VOLUME 2

SECTION 1

ENVIRONMENT

The Responsibility of
The National Environment
and Planning Agency (NEPA)
10 Caledonia Avenue
Kingston 5

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CHAPTER 1

LEGAL AND INSTITUTIONAL FRAMEWORK

1.0 BACKGROUND

The term environment refers to the totality of factors that impact on an entity including the physical, biological, economic and technological dimensions that are themselves inextricably interconnected. Environmental degradation has increased in tandem with human development and from as early as the mid 1970's, international and local attention has focused on strategies to halt this decline. Balancing economic growth and development with social and environmental imperatives is one such strategy that in effect embodies the principles of sustainable development.

In support of sustainable development principles in Jamaica, both nationally and locally, the principal environmental agency, the National Environment and Planning Agency (NEPA) has compiled information to provide guidance to developers and investors in keeping with the national legislative framework and international conventions. Thorough environmental assessments and effective management of development are critical to environmental protection- the basis for economic growth and the safeguarding of human life and well-being.

This Section outlines the legislative and institutional framework within which the developer must operate. In addition, the types of applications related to environmental management and the categories of enterprise, construction or development prescribed in law which require permits or licences will be defined.

These guidelines will benefit the developer since it will make it easier to provide a full and complete application, the first time it is submitted. This will enable applications to be processed smoothly without the need for NEPA to request additional information which lengthens the processing time.

1.1 LEGAL AND INSTITUTIONAL FRAMEWORK

1.1.1 The Natural Resources Conservation Authority Act (1991)

The Natural Resources Conservation Authority Act provides for the management, conservation and protection of the natural resources of Jamaica. The Act establishes the Natural Resources Conservation Authority, a body of persons appointed by the Minister in charge of the Environment. The functions of the Authority include the taking of such steps that are necessary to ensure the effective management of the physical environment of Jamaica; including the management of marine parks and protected areas. Section 9 of the Act creates a Ministerial discretion to declare parts of or the entire island a 'prescribed area', in which specified activities require a permit, and an environmental impact assessment may also be required.

The Natural Resources (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order, 1996 and the Permits & Licensing Regulations were passed pursuant to section 9 of the Natural Resources Conservation Authority Act, 1991. The Order provides that the entire island of Jamaica is a prescribed area and lists specified categories of enterprise, construction or development that require a permit.

The Act also addresses Sewage and Trade Effluent discharges as well as air emissions. Regulations are being developed to specifically address these sources of pollution. Under the new regulations the polluter pays principle will be incorporated.

1.1.2 The Town and Country Planning Authority (TCPA) Act (1957)

The TCPA makes provision for environmental clearance on applications prior to planning approval. This Act is dealt with in detail in Volume 1 Section 1 of the Manual.

1.1.3 The Beach Control Act (1956)

This legislation was enacted to ensure the proper management of Jamaica's coastal and marine resources by a system of licensing of activities on the foreshore and the floor of the sea. The Act also addresses other issues such as access to the shoreline, and other rights associated with fishing and public recreation, as well as the establishment of marine protected areas. It is currently undergoing substantive review to address more contemporary legal and management issues including the expansion of the Judges discretion on sentencing, an increase in fines and the introduction of valuing natural resources based on defined criteria. The Beach Control Act was amended in 2004 to include jurisdiction over the water column (body of water over the floor of the sea).

1.1.4 The Watersheds Protection Act (1963)

The purpose of this Act is to provide for the protection of watersheds and areas adjoining watersheds and to promote the conservation of water resources. The entire island however for management purposes is divided into 26 watershed units. The Act makes provision for conservation of watersheds through the implementation of provisional improvement schemes whereby soil conservation practices are carried out on land.

A Watershed Policy is now under consideration with a view to taking watershed management to another level of greater effectiveness. This includes a review of the Act and the development of regulations. A National Integrated Watershed Management Council was established by Cabinet in 2001 with the mandate to implement a National Integrated Watershed Management Framework including the coordinator of watershed activities of the public and private sectors, NGO's, CBO's etc.

1.1.5 The Wildlife Protection Act (1945)

This Act is primarily concerned with the protection of specified species of fauna. This Act has also undergone review particularly in the area of increased fines and the number of animals now enjoying protected status. Further amendments are being undertaken to address a variety of other issues relating to the management and conservation of these natural resources and the inclusion of flora.

1.2 Enabling Regulations

The enabling regulations associated with these Acts are as follows:

i The Natural Resources Conservation (Permits and Licences) Regulations, 1996, Revised 2004

ii The Natural Resources (Hazardous Waste) (Control of Movement) Regulations, 2002

iii Endangered Species Regulations

iv Beach Control (Hotel, Commercial and Public Recreational Beaches) Regulations

v Beach Control (Crown Licences) Regulations

1.3 RELATED LEGISLATION

Other related legislations include:

- i The KSAC Building Act and the Parish Councils Building Act (A New National Building Act and code are being drafted).
- ii The National Solid Waste Management Authority Act
- iii The Town and Country Planning Act
- iv The Town and Country Planning Amendment Act
- v The Local Area Improvements Act
- vi The Maritime Authority Act
- vii The Public Health Act
- viii The Water Resources Authority Act
- ix The Mines and Quarries Act
- x Pesticides Control Act
- xi Endangered Species Act
- xii Ozone Act

1.4 ENVIRONMENTAL CHALLENGES

Jamaica recognises that it faces many environmental challenges as a small island state. Some of these issues include among others:

- i Loss of species and biodiversity
- ii Ozone depletion
- iii Hazardous waste management
- iv Pollution from land bases sources.

1.5 ENVIRONMENTAL CONVENTIONS

The Government of Jamaica is addressing these international and global concerns through multilateral and regional agreements with other states. Steps are being taken to ratify or accede to the many environmental conventions discussed, thereby committing itself to adopting administrative policy, and legal mechanisms to implement these agreements and promoting sustainable development at the national level.

1.6 INTERNATIONAL CONVENTIONS

The International Conventions which influence our local legislation relating to the environment are:

1.6.1 Regional

i Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region, Cartagena de Indias (Cartagena Convention)

ii Protocol to the Cartagena Convention concerning Pollution from Land-Based Sources and Activities in the Wider Caribbean Region

1.6.2 International

i Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal

ii Stockholm Convention on Persistent Organic Pollutant

iii Convention on Wetlands of International importance especially as habitat for waterfowl. (Ramsar Convention)

iv Convention on Biological Diversity

v Convention on International Trade in Endangered Species of Wild Flora and Fauna

vi Vienna Convention on the Protection of the Ozone Layer

vii The Montreal Protocol on Substances that Deplete the Ozone Layer (a Protocol under the Vienna Convention)

viii International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78)

ix United Nations Framework Convention on Climate Change (UNFCC)

1.7 INSTITUTIONAL FRAMEWORK

The institutional framework associated with the legislation outlined is as follows:

Institution	Associated Legislation
NEPA	i NRCA Act, Wildlife Protection Act, Endangered Species (Protection, Conservation and Regulation of Trade) Act, Watersheds Protection Act, Beach Control Act, Ozone Act ii NRC (Permits and Licences) Regulations iii NRCA (Hazardous Waste) (Control of Movement) Regulations iv NRCA (Wastewater and Sludge) Regulations v NRCA Air Quality Regulations vi Natural Resources Blue and John Crow Mountain vii National Parks Regulations viii Natural Resources Marine Park Regulations ix Wildlife Protection Hunters Licences Regulations x Endangered Species Regulations xi Beach Control (Hotel, Commercial and Public Recreational Beaches) Regulations xii Beach Control Authority (Licensing) Regulations xiii Beach Control (Crown Licences) Regulations xiv Beach Control (Protected Area) (Ocho Rios) Order xv Natural Resources Negril Marine Park Order xvi Natural Resources Montego Bay Marine Park Order xvii Negril Environmental Protection Area Order
National Solid Waste Management Authority (NSWMA)	i National Solid Waste Management Act
Water Resources Authority	i Water Resources Authority Act
Ministry of Health – Environmental Health Unit Pesticides Control Authority	i Public Health Act ii Pesticides Control Act
Maritime Authority	i Maritime Authority Act ii MARPOL 73/78

CHAPTER 2

GENERAL GUIDELINES FOR ENVIRONMENTAL PERMIT AND LICENCE APPLICATIONS

2.0 PERMIT AND LICENCE SYSTEM

The Permit and Licence system is governed by provisions of the NRCA Act (1991), the NRCA (Prescribed Areas) (Prohibition of Categories of Enterprise, Construction and Development) Order and the NRCA (Permit and Licence) (Forms, Processing and Fees) Regulations (1996) (Amended 2004). These regulations seek to effectively manage development activities and their deleterious effects (direct and indirect) on Jamaica and its Territorial Sea as they relate to the environment and human health. The NRCA, in fact, is not entitled to grant a permit or licence if the activity in question is likely to cause injury to the environment or to public health.

2.1 GUIDELINES

These Guidelines describe the procedures for submitting applications for environmental permits and licences and also outline the obligations, breaches and consequences associated with the holding of permits or licences.

2.2 PERMITS

A Permit is required to undertake any construction, enterprise or development of a prescribed nature anywhere in the island and the Territorial Sea. The permit is intended to safeguard the various environmental/natural resources from direct damage due largely, but not exclusively, to physical development. Permits are required for new activities.

2.3 LICENCES

The discharging of any sewage or trade effluent or other polluting matter into the air, ground or water, or the construction, reconstruction or alteration works requires the obtaining of a Licence. This is to safeguard the various environmental media from contamination. Licences may be required for both existing and new facilities.

2.3.1 Non Requirement of a Licence

A licence is not however required where the discharge:

i results only from a use of water made in pursuance of a licence to abstract and use water granted under any enactment, or

ii is in accordance with good agricultural practice, as determined by the Authority after consultation with the Ministry responsible for agriculture, or

iii is caused or permitted in an emergency in order to avoid a greater danger to the public and, as soon as practicable thereafter, particulars of the discharge are furnished to the Authority, or

iv results from the domestic waste effected by means of absorption or soak away pits or other prescribed waste disposal system and is an accordance with such provisions as may be prescribed by or under the NRCA Act or any other law in force pertaining to such disposal.

2.3.2 Existing Facilities

Existing facilities are those which have obtained all planning approvals prior to January 1, 1997 and in some instances approvals prior to January 2004 (amendment of the Natural Resources Conservation (Permits and Licences) Regulations). Licences for existing facilities will be phased in and the public will be notified of the effective dates to apply for the licences for stack emissions, sewage and trade effluent discharges.

2.4 APPLICATION FOR PERMIT

An application for a permit is comprised of:

i a completed Permit Application form supplied by NEPA - in triplicate

ii a completed Project Information Form supplied by the NEPA- in triplicate

iii other accompanying documentation as listed on the application form (in triplicate), together with the prescribed application fee.

Permit Application and Project Information Forms are shown in Appendix 2 and 3 respectively.

On completion, the application package is taken or mailed to the Applications Secretariat Branch, National Environment and Planning Agency (NEPA) 10 Caledonia Avenue, Kingston 5, Jamaica.

2.5 PROCESSING APPLICATION FOR PERMIT

The processing of the application for permit is outlined in the flowchart (Figure 1).

Incomplete Project Information Forms will NOT be accepted.

2.5.1 EIA may be required

In applying for a permit, an EIA may be required. In such case, the applicant will be notified within 10 days of receipt of the application. The project proponent and/or their representatives will be provided with the Terms of Reference (ToRs) designed for the category of development.

The respective ToRS need to be modified as appropriate and submitted to NEPA for approval. The final scope of the EIA study will be agreed on by the project proponent and NEPA and the EIA study will then proceed in accordance with the approved ToRS. (For full details on the requirements for conducting EIAs, see Volume 2 Section 2 of the Manual).

2.5.2 Notification to Applicant

The notification to the applicant will be copied to related agencies and departments of government. NRCA Act Section 8 obliges agencies/departments to consult the NRCA before deciding any matter whether provisionally or finally, in respect of which the Authority has functions to perform.

