

# **ENVIRONMENTAL ASSESSMENT GUIDELINES FOR THE MANUFACTURING INDUSTRY SECTOR**



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Environmental Protection Agency  
under the  
Ghana Environmental Assessment Capacity Development Programme (GEACAP)  
and  
Ghana Environmental Assessment Support Programme (GEASP)**

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## FOREWORD

The Environmental Assessment Regulations, LI 1652, was promulgated in 1999 to give comprehensive legal cover to the Ghana Environmental Impact Assessment procedures. These Regulations require that all developmental activities likely to impact adversely on the environment must be subject to Environmental Assessment. The objective of the LI is to ensure that such development activities are carried out in an environmentally sound and sustainable manner. The requirements of the LI, however, place enormous responsibilities on all stakeholders involved in development in Ghana. The nature of the responsibilities varies for different stakeholders, depending on their statutory functions, areas of jurisdiction and interests such as policy makers, implementing or regulatory agencies, planning authorities, financial intermediaries or institutions providing training or consultants providing services in EIA.

A national Environmental Assessment Capacity Development Programme (GEACaP) was initiated in 2001 with financial assistance from the Netherlands Government. This was to assist all relevant institutions in meeting their respective obligations under the LI, and to promote sustainable development in Ghana. An important aspect of the programme was the development of Environmental Assessment Sector Specific Guidelines for eight sectors, namely; Transportation, Mining (revision), Tourism, General Construction & Services, Energy, Manufacturing, Agriculture and Health. Eight networks made up of representatives from relevant stakeholder institutions were formed to facilitate the development of the guidelines for these sectors. The key objectives of the Manufacturing Sector Core Team included:

1. Defining the screening criteria for environmental assessment for manufacturing sector investments.
2. Determining the scope of Environmental Impact Assessment (EIA) for the sector.
3. Providing systematic procedures on Environmental Impact Statement (EIS) preparations for the sector.
4. Providing guidelines on common potential impacts and mitigation measures.

This document covers all the areas outlined above and it is intended to provide guidelines for the conduct of environmental assessment in the manufacturing sector in Ghana

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2. Mr. Lambert Faabuleon EPA
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- 5.
- 6.



## ABBREVIATIONS

AER	Annual Environmental Report
AGI	Association of Ghana Industries
AGOA	African Growth and Opportunities Act
BPE	Best Practicable Environmental Operation
Cd	Cadmium
CEPs	Custom Excise And Preventive Service
CFCs	Chlorofluorocarbons
CO	Carbon Monoxide
CSIR	Council For Scientific & Industrial Research
DANIDA.	Danish International Development Agency
ECOWAS,	Economic Commission for West African States
EIA	Environmental Impact Assessment <sup>5</sup>
EIS	Environmental Impact Statement
EMP	Environmental Management Plan
EPA	Environmental Protection Agency
FAGE	Federation of Association of Ghanaian Exporters
GDP	Gross Domestic Product
GEACaP	Ghana Environmental Assessment Capacity Development Program
GIPC	Ghana Investment Promotion Centre
GNCCI	Ghana National Chambers of Commerce and Industry
GOG	Government of Ghana
Hg	Mercury
MoLGRDE	Ministry of Local Government and Rural Development and Environment
NBSSI,	National Board for Small Scale Industries
NepEP	National Environmental Policy
NGO's	Non-Governmental Organisations
NO	Nitrogen Oxides
NO <sub>2</sub> .	Nitrogen Dioxide

O <sub>3</sub>	ozone
Pb	Lead
PCB	Polychlorinated biphenyl.
PEF	Private Enterprise Foundation
PER	Preliminary Environmental Report
PERer	Preliminary Environmental Report
PM	Particulate Matter
SEA	Strategic Environmental Assessment
SO <sub>2</sub>	Sulphur Dioxide,
SOEs	State Owned Enterprises
TORor	Terms of Reference
TQM	
TRC	Technical Review Committee
TSP	Total Suspended Particulates (TSP)
USAID,	United Agency for International Development
VOCs	Volatile Organic Compounds
VRArA	Volta River Authority
WTO,	World Trade Organization
SOEs	State Owned Enterprises
SITC	Standard International Trade Classification

## Table of Contents

FOREWORD.....	ii
ACKNOWLEDGEMENT.....	iii
ABBREVIATIONS.....	v
CHAPTER ONE: BACKGROUND ON GHANA'S MANUFACTURING INDUSTRY SECTOR	1
1.0 Background.....	1
1.1 The Current Status of Sustainable Industrialization Policies.....	3
1.2 Critical Issues Highlighted in National Sustainable Industrialization (SI) Policies, Major Constraints and Proposed Solutions, etc. ....	4
1.3 Agencies, Programmes and Projects to Revamp Business and Industry .....	4
1.3.1 National Board For Small Scale Industries (NBSSI).....	4
1.3.2 Divestiture Implementation Programme.....	5
1.3.3 The Gateway Project.....	5
1.3.4 Trade and Investment Programme .....	5
1.3.5 The Ghana Free Zone Board.....	5
1.3.6 Private Enterprise Foundation (PEF) .....	5
1.3.7 Association of Ghana Industries (AGI) .....	6
1.3.8 Ghana National Chambers of Commerce and Industry (GNCCI) .....	6
1.3.9 Federation of Association of Ghanaian Exporters (FAGE).....	6
1.4 Need for the Sector Specific Environmental Assessment Guidelines for Manufacturing Industry Sector .....	7
1.4.1 Objectives of the Guidelines .....	7
1.4.2 Scope of The Environmental Assessment Guidelines for the Manufacturing Industry Sector.....	8
CHAPTER TWO: SECTOR RELATED ACTIVITIES .....	9
2.0 Introduction.....	9
2.1 Schedule 1 Undertakings.....	9
2.2 Schedule 2 Undertakings.....	10
2.3 Screening of Undertakings in the Manufacturing Industry Sector.....	11
2.3.1 Legal Framework .....	11
2.3.2 General Considerations.....	12
2.3.3 Further Reports .....	12
2.3.4 Special Conditions, Refusal to Issue of Permit.....	12
2.3.5 Referrals.....	13

2.4	Screening Criteria.....	13
2.4.1	Rating of Criteria .....	14
2.5	Explanatory Notes on Ratings of Criteria .....	17
2.5.1	Registration Requirements.....	17
2.5.2	Protected/Ecologically Sensitive Areas .....	17
2.5.3	Potential Pollution Impacts .....	18
2.5.4	Other Rating Considerations.....	18
CHAPTER THREE: POTENTIAL IMPACTS FROM MANUFACTURING INDUSTRIES		20
3.0	Introduction.....	20
3.1	Air Pollution.....	20
3.1.1	Volatile Organic Compounds (VOCs).....	20
3.1.2	Particulate Matter (PM) .....	20
3.1.3	Particulate Matter (PM <sub>10</sub> ).....	20
3.1.4	Heavy Metals .....	21
3.1.5	Carbon Monoxide (CO) .....	21
3.1.6	Carbon Dioxide (CO <sub>2</sub> ) .....	21
3.1.7	Chlorofluorocarbons (CFCs) .....	21
3.2	Water Pollution .....	21
3.2.1	Eutrophication.....	22
3.2.2	Saprophication .....	22
3.2.3	Bacterial .....	22
3.2.4	Toxic Effects.....	22
3.2.5	Impact on the Bottom Layer of Water Bodies .....	22
3.2.6	Acidification .....	22
3.3	Soil and Groundwater Pollution.....	22
3.4	Hazardous Compounds and Waste.....	24
3.5	Ambient Noise.....	24
3.6	Occupational Health and Safety .....	25
3.6.1	Chemical Hazards .....	25
3.6.2	Physical Hazards.....	25
3.6.3	Biological Hazards.....	25
3.7	Major Accidents and Fires .....	26
3.8	Socio-economic Effects.....	26
3.9	Other Secondary Effects.....	27



CHAPTER FOUR: MITIGATION OF ENVIRONMENTAL IMPACTS .....	29
4.0 Introduction.....	29
4.1 Scope of Mitigation Guidelines.....	29
4.1.1 Principles of Cleaner Production .....	29
4.1.2 Technical Measures .....	30
4.1.3 Resources .....	32
4.1.4 Hazardous Compounds and Waste .....	36
4.1.5 Waste Treatment .....	36
4.1.6 Ambient Noise .....	36
4.1.7 Socio-Economic Effects.....	37
4.1.8 Other Secondary Effects .....	38
4.2 Occupational Health and Safety.....	38
4.2.1 Hearing Protection .....	38
4.2.2 Head Protection.....	38
4.2.3 Eyes Protection .....	38
4.2.4 Respiratory Protection .....	38
4.2.5 Foot Protection.....	38
4.2.6 Hand Protection .....	38
4.2.7 First Aid Equipment.....	38
4.2.8 First Aid Personnel and Training.....	39
4.2.7 Proper Ventilation, or Air Conditioning.....	39
4.2.8 Proper Sanitary Conditions .....	39
4.2.9 Health and Safety Manual.....	39
4.2.10 Air Pollution in Work Place.....	39
4.2.11 Chemical Hazards .....	40
4.2.12 Noise .....	40
4.3 Emergency Plans, Fires and Extinguishers .....	40
4.3.1 Emergency Plan .....	40
4.3.2 Environmental Reporting.....	40
4.3.3 Communication.....	40
4.3.4 Central Control Area.....	40
4.3.5 First Aid .....	41
4.3.6 Medical Service Back up .....	41
4.3.7 Evacuation.....	41

4.3.8	Search and Rescue Plan .....	41
4.3.9	Control of Hazardous Materials.....	41
4.3.10	Confirming Pollution and Clean-up.....	41
4.3.11	Material and Supplies .....	41
4.3.12	Mock Drills .....	41
4.4	Handling of Fire Hazards .....	41
4.4.1	Class “A” Fires and Extinguishers.....	42
4.4.2	Class “B” Fires and Extinguishers.....	42
4.4.3	Class “C” Fires and Extinguishers.....	42
4.4.4	Class “D” Fires and Extinguishers.....	42
4.5	Monitoring and Reporting.....	42
4.6	Environmental Management .....	44
4.6.1	Human Resource Development .....	44
4.6.2	Environmental Management System (EMS) .....	45
APPENDICES .....		50
Appendix 1: Environmentally Sensitive Areas .....		50
Appendix 2: Environmentally Quality Guidelines.....		52

**LIST OF FIGURES**

Figure		Page
1.1	Number of establishments by industrial sector.....	10
1.2	Number of persons engaged by industrial sector.....	11
1.3	Output by industry sector.....	11

**LIST OF TABLES**

Table		Page
1.1	Contribution of various sectors to Gross Domestic Product.....	8
3.1	Sound Levels and Examples of Sources.....	29
3.2	The Nature of Fire.....	31
4.1	Typical Common Pollution Control Equipment for Various Pollutants.....	34
4.2	Advantages and Disadvantages of fabric Filter Systems (Baghouses).....	34
4.3	Advantages and Disadvantages of Electrostatic Precipitators (ESPs).....	36
4.4	Level of air Emissions that should not be exceeded (EPA draft Stack Emission Standards).....	36
4.5	Ambient Air Quality Standard and Measurement Methods Standard.....	36
4.6	General Effluent Quality Guidelines for Discharge into Natural Bodies.....	37
4.7	Ambient Noise Level Standards.....	40
4.8	A Two-step Approach in Identify Hazards and Mitigative Measures.....	42
4.9	A Selection Occupational Threshold Limit Values (TLV) for Work Place, Based on 8-hours Daily Exposure for Adults.....	43
4.10	Overview of Environmental Monitoring Parameters and Possibilities, both emissions and Ambient Monitoring.....	47



## CHAPTER ONE: BACKGROUND ON GHANA'S MANUFACTURING INDUSTRY SECTOR

### 1.0 Background

Ghana's economy has been growing steadily with an annual GDP rate of 4-5% since 2001, which is relatively high among African countries. Growth further accelerated in 2004 and 2005, achieving the annual rate of 5.8%. The trend of strong growth that started in 2003 is attributable to enhanced agricultural production. Sale from cocoa production in particular grew by 16%, 30% and 13% between 2003, 2004 and 2005 respectively and served as a vehicle to push GDP upward. These successful results were driven by the continuous rise in cocoa beans price after 2002 and the growth trend in volume of export since 2003. This reflects that the Ghanaian economy is subjected to the volatile nature of this international commodity. On the other hand, the diamond exports have grown on a value basis since 2003, while the mining sector's growth rate fell below that of the national economy.

The agriculture and livestock sector, which accounts for one fourth of GDP, has been maintaining the annual growth rate of over 5% to 6% in recent past. In contrast, the manufacturing sector has been relatively slow (with GDP ? 5% or less) in recent years, except for 2005. Between 2003 and 2005, its growth rate fell below the national average. Similarly, the service sector has experienced moderate growth of 5% or less, except for 2005.

**Commented [H1]:** Do we have growth rates available for the period beyond 2005 specially as these guidelines are being finalized 5 years later

Table 1.1: Gross domestic product - constant 1993 prices (Billions of Cedis, Growth rate %)

	2000	2001	2002	2003	2004	2005*	% (2005)
<b>AGRICULTURE</b>	<b>1,849.1</b>	<b>1,923.5</b>	<b>2,007.2</b>	<b>2,128.9</b>	<b>2,288.4</b>	<b>2,437.6</b>	<b>37.0%</b>
		<b>4.02%</b>	<b>4.35%</b>	<b>6.06%</b>	<b>7.49%</b>	<b>6.52%</b>	
Agriculture and Livestock	1,251.7	1,314.3	1,382.6	1,455.9	1,533.1	1,625.1	25%
		5.00%	5.20%	5.30%	5.30%	6.00%	
Cocoa Production and Marketing	177.9	176.1	175.2	204.0	265.0	300.0	4.5%
		-1.01%	-0.51%	16.44%	29.90%	13.21%	
Forestry and Logging	182.1	190.8	200.4	212.6	225.0	237.6	3.6%
		4.78%	5.03%	6.09%	5.83%	5.60%	
Fishing	237.4	242.2	249.0	256.4	265.4	275.0	4.2%
		2.02%	2.81%	2.97%	3.51%	3.62%	
<b>INDUSTRY</b>	<b>1,295.3</b>	<b>1,333.3</b>	<b>1,396.2</b>	<b>1,466.8</b>	<b>1,542.1</b>	<b>1,628.4</b>	<b>24.7%</b>
		<b>2.93%</b>	<b>4.72%</b>	<b>5.06%</b>	<b>5.13%</b>	<b>5.60%</b>	
Mining and Quarrying	285.9	281.4	294.0	307.8	321.7	331.4	5.0%
		-1.57%	4.48%	4.69%	4.52%	3.02%	
Manufacturing	471.7	489.1	512.6	536.2	560.8	591.7	9.0%
		3.69%	4.80%	4.60%	4.59%	5.51%	
Electricity and Water	132.3	137.9	143.5	149.5	155.1	165.4	2.5%
		4.23%	4.06%	4.18%	3.75%	6.64%	
Construction	405.4	424.8	446.1	473.3	504.6	539.9	8.2%
		4.79%	5.01%	6.10%	6.61%	7.00%	
<b>SERVICES</b>	<b>1,525.3</b>	<b>1,602.7</b>	<b>1,678.1</b>	<b>1,756.7</b>	<b>1,839.8</b>	<b>1,939.5</b>	<b>29.4%</b>
		<b>5.07%</b>	<b>4.70%</b>	<b>4.68%</b>	<b>4.73%</b>	<b>5.42%</b>	
Transport, Storage and Communication	244.9	258.4	273.1	288.9	305.1	323.4	4.9%
Wholesale and Retail Trade, Restaurant and Hotels	351.5	360.4	300.1	400.6	420.7	455.0	
Finance, Insurance, Real Estate and Business Services	220.0	229.9	242.5	255.2	267.4	282.4	4.3%
Government Services	564.8	593.0	614.4	639.0	667.1	700.5	
Producers of Private non-profit Services	97.3	103.6	108.2	112.6	117.3	122.3	1.9%
	46.8	48.3	49.8	51.4	53.2	55.1	
<b>SUB-TOTAL</b>	<b>4,669.7</b>	<b>4,859.2</b>	<b>5,081.5</b>	<b>5,352.5</b>	<b>5,670.3</b>	<b>6,005.5</b>	<b>91.0%</b>
Net Indirect Taxes	472.4	497.9	519.3	542.2	565.5	590.6	9.0%
<b>EQUALS : G.D.P. in Purchasers' Values</b>	<b>5,142.1</b>	<b>5,357.1</b>	<b>5,600.8</b>	<b>5,894.6</b>	<b>6,235.8</b>	<b>6,596.1</b>	<b>100.0%</b>
		<b>4.18%</b>	<b>4.55%</b>	<b>5.25%</b>	<b>5.79%</b>	<b>5.78%</b>	

