SUPERIOR WATERSHED PARTNERSHIP
LAKE SUPERIOR • LAKE MICHIGAN • LAKE HURON
2 Peter White Drive • Presque Isle Park • Marquette, Michigan 49855
Phone: (906) 228-6095 • Fax: (906) 228-6863 • www.superiorwatersheds.org

CEMP Monitoring Report

RE: SWP Monitoring Confirms Elevated Sulfate Levels Within Temporary Development Rock Storage Area (TDRSA) Trending Down

Type of Monitoring - Permit Verification or Additional: Verification - Mine Permit MP012007

Summary: In July, 2012 Rio Tinto monitoring confirmed high levels of sulfates (610 mg/L) in the leak detection sump above the MDEQ permit levels of 500 mg/L. Since then, sulfate levels have been decreasing as confirmed by both Rio Tinto monitoring and SWP independent monitoring. Monitoring by both parties will continue on a regular basis as required by permit or the CEMP work plan.

Chronology:

September 2010	Construction of the TDRSA began
September/October 2010	Secondary liner installed and leak survey performed
October/November 2010	Primary liner, risers and pumping system installed
August/September 2011	Certificate of Quality Assurance for construction of liner systems submitted and approved by MDEQ
September 2011	MDEQ inspects final grading prior to placement of any development rock
Q3 2011	Rio Tinto's monitoring of the TDRSA began at the start of operations
Early 2012	Rio Tinto identified rising sulfate levels and notified MDEQ of the upward trend. Rio Tinto initiated an investigation prior to arriving at the permit threshold of 500 mg/L. The investigation included reviewing construction materials, analyzing the aggregate used in construction, and fingerprinting the water in both sumps to see if they were of the same quality. Rio Tinto's investigation did not identify a source of sulfate. However due to the upward spike and subsequent depletion, it is apparent there was a small source. Rio Tinto speculates that a small amount of the aggregate used in construction of the liner contained a sulfate material.
September 2012	Rio Tinto notified SWP about the elevated sulfate levels before the CEMP was signed.
December 2012	Rio Tinto adds nitrogen compounds to the monitoring parameter list because they are a better indicator for leakage through the lining system
December 2012	SWP conducted monitoring of water samples from the TDRSA
January 2013	Rio Tinto investigation and conclusions submitted to MDEQ
January 2013	Lab Results Received by SWP
January 2013	Report Released to Public

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Details: The Temporary Development Rock Storage Area (TDRSA) is located on-site at the Rio Tinto mine (see map) near Big Bay, Michigan and is designed to hold development ("waste") rock for a period of several years until it is put back in the ground to fill the voids where ore was removed. The TDRSA has two lining systems; a primary lining and a secondary lining known as the leak detection sump (see photos, diagram). On December 4, 2012 SWP staff conducted duplicate, split-sampling of both the primary and secondary lining systems. SWP water samples were sent to the EPA-approved Underwriters Laboratories (UL) in Chicago, Illinois. The SWP received lab results on January 14, 2013 indicating that water in the secondary lining system had sulfate levels of 430 milligrams per liter (below the allowable DEQ permit levels of 500 mg/L). Rio Tinto provided SWP with their monitoring results on January 2, 2013. The results of SWP's duplicate monitoring corroborate Rio Tinto results indicating similar sulfate levels which have been declining since August, 2012 (see both, SWP monitoring report and Rio Tinto monitoring report). It is important to note that all water from both the primary and secondary lining systems is captured in the Contact Water Basins (CWB) and treated at the Wastewater Treatment Plant (WTP) before being reused in the mine or discharged to the Treated Water Infiltration System (TWIS).

SWP Concerns: The TDRSA is designed and constructed to exacting industry standards, much like a hazardous waste facility. However, if a leak developed in the secondary lining system, water containing elevated sulfates could leach into the adjacent soil and cause groundwater contamination. While the risk of the secondary liner leaking is very low, the impact could be significant. Rio Tinto has indicated that the TDRSA secondary liner filled with an estimated 26,000 gallons of water during the construction process. To date only 2,793 gallons have been purged from the secondary liner to the Contact Water Basins for future treatment.

