

Copper Queen Branch/Freeport-McMoRan Corporation 36 Mass Algawas 92 Bisbee, Arizona 85603

October 1, 2008

Cynthia S. Campbell Manager, Water Quality Compliance Section Arizona Department of Environmental Quality 1110 West Washington Street Phoenix, Arizona 85007

RE: Mitigation Order, Docket No. P-121-07
Results of Monthly Sulfate Monitoring and Trend Analysis

Dear Ms. Campbell:

In accordance with Mitigation Order on Consent, Docket No. P-121-07 Freeport-McMoRan Corporation, Copper Queen Branch (CQB) has conducted five rounds of monthly water quality sampling at six drinking water supply wells that had sulfate concentrations between 135 mg/L (milligrams per liter) and 250 mg/L in their initial samples. The enclosed letter from Hydro Geo Chem, Inc. evaluates the results of the water quality sampling and provides recommendations for ongoing monitoring based on the results of the monthly sampling. CQB plans to implement the proposed monitoring schedules in November 2008 unless we hear otherwise from Arizona Department of Environmental Quality by October 27, 2008. The monitoring recommendations for drinking water supplies will be re-evaluated for development of the Mitigation Plan.

If you have any questions or require anything additional please contact me at 520-432-6206.

Sincerely,

Rebecca A. Sawyer

Senior Environmental Engineer

Copper Queen Branch

Enclosure



September 29, 2008

Rebecca A. Sawyer Senior Environmental Engineer Freeport-McMoRan Corporation Copper Queen Branch 36 West Highway 92 Bisbee, Arizona 85603

RE: Mitigation Order, Docket No. P-121-07

Results of Monthly Sulfate Monitoring and Trend Analysis

Dear Ms. Sawyer:

This letter describes and evaluates the results of monthly water sampling and analysis of sulfate in six drinking water supply wells conducted pursuant to Section 4 of the Work Plan<sup>1</sup>. As outlined in Section 4 of the Work Plan "a water supply having a discrete sulfate concentration between 135 milligrams per liter (mg/l) and 250 mg/l will be monitored monthly for four months to determine whether concentrations are increasing and to identify any trend in sulfate concentration over time. Based on the apparent trend in sulfate concentrations, a monitoring schedule will be developed for the supply. If the trend indicates increasing concentrations, an interim action will be selected and an implementation plan will be developed."

In February 2008 water quality sampling for the well inventory<sup>2</sup> identified six wells (BIMA, BLOMMER, FULTZ, RAY, ROGERS 803, and SCHWARTZ) verified as drinking water supply wells that had a discrete sulfate concentration between 135 mg/l and 250 mg/l. These six wells were sampled for sulfate monthly from April to August 2008. The following table provides the results of the sampling. Analytical reports for February through June 2008 are included as Appendix D in the First and Second Quarters Groundwater Report<sup>3</sup>. Analytical reports for the July and August 2008 sampling will be included in the third quarter monitoring report.

DATE	BIMA	BLOMMER	FULTZ	RAY	ROGERS 803	SCHWARTZ
Feb-08	210	206	152	159	138	158
Apr-08	190	201	137	125	128	122
May-08	195	211	131	123	141	130
Jun-08	225	193	111	130	129	129
Jui-08	204	203	152	120	134	245
Aug-08	256	189	137	129	128	131

Results presented as sulfate in mg/l

<sup>&</sup>lt;sup>3</sup> HGC, 2008. First and Second Quarters 2008 Groundwater Monitoring Report, Task 2.2 of Aquifer Characterization Plan Mitigation Order on Consent No. P-121-07, Cochise County, Arizona. July 30, 2008.



Hydro Geo Chem, Inc. (HGC) 2008. Revision 1, Work Plan to Characterize and Mitigate Sulfate with Respect to Drinking Water Supplies in the Vicinity of the Concentrator Tailing Storage Area, Cochise County, Arizona. July 3, 2008.