Note \*: Provisional

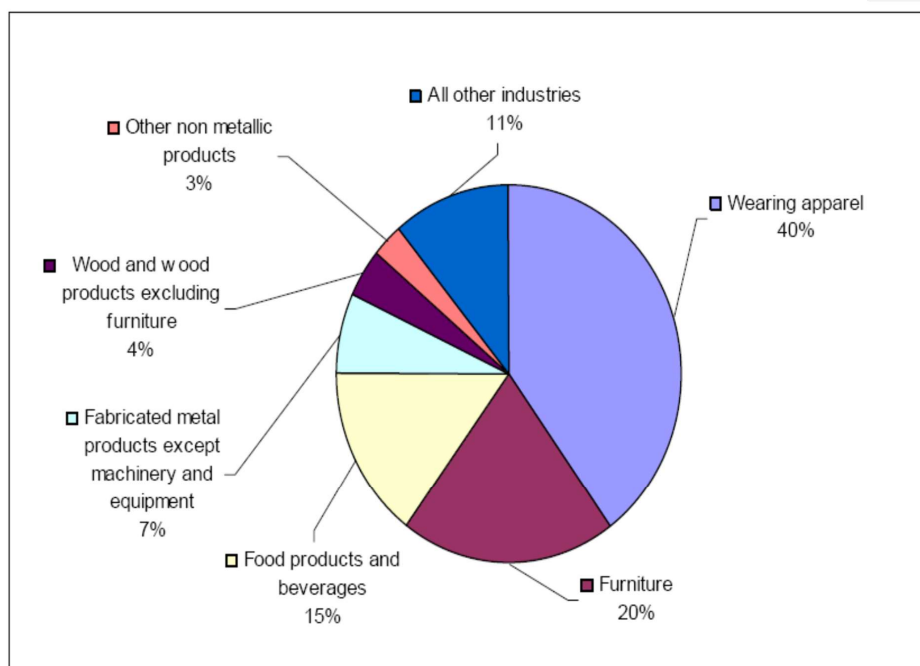
Source: Bank of Ghana

Currently the GDP share of manufacturing sector is about 9% and it has not changed for the last decade. In addition, GDP share for agriculture, industry and service are 37%, 25% and 29% which have been stable since 2000.

Based on the National Industrial Census 2003 issued in June 2006, the manufacturing industries in the country are broadly classified and their proportion by number is, presented in Fig.1. below, is, which was conducted in two phases between October 2003 and February 2005. Industrial classification is based on Standard International Trade Classification (SITC) Version 98. The census covers “recognizable establishments” and does not include all household industries.

### Industry Sector

In the country’s manufacturing industry, companies manufacturing apparel (40%), furniture (20%), and food and beverage (15%) account for three fourths in terms of the number of establishments, and the apparel industry holds a dominant share. (Number of total establishments is 24,133.).



Source: National Industrial Census 2003

Figure 1.1: Number of establishments by industrial sector

The food and beverage industry is also a key sector in terms of output, reflecting the fact that agriculture is the country's major economic base and provides a variety of materials for industries using or processing them, while the industry includes products that serve the domestic market, such as flour, cooking oil, and beverages (both alcohol and non-alcohol). Finally, the apparel industry's production is so small that it is included in "all other industries" category although the industry occupied 40% of total establishments.

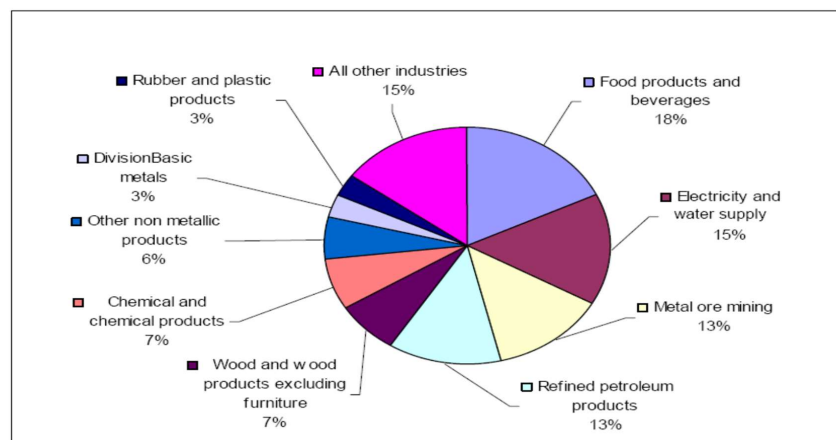


Figure 1.2: Output by industry sector

### 1.1 The Current Status of Sustainable Industrialization Policies

To reverse the poor performance of the industrial sector, the Government of Ghana through the Ministry of Trade and Industry approached UNIDO in 1998 for support. After due consultations and the fielding of missions, an Integrated Industrial Development Programme was formulated and adopted in 1999.

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Commented [H3]: What form of support?

The Integrated Programme is aimed at building capacity for the development of growth-oriented and competitive Micro, Small and Medium Enterprises (MSMEs) by addressing a number of structural weaknesses and imbalances in the industrial sector including:

- Over concentration of industrial activity in few locations (Accra, Tema, Kumasi, Sekondi and Takoradi)
- The absence of effective linkage between large firms and the MSME segments,
- The "missing middle" as an integrating and dynamic force of industrial development
- Very little integration of rural areas and rural population into industrial activity.

Ghana's integrated programme operates through the following five (5) components:

- Policy Development Implementation and Monitoring
- Capacity Building for Industrial Competitiveness (with emphasis on agro-based MSMEs)
- Networking services for MSMEs.
- Cleaner Production and Environmental Protection
- Industrial Energy Efficiency and renewable Energy Development.

## 1.2 Critical Issues Highlighted in National Sustainable Industrialization (SI) Policies, Major Constraints and Proposed Solutions, etc.

The critical issues highlighted include:

- Putting the private sector, and private entrepreneurs, in the driving seat for industrial development
- Ghana's industrial development strategy is about Enterprise competitiveness strategy
- Healthy Private Public Partnership needed to ensure industrial development.

The major constraints impeding business/industrial development and some actions to address them are:-

- i. **Weak Policy Co-ordination**
  - Establish Private Public Partnership (PPP) for industrial development and competitiveness, embracing all key stakeholders, to jointly own the policy and ensure its implementation.
- ii. **Lack of Cost Competitiveness Infrastructure**
  - Integrate Ghana and ECOWAS utilities as part of privatization/deregulation actions to ensure an attractively large market for potential investor or suppliers.
  - Develop specific policies for private public partnership for development of infrastructure
- iii. **Limited Market Size**
  - Increase market size through strengthening ECOWAS
  - Exploit market access opportunities under the Lome Convention, AGOA, WTO, etc.
- iv. **Inadequate Finance and Credit**
  - Increase in Industrial Finance Institutions to develop sustainable and financially viable industrial activities
  - Create a special fund for industrial development
  - Develop and foster domestic savings
- v. **Macro Economic Instability**
  - Manage the real exchange rate to remain at a competitive level once achieved
  - reduce government's "crowding out" effect in the domestic credit market
  - Simplify tax remittance procedures
- vi. **Inadequate Technology**
  - Strengthen the relationship between the private sector and research institutions
  - Establish a national support for industrial Research and Development
  - Facilitate the commercialization of Research and Development opportunities.
- vii. **Low skills Development**
  - Government and private sector to initiate and develop a manpower needs plan
  - Strengthen the relationship between higher education institutions and the private sector

## 1.3 Agencies, Programmes and Projects to Revamp Business and Industry

### 1.3.1 National Board For Small Scale Industries (NBSSI)

Act 434 established the NBSSI in 1985 to oversee the growth of micro and small-scale industries in Ghana. The Board developed a policy document that sought to assist micro and small-scale industries in technology and product development, market development, inter



industry linkage and networking, entrepreneurship development, financing and to promote enterprise culture through counseling and guidance for the self-employed.

### **1.3.2 Divestiture Implementation Programme**

A large number of State Owned Enterprises (SOEs) have operated in the manufacturing and agricultural sectors. The SOEs were characterized by poor financial performance and low productivity. The divestiture programme was launched by the government in 1988 in response to the need to make the enterprises more efficient and to reduce their dependence on the public sector.

### **1.3.3 The Gateway Project**

The objectives of the project are to implement measures designed to attract a critical mass of export-oriented forms and facilitate trade to accelerate growth through:-

- Development of off-site infrastructure for privately financed export processing zone; and
- Improvement of the quality and standards of services delivered by institutions and agencies responsible for trade and investment.

It also seeks to increase the competitiveness of Ghanaian products in the global market vis-à-vis the reform of legislative, regulatory and incentive systems, institutional strengthening and capacity building, development of private participation and consensus building. The total project cost US\$ 560 million and is being financed by the World Bank/IDA, the Ghana Government and Local private Investors.

### **1.3.4 Trade and Investment Programme**

The manufacturing sub-sector was supposed to benefit from several initiatives taken under Structural Adjustment programme (SAP) to produce for export. One of such programme is the Trade and Investment Programme (TIP). Under TIP constraints inhabiting public and private sector activities in technical and institutional matters were to be addressed to create an enabling environment for expansion.

### **1.3.5 The Ghana Free Zone Board**

The Free Zone Board was set up in 1995 by an Act of Parliament (Act 504). The Act affords free zone enterprise the right to produce goods and services, which are not hazardous to the environment for export. Enterprise established in the free zones enjoy some privileges, which include total exemption from payment of direct and indirect duties, and levies on all export commodities manufactured in the free zones.

### **1.3.6 Private Enterprise Foundation (PEF)**

PEF is the premier private sector umbrella organisation founded through the initiative of four (4) major business associations viz-Association of Ghana Industries, the Ghana National Chamber of Commerce and Industry, Ghana Employers Association and Federation of Association of Ghanaian Exporters, with the financial assistance from USAID, the Government of Ghana and DANIDA.

PEF provides leadership in private sector coordination, advocacy, promotion and support (technical, managerial, marketing and financial). Through cooperation with the Trade Union Congress, PEF promotes industrial harmony by active involvement in wages and service conditions negotiations and education, to achieve higher productivity. Above all, PEF is to

promote production of excellent, superior and global competitive goods and services, promote creativity and good business practice, to ensure long-term success and growth of the private sector.

#### **1.3.7 Association of Ghana Industries (AGI)**

The AGI is a non-profit voluntary business association with more than 1500 members-large, medium and small industries-operating in all parts of Ghana. Members-companies of the Association, from both the private and the public sectors, account for the majority of the nation's industrial output. The main objectives of the Association are:-

- To provide a central organisation for the promotion of the interests of industry in Ghana
- To study, support or oppose legislative or other measures affecting industry in Ghana
- To consider all concerns connected with industries in Ghana and to present the views and suggestions of industry to Government.

#### **1.3.8 Ghana National Chambers of Commerce and Industry (GNCCI)**

Members of GNCCI is open to any registered established in all sectors of the economy including trade, banking and insurance, motor and transport, shipping and ports operations, manufacturing industries, professional services, export, agriculture and fishing, and building and engineering.

The main objective of GNCCI is to provide the sector a constant flow of commercial intelligence and a range of practical services designed to help their business operations. The GNCCI is charged with the following functions:

- Promotion and protection of trade, commerce, industry and manufacturing
- The collection and circulation of statistics relating to trade, commerce, industry and manufacturing
- Provision of facilities for the communication and interchange of views between members of the chambers on the one hand and departments of Government, public institutions and other associations.

Additionally GNCCI provides services in communications, research and seminars to members.

#### **1.3.9 Federation of Association of Ghanaian Exporters (FAGE)**

It was felt that a strong private sector responsive to building up the capability of its members and talking to Government with one voice will go very far and spearhead the achievements of set goals. With the setting up of a private not for profit organization, Ghana's private Sector dynamism can achieve results as it has in other countries.

FAGE a private non-government, apolitical, non-profit making organization, was established with the assistance of USAID and Government of Ghana under the trade and Investment Programme (TIP). The mission of FAGE, inter alia is:-

- To be the umbrella organization, which represents the interests of the exporters of non-traditional products, particularly interests common to its members as well as those of the individual associations.
- To work towards the expansion and diversification of Ghana's exports to foreign markets and to raise the productivity of exporting firms

- To guide and influence collective efforts of private business enterprises in Ghana to serve the development needs of the non-traditional sub-sector.

#### **1.4 Need for the Sector Specific Environmental Assessment Guidelines for Manufacturing Industry Sector**

The Environmental Assessment Regulations 1999, LI 1652 require that all developmental activities including the manufacturing industry activities likely to impact adversely on the environment must be subject to Environmental Assessment. In order to ensure compliance with the requirements of the EA regulations sector specific guidelines would have to be developed that can help standardize impact assessment process and improve practice in the manufacturing sector..

Industry is the key to the accelerated socio-economic development of the country. As industrial growth gathers momentum, there will be a need to ensure that it does not result in environmental degradation or in any way mars environmental sustainability that may have serious implications on labour productivity and resources availability. Further, a large part of the increased industrial growth is envisaged to occur through export of manufacturers to developed countries. In these destination markets, environmental standards have been and will continue to become more demanding.

Unless Ghanaian producers are able to comply with environmental standards stipulated by the importing countries, prospects for exports may weaken. For these reasons, the Ministry of Trade and industry is ensuring that, as part of an accelerated growth strategy, measures have been initiated to permit a pattern of industrial growth compatible with environmental concerns.

##### **1.4.1 Objectives of the Guidelines**

The specific objectives for developing the these *Environmental Assessment Guidelines for the Manufacturing Industry Sector* include the following:

- (i) to provide guidance to EIA Administrators and proponents on the level of environmental assessment required for various categories of industrial activities
- (ii) Provide an overview of the potential environmental impacts and possible mitigative measures that should be considered for a given project, including r guidance on pollution thresholds.
- (iii) to serve as an important source of information on sound environmental management and operational practices for proponents during the project inception and preparatory phases. This will ensure that environmental aspects are considered early enough in the project cycle, thereby, ensuring incorporation of appropriate mitigative measures to reduce pollution problems.

#### **1.4.2 Scope of The Environmental Assessment Guidelines for the Manufacturing Industry Sector**

The guidelines addresses the following four main elements to ensure good practices in environmental management of impacts associated with manufacturing industry :

- i. description of pollution sources and effects;
- ii. recommendation of the mitigative measures to control and reduce or prevent pollution;
- iii. recommendations on the maximum permissible emission levels (air emissions, water discharges, noise levels etc.); and
- iv. monitoring activities that should be considered for the manufacturing industry sector.

