Temporal Trend Testing Results Notes; J Seymour

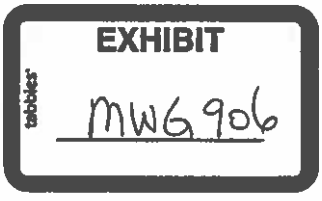
29 February 2016

- Used Groundwater concentration data through 2014 in the statistical analysis.
- based on ordinary least-squares linear regression using Microsoft Excel and included the following steps:
  - For non-detect groundwater monitoring results, one-half of the analytical reporting limit was used as a numerical value of the concentration.
  - Used the Microsoft Excel array function "LINEST" to calculate the slope and the standard error of the slope for each monitoring well's time data series. The linear regression allowed for the calculation of a constant - not used in interpretation of the slope. The slope represents the statistically expected change in concentration over time.
  - Compared the calculated slope to the calculated standard error of the slope. If the standard error was greater in magnitude than the slope - no conclusion about the presence of an increasing or decreasing temporal trend.
  - If the calculated slope was greater than the calculated standard error of the slope- a conclusion about the presence of a temporal trend. Positive slope values signify increasing slopes, and negative slope values indicate decreasing slopes.

RESULTS

At Joliet #29:

- Boron concentrations:
  - Increasing at 18 percent of monitoring wells
  - Decreasing at 55 percent of monitoring wells
  - No conclusion for 27 percent of monitoring wells
- Manganese concentrations:
  - Increasing at 9 percent of monitoring wells
  - Decreasing at 73 percent of monitoring wells
  - No conclusion for 18 percent of monitoring wells
- Sulfate concentrations:
  - Increasing at 9 percent of monitoring wells



        - Decreasing at 45 percent of monitoring wells
        - No conclusion for 45 percent of monitoring wells
- At Powerton:
    - Boron concentrations:
        - Increasing at 6 percent of monitoring wells
        - Decreasing at 31 percent of monitoring wells
        - No conclusion for 63 percent of monitoring wells
    - Manganese concentrations:
        - Increasing at 31 percent of monitoring wells
        - Decreasing at 25 percent of monitoring wells
        - No conclusion for 44 percent of monitoring wells
    - Sulfate concentrations:
        - Increasing at 56 percent of monitoring wells
        - No conclusion for 44 percent of monitoring wells
- At Waukegan:
    - Boron concentrations:
        - Increasing at 22 percent of monitoring wells
        - Decreasing at 22 percent of monitoring wells
        - No conclusion for 56 percent of monitoring wells
    - Manganese concentrations:
        - Increasing at 33 percent of monitoring wells
        - No conclusion for 67 percent of monitoring wells
    - Sulfate concentrations:
        - Increasing at 33 percent of monitoring wells
        - Decreasing at 33 percent of monitoring wells
        - No conclusion for 33 percent of monitoring wells
- At Will County:
    - Boron concentrations:
        - Increasing at 70 percent of monitoring wells
        - Decreasing at 10 percent of monitoring wells
        - No conclusion for 20 percent of monitoring wells
    - Manganese concentrations:

        - Increasing at 40 percent of monitoring wells
        - Decreasing at 30 percent of monitoring wells
        - No conclusion for 30 percent of monitoring wells
    - Sulfate concentrations:
        - Increasing at 20 percent of monitoring wells
        - Decreasing at 50 percent of monitoring wells
        - No conclusion for 30 percent of monitoring wells

constituent concentrations frequently decrease over time at the four sites – compared to Kunkel report.[1]

[1] Kunkel, December 2015, p 10

Table 1

Summary of Joliet No. 29 Groundwater Constituent Temporal Trend Testing Results

Monitoring Well	Boron		Manganese		Sulfate	
	Trend Direction [a]	Slope (mg/L/yr)	Trend Direction [a]	Slope (mg/L/yr)	Trend Direction [a]	Slope (mg/L/yr)
MW-01	Decreasing	-0.024	Increasing	0.0033	Decreasing	-22
MW-02	Decreasing	-0.045	Decreasing	-0.00044	Decreasing	-15
MW-03	Increasing	0.04	Decreasing	-0.013	No conclusion	--
MW-04	No conclusion	--	Decreasing	-0.038	No conclusion	--
MW-05	Increasing	0.041	No conclusion	--	Increasing	33
MW-06	Decreasing	-0.037	Decreasing	-0.017	No conclusion	--
MW-07	Decreasing	-0.052	Decreasing	-0.03	Decreasing	-10
MW-08	No conclusion	--	No conclusion	--	No conclusion	--
MW-09	Decreasing	-0.021	Decreasing	-0.2	No conclusion	--
MW-10	Decreasing	-0.025	Decreasing	-0.01	Decreasing	-13
MW-11	No conclusion	--	Decreasing	-0.0051	Decreasing	-9.6

Abbreviations:

"mg/L/yr" = milligrams per liter per year

"--" = calculated standard error was greater in magnitude than calculated slope

Notes:

(a) Increasing and decreasing trends are based on positive and negative slopes, respectively, calculated by ordinary least-squares linear regression using Microsoft Excel. For calculated slopes that were less in magnitude than the calculated standard error of the slope, no statistically significant conclusion of a temporal trend could be made.