<sup>&</sup>lt;sup>2</sup> HGC, 2008. Well Inventory Report, Task 1 of Aquifer Characterization Plan for Mitigation Order on Consent No. P-121-07, Cochise County, Arizona. July 3, 2008.

#### Mann-Kendail Analysis

A Mann-Kendall statistical trend analysis was conducted to determine if concentrations of sulfate are increasing or decreasing over time in samples collected from the six drinking water supply wells. The Mann-Kendall test is a non-parametric test for identifying trends in time series data. The test compares the relative magnitudes of sample data rather than the data values themselves. One particular benefit of this test is that the data need not conform to any particular distribution. Moreover, the test can be used with a minimum of four rounds of sampling results. An Excel based macro<sup>4</sup> was used to process the input time series data, perform the trend analysis, and report the results (Attachment).

#### Mann-Kendall Trend Results

Based on guidance in Gilbert<sup>5</sup>, a trend was considered significant if the "confidence in trend" metric, (1-p) x 100%, was  $\geq$  80% which represents a significance level of  $\alpha$  = 0.2. Statistically significant (86% confidence level) increasing and decreasing trends were observed in wells BIMA and BLOMMER, respectively. The four remaining wells did not have a trend that was statistically significant. The results are shown in the following table and the best fit trend lines for the sulfate time concentration plots are shown in Figure 1.

Event	Sample Date	BIMA	BLOMMER	FULTZ	RAY	ROGERS 803	SCHWART Z
1	Feb-08	210	206	152	159	138	158
2	Apr-08	190	210	137	125	128	122
3	May-08	195	211	131	123	141	130
4	Jun-08	225	193	111	130	129	129
5	Jul-08	204	203	152	120	134	245
6	Aug-08	256	189	137	129	128	131
	nn-Kendall Statistic (S)	7	-7	-3	-5	-4	3
ma	Probability <sup>6</sup> (p)	0.136	0,136	0.360	0.235	0.235	0.360
Co	onfidence in Trend (1-p)	86%	86%	64%	77%	77%	64%
	Number of Rounds (n)	6	6	6	6	6	6
	Average	213.3	202.0	136.7	131.0	133.0	152.5
	Standard Deviation	24,229	9,077	15.24	14.213	5.586	46.984
Coeffic	cient of Variation (COV)	0.114	0.045	0.112	0.108	0.042	0.308

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Trend ≥ 80% Confidence Level	INCREASING	DECREASING	No	No	No Trend	No Trend_
			No	No	No Trend	No Trend
Trend ≥ 90% Confidence Level	No Trend	No Trend	140	140	No Helia	HO HOIL
110110						

Stability Test; If No Trend Exists			CV <= 1	CV <= 1	CV <= 1	CV <= 1
at 80% Confidence Level	NA	NA	STABLE	STABLE	STABLE	STABLE

Based on available data, drinking water supply wells FULTZ, RAY, ROGERS 803, and SCHWARTZ show no significant trend, suggesting that the sulfate concentrations are stable. However; even though the trend at SCHWARTZ was not significant, a positive Mann-Kendall statistic indicates that the sulfate concentration may be increasing and it is recommended that it

<sup>&</sup>lt;sup>4</sup> State of Wisconsin, 2001. Department of Natural Resources, Chapter NR 700 Appendix A, Mann-Kendall Statistical Test, Form 4400-215.

<sup>&</sup>lt;sup>5</sup> Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, New York.

<sup>&</sup>lt;sup>6</sup> U.S. Environmental Protection Agency, 1998. Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA QA/G-9, Table A-11: Probabilities for the Small Sample Mann-Kendall Test for Trend. January.

Ms. Rebecca Sawyer September 29, 2008 Page 3 of 3

remain on a monthly monitoring schedule an additional quarter at which time another trend analysis will be conducted. Wells FULTZ, RAY, and ROGERS 803 have a negative Mann-Kendall statistic indicating that the sulfate concentration at these wells may be decreasing. BLOMMER also has a negative Mann-Kendall statistic and a statistically significant decreasing trend. Quarterly monitoring is recommended for BLOMMER, FULTZ, RAY, and ROGERS 803.