## CHAPTER TWO: SECTOR RELATED ACTIVITIES

### 2.0 Introduction

Under the Ghana Environmental Assessment Regulations, 1999 (L I 1652) undertakings are categorized into Schedules 2 and 1 representing those for which Environmental Impact Assessment (EIA) is mandatory and those that may require only registration.

### 2.1 Schedule 1 Undertakings

Schedule 1, Regulation 1(1) of the EA regulations provides a list of undertakings requiring registration and Environmental permit. This category of undertakings may be adequately assessed at the registration and preliminary assessment levels. These include the following:

#### 2.1.1 *Meat and poultry products-*

- abattoirs;
- meat, fat or oil processing facilities
- poultry processing facilities

#### 2.1.2 *Fish products*

- flours, prepared cereal foods and feeds-
- feed mills

#### 2.1.3 *Beverages*

- distillery products;
- brewery products;
- wines

#### 2.1.4 *Rubber products*

- tyres and tubes;
- rubber hoses and beltings;
- Other rubber products

#### 2.1.5 *Plastic Products*

- foamed and expanded plastic products;
- plastic pipes and pipe fittings;
- plastic films and sheeting;
- other plastic products

#### 2.1.6 *Leather and allied products*

- Leather and allied products
- Leather tanneries

#### 2.1.7 *Primary textile*

- man-made fibres and filament yarns;
- spun yarns and woven cloths;
- broad knitted fabrics

#### 2.1.8 *Textile products*

- natural fibres processing and felt products;
- carpets, mats and rugs;
- Canvas and related products
- Other textile products

**2.1.9 Wood**

- sawmill, planing mill and shingle mill products industries;
- banners and plywood;
- Other wood products;
- wood preservation facilities which use hazardous chemicals or similar chemical process;
- particle board or wafer board production.

**2.1.10 Paper and allied products**

- pulp and paper;
- asphalt roofing;
- other converted paper products.

**2.1.11 Primary metals**

- Fabricated metal products

**2.1.12 Transportation equipment**

- Shipbuilding and repairs;
- Facilities engaged in building and repairing all types of ships above 4,000 tones displacement including marine production platforms for petroleum, natural gas or mineral resource extraction.

**2.1.13 Non-metallic mineral products**

- Refined petroleum products
- Chemical and chemical products
  - industrial chemicals;
  - agricultural chemicals;
  - plastics and synthetic resins;
  - Paints and varnishes.
  - soaps and cleaning compounds;
  - other chemical products

**2.1.14 Other manufacturing**

- Scientific and professional equipment
- Photographic films and plates manufacturing;
- floor tiles, linoleums and coated fabrics manufacturing;

**Commented [H4]:** Is it films and goods?

**2.1.15 Other manufactured products.****2.2 Schedule 2 Undertakings**

Schedule 2, Regulation 3 of the Environmental Assessment Regulations stipulates undertakings for which Environmental Impact Assessment (EIA) is mandatory.

- Chemical - where production capacity of each product or combined products is greater than 100tonnes/day.
- petrochemicals-all sizes or raw materials requirements of 100tonnes/day or greater;
- non-ferrous metal-smelting-
- Aluminum-all sizes;
- Copper-all sizes;
- Others-producing 50tonnes/day and above products;
- Non-metallic-cement-
- Lime - 10tonnes/day and above burnt lime rotary kiln or 50tonnes/day and above vertical kiln.

- Iron and steel;
- Shipyard;
- Pulp and paper.

### **2.3 Screening of Undertakings in the Manufacturing Industry Sector**

The environmental permitting process is to ensure that any new undertaking, process, plant or equipment that are likely to have significant impacts on the environment are assessed for their environmental impact prior to installation or operation. All processes, plant and equipment installed must meet minimum national and international environmental quality standards. Often the specification of commonly or best available technology will mean that performance is well above the minimum standards.

An initial step, to be taken in the preliminary stages of project planning, is to screen the proposed project. This is a preliminary examination for determining whether or not the project is likely to involve significant environmental effects. using guidelines, checklists, positive lists etc. The Schedules 1 and 2 of the Environmental Assessment Regulations 1999, LI 1652 provides a list of projects that require various levels of assessment.

Screening can determine the obligation for an EIA; and the likely environmental impacts of a project to be expected

If the output of this determination were to indicate that the project is not likely to have significant negative/minor/insignificant impacts, then the Environmental Permit can be given to the proponent based on the screening report.

If the screening report indicates that a follow-up study is needed, then an appropriate Environmental Impact Statement (EIS) report is to be prepared by the proponent of the project. This is to be prepared in sufficient scope and detail to enable the Technical Review Committee (TRC) of the EPA to evaluate the overall worth of the project in terms of economic benefits versus possible impairments to precious environmental resources or values.

#### **2.3.1 Legal Framework**

Screening criteria are covered in Regulation 5 (1) & (2) and regulation 6 of the Environmental Assessment Regulation, 1999 (LI 1652). These regulations specify the requirement of preparing a screening report prior to constructing a plant or establishing equipment or altering the process, taking into consideration the following:

- (a) The location, size and likely output of the undertaking;
- (b) The technology intended to be used;
- (c) The concerns of the general public, if any, and in particular concerns of immediate residents if any;
- (d) Land use; and
- (e) Any other factors of relevance to the particular undertaking to which the application relates.

Regulation 5(2) of the EA Regulations also requires that an applicant shall for the purpose of enabling the Agency, determine the level of environmental assessment of his undertaking, prepare and submit to the Agency a report on the undertaking that must indicate:

- (a) The environmental, health and safety impacts of the undertaking;
- (b) A clear commitment to avoid any adverse environmental effects which can be avoided in the implementation of the undertaking;
- (c) A clear commitment to address unavoidable environmental and health impacts and steps where necessary for their reductions; and
- (d) Alternatives to the establishment of the undertaking.

Regulation 6 of the EA Regulation requires that after the screening under regulation 5 the Agency shall issue a screening report on the application and shall state in the screening report whether the application

- (a) is approved; or
- (b) is objected to; or
- (c) requires submission of a preliminary environmental report; or requires the submission of an environmental impact statement.

### **2.3.2 General Considerations**

- i. EPA encourages prior discussion/consultation and/or the submission of draft Form EA1 to provide feedback to the client about the content of the application. Feedback on drafts should normally be given within a matter of days.
- ii. All attachments to Form EA1 must contain clear, concise and unambiguous conditions, which precisely specify the obligations of the proponent.
- iii. The final screening report should give a balanced view of the important works to be installed in a project in order to protect the environment. This means that the screening report may contain conditions that relates to works already proposed by the applicant particularly if the works are critical in relation to environmental protection.
- iv. As with any assessment, the degree of the assessment should be related to the complexity and potential for impact.

### **2.3.3 Further Reports**

- i. The outcome of screening may require further reports or investigations to be completed. Normally a date would be specified for their submission before the environment permit is issued.
- ii. Where EPA has specified the requirement for the installation of any equipment not earlier proposed by the applicant, all design details should be submitted before the issuance of the environmental permit. .

### **2.3.4 Special Conditions, Refusal to Issue of Permit**

- i. If a Partner department (e.g. Ghana Wildlife Division, Ghana National Fire Service or other relevant department) advises EPA that public health or the environment will be endangered as a consequence of the proposed undertaking, EPA **must** refuse to issue approval.
- ii. If the undertaking is prohibited by a planning scheme, EPA must refuse to issue approval. Environmental permit is not issued until zoning status has been clarified by the Town and Country Planning Department.



- iii. If a planning permit is required but has not yet been issued, a standard condition must be included in the approval specifying that the environmental permit does not take effect until the planning permit is issued.
- iv. Regulation 21(2) of the Environmental Assessment Regulations states that “Failure to commence operation of the undertaking within 18 months renders the permit invalid after the period.

### 2.3.5 Referrals

- i. The purpose of referrals is for::
  - a. Ensuring that all directly affected organizations, including local interest groups, community groups & interested adjacent landholders, are aware of it and are given opportunity to provide comments to EPA;
  - b. Receiving requisite background information from organizations in their particular areas of expertise to supplement EPA’s assessment; and
  - c. Receiving an indication of potential impacts, from the perspective of other organizations.
- ii. All directly affected organizations should be given the opportunity to comment on an application to guide the Agency in taking a decision on the project and to avoid potential legal complications should an objection to EPA’s decision be made at a later stage.
- iii. The extent to which an application is referred should depend upon its complexity and potential for impact.
- iv. The EPA is responsible for:
  - a. Determining the relevant stakeholders to which an application should be referred; and
  - b. Ensuring that an application is referred to all relevant stakeholders.
- i. All comments received must be taken into account. The relative merit of each comment must be judged and assessed. This may mean adding or changing proposed environmental permit conditions to ensure that valid concerns are addressed. If concerns are of a serious nature then a Public Hearing should be held in accordance with Regulation 17 of LI 1652. Contacts made with protection agencies and their comments should be noted.
- ii. Although specific times are defined for the receipt of comments (e.g. 21 days for comments from public n
- iii. otices) late comments should normally be accepted unless there is good reason not to do so.

### 2.4 Screening Criteria

The following criteria are used to classify undertakings into Low (L) Potential Impact Magnitude, Medium (M) Potential Impact Magnitude and High Potential Magnitude:

- i. Staff strength
- ii. Annual turnover
- iii. Sensitivity of proposed project site
- iv. Potential pollution impacts
- v. Potential traffic impacts
- vi. Potential occupational health and safety hazards
- vii. Potential fire and explosion hazards
- viii. Potential impact on flora and fauna

- ix. Potential impacts on ecosystem goods and services
- x. Potential to deal with environmental impacts

### 2.4.1 Rating of Criteria

A rating system, based on ten-point scale and three-point scale for sub-criteria, to assess proposals with respect to various attributes of the above criteria is suggested here in the guideline. The overall impact significance will be determined from the total ratings of all the criteria and the final interpretation will be as follows:

Total Rating Points (Potential Impact Magnitude)	Potential Environmental Impact Significance	Screening Decision
39 and below	Low (L)	Issue Permit
40-69	Medium (M)	Provide additional information or Conduct Preliminary Environmental Assessment (PEA)
70 and above	High (H)	Permit denied or Conduct Environmental Impact Assessment (EIA)

#### 2.4.1.1 Rating of Staff Strength

Number of Staff	Rating	Impact Potential
1-9	1	L
10-19	2	
20-29	3	
30-39	4	M
40-49	5	
50-59	6	
60-69	7	H
70-79	8	
80-89	9	
90 and above	10	

#### 2.4.1.2 Rating of Annual Turn Over

Annual Turn Over (US\$)	Rating	Impact Potential
Up to 100,000	1	L
200,000	2	
300,000	3	
400,000	4	M
500,000	5	
600,000	6	
700,000	7	H
800,000	8	
900,000	9	
1,000,000 and above	10	

#### 2.4.1.3 Rating of Location Sensitivity (See Legend)

- (a) Proximity to river or other freshwater body

Location	Rating	Impact Potential
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**Commented [H5]:** Wetland functions, size and quality of the water body is also an important criteria for determining potential impact. A small wetland supporting endangered species of high conservation significance located more than 500 meters may have greater impact potential than a larger water body having higher pollutant load located 500m away from the project site.

More than 1000metres	1	L
Between 500metres and 1000m	2	M
Within 500metres	3	H
Alteration of wetland and water body functions	3	H
Water quality impacts	3	H

## (b) Proximity to Environmentally Sensitive Areas

Location	Rating	Impact Potential
More than 1000metres	1	L
Between 500metres and 1000m	2	M
Within 500metres	3	H

\*Environmentally Sensitive Areas are defined by the Schedule 5 of the Environmental Assessment Regulations

## (c) Proximity to Sensitive Receptors (e.g. Schools, Hospitals etc)

Location	Rating	Impact Potential
More than 1000metres	1	L
Between 500metres and 1000m	2	M
Within 500metres	3	H

## (d) Proximity to rural settlements

Location	Rating	Impact Potential
More than 1000metres to settlements of less 100 people	1	L
Between 500metres and 1000m to settlements of more than 100 people but less than 500	2	M
Within 500metres to settlements of 500+ population	3	H

## (e) Proximity to Urban Settlements

Location	Rating	Impact Potential
Location within industrial and commercial zone of less 100 people	1	L
Between 500-1,000m from residential area of settlements of more than 100 -500 people	2	M
Within 500m from a residential area of more than 500 people	3	H

## (e) Concerns of the General Public

## (f)

Concerns	Impact Potential	
No objections	1	L

Minor concerns	2	M
Strong objections (Verbal and written objections and demonstrations)	3	H

#### 2.4.1.4 Potential Pollution Impact

##### (a) Potential Pollution Impacts (Discharges into water)

Potential Impact Magnitude	Rating
L	Within the EPA Environmental Quality Guidelines (1-3)
M	Potential to exceed EPA Guidelines by up to 60% (4-6)
H	Potential to exceed the EPA Guidelines by more than 60% (7-10)

##### (b) Potential Pollution Impacts (Emissions into air)

Potential Impact Magnitude	Rating
L	Within the EPA Environmental Quality Guidelines (1-3)
M	Potential to exceed EPA Guidelines by up to 60% (4-6)
H	Potential to exceed the EPA Guidelines by more than 60% (7-10)

##### (d) Potential Pollution Impacts (Discharges on to land)

Potential Impact Magnitude	Rating
L	Within the EPA Environmental Quality Guidelines (1-3)
M	Potential to exceed EPA Guidelines by up to 60% (4-6)
H	Potential to exceed the EPA Guidelines by more than 60% (7-10)

##### (e) Potential Pollution Impacts (Noise nuisance)

Potential Impact Magnitude	Rating
L	Within the EPA Environmental Quality Guidelines (1-3)
M	Potential to exceed EPA Guidelines by up to 60% (4-6)
H	Potential to exceed the EPA Guidelines by more than 60% (7-10)

#### 2.4.1.5 Potential Traffic Impacts

Traffic	Rating	Potential Impact Magnitude
Low	1	L
Medium	2	M
High	3	H

#### 2.4.1.6 Potential Risks of Occupational Health and Safety Hazards

Potential Risk or OHS hazards	Rating	Potential Impact Magnitude
Low risks	1	L
Moderate risk	2	M
High risks	3	H

#### 2.4.1.7 Potential Fire and Explosion Hazards

Potential Fire and explosion hazards	Rating	Potential Impact Magnitude
Low risks	1	L
Moderate risk	2	M
High risks	3	H

#### 2.4.1.8 Potential Impacts on flora and fauna and biodiversity

**Commented [H6]:** How do you measure low, medium and high traffic to determine the level of impact and its rating. This guideline must provide a guidance on evolving a criteria to qualify traffic just as guidance has been provided to qualify other parameters. Traffic volume based on number of vehicles per day operating in an area can help determine impact potential due to anticipated changes in the traffic volume associated with the proposed development. Fuel use and type of vehicle have also been used in some assessments in some countries.

**Commented [H7]:** Criteria for defining low, moderate and high risk is needed for ranking. Possibility of handling hazardous wastes, processing or production of hazardous chemicals and volatile substances (never, sometimes and always) could be used to determine potential impact and the rating of risk associated with the project.

**Commented [H8]:** Similarly, levels of risks have to be qualified based on the possibility (never, sometimes and always) of handling of inflammable substances explosives and volatile substances. The nature of operations can also be additionally considered in the rating criterion.