Table 2
Summary of Powerton Groundwater Constituent Temporal Trend Testing Results

Monitoring Well	Boron		Manganese		Sulfate	
	Trend Direction [a]	Slope (mg/L/yr)	Trend Direction [a]	Slope (mg/L/yr)	Trend Direction [a]	Slope (mg/L/yr)
MW-01	No conclusion	--	No conclusion	--	No conclusion	--
MW-02	No conclusion	--	No conclusion	--	Increasing	9.1
MW-03	Decreasing	-0.088	No conclusion	--	Increasing	5.9
MW-04	No conclusion	--	Decreasing	-0.16	Increasing	65
MW-05	Decreasing	-0.1	Decreasing	-0.13	Increasing	25
MW-06	No conclusion	--	Increasing	0.46	Increasing	54
MW-07	No conclusion	--	No conclusion	--	No conclusion	--
MW-08	No conclusion	--	No conclusion	--	Increasing	35
MW-09	No conclusion	--	No conclusion	--	No conclusion	--
MW-10	Increasing	0.44	Decreasing	-0.25	Increasing	19
MW-11	Decreasing	-0.22	Increasing	1.7	No conclusion	--
MW-12	Decreasing	-0.16	Increasing	0.2	Increasing	37
MW-13	No conclusion	--	No conclusion	--	No conclusion	--
MW-14	No conclusion	--	Increasing	0.18	No conclusion	--
MW-15	Decreasing	-0.1	Increasing	0.05	Increasing	70
MW-16	No conclusion	--	Decreasing	-0.006	No conclusion	--

Abbreviations:

"mg/L/yr" = milligrams per liter per year

"--" = calculated standard error was greater in magnitude than calculated slope

Notes:

(a) Increasing and decreasing trends are based on positive and negative slopes, respectively, calculated by ordinary least-squares linear regression using Microsoft Excel. For calculated slopes that were less in magnitude than the calculated standard error of the slope, no statistically significant conclusion of a temporal trend could be made.

Table 3
Summary of Waukegan Groundwater Constituent Temporal Trend Testing Results

Monitoring Well	Boron		Manganese		Sulfate	
	Trend Direction [(a)]	Slope (mg/L/yr)	Trend Direction [(a)]	Slope (mg/L/yr)	Trend Direction [(a)]	Slope (mg/L/yr)
MW-01	No conclusion	--	No conclusion	--	Decreasing	-35
MW-02	Increasing	0.12	Increasing	0.024	Increasing	39
MW-03	Decreasing	-0.1	Increasing	0.00099	Increasing	23
MW-04	Increasing	0.26	No conclusion	--	Increasing	23
MW-05	No conclusion	--	No conclusion	--	Decreasing	-63
MW-06	No conclusion	--	No conclusion	--	No conclusion	--
MW-07	Decreasing	-9.8	Increasing	0.051	Decreasing	-190
MW-08	No conclusion	--	No conclusion	--	No conclusion	--
MW-09	No conclusion	--	No conclusion	--	No conclusion	--

Abbreviations:

"mg/L/yr" = milligrams per liter per year

"--" = calculated standard error was greater in magnitude than calculated slope

Notes:

(a) Increasing and decreasing trends are based on positive and negative slopes, respectively, calculated by ordinary least-squares linear regression using Microsoft Excel. For calculated slopes that were less in magnitude than the calculated standard error of the slope, no statistically significant conclusion of a temporal trend could be made.

Table 4
Summary of Will County Groundwater Constituent Temporal Trend Testing Results

Monitoring Well	Boron		Manganese		Sulfate	
	Trend Direction [(a)]	Slope (mg/L/yr)	Trend Direction [(a)]	Slope (mg/L/yr)	Trend Direction [(a)]	Slope (mg/L/yr)
MW-01	No conclusion	--	Increasing	0.019	Decreasing	-41
MW-02	Increasing	0.31	Increasing	0.0071	No conclusion	--
MW-03	Increasing	0.25	Decreasing	-0.021	Increasing	95
MW-04	Increasing	0.32	No conclusion	--	Decreasing	-260
MW-05	Increasing	0.15	Increasing	0.025	Increasing	100
MW-06	Increasing	0.16	Increasing	0.008	Decreasing	-62
MW-07	Decreasing	-0.27	Decreasing	-0.017	Decreasing	-71
MW-08	Increasing	0.27	No conclusion	--	No conclusion	--
MW-09	No conclusion	--	No conclusion	--	No conclusion	--
MW-10	Increasing	0.17	Decreasing	-0.025	Decreasing	-18

Abbreviations:

"mg/L/yr" = milligrams per liter per year

"--" = calculated standard error was greater in magnitude than calculated slope

Notes:

(a) Increasing and decreasing trends are based on positive and negative slopes, respectively, calculated by ordinary least-squares linear regression using Microsoft Excel. For calculated slopes that were less in magnitude than the calculated standard error of the slope, no statistically significant conclusion of a temporal trend could be made.