SWP Recommendations: SWP will continue to monitor the water in between the TDRSA liner layers and provide trend analysis concerning the sulfate level. SWP may also initiate additional monitoring parameters in an effort to detect any leaks and potential groundwater contamination.

Site legend

01 **Treated Water Infiltration System -** Infiltration system that slowly releases treated water back into the environment through a series of insulated, perforated pipes laying on the grounds surface.

02 **Power House -** Industrial facility for the distribution of power and backup generation of electric energy.

03 **Storage Facility -** Storage for supplies used in the mining operation.

04 **Water Treatment Plant -** A state of the art, reverse osmosis water treatment plant to purify water from operations.

05 **Truck Wash -** All vehicles leaving the main operations area are required to go through the truck wash to clean the vehicles before they leave the area. Water is captured and sent to the water treatment plant for processing. Water that is not recyclable will be routed to the water treatment plant for processing.

06 **Mine Services Buildings -** The buildings and structures utilized for supporting Eagle. These include offices, maintenance facilities, a mine dry and other mine support services.

07 **Contact Water Basins -** All water that comes into contact with mining activities will be stored in two basins and pumped into the water treatment plant for purification. The basins are designed to hold water in excess of a 100 year rain event.

08 **Non-Contact Water Basin -** Water not directly related to mining activities, such as snow and rain, will be collected in these basins. Water will flow to these basins and be naturally reabsorbed into the ground.

09 **Coarse Ore Storage -** Closed storage facility for coarse, uncrushed ore that is brought to the surface. Underground mine trucks will off load the ore which in turn will be loaded into highway trucks and taken to the Humboldt Mill.

10 **Temporary Development Rock Storage Area -** Environmentally secure storage facility for development rock, all rock removed from the underground that is not considered ore. The facility features a multilayered liner, leak detection system and sump pump to collect water which will be treated by the water treatment plant. All development rock will be returned underground as fill.

11 **Portal -** Entrance to decline leading to the underground development and ore body.

12 **County Road Triple A**

Rio Tinto Eagle Mine
4547 County Road 601
Champion, MI 49814
T 906-486-1257
F 906-486-1053

9 January 2013

Mr. Joe Maki
Michigan Department of Environmental Quality
420 5th Street
Gwinn, MI 49841

Subject: Temporary Development Rock Storage Area (TDRSA) Leak Detection Sump Sulfate Results – Rio Tinto Eagle Mine, Marquette County, Michigan

Dear Mr. Maki:

As you know, Rio Tinto designed and constructed the Eagle Mine TDRSA with two lining systems – the primary lining system and sump (referred to as the contact sump), and the secondary lining system and sump (known as the leak detection sump). Water collected from both sumps is analyzed as required by Mine Permit MP 01 2007. Special permit conditions F18 - F22 require samples to be collected from the leak detection sump and analyzed for sulfate and pH. If the sulfate concentrations exceed 500 mg/L and/or the average daily flow rate exceeds 25 gallons per acre per day then the permit states it is indicative of leakage from the primary lining system, or contact sump.

As previously discussed with the Department, the sulfate result from the leak detection sump collected in July 2012 measured 610 mg/L. Rio Tinto notified the Department of an upward trend prior to July and again after it received the July sample results. Subsequent results show a rapid decline in sulfate levels in the leak detection sump below the 500 mg/l screening level.

Rio Tinto initiated an investigation to determine the cause of these results. The investigation consisted of a review of the construction materials, an increase in parameters to be analyzed in order to "fingerprint" the water quality, and a comparison in analytical results between the TDRSA leak detection and contact water sumps.