As an interim action for BIMA, having a statistically significant increasing trend and a discrete sulfate concentration > 250 mg/l in August 2008, Freeport-McMoRan Copper Queen Branch (CQB) has offered to provide bottled water. Quarterly monitoring also is recommended for this well.

Please do not hesitate to call us if you have any questions about the data analysis or the monitoring recommendations described in this letter.

Sincerely,

Daniel R. Simpson

Senior Hydrogeologist

James R. Norris Arizona Registered Geologist No. 30

Attachment

Michael Jaworski, Freeport-McMoRan Copper Queen Branch

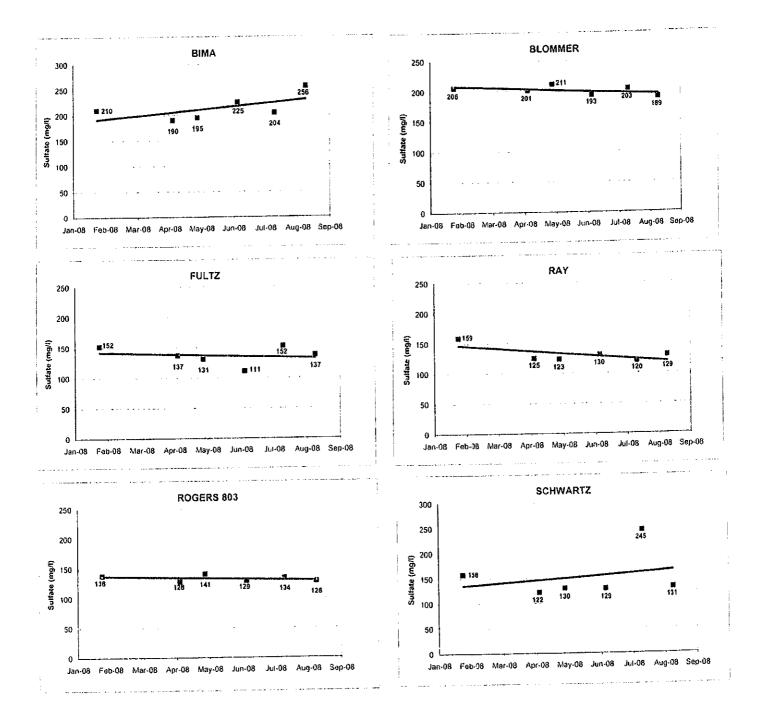
**NORRIS** 

Sheila Deely, Freeport-McMoRan Copper & Gold, Inc.

Dalva Moellenberg, Gallagher & Kennedy

Stuart Brown, Bridgewater Group, Inc.

### FIGURE 1. TIME SERIES GRAPHS OF SULFATE CONCENTRATION OVER TIME



# ATTACHMENT MANN-KENDALL TREND ANALYSIS

Bisbee Mitigation Order - Sulfate Trend Analysis

Event	Sample Date	BIMA	BLOMMER	FULTZ	RAY	ROGERS 803	SCHWARTZ
CAGIII	Feb-08	210	206	152	159	138	158
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	May-08	195	211	131	123	141	130
	Jun-08	225	193	111	130	129	129
	Jul-08	204	203	152	120	134	245
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	Number of Rounds (n)	6	6	6			152
Average Standard Deviation		213.3	202.0	136.7	131,0	133.0	
		24.229	9.077	15,240	14,213	5.586	46.98
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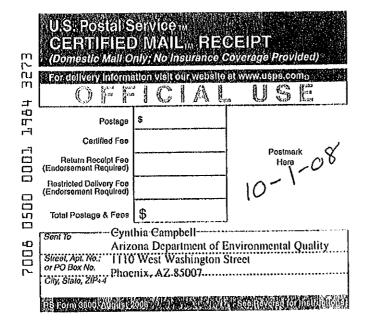
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September 29, 2008

