

---

## EXECUTIVE SUMMARY

The Ghana Manganese Company Ltd. (GMC) owns and operates the Nsuta Manganese Mine, located in the Tarkwa-Nsuaem Municipal Assembly of the Western Regional Administrative Area in the South West of Ghana. The mine has been in operation for ninety-six (96) years and has a total concession area of 175km<sup>2</sup>. Its current mining activities fall within the 4.6km<sup>2</sup> whiles historical working areas and various infrastructures such as the Nsuta Village, Mine Offices, and Workshops add-up to form a total land take of 8.98km<sup>2</sup> utilized by the project site at Nsuta in the Dadwen Extension of the concession.

This Annual Environmental Report has been prepared in respect of the year under review (i.e. 2012). It projects the environmental improvements in and around the mine including assistance to the communities within the Awudua and Esuaso Divisional Stool Councils.

During the year under review, Consolidated Minerals Limited Australia (CMLA) in Australia carried out the following technical and engineering updates, as per the scope of work of the technical services model:

- Updating of X-sections,
- Updating of the block volume,
- Geological and Resource modeling,
- Geotechnical advice,
- Exploration review, planning and summary of results,
- Quarterly reconciliation and updating of the mine plan for re-sequencing.

A JORC compliant review of the GMC mineral resources and ore reserves during the period July 2011 – June 2012 was conducted by SRK Consulting (phase 1). This exercise has been followed-up by a mineral resource estimate for the total GMC deposits, including pits A & B. This phase 2 will be concluded in H1 2013.

GMC Corporate Social Responsibility (CSR) program consists of four (4) components namely: Sustainable Alternative Livelihood Programs, Educational Bursary Scheme, Infrastructural Projects and General Support. In 2012, these programs continued with a total active expenditure of US\$343,688.63.

Infrastructural projects in communities were completed and successfully commissioned and handed over to the various communities for use and maintenance during the year under review.

GMC participated in the First-aid and Safety Competition during the year and placed second (2<sup>nd</sup>) in the overall National Competition having placed first (1<sup>st</sup>) in an earlier Zonal Competition.

In addition to the above, the following environmental activities were also carried out:

- EPA successfully conducted the 2011 Akoben audit on the 10<sup>th</sup> of May 2012. No major issues emerged however there were some recommendations by EPA. Based on the internal disclosure by EPA, GMC achieved a GREEN (high ranking) rating.

- Three hundred and forty-three (343) nitrogen fixing tree seedlings were nursed and planted on Hill B reclaimed site, residential areas, Zongo dump, golf course and along the Kawere stream.
- Forty-five (45) bunches of fresh plantain were harvested from the Hill B Reclamation Site and supplied to the GMC Catering Services.
- On a continuous basis, the company's Environmental Policy Statement was discussed with workers who had returned from their annual leave during HSE induction. This is to make them aware of the company's commitment to HSE issues and the role of employees in achieving the company's goal.
- As part of this year's World Environmental Day theme, one hundred and four (104) Acacia seedlings were planted on a piece of land near the Ofra and teak plantation whilst a hundred and twenty four (124) royal palm seedlings were nursed. These will be transplanted at vantage points to improve the aesthetic value of the mine.
- The Monitoring and Evaluation Manager and an officer of the Minerals Commission paid a day's monitoring visit to the mine. The visit was in fulfillment of the functions of the commission which enjoins it to monitor the operation of mining companies and report to the government.
- The Ankobra Basin Officer of the Water Resources Commission visited the mine for inspection of water bodies and their management.
- The Environmental Protection Agency organized a Public Hearing on 5th October 2012, at Tarkwa Bansa. This was in connection with the proposed re-entering of the Pit C North Project. Among the representatives and dignitaries present were the EPA, Ghana Manganese Company, Minerals Commission, Inspectorate Division, the MCE of Tarkwa Nsuaem Municipal Assembly, and Ghana News Agency, elders from the Esuaso Divisional Stool Council, the Tufuhene, elders and people of Tarkwa Bansa.
- The Inspectorate Division of the Minerals Commission visited the mine quarterly.

