APPENDIX 3.2.3.5

SGS 2nd Quarterly Report for Surface Water Sampling

PERSEUS MINING LIMITED

SURFACE WATER MONITORING REPORT

AYANFURI

March 2009 – AC0852-0027

PREPARED BY SGS ENVIRONMENT

PERSEUS MINING LIMITED

SURFACE WATER MONITORING REPORT

AYANFURI

Project N°: AC0852-0027

March 2009

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1.0 INTRODUCTION

This report is the second for a quarterly water quality monitoring exercise conducted by SGS Environment, for Perseus Mining Limited. It presents results of surface water sampling from December 1 to 4, 2008. The previous report with reference October 2008 - AC0852-0027, outlined the objectives of the sampling programme, scope of works and described the sampling locations. New locations were added to the previous sampling sites for the December sampling, and are described in this report.

1.1 SAMPLING LOCATIONS

Fourteen surface water sampling locations were selected for the December, 2008 sampling exercise. These sites comprised of six locations which were sampled during the previous sampling exercise and eight new additions. As was the case for the previous sampling locations, the new locations have been selected to reflect any impact that might have occurred within the catchment or where impacts could potentially occur during Project implementation. These sites are either upstream, downstream of close to potential pollution sites. Locations for water sampling in December 2008 are provided in Table 1.1.

Table 1.1: Sampling locations

New location	Location ID	Previous location	Location ID
Top end of HLP stream near Nkotumso	AS1	Akesuoa River downstream of Nkotumso Village	PA3
Downstream of HLP stream opposite HLP	AS2	Akesuoa River upstream of Nkotumso Village	PA4
Downstream of Chirawewa	PA16	Subin river downstream of Odumkrom	PA7
Upstream of Dabiasem	PA17	Asuafu River downstream of Nkonya Village (locals refer to stream as Amobri)	PA11
Asuaa before junction with Subin	PA19	Drainage immediately downstream of Abenabena Village	PA13
Culvert on Sefwi Bekwai road near Odumkrom Village	PA20	Subin River at the railway crossing	PA15
Pond on Fobinso haul road below HLP	PA21		
Chirawewa pond below waste dump	PA23		

Map showing these locations will be provided in next (3rd) sampling report.

1.2 DESCRIPTION OF ADDITIONAL (NEW) SAMPLING LOCATION

1.2.1 Top end of HLP stream near Nkotumso (AS1)

Site AS1 is a small canal that carries effluent from an abandoned heap leach site. AS1 is at the top end (upstream) of the heap leach and close to the Nkotumso village.

1.2.2 Downstream of HLP stream opposite HLP (AS2)

Similar to AS1 above, site AS2 was also sampled from the heap leach canal. AS2 is located downstream of the heap leach site.

1.2.3 Downstream of Chirawewa (PA16)

Site PA16 is located on the Chirawewa stream, which flows along the Chirawewa pit. The topographic map from the Ghana Survey Department for the area refers to the stream as Danyami stream. The stream merges with the Subin River and runs along the outskirt of the Ayanfuri township before intersecting the trunk road linking Ayanfuri and Gyaaman.

1.2.4 Upstream of Dabiasem (PA17)

Site PA17 is located upstream of Dabiasem village and to the east of Nkonya village. The stream is used by the indigenes for domestic purposes.

1.2.5 Asuaa before junction with Subin (PA19)

Site PA 19 is located on the Asuaa stream. The stream intersects the Ayanfuri and Dunkwa trunk road and flows along the outskirt of Ayanfuri, from where it merges with Subin and Danyami streams further North of Ayanfuri.

1.2.6 Culvert on Sefwi Bekwai road near Odumkrom (PA20)

Site PA20 is at the second culvert, when approaching Gyaaman from Ayanfuri. The stream is a tributary of the main Subin stream that lies further to the North of Ayanfuri.

1.2.7 Pond on Fobinso haul road below HLP (PA21)

Site PA 21 is a pond along the access road to Fobinso village. The road is a second class road, off the main Ayanfuri and Nkotumso trunk road. Ponds along the road are a result of illegal artisanal miners, whose activities have left behind large pits which have become receptacles for rainwater.

1.2.8 Chirawewa pond below Waste Dump (PA23)

Site PA23 is a pond that has resulted from creation of the Chirawewa pit. The pond lies below the waste dump and collects debris and organic waste from vegetation at the borders of the pond.

2.0 METHODOLOGY

2.1 WATER SAMPLING

SGS Environment has Standard water sampling procedures document, *'Field Sampling Procedures, August 2008; 2nd Edition'.* This document has been submitted to Perseus Mining and was adhered to in the December sampling exercise as was done in the previous sampling.