**Commented [H9]:** Rating of impact based on size of land impacted may not be the best option to capture the impacts on flora and fauna. Number of species of animals and plants reflecting overall species diversity and the number of protected species found reflecting conservation importance of land on to be impacted would also need to be considered for more assessing the impact potential more realistically

Land Area	Rating	Potential Impact Magnitude
Up to 0.50 ha	1	L
0.51-1.0ha	2	M
1.00 ha and above	3	H

#### 2.4.1.9 Capacity to Deal with Environmental Impacts (Technological Inputs)

Capacity to deal with environmental impacts (See Legend)	Rating	Potential Impact significance
High Capacity	1	L
Moderate Capacity	2	M
Low Capacity	3	H

#### 2.4.1.10 Capacity of Receiving Medium (Air, Water, Land) to accommodate Pollutants

Capacity to deal with environmental impacts (See Legend)	Rating	Potential Impact significance
Low Capacity (receive less pollutants)	1	L
Moderate Capacity	2	M
High Capacity	3	H

## 2.5 Explanatory Notes on Ratings of Criteria

### 2.5.1 Registration Requirements

The criteria used in the screening exercise ...requires that proponents conduct basic baseline environmental quality monitoring (air quality, noise levels, and water quality where appropriate) as part of the registration and preliminary assessment.

### 2.5.2 Protected/Ecologically Sensitive Areas

Protected/ecologically sensitive areas refer to those listed in Schedule 5 Regulation 30 (2) of LI 1652 as follows:

- i. All areas declared by law as national parks, watershed reserves, wildlife reserves and sanctuaries including sacred groves.
- ii. Areas with potential tourist value.
- iii. Areas, which constitute the habitat of any endangered or threatened species of indigenous wildlife (flora and fauna)
- iv. Areas of unique historic, archaeological or scientific interests.
- v. Areas, which are traditionally occupied by cultural communities or those that provide resources for sustenance of tribal and indigenous people (fishing areas, fuel and fodder resources, medicinal plants etc.)
- vi. Areas prone to natural disasters (geological hazards, floods, rainstorms, earthquakes, landslide, volcanic activity etc).
- vii. Areas prone to bushfires.
- viii. Hilly areas with critical slopes
- ix. Areas classified as prime agricultural lands.
- x. Recharge areas of aquifers.
- xi. Water bodies characterized by one or any combination of the following conditions:
  - a. Water tapped for domestic purposes;
  - b. Water within the controlled and/or protected activities.
- xii. Mangrove areas characterized by one or any combination of the following conditions:

- a. Areas with primary pristine and dense growth;
- b. Areas adjoining mouth of major river system;
- c. Areas near or adjacent to traditional fishing grounds;
- d. Areas, which act as natural buffers against shores erosion, strong winds or storm floods.

### **2.5.3 Potential Pollution Impacts**

- The Potential Pollution Impacts of a proposed undertaking will be based on the previous year's average of Monthly Environmental Quality Monitoring returns (MEQMRS) of similar existing undertakings in the country as compiled from EPA's Industrial Database and lessons learnt during monitoring visits of similar undertakings.
- The parameters to be used for determining Potential Pollution Impact will be as follows:
  - i. Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD)
  - ii. Total Suspended Solids (TSS)
  - iii. pH
  - iv. Noise levels
  - v. Conductivity
  - vi. Bacteriological quality
  - vii. Selected air emissions (PM<sub>10</sub>, TSP, SO<sub>2</sub>, NO<sub>x</sub>, CO)
  - viii. Three other parameters on sub-sector specific bases (These will be agreed upon prior to the issue of guideline).

### **2.5.4 Other Rating Considerations.**

- Individual reviewers should independently rate the potential impact based on individual ratings for screening criteria and then the overall potential impact should be calculated based on an average of these individual ratings.
- As a means of crosschecking the ratings and reducing subjectivity, a group of experts with technical knowledge on the specific industry sub-sector should be given the opportunity to score the proposals. Where the scores are comparable, an overall average could be used. Where there is a wide disparity in the ratings, the exercise may be repeated for the worst scenario selected.
- Where the proponent fails to provide adequate information to enable the reviewers rate the proposal, additional information should be requested.
- Proponents should be encouraged to submit draft completed Form EA1 to EPA for comments and advice before submitting the final form for screening. Normally such advice could be provided within hours.
- Where comprehensive data and financial resources are adequate, modeling should be conducted and GIS maps produced to provide a clear picture of the potential environmental impacts
- Weightings may be attached to the various criteria and it is proposed that these be decided by the review team on a site-specific basis. A total weighting of 100% could then be divided among the relevant criteria taking into consideration the peculiar circumstance at the proposed/alternative project sites.

- Reviewers are encouraged to recommend additional criteria for the screening of applications.

## CHAPTER THREE: POTENTIAL IMPACTS FROM MANUFACTURING INDUSTRIES

### 3.0 Introduction

This chapter describes the potential impacts on the environment and humans caused by manufacturing industry. Impacts include air pollution, discharges to water, noise among others.activities.

### 3.1 Air Pollution

Emissions to air are usually found as dusts or gases. Dusts are likely to result in health problems when concentrations exceed threshold limits. In addition, dusts often contain toxic materials like heavy metals, chloro-organic substances or tars.

The most common gaseous emissions are- sulphur dioxide (SO<sub>2</sub>), Carbon Monoxide (CO) and Nitrogen Oxides (NO<sub>x</sub>) all produced by burning of fossil fuels and as products of various industrial processes. NO<sub>x</sub> is a term used for a mixture of NO and NO<sub>2</sub>. Both components may cause respiratory problems for humans. The effect of SO<sub>2</sub> is compounded when found in combination with small particles of dust. High concentration of SO<sub>2</sub> may cause direct effects on vegetation ( necrotic lesions). Sulphur and Nitrogen compounds are the main constituents of acid rain and may cause acidification of surface water, groundwater and soils. Corrosion of materials is caused by these components. NO<sub>x</sub> is also a precursor to ozone formulation.

#### 3.1.1 Volatile Organic Compounds (VOCs)

This is group of compounds, which is a product of the burning of fossil fuels, and is emitted from various chemical activities. Some of the VOCs may be carcinogenic (e.g. PAH, Benzene). Some of the VOC can cause work place problems. The main problem with VOC is its importance in building high ambient air concentrations of ozone (O<sub>3</sub>).

Ozone (O<sub>3</sub>) is a photochemical oxidant and is a gas not emitted, but produced in the atmosphere when air masses containing a mixture of NO<sub>2</sub>, CO and VOC are exposed to sunlight. O<sub>3</sub> at ground level can give various effects e.g. changes in the lung function of human causing respiratory suffering. O<sub>3</sub> is also known to cause damage to forest and vegetation, and materials such as rubber and plastics. In addition to ground level O<sub>3</sub>, which is regarded as a pollutant, O<sub>3</sub> gas is found at higher elevations in the atmosphere. This O<sub>3</sub> layer is vital to living organisms as it traps the harmful part of the ultra-violet rays and shields the earth from their harmful effects (see also CFCs below).

#### 3.1.2 Particulate Matter (PM)

Dust is particles of various sizes. Several terms associated with sampling methods are used to describe particulates. The two most frequently used terms are Total Suspended Particulates (TSP) and the Particulate Matter (PM). The PM includes particles of various sizes and includes a proportion of particulates that are not able to enter the human respiratory tract. Therefore, PM is not a good indicator of health-related exposure.

#### 3.1.3 Particulate Matter (PM<sub>10</sub>)

This includes only particles smaller than 10µm in diameter (microns or micrometer). These are considered respirable. Since dust ranges from 0.1-25µm, most dust is respirable. PM<sub>10</sub> is estimated to be 50-60% of TSP. Particles larger than PM<sub>10</sub> settle more readily than smaller particles. However, smaller particles have a proportionally larger surface area than larger



particles. Therefore, small particles present more of an opportunity for toxic materials to get in contact with the surface of the lungs and be absorbed. Furthermore, dust can also transport smaller particles of carcinogenic compounds. Sometimes a third group is introduced, the fine fraction (PM<sub>2.5</sub>) with particles less than 2.5µm in diameter. These are mainly produced by burning of fossil fuels etc. Whereas the larger fractions are mainly mechanically produced (earth dust, water and tear).

Dust particles larger than PM<sub>10</sub> which may be called settleable dust, deposit in the vicinity of the source. A deposition rate of approx. 10g/m<sup>2</sup> per 30 days or more in most industrialized countries is regarded as high, but in many countries in Africa a rate of 10g/m<sup>2</sup> per 30 days is not regarded as high. A deposition rate of 3g/m<sup>2</sup> per 30 days or more is considered normal background deposition rate in unpolluted areas. In areas near a desert the background deposition level will be higher, e.g. in Cairo approx. 50g/m<sup>2</sup>.

### 3.1.4 Heavy Metals

Heavy metals as air pollutants originate from many different sources like combustion of oil products, industrial processes, and incineration of waste. The metals are usually found as dust in the form of oxide, and other compounds. The metals most focused upon, due to their very serious environmental effects (long term effects like bio-accumulation as well as high acute toxicity) are Mercury (Hg), Cadmium (Cd) and Lead (Pb).

### 3.1.5 Carbon Monoxide (CO)

Carbon monoxide (CO) also originates from the burning of fossil fuels and some industry process. CO is normally not considered a pollutant affecting the ambient air quality, but rather causing a workplace health problem. The gas reduces the uptake of oxygen in the blood and can, at high concentrations and long exposure times, be fatal. CO increases the risk of heart problems (angina pectoris) that may cause chest pain. CO is converted to CO<sub>2</sub> in the atmosphere.

### 3.1.6 Carbon Dioxide (CO<sub>2</sub>)

Carbon Dioxide is a product of burning of fossil fuels, cement production, metal production, and as a result of deforestation. CO<sub>2</sub> is the most important greenhouse gas contributing to global warming. Other components contributing to the global warming are dinitrogen oxide (N<sub>2</sub>O) and methane (CH<sub>4</sub>).

### 3.1.7 Chlorofluorocarbons (CFCs)

Chlorofluorocarbons (CFCs) are used as refrigerants or in cooling systems and halon is used in stationary fire fighting systems. The CFCs cause depletion of the ozone layer protecting the earth from the dangerous ultra-violet (UV)-radiation. Their use is, therefore, restricted by the Montreal Protocol, which has been signed by most of the African countries.

## 3.2 Water Pollution

Discharge of wastewater may contain pollutants both in the form of suspended solids and dissolved compounds. The effects of water pollution may be divided into four groups; eutrophication, saprophication, bacterial growth, toxic effects and acidification.

### **3.2.1 Eutrophication**

Eutrophication is caused by large supplies of nutrients (nitrogen and phosphorous) and/or dissolved organic matter. The consequences are increased growth of algae and/or consumption of too much of the oxygen in the receiving waters in the degradation process of organic matter, resulting in anaerobic or near anaerobic conditions. This is a threat to fish and other living species.

### **3.2.2 Saprophytication**

Saprophytication refers to oxygen deficiency caused by decay of organic materials.

### **3.2.3 Bacterial**

This refers to the presence of harmful bacteria from sources such as sewage and wastewater from slaughterhouse and other sources.

### **3.2.4 Toxic Effects**

Toxic effects are related to the discharges of heavy metals, chlorinated organic compounds and bio persistent (not degradable) organic compounds. The toxic effects may be acute as well as chronic. The chronic effects are the environmentally most serious. Examples of compounds, which may cause chronic effects, are mercury, cadmium, lead, DDT, PCD (polychlorinated biphenyl) and pentachloro phenol.

### **3.2.5 Impact on the Bottom Layer of Water Bodies**

Impact on the bottom layer is caused by too large supplies of either suspended organic or inorganic material (e.g. by accidental oil spill). The suspended solids will precipitate to the bottom and in case of too high or long lasting sedimentation rates; destroy the natural habitat of the bottom layers. If the suspended solids are organic, anaerobic conditions will develop in the new top sediment.

### **3.2.6 Acidification**

Acidification is closely linked to the atmosphere emissions of acidic gases like SO<sub>2</sub> and NO as described in para 3.1. In the atmosphere the gases are oxidized forming sulphate and nitrate compounds. Deposition of both sulphur and nitrogen compounds may cause acidification of surface water and soil.

In Africa, acidification problems are observed in the vicinities of some Chemical Industrial Plants and Refineries.

## **3.3 Soil and Groundwater Pollution**

Airborne pollutants (e.g. SO<sub>2</sub>, acid rain, dust, ozone, heavy metals etc.), surface water pollutants and deposited hazardous materials may cause serious soil and ground pollution.

Vegetation, soil and groundwater are important parts of our life cycle. The vegetation may be affected directly by airborne gases like e.g. SO<sub>2</sub> and ozone, or indirectly through e.g. acidification of the soil causing imbalance in the uptake and content of nutrients. These problems have been known for long time in the industrialized world in Europe and North America. Parts of West Africa and the south Eastern coast of Africa are known to have sensitive soil with respect to acid rain. Furthermore, acidification is identified as a possible future problem in parts of West Africa.

Grain and other agricultural products used for food for humans or animals may take up heavy metal and other accumulating hazardous compounds. The result of these effects may be reduced growth of important agricultural products and an increased human uptake of toxic materials through polluted food.

Pollutant discharges to soil or ground water can cause serious damages to drinking water resources . Both organic and inorganic chemicals and materials pose a threat to the ground water quality. Acidified soil is known to increase the leakage of aluminum in the ground water. When the polluted ground water reaches surface water, toxic effects as described in the previous chapter may occur.

Curing a site with polluted ground or groundwater is normally very expensive. This has convinced many industries about the fact that 'prevention is better than cure'.

### 3.4 Hazardous Compounds and Waste

Many industries use hazardous and toxic materials and other chemicals in their production. Proper handling, storage and use of these materials are necessary to avoid accidents, which may harm people and the environment.

Waste from industrial operations may often be separated into hazardous wastes, and wastes to be disposed of as ordinary household waste. In the first group, we typically find waste oil, solvents, tars, PCB (Polychlorinated Biphenyl), dust and sludge containing soluble heavy metals or other toxic substance, and asbestos. Because of their potential harmful effects, such waste must be disposed of or treated separately in an environmentally acceptable manner. Around the world, more than 80,000 chemicals are being commonly used today. Some of these chemicals are known to be extremely hazardous and can cause death through ingestion, inhalation or skin contact. Various international declarations and conventions relevant to hazardous chemicals and waste have been signed.

Other wastes can usually be handled by the municipal waste treatment systems. Some non-hazardous waste types like bark and wooden waste may be used as fuel while other may be processed as animal feed.

### 3.5 Ambient Noise

Ambient noise can cause sleep disturbance for people living close to industrial premises. Noise levels should therefore be lower at nighttime than during the day. More often, noise is a serious problem for people working on site and is therefore considered as an occupational health and safety problem.

Noise levels are measured in decibels (dB). If the level of sound is increased by 3dB, it would seem to the ears as if the sound intensity has doubled. Certain instruments measure the level of sound by an "A" scale, which is a scale of the frequencies heard by the human ear. Measurements done on this scale are referred to as dB(A). Table 3.1 give examples on various sound levels.

Table 3.1 Sound levels and examples of sources

Range	Sound level in dB(A)	Sources
Harmful range	140	Jet engine
	130	Riveting hammer
	120	Propeller aircraft
Critical zone	110	Rock drill
	100	Plate fabrication shop
	90	Heavy vehicle
Safe range	80	Very busy traffic
	70	Private car
	60	Ordinary conversation
	50	Soft music from radio
	40	Quiet whisper
	30	Quiet urban dwelling\
	20	Rustle of a leaf
	10	THRESHOLD OF HEARING

### 3.6 Occupational Health and Safety

Several of the activities related to an industrial site might cause harm to the workers. In several cases an incident may cause a threat to both the environment and the workers. The most common occupational health hazards can be divided into four categories:

#### 3.6.1 Chemical Hazards

Chemical Hazards, such as mist, vapours, gases fumes, dusts, smoke. Chemical substances can harm the skin, eyes, or result in toxic effects through physical contact or inhalation. Compounds like benzene and PAH are known to cause cancer. Quartz dust and asbestos can lead to serious damages to lungs. Many heavy metals and solvents are known to cause serious occupational health effects.