.....  
**Managing Director**  
 Ghana Manganese Co. Ltd

## 1.0 INTRODUCTION

Ghana Manganese Company Limited (GMC) is located at Nsuta near Tarkwa in the Tarkwa-Nsuaem Municipal Assembly. It is the only producing manganese mine in Ghana. Nsuta town is 4km from Tarkwa, the seat of the Tarkwa-Nsuaem Municipal Assembly (TNMA).

In 2012, GMC actively mined and developed Pit C. According to the pit and waste dump designs of the Life of Mine plan (LOM), GMC will move into other pits (A & B) in the future.

The mining method employed is exclusively open-cast, comprising drilling, blasting, loading and hauling. Thereafter the ore is processed (crushed and screened with no chemical addition) and stockpiled for transportation by rail and road to Takoradi Port for shipment.

The management of GMC, conscious that mining and its associated activities affect the environment in which it operates, ensures that within its economic limits and the need to be internationally competitive, the Company's activities are carried out with due cognizance of the Environment.

## 2.0 BRIEF DESCRIPTION OF COMPANY'S ACTIVITIES

### 2.1 Mining

During the year under review, mining operations were limited to Pit C. GMC's attention focused on the Pit C central and the southern sectors of the pit, involving cutback and establishment of a temporary access ramp for ongoing mining operations.

Manganese Carbonate ore was the main ore body exploited during the year under review with the budgeted stripping ratio of 1: 16.08 (ton: ton).

### 2.2 Mining Operations

Total ore mined during the year under review was 1,606,355 tonnes. This represents 103.3 % of the total budget figure of 1,554,815 tonnes (ref. tables 1 and 2 below).

<b>PIT C</b>	<b>Tonnage Mined</b>	<b>PIT C</b>	<b>Tonnage Mined</b>
Central West	117,705	Central West	5,817,531
Central W. North	552,730	Central W. North	2,896,905
Central East		Central East	4,524,004
Southwest	148,565	Southwest	2,630,043
Southeast	787,355	Southeast	6,557,203
<b>Total</b>	<b>1,606,355</b>	<b>Total</b>	<b>22,425,685</b>

*Table 1: Total ore mined for 2012.*

*Table 2: Total waste mined for 2012.*

Total waste mined during the year under review was 22,425,685 tonnes. This represents 89.7 % of the total budget figure of 25,006,839 tonnes (ref. table 2 above), resulting in an ore to waste stripping ratio of 1:13.96 (ton: ton). During the year under review, sub-soils totaling 8,301,007 metric tons were generated from development of Pit C Central West, Central East and Southeast footwall and hanging wall respectively and were stockpiled at the Hill B soft dump for future closure reclamation/ rehabilitation works.

### **2.3 Mine Geotechnical Assessment**

In 2012, the mines geotechnical assessment of slope design parameters for Pit C was reviewed. The revised analysis is based on previous logging data and on new information collected by Group Geotechnical Engineer for Consolidated Minerals.

The review mainly focuses on a revised assessment of the batter stability, recognizing the presence of a number of different structural domains with the pit. The relationship defining the overall slope angle to overall wall height for the fresh metasediments; and the slope design parameters for the oxide and transitional zones are still considered appropriate for the purposes of design.

### **2.4 Topsoil and Subsoil Management**

During the year under review, sub-soils totaling 8,301,007 metric tons were generated from development of Pit C Central West, Pit C Central East, Pit C South West and Pit C South East footwall and magazine wall respectively. The sub-soil mined was stockpiled at the Hill B dump extension sub-soil stockpile for use during future closure reclamation/ rehabilitation works. Action was taken to prevent erosion of the stockpile and that was by broadcasting peruvia seeds. Regular inspections at the mine face to ensure correct buffer zone, bench and berm parameters that are in compliance with Akoben Criteria was carried out during the year under review. Plates 1 and 2 show topsoil and subsoil management.



*Plate 1: subsoil stockpile*



*Plate 2: Hill B stockpile under construction*

## 2.5 Equipment Efficiency and Availability

Equipment efficiency and availability have been good. Tables 3 and 4 below show brief overview of availabilities and utilization of key equipment for the year.