This investigation included sending a sample of the aggregate utilized in the construction of the leak detection sump to a laboratory for analysis. The results indicated that the aggregate was not the source of the sulfate. However, due to the rapid increase and immediate depletion of sulfate it was apparent that some small finite source was introduced during construction. It may have been associated with the liner (i.e. coatings), seam sealing, or other material utilized during that time.

In addition to evaluating the construction materials for potential causes, parameters were added to the sampling suite in order to "fingerprint" the water in both the contact and leak detection sumps. This allowed for a direct comparison of the water quality to determine if the leak detection sump was receiving water from the contact sump indicating a leak in the composite lining system.

Review of the data (attached) has identified clear differences in the concentrations of sulfate, magnesium, chloride, and nitrate between the two sumps. This indicates that it is highly unlikely that the brief period of elevated sulfate results was due to a leak in the lining system. In addition, as noted above, the sulfate results in the leak sump have decreased the last three sampling periods to a level below 500 mg/L while the sulfate results in the TDRSA contact sump have steadily increased, further indicating that there was no leakage of material from the contact sump.

The other parameter monitored as a leakage indicator is the water volume to ensure it does not exceed 25 gallons per acre per day. The average daily flow rate in the leak detection sump is 0.31 gal/acre/day, well below the permit threshold. It was expected that water would be present in the leak detection sump due to rainfall events during construction and prior to installing the composite liner over the leak detection sump. Golder Associates, Inc. calculated that more than 26,000 gallons of water entered the sump during construction.

Following our analysis of the data, Mark Logsdon of Geochimica also performed a review and provided input. He confirmed that the water quality from the two sumps is distinctly different. Mark noted that the most prominent difference in the contact and leak detection layer water is the nitrate results, which is a tracer from blasting emulsion. The observed values in the leak detection sump represent baseline levels near the detection limit while the observed values in the TDRSA contact sump are significantly higher. The solubility of nitrate is not controlled by any materials in the sump, which is not the case for sulfate, therefore there would be distinctly elevated nitrate in the leak detection sump if there was leakage from the primary lining system. In addition, Rio Tinto evaluated the contact and leak detection sump waters for ammonia due to the potential for nitrate to be converted to ammonia in a reducing environment. The results in the leak sump were found to be near the laboratory detection limit while ammonia results from the contact water sump were again significantly higher.

Collectively, these data and evaluations geochemically eliminate the possibility of a leak from the TDRSA primary sump into the leak sump as the cause of the transient sulfate results last year. Due to the results of the investigation, Rio Tinto also determined that sulfate will not be used internally as the single indicator parameter for monitoring the leak detection sump. Due to the absence of solubility controls on nitrate in the sump, it is a more reliable indicator of leakage through the liner and will be added to the routine sampling suite. Ammonia and nitrite will also be added. Trends will be documented and reviewed, and any upward trending will be reported to the Department.

If you have any questions or comments, please do not hesitate to contact me at 906-486-1257.