As part of the standard procedures, field logs and Chain of Custody forms were filled in the field and received when samples arrive at the MASLAB. Copies of all Sample Submission Sheets and Chain of Custody Forms are presented in Appendix 2.1.

2.2 SAMPLING TEAM

Details of the sampling team are provided in Table 2.1.

Table 2:1: Sampling team

Names	Designation	Company
Dr Edward Watkin	Environment Manager	Perseus Mining Ltd
David Afful	Field Staff	Perseus Mining Ltd
Ekow Woode	Environmental Scientist	SGS Environment
Jacob Lamptey	Field Assistant	SGS Environment

2.3 ANALYSIS

As was the case in the previous sampling, field *(in-situ)* parameters were determined by a TPS multi-parameter meter (Model 90 FL). Representative surface water samples collected from each location were kept in an ice chest and delivered to the SGS Monitoring and Analytical Services Laboratory (MASLAB) in Tema and analysed in accordance Terms of Reference provided by Perseus Mining. All samples were analysed according to "Standard Methods for the Examination of Water and Wastewater" of the American Public Health Association, 2005 edition.

3.0 RESULTS AND DISCUSSION

3.1 RESULTS

Tables 3.1 present results of field parameters, heavy metals and physico-chemical parameters analysed. Result of Quality Assurance is also provided to validate the efficient of sampling and handling of samples throughout the entire exercise. Where feasible the results are compared with previous samples collected from the same locations to determine any temporal variation. Results of the laboratory analysis are provided in Appendix 3.1.

3.2 DISCUSSIONS

3.2.1 pH and Conductivity

The pH of water samples was slightly acidic to neutral. It ranged from 6.1 (PA16 - downstream of Chirawewa) to 7.8 (PA100 – pond on Fobinso haul road below Heap Leach). All samples had pH within the recommended range for drinking water set by the WHO. There is no indication of a water quality problem regarding pH at the sampled locations.

The highest conductivity was 220.6 µS/cm recorded at PA 13 (drainage immediately downstream of Abenabena village) and the lowest record was 40.2 µS/cm, at PA 23 (Chirawewa pond below waste dump). For locations that had previous results, the conductivity increased at four locations. The increased was significant at PA11 and PA4. It is possible that some artisanal mining activities upstream of the Abenabena village are responsible for the release of salts that have influenced the levels of conductivity. There are no available guideline values by the IFC/WB and WHO for comparison.

3.2.2 Physico-chemical parameters

Nitrate levels at all sampling locations were below guideline value (50 ppm) of IFC/WB and the WHO, except PA20 (76.4 ppm), which exceeded the guideline. It is possible that farmers upstream or along the banks apply nitrogen fertilizer that has contributed to nitrate in water at that location.

Sulphate levels at all locations were below the WHO guideline set at 250 ppm. The highest level recorded was at PA20 (135.9 ppm). Sulphate in water can result from decaying plant and animal matter and ammonium fertilizers containing sulphates. Given that PA20 also recorded the highest nitrate level, it is possible that the source of sulphate is also from fertilizer application on farms within the stream's catchment.

Total Suspended Solids (TSS) at four locations had results exceeding the IFC/WB guideline value set at 50 ppm. The order was as follows: PA15 (720.7 mg/l) > PA19 (675.2 mg/l) > PA11 (142.9 mg/l) > PA4 (57.4 mg/l). Location PA 15 recorded the highest TSS in the previous sampling, though current results showed a decline. Artisanal mining activities discharge waste water from their gold processing activities, which could be responsible for the high TSS at PA15.

The highest TDS recorded was at PA20 (640 mg/l) and the lowest (28mg/l) was recorded at PA23. However, all levels recorded were well below the WHO guideline.