<b>Equipment</b>	<b>Availability</b>	<b>Equipment</b>	<b>Availability</b>
Caterpillar dozers	93.3%	RH 30 excavators	82.5%
Komatsu dozers	85.5%	Motor graders	83.4%
RH 40 excavators	81.3%	Production Drill rigs	60.1%
CAT 777F	94.3%	Bucyrus RH 90C	94.8%
Articulated dump trucks	79.0%	Exploration drill rigs	78.2%
Komatsu 465/7dump truck	87.2%	Front End Loaders	91.7%

*Table 3: Overview of key equipment availability for the year 2012.*

<b>Equipment</b>	<b>Utilization</b>	<b>Equipment</b>	<b>Utilization</b>
Caterpillar dozers	88.4%	RH 30 excavators	77.3%
Komatsu dozers	67.5%	Motor graders	85.6%
RH 40 excavators	85.4%	Production Drill rigs	79.9%
Articulated dump trucks	79.6%	Exploration drill rigs	72.1%
Komatsu 465/7dump truck	91.3%	Front End Loaders	37.2%
CAT 777F	91.2%	Bucyrus RH 90C	90.5%

*Table 4: Overview of utilizations of key equipment for the year 2012.*

## 2.6 Exploration Activities on the Mine

Ghana Manganese Company Limited is responsible for planning and execution of exploration and in fill bore hole drilling program on the mine.

### 2.6.1 Exploration Sites

Currently, exploration and infill borehole drilling sites are concentrated in pit C Central west.

### 2.6.2 Drilling information

Reverse Circulation and diamond drilling rigs were used in the drilling exploration and infill grade control work executed in all the operational mine pits.

### **2.6.3 Reverse Circulation drilling**

Drilling pattern is a grid system which drill 15.0 meters along strike and 10 meters across strike with a maximum depth of 54.0 meters deep (i.e.  $15 \times 10 \times 54.0$  meters). In 2012, Reverse Circulation grade control drilling was executed in all the operational mine pits to gain knowledge on the control of the general grade distribution in each mine pit. Also Pit B was given on contract to assess possible increase in the manganese carbonate ore potential. Drilling pattern was done in a grid of 30x15x280 metres.

### **2.6.4 Diamond Drilling**

Diamond drilling on the mine is used to investigate the possible extension of Manganese Carbonate ore body which is the main product being mined. Depth drilled varies, depending on the purpose of study that is used for.

Four (4) wire line core drilling rigs are currently in operation (i.e. one (1) Boart long year 38 model machines and three (3) Atlas Copco wire line core drilling rig model CS14)

### **2.6.5 Pit A**

Diamond drilling of infill bore holes was completed at Pit A to re-drill the known mineralization with angled holes to confirm historical data and to convert inferred material into indicated resource.

### **2.6.6 Pit B**

Infill and exploration drilling on the main ramp of pit B was completed. All the holes were angled holes directed towards the existing mine pit with the view of intersecting possible extension of manganese carbonate ore.

### **2.6.7 Pit C South East**

Exploration drilling to investigate possible additional ore zones beyond the existing pit towards the soft waste dump, east of the mine pit will drilled in the year under review.

### **2.6.8 Pit C Central East**

Re-drilling of infill holes in known mineralized zones in pit C Central East were completed within the year. Most of the drilled boreholes intersected Manganese Carbonate ore which convert inferred material into indicated resource.

### 2.6.9 Pit C Central West

Re-drilling of infill holes in known mineralized zones in pit C Central west was completed. Purpose for this drilling exercise is to upgrade the existing manganese carbonate ore reserve and grade control distribution in the mine pits.

## 2.7 Development of PIT C

The LOM pit shell has been extended to enable maximum extraction of the ore body. The areas which fall within the pit shell needs to be developed to open-up so as to achieve the aims of the extended life of the mine. The pit has been re-designed as per standard bench heights and slope and to reach the ultimate pit bottom. Plates 3, 4, 5 and 6 show initial and progress stages of Pit C.



*Plate 3: Pit CCW before development.*



*Plate 4: Pit CCW under development.*



*Plate 5: Pit CCE before development.*



*Plate 6: Pit CCE under development.*



### 3.0 CARBONATE PROCESSING PLANT

During the year under review, the plant processed high and low grade material and achieved the set target for the year. Preventive and Planned maintenance were effectively carried out resulting in good Plant availability. Parts were replaced on some of the major equipment - Cone and Jaw crushers, Screens, Conveyors.