2.5.3 Public Presentation

A public presentation is required for all projects requiring EIA. However, the Authority reserves the right to wave the requirement for a public presentation from time to time. Guidelines for Public Presentation have been developed to assist proponents in convening these sessions (See Volume 2 Section 2 Chapter 9 for more details).

2.5.4 Decision of the Authority

In arriving at its decision for granting a permit, the Authority will consider the comments, if any, from outside agencies, experts, and the public, besides its own analysis. The decision whether to grant a permit, or the terms and conditions to be attached to the grant of a permit, may be guided by application of specific standards in use from time to time.

2.5.5 Refusal of Permit

Where an application for permit is refused, the Authority will notify the applicant of the reasons for the decision and of his right of appeal to the Minister under Section 35 of the NRCA Act. The applicant may also appeal to the Minister where he/she objects to the terms and conditions attached to the grant of the Permit.

2.5.6 Review Period

The review and decision-making period for applications could take up to 90 days except in instances where an EIA is required. In such cases a longer period may be required.

2.5.7 Current Fees

Permit fees are as follows:

i Application for Permit ——-$2000.00 (non-refundable and payable upon submission of the application)

ii Permit Fees range from $15,000.00-$25,000.00 (payable upon the collection of the permit)

Fees may be adjusted at any time.

2.5.8 Validity

The validity of the Permit is indefinite. However, if the permitted activity does not commence within five years after the date of this Permit, then this Permit is void and the Permittee shall re-apply for a new Permit.

2.5.9 Breaches and Consequences

A Permit may be suspended or revoked if any of its terms or conditions is breached, or if the holder fails to submit any documents and information as the Authority may require.

The undertaking of a prescribed activity without the holding of an appropriate Permit will bring substantial penalties, on conviction in a court of law.

2.6 Applying for a Licence

An application for a licence is comprised of:

i a completed Licence application form - in triplicate

ii accompanying documentation as listed on the application form, together with the prescribed application fee.

On completion, the application package is taken or mailed to the Applications Secretariat Branch, National Environment and Planning Agency (NEPA) at 10 Caledonia Avenue, Kingston 5, Jamaica, or any NEPA Parish Office.

2.6.1 Processing Application for Licence

The processing by the NRCA of an application for a Licence to discharge sewage and trade effluent is outlined in the flowchart (Figure 1). In applying for a licence for a new facility, additional documentation, information or an EIA may be required. This may be subsumed in the processing of the concurrent application for a permit. Whether the licence is for a new or existing facility (i.e. existing at the effective date of the Regulations), the procedure with respect to requesting and handling of any additional documents, information or EIA is the same as described in Figure 1.

2.6.2 Existing Facility

An existing facility may be licensed provisionally for a specified time frame within which the facility will be upgraded to meet current standards. The terms and conditions of such a licence will be agreed on with the Authority.

2.6.3 Other Required Permits and Licences

In addition, other permits and licenses may be required under the Beach Control Act, NRCA Act, Wild Life Protection Act, Natural Resources (National Parks) Regulations; Endangered Species (Protection, Conservation and Regulation of Trade) Act, Natural Resources (Marine Parks) Regulations and Amendments.

2.6.4 Current Fees

Licence fees are as follows:

i Application for Licence - $2000.00 (non-refundable and payable upon submission of the application)

ii Licence Fees - $7,500.00 (payable upon the collection of the licence)

iii Licence renewal Fee - $7,500.00 (payable upon the collection of the licence)

iv An additional fee of $6,500.00 is charged for late renewals (non-refundable and payable upon submission of the application)

Fees may be adjusted at any time.

2.6.5 Validity

The validity of the Licence is five (5) years. The licensee must apply for renewal of the licence at least sixty (60) days before expiry.

2.6.6 Breaches and Consequences

A licence may be revoked if, among other things:

i there is persistent non-compliance with any of its terms or conditions

ii it is discovered that the licensee had deliberately submitted false, misleading or incomplete information during the application process, or had attempted to falsify self-monitoring records.

2.6.7 Suspension or Revocation of Licence

In the case of non-submittal of monitoring reports and other relevant documentation requested within the time specified in the licence, the Authority may also suspend or revoke the licence, and the Minister may take such steps as are necessary to ensure its cessation.

2.6.8 Discharge of sewage or trade effluent

The discharge of any sewage or trade effluent or other polluting matter into air, ground or water, except in specified circumstances, will bring substantial penalties, on conviction in a court of law.

2.7 PUBLIC REGISTER

Information supplied or collected as part of the application or monitoring process shall be placed on a register maintained by the Authority and accessible to the public. The register may include, copies of applications, permits, licences, amendments thereto, reported and collected data.

2.7.1 Exclusion from Public Exposure

The Authority will evaluate for exclusion from such public disclosure any information indicated by the applicant to be proprietary or commercially sensitive, or whose disclosure would be contrary to the interests of national security. Applicants shall accordingly identify and as far as possible physically separate any such material at the time of submitting the application, giving precise reasons for desiring exclusion of same from public disclosure.

Note
In addition to obtaining environmental permission for the prescribed categories from the NRCA, applicants are reminded that other permissions are required for development to take place. These include planning approvals from the Town and Country Planning Authority or the KSAC/Local Planning Authority/Parish Council and also building approvals from the KSAC/Parish Council.

2.8 Flowchart showing the Processing of an Application for Permit

The following is the procedure for processing applications. The flowchart outlines the different stages of the Environmental Permit and Licence Applications Process, beginning with the submission of the application through to the step when the Authority takes the decision. The chart also shows the follow-up and monitoring stages of post-permit activities.

2.8.1 Flow Chart

Processes highlighted in the Flow Chart are:

i screening of the application to determine the need for an environmental impact assessment (EIA)

ii the EIA Review, inclusive of evaluation by technical officers and technical Committees of the Agency as well as public/stakeholder involvement in the review.

N.B.
For information on Environmental Impact Assessments, please consult "Guidelines for Conducting Environmental Impact Assessments/and Public Hearings (Volume 2 Section 2 of this Manual).

2.9 ENVIRONMENTAL PERMIT AND LICENCE APPLICATION CHECKLISTS

In submitting an application for an Environmental Permit or for an Environmental Licence to Discharge Sewage Effluent or Trade Effluent, the following checklists have been collated to ensure that every developer is aware of the requirements for submission, and that these requirements are met.

Please ensure that ALL relevant documents accompany the application.

2.9.1 Environmental Permit Checklist

i Completed Permit Application Form (3 copies)

ii Completed Project Information Form (3 copies)

iii Completed Licence Application Form (if there will be a discharge of Trade or Sewage and or Poisonous or Harmful Substances into the environment). (3 copies)

iv Beach Licence Application Form (Licence Under the Beach Control Authority for any modification to the Foreshore and Floor of the Sea)

v Application Fee of $2000.00

vi TRN

vii Contact information – Telephone, Cellular phone, Fax, Email

viii Location Map (Drawn to Scale)

ix Layout Plan or Site Plan of facility/development (including dimensions) (3 copies)

x Detailed Design of Project including: -

- The proposed method of sewage treatment and disposal
- The location and setback of the sewage treatment facility on the Subdivision or Layout plan (3 copies)

xi Proof of Ownership (Registered title or information on land ownership)

- If the applicant is not the owner, a letter of authorization witnessed by a Justice of the Peace must be provided.

xii Project Brief (Short description of the project)

- Process flow, raw materials, wastes generated and waste treatment and disposal methods (Industrial Projects)

- Leak detection systems, tank type and size, and type of fuel to be stored (Petroleum Storage Facilities)

xiii Design Report- Applicable only to Sewage and Waste Water Facilities (3 copies)

xiv Drainage Plan showing contour/spot height, stormwater flow, method of entrapment and disposal.

2.9.2 Environmental Licence Checklist

i Licence Application Form (3 copies)

ii Completed Project Information Form (3 copies)

iii Completed Permit Application Form (if the project falls within any of the prescribed categories) (3 copies) iv Beach Licence Application Form (Licence Under the Beach Control Authority for any modification to the Foreshore and Floor of the Sea)

v Location Map (Drawn to Scale)

vi Layout Plan or Site Plan of facility/development (including dimensions) (3 copies)

vii Detailed Design of Sewage/Waste Water (Trade Effluent) Facility (including Discharge Points- Coordinates must be stated) (3 copies)

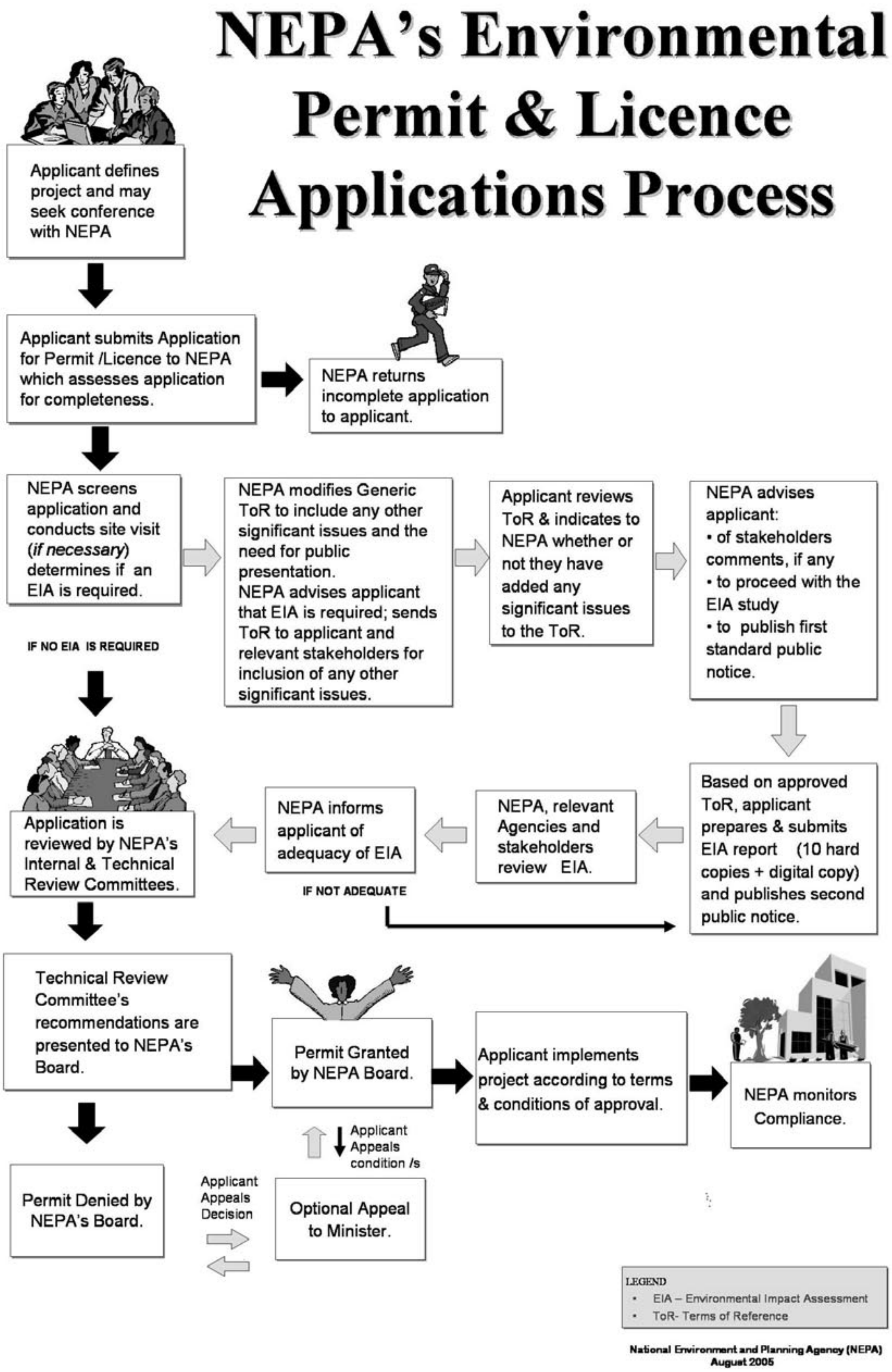
viii Proof of Ownership (Registered title or information on land ownership)

ix Project Brief
x Application Fee of $2000.00

xi TRN

xii Contact information – Address, Telephone, Cellular phone, Fax, Email

Figure 1 Flowchart for the processing of the application for permit and Licence is outlined below.



