

Wisconsin Department of Natural Resources
Bureau for Remediation & Redevelopment (RR/3)
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Madison, WI 53707-7921



FAX COVER SHEET

OUR FAX NUMBER IS 608/267-7646

DATE:	7/28/99
TO:	GILBERTO ALVAREZ
AGENCY/COMPANY:	EPA Reg. 5
FAX NUMBER:	312/353-3159
SUBJECT:	REANALYSIS OF DATA IN NA STUDY
COMMENTS:	<p>① Summary Table with the original R^2 (darkened) and re-calculated R^2. The contaminant levels were also correlated with groundwater elevation.</p> <p>② Example plot of re-analysis for Broadview IL MW-5. See my original e-mail for further explanation.</p> <p>③ I'll mail (snail-mail) the hard copy.</p>
FROM:	RESTY PELAYO
PHONE NUMBER:	608/267-3539
NUMBER OF PAGES INCLUDING COVER SHEET:	3

Reanalysis of AMOCO Data Originally Summarized in Table 3 in *Natural Attenuation Study in Wisconsin and Illinois*

Hydraulic Conductivity (cm/s)	Highest Benzene Concentration (µg/l)	Data Source	Log [Concentration] vs Time	Log [Concentration] vs Time	Log [Concentration] vs Groundwater Elevation	GW Elev. Explains Data Better?
			Original R ² (%)*	Recalculated R ² (%)*	R ² (%)**	
3 x 10 ⁻³	16 300	MW-3 in Concord WI MW-4 in Concord WI		78 50	8 3	No No
8 x 10 ⁻⁵	8600 220 34	GMOV-1S in Hales Corners WI GMOV-3S in Hales Corners WI OW-6 in Hales Corners WI		30 24 27	31 36 29	Yes Yes Yes
5 x 10 ⁻⁴	2000 1000 110	MW-2 in Chicago IL MW-3 in Chicago IL RW-3 in Chicago IL		44 51 17	Insufficient Data Insufficient Data Insufficient Data	
5 x 10 ⁻⁵	120 230 55	MW-3 in Broadview IL MW-5 in Broadview IL MW-10 in Broadview IL		38 7 13	36 18 30	No Yes Yes
1 x 10 ⁻⁶	210 98	MW-14 in Highland Park IL MW-15 in Highland Park IL		5 45	4 3	No No

* This R² measures how much variability in the concentration data can be explained with the passing of time (i.e., by natural attenuation). The data analyzed in the original study are missing the most recent monitoring well data in the appendices and several of the data were probably erroneously entered.

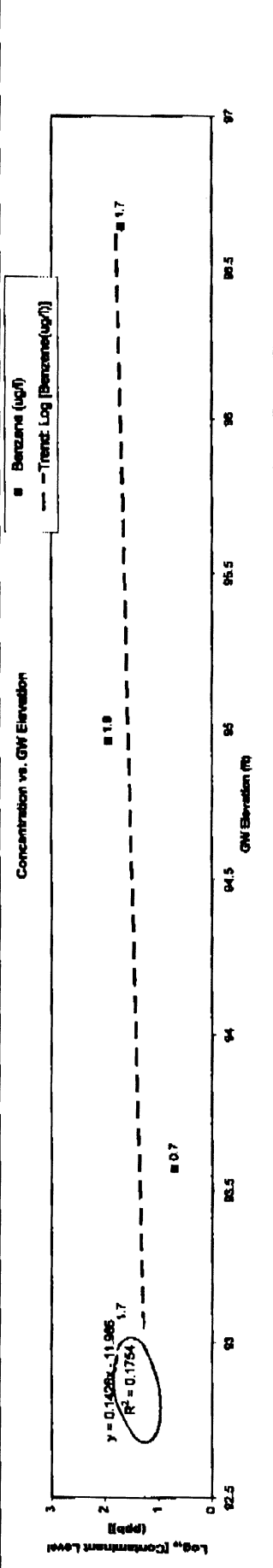
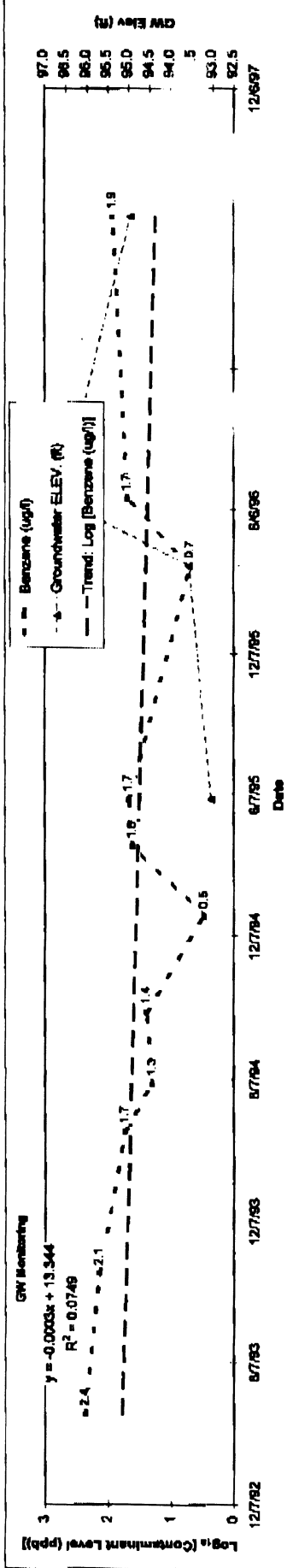
** This R² measures how much variability in the contaminant levels can be explained by mere fluctuations in groundwater elevations.