No major structural changes were undertaken in the plant. Only minor structural repairs were carried out as follows:

- 1 LUMP CONVEYOR: Replaced bad cross members;
- 2 LUMP CONVEYOR: Paint supports;
- SCREEN TOWER: Replaced two ladders.

Plates: 7 and 8 show Lumps # 2 conveyor supports and Screen tower ladder respectively. Belt splicing awareness training was conducted as part of GMC Safety procedures.



*Plates 7: shows Lumps # 2 conveyor supports*



*Plates 8: shows Screen tower ladder*

### 4.0 ENVIRONMENTAL PROJECTS FOR 2012

#### 4.1 Operation of Volatilization Pad (VP)

The company does not directly utilize or discharge hazardous chemicals into the environment due to the nature of its beneficiation process. However, hydrocarbons are used in machinery and equipment and therefore generate hazardous waste such as waste oil and hydrocarbon related



waste i.e. oil filters, rags, contaminated soils/saw dust were properly segregated and disposed off at the volatilization pad. All used oil filters are drained and crushed before disposal.

The pad is sited at Pit A close to the domestic waste dump. Plates 9 and 10 below show volatilization pad under operation.



*Plate 9 shows volatilization pad under operation.*

The pad, which measures about 20m x 20m, is lined with HDPE on which subsoil is put and compacted. This facility has been in existence for the past two (2) years. Within the first year, the HDPE was stolen on two occasions in the presence of security personnel on guard. This prompted management of the company to fence off the entire area in 2012 in order to prevent or avoid the material being stolen. The fencing was done and the facility was dully locked.

#### **4.2 De-silting of Kawere Stream**

Desilting of the Nsuta-Zongo stretch of the Kawere stream, which was part of EPA 2011 audit recommendation, has commenced. To serve as an employment opportunity, fifteen (15) workers drawn mainly from the Zongo community were contracted for the project. Field observation shows that work done is producing the desired result as water is flowing freely at previously stagnant portions of the stream.

#### **4.3 Pit “B” De-watering**

GMC Ltd planned to continue with its mining operations of Pit B and therefore has commissioned this investigation to provide guidance on the quality of the pit water and its subsequent management. The results of the survey will thus be used as a guide to evaluate the options for discharging the pit water into the general environment. The objectives of this study are to:

- determine the status of selected physical, chemical and biological parameters of water and sediment in Pit B and
- ascertain the potential effects of discharging the water into the general environment.

The volume of water in Pit B is thus computed to be 4,966,000 m<sup>3</sup>. The general physico-chemical status of Pit B water, with respect to the parameters of temperature, turbidity, hardness, hydrogen ion concentration, total dissolved solids, total suspended solids and surface water dissolved oxygen showed the water to be suitable for discharge as per the Ghana EPA Effluent Discharge Guidelines for mines and mining processes.

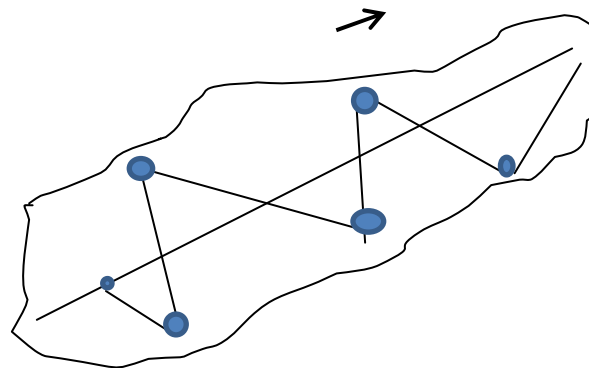
- Concentrations of heavy metals in the water column are below the maximum allowable limits for discharge into the environment.
- The low level of nutrients recorded from surface waters of Pit B, depict it to be an unproductive oligotrophic system with very little chances of eliciting eutrophication in the receiving water bodies.
- Risk assessment conducted on the viability of the pit waters being discharged into the general environment suggests a medium to low impacts of the water discharge on the environment. The overall impact significance is low.