CHAPTER 3

HAZARD IDENTIFICATION AND MITIGATION

3.0 Hazard Identification

Hazard identification must be taken into consideration during the planning and construction stages of development with the aim of devising appropriate mitigation measures.

3.1 Hazard Mitigation

3.1.1 Fire Control

Safety precautions against fire must be assessed, implemented, documented and functional at all times and water supply for fire hoses must be secured. Fire exits or fire escape routes should be incorporated.

3.1.2 Natural disaster mitigation

The design of all infrastructure projects must accommodate the potential occurrence of a natural disaster and as such include the necessary mitigation measures to ensure minimum damage from disaster events. This includes but is not exclusive to:

i Earthquake mitigation

Designs must uphold the minimum building standards recommended for Jamaica as indicated by the Building Code.

ii Storm mitigation

This includes heavy rain, storm surges, tropical storms, hurricanes, mitigation measures for strong winds and high levels of precipitation and runoff. Road and building designs must therefore have adequate drainage measures and buildings and other structures must maintain the minimum standards under the Building Code for wind resistance.

3.1.3 Safety

Care must be taken to ensure that designs promote a safe work site and safe operation of the facility. The following must be considered:

i Materials: No toxic paints or construction materials (e.g., lead-based paints, asbestos) may be used within the buildings or on water supply projects.

ii Site Safety: Designs must factor in terrain and other potential areas of danger that my lead to an unsafe work site. Where there is potential for danger on a site, cautions and recommendations for safe implementation must be outlined.

iii Store necessary hazardous materials in a secure location and weatherproof location, such as a construction trailer or a steel cabinet with a strong lock. Ensure that all workers are trained in handling procedures for hazardous waste, and issue hazardous products only to trained, authorised persons.

iv Ensure that all residue materials and contaminated containers are collected and stored in a well-marked, secure and weatherproof location, and dispose of residuals in an environmentally sound manner.

v Provide personal protective equipment (glovers, respirators, clothing, boots, etc.) that is appropriate to the position and level of exposure of workers.

vi Provide spill-cleaning equipment, such as absorbent materials, and train workers in clean-up procedures to prevent hazardous waste from entering soil, drains and watercourses.

vii Repair equipment fluid leaks immediately (e.g. fuel, engine oil, gear oil, coolants, and hydraulic fluid).

CHAPTER 4

PRESCRIBED CATEGORIES OF PROJECTS REQUIRING PERMITS

4.0 PRESCRIBED AREAS

A "prescribed area" means "an area prescribed by the Minister with responsibility for the environment by order under section 9 of the NRCA Act". A permit is required to undertake any construction, enterprise or development of a prescribed nature anywhere in the island and the Territorial Sea. Prescribed categories of projects are grouped into: development projects; industrial projects and other projects.

4.1 INTRODUCTION: DEVELOPMENT PROJECT TYPES

Development projects principally involve a construction component. Buildings, e.g. dwellings, business offices, hospitals, etc., may require an array of associated infrastructure development including, complete sewerage systems, waste treatment and disposal facilities, road construction, potable water and energy supplies.

The following section outlines the different activities that will be common to all development projects. For those development projects where the environmental considerations are unique, such considerations will be addressed within the particular prescribed category.

Planning should consider the baseline state of the receiving environment as a priority and determine the extent that pollutants are likely to be tolerated before they manifest as significant impacts. Within the urban environment, the most immediate natural receptors of potential impacts from the operation of urban infrastructure are air quality, surface water and groundwater. Soils are also vulnerable to contamination from poor site practices.

Development projects will generate sewage and refuse that require treatment and disposal. These projects may also generate noise, dust and additional traffic during operation, leading to air pollution and congestion.

4.2 General Environmental Considerations

The environmental considerations associated with development projects can be looked at based on the stages of implementation – site selection and planning, construction, and post-operation. For each stage, environmental aspects are discussed. Where an existing building construction project is to be improved, the options will be more limited but the issues will be the same.

4.2.1 Site Selection and Planning

The environmental impacts of construction and operation are established during the early phases of site selection and planning. Planning, site selection and design form an important stage in the development of these projects and will determine their environmental impact(s) throughout construction and operation. Reducing the environmental impact of development will be best achieved through investigation at the project preparation stage.

Appropriate site selection and investigation can substantially reduce environmental impacts. Important factors for consideration during site selection include:

- The environment where the development will occur;
- The impact on the biodiversity[1] and habitat loss due to construction and operations;
- Proximity to local communities;
- Provision of affordable water supply, sanitation and sewage collection;
- Proximity to sensitive surface or ground water bodies (e.g. water used for drinking);
- Compliance with land zoning policy;
- Compatibility with national planning, policy, legal and regulatory framework;
- Ability to meet relevant local and international standards;
- Geological conditions (for excavations processes);

1 For information on Biodiversity, please see Chapter 54, Paragraphs 54.5-54.5.1 and Glossary of Terms Appendix 1

- Green building basics[1];

- Provision of appropriate materials, technology and skilled labour for construction and management (operation and post-operation)

4.2.2 Mitigation and Monitoring Measures

It may be necessary to assess the relative importance of these factors and reach a compromise between the potential impacts, which achieves an appropriate balance. Consideration of the above factors may highlight opportunities for the implementation of mitigation and monitoring measures. Particular attention should be paid to potential impacts on human health, which can be cumulative and long-term.

4.2.3 Design Issues

Particular issues of potential concern relating to the design include:

i Construction materials to be used in view of the potential landscape impact and sensitivity of location;

ii Types, sources and transportation of construction materials,

iii Use of construction methods that will limit disruption to adjacent communities,

iv Waste management options (solid waste treatment and/or disposal, sewage and wastewater treatment and/or disposal)

v Scope for the provision of on-site wastewater treatment facilities,

vi Water supply and sanitation and the efficient use of the resource,

vii Energy use and efficiency,

viii Surface water runoff and drainage,

ix Potential pollution control technologies (particularly land and water-related), feasibility and effectiveness;

x Prevention of traffic noise (heavy machinery used in construction phase)

1 Green Buildings are designed to meet certain objectives such as protecting occupant health, using energy, water and other resources more efficiently, and reducing the overall impact to the environment.

xi Capacity to accommodate future sector demands,

xii Constraints to future expansions – physical, environmental and planning.

N.B. *For information on planning standards relating to different types of development, see Volume1: Section 1 - of this Manual.*

4.3 CONSTRUCTION

These projects principally involve a construction component, which usually includes the following activities:

- Abstraction of minerals,
- Use of heavy machinery, and
- Traffic generated by transportation and disposal of construction wastes.

4.3.1 Urban Development

Any urban development that requires the utilisation of local services such as water, energy, waste treatment, disposal and transportation, but for which special provisions have not been made, may act as potential sources of impact on the existing service users.

4.3.2 Construction Works

Construction works on these projects will include, but not be limited to, the following activities:

- Site preparation, including clearance of vegetation;
- Installation of site compounds and storage facilities;
- Foundations;
- Installation of services to provide electricity, water supply and waste management;
- Construction of buildings and
- Landscaping and site restoration.

4.3.3 Environmental Impacts

Construction can have several types environmental impacts, including:

- Soil erosion, degradation, contamination, disturbance of old contaminated sites;
- Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;
- Generation of dust from earthmoving and stockpiled soil or from construction activities;
- Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;
- Solid waste generation;
- Noise and possible odour from construction activity, including traffic that is generated;
- Added traffic and related impacts during and after construction.

4.4 POST-OPERATION

The post-operation phase of these facilities may include:

- Deterioration of structures (degradation or collapse)
- Removal of structures (demolition)
- Contamination (long-term pollution of soil, water or sediment)
- Disposal of residues (contaminated land).

4.4.1 Decommissioning Development

Specifically, environmental impacts associated with decommissioning development projects with fuel storage tanks will most likely be associated with contaminated soils.

4.4.2 Contaminated Land and Water

Before a site, or part of it, can be redeveloped, the presence of contaminated land and water must be established and remedial measures taken, where required, to prevent risk to human health and the environment.

4.5 General Environmental Impacts

The following details the impacts on the environment that should be considered for these development projects.

4.5.1 Air Quality

Potential impacts on air quality from site-preparation or construction will principally be associated with increased dust generation (due to materials being transported and to excavation activities), which may have human health and socio-economic impacts. Dust can act as a respiratory irritant to humans, can cause a local nuisance (e.g. by covering windows and plants), impair visibility and result in a reduction and loss of crops (considerable amounts of dust may reduce photosynthesis).

4.5.2 Land and Soil Resources

i Impacts to ground conditions caused by the construction will vary widely, depending on the site's geological conditions. These impacts will be largely related to excavation activities and may include:

- Soil degradation from erosion of exposed surfaces (e.g. due to increased runoff or earth movement);
- Compaction of the soil due to vehicle movements (causing reduced infiltration of water and difficulty of penetration by plant roots);
- Land slips and slides (e.g. due to poor embankment grading);
- Ground contamination from the spillage of materials (e.g. vehicle fuel) or release of contaminants present in the soil (caused by physical disturbance of soils) and
- Disturbance of geological strata during excavation activities.

ii In addition, depending on the character of the site there may be some loss or disruption of ecological habitats and wild species.

iii Modernisation or expansion may involve areas already contaminated by past activities. The extent of contamination should be established and remediation options determined prior to development.

iv Impacts may include the loss of wetlands and wild-lands (together with their rich genetic diversity and hydrological buffering capacity), coastal zones, recreational areas, and forest resources.

v Important land resources include minerals, fossil fuels, fertile soil, forests, wetland and wildlife. Increased construction of recreational facilities has increased the pressure on these resources and on scenic landscapes.

4.5.3 Water Quality

i Site preparation and construction of an urban infrastructure may impact surface and groundwater quality and hydrological conditions (e.g. alteration of surface flows). These impacts are likely to arise mainly during excavation and earth movement activities.

ii Paved and low permeability surfaces can change water drainage and flow in the surrounding areas. Environmental effects associated with operations could include the following:

- Surface runoff, with the risk of flooding during high rainfall;
- Pollution of local water bodies and groundwater due to contaminants carried during surface runoff
- Increased sediment loading into surrounding water bodies
- Introduction of pollutants into surface water or groundwater due to routine operations or as a consequence of accidents.

iii Potential impacts include surface water contamination caused by fuel spillage, increased surface runoff and sedimentation (with associated water quality impacts e.g. increased turbidity) and contamination of groundwater supplies.

4.6 Environmental Management Systems

i An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"That part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

ii An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

> ***N.B***. *Please contact NEPA for additional information on Environmental Management Systems. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"*

4.7 Standards

In general, the following standards may apply to development projects, and can be found as Appendices to this Section:

i Ambient Air Quality (Appendix 5)
ii Stack Emissions (Appendix 6)
iii Noise (Appendix 7)
iv Trade Effluent (Appendix 8)
v Sewage Effluent (Appendix 9)
vi Sludge (Appendix 10)
vii Standards for effluent to be used as irrigation. (Appendix 11)

Specific standards, where applicable, are listed within each prescribed category.

