreadsheet tests the data for both increasing and decreasing trends at both 80 percent and 90 percent confidence levels. If a declining trend is present at 80 percent but not at 90 percent, a site is still eligible for closure under Comm 46 and NR 746 provided that other conditions in those rules are met. If an increasing or decreasing trend is not present, an additional coefficient of variation test is used to test for stability, as proposed by Wiedemeier et al, 1999. For additional information, refer to the Interim Guidance on Natural Attenuation for Petroleum Releases, dated October 1999. Refer to the guidance for recommendations on data entry for non-detect values.

| Site Name = Former Raytheon Facility | | BRRTS No. = | | Well Number = MW-268M | |

| Event Number	Sampling Date (most recent last)	Molar CVOC Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	6-Jan-03	137.86					
2	30-Apr-03	92.22					
3	2-Oct-03	102.12					
4	11-Feb-04	96.97					
5	29-Apr-04	107.77					
6	21-Jul-04	95.93					
7	10-Dec-04	77.49					
8							
9							
10							
	Mann Kendall Statistic (S) =	-9.0	0.0	0.0	0.0	0.0	0.0
	Number of Rounds (n) =	7	0	0	0	0	0
	Average =	101.48	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Standard Deviation =	18.602	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Coefficient of Variation(CV)=	0.183	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Error Check, Blank if No Errors Detected			n<4	n<4	n<4	n<4	n<4
Trend ≥ 80% Confidence Level		**DECREASING**	n<4	n<4	n<4	n<4	n<4
Trend ≥ 90% Confidence Level		No Trend	n<4	n<4	n<4	n<4	n<4
Stability Test, If No Trend Exists at 80% Confidence Level		NA	n<4 n<4	n<4 n<4	n<4 n<4	n<4 n<4	n<4 n<4
Data Entry By = JDF			Date = 28-Sep-05	Checked By =			

Total CVOC Plume Molar Concentration Trend
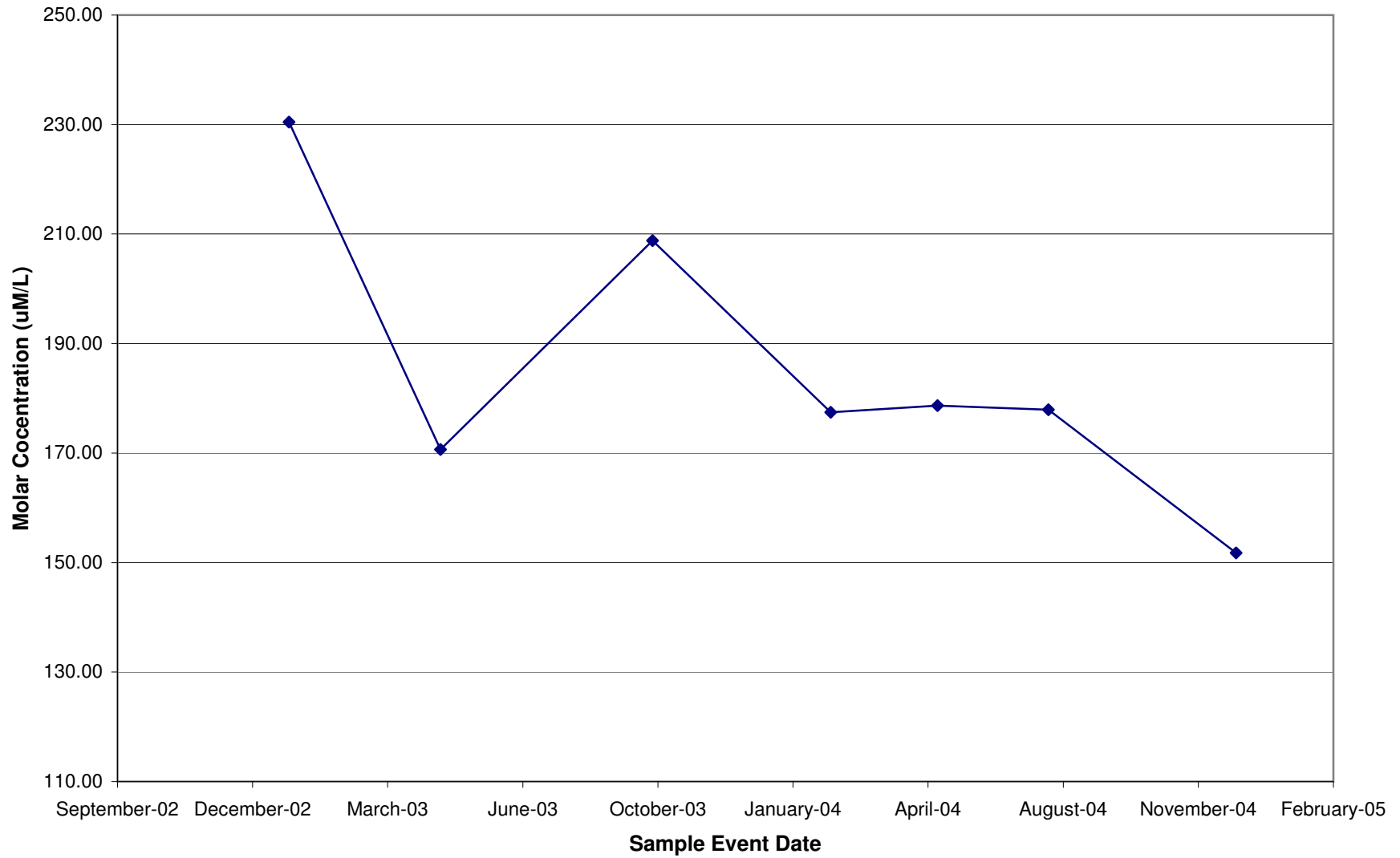
State of Wisconsin
Department of Natural Resources
Remediation and Redevelopment Program

Mann-Kendall Statistical Test
Form 4400-215 (2/2001)

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Site Name = Northern Area Plume of Former Raytheon Facility   BRRTS No. =   Well Number = Molar Sum

Event Number	Sampling Date (most recent last)	Molar CVOC Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)	Concentration (leave blank if no data)
1	6-Jan-03	230.46					
2	28-Apr-03	170.67					
3	2-Oct-03	208.80					
4	11-Feb-04	177.45					
5	30-Apr-04	178.66					
6	21-Jul-04	177.92					
7	7-Dec-04	151.74					
8							
9							
10							
	Mann Kendall Statistic (S) =	-9.0	0.0	0.0	0.0	0.0	0.0
	Number of Rounds (n) =	7	0	0	0	0	0
	Average =	185.10	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Standard Deviation =	26.113	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
	Coefficient of Variation(CV)=	0.141	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

Error Check, Blank if No Errors Detected			n<4	n<4	n<4	n<4	n<4
Trend ≥ 80% Confidence Level		DECREASING	n<4	n<4	n<4	n<4	n<4
Trend ≥ 90% Confidence Level		No Trend	n<4	n<4	n<4	n<4	n<4
Stability Test, If No Trend Exists at			n<4	n<4	n<4	n<4	n<4
80% Confidence Level		NA	n<4	n<4	n<4	n<4	n<4

Data Entry By = JDF   Date = 28-Sep-05   Checked By =