Pit B water meets the effluent discharge guidelines of the Ghana Environmental Protection Agency and thus discharging Pit B waters into the environment will present little or no ecological problems in the environment

The water of PIT B was assessed for the physico-chemical, biological and elemental contamination status ahead of a possible discharge of water into the general environment to facilitate the continuation of mining of the pit. The study involved an in-situ assessment of the environmental parameters of ambient and water temperatures, total suspended solids (TSS), hydrogen-ion-concentration (pH), and dissolved oxygen (DO) among others. Water samples were also collected in acid-cleaned and rinsed sample bottles and transported to the laboratory for analysis of nutrients, microbiology and chemical elements. Eight heavy metals of ecological and biological importance including iron (Fe), arsenic (As), mercury (Hg), nickel (Ni), cadmium (Cd), manganese (Mn), copper (Cu) and lead (Pb) were collected and analyzed for their concentrations.



*Plate 11: View of GMC Pit B.*  
*area*



*Figure 1: Sketch of Pit B showing sampling area*

The levels of heavy metals in water were very low. With the exception of Fe ( $0.066 \pm 0.015 \text{ mg/L}$ ) and all the elements investigated recorded values below the respective equipment detection limits. Fe in sediment samples however, had comparatively higher mean values at  $67.325 \pm 7.87 \text{ mg/g}$ . High levels of Fe in such environments are expected and would not be expected to present any danger to the environment as the bottom mud and substrata will be managed before disposal. Results of the analysis have been submitted to EPA in support for a permit to dewater Pit B.

#### **4.4 Development of Environmental Department Staff**

As part of the company's in-house training program for employees, four (4) officials of the Environmental department were given a hands-on training in water and effluent quality monitoring to enhance the department's monitoring program in order to achieve good environmental stewardship. Plates 12 and 13 show trainees on practical session and the training session respectively.

Porta Lab Water Monitoring Equipment training took place from April 19-22, 2012 at the Environmental Department. It was conducted by a private consultant who took the staff of the Environmental Department through the use of this newly bought laboratory equipment.

The objectives of the training programme were:

- To build capacity of staff in water and effluent quality monitoring and
- To carry out hands on training for staff of the GMC environmental department to enhance their monitoring programme to achieve good environmental stewardship.



*Plate 12: Trainees on practical session*



*Plate 13: Training session*

The training consisted of three (3) main parts;

- Power point presentations on water pollution, the need for monitoring, sampling protocols and techniques.
- Familiarization of equipment making up the porta lab and principles of operation.
- Hands on training on the various equipment, calibration and usage (that is how to carry out the various tests of both micro-biological and physico-chemical parameters of water.)

Under water pollution, topics such as main causes of water pollution, point and nonpoint sources of water pollution were treated. The need to carry out quality monitoring and parameters to monitor depending on what the water is intended to be used for was also treated.

On water monitoring protocols, the presentation covered Definition of Sampling, Formulation of Sampling Objectives, Identification of Sampling Sites, Things to consider in selection, establishing a sampling station, Preparation, Selecting sampling bottles, sampling equipment, Sampling technique, Sampling and Preservation of samples.

The Portalab (Advanced Portable Water Quality Testing Laboratory) is said to be designed for combined testing of both the micro-biological and physico-chemical parameters of water. It is also suited for wide parameter surveillance or longer term monitoring where extreme accuracy is important, suitable for use either in the lab or the field and conforms fully to WHO guidelines on water quality monitoring. It consists of the P<sup>H</sup> meter, the turbid meter for measuring the turbidity, conductivity meter for measuring conductivity and Total Dissolved Solids (TDS), Arsenator for measuring the Arsenic level, Autoclave for micro-biological tests such as faecal coliform, Total coliform and E-coli, and Photometer for carrying out several tests on metals, nutrients etc.

The use of all equipment in the Portalab and others such as the autoclave were demonstrated and thereafter used by trainees under supervision so as to ensure officers are capable of handling the equipment and carrying out the various water quality analyses professionally.

A field trip was then embarked on to the GMC golf course where there is the sampling point named main reservoir/WP sump. Water was sampled and physical parameters which could be carried out in-situ such as PH, conductivity, temperature and turbidity were tested at the sample location. The water sample collected was then sent to the laboratory and other parameters tested for. The training although a very intensive one was very informative and trainees have become more confident in the collection of samples and analysing for the various water quality parameters which hitherto has been performed at SGS Laboratory.