CHAPTER 5

SUBDIVISIONS OF 10 OR MORE LOTS; HOUSING PROJECTS OF 10 OR MORE HOUSES

5.0 SUBDIVISION

Subdivision is the act of legally dividing or re-dividing a parcel or a tract of land into smaller portions which requires approval of government. Approval for subdivision is required both under the Local Improvement Act and the NRCA Act. Major types of subdivisions include residential, commercial, agricultural and industrial. There can also be various combinations, once the uses are compatible. Subdivisions are categorised into two groups, those that are ten (10) lots and over and those that are nine lots and under. A permit is required for subdivision of ten (10) lots or more.

5.1 HOUSING DEVELOPMENT

A housing development is also referred to as a residential development. It involves the construction of houses or residences which may be single-family units or multi-family units or a mixed development. A housing project of ten (10) units or more require a permit.

5.2 STANDARDS

The following standards are applicable to these projects:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

CHAPTER 6

OFFICE COMPLEXES, SHOPPING CENTRES AND HOTEL/RESORT COMPLEXES

6.0 OFFICE COMPLEXES GREATER THAN 5000 SQUARE METRES

6.0.1 Description of Office Complex

An office complex is a form of commercial building, which contains spaces mainly designed for office use. The primary purpose of an office building is to provide a working environment for administrative and managerial workers. These workers usually occupy set areas within a complex and usually are provided with desks, computers and other equipment they may need within these areas.

6.0.2 Office Building

An office building may be divided into sections for different enterprises or may be dedicated to one company. In either case, each company will typically have a reception area, one or several meeting rooms, singular or open-plan offices, as well as toilets. Many office buildings also have kitchen facilities and a staff room.

6.0.3 Standard Facilities

Standard facilities in modern office buildings include the following:

i Water

ii Electricity (distribution through entire office space with many separate points)

iii Optical connections to local telecommunications providers

iv Parking (sometimes underground under the office)

v Structured cabling for internal networking and telecommunications.

6.0.4 Standards

The following standards are applicable to these development projects:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

6.1 Shopping Centres

6.1.1 Description of a Shopping Centre

A shopping centre is a concentration of retail, service, and entertainment enterprises designed to serve the surrounding community. This facility will usually have a common parking lot for all enterprises as well as common sanitary amenities for shoppers.

6.1.2 Standards

The following standards are applicable to these development projects:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

6.2 Hotel/Resort Complex of More than 12 Rooms

A hotel is an establishment that provides lodging, usually on a short-term basis. In addition to lodging, a resort will also provide a number of additional guest services such as a restaurant, a swimming pool, sports facilities, entertainment and shopping.

6.3 Environmental Impacts

In addition to the general environmental impacts, the following section details the specific impacts on the environment that should be considered for these development projects.

6.3.1 Air Quality

Transport by air, road, and rail is continuously increasing in response to the rising number of tourists and their greater mobility. Transport emissions and emissions from energy production and use are linked to acid rain, global warming and photochemical pollution. Air pollution from tourist transportation has impacts on the local and global environment, especially from carbon dioxide emissions related to transportation energy use.

6.3.2 Noise

Noise pollution will arise from airplanes, cars, and buses, as well as recreational vehicles such as jet skis. In addition to its impact on humans, it causes distress to wildlife, especially in sensitive areas.

6.3.3 Land and Soil Resources

Hotel and resort complexes will directly impact natural resources, both renewable and non-renewable, by the use of land and the use of building materials. Additional impacts may include the loss of wetlands and wild lands (together with their rich genetic diversity and hydrological buffering capacity), coastal zones, recreational areas, and forest resources.

6.3.4 Waste Disposal

Waste disposal may be a serious problem, and improper disposal will be a major despoiler of the natural environment - rivers, scenic areas, and roadsides. Solid waste and littering can degrade the physical appearance of the water and shoreline and cause the death of marine animals.

6.3.5 Water Quality

Fresh water is one of the most critical natural resources. Hotel and resorts (with swimming pools and golf courses, in particular) generally overuse this resource. This can result in water shortages and degradation of water supplies, as well as generating a greater volume of wastewater.

6.3.6 Construction

Construction of hotels, recreation and other facilities often lead to increased water pollution by sewage. Wastewater may pollute water bodies, damaging the flora and fauna.

6.4 STANDARDS

The following standards are applicable to these development projects:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

CHAPTER 7

AIRPORTS, AIRFIELDS AND TRANSPORTATION CENTRES

7.0 AIRPORTS, RUNWAYS AND AIRFIELDS INCLUDING EXPANSION GREATER THAN 20%

There are many types and uses of airports and airfields, ranging from small recreational airfields to international cargo and passenger airports. Airports may have a complex of buildings, which include terminals and/or concourses as well as storage and loading areas for cargo.

7.0.1 Airport Infrastructure Projects

Airport infrastructure projects including new airports and runways, runway extensions, new hangars, new terminals and/or concourses, parking areas and drainage and treatment systems will have an effect on the environment. Airport infrastructure with the potential to impact on the environment include:

i Runways, taxiways, maintenance areas and hangars (surface runoff, oil spillage, oil and chemical storage and wastes)

ii Approach lighting systems, ground lighting, signage and air traffic control tower and navigational aids (visual impacts, energy use and waste bulbs)

iii Administration buildings (office waste, energy use, water supply, sanitation)

iv Terminal buildings including aircraft gates, customs and immigration, concessionary stands, baggage handling, security, transit lounges, and car parks (sanitation, water supply, energy use, solid waste)

v Fuel storage tanks and re-fuelling areas (fuel spillage, accident hazards)

vi Maintenance of aircraft, vehicles and equipment (chemicals and wastes)

vii Fire station and accident training ground (water supply, contaminated water disposal)

viii Wastewater treatment and water supply reservoirs (water use and polluting discharges).

7.1 Environmental Impacts

In addition to the general environmental impacts, the following paragraphs detail the impacts on the environment that should be considered in environmental assessment for these development projects.

7.1.1 Air Quality

Potential sources of air pollution include emissions from:

- Aircraft engines, including carbon monoxide, volatile organic compounds, particulates and others,
- Airport related vehicles (airport vehicles, staff and passenger vehicles, cargo vehicles and public transport),
- Power units used to power the aircraft on the ground,
- Air conditioning systems for terminals, hangars and administrative buildings,
- Fuel storage tanks and refuelling of tanks and aircraft, and
- Solvents used during maintenance activities and painting.

7.1.2 Air Pollution

The main source of low-level air pollution is likely to be aircraft activity on the ground and vehicular traffic. Aircraft activity is also important in terms of the emissions at higher altitudes and their contribution to climate change and ozone depletion.

7.1.3 Airport Emissions

The significance of airport emissions from airport operations depends on:

- Existing air quality in the area,
- Size of the airport, including aircraft mix,

- Air traffic movement and predicted road traffic,
- Fuel used for airport air conditioning plant,
- Number of people affected.

7.2 STANDARDS

The following standards are applicable to these development projects:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

7.3 TRANSPORTATION CENTRES

Transportation centres are areas where numbers of vehicles will congregate. This is an important development in urban transport. Transportation centres will have large areas of paved or impermeable surfaces and may include buildings for passengers, as well as concessionary stands and car parks. These development projects should consider the impact of stormwater runoff and the effect on the environment.

7.3.1 Infrastructure

Infrastructure with the potential to impact on the environment include:

- Bus bays and car parks (surface runoff, oil spillage, and wastes)

- Lighting systems (energy use and waste bulbs)

- Administration buildings (office waste, energy use, water supply, sanitation)

- Terminal buildings including concessionary stands and car parks (sanitation, water supply, energy use, solid waste)

7.4 ENVIRONMENTAL IMPACTS

In addition to the general environmental impacts, the following section details the impacts on the environment that should be considered in environmental assessment for these development projects.

7.4.1 Air Quality

Potential sources of air pollution include emissions from:

- Dust during construction works,
- Vehicle engines, including carbon monoxide, volatile organic compounds, particulates, and others,
- Air conditioning systems for administrative buildings,
- Solvents used during maintenance activities and painting.

The significance of emissions from operations depends on:

- Existing air quality in the area,
- Traffic movement and predicted road traffic,
- Fuel used for air conditioning plant,
- Number of people affected.

7.3 STANDARDS

The following standards are applicable to these development projects:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

CHAPTER 8

HOSPITALS

8.0 BACKGROUND

The healthcare industry provides a variety of services to support the healthcare needs of a community or individuals. Many of the activities in healthcare result in waste outputs and air or water pollution. In order to understand which activities generate polluting waste outputs, it is necessary to look at various functions within healthcare, and understand the products and supplies used and the resulting wastes. Much of the waste in healthcare is solid waste consisting of paper, cardboard, glass, plastic, and metals. A subcomponent of healthcare waste is infectious waste.

8.1 HEALTHCARE

Healthcare is very different from industries that have a defined 'product line,' a finite number of raw materials and defined and consistent 'waste outputs.' There are many procedures, tests, processes and activities, which encompass as many materials. The hazardous component in healthcare waste tends to be made up of small amounts of many different wastes, emanating from many different departments. Due to the decentralized nature of service delivery in healthcare, there can be various departments with different functions all generating various amounts of hazardous waste.

8.2 SERVICE AREAS

Hospitals are most often described by speciality or service areas. Some of these areas include, but are not limited to: cardiology, critical care, emergency services, family practice, general surgery, gynaecology, infectious disease, internal medicine, laboratory and analysis, medical monitoring/computer services, morgue, neurology, neurosurgery, obstetrics, oncology, pathology, pharmacy, radiology, residential care, and urology.

8.3 ENVIRONMENTAL IMPACTS

In addition to the general environmental impacts, the following paragraphs detail the impacts on the environment that should be considered in environmental assessment for these development projects.

8.3.1 Air Quality

At hospitals, air emissions come from air conditioning and refrigeration, boilers, medical waste incinerators (if on site), asbestos, paint booths, ethylene oxide sterilization units, emergency generators, anaesthesia, laboratory chemicals, and laboratory fume hoods.

8.3.2 Incinerators

Incinerators may be used by hospitals, healthcare facilities, and commercial waste disposal companies to burn hospital waste and or medical/infectious waste. When burned, hospital waste and medical/infectious waste may emit various air pollutants, including hydrochloric acid, dioxin/furan, and the toxic metals lead, cadmium, and mercury.

8.3.3 Land and Soil Resources

i Municipal Solid Waste

The majority of hospital and healthcare wastes are produced under circumstances identical to restaurants and food industry facilities, hotels, and office complexes. The industry generates large volumes of solid wastes, which may be disposed of in an appropriate waste disposal site. By keeping these wastes separate from medical/hazardous waste, there would be no need for treatment prior to disposal.

ii Bio-hazardous Waste (Regulated Medical Waste)

The concern with and need for better management of healthcare waste largely relates to those wastes that can potentially harbour and transmit infectious diseases. This includes a wide range of materials that are considered contaminated, or pose special risks (e.g. sharps).

Wastes usually considered in this category include:

- Cultures and stocks of infectious agents
- Human pathological waste, including tissues, organs, and body parts and body fluids that are removed during surgery or autopsy, or other medical procedures, and specimens of body fluids and their containers.

- Human blood and blood products

- Sharps that have been used in patient care or treatment or in medical, research, or industrial laboratories, including hypodermic needles, syringes, scalpel blades, blood vials, needles with attached tubing, and culture dishes. Also included are other types of broken or unbroken glassware that were in contact with infectious agents, such as used slides and cover slips.

- Isolation wastes including biological waste and discarded materials contaminated with blood, excretions, and secretions from patients who are isolated to protect others from certain highly communicable diseases.

- Unused sharps including unused, discarded hypodermic needles, suture needles, syringes, and scalpel blades.

iii Hazardous Waste

There are some special waste streams that fall most logically under the heading of "hazardous" such as mixed waste, pharmaceutical waste, pressurized containers and ignitable compressed gas, and universal waste. These wastes have to be treated as hazardous, with the appropriate method and technology, before final disposal to an approved facility.

To be considered hazardous waste, wastes are ignitable, reactive, corrosive, or toxic. There are eight hazardous waste types that are commonly used in healthcare facilities: mercury, chemotherapy and antineoplastic chemicals, formaldehyde, photographic chemicals, radio nuclides, solvents, anaesthetic gases, and toxic, corrosive, and miscellaneous chemicals.