Rebecca A. Sawyer Senior Environmental Engineer Freeport-McMoRan Corporation Copper Queen Branch 36 West Highway 92 Bisbee, Arizona 85603

RE: Mitigation Order, Docket No. P-121-07

Results of Monthly Sulfate Monitoring and Trend Analysis

Dear Ms. Sawyer:

This letter describes and evaluates the results of monthly water sampling and analysis of sulfate in six drinking water supply wells conducted pursuant to Section 4 of the Work Plan'. As outlined in Section 4 of the Work Plan "a water supply having a discrete sulfate concentration between 135 milligrams per liter (mg/l) and 250 mg/l will be monitored monthly for four months to determine whether concentrations are increasing and to identify any trend in sulfate concentration over time. Based on the apparent trend in sulfate concentrations, a monitoring schedule will be developed for the supply. If the trend indicates increasing concentrations, an interim action will be selected and an implementation plan will be developed."

In February 2008 water quality sampling for the well inventory<sup>2</sup> identified six wells (BIMA, BLOMMER, FULTZ, RAY, ROGERS 803, and SCHWARTZ) verified as drinking water supply wells that had a discrete sulfate concentration between 135 mg/l and 250 mg/l. These six wells were sampled for sulfate monthly from April to August 2008. The following table provides the results of the sampling. Analytical reports for February through June 2008 are included as Appendix D in the First and Second Quarters Groundwater Report<sup>3</sup>. Analytical reports for the July and August 2008 sampling will be included in the third quarter monitoring report.

DATE	BIMA	BLOMMER	FULTZ	RAY	ROGERS 803	SCHWARTZ
Feb-08	210	206	152	159	138	158
Apr-08	190	201	137	125	128	122
May-08	195	211	131	123	141	130
Jun-08	225	193	111	130	129	129
Jul-08	204	203	152	120	134	245
Aug-08	256	189	137	129	128	131

Results presented as sulfate in mg/l

<sup>&</sup>lt;sup>3</sup> HGC, 2008. First and Second Quarters 2008 Groundwater Monitoring Report, Task 2.2 of Aquifer Characterization Plan Mitigation Order on Consent No. P-121-07, Cochise County, Arizona. July 30, 2008.



<sup>&</sup>lt;sup>1</sup> Hydro Geo Chem, Inc. (HGC) 2008. Revision 1, Work Plan to Characterize and Mitigate Sulfate with Respect to Drinking Water Supplies in the Vicinity of the Concentrator Tailing Storage Area, Cochise County, Arizona. July 3, 2008.

<sup>&</sup>lt;sup>2</sup> HGC, 2008. Well Inventory Report, Task 1 of Aquifer Characterization Plan for Mitigation Order on Consent No. P-121-07, Cochise County, Arizona. July 3, 2008.

#### Mann-Kendall Analysis

A Mann-Kendall statistical trend analysis was conducted to determine if concentrations of sulfate are increasing or decreasing over time in samples collected from the six drinking water supply wells. The Mann-Kendall test is a non-parametric test for identifying trends in time series data. The test compares the relative magnitudes of sample data rather than the data values themselves. One particular benefit of this test is that the data need not conform to any particular distribution. Moreover, the test can be used with a minimum of four rounds of sampling results. An Excel based macro<sup>4</sup> was used to process the input time series data, perform the trend analysis, and report the results (Attachment).

#### Mann-Kendall Trend Results

Based on guidance in Gilbert<sup>5</sup>, a trend was considered significant if the "confidence in trend" metric, (1-p) x 100%, was  $\geq$  80% which represents a significance level of  $\alpha$  = 0.2. Statistically significant (86% confidence level) increasing and decreasing trends were observed in wells BIMA and BLOMMER, respectively. The four remaining wells did not have a trend that was statistically significant. The results are shown in the following table and the best fit trend lines for the sulfate time concentration plots are shown in Figure 1.