In conclusion, the environmental officers are now well trained to carry out sampling and analyses of water quality. On this basis, there is the need for in-service training on the other monitoring aspects notably noise, dust and blast monitoring.

Within the year 2012, a total amount of One hundred and twenty nine thousand, three hundred and fifty nine dollars, sixty eight cents (\$129,359.68) was used on laboratory equipment and field implements by the department.

#### **4.5 Reclamation of Waste Dump**

The reclamation/rehabilitation of the Hill B waste dump was continued steadily for the year under review. In 2012 daily agronomic practices mostly weeding in and around the plantain and palm trees and application of NPK (15:15:15) fertilizers, pruning dead branches to improve aeration were carried out in the plantation to promote healthy growth and high yield.



*Plate 14: shows spreading of topsoil seedlings*



*Plate 15: shows current state of the palm*

Plantains inter-cropped with the palm trees, have started fruiting and on the average three bunches are harvested weekly to supplement workers and the hospital canteen. An appreciable quantity of cassava and plantain were harvested from the Hill B reclaimed site. See plates 14 and 15 above. The sizes of the crops (yield) were also found to be encouraging considering the maturity period of the crops. This is seen as a good indicator of the fertility of the soil at the reclaimed site.



The plantains on the farm after the first harvest continue to show good signs of better yield in the second year.

A second batch of cassava has also been planted which is expected to be harvested early next year so that a fair idea of its yield could also be known. Forty- five bunches of plantain were harvested from the reclamation site during the year under review.

#### **4.5.1 Weed Control**

Weeding as an agronomic activity was carried out daily on the land. This was done to get rid of any unwanted plant species from competing with the species for nutrients. Cutlasses were the only tool used for the weeding operation.

#### **4.5.2 Tree Seedling Nursery**

The tree nursery produced various tree species including Royal palm seedlings. At the nursery tree species such as *Senna siamea*, *Acacia alata*, *Terminalia superba*, *Polyalthal Longifolia* and *Royal palm* seedlings were raised in polypots and transplanted in various locations in the mine village. Three hundred and forty-three (343) nitrogen-fixing tree seedlings were nursed and planted along the pit periphery, residential areas, Zongo dump, and reclaimed site and along the Kawere stream.

Reclamation programs in the teak and ofram afforested areas were vigorously pursued during the year under review to promote ecological integrity of the site and surrounding landscapes. Various places including along the road from the main security gate to the hospital, Ofram and teak plantations and surroundings of the nursery were weeded.

Pruning of trees at some bungalows continued; dead and /or obstructing branches of trees were removed to improve their aesthetic value as well as avoid any unforeseen accident.

##### **4.5.2.1 Major Activities at the Nursery for the Year 2012**

The main activities carried out in the nursery within the year under review were generally, maintenance of the nursery such as weeding of surroundings, uprooting of weeds around seedlings and tree planting. Trees in residential areas were also pruned to improve their aesthetic value. Table 7 below demonstrates the number of trees planted on the mine and village in 2012.



S/N	Month	No. Of Tress Planted	Location	Type Of Trees Planted	Remarks
1	January	6	1. Stores Car Park	Royal Palm	Aesthetic Value
2	February	38 17 42 33	2. Golf Course 3. Golf Course 4. Roman School 5. Methodist School	Acacia Ofram Acacia Acacia	Aesthetic Value Aesthetic Value Shade & Aesthetic Value Shade & Aesthetic Value
3	March	11 31	6. Old Compound 7. New Compound	Ofram Acacia	Shade & Aesthetic Value Shade & Aesthetic Value
4	April	7  26	8. Along Police Station – Post Office Road 9. Behind Zongo Dump	Royal Palm  Acacia	Aesthetic Value  Aesthetic Value, Break Dust,
5	May	104	10. Near Ofram and Teak Plantation	Acacia	Shading and Aesthetic value
6	June	21	11. Golf Course	Royal Palm	Aesthetic Value
7	August	3	12. Along Police Station – Post Office Road	Royal Palm	Aesthetic Value
8	October	4	13. Administration Block	Royal Palm	Aesthetic Value

*Table 7: shows locations and number of trees planted in 2012.*