Intake of chemical compounds in the body is generally through breathing (most common), through contact with skin, oral intake or through injunction (e.g. when working with high-pressure air or liquids, or with sharp objects as in laboratories).

#### 3.6.2 Physical Hazards

Physical hazards may result from noise, radiation, extremes of temperature and humidity, air pressure, vibrations, electricity, microwaves, lasers and infrared and ultraviolet radiations.

Noise is common in many industry sectors. Machinery and engines generally produce noise levels of 85-100dB(A) or above that may impair hearing or may even cause deafness. In addition, noise may cause increase heart rate and increased blood pressure. Furthermore, noise also stresses other parts of the body, causing abnormal hormonal secretions, muscle tension, nervousness, sleeplessness and fatigue. Examples of sound sources and critical levels are found in the box above.

Other accidents which may cause acute injuries or be fatal for the workers may occur (e.g. cuts from sharp objects, sliding on a slippery surface, workers being hit by falling objects, a body part being trapped in working machinery, explosions etc).

#### 3.6.3 Biological Hazards

This refers to occurrence or increase in pests, contaminants and disease vectors such as insects, mould, fungi, bacteria, viruses, gastro-intestinal parasites and other agents. Occupations involving food or food processing, plants and animals, laboratory personnel, research personnel etc. all have high levels of exposures to disease vectors. Miners and farmers are particularly at a great risk because of the contact with the soil. In addition to the infectious agents and disease vectors described above, one should also bear in mind risks of snake and dog bites in work place ***Ergonomic Hazards***

Ergonomics is the science of people at work. It is concerned with making the interface of the man/machine/work environment as safe, efficient and comfortable as possible. Typical concerns include workstation design, work posture, manual materials handling, work/rest cycles and seating. Both the psychological and the physiological aspects of the workplace are important.

Improper lifting techniques and poor workplace design are sources of several injuries and postural disorders each year. Ergonomic solutions to a problem may be as simple as adding a

footrest to a workbench, providing an adjustable stool, raising the work surface to a comfortable level or avoiding incorrect lifting methods.

### 3.7 Major Accidents and Fires

Several processes and substances used in industry have a potential for creating major accidents in the form of explosions and fires or releases of toxic and harmful gases. Examples of such “high risk” factors are the production of poisonous gases like chlorine (Cl<sub>2</sub>), Sulphur dioxide (SO<sub>2</sub>) and ammonia (NH<sub>3</sub>), production of toxic chemical like pesticides and production or use of iso-cyanates, mercury, explosives or reactive substances like hydrogen. Oil refineries and petrochemical plants and many other industries, as well as storage tanks for gasoline and other flammable liquids and gases, are susceptible to fires and explosions. Certain equipment like smelting furnaces, chemical reactors or processes operating under high pressure and/or high temperature are prone to serious accidents.

The behaviour of fire from its inception through the complete burning process is entirely predictable. It follows well-defined patterns, often referred to as the “nature of Fire”. Fire itself is a chemical reaction known as combustion, in which combustible material is oxidized rapidly. There are four important factors in a fire-oxygen, fuel, heat and the chain reaction. Removal of one of these elements rapidly extinguishes the fires (see Table 3.2).

Table 3.2 The Nature of Fire

	The Four Element of a Fire
Fuel	Any material that can be oxidized rapidly such as wood, paper, oil grease, certain metals, dust, gases and so forth. Fires are classified according to the type of fuel involved (see section 4.3.2)
Oxygen	Fire needs only 16% oxygen to burn. The air we breathe contain 21% oxygen. The more oxygen available, the more intense the fire becomes. Some fuels contain sufficient oxygen within their make-up to support burning and therefore, may burn in an oxygen-fuel environment.
Heat	Often confused with temperature, heat is a type of energy said to be in “disorder”, while temperature is a measure of that disorder. Heat can also reignite a fire that has been “put out” if the extinguishing agent has not cooled it sufficiently.
Chemical chain reaction	The fuel is initially heated, putting off a gas or vapour that is ignited, but as the fire sets up a chain reaction, the fuel itself begins to burn, and may continue until all of it is consumed.

### 3.8 Socio-economic Effects

Large-scale industrial development may affect the socio-economic and socio-cultural conditions of an area. During the project identification and preparation phases it is important to focus on the existing and traditional ways of management of the natural resources and production. The local population often has knowledge and experience about sustainable consumption of the natural resources. In marginal and extremely vulnerable ecosystems, traditional management of the natural resources may represent the optimum use of these resources.

The local population in many areas can be strongly tied to the natural resource base and to utilization of local natural resources. The moving of people and their activity to other areas

because of the establishment of an industry many cause conflicts and unpredictable indirect environmental impacts. The establishment of an industrial plant may cause a development process, which may induce changes in the population's socio-cultural and health conditions and material benefits. Indigenous people are especially vulnerable to be receptors of undesirable changes in cases where industry establishments may have diverse and several negative impacts.

Various socio-cultural conditions may have extensive impacts on the working conditions of the industry. For instance, the division of labour may be strict and related to gender, prestige, class, age, religion, etc. women comprise an increasing share of the industrial workers in many countries, and they are often exposed to poor and hazardous working conditions and paid low salaries.

Population movement and demographic changes as a consequence of an industrial establishment may cause increased exploitation of the natural resources in places where the new settlements emerge. In new settlement' areas, pressures may increase due to greater demands for drinking water resources, increase in volumes of wastewater and solid wastes, and increase in exploitation of forests sources for fuel and building materials. Increased settlement may also create pressure on agricultural areas.

An industry project normally generates employment in other sectors, e.g. transport, maintenance, service functions and public administrations. Depending on the conditions, each industrial job can generate 2-3 jobs in other sectors. The establishment of respective infrastructure and buildings will turn cause impacts on the environment.

### **3.9 Other Secondary Effects**

Industrial activities may constitute a threat to biodiversity, because of the location and the nature of the activity (e.g. mining for raw material, and exploitation of forests e.g. for pulp and paper industry).

The natural forest of the African continent contains tens of thousands of plant species, many of which have not been identified or studied. Globally, it is assumed that 50-90% of all living species is found in tropical forests. Traditional rural live hoods in much of Ghana benefit from plant diversity for the continuous supply of different foods as well as other necessities, and to compensate for the vicissitudes of climate. Progress in biotechnology, agriculture, animal husbandry and forestry will depend to a great extend on the development of new strains and cultivates from the wild plant genetic resources. If the wide variety of species is not adequately safeguarded, in the long-term many species will be lost forever due to the irrational exploitation of forest and through other land clearing activities.

Erosion and sedimentation is a major environmental problem in Africa. Timber logging and other industries must be aware of the possible effects of removing the forest cover of an area. Mining is an example of an industry where man-made changes in landscape can accelerate detrimental erosion processes.

Many industrial plants take up large land areas or are very dominating in the landscape. Open pit mining will often cause an aesthetic and visual impact. Industrial establishments are often implemented without the assistance of architects and landscape specialists. An important preventive measure is to ensure that this type of visual impacts are contained during the planning stage. During the construction it is important to restrict unnecessary cutting of trees, excessive excavation and deposition of superfluous excavated masses. In the operational phase,

important aspects such as regular maintenance and housekeeping must be undertaken responsibly for disposal of all wastes.

In addition, stagnant water collected in man-made pits may become a breeding ground for malaria transmitted mosquitoes or other diseases. Care should be taken to minimize these negative impacts.



## CHAPTER FOUR: MITIGATION OF ENVIRONMENTAL IMPACTS

### 4.0 Introduction

The purpose of mitigation in EIA is to:

- look for better ways to implement project activities so that negative impacts of the activities are eliminated or minimized and the environmental benefits are enhanced;
- make sure that the public or individuals do not bear costs which are greater than the benefits which accrue to them.

Remedial action can take several forms, i.e. avoidance, mitigation and compensation:

- **Avoidance** or prevention is of course the most desirable and can be achieved through modifications of plans, designs or schedules.
- **Mitigation** is the application of design, construction or scheduling principles and practices to minimise or eliminate (occurring) effects. Mitigation measures include restoration and rehabilitation of ecosystems, re-creation of habitats and natural resources.
- **Compensation** is often associated with *residual* impacts (that is after prevention and mitigation) and generally involves monetary payments for damage caused by the project. For example, compensation of resettled farmers for income lost (as a result of the construction of a hydroelectric dam).

Effective mitigation requires a proper understanding of the problem. The feasibility of mitigation and compensation measures should be assessed from financial, technical, social and political viewpoints.

### 4.1 Scope of Mitigation Guidelines

The general guidelines for the mitigation of environmental impacts in the manufacturing industry should cover the above and principles of Cleaner Production, Occupational Health and Safety; Emergency Plans, Monitoring and Reporting, Environmental management etc

#### 4.1.1 Principles of Cleaner Production

If developments in the manufacturing industry sector are to be sustainable in the long run, large improvements in environmental performance are required. There should not be any conflict between clean businesses and profitable businesses. On the contrary, reducing pollution and waste very often means more efficient competitive operations.

A special concept called Cleaner Production (CP) has been developed to identify and carry out preventive actions for reducing the total pollution load from a site by internal measures rather than “end-of-pipe” solutions. The basis for this concept is the systematic efforts to reduce the generation of pollution and waste through use of mass and energy balance.

Cleaner Production is the use of materials, processes and practices to reduce or eliminate pollutants or wastes from originating. It includes practices that reduce the use of hazardous and non-hazardous materials, energy, water or other resources, as well as those that protect natural

resources through conservation or more efficient use. According to the Cleaner Production principles, measures should be implemented in the following order:

- (i) Preventing pollution and waste through actions at the sources;
- (ii) Recycling pollutants and waste on site;
- (iii) Recycling off-site what cannot be recycled on-site;
- (iv) Using the pollutants and wastes, which cannot be recycled for energy production;
- (v) Treating residual pollutants.

It is important to use cost-benefit considerations to ensure that environmental improvements are initiated where the potentials for savings are the greatest. Experience shows that the Cleaner Production method results in both reductions in pollution and waste, as well as a more efficient and competitive operations.

#### 4.1.2 Technical Measures

No matter how clean and efficient the production process is, there will usually be residual waste and pollutants, which must be disposed off or treated. Technologies for treatment of pollution of air and water streams are well developed (see Table 4.1).

The pollution control equipment must operate efficiently during normal and near normal (sub-optimal operating conditions). There can however be exceptions of emergency situations, causing hazards for equipment and personnel, when the pollution control equipment can be switched off or by-passed. Furthermore, the pollution control must be well maintained by ensuring the availability of spare parts and adequate training of personnel to conduct proper maintenance and repair of the equipment.

Pollution loads from various industry sectors (e.g. textiles, cement, etc) can be contained or controlled by use of different technology and equipments. An example of the advantages and disadvantages some preferred technology options are presented in tables 4.2 and 4.3 for guidance.

Table 4.1: Typical Common Pollution Control Equipment for Various Pollutants

Emitter	Technologies for controlling and reducing environmental pollutants
Air Pollutants	<ul style="list-style-type: none"> <li>• Textile filter, electrostatic precipitators or scrubbers for particulate materials.</li> <li>• Absorbers, adsorbers, cooler, incinerators, flares or catalytic converters for gaseous pollutants.</li> </ul>
Water Pollutants	<ul style="list-style-type: none"> <li>• Sedimentation or flocculation for solids or droplets (oil, fat).</li> <li>• Biological treatment for degradable organic compounds.</li> <li>• Physical-chemical methods (filtration, ultra filtration, chemical treatment, adsorption) for organic compounds.</li> </ul>
Noise	<ul style="list-style-type: none"> <li>• Selection of equipment (Low-noise fans)</li> <li>• Noise reduction at source</li> <li>• Noise screens</li> <li>• Enclosures</li> <li>• Silencers</li> </ul>

Table 4.2 Advantages and disadvantages of Fabric Filter Systems (baghouses)

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Very high collection efficiency (99.9%) for both coarse and fine particulates;</li> <li>• Relatively insensitive to gas stream fluctuations and large changes in inlet dust loading for continuous clean filter;</li> <li>• Filter outlet air can be recirculated.</li> <li>• Dry recovery of collected material for subsequent processing and disposal.</li> <li>• No corrosion problem;</li> <li>• Simple maintenance, flammable dust collection in the absence of high voltage;</li> <li>• High collection efficiency of sub micron smoke and gaseous contaminants through the use of selected fibrous or granular filter aids;</li> <li>• Various configurations and dimensions of filter collections; and</li> <li>• Relatively simple operation.</li> </ul>	<ul style="list-style-type: none"> <li>• Requirement of costly refractory mineral or metallic fabric at temperature in excess of 550°F;</li> <li>• Need for fabric treatment to remove collected dust and reduce dust seepage of certain dusts;</li> <li>• Relatively high maintenance requirement;</li> <li>• Explosion and fire hazard of the concentration (50/m<sup>3</sup>) of certain dusts in the presence of accidental spark or flame, fabric fire hazard in case of readily oxidisable dust collection.</li> <li>• Shortened fabric filter life at elevated temperatures and in the presence of acid or alkaline particulate or gas constituents;</li> <li>• Potential crusty caking of plugging of the fabric, or need for special additive due to hygroscopic materials, moisture condensation, or tarry adhesive components;</li> <li>• Respiratory protection equipment needed for fabric replacement; and</li> <li>• Medium pressure-drop requirements (typically in the range of 4 to 10 in water column)</li> </ul>

Table 4.3 Advantages and Disadvantages of Electrostatic Precipitators (ESPs)

Advantages	Disadvantages
<ul style="list-style-type: none"> <li>• Collection efficiencies of 99.9% or greater of coarse and fine particulates at relatively low energy consumption;</li> <li>• Dry collection and disposal of dust; low pressure drop (typical less than 0.5 inch of water column);</li> <li>• Continuous operation with minimum maintenance;</li> <li>• Relatively low operation costs;</li> <li>• Operation capability at high temperatures (up to 1300°F) and high pressure (up to 150psi ) or under vacuum and;</li> <li>• Capability to handle relatively large gas flow rate (of the order of 50,000m<sup>3</sup>/minute)</li> </ul>	<ul style="list-style-type: none"> <li>• High capital cost (approximately USD 15/sq.ft of plate area);</li> <li>• High sensitivity to fluctuations in gas stream conditions (flow rates, temperature, particulate and gas composition, and particulate loading);</li> <li>• Difficulties with the collection of particles with extremely high and low resistivity;</li> <li>• Relatively large space requirement for installation.</li> <li>• Explosion hazard of dealing with combustible gases or particulates;</li> <li>• Special precautionary requirements for safeguarding personnel from high voltage;</li> <li>• Production of ozone by the negatively charged electrodes during gas ionizations; and requirements of highly trained</li> </ul>

	maintenance personnel.
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### 4.1.3 Resources

Resources to be considered are non-renewable energy such as fossil fuel, and gas well as other natural resources especially water in arid or polluted areas. Following measures are suggested to minimise consumption of non renewable sources:

#### 4.1.3.1 Resources Consumption

Increased energy efficiency in addition to conserving scarce resources (oil, gas and firewood), will usually lead to reduction of emission of greenhouse gasses and other pollutants. The preferred order of options for energy conservation is:

- (i) Reducing energy requirements by process or operational changes, e.g. heat recovery from hot flue gas and high-efficiency electric motors;
- (ii) Substitution to a less polluting energy sources, e.g. use of natural gas instead of coal, and conversion to gas powered vehicle.

#### 4.1.3.2 Water Conservation

Water conservation is important both, to conserve scarce resources and to reduce water pollution. Options for reducing fresh water consumption are:

- (i) Adopting dry processes instead of wet, e.g.: filter instead of water scrubbers for dust removal from gases;
- (ii) Reducing consumption through water-savings measures and preventing leaks
- (iii) Reuse of water, e.g. counter-current rinsing in electroplating, Reuse of wastewater by using carefully treated and controlled sewage water for irrigation.