Event	Sample Date	BIMA	BLOMMER	FULTZ	RAY	ROGERS 803	SCHWART Z
	Feb-08	210	206	152	159	138	158
2	Apr-08	190	210	137	125	128	122
3	May-08	195	211	131	123	141	130
4	Jun-08	225	193	111	130	129	129
5	Jul-08	204	203	152	120	134	245
6	Aug-08	256	189	137	129	128	131
	n-Kendali Statistic (S)	7	-7	-3	-5	-4	;
mai	Probability 6 (p)	0.136	0.136	0.360	0.235	0.235	0.36
Cor	nfidence in Trend (1-p)	86%	86%	64%	77%	77%	64%
	Number of Rounds (n)	6	6	6	6	6	L
	Average	213.3	202.0	136.7	131.0	133.0	152.
	Standard Deviation	24.229	9.077	15.24	14.213	5.586	46.98
Coeffici	ent of Variation (COV)	0,114	0.045	0.112	0.108	0.042	0.30

Trend ≥ 80% Confidence Level	INCREASING	DECREASING	No	No	No Trend	No Trend
Trend ≥ 90% Confidence Level	No Trend	No Trend	No	No	No Trend	No Trend
Itelia 2 30/6 Collidante Love.	110 (1011					

Stability Test; If No	rand Eviete			CV <= 1	CV <= 1	CV <= 1	CV <= 1
at 80% Confiden		NA	NA.	STABLE	STABLE	STABLE	STABLE
20 00 10 0011112011	w				·		

Based on available data, drinking water supply wells FULTZ, RAY, ROGERS 803, and SCHWARTZ show no significant trend, suggesting that the sulfate concentrations are stable. However; even though the trend at SCHWARTZ was not significant, a positive Mann-Kendall statistic indicates that the sulfate concentration may be increasing and it is recommended that it

<sup>&</sup>lt;sup>4</sup> State of Wisconsin, 2001. Department of Natural Resources, Chapter NR 700 Appendix A, Mann-Kendall Statistical Test, Form 4400-215.

<sup>&</sup>lt;sup>5</sup> Gilbert, R.O. 1987. Statistical Methods for Environmental Pollution Monitoring. Van Nostrand Reinhold, New York.

<sup>&</sup>lt;sup>6</sup> U.S. Environmental Protection Agency, 1998. Guidance for Data Quality Assessment, Practical Methods for Data Analysis, EPA QA/G-9, Table A-11: Probabilities for the Small Sample Mann-Kendall Test for Trend. January.

Ms. Rebecca Sawyer September 29, 2008 Page 3 of 3

remain on a monthly monitoring schedule an additional quarter at which time another trend analysis will be conducted. Wells FULTZ, RAY, and ROGERS 803 have a negative Mann-Kendall statistic indicating that the sulfate concentration at these wells may be decreasing. BLOMMER also has a negative Mann-Kendall statistic and a statistically significant decreasing trend. Quarterly monitoring is recommended for BLOMMER, FULTZ, RAY, and ROGERS 803.

As an interim action for BIMA, having a statistically significant increasing trend and a discrete sulfate concentration > 250 mg/l in August 2008, Freeport-McMoRan Copper Queen Branch (CQB) has offered to provide bottled water. Quarterly monitoring also is recommended for this well.

Please do not hesitate to call us if you have any questions about the data analysis or the monitoring recommendations described in this letter.