8.3.4 Water Quality

i Wastewater sources from healthcare facilities include:

- Sinks, floor drains, showers, toilets, dish and laundry washing machines, and tubs;

- Photographic development drains from radiology (X-rays), other imaging, and dentists; and

- Stormwater.

ii A large facility usually contains thousands of drains and proper drain disposal practices should be in place in each area. Most facilities discharge sink, shower, toilet, and tub wastewater to wastewater treatment facilities or onsite systems (septic tanks).

iii Photographic development (X-ray) wastewater may be filtered to recover silver before it is discharged. Mechanical shop floor drains should drain to a wastewater facility and not simply empty into the soil.

iv Healthcare facilities generate stormwater from building and parking lot areas or from aboveground or underground oil or fuel storage tank areas. Hospitals with construction areas of one acre or larger should consider stormwater in their environmental management plans. Healthcare facilities with underground storage tanks (USTs) or aboveground storage tanks (ASTs) need to consider the Oil Pollution Prevention requirements and NEPA's guidelines for storage.

8.4 STANDARDS

The following standards are applicable to these development projects:

- Ambient Air Quality (Appendix 5)
- Stack Emissions (Appendix 6)
- Noise (Appendix 7)
- Trade Effluent (Appendix 8)
- Sewage Effluent (Appendix 9)
- Sludge (Appendix 10)
- Standards for effluent to be used as irrigation. (Appendix 11)

CHAPTER 9

THEME PARKS AND GOLF COURSES

9.0 THEME PARKS

Theme parks are entertainment areas, which include recreational, sporting and amusement activities. These facilities include seating areas, concessionary stands, sanitary facilities, administrative offices and car parks. These parks generally have large areas of paved or impermeable surfaces for vehicular traffic, as well as car parks. Storm water is therefore an important environmental consideration for these developments.

9.0.1 Infrastructure

Infrastructure with the potential to impact on the environment include:

i Pedestrian walkways, car parks and maintenance areas (surface runoff, oil spillage, oil and lubricant storage and wastes)

ii Lighting systems, signage (visual impacts, energy use and waste bulbs)

iii Administration buildings (office waste, energy use, water supply, sanitation)

iv Concessionary stands, security, sanitary facilities and visitor amenities, and car parks (sanitation, water supply, energy use, solid waste)

v Fuel storage tanks and re-fuelling areas (fuel spillage, accident hazards)

vi Maintenance of equipment (chemicals and wastes)

vii Wastewater treatment and water supply reservoirs (water use and polluting discharges).

9.1 ENVIRONMENTAL IMPACTS

In addition to the general environmental impacts, the following paragraphs examine the impacts on the environment that should be considered for these development projects.

9.1.1 Air Quality

Potential sources of pollution include emissions from:

- i Dust during construction works,
- ii Park vehicles (staff and passenger vehicles, and public transport),
- iii Emergency power generating units,
- iv Air conditioning systems for administrative buildings,
- v Fuel storage tanks, and
- vi Solvents used during maintenance activities and painting.

9.1.2 Airport Emissions

The significance of airport emissions from airport operations depends on:

- i Existing air quality in the area,
- ii Size of the park,
- iii Predicted road traffic,
- iv Fuel used for air conditioning plant and emergency power generation,
- v Number of people affected.

9.2 STANDARDS

The following standards are applicable to these development projects:

- i Ambient Air Quality (Appendix 5)
- ii Noise (Appendix 7)
- iii Sewage Effluent (Appendix 9)

9.3 GOLF COURSES

Golf courses are intimately associated with the surrounding landforms and vegetation of a site. A recreational facility designed and developed for uses including but not limited to a golf course, driving range, putt-putt golf with associated indoor activities such as concessionary stands, administrative offices, meeting rooms, storage facilities, sanitary facilities and car parks. Golf courses are large landscaped areas, requiring no fixed dimensions. Within certain basic parameters this gives an inherent flexibility to the layout of each course. In turn this creates the opportunity for golf courses to encapsulate natural features within the 'roughs' and non-playing areas. In this way, golf courses may be able to preserve valuable areas of natural habitat. Golf courses are usually closely associated with tourism related activities and hotel /resort development

9.4 ENVIRONMENTAL CONSIDERATIONS

The environmental considerations associated with these development projects can be looked at based on the stages of implementation – site selection and design, construction and operation.

9.4.1 Site Appraisal and Design

Site selection is an important preliminary step in the development process and must precede the design stage. When conducting a site appraisal, it is important to:

i Assess suitability of site – evaluating the environmental sensitivity of the site and the major potential constraints and enhancement opportunities.

ii Identify the key issues requiring further study - to prioritise the environmental constraints relating to a particular site.

iii Scoping of further works – to provide a detailed brief for the further environmental studies required.

9.4.2 Site Selection

The site selection process should cover the following aspects:

i Environmental context, statutory/planning context, protected areas and designations

ii General characteristics and land use

iii Physical environment, climate, hydrology, soils, topography and land area

iv Water availability and quality, potential sources of water supply, aquifer characteristics v Landscape and heritage, landform character, visual constraints, amenity

vi Ecology, natural habitats, flora and fauna, species of conservation concern, nature conservation issues

vii Level of environmental sensitivity of the site; compatibility with golf land use, potential opposition, enhancement opportunities, further studies required.

9.4.3 Potential Environmental Impacts

The major potential environmental impacts that should be considered during the design are:

i Use of construction methods that will limit disruption to adjacent communities,

ii Waste management options

iii Water supply and sanitation and the efficient use of the resource,

iv Capacity to accommodate future sector demands

9.4.4 Impact Avoidance

i All projects, no matter how minimally constructed, involve modification of land use and management. This inevitably has some environmental effects, which need to be understood and taken into account.

ii At the simplest level a basic assessment is adequate. As sites and projects become more and more complex, effectively rising up a sensitivity gradient, the level of detail required becomes more substantial. There is no cut-off point between a basic and a detailed study, since each case is unique.

9.4.5 Construction

This is the critical stage during which any mistake will cause actual environmental damage. The key is to ensure that environmental safeguards are implemented correctly.

9.5 Environmental Impacts

The following section details the potential areas of concern that should be considered in environmental assessment for these development projects.

9.5.1 Water

i Water is a fundamental aspect of golf course management. Even in the most minimal circumstances, some watering of the greens is necessary on occasions. More commonly, the greens, approaches and tees are irrigated on a regular basis.

ii Golf courses use large volumes of water and this is an area of legitimate public concern. This issue is crucial in dry zones, due to the overall scarcity of fresh water and where there are so many demands on the water supply.

iii Water is a valuable resource and has to be used efficiently. In densely populated areas, where summer time restrictions are imposed on the public water supply, the continued heavy usage for non-essential purposes creates a bad public image. Water conservation is clearly a major issue confronting the golf industry.

iv In planning an irrigation regime, the key factors to take into account are evapo-transpiration, soil type and crop factor (a function of leaf area and transpiration rate). Different turf-grasses have different water requirements and the most suitable types should be determined based on the climate and hydrology of the region.

v It should also be stressed that on most golf courses there is a tendency to over-water. This leads to undesirable species invading the turf and potential disease problems. There is considerable potential for a significant reduction in water quantities used on most golf courses today, without any detrimental effect on turf quality.

9.5.2 Pollution

i Pollution covers a number of different aspects but mostly refers to the use of chemicals on golf courses. There is widespread public concern about pesticides (herbicides, fungicides and insecticides) and fertilizers applied to golf turf and their potential effects on natural ecosystems, including the risk of groundwater and the eutrophication of coastal marine waters. It is also important to consider the fate of chemicals when applied to turf grass systems.

ii In view of the filtering properties of turf grass ecosystems, and of the relatively small quantities of chemicals used, professionally managed golf courses present a negligible risk of ground water contamination, or poisoning of wildlife.

iii Other types of pollution concern nuisance factors such as intrusive lighting from clubhouses, car parks and driving ranges. These are sometimes cited as causes for objection to golf course development proposals. In addition, increased traffic flows along narrow rural roads and through local communities are claimed to create noise pollution and disturbance. Golf clubs must obviously recognize their responsibilities as good neighbours within their local community.

9.5.3 Land use

i The impact of golf courses in the countryside was of concern partly in relation to the visual perception of a golf course as an artificial, 'suburban' landscape, appearing out of place in a rural environment.

ii Agricultural land may be targeted for golf development. In environmental terms, intensively managed agricultural land is generally accepted as being of low ecological and landscape value. The prospect of converting some of this land into an alternative green field use, which allows a greater diversity of vegetation types, as would be the case with golf, has many potential attractions to conservationists.

iii Access is also a crucial issue in such areas. Existing rights of way have to be respected and safeguarded, consequently new courses will increasingly be required to improve, rather than restrict, public access.

9.6 STANDARDS

The following standards are applicable to these development projects:

- i Ambient Air Quality (Appendix 5)
- ii Noise (Appendix 7)
- iii Sewage Effluent (Appendix 9)

CHAPTER 10

WATER TREATMENT AND STORAGE FACILITIES

10.0 BACKGROUND

This chapter deals with the treatment of water and storage facilities including Water Supply, Desalination Plants, Sewage and Industrial Wastewater, Reservoirs, Dams, Dykes and Aqueducts

10.1 WATER SUPPLY

Water supply is the process or activity by which water is provided for some use, e.g. to a home, factory or business. The term may refer to the supply of water provided in this way.

10.1.1 Basic Source of Water

The basic source of water is rainfall, which collects in rivers and lakes, under the ground, and in artificial reservoirs. Groundwater is tapped by means of wells. Most often water must be raised from a well by pumping. Water that collects in rivers, lakes, or reservoirs is called surface water. Most large water supply systems draw surface water through special intake pipes or tunnels and transport it to the area of use through canals, tunnels, or pipelines, which are known as mains or aqueducts. These feed a system of smaller conduits or pipes that take the water to its place of use.

10.1.2 An Aqueduct

An aqueduct is an artificial channel that is constructed to convey water, chiefly for providing a densely populated region with a supply of freshwater. Some aqueducts consist of tunnels cut through rock, while others are conduits made of some sturdy material. The topography of the land influences the design of the aqueduct, usually part of the structure is above ground and part below.

10.1.3 Waterworks

A complete water supply system is often known as a waterworks. Sometimes the term is specifically applied to pumping stations, treatment stations, or storage facilities. Storage facilities are provided to reserve extra water for use when demand is high and, when necessary, to help maintain water pressure.

10.2 WATER TREATMENT

Water treatment systems are used to provide water of high enough quality for human consumption. The type of water treatment systems needed, will be defined by the standard of water quality required plus the quality of the source water. These sources can be:

i Groundwater sources, unless contaminated, are often already of high quality, as the water has been purified during its movement within the ground;

ii Surface water sources may have to be treated for the reduction or removal of sediment, algae, micro organisms, odour, colour and chemical contamination.

iii In particular circumstances where a ready supply of fresh water is not available, treatment may also be needed to reduce salinity. Water treatment systems will rarely be implemented in the absence of a water distribution system.

10.2.1 Water Treatment System

The development of a water treatment system implies the existence or simultaneous development of a large water source or reservoir. Water treatment facilities include those operating one or more of the following processes:

i Simple physical treatment and disinfection (e.g. rapid filtration and disinfection);

ii Normal physical treatment, chemical treatment and disinfection (e.g. pre-chlorination, coagulation, flocculation, decantation, filtration, disinfection);

iii Intensive physical and chemical treatment, extended treatment and disinfection (e.g. break-point chlorination, coagulation, flocculation, decantation, filtration, adsorption, disinfection);

iv Desalination.

Specifically, desalination is the removal of salt from brine, particularly seawater. Distillation is the most widely used desalination process today. Commercial desalination is most commonly based on evaporation and subsequent condensation.