Sincerely,

Amanda Zeidler
Environmental Analyst

Cc: Superior Watershed Partnership

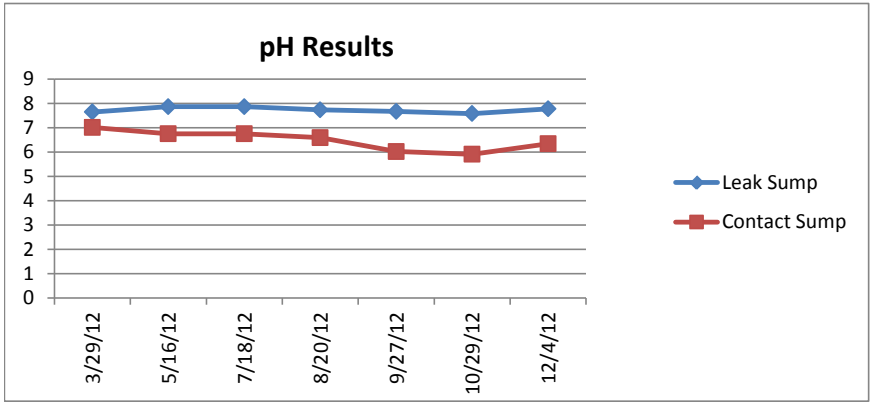
enclosure

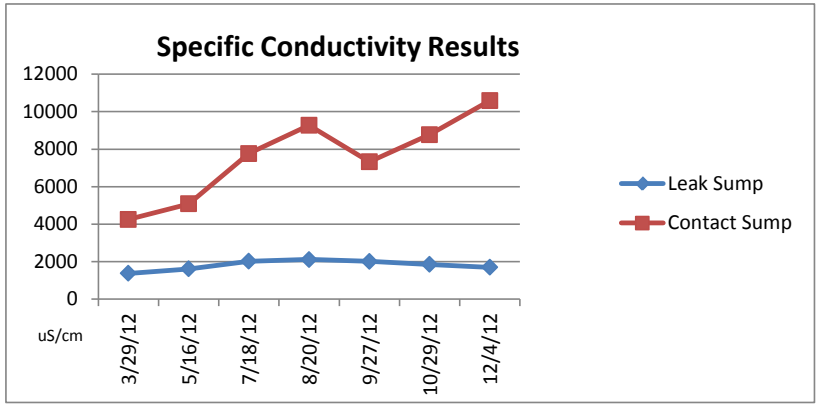
TDRSA Leak Dection and Contact Sump Results

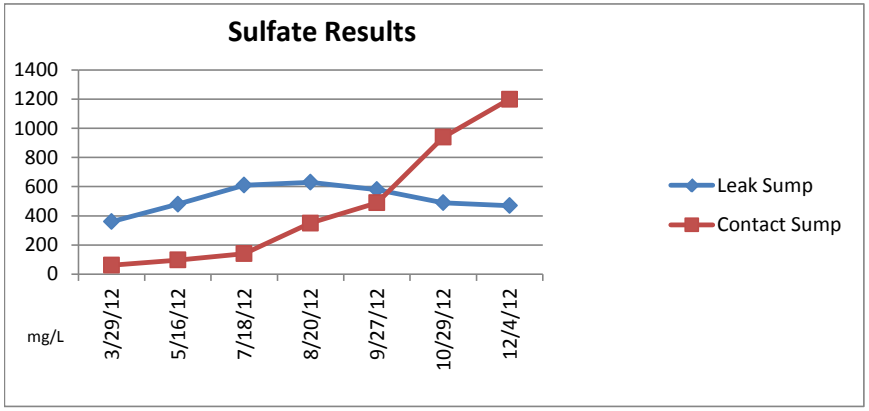
Parameter	3/29/12 TDRSA Leak Sump	3/29/12 TDRSA Contact Sump	5/16/12 TDRSA Leak Sump	5/16/12 TDRSA Contact Sump	7/18/12 TDRSA Leak Sump	7/18/12 TDRSA Contact Sump	8/20/12 TDRSA Leak Sump	8/20/12 TDRSA Contact Sump	9/27/12 TDRSA Leak Sump	9/27/12 TDRSA Contact Sump	10/29/12 TDRSA Leak Sump	10/29/12 TDRSA Contact Sump	12/4/12 TDRSA Leak Sump	12/4/12 TDRSA Contact Sump
Magnesium (mg/L)	NS	NS	9.1	93	13	190	12	240	12	220	10	390	7.4	420
Sodium (mg/L)	NS	NS	280	370	390	440	400	550	390	420	420	580	330	620
Chloride (mg/L)	NS	NS	5	530	5.2	350	7.3	340	8.2	260	7.4	140	6.5	170
Sulfate (mg/L)	360	61	480	97	610	140	630	350	580	490	490	940	470	1200
Nitrate (mg/L)	NS	NS	NS	NS	NS	NS	7	910	7.8	660	5	910	4.4	1300
Nitrite (mg/L)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.94	39
Ammonia (mg/L)	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	0.37	76
Average Daily Flow Rate (gal/acre/day)	0.21	NS	0.15	NS	0.42	NS	0.43	NS	0.32	NS	0.32	NS	0.10	NS
pH	7.65	7.01	7.87	6.75	7.87	6.75	7.74	6.59	7.67	6.02	7.58	5.91	7.78	6.34
Specific Conductivity (uS/cm)	1369	4245	1611	5079	2019	7765	2108	9280	2007	7323	1846	8776	1697	10590