Table 3:1: Results of analysis

SITES		pH	Cond. (µS/cm)	TDS (mg/l)	TSS (mg/l)	NO3 (mg/l)	SO4 (mg/l)	Tot. Al (mg/l)	Tot.As (mg/l)	Tot. Cd (mg/l)	Tot. Cr (mg/l)	Tot. Cu (mg/l)	Tot. Fe (mg/l)	Tot. Mn (mg/l)	Tot. Pb (mg/l)	Tot. Zn (mg/l)
AS1	last	6.2	n.d	n.d	n.d	n.d	n.d	n.d	0.002	n.d	n.d	n.d	n.d	n.d	n.d	n.d
AS2	last	6.6	n.d	n.d	n.d	n.d	n.d	n.d	0.044	n.d	n.d	n.d	n.d	n.d	n.d	n.d
PA3	last	7.7	106.8	115	19.8	1.75	<1	<0.2	<0.002	n.d	n.d	n.d	5.43	1.44	n.d	<0.02
PA3	previous	6.6	101.5	67	9.1	0.14	<1	<0.2	0.003	n.d	n.d	n.d	2.57	<0.05	n.d	0.04
PA4	last	6.3	147.5	88	57.4	<0.06	15.3	1.5	0.005	n.d	n.d	n.d	10.4	0.35	n.d	<0.02
PA4	previous	6.1	111.5	74	13.4	0.21	<1	<0.2	0.004	n.d	n.d	n.d	2.88	<0.05	n.d	0.03
PA7	last	6.5	184.4	112	33.9	0.99	<1	<0.2	0.01	n.d	n.d	n.d	8.16	0.28	n.d	<0.02
PA7	previous	6.7	205.4	111	8.8	0.12	<1	<0.2	0.015	n.d	n.d	n.d	3.52	<0.05	n.d	0.07
PA11	last	6.3	211.9	52	142.9	0.12	<1	5.2	0.024	n.d	n.d	n.d	46.4	0.17	n.d	0.02
PA11	previous	6.3	60.2	70	192	0.07	1.6	1.1	0.062	n.d	n.d	n.d	14.8	<0.05	n.d	0.07
PA13	last	7.2	220.6	122	14.5	7.88	1.4	9.2	0.005	n.d	n.d	n.d	9.38	1.58	n.d	<0.02
PA13	previous	6.5	93.5	236	424	1.09	6.6	14.1	0.021	n.d	n.d	n.d	38.9	<0.05	n.d	0.08
PA15	last	6.9	113.4	99	720.7	1.08	30.2	46.9	0.13	n.d	n.d	n.d	70.1	0.05	n.d	0.09
PA15	previous	7.2	126.9	638	1945	1.05	26.7	36.8	0.53	n.d	n.d	n.d	127	<0.05	n.d	0.04
PA16	last	6.1	97.1	62	37.6	2.36	<1	0.4	0.03	n.d	n.d	n.d	10.9	<0.05	n.d	<0.02
PA17	last	6.6	74.3	51	8.7	<0.06	<1	<0.2	0.004	n.d	n.d	n.d	3.51	0.14	n.d	<0.02
PA19	last	6.9	71.6	57	675.2	1.45	20.2	32.2	0.086	n.d	n.d	n.d	50.2	<0.05	n.d	0.03
PA20	last	7.7	106.8	640	34.7	76.4	135.9	3.4	0.43	<0.02	0.06	<0.02	2.38	0.06	<0.02	<0.02
PA21	last	7.7	154.2	88	31.1	0.34	<1	<0.2	0.098	<0.02	<0.03	<0.02	0.36	<0.05	<0.02	<0.02
PA23	last	6.7	40.2	28	10.3	0.53	<1	<0.2	0.016	<0.02	<0.03	<0.02	1.86	<0.05	0.08	<0.02
PA100	last	7.8	149.4	<4	<1	<0.06	<1	<0.2	<0.002	<0.02	<0.03	<0.02	<0.05	<0.05	<0.02	<0.02
PA50(Blank)	last	n.d	n.d	85	4.9	0.17	1.1	<0.2	0.094	<0.02	<0.03	<0.02	0.4	<0.05	<0.02	<0.02
IFC/WB		**6 to 9**	**-**	**-**	**50**	**50**	**-**	**0.01**	**0.1**	**0.1**	**-**	**0.5**	**3.5**	**-**	**0.1**	**2**
WHO		**6 to 9**	**-**	**1000**	**-**	**50**	**250**	**-**	**0.01**	**0.003**	**0.05**	**1**	**0.3**	**0.5**	**0.01**	**3**

Shaded cell exceed guideline values
NB: Only results of last sampling that exceeded guidelines are shaded

3.2.3 Heavy Metals

Results of heavy metals analysed are also provided in Table 3.1. These results are compared with either the WHO or IFC/WB guideline values. Where both guidelines are available the stringent of the two is used in the discussion.

Arsenic (As) and Iron (Fe) had respectively 60 % and 100% of samples analysed exceeding WHO guideline values. The gold bearing rocks at the area is arsenopyrite, which give rise to Arsenic, Iron and Sulphur.

The highest As level recorded was at PA20 (0.43 ppm). PA100 and PA3 had levels below detection limits set by the laboratory. The order for As was as follows: PA20 > PA15 > PA21 > PA19 > AS2 > PA16 > PA11 > PA23. Almost all the sites reported, have current or previous mining activities that give rise to As in water. It is possible that leachate from abandoned mine waste heap close to Odumkrom or artisanal mining activities further upstream are responsible for the high As record at PA20. Traditional ore processing occurs upstream of PA15 and could be responsible for the As level recorded. Illegal artisanal mining activities are responsible for the ponds created along the Fobinso haul roads, which also collect rainwater. It is possible that the activities of the miners are responsible for As levels recorded at PA12. The reasons above could also be responsible for levels of As recorded at other sampling locations.