10.3 WATER STORAGE

Dams are the main means of impounding water for irrigation, domestic and industrial water supply, for flood control or in order to provide the power for generating hydroelectricity. The term refers to the impounding structure, but is often used as a short cut to describe the structure plus the water reservoir that normally lies behind it.

10.3.1 Reservoirs and Dams

i The scale and complexity of the structures and the size of the associated reservoirs vary enormously. They may be built singly or in groups and have single or multiple purposes.

ii Both construction and operation of dams and reservoirs affect the environment. The main activities involved are the construction of a barrier and installation of associated equipment followed by a period of filling the reservoir before the system goes into full operation. Once built, dams normally have a long life expectancy but still require inspection and maintenance to ensure safety and reservoirs have a tendency to accumulate silt, which can reduce storage volume significantly. Dams and reservoirs may also need to be decommissioned due to safety concerns.

10.3.2 Dykes

A dyke is a permanent earthwork that is built along the edge of a water body to prevent it from flooding onto adjacent lowlands.

10.4 WASTEWATER TREATMENT AND DISPOSAL

Wastewater generated by domestic or industrial premises generally require some form of treatment and disposal. Wastewater treatment can be undertaken locally, at source such as an industrial treatment plant, or might be centralised and serviced by sewage and industrial wastewater collection systems that transport untreated flows to a larger municipal treatment facility. Types of treatment systems covered in this section include:

i Physical (e.g. mechanical screening, sedimentation)
ii Chemical (e.g. chemical precipitation, activated carbon adsorption)
iii Biological (aerobic and anaerobic)

10.4.1 Wastewater Treatment Processes

These processes all serve to reduce the loads of potentially harmful substances so that the wastewaters can be disposed of safely and without causing unacceptable levels of pollution. The processes may be applied alone or in combination in a variety of applications, including:

- i Conventional biological treatment works
- ii Septic tanks
- iii Stabilisation ponds
- iv Oxidation ditches
- v Aerated lagoons
- vi Use of existing wetlands for polishing
- vii Artificial wetlands
- viii Other advanced technologies, appropriate to the type of pollution

10.4.2 Wastewater Treatment- Urban Centres

Urban centres should be served by wastewater treatment facilities designed specifically for an appropriate mix of domestic and industrial wastewater, plus stormwater runoff where it enters the system.

10.4.3 Stormwater Runoff

Stormwater runoff may contain high solids loads, high organics loads (e.g. oils) and potentially high concentrations of toxic contaminants (e.g. from industrial lands). In this light, urban wastewater treatment systems that receive stormwater runoff should encompass treatment of runoff in order to prevent significant adverse contamination of local surface and/or marine waters. However, collection and treatment of stormwater can present problems by overloading wastewater collection systems. This should therefore be budgeted for in the design phase.

10.4.4 Final Disposal

A further important consideration is the final disposal of the treated wastewater and waste materials generated by the treatment systems since these can have significant implications for the environment. Consideration needs to be given to:

- i Final disposal options for treated wastewaters and their effect on receiving waters and aquatic and inter tidal ecosystems;

ii The disposal and/or use of solid wastes (screenings and sludge) resulting from treatment.

10.5 Environmental Considerations

The environmental issues associated with implementation phases of water treatment projects; planning and site selection, construction, operation/maintenance and post-operation are described below.

10.5.1 Site selection and planning

Planning, site selection and design form an important stage in the development of water treatment systems and storage facilities and will determine its environmental impact throughout its construction, operation and post-operation.

i Water Treatment

It is critical that the location of a water treatment system is based on considerations of the availability and sustainability of a suitable resource and the ability to supply treated water to the user population.

ii Water Treatment System

During the planning stage, data will need to be gathered to determine if there is a reliable source of water and to assess its typical and seasonal quality and, therefore, the level of water treatment required. It is also a prerequisite of a water treatment system that an effective water distribution system is in place or is planned as a concomitant development. Normally a water treatment system would be considered as part of an overall water supply project.

iii Water Storage

Appropriate site selection and investigation can substantially reduce impacts on the environment. The following important factors for consideration include:

- Need for and purpose of a dam;
- Extent and location of population that will benefit;

- Suitable topography for the construction of a reservoir;
- Geology and natural seismic activity of the site(s);
- Potential induced seismic activity from dam and reservoir pressures;
- Availability of construction materials;
- Extent of resettlement needs;
- Value of agricultural land lost;
- Historical or cultural value of land lost;
- Ecological loss;
- Changes in river habitats including fish migration possibilities, and on fisheries;
- Effects on surrounding land use from changes in hydrology and water quality and quantity;
- Associated needs to protect water quality and quantity (erosion control and other management needs, wastewater treatment);
- Changes in downstream hydrology and their influence on sedimentation or erosion rates;
- Changes in water availability and water quality for other users and for aquatic ecosystems.
- The relative importance of these factors will vary from site to site. A compromise will normally be needed between competing factors to achieve an appropriate balance.

iv Dam Design

Once basic dam design options are identified, detailed work is needed to refine the feasibility analyses, including:

- Geological and seismological surveys to confirm site suitability (foundation strength, stability, impermeability);

- Hydrological assessment to determine the rate of reservoir fill, safe yield and the probable maximum flood for design of spillway or other flood control mechanism;

- Evaluation of alternative quarry and other material sources; specifications for materials and equipment.

v Wastewater Treatment

Appropriate site selection and investigation can substantially reduce impacts caused by a wastewater treatment system. If wastewater treatment systems are flooded they can spread disease and human excreta; the elevation of a site is, therefore, a very important consideration. Additionally, the site should be close to the population being served in order to reduce the costs and complexities in developing an appropriate wastewater collection system.

vi Design

Planning should ensure that the design process is based on a thorough understanding of the community needs in terms of wastewater volume and loading (i.e. total throughput of organic matter) as these factors fundamentally influence the treatment design needs. The design should also take account of any expected fluctuations in volume and loading needs, particularly where there are seasonal fluctuations (e.g. related to tourism or wet and dry seasons).

vii Urban Wastewater Treatment Systems

These can have major adverse environmental impacts unless they are correctly planned, sited, designed, constructed, operated and maintained. By their nature, urban wastewater treatment plants receive high loads of organic and chemical waste material, and without appropriate treatment this will result in significant adverse impacts in the receiving water, which would not otherwise have arisen.

viii Level of Treatment

The level of treatment to be achieved depends on the regulated environmental standards in the treated effluent and sludge, as well as environmental quality objectives that must be achieved in the receiving environment. The aim is to minimise the impact on aquatic ecosystems and sustain the water resource for human uses for receiving water bodies. In the case of effluents that are to be applied to crops or otherwise used on land, the standards for each case will be set to prevent crop and groundwater contamination.

ix Future Expansion

It is important to reserve space for future expansion when acquiring sites and designing facilities. The planning process should also address questions of funding, particularly for urban wastewater treatment systems with a high proportion of wastewater from industrial sources.

x Long Term Impact

Particular attention should be paid to the long-term impact of the effluent on the receiving environment. The siting of a large capacity waste treatment facility may well meet with resistance from the residents in the immediate vicinity. This might be as a result of loss of land, of amenity or recreational value, or because of aesthetic impacts such as odours, unsightly facilities or perceived health risks. These problems may be economically significant if the area benefits from tourism or other sensitive economic activities.

N.B. *For information on planning standards wastewater treatment and storage facilities see Volume 1: Section 1- and Volume 4 Section 4*

10.6 CONSTRUCTION

The duration of the construction phase will depend on the complexity of the project and the nature of the environment.

10.6.1 Types of Environmental Impacts

Construction for developments can have several types environmental impacts, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;

- Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;

- Generation of dust from earthmoving and stockpiled soil or from construction activities;

- Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;

- Solid waste generation;

- Noise, dust and traffic associated with construction sites, quarries and camps and access or haul roads;

- Land taken for construction related activities. Some of these can be temporary such as the construction camps or temporary spoil storage areas while others are permanent such as the dam site and spillway, access roads and quarries. The effect will depend on the nature of the existing land use or habitat.

- Socio-economic and cultural and health impacts on local populations from the presence of migrant labour or from the change of lifestyle of local employees of the project.

- Added traffic and related impacts during and after construction.

Those impacts that are more specific to water treatment projects are associated with the risk of contamination of the water resource itself.

10.6.2 Wastewater Treatment and Disposal

In addition to the above, prior to construction, the composition of the wastewater must be determined and the required receiving water quality defined. It is also a prerequisite of a wastewater treatment system that an effective wastewater collection system is in place or is planned as a concomitant development.

10.7 OPERATION

10.7.1 Water Treatment

The processes involved in the operation of a water treatment project will depend on the type and quality of water resource exploited (i.e. groundwater, surface water, saline water) and the type and level of treatment required for the proposed water use.

10.7.2 Water Storage

Dam operating characteristics vary with the use made of the water. However, all dams allow controlled quantities of water to be used over time. Where dams are built for irrigation or for domestic/industrial supply, water is normally abstracted at the dam and the total amount of water flowing into the river is reduced. Flows into both abstraction point and river can be regulated to meet demand. Provisions need to be made for flood control or other arrangements taking seasonal or excess water out of the reservoir.

10.7.3 River Flow Regulation

Where a river has more than one dam along its length, abstraction conditions and flood control need to be considered in an integrated way. Such cascade management is likely to create the need for relatively sophisticated methods of flow regulation.

10.7.4 Dams

Key issues during operations of dams are:

i The effect of a large water body on the microclimate, and
ii Health implications in relation to the presence of habitats for disease vectors

Dams and their associated infrastructure can have a very long life if the water source is not over-exploited. Mechanical equipment may need to be replaced during this time and the opportunity should be taken to ensure that replacements make full use of technological advances that may have been made in the intervening period.

10.7.5 Wastewater Treatment

i The successful operation of a wastewater treatment project will result in a central point of disposal of treated wastewaters. Because the disposal point is centralised, there is a reduced probability of harm to other environments but potentially an increased probability adjacent to the treatment plant and in the receiving waters.

ii If the treatment process is compromised, e.g. through inadequate capacity or poor management of operational processes, the probability of adverse contamination of the receiving water can be high. Therefore, impacts during operation depend significantly upon the sensitivity of the receiving water and the correct design and operation of the treatment system.

10.8 POST OPERATION

10.8.1 Water Treatment

A water treatment system should ideally be based on a sustainable resource and use locally appropriate technology and, therefore, should have a very long lifetime. Mechanical equipment may have to be replaced routinely or on failure, or upgraded as technology improves or water demand increases.

10.8.2 Decommissioning of a Treatment Facility

Decommissioning of a treatment facility is, therefore, usually associated with obsolescence resulting from a decision to introduce more advanced technology or a higher capacity facility. Decommissioning may be also required for non-sustainable sources or sources that become contaminated and can no longer be abstracted.

As part of the decommissioning process, it is important to ensure provision of an alternative source of treated water for the population.

10.8.3 Water Storage

i Potential environmental issues associated with decommissioning of reservoirs include:

- Potential for failure of the dam, releasing a large volume of water and sediment;

- Possible health implications if a body of stagnant water remains;

- Socio-economic impacts due to loss of resource and employment.

ii Draining the reservoir will remove the impacts associated with a stagnant water body and the potential for dam failure. The dry land produced after draining a reservoir should be developed as much as possible to produce an environment capable of supporting a diverse range of wildlife. The feasibility of reinstatement of any agricultural activities will need to be investigated.

10.8.4 Wastewater Treatment

A wastewater treatment project should ideally be based on locally appropriate technology and, therefore, should have a very long life span. Mechanical equipment may have to be replaced routinely or on failure, or upgraded as technology improves or treatment demand increases. Decommissioning of a treatment facility is, therefore, usually associated with obsolescence resulting from a wish to introduce more advanced technology or a higher capacity facility. As part of the decommissioning process, it is important to ensure provision of an alternative means of wastewater treatment.