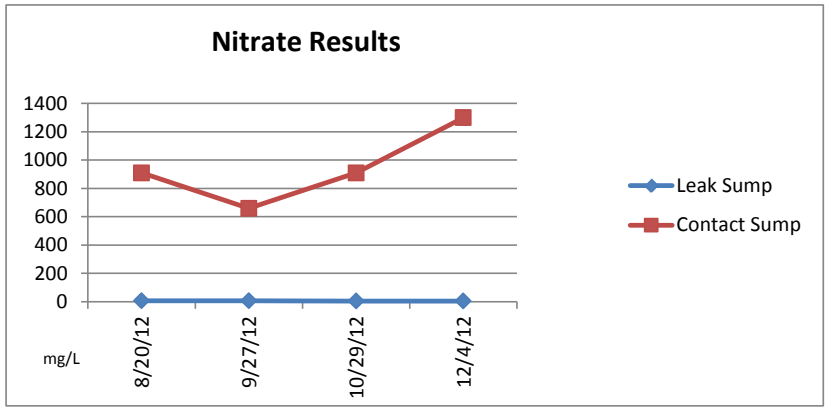
NS = Not sampled

TDRSA Leak Dection and Contact Sump Results

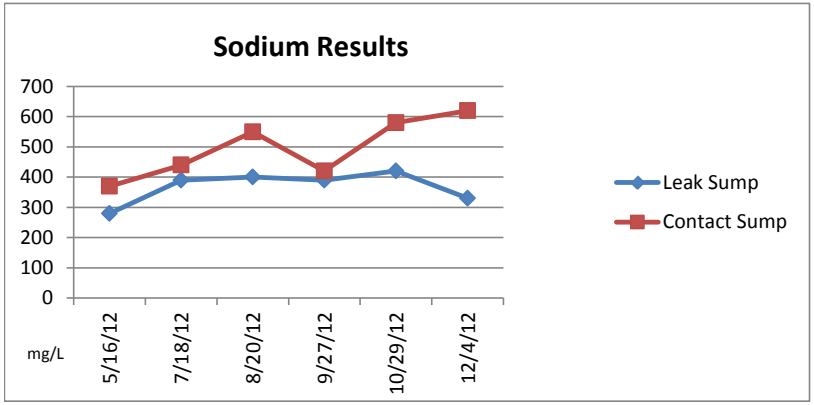


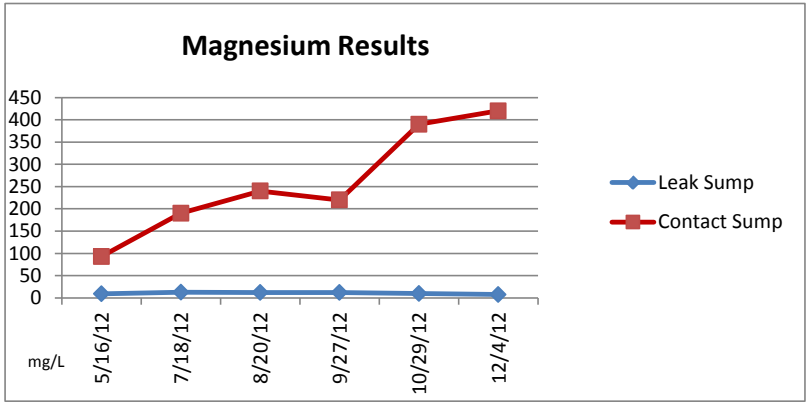


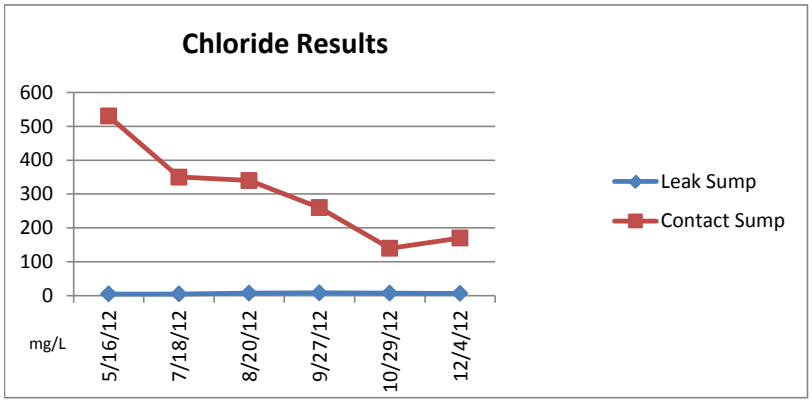




TDRSA Leak Dection and Contact Sump Results







LABORATORY REPORT

This report contains 4 pages.
(including the cover page)

If you have any questions concerning this report, please do not hesitate to call us at (800) 332-4345 or (574) 233-4777.

UL LLC
110 S. Hill St., South Bend, IN 46617-2702 USA
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Sample Analysis Results

Client: Superior Watershed Partnership And Land Trust **Order No.** 229140
Contact: Geraldine Grant **Receipt Batch No.** 289340

Analytical Method for RD100:

This was an IC method based on EPA Method 300.0 with calibration ranges for Chloride from 2.0 mg/L to 30 mg/L, Nitrate from 0.5 mg/L to 15 mg/L, and Sulfate from 5.0 mg/L to 100 mg/L. The linear calibration curves are included in the body of this report. The client was quoted lower reporting limits than are typically used for the analytes of interest. But due to the amount present in the samples, the standard calibration range recommended for this method was used instead.