Sincerely,

Daniel R. Simpson

Senior Hydrogeologist

James R. Norris
Arizona Registered Gevlo

Attachment

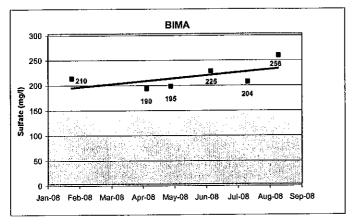
cc: Michael Jaworski, Freeport-McMoRan Copper Queen Branch

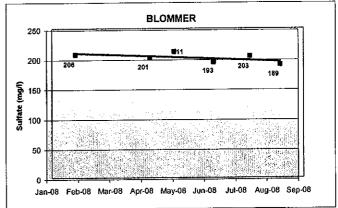
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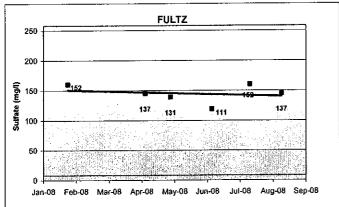
Sheila Deely, Freeport-McMoRan Copper & Gold, Inc.

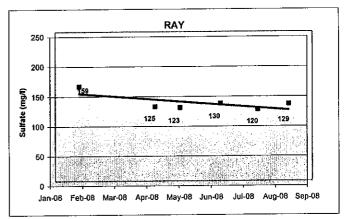
Dalva Moellenberg, Gallagher & Kennedy Stuart Brown, Bridgewater Group, Inc.

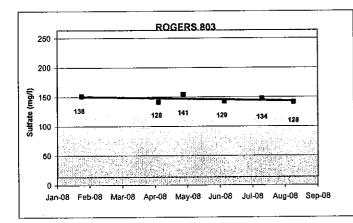
#### FIGURE 1. TIME SERIES GRAPHS OF SULFATE CONCENTRATION OVER TIME

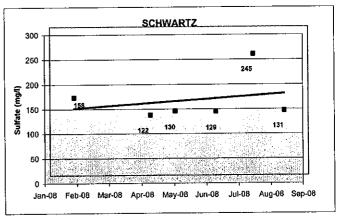












## ATTACHMENT MANN-KENDALL TREND ANALYSIS

Bisbee Mitigation Order - Sulfate Trend Analysis

Event	Sample Date	BIMA	BLOMMER	FULTZ	RAY	ROGERS 803	SCHWARTZ
1	Feb-08	210	206	152	159	138	158
2	Apr-08	190	210	137	125	128	122
3	May-08	195	211	131	123	141	130
4	Jun-08	225	193	111	130	129	129
5	Jul-08	204	203	152	120	134	245
6	Aug-08	256	189	137	129	128	131
7							
8							
9	T'''						
10	T						
Ma	nn-Kendall Statistic (S)	7	-7	-3	-5	-4	
	Number of Rounds (n)	6	6	6	6	6_	
	Average	213.3	202.0	136.7	131,0	133.0	152.
	Standard Deviation	24,229	9.077	15,240	14.213	5.586	46.98
Coaffic	lent of Variation (COV)	0,114	0.045	0.112	0.108	0.042	0.30

Error Check, If No Errors - Blank	<u> </u>					
Trend = 80% Confidence Level	INCREASING	DECREASING	No Trend	No Trend	No Trend	No Trend
Trend = 90% Confidence Level	No Trend	No Trend	No Trend	No Trend	No Trend	No Trend

Stability Test; if No Trend Exists at 80%		•	CV <= 1	CV <= 1	CV <= 1	CV <= 1
2 Stability 1621; It NO Trend Exists at one			****	72		07451.0
Confidence Level	NA NA	NA NA	STABLE	STABLE	STABLE	STABLE
Companie rate	191	101				

DATA ERROR	Event	BIMA	BLOMMER	FULTZ	RAY	ROGERS 803	SCHWARTZ
CHECKS	1	-1	-1	-1	-1	-1	-1
-	2	-1	-1	-1	-1	-1"	-1
Checks for data	3	-1	-1	-1	-1	-1	-1
with values less	4	-1	-1	-1	-1	-1	-1
han zero or text	5	-1	-1	-1	-1	-1	-1
a space is seen	6	-1	-1	-1	-1	-1	1
s text in Excel).	7	-1	-1	-1	<u>-1</u>	-1	1
	8	-1	-1	-1	-1	-1	1
Viinus one (∙1)	9	-1	-1	-1	-1	-1	-1
shown if no	10	-1	-1	-1	-1	-1	1
error.	Data Error?	no error	no error	no error	DO BLLOL	no error	no error