10.9 ENVIRONMENTAL IMPACTS

The principal impacts of these projects are positive, with human health as the main beneficiary. However, it is important to remember that the larger the population served, the more likely it will be that the water problems are important. Issues include:

i Ensuring the sustainability of water sources through adequate abstraction strategies covering all water uses;

ii Risks of contamination at the point of abstraction, in transport and at point of use from inappropriate sanitary measures,

iii Risks of ground water contamination from sewage seepage;

iv Increased pressure on local environment following migration towards new sources of water;

v Increased pressure on cultivation or pastoral systems of changes in water availability;

vi Disruption of aquatic ecosystems by flow reduction below abstraction points.

10.9.1 Severity of Impacts

The severity of the impacts depends upon:

i The scale and number of projects

ii The sensitivity of the local environment

iii Resource sustainability (determined by climate and other factors)

iv Groundwater vulnerability (determined by geology)

v Land uses and associated chemical contamination that may impact on water quality (in particular agricultural pesticides and fertilisers)

vi Inappropriate use of abstracted water, particularly high-volume use for agriculture

vii Community responsibility.

10.10 ENVIRONMENTAL ASSESSMENTS

The following paragraphs examine the impacts on the environment that should be considered in environmental assessment for these development projects.

10.10.1 Air Quality

i Water Treatment

- The impacts on air quality of a water treatment scheme will be minimal during construction. There may be release of dust or other particulate matter by heavy machinery.

- Impacts on air quality from the operation of a water treatment scheme are likely to be minimal. The scale will depend on the type of treatment applied. Physical treatment has no significant implications, but chemical treatment can potentially result in the release of harmful chemicals, depending on the type of disinfection used. In particular, disinfection processes based on chlorine have the potential to release both the chlorine and volatile by-products of chlorination, which can include compounds of toxicological concern such as chloromethanes.

ii Water Storage

- Impacts on air quality include emissions from the plant required to construct the dam, and dust and noise generated by quarrying for dam materials and by construction activities and traffic. Methane, hydrogen sulphide or carbon dioxide may be produced by the anaerobic decomposition of vegetation in the flooded area, mainly during the reservoir-filling period.

- Windblown dust may occur during periods of low reservoir levels, depending on the local weather systems, topography and geological conditions.

iii Wastewater Treatment

- Air quality impacts of a wastewater treatment scheme are likely to be minimal during construction. There may be release of dust or other particulate matter during excavations and use of heavy machinery.

- Impacts on air quality from the operation of a wastewater treatment facility are associated with odour from the treatment processes and sludge disposal operations. There may be the emission of volatile organic compounds from the treatment process if these are present in industrial wastewaters.

10.10.2 Noise

Noise from treatment processes and generators can be an issue for local residents.

10.10.3 Land and Soil Resources

i Water Treatment

Impacts on ground conditions caused by the construction of water treatment schemes will vary widely, depending on the scale of the project and the site's geological conditions. These impacts will be largely related to excavation activities.

Impacts during operation may occur as a result of disposal of sludge from the treatment process onto land. Specifically, desalination plants will result in high saline wastes, which will need to be disposed of in an appropriate manner.

ii Water Storage

Impacts caused by the construction of a dam will vary widely, depending on the size of the scheme, surface and geological conditions. They may include:

- Soil erosion from removal of vegetation and earth movement as well as from inadequate drainage on access roads or site manoeuvring or storage areas;
- Compaction from vehicle movements;
- Land slips and slides due to poor slope control;
- Ground contamination from materials spillage;
- Quarry sites.

iii Reservoir Filling

Impacts caused by reservoir filling are the serious and permanent loss of land, including loss of natural habitats, settlements or agriculture previously supported by the lost areas and potential effects on productivity due to changes in the groundwater regime close to the reservoir.

v Wastewater Treatment

- Impacts on ground conditions caused by the construction of wastewater collection and treatment systems will vary widely, depending on the scale of the project, the type of system and the site's geological conditions.

- During operation, the primary concerns are the potential for contamination of land resulting from the escape of wastewaters (e.g. overflows during periods of flooding), and the disposal of sludge from the treatment system. A further area of concern is the build-up of contaminants in soils where treated effluent or sludge is applied repeatedly to the land.

- If the wastewater is wholly domestic in origin, concerns are primarily related to microbiological health and risks to local human populations. However, if the wastewater also includes industrial or other chemicals that might persist, longer-term contamination issues may become a concern.

10.10.4 Water Quality

i Water Treatment

- Potential impacts during construction include: surface water contamination caused by fuel or other chemical spillage and increased surface runoff and sedimentation with associated water quality impacts (e.g. increased turbidity).

- During operation most water treatment facilities produce a sludge or wastewater that has high levels of solids and chemical contamination and which might possibly contaminate surface waters through poor waste management or inappropriate disposal. There is also the possibility of accidental release of water treatment chemicals such as chlorine, and laboratory chemicals resulting in adverse environmental effects in receiving waters.

- The operation of a water treatment project requires the abstraction of water and will lead to decreased flow within an abstracted watercourse or groundwater.

ii Water Storage

- Construction of a reservoir can affect a large area from the upper limits of the catchment area to the sea. Potential impacts include surface water contamination caused by fuel spills during construction, increased surface runoff and sedimentation and contamination of water supplies in the reservoir and downstream. Impacts on the local hydrology during construction activities may be caused by the interruption of subsoil and overland drainage and by increased runoff due to soil surface compaction. This can damage aquatic ecosystems temporarily or permanently.

- The impacts due to the operation of a reservoir scheme for water supply may include profoundly changing the river system. Dramatic changes can occur in the timing of flow, quality, quantity and use of water, aquatic biota, and sedimentation in the river basin.

- Changes in the residence time from a running watercourse to a standing body of water will result in the deposition of suspended particles. There may also be an increased input of sediment due to increased activities upstream of the reservoir due to improved accessibility. This will limit the storage capacity of the reservoir and rob the downstream waters of sediment. Many agricultural areas on floodplains depend on nutrient-rich silt to sustain productivity. As sediment is no longer deposited on the floodplain downstream, the loss of nutrients may be compensated by fertiliser inputs to maintain agricultural productivity.

- In contrast, sedimentation in a reservoir provides higher quality water for irrigation, industry and human consumption. Sedimentation at the reservoir entrance may cause flooding upstream. Constant high water in a reservoir may also contribute to increased sedimentation by erosion of the reservoir shoreline and to modification of the groundwater profile adjacent to the shores.The latter could result in the entry into solution of undesirable materials.

- Where downstream watercourses are used as receptors for human, agricultural or industrial wastes, the capacity of the stream to assimilate lower stream flows due to reservoir regulation may limit discharges with a resultant reduction in water quality.

- The operation of a reservoir is also likely to increase the opportunity of nitrification due to the lack of turbulence and the ratio between volume and surface area. The decomposition of organic matter on flooded land will also enrich the nutrients in the reservoir. Fertilisers used upstream add to nutrients accumulating and recycling in the reservoir. This can support reservoir fisheries but also stimulates the growth of algal mats or aquatic weeds, such as water lettuce and water hyacinth. These weeds can be expensive nuisances when they clog outflows and irrigation canals, damage fisheries, limit recreation, increase water treatment costs, impair navigation and substantially increase water losses through transpiration.

- Additional effects of changes in the hydrology of the river basin include altered levels of the water table both above and below the reservoir. This can cause water tables to stay consistently high, causing salt accumulation in soil on farmland and marsh creation.

- Reservoir water level and outflow control is one of the most important aspects of water supply management and, if poorly managed or subject to severe drought or flood conditions, damage may occur both to the reservoir itself and downstream of the facility. If facilities are not adequately maintained then the standard of service will decrease and the water quality will suffer.

- The construction of a reservoir may promote recreation or other development in the catchment. This can affect the water quality and quantity within the reservoir and the sediment and pollutant load entering the reservoir.

iii Wastewater Treatment

- Construction of a wastewater treatment system may impact on the water environment particularly as wastewater treatment systems are commonly adjacent to watercourses. Potential impacts include: surface water contamination caused by fuel or other chemical spillage; increased surface runoff and sedimentation (associated with earthworks see above) with associated water quality impacts (e.g. increased turbidity); and contamination of groundwater supplies (e.g. by the percolation of contaminants, such as spilled fuel, into the aquifer).

- During operation of a wastewater treatment plant, the final effluent is normally discharged into the local watercourse (river, lake, lagoon, estuary, coastal water). All municipal wastewater will contain suspended and dissolved solids (inorganic and organic matter, nutrients, oil and grease, toxic substances, and pathogenic micro-organisms) at relatively concentrated levels. Effluents with a significant proportion of industrial wastewater will be more likely to have elevated levels of toxic chemicals present. Potential impacts will depend on the quality of the effluent and the assimilative capacity of the receiving water. Adverse impacts can result from excess organic loading and the discharge of potentially toxic organic and inorganic chemicals. Potential effects include eutrophication, reduced biological quality, and the limitation of further uses of the water resource.

  Sewage sludge disposal sites may result in groundwater pollution if there is significant leaching, depending on the water-tightness of the waste disposal facility, the depth of the groundwater table, and the permeability of the ground below the application site.

10.10.5 Biodiversity

i Water Treatment

Reduced water flow caused by the operation of a water treatment project will have an impact on the aquatic life in the affected watercourse. Effluent from the water treatment project may have adverse effects on aquatic life if discharged without treatment to surface water.

ii Water Storage

- Riverine and estuarine ecosystems may be impacted by changes in the river flow, deterioration of water quality, water temperature changes, loss of spawning grounds, reduction in sediment downstream of the reservoir and barriers to fish migration.

- Wildlife will also be impacted by the loss of habitat resulting from reservoir filling and land use changes in the river basin. Migratory patterns of wildlife may be disrupted by the reservoir and associated developments. Adverse effects on aquatic fauna in a reservoir can result when the waters are severely drawn down. Shore and bank vegetation may be destroyed, diminishing food resources for waterfowl and fish. If the water body is severely reduced in volume then the concentration of any pollutants present may be such that aquatic species are harmed, affecting numbers and productivity. The pollutants that are present will be concentrated rendering the water harmful to fish.

iii Wastewater Treatment

Wastewater discharge to receiving waters can have harmful effects on ecosystems due to pollution causing:

- Eutrophication (excessive growth of plants and algae) resulting from excess nutrient (nitrogen and / or phosphorus), particularly into confined waters such as a lake or bay;

- Depletion of dissolved oxygen in the water due eutrophication and to high organic load of the final effluent;

- Acute and chronic toxic effects (directly or resulting from bio-accumulation in the food chain) of chemicals present in final effluent for example of heavy metals and persistent organic compounds.

iv Contamination

Sustained contamination of surface water can result in severe reductions in aquatic community diversity, with a few pollution-tolerant species dominating. Short-term contamination by toxic levels of chemicals can result in significant mortality of aquatic organisms, with the most severe effects often seen for fisheries.

10.11 STANDARDS

The following standards are applicable to these development projects:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)
- Trade Effluent (Appendix 8)
- Sewage Effluent (Appendix 9)
- Sludge (Appendix 10)
- Standards for effluent to be used as irrigation. (Appendix 11)

10.12 NRCA GUIDELINES FOR SEWAGE TREATMENT SYSTEMS

The assessment for a sewage treatment system should consider the following:

i The treatment system being proposed and the elements of that system.

ii The estimated throughput of sewage, the design calculations of the sewage treatment systems and capacity of receiving body (environment) to accommodate the quantity of discharged treated effluent.

iii The anticipated level of treatment. All discharges are required to meet the NRCA Sewage Effluent Standards, which requires essentially a secondary level of treatment. Effluent used for irrigation is required to meet the NRCA Interim Irrigation Discharge Standards.

iv The sensitivity of the environment to which the treated effluent will be discharged (flora, fauna, water resources, etc to be impacted).

v The potential for impact from cumulative effects: Where the environment is particularly sensitive, or the potential impact from cumulative effects is significant, a higher level of treatment (e.g. tertiary) may be required.

vi The approval of the design specifications by the Environmental Health Unit (EHU) of the Ministry of Health. Generally, this approval is a prerequisite to the granting of a NRCA permit.

vii The layout of the sewage treatment plant with dimensions (drawings).

viii Risk of contamination to water resources (ground and surface water). Typically, sewage treatment systems with discharges into the ground (e.g. Tile Fields, Absorption Pits) will require the recommendation of the Water Resources Authority (WRA).

ix NWC acceptance letter for systems whose ownership is being transferred.

x Sludge/ solids disposal.

xi An approved drainage plan is required.

xii The maintenance contingency programme in place to ensure the consistent generation of an effluent of satisfactory quality. This will include personnel/agency responsible for maintenance, maintenance programme and contingencies.