#### 4.1.3.3 Air Pollution

The EPA Stack Emission and ambient air quality guidelines (see Tables 4.4, 4.5 and Annex D) should be considered when planning projects in the manufacturing industry sector. The location of a plant should be considered. Microclimate and topographical conditions may lead to building up of high concentrations of air pollutants, both the primary gases (e.g. SO<sub>2</sub>, NO<sub>x</sub> etc.) and the secondary gases (e.g. ozone). Emission sources located in a valley may cause considerable decline in air quality during inversion periods (stable air with no wind) as there will be only minor or no exchange of the polluted air. If the plant is especially located near residential areas, many people are likely to be affected by exposure to emissions. Model calculations of air quality around a plant should be conducted for new and existing plants to predict air quality situations So that appropriate measures can be suggested to control or regulate the emissions

Table 4.4 Thresholds for emissions of particulate and gaseous pollutants in air (EPA Stack Emission guidelines)

No.	Pollutant	Applicable to	Standard
1	Smoke	All stationary fuel burning source	Ringlemann No.2 or equivalent opacity (not to exceed for more than 5 minutes in any period or one hour)
2.	Solid particles	Any trade, industry, process, industrial plant or fuel-burning equipment	200mg/m <sup>3</sup>
3	Sulphur acid mist or	(a) Any trade, industry or combustion	120mg/m <sup>3</sup> as Sulphur trioxide

**Commented [H10]:** Again, a mix up in presentation of information in relevant sections of the document. The guidance in Table 4.4 and 4.5 is needed in the prediction and evaluation stage and not under mitigation where measures are to be suggested for remedying the impact. There also, reference should be drawn to the need of such an assessment to predict the changes in air quality based on existing standards and the Tables on standards should be included as an appendices.

	Sulphur trioxide	(other than combustion processes and plants for the manufacture of sulphur acid) (b) Any trade, industry or process in which sulphuric acid is manufactured.	30,000mg/m <sup>3</sup> as Sulphur trioxide
4.	Fluorine Compounds	Any trade, industry or process in the operation of which fluorine, hydro fluoric acid or any inorganic fluorine compounds are emitted	100mg/m <sup>3</sup> as Hydrofluoric acid.
5.	Hydrogen Chloride	Any trade, industry or process	200mg/m <sup>3</sup> as Hydrogen chloride
6	Chlorine	Any trade, industry or process	100mg/m <sup>3</sup> as Chlorine
7	Hydrogen sulphide	Any trade, industry or process	5ppm as Hydrogen sulphide gas
8	Nitric acid or oxide or nitrogen	Any trade, industry or process in which manufacture of nitric acid is carried out	2000mg/m <sup>3</sup> as nitrogen dioxide
9	Nitric acid or oxides of nitrogen	Any trade, industry or process other than nitric acid plant	1000mg/m <sup>3</sup> as Nitrogen dioxide
10	Carbon monoxide	Any trade, industry or process	1000mg/m <sup>3</sup> as Carbon monoxide

Table 4.5 Ambient Air Quality Standards and Measurement Methods Standard

Substance	Time weighted average, (TWA)		Averaging Time
Sulphur Dioxide (SO <sub>2</sub> )	900µg/m <sup>3</sup>	Industrial	1 hr
	700µg/m <sup>3</sup>	Residential	1hr
	150µg/m <sup>3</sup>	Industrial	24hrs
	100µg/m <sup>3</sup>	Residential	24hr
	80µg/m <sup>3</sup>	Industrial	1yr
	50µg/m <sup>3</sup>	Residential	1yr
Nitrogen oxides (Measured as NO <sub>2</sub> )	400µg/m <sup>3</sup>	Industrial	1hr
	-	Residential	1hr
	150µg/m <sup>3</sup>	Industrial	24hrs
	60µg/m <sup>3</sup>	Residential	24hr

Table 4.5 continued

Substance	Time weighted average, (TWA)		Averaging Time
Total Suspended Particulate (TSP/SPM)	230µg/m <sup>3</sup>	Industrial	24hr
	150µg/m <sup>3</sup>	Residential	24hr
	75µg/m <sup>3</sup>	Industrial	1yr
	60µg/m <sup>3</sup>	Residential	1yr
PM <sub>10</sub>	70µg/m <sup>3</sup>		24hr
Smoke	150µg/m <sup>3</sup>	Industrial	24hr
	100µg/m <sup>3</sup>	Residential	24hr
	50µg/m <sup>3</sup>	Industrial	1yr
	30mg/m <sup>3</sup>	Residential	1yr
Carbon Monoxide (CO)	100mg/m <sup>3</sup>		15minutes
	60mg/m <sup>3</sup>		30minutes
	30mg/m <sup>3</sup>		1hr

	10mg/m <sup>3</sup>		8hr
Hydrogen Sulphide (H <sub>2</sub> S)	150µg/m <sup>3</sup>		24hr
Mercury (Hg)	1µg/m <sup>3</sup>		1yr
Lead (Pb)	2.5µg/m <sup>3</sup>		1yr
Cadmium Cd)	10-20ng/m <sup>3</sup>		1yr
Manganese (Mn)	1µg/m <sup>3</sup>		24hr
Dichloromethane (Methylene Chloride)	3mg/m <sup>3</sup>		24hr
1,2 Dichloromethane	0.7mg/m <sup>3</sup>		24hr
Trichloroethane	1mg/m <sup>3</sup>		24hr
Tetrachlorethene	5mg/m <sup>3</sup>		24hr
Toluene	8mg/m <sup>3</sup>		24hr
Arsenic	6mg/l	Industrial	24hr
	3mg/l	Residential	24hr
Fluoride	10µg/l		24hr

#### 4.1.3.4 Water pollution

Water resources may be affected in different ways; e.g. by restricting the allowable production rate for drinking water or by pollution of the water source caused by effluents from the industry. Both surface water and groundwater may be affected. Water, especially high quality drinking water, is a scarce resource in many places in Africa. When considering siting of new manufacturing industries, the supply and quality of water necessary for the operation should be investigated. Furthermore, one should be assured that the supply of drinking water to adjoining communities are not affected (Table 4.6 below provides some guidance on permissible effluent quality discharge limits).

**Commented [H11]:** Refer to my earlier comment.

The information presented here also is for guidance on prediction and evaluation of changes in water quality. Provide here the guidance on measures to reduce water pollution

Table 4.6 General Effluent Quality Guidelines for Discharges into Natural Water Bodies.

No	Parameter/Description	Maximum Permission Levels
1	pH	6-9
2	Temperature	< 3° C above ambient
3	Colour (TCU)	200
4	Oil and Grease (mg/l)	10
5	BOD5 (mg/l)	50
6	COD (mg/l)	250
7	Total Dissolved Solids (mg/l) (TDS)	1000
8	Total Suspended Solids (mg/l) (TSS)	50

Table 4.6 continued

No	Parameter/Description	Maximum Permission Levels
9	Turbidity (NTU)	75
10	Conductivity (µS/cm)	1500
11	Total Coliforms (MPN/100ml)	400
12	E. Coli (MPN/100ml)	10
13	Ammonia As N (mg/l)	1.0
14	Nitrate (mg/l)	50
15	Fluoride (mg/l)	1.0
16	Phenol (mg/l)	1.0
17	Sulphide (mg/l)	1.5

18	Total phosphorus (mg/l)	2.0
19	Total Cyanide (mg/l)	1.0
20	Free Cyanide (mg/l)	0.2
21	Cyanide as Weak Acid dissociable (mg/l)	0.6
22	Total Arsenic (mg/l)	0.5
23	Soluble Arsenic (mg/l)	0.1
24	Cadmium (mg/l)	<0.1
25	Chromium (+6) mg/l	0.1
26	Total chromium (mg/l)	0.5
27	Copper (mg/l)	2.5
28	Lead (mg/l)	0.1
29	Nickel (mg/l)	0.5
30	Selenium (mg/l)	1.0
31	Zinc (mg/l)	5
32	Mercury (mg/l)	0.005
33	Silver (mg/l)	5
34	Tin (mg/l)	5
35	Aluminium (mg/l)	5.0
36	Antimony (mg/l)	1.5
37	Benzo (a) pyrene (mg/l)	0.05
38	Chloride (mg/l)	250
39	Sulphate (mg/l)	200
40	Chlorine	250
41	Trichloroethylene ( $\mu\text{g l}^{-1}$ )	7
42	Total Hardness ( $\text{mg l}^{-1}$ )	500
43	Barium ( $\text{mg l}^{-1}$ )	0.7
44	PCBs-polychlorinated biphenyls ( $\mu\text{g l}^{-1}$ )	20
45	Manganese (Mn) ( $\mu\text{g l}^{-1}$ )	0.1
46	Perchloroethylene ( $\mu\text{g l}^{-1}$ )	40
47	Benzene ( $\mu\text{g l}^{-1}$ )	10
48	Influent raw water	I* 15% of influent parameter

Where I\* is influent raw water

#### Legend to Table 4.6

- The threshold values for parameter(s) contained in effluents arising from any operation involving the use of untreated water (i.e. sea, underground water, etc) shall not be of a quality that is 15% worse than the intake water (influent) quality for all measurable parameters of interests, irrespective of the sector industry. Companies operating under the special guidelines should first seek permission from EPA with regard to the effluents quality.
- The temperature increase in the receiving waters caused by the effluent should not exceed 3° C at the edge of the zone where initial dilution takes place. Where the zone is not defined one should use 100 meters from the point of discharge.

#### 4.1.4 Hazardous Compounds and Waste

All waste products should be separated into three main categories; municipal waste, production waste and hazardous waste. Within these main categories, waste material should be further sorted taking their properties into account, e.g. waste oil is one sub-category; recyclable paper and wooden waste suitable for energy production are others. By active exploitation of the options for recycling and energy production, the total amounts of waste for final disposal will decrease.

Waste for final disposal must be treated in an environmentally safe manner to avoid leaching, contamination etc. furthermore, if contractors are used to transport and dispose the waste, the company should ensure that the contractor handles the waste in a safe and environmental sound manner. Such requirements could be included in the contractor's contract and followed up by inspections or audits of the contractor.

All liquid hazardous and toxic materials (e.g. fuel oils, lube, and hydraulic oils) should be stored in especially designed areas, able to collect and hold leakage. In a fuel tank area, the desired collection capacity should be the volume of the largest tank within the area, + 10% of the volume of all other tanks in the area. All hazardous chemicals and products should be accompanied by material safety data sheets (MSD).

Environmentally sound waste management implies giving a high priority to waste prevention and the options for waste prevention include the following:

- Recycling or re-use (Send scrap iron to the secondary steel industry). (Returnable bottles for beverages)
- Use of waste as raw material for other industries (Saw dust conversion to fuel pellets. Metallurgical slags used as cement additives.
- Use of waste as an energy sources (used tyres as supplementary fuel in cement kilns. Waste lubricant oil as fuel)

#### 4.1.5 Waste Treatment

If waste prevention and recycling options cannot be implemented, destruction or disposal by land filling should be considered. Options for waste treatment (with examples) are:

- Incineration, preferably with energy (Non-hazardous combustible materials in ordinary municipal incinerators and chlorinated organic compounds in special incinerators for hazardous wastes);
- Biological treatment (Stabilization of organic sludges from wastewater treatment by aerobic or anaerobic treatment and composting of degradable waste);
- Mechanical confinement (Encapsulation of wastes in concrete or plastics and placement in durable containers).

#### 4.1.6 Ambient Noise

Most manufacturing industries produce ambient noise levels. In the planning phase of new activities, predictions of ambient noise levels at the nearest residential areas, schools, hospitals or other sensitive areas, should be performed to ensure that these levels are kept within permissible levels. The recommended ambient noise levels are summarized in Table 4.7.

Table 4.7 Ambient Noise Level Guidelines



Zone	Description of Area of Noise Reception	Permissible Noise Level DB(A)	
		Day (0600-2200)	Night (2200-0600)
A	Residential area with negligible or infrequent transportation.	55	48
B1	Educational (school) and health (hospital, clinic ) facilities	55	50
B2	Areas with some commercial or light industry	60	55
C1	Areas with some light industry, places of entertainment or public assembly, and places of worship such as churches and mosques.	65	60
C2	Predominantly commercial areas.	75	65
D	Light industrial areas	70	60
E	Predominantly heavy industrial areas	70	70

If the expected equivalent ambient noise levels surpass the given noise levels, suitable noise abatement measures should be planned and implemented. The measures may range from relocation of the plant, building-in of noise reducing equipment, use of baffles in gas piping, use of noise certified equipment etc. also restrictions on when certain noise producing operations are allowed should be considered (e.g. not performed during night-time). Such restrictions must also be regularly controlled to ensure compliance.

The distance from the noise source is important to consider, especially in the case of larger plants where several smaller noise producing sources may create large noise problems if the distance to dwellings is not sufficient. To avoid noise problems, residential areas or similar (see Table 4.7 above) should not be allowed near the plant. Recommended minimum acceptable distance from large process industries to residential areas or similar areas is approximately 500meters.

The noise in the surroundings of the plant should be measured once the plant is in normal operation and the records of the measurements should be kept. If the measured equivalent noise level exceeds the values given, additional measures should be taken.

#### 4.1.7 Socio-Economic Effects

To avoid negative impacts on the environment as described in section 3.8, it is important to consider the local knowledge and experience present. Industries with a potential of affecting any residential area or other sensitive establishments like hospitals and school be located at a sufficient distance from these areas.

Changes in the settlement patterns and the demographic composition as consequence of individual projects will usually be moderate. Few projects comprise more than a few hundred employees, and in case of larger plants, a full social impact analysis should normally be implemented. For small industries with for instances less than 50 employees, there will in most cases usually be minor environmental impacts for the community. One should be particularly aware of the impacts when an industrial project may affect:

- traditional settlement patterns;
- Extensive secondary developments in the surrounding areas, like establishment of new activities, settlement areas, roads and waste deposits;
- important areas for indigenous peoples and other ethnic groups;
- the gender composition of the work force.

Considerations should also be given to unique natural or cultural landscape areas or objects of historical, archaeological, cultural, religious, aesthetic or scientific values.

#### **4.1.8 Other Secondary Effects**

Many cultured plants are sensitive to pollutions. Manufacturing Industries with emissions of toxic substances to the atmosphere should not be located in agricultural areas and should avoid toxic discharges in agricultural areas dependent on irrigation. Regarding biodiversity, care should be taken to minimize the impacts as described in section 3.9. Projects threatening endangered or vulnerable species should be thoroughly assessed. Care should be taken to minimize the aesthetic and visual impacts of a project.

### **4.2 Occupational Health and Safety**

All industrial activities create possible risks for the workers, although to various degrees. For all companies, certain general activities should be performed, and certain personal protective equipment should, as a minimum, be available for all workers in order to minimize the risk of health effects or acute injuries. Some of the following measures and protective equipment, to ensure occupational health and safety of industrial workers are recommended: :

#### **4.2.1 Hearing Protection**

Protective aids should be used if the noise is above certain limits, or if the worker is exposed to high noise levels for a short time, or if the worker is exposed to relatively lower levels over a long period.

#### **4.2.2 Head Protection**

A helmet should be provided to protect the head and avoid injuries in case falling objects hit the worker or a hard/sharp object hits his head. Furthermore, protection against heat, spraying of chemicals etc. should be considered.

#### **4.2.3 Eyes Protection**

Use of glasses or a mask should be encouraged or made mandatory to ensure protection of eyes from particles and chemicals entering the eyes or strong lights hitting the eyes etc.