THIS BLOCK OF CEI	LS USED TO FIND EF	RRORS IN DATES		
DATE ERROR	Date	Text in Date?	Consecutive?	Data w no date?
CHECKS	Feb-08	-1	-1	-1
	Арг-08	-1	-1	-1
Checks include	May-08	-1	-1	-1
a test for	Jun-08	-1	-1	-1
consecutive	Jul-08	-1	-1	-1
dates and text.	Aug-08	-1	-1	-1
	BLANK	-1	-1	-1
Minus one (-1)	BLANK	-1	-1	-1
shown if no	BLANK	-1	-1	-1
error.	BLANK	-1	-1	-1
	Date Error?	no error	no error	no error

Ma	ann Kendall S Values	<u> </u>
Values of n	Smax@0.2	Smax@0.1
4	-4	-6
5	-5	-7
6	-6	-8
7	-7	-10
8	-8	-11
9	-10	-14
10	-11	-16

TEST FOR	Number of Rounds	BIMA	BLOMMER	FULTZ	RAY	ROGERS 803	SCHWARTZ
INCREASING	4						
OR	5					<u> </u>	
DECREASING	6	1	-1	0	00		
TREND @ 80%	7						
	8						
If +1, Increasing	9				ļ		
If -1, decreasing	10				<u> </u>	<del> </del>	11-121
if 0, neither.		Increasing	Decreasing	Neither	Neither	Neither	Neither

TEST FOR	Number of Rounds	BIMA	BLOMMER	FULTZ	RAY	ROGER\$ 803	SCHWARTZ
INCREASING	4						
OR	5						
DECREASING	6	0	0	0	0	L- 0	
TREND @ 90%	7					<u> </u>	
_	8					<u> </u>	
If +1, Increasing	9						
If -1, decreasing	10						N. 30
If 0, neither.		Neither	Neither	Neither	Neither	Neither	Neither

## ATTACHMENT MANN-KENDALL TREND ANALYSIS

			Righae Mil	loation Ord	er - Sulfate	Trend Ana	lysis		Well:	BIMA
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7		Event 9	Event 10	
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							Mariji Atrik	ian Statesti	. (O) —	
		130	Riches Mit	leation Orr	er - Sulfate	Trend Ana	ivsis		Well:	BLOMMER
Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	
208	210	211	193	203	189					Sum Rows
	1	1	-1	-1	•					
		1	-1	-1	•					
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	125	Event 3 123	Event 4 130 -1	Event 5 120 -1	Event 6 129 -1	e Trend An Event 7	alysis		Well:	RAY Sum Rows
	125	Event 3 123 -1	Event 4 130	Event 5 120 -1 -1	Event 6 129 -1 1	e Trend An Event 7	alysis		Well:	RAY Sum Rows
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	125	Event 3 123 -1	Event 4 130 -1	Event 5 120 -1 -1	Event 6 129 -1 1 1	e Trend And Event 7	alysis	Event 9	Well: Event 10	RAY Sum Rows
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Event 1 138	Event 2 128 -1	Event 3  123 -1 -1 -1  Event 3 141 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1 -1	Bisbee Mi Event 4 129 -11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	tigation Or   Event 5   120	Event 6 129 1-1 1-1 1-1 1-1 1-1 1-1 1-1 1-1 1-1 1-	e Trend An Event 7  e Trend An Event 7	Mann Ken  Mann Ken  Mann Ken  Mann Ken  Mann Ken  Mann Ken	dall Statist	Well: Event 10  C (S) =  Well: Event 10  C (S) =	ROGERS 803 Sum Rows SCHWARTZ
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