The highest Fe level was recorded at PA15 (70.1 ppm) and the lowest was at PA100 (0.4 ppm). The order was as follows: PA15 > PA19 > PA11 > PA 16 > PA4 > PA13 > PA7 > PA3 > PA17 > PA20 > PA23 > PA21. It is possible that the presence of pyrite as a component of the geology could be responsible for the high Fe content in water.

Further to the above, the gold bearing rocks at the area are arsenopyrite, which give rise to Arsenic, Iron and Sulphur. These could possibly account for the high levels of As and Fe > WHO guidelines for almost all the sampled locations.

Copper (Cu) and Zinc (Zn) levels in all water samples tested had results lower than the WHO guideline value. These levels could possibly be attributed to natural load. One location PA20 recorded Chromium (Cr) level higher than the WHO set limit. Manganese (Mn) levels at two locations, PA3 and PA13 exceeded the WHO set value of 0.5 ppm.

MASLab has set detection limits for all metal parameter provided in the TOR. Unfortunately, some detection limits are higher than guideline values set by the world bodies for surface waters. This means levels above the guideline limit, but below the laboratory's detection limit will not be reported to reflect the actual level in the water samples. Results of Aluminium (Al), Cadmium (Cd), and Lead (Pb) fall in this category. Parameters that were not required to be determined by Perseus Mining are indicated by the letters n.d (not determined).

3.2.4 Weather Influences on results

Further sampling and data are required to be able to establish a trend in pollution levels and how these levels are influenced by variations in season. It is expected that once the various quarterly sample collection of 2009 are completed, a trend could be determined taking into consideration the levels from previous results.

4.0 CONCLUSION

Based on the results obtained the following conclusions may be drawn.

pH of stream samples remained within recommended WHO guideline limits. Where variations were recorded, the range was narrow. It could be concluded that mining activities have not affected pH of the streams

Arsenic levels at most (60%) of the sampling locations were above WHO guideline values. Though the parent rocks are arsenopyrite, further Arsenic studies within the project catchment is required to establish the source(s), as natural load or from previous and current mining activities. A similar investigation may be required for Iron, which had all sites exceeding the WHO guideline.

The culvert on Sefwi Bekwai road near Odumkrom (PA20) recorded relatively high levels of Arsenic, Chromium, Nitrate, Total Dissolved Solids, Total Suspended Solids, and Sulphate. This could be due to a number of factors such as farming with fertiliser input, mining, etc. The catchment area of the stream would require further investigation to account for the results. Artisanal activities at PA15 could account for the higher TSS at the location, however, the catchment of the Subin stream which has PA15 would also require further investigation.

APPENDIX 2.1

SAMPLE SUBMISSION SHEETS AND CHAIN OF CUSTODY FORMS

FOD1289

SGS

SAMPLE SUBMISSION SHEET

Lab Use Only

Job #

Date Received . . / . . / . .

Time _____

By _____

CLIENT ED WATKIN

Company CENTRAL ASHANTI GOLD (PERSEUS) Order # _____

Location AYANFURI ☐ Urgent Required by . . / . . / . .

Sender's Name EKOW WOODE Client Code _____

SAMPLE TYPE

☐ Rock Chips	☐ Diamond Split	☐ Diamond Spot	☐ RC	☐ RAB
☐ Trench	☐ Soil	☐ Pulp	☐ Tailing	☐ Stream Sediment
☐ Vegetation	☑ Water	☐ Food/Feed	☐ Oil	☐ Other

Sample Description _____

Sample Mineralogy ☐ Sulphide Rich ☐ Carbonate Rich ☐ Iron Rich ☐ Oxide Rich ☐ Graphite Rich

SAMPLE IDENTIFICATION & ANALYSIS REQUESTED

Sample Identification	Nb	Analysis & Elements Required	Codes
AS1, AS2	2		
PA15, PA20, PA3	3		
PA21, PA100FD, AP23	3		
PA13, PA11, PA17	3		
PA16, PA19, PA4	3		
PA7, PA5D	2		
Total Number of Samples	16		

SPECIAL INSTRUCTIONS

RECEIVED 04 DEC 2008

SAMPLE DISPOSAL INSTRUCTIONS

Store Crushed Sample then discard ☐ Period _____ Store pulp then discard ☐ Period _____

Store Crushed Sample then return to sender ☐ Period 9 Store pulp then return to sender ☐ Period _____

☐ Other (Specify) _____

Client Signature Location _____ Date . . / . . / . .

Lab Use Only

Sample Checked / Sorted by _____ Date . . / . . / . . Sample Weighed by _____

Sample Unidentified _____

Sample Missing _____ Sample Analysed by _____

Remark _____ Total samples [_____]

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