#### **4.2.4 Respiratory Protection**

To protect workers against inhalation of dust and chemical substances, respiratory protection should be available

#### **4.2.5 Foot Protection**

Special footwear should be worn to avoid injuries when hard/heavy objects hit a foot or to protect against e.g. wet working conditions.

#### **4.2.6 Hand Protection**

Special gloves should be worn when working with sharp and hot objects, chemical, etc.

#### **4.2.7 First Aid Equipment**

First aid equipment should be easily available with: more traditional equipments also include:

- Eye bath
- Appropriate antidotes for treating acute poisoning of chemicals and waste, or when bitten by poisonous snakes or similar danger (if relevant).

#### 4.2.8 First Aid Personnel and Training

A minimum number of personnel should be identified as first aid personnel and be given the necessary training. Training should also be extended to all other personnel of the company.

#### 4.2.7 Proper Ventilation, or Air Conditioning

Proper ventilation or air conditioning is important to reduce the concentrations of dust and chemical compounds in the working atmosphere and to ensure appropriate working temperature.

#### 4.2.8 Proper Sanitary Conditions

These are necessary to reduce the risk of infections and several other problems. Also showers or similar equipment should be available if the workers may be exposed to high levels of dust fall, radioactivity, spray of chemicals, etc.

#### 4.2.9 Health and Safety Manual

A Health and Safety Manual, which focuses on important procedures and mitigation measures should be prepared and made available to all workers (see also section 4.3-emergency Plans).

#### 4.2.10 Air Pollution in Work Place

Occupational threshold limit values are given for number of chemical compounds. Table 4.9 summarizes a selection of occupational threshold limits (TLV) for working areas. TLV for several other compounds can be found in the Encyclopedia of Occupational Health and Safety.

Asbestos is considered extremely harmful to human beings. The workers should wear sufficient personal protective equipment when working with asbestos material (e.g. under demolition of materials containing asbestos).

Table 4.9: A Selection of Occupational Threshold Limit Values  
(TLVs for work place, based on 8-hours daily exposure for adults)

Parameter	TLV	
	ppm	Mg/m <sup>3</sup>
Cadmium and inorganic compounds	-	0.04-0.05
Chromium and its compounds (as Cr)	-	0.5
Dust, total	-	5-10
Dust, respirable	-	5-10
Glass Fibre Dust	-	0.05
Hexavalent Chromium (as Cr)	10	15
Hydrogen Sulphide	-	0.15
Lead (as Pb)	-	0.5
Lindane	-	0.05
Mercury and its compounds (as Hg)	-	1
PAH	-	1)
SO <sub>2</sub>	5	10
Tin Organic Compounds	0.1	
Toluene di Isocyanide	0.02	0.14
Trichlorethane	100	

Several PAH compounds are suspected human carcinogens and exposure to workers by these compounds should be as low as possible.

#### **4.2.11 Chemical Hazards**

All hazardous chemicals and products should be accompanied by material safety data sheet ((MSD). These MSA should be easily available for the employees.

#### **4.2.12 Noise**

Hearing protection should be regarded mandatory if the noise level is 85dB (A) or above measured as 8 hours equivalent level. In the interval 75-85dB (A) hearing protections should be regarded as voluntary. In addition, no worker should be permitted to enter, for any period of time whatsoever, into an area where the sound level is equal to, or exceeds, 115dB (A) unless he is wearing appropriate hearing protection. Nobody should ever enter areas where the sound level exceeds 140dB (A)

### **4.3 Emergency Plans, Fires and Extinguishers**

#### **4.3.1 Emergency Plan**

Most of the activities described above deal with preventive measures. However, in order to minimize impacts on human health and the environment in case of an accident, it is essential to have emergency plans and necessary equipments available. Serious accidents often have an impact on both humans and the environment.

The company should have emergency plans available. At least the following topics are recommended to be included in an emergency plan:

#### **4.3.2 Environmental Reporting**

There should be a procedure for emergency reporting, which is communicated to, and understood by all personnel. Furthermore, individuals who 'receive' the emergency communication should also be adequately trained to handle the emergency. The procedures should include making a directory of important phone numbers (fire service, first aid, medical help, police etc) available to all key personnel and organisations. Additionally, important phone numbers should also be posted near telephones.

#### **4.3.3 Communication**

The emergency plan should describe alternative ways of communication in case the regular communication system breaks down during an accident (e.g. mobile telephones, radio communication etc). These systems should include communication between emergency key personnel, first aid personnel, fire brigade (local and public), authorities etc.

#### **4.3.4 Central Control Area**

The control center should have appropriate maps, fire water systems drawings, emergency communications, a listing of site emergency response equipment, technical materials mutual aid information, and access to meteorological data (if there is a likelihood of release of potential

hazardous chemicals which require emergency response). Companies should also have alternative control arrangements in case the designated control area is unavailable because of the emergency.

#### **4.3.5 First Aid**

A list of names of qualified first aid personnel and the first aid equipment should be easily accessible for seeking help at the earliest instance. The first aid personnel should be given appropriate training.

#### **4.3.6 Medical Service Back up**

A back up system to handle accidents resulting in the need for treatment beyond the qualification or possibility of the first aid should be identified.

#### **4.3.7 Evacuation**

A plan should be prepared for evacuation of people to predetermined areas of safety and an “assembly” system to account for missing persons.

#### **4.3.8 Search and Rescue Plan**

In Ghana, search and rescue is the responsibility of the municipal/local authority agencies (Fire Service, police Service, and sometimes the Armed Forces). In some cases it may be necessary for a company to train and equip their own Search and Rescue Teams.

#### **4.3.9 Control of Hazardous Materials**

Control of hazardous materials in the event of an emergency refers to chemicals, fuels, radioactive sources, gas cylinders, etc. Special fire-fighting procedures for areas where hazardous materials are stored should be available.

#### **4.3.10 Confirming Pollution and Clean-up**

The plan should include precautions necessary to prevent, discover, stop, remove and limit the effects of the accident, with respect to people, environment and equipment. This includes the cleaning up transportation of hazardous materials and other waste and appropriate disposal of waste.

#### **4.3.11 Material and Supplies**

During an accident, essential equipment or parts (e.g. cleaning equipment, process controls etc) may have been damaged or lost. It is essential to have a plan on how to obtain such essential equipment or spare parts as soon as possible in order to continue the work without posing hazards to people or environment and without loss of production.

#### **4.3.12 Mock Drills**

Mock drills should be conducted regularly. Reports from the drills summing up the experience and giving suggestions for improvements should be prepared.

### **4.4 Handling of Fire Hazards**

The various types of fires and the respective extinguishers to be used are described below. The fires and their extinguisher are normally divided into four classes:

#### **4.4.1 Class “A” Fires and Extinguishers**

Class “A” fires are the most common type, and involve ordinary combustible materials such as wood, paper, rubber, dust, most plastics and combinations of these. Water is the most often used as an extinguisher to exert a cooling or quenching effect to reduce the heat of the burning materials. Other agents used to combat Class “A” fires are usually a water-based combination of chemicals to increase the efficiency. Dry power will may also reduce the Class “A” fire under some conditions, due to smothering effects. Halon can interrupt the chain reaction and quickly snuff out the blaze. Neither of these however have the cooling capacity comparable to that of water and therefore water is the most often used.

#### **4.4.2 Class “B” Fires and Extinguishers**

Class “B” fires are those involving flammable liquids, greases and gases. The normal method of extinguishing involves the smothering effect in which oxygen is excluded from the fire. Foam is often used to float on the surface and cut off the oxygen. Other methods involve removal of the fuel through draining or other measures. Water should never be used on a class “B” fire unless it is specially treated with chemicals and/or used as a very fine spray.

#### **4.4.3 Class “C” Fires and Extinguishers**

This class of fire involves the presence of electrical energy, such as faulty wiring or electrical appliances and tools. Once the electricity is removed, the remaining fuel will constitute either a Class “A”, or “B” or “D” fire. First consideration in fighting the Class “C” fire is to use an extinguishing agent, which is non-conductive and will send the shock to the user. The safest procedures with these fires is to first cut off or de-energize the source, then treat the fires as “A”, “B” or “D”, depending on the specific fuels burning. Several types of power and carbon dioxide agents are available. Multi-Purpose extinguishers are the most popular type of extinguishers to handle several classes of fires.

Another way to remember these first three classes of fires is:

A = Materials leaving ASH

B = Materials that may BOIL

C = Equipment operated by electrical CURRENT

#### **4.4.4 Class “D” Fires and Extinguishers**

Perhaps the most dangerous of the four classifications is the Class “D” fire resulting from the burning of combustible materials such as magnesium, zirconium, sodium and potassium. Selection of extinguishing agents is critical; since burning metal may explode violently if the wrong agent is used or if it contains moisture. The extremely high temperatures of the metals make most of the commonly used agents ineffective or even dangerous. Most burning must be extinguished by smothering the fire. There is no agent available that will control fire in all combustible metals. Each metal must be analysed and a specific agent selected. Extinguishing agents may include potassium bicarbonate and potassium chloride. Some metals may also be extinguished by using dry sand.

### **4.5 Monitoring and Reporting**

Environmental data must regularly be obtained for any manufacturing industry project in order to:

- Ensure compliance with legislative requirements, including EPA Act, 1994 (Act 490) and the Environmental Assessment Regulations, 1999 (LI 1652) and the National Environmental Quality Standards Regulations, 2000 (Proposed);
- Ensure company management of acceptable environmental performance; and
- Document such performance to internal and external stakeholders.

The amount of environmental data needed for any project must be determined by the quantity and composition of releases and sensitivity of the surroundings. In sensitive situations, large amounts of data may be required. In other cases, simple calculations and a few spot samples are sufficient. Collection of environmental data can be done using engineering estimates, environmental modeling, source measurements, ambient measurements and direct observations.

Data collection in the surroundings should in many cases cover a 12 months period, to give a proper representation of seasonal cycles in climates, vegetation and productions. Measurements of emission are required also of abnormal situations, when releases or occupational loads deviate from normal conditions. Examples are periods when production is closed down, start-up operations or period when pollution control equipment is not functioning. Records are needed to document and environmental significance of such situations.

An industry project with significant environmental impacts should establish a monitoring program describing pollution parameters and procedures for measurements. The procedures will include location where measurements are to be made; duration of measurements, methods, responsibilities and how data are to be prepared (see Table 4.10).

The proposed National Environmental Quality Standards Regulations gives guidance on specific parameters, which are recommended to be included in a monitoring program for various categories of industries.

Supervising environmental performance of a project is important to reduce environmental risks, get information on the state of affairs, and monitor status and compliance of environmental performance.

Table 4.10: Overview of Environmental Monitoring Parameters and Possibilities, both Emissions and Ambient Monitoring

Pollution Type	Monitoring Parameters and Methods
Air Pollution	Taking representative stack samples and analyzing SO <sub>2</sub> , NO <sub>x</sub> and dust normally measure emissions. Stack sampling is complicated and expensive. Dustfall and sulphur dioxide are examples of ambient air parameters which can be monitored by simple and inexpensive methods.
Water Pollution	Parameters such as pH and suspended solids can be determined at reasonable cost. Costs of analyzing BOD, oil and heavy metals are somewhat higher. Measurements of complicated organic compounds such as PCB or dioxins are very expensive.
Ambient Noise	Maximum and equivalent dB(A) levels are usually measured by a limited number of short-term (i.e. half-hour) measurements at predetermined locations.
Occupational Health	Workplace air quality parameters like respirable dust, toxic dusts (silicates, asbestos, etc), gases (SO <sub>2</sub> , CO, NO <sub>2</sub> ) or noise levels in dB(A) are measured at fixed locations, by instruments carried by workers, or by individual responses (medical examinations).
Wastes	Records of quantity of main categories of waste, and how they are treated and disposed of, should be obtained.

Ambient Monitoring	Concentration of pollutants by analyzing samples of air, water or soil. Concentrations by automatic, continuous monitoring instruments for air, water or noise. Pollutant concentration is biologic material, by analyzing collection of samples. Analysis of effects of pollution, e.g. damage to crops and vegetation.
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## 4.6 Environmental Management

Successful environmental management requires that the mitigation measures are implemented at the correct time and in the correct way. This means a clearly written and agreed plan of action has to be prepared. This plan is called an environmental management plan.

An environmental management plan should:

- contain a statement of the proponent's environmental policy including compliance of the project with any legislation or standards;
- designate a person to be responsible for the overall implementation of the plan;
- include a schedule of tasks to be undertaken to comply with the recommendations of the EIA report and the requirements of the approval. This schedule should include any required training of staff;
- allocate responsibility for carrying out the tasks;
- include a system of reporting on the progress of the tasks (and budget);
- include a system for the monitoring and auditing of the plan's achievements in environmental protection/enhancement; and
- contain a contingency plan of actions to be taken when monitoring results indicate that impacts are not in accordance with predictions or required standards.

The environmental management plan can be used as basis for generating environmental performance standards and requirements that can be included in the contracts of those carrying out the works or providing supplies. It can also be used as the basis of an environmental management system during the operational phase of the project.

### 4.6.1 Human Resource Development

It is generally accepted that the majority of accidents can be related to human factors, rather than technical malfunctioning. Education and training of leaders at all levels and of other employees should therefore be regarded as an important form of mitigative measure to control the activities that may result in unintended impacts on the environment.

The knowledge and skills necessary to achieve environmental objectives should be systematically identified. Such information should be considered during personnel selection, recruitment, and training and skills development. The organisation should also ensure that contractors working at the site provide evidence that they have the requisite knowledge and skills to perform the work in an environmentally responsible manner. The organisation should have a training program, which should include:

#### 4.6.1.1 Identification of the Employees' Needs for Training

This could be determined by line managers through personal interviews, questionnaires or through interaction and other related techniques.



#### **4.6.1.2 Develop a Training Plan to Address Defined Needs**

The plan should at least include the names of the employees identified for receiving training, the topics to be covered and the schedule of training. Indicative topics for training may include:

- Understanding the effects of various activities of the company on the environment.
- Process control.
- Maintenance of process, cleaning, and monitoring equipment.
- Waste handling
- How to conduct monitoring
- Relevant safety rules and the use of personal protection equipments.
- Maintenance of personal protection equipments.
- Management training.

Verify that the training activities meet regulatory or organizational requirements and that the trainers and trainees have minimum knowledge to conduct or benefit from such training opportunities. The training can be given to individuals or to groups. The training can be conducted by internal experienced employees or by external expert

#### **4.6.1.3 Document and Evaluate the Training Received**

The organisation should be able to document that the training activities have been conducted, preferably according to the plan. It is also recommended to evaluate the effectiveness of the training to ensure that the employees receive the expected knowledge. This can be done through interviews or questionnaires where the participants are asked about the outcome and feedback on their training.

Systematic training activities are also regarded as a part of an Environmental Management System, as described in the next section.

### **4.6.2 Environmental Management System (EMS)**

The EMP is a plan to manage environmental impacts where as EMS is to ensure company's environmental performance and promote environmental ethics. An Environmental Management System (EMS) is the collection of policies, procedures, records, instructions, specifications, etc. set up to control the different areas and processes of the organization. The management system must be a living system giving guidelines and requirements on how to perform different jobs. Good documentation is a fundamental part of any operational management system. It is thus an important vehicle for communication, learning, and initiation of proper action.

The important element of the EMS, is the policy documents, which provides directives for the environmental work performance of the company, procedures for carrying out the assigned work and maintenance of records documenting performance. Further, manuals describe the improvement programs, how to run various processes, how the EMS works, environmental requirements, and the interrelationship between documents.

An environmental management system should be based on and integrated with the management's practices already in place in the organization. All companies will have goals, plans, system of responsibility and accountability, ways to deal with complaints, and rules for

which records should be kept and registered etc. The existence of a formalized system for managing environmental issues will ensure better environmental performance and enable demonstration of improved environmental performance.