N.B. *For additional information please see Volume 3, section 4: Wastewater treatment and Excreta Management.*

CHAPTER 11

INDUSTRIAL PROJECTS

11.0 BACKGROUND

Industrial projects entail the production and manufacture of goods or commodities, especially on a large scale.

11.0.1 Industrial Processes

These projects generally take raw materials through processes, which convert or manufacture the desired product (s). All industrial processes will generate wastes, such as solid wastes, sewage and trade effluent, air emissions and noise. These will have an impact on the environment in which they are located, for e.g., the release of "cooling" waters into aquatic environments will cause thermal pollution. Proper management of wastes and the use of cleaner production technologies will facilitate the reduction in the severity of environmental impacts.

11.0.2 Fossil Fuels

Many industries burn fossil fuels for their process heating. Major consumers of fossil fuels are the steel, cement, metal and the petrochemical industries. Burning of fossil fuels in commercial and industrial boilers and furnaces will result in emissions. These emissions are usually carbon dioxide, nitrogen, oxygen, water, carbon monoxide, nitrogen oxides, sulphur dioxide, volatile organic compounds and particulates. The latter five products of combustion, which are considered pollutants, are known to cause harmful effects on human beings and the environment.

11.0.3 Emission of Hazardous Air Pollution (HAPS)

A serious concern is the emission of hazardous air pollutants (HAPs), which are chemicals that cause serious health and environmental effects. Health effects include cancer, birth defects, nervous system problems and death due to massive accidental releases. Hazardous air pollutants are released by sources such as chemical plants, dry cleaners, printing plants, and motor vehicles (cars, trucks, buses, etc.)

11.0.4 Effects of Pollutants

The effects of pollutants on the environment and human health are listed in the table below:

Pollutants	Effect on environment	Effect on health
Carbon monoxide	Toxic gas will make up the air composition	Fatal to people with heart and lung disease Cause headaches and dizziness in healthy people
Nitrogen oxide	Production of ozone and acid rain	Respiratory problem
Sulphur dioxide	Production of acid rain	Reduced lung function
Volatile organic compounds	Ozone formation	Mostly cancer causing chemical
Particulate matter	Corrosive and toxic to plants and animals	Harmful to human

11.1 General Environmental Considerations

The environmental considerations associated with industrial projects can be looked at based on the stages of implementation – project planning and site selection, construction, operation and post-operation.

Operational aspects are usually unique to the type of industry and are therefore addressed within each prescribed category.

11.1.1 Site Selection and Planning

i The environmental impacts of construction and operation are established during the early phases of project planning. Reducing the environmental impact will be best achieved through investigation at the project preparation stage.

ii There should be a full examination of process by-products and wastes to identify options for waste minimisation. In some cases, substituting raw material may lead to changes in the process. Often, re-using or recycling by-products reduces waste production. Recovering valuable materials from waste streams can be economically and environmentally sensible. Detailed planning may also reveal that some waste streams can be completely avoided.

iii Some waste minimisation options to consider during the planning stage are:

- changing the processes or equipment
- changing the composition, packaging or durability of products
- changing or reducing raw material inputs
- improving the control of the process
- improving the materials handling and cleaning operations
- improving the maintenance and repair of equipment
- recycling waste internally
- re-using waste on site
- recovering materials from waste streams.

iv Once streams, process operations, raw materials, fuel supplies and product ranges have been identified, the methods of storing and handling materials and ways of segregating, treating and disposing of wastes must be addressed to minimise the potential for land contamination and air and water pollution. Underground tanks can leak into soils for long periods before being detected, leading to high clean-up costs.

v Site selection is a critical environmental issue for many industries. Careful site selection can greatly reduce the environmental nuisance. Relevant site information should include:

- the closeness to existing and future housing developments, and to land zoned to permit housing or other land uses not compatible with the proposed development

- the site hydrology: flood liability, site drainage and closeness to watercourses and groundwater resources used for domestic, agricultural or town water supply

- the prevailing wind conditions

- the landform and the likely direction of drift of odour or effects of noise

- the adequacy of the land area to house all projected activities
- the erosion hazard
- the local road network
- corridors for power and other services
- suitability of the site for possible land disposal

vi When choosing your site, it is important to consider the following factors:

- The environment where the development will occur,
- The impact on the biodiversity[1] and habitat loss due to construction and operations,
- Compatibility with national planning, policy, legal and regulatory framework,
- Land use in the surrounding areas to be affected by the development, especially local communities, and
- Availability of appropriate materials, construction labour force and transport to site.

11.2 Environmental Impact

The major potential environmental impacts that should be considered during design are:

i Types, sources and transportation of construction materials,

ii Use of construction methods that will limit disruption to adjacent communities,

iii Waste generation (air emissions, wastewater, solid waste, hazardous waste)

iv Waste management options, including cleaner production methodologies,

[1] For Information on Biodiversity see Chapter 54 Paragraphs 54.5-54.5.1 and Appendix 1

v Water supply and sanitation and the efficient use of the resource,

vi Energy use and efficiency,

vii Surface water runoff and drainage and

viii Constraints to future expansions – physical, environmental and planning.

11.3 CONSTRUCTION

Construction works on these projects will include, but not be limited to, the following activities:

i Site preparation, including clearance of vegetation;

ii Installation of site compounds and storage facilities;

iii Foundations;

iv Earthworks for appropriate profiles;

v Installation of services to provide electricity, water supply and waste management;

vi Construction of buildings; and

vii Landscaping and site restoration.

11.3.2 Environmental Impacts from Construction

Construction can have several types environmental impacts, including:

i Soil erosion, degradation, contamination, disturbance of old contamination;

ii Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;

iii Generation of dust from earthmoving and stockpiled soil or from construction activities;

iv Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;

v Solid waste generation;

vi Noise and possible odour from construction activity, including traffic that is generated;

vii Access for equipment and materials - through road, river or port with associated traffic and infrastructure development (particularly if new facilities are required) with potential habitat loss or severance and safety risks,

viii Added traffic and related impacts during and after construction.

11.3.3 Data on Plants and Animals

In areas likely to be disturbed by construction of the proposed development, the site description should include data on plants and animals, such as:

i major plant communities
ii the status and conservation significance of vegetation
iii the occurrence of any rare or threatened species
iv the presence of any introduced species
v the heritage or cultural significance

11.4 Post Operation

The post-operation of these facilities may include:

i Deterioration of structures (degradation or collapse)
ii Removal of structures (demolition)
iii Contamination (long-term pollution of soil, water or sediment)
iv Disposal of residues (contaminated land).

11.5 Contaminated Land and Water

Before a site, or part of it, can be redeveloped, the presence of contaminated land and water must be established and remedial measures taken where required to prevent risks to human health and the environment.

11.6 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts.

11.2.1 Mitigation Measures

For these industrial projects, the identification and implementation of mitigation measures should form part of an environmental management plan, which may be an output of the Environmental Impact Assessment. Implementation of the plan is undertaken through an Environmental Management System, which should include a long-term pollution risk minimisation component.

11.2.2 Environmental Management Plans

Environmental management plans should address ways to reduce material inputs, re-engineer processes to reuse by-products, improve management practices, and employ substitute toxic chemicals. The environmental management plan is the key tool for determining how to minimise environmental effects. It needs to be kept up to date as technologies and needs evolve.

N.B. *For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"*

11.7 Standards

In general, the following standards are applicable to industrial facilities, and can be found as appendices to this section:

Ambient Air Quality (Appendix 5)
Stack Emissions (Appendix 6)
Noise (Appendix 7)
Trade Effluent (Appendix 8)
Sewage Effluent (Appendix 9)
Sludge (Appendix 10)
Standards for effluent to be used as irrigation. (Appendix 11)

For those Prescribed Categories to which all of these standards are not applicable, a list of relevant standards is provided within the category.

CHAPTER 12

CHEMICAL PLANTS

12.0 DEFINITION

Chemical plants are those facilities that manufacture both inorganic and organic chemicals. The environmental impacts, therefore, would depend on the type of chemicals being manufactured as well as the process or processes being employed within the facility.

The chemical industry produces many materials that are essential to modern life: plastics, pharmaceuticals, and agricultural chemicals are some examples. Although these end products have very different characteristics, they are created from a relatively small number of raw materials.

12.1 INORGANIC CHEMICALS

The inorganic chemical industry manufactures chemicals that are often of a mineral origin, but not of a basic carbon molecular structure. Inorganic chemicals are used at some stage in the manufacture of a great variety of other products. The industry's products are used as:

i Basic chemicals for industrial processes (i.e. acids, alkalis, salts, oxidizing agents, industrial gases, and halogens);

ii Chemical products to be used in manufacturing products (i.e. pigments, dry colours, and alkali metals); and

iii Finished products for ultimate consumption (i.e. mineral fertilizers, glass, and construction materials).

12.2 ORGANIC CHEMICALS

The organic chemicals industry manufactures carbon-containing chemicals, obtaining raw materials from petroleum and converting them to intermediate materials or basic finished chemicals.

Although the organic chemicals industry manufactures thousands of chemicals, there are basic principles that are common to most production processes. Assuming that raw materials do not need to be purified, the two major steps in this industry are:

i Chemical reaction, and

ii Purification of reaction products.

12.3 Environmental Impacts

The major environmental impacts from the chemical plants will be caused during the operation of these facilities. Typical major concerns include:

i The performance of equipment in terms of pollution or generating accident risks,

ii The disposal of wastes generated,

iii The risks associated with the storage of raw materials and products,

iv The secondary impacts of wastewater treatment.

The following paragraphs detail the impacts of chemical plants on the environment, which should be considered in environmental assessment for these projects.

12.3.1 Air Quality

i Inorganic Chemicals

Air emissions from the inorganic chemicals industry consist mainly of chlorine gases. Chlorine is released as fugitive emissions from the cells or the tail gases. Process gases are wet scrubbed with caustic soda or ash solutions to remove chlorine and mercury vapour. Residual chlorine emissions will be negligible. For the Mercury Cell Process, mercury vapour will also be released.

ii Organic Chemicals

Potential sources of air emissions include:

- Point source emissions from stacks, vents, material loading or unloading operations,
- Fugitive emissions from pumps, valves, flanges, tanks, etc.
- Secondary emissions from waste and wastewater treatment units, cooling towers, process sewer, spill/leak areas.

iii The types of pollutants a single facility will release depend on the feedstock, processes, and equipment in use as well as maintenance practices.

12.3.2 Water Quality

i Wastewater streams may arise from equipment wash solvent/water, lab samples, surplus chemicals, product washes/purifications, seal flushes, scrubber blow down, cooling water, steam jets, vacuum pumps, leaks, spills, solvents, waste oils or lubricants.

ii Groundwater contamination may arise from unlined ditches, process trenches, wastewater treatment ponds, product storage areas, tank and tank farms, aboveground and underground piping, and manufacturing maintenance facilities.

iii The types of pollutants a single facility will release depend on the feedstock, processes, and equipment in use as well as maintenance practices

iv Inorganic Chemicals

In general, wastewaters may contain caustic soda solutions and high concentrations of salt and/or sodium sulfate. Significant levels of copper may also be present in the wastewater due to corrosion of pipes and other equipment.

v For the Mercury Cell Process