A program by Risty Palyco, 2003, Missouri Department of Natural Resources, 604/267-3639
(date of monitoring data)

Groundwater monitoring data (unit)

MVA-5

Groundwater ELEV. (ft)	Sampling Date	Benzene (ug/l)	Log ₁₀ [Benzene] (ug/l)	Max	Min
47.83	10/7/83	47.84	1.68	50.0	44.84
230.0	142.0	54.0	1.7	50.0	62.096
2.4	2.1	1.7	1.4	1.7	1.9
					62.297



C:\ITEMP\Tables\99\Table 3 Summary

From: "Pelayo, Aristeo" <PelayA@mail01.dnr.state.wi.us>
To: "'alvarez.gilberto@epamail.epa.gov'" <alvarez.gilb...>
Date: 7/20/99 12:41pm
Subject: NA Study in Wisconsin and Illinois

Dear Gilberto,

Thank you for sending me a copy of the AMOCO study. It provided me a good set of data on several clay sites which, you may know, we are currently re-evaluating in Wisconsin.

I assume that the best data (from 60+ monitoring wells at 8 sites in the study) providing validation of natural attenuation for benzene in clay sites are summarized in Table 3 of the report.

I tried to reproduce Table 3. In so doing, I think I found several discrepancies between what were used (in plots) to determine benzene half-life estimates in Table 3, and the raw data in the appendix tables:

1.) For all the monitoring wells in Table 3, the data analyzed in the study to show a temporal fit to the data did not include the most recent data included in the appendix tables. For instance, MW-14 in Highland Park IL did not include the 6/19/97 observed 320 ppb (p. 93) of benzene (the highest concentration observed from this MW).

2.) I think that several data were erroneously entered. For instance, the plot for MW-14 in Highland Park IL showed a concentration of 20 ppb (p. 137) while the 7/2/96 data in the appendix table showed 200 ppb (p. 93). Or the plot for RW-3 in Chicago IL showed a concentration of 1.7 ppb (p. 136) while the 12/95 data in the appendix table for RW-13 showed 170 ppb (p. 113).

Reanalysis:

I reanalyzed the raw data provided in the report's Appendix tables. I provide a summary of my reanalysis in the attached Excel file. I not only did a temporal fit to explain the observed variation of concentration with time, but I also did a fit of the concentration as a function of the groundwater elevation. The last column in the attached table showed whether the benzene concentrations can be better fit by the fluctuating groundwater elevations ("Yes") at the monitoring well or by the passage of time ("No").

As example of my reanalysis, let's look at MW-5 in Broadview IL. For this particular well, the original report has a plot in p. 132 showing the data used for the report's Table 3. Note that the "p. 132 plot" did not include the most recent 85 ppb listed in p. 101, and the "p. 132 plot" included 2 extraneous points where the raw data in p. 101 listed the events as NS (not sampled). The attached Excel file includes a sheet showing my reanalysis of data for MW-5 in Broadview IL (from p. 101 of original report). By including the most recent 85 ppb data and not using any NS events, the R-squared fit to the data decreases and for this particular well, the estimated half-life (originally at 250 d in report's Table 3) increases (to 890 d). When the logarithm of the benzene concentrations are plotted as a function of groundwater elevation (in report's p. 98), the limited data (only 4) has a better R-squared compared to the temporal fit even though the

R-squared coefficient (for Log concentration vs GW elevation) is very poor at only 18%.

Results:

Half the MWs with sufficient groundwater elevation data shows that groundwater elevation data can better explain the observed variation in the benzene concentrations than the temporal (i.e., Natural Attenuation) explanation. The MWs showing the best evidence for NA (benzene concentrations decline with time) are from a site with higher hydraulic conductivity ($10e-3$ cm/s) and sites with tighter formations where the highest benzene concentration is less than 2000 ppb.

<<Table3.xls>>

Again, thank you and if you'd like to discuss further or if you can't open the attached Excel file, please call me or send me a note.

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