The ISO 14001 standard for Environmental System (1996) is increasingly accepted around the world as the standard against which organizations are measured and certified in environmental management. This is especially true for those organizations, which are engaged in international trade or multinational ownership. Companies complying with the requirements in the standard can achieve an ISO 14001 certificate after being evaluated by an accredited certification body. Even if an organization is not interested in certification the standard is useful to define the essentials of how to manage environmental concerns.

The beneficiary should establish an environmental management system. The EMS can either be documented separately, or be integrated with another management system in the company (e.g. the quality management system). The elements that normally would be a part of an environmental management system are listed below. These are based on the ISO 14001 standard. The EMS can be divided into five main parts:

- Policy
- Planning
- Implementation and Operation
- Checking and Corrective Action
- Management Review

The company should not necessarily follow the above EMS structure, but consider adopting the most suitable structure depending on e.g. operational and organizational factors.

#### **4.6.2.1 Environmental Policy**

The top management should establish an environmental policy that is a public statement of the intentions and principles of action of the company regarding its environmental effects. The company's environmental policy reflects the environmental responsibility and commitment at the top levels. The commitment is further strengthened when the company's environmental policy is signed by the top manager.

#### **4.6.2.2 Planning**

##### ***(a) Legal and Other Requirements***

A system should be in place to ensure that the company has updated knowledge of about the legal aspects and access to other legal information relevant to the company.

##### ***(b) Objective and Targets***

The objective can be regarded as the long-term goal arising from the policy and evaluation of the environmental effects of the company and applicable legislation that the company sets to achieve. The goals should be quantified where applicable. The targets can be regarded as short-term goals (e.g. one year), quantitative performance indicators, arising from the objectives and that need to be met in order to meet those objectives.

##### ***(c) Environmental Action Plans***

Action plans should be established to achieve the various objectives and targets, by identifying the personnel to shoulder responsibilities within a set time frame for the activities etc.

#### **4.6.2.3 Implementation and Operation**

##### ***(a) Organization and Responsibilities***

The roles, responsibilities and authorities regarding environmental management and task should be defined and documented (job instructions). Furthermore, this information should be communicated to the employees.

##### ***(b) Training, Awareness and Competence***

The company should establish procedures for identifying training needs. The company should also ensure that the contractors working on its behalf are able to demonstrate that their employees have the required training. Furthermore, the company should have procedures to ensure that its employees are aware of:

- The importance of compliance with the environmental policy and procedures.
- The significant impacts (actual or potential) of their activities and the environmental benefits of improved personal performance.
- Their roles and responsibilities in achieving compliance with the environmental policy and related procedures and with requirements of the environmental management system, including emergency preparedness and responses.
- The potential consequences of departure from specified operating procedures.

##### ***(c) Communication***

The company should establish procedures for internal communication between various levels and functions of the company and procedures for receiving, documenting and responding to relevant communication from external parties.

##### ***(d) Environmental Management System Documentation***

The company should establish and maintain information (paper or electronic) to describe the core elements of the environmental management system.

##### ***(e) Document Control***

Procedures for controlling documents should be established to ensure that:

- They can be easily located when required;
- They can be periodically reviewed, revised and approved;
- The current version of relevant documents are available at all locations where operations essential to the effective functioning of the system are performed
- Obsolete documents are promptly removed from all points of issue and point of use.

The documents should be legible, dated (with dates of all subsequent revisions) readily identifiable, and maintained in an orderly manner. Procedures and responsibilities should be established and maintained for creation and modification of the various types of documents.

##### ***(f) Operational Control***

The company should identify those operations and activities that are significant from environmental aspects and ensure that policy, objectives and targets are in line to address these. The organisation should establish documented procedures to cover situations where the absence of such procedures could lead to deviations from the environmental policy, objective and targets.

***(g) Emergency Preparedness and Response***

The company should establish and maintain procedures to identify potential for, and response to, accidents and emergency situations, and for preventing and mitigating the environmental impacts that may be associated with them. See also chapter 4.3.1 Emergency plans

**4.6.2.4 Checking and Corrective Action**

***(a) Monitoring and Measurement***

The company should have procedures to regularly monitor and measure the key characteristics of its operations and activities that can significantly impact the environment. Monitoring equipment should be calibrated and maintained and records of this process be retained.

***(b) Non-conformance and Preventive Action***

The company should have procedures for defining responsibility and authority for handling and investigating non-conformance and taking appropriate corrective and preventive actions. The following basic elements should be included:

- identifying the cases of non-conformance
- Identifying and implementing the necessary corrective action,
- implementing or modifying controls necessary to avoid non-conformance in future,
- Recording any changes in procedures resulting from the corrective action

***(c) Records***

The company should have procedures for the identification, maintenance and disposition of environmental records. These should include training records and the results of audits and reviews.

***(d) Environmental Management System (EMS) Audit***

The EMS should regularly be audited to determine whether or not the EMS has been properly implemented to provide information to the management. The audit program should cover:

- the activities and areas to be considered in audits
- the frequency of audits.
- the responsibilities associated with managing and conducting audits;
- the communication of audit findings
- auditor competence
- how audits will be conducted

#### **4.6.2.5 Management Review**

The company's top management should, at regular intervals, review the environmental management system, to ensure its continuing suitability, adequacy and effectiveness. The reviews should include:

- results from audits
- the extent to which objectives and targets have been met,
- the continuing suitability of the environmental management system in relation to changing conditions and information,
- concerns amongst relevant interested parties. Observations, conclusions and recommendations should be documented for necessary action.

## **APPENDICES**

### **Appendix 1: Environmentally Sensitive Areas**

**Description of sensitive areas**

1. All areas declared by law as Wildlife Conservation area
2. Areas which constitute the natural habitat(s) of any threatened (endangered, data deficient and vulnerable), rare, endemic flora and fauna
3. All known historical, cultural, archeological and scientific sites that are of public interest
4. Areas known to be prone to natural environmental disturbance including coastal erosion, flooding, geological hazards (earthquake, tremor, landslide) and radioactive emissions
5. Hilly areas with gradient above 45 degrees and prone to erosion or rock fall or mudslide or landslide.
6. Areas (of land) adjoining water bodies of minimum distance 50 meters away from the bank of the water body
7. Water bodies characterized by one or more of the following conditions:
  - a) used for domestic purposes,
  - b) water within controlled/ protected areas,
  - c) supports wildlife and fish,
  - d) head waters.
8. Mangrove area characterized by one or more of the following conditions:
  - a) adjoining mouth/estuary of a river/stream system;
  - b) habitat for wildlife;
  - c) spawning ground for fish;
  - d) near or adjacent to traditional fishing ground;
  - e) acting as natural buffer against shore erosion, strong winds or for storm floods

**Environmentally Quality Guidelines**  
**Ambient Air Quality Guidelines**

Substance	Time Weighted Average (TWA)		Averaging Time
Sulphur Dioxide (SO <sub>2</sub> )	900 µg/m <sup>3</sup>	Industrial	1 hour
	700 µg/m <sup>3</sup>	Residential	1 hour
	150 µg/m <sup>3</sup>	Industrial	24 hours
	100 µg/m <sup>3</sup>	Residential	24 hours
	80 µg/m <sup>3</sup>	Industrial	1 year
	50 µg/m <sup>3</sup>	Residential	1 year
Nitrogen Oxides (Measured as NO <sub>2</sub> )	400 µg/m <sup>3</sup>	Industrial	1 hour
	200 µg/m <sup>3</sup>	Residential	1 hour
	150 µg/m <sup>3</sup>	Industrial	24 hours
	60 µg/m <sup>3</sup>	Residential	24 hours
Total Suspended Particulate	230 µg/m <sup>3</sup>	Industrial	24 hours
	150 µg/m <sup>3</sup>	Residential	24 hours
	75 µg/m <sup>3</sup>	Industrial	1 year
	60 µg/m <sup>3</sup>	Residential	1 year
PM <sub>10</sub>	70 µg/m <sup>3</sup>		24 hours
Smoke	150 µg/m <sup>3</sup>	Industrial	24 hours
	100 µg/m <sup>3</sup>	Residential	24 hours
	50 µg/m <sup>3</sup>	Industrial	1 hour
	30 mg/m <sup>3</sup>	Residential	1 hour
Carbon Monoxide	100 mg/m <sup>3</sup>		15 min
	60 mg/m <sup>3</sup>		30 min
	30 mg/m <sup>3</sup>		1 hour
	10 mg/m <sup>3</sup>		8 hours
Hydrogen Sulphide	150 µg/m <sup>3</sup>		24 hours
Mercury	1 µg/m <sup>3</sup>		1 year
Lead	2.5 µg/m <sup>3</sup>		1 year
Cadmium	10 - 20 ng/m <sup>3</sup>		1 year
Manganese	1 µg/m <sup>3</sup>		24 hours
Dichloromethane (Methylene Chloride)	3 mg/m <sup>3</sup>		24 hours
1,2-Dichloroethane	0.7 mg/m <sup>3</sup>		24 hours
Trichloroethane	1 mg/m <sup>3</sup>		24 hours
Tetrachloroethene	5 mg/m <sup>3</sup>		24 hours



**SECTOR SPECIFIC EFFLUENT QUALITY GUIDELINES FOR DISCHARGES INTO NATURAL WATER BODIES**  
**(MAXIMUM PERMISSIBLE LEVELS)**

	PARAMETER	SECTORS						
		Textile	Food & Beverages	Paints & Chemicals	Pharmaceuticals	Paper and Pulp	Hotels and Resorts	Wood and wood processing
1.	pH	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9
2.	Oil & Grease (mg/l)	5	5	10	5	10	5	5
3.	Temperature increase	< 3°C above ambient	< 3°C above ambient	< 3°C above ambient	< 3°C above ambient	< 3°C above ambient	< 3°C above ambient	< 3°C above ambient
4.	Colour (TCU)	400	200	300	150	200	150	250
5.	COD (mg/l)	250	<b>250</b>	250	250	250	250	250
6.	BOD <sub>5</sub> (mg/l)	50	50	50	50	50	50	50
7.	Total Dissolved Solids (mg/l)	1000	1000	1000	1000	1000	1000	1000
8.	Chromium (+6) mg/l	0.1				0.1	0.1	0.1
9.	Sulphide (mg/l)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
10.	Phenol (mg/l)	2	2	2	2	2	2	2
11.	Total Coliforms (MPN/100 ml)	400	400	400		400	400	400

		<b>Textile</b>	<b>Food &amp; Beverages</b>	<b>Paints &amp; Chemicals</b>	<b>Pharmaceuticals</b>	<b>Paper and Pulp</b>	<b>Hotels and Resorts</b>	<b>Wood and wood processing</b>
<b>12</b>	E. Coli (MPN/100 ml)	10	10	10	10	10	10	10
<b>13.</b>	Turbidity (N.T.U.)	75	75	75	75	75	75	75
<b>14.</b>	Total Suspended Solids (mg/l)	50	50	50	50	50	50	50
<b>15.</b>	Lead (mg/l)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
<b>16.</b>	Nitrate (mg/l)	50	50	50	50	50	50	50
<b>17.</b>	Total Phosphorous (mg/l)	2	2	2	2	2	2	2
<b>18.</b>	Conductivity (µS/cm)	1500	1500	1500	1500	1500	1500	1500
<b>19.</b>	Mercury (mg/l)	0.005	0.005	0.005	0.005	0.005	0.005	0.005
<b>20.</b>	Ammonia as N (mg/l)		1.0				1.0	1.0
<b>21.</b>	Total Pesticides (mg/l)		0.5				0.5	0.5
<b>22.</b>	Total Arsenic (mg/l)	1.0	1.0	1.0	1.0	1.0	1.0	1.0
<b>23.</b>	Soluble Arsenic ( mg/l)	0.1	0.1	0.1	0.1	0.1	0.1	
<b>24.</b>	Alkalinity as CaCO <sub>3</sub> (mg/l)	150	150	150		150		
<b>25.</b>	Fluoride (mg/l)		10					
<b>26.</b>	Chloride (mg/l)	250	250	250	250	250	250	250

**SECTOR SPECIFIC EFFLUENT QUALITY GUIDELINES FOR DISCHARGES INTO NATURAL WATER BODIES**  
**(MAXIMUM PERMISSIBLE LEVELS)**

	PARAMETER	SECTORS						
		Cement, Ceramics and Tiles Industry	Thermal Power Plant	Glass Industry	Hospitals and Clinics	Oil and Gas Exploration, Production and Refining	Mining and Minerals Processing	Metals Industry
1.	pH	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9
2.	BOD <sub>5</sub> (mg/l)	50	50	50	50	50	50	50
3.	Oil & Grease (mg/l)	5	5	5	5	10	10	5
4.	Total Dissolved Solids (mg/l)	1000			1000	1000	1000	1000
5.	Total Suspended Solids (mg/l)	50	50	50	50	50	50	50
6.	Cadmium (mg/l)	0.1				0.1	0.1	0.1
7.	Total Phosphorus (mg/l)	2.0	2.0	2.0	2.0	2.0	2.0	2.0
8.	Temperature increase	< 3°C above ambient	< 3°C above ambient	< 3°C above ambient	< 3°C above ambient	< 3°C above ambient	< 3°C above ambient	< 3°C above ambient
9.	Colour (TCU)	200	200	150	150	200	150	200
10.	COD (mg/l)	250	250	250	250	250	250	250
11.	Chromium (+6) mg/l	0.1		0.1	0.1	0.1	0.1	0.1
12.	Sulphide (mg/l)	1.5	1.5	1.5	1.5	1.5	1.5	1.5
13.	Phenol (mg/l)				2	2	2	2
14.	Total Coliforms (MPN/100 ml)			400	400	400	400	400
15.	E. Coli (MPN/100 ml)			10	10	10	10	10

16.	Turbidity (N.T.U.)	75	75	75	75	75	75	75
17.	Lead (mg/l)	0.1	0.1	0.1	0.1	0.1	0.1	0.1
18.	Nitrate (mg/l)	50	50	50	50	50	50	50
19.	Conductivity ( $\mu$ S /cm)	1500			1500	1500	1500	1500
20.	Mercury (mg/l)				0.005	0.005	0.005	0.005
21.	Zinc (mg/l)					10	10	10
22.	Tin (mg/l)							5
23.	Total Chromium (mg/l)					0.5	0.5	
24.	Total Iron (mg/l)					10	10	10
25.	Free Cyanide (mg/l)						0.2	
26.	Cyanide as Weak Acid Dissociable (mg/l)						0.6	
27.	Total Cyanide (mg/l)						1.0	
28.	Aluminium (mg/l)							5.0
29.	Total Antimony (mg/l)						1.5	1.5
30.	Fluoride (mg/l)							10
31.	Chloride (mg/l)							250
32.	Alkalinity as CaCO <sub>3</sub> (mg/l)							150
33.	Copper (mg/l)					5	5	5
34.	Total Arsenic (mg/l)	1.0		2			1.0	1.0
35.	Soluble Arsenic (mg/l)	0.1					0.1	0.1

**Ambient Noise Level Standards in Ghana**

Zone	DESCRIPTION OF AREA OF NOISE RECEPTION	Permissible Noise Level in dB (A)	
		Day 06:00 – 22:00	Night 22:00 – 06:00
A	Residential areas with negligible or infrequent transportation	55	48
B1	Educational (school) and health (hospital clinic) facilities	55	50
B2	Area with some commercial or light industry	60	55
C1	Area with some light industry, place of entertainment or public assembly and place of worship such as churches and mosques	65	60
C2	Predominantly commercial areas	75	65
D	Light industrial areas	70	60
E	Predominantly heavy industrial areas	70	70