5 mL of sample was analyzed in an analysis batch that contained an initial calibration curve, an initial laboratory reagent blank (LRB), a laboratory fortified blank (LFB), and an Instrument Performance Check (IPC). The analysis batch concluded with an ending Instrument Performance Check (IPC), and a laboratory reagent blank (LRB). The sample results are reported in the following tables:

SAMPLE LAB ID: 2749948 **SAMPLE SITE:** EMTDRSA-SUMPCEM-1001003

Analyte	MRL (mg/L)	Sample Result (mg/L)	Initial IPC Recovery (%)	Ending IPC Recovery (%)
Sulfate	5	430	96.1	97.0

SAMPLE LAB ID: 2749949 **SAMPLE SITE:** DUPM002CEM-1001004(MPWW)

Analyte	MRL (mg/L)	Sample Result (mg/L)	Initial IPC Recovery (%)	Ending IPC Recovery (%)
Sulfate	5	426	96.1	97.0

SAMPLE LAB ID: 2749950 **SAMPLE SITE:** EMCWB-SUMPCEM-1001005

Analyte	MRL (mg/L)	Sample Result (mg/L)	Initial IPC Recovery (%)	Ending IPC Recovery (%)
Sulfate	5	1140	96.1	97.0

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SAMPLE LAB ID: 2749951 **SAMPLE SITE:** DUPM003CEM-1001006(MPWW)

Analyte	MRL (mg/L)	Sample Result (mg/L)	Initial IPC Recovery (%)	Ending IPC Recovery (%)
Sulfate	5	1129	96.1	97.0

Analyzed By: _____ Date: 1-7-13

Reviewed By: _____ Date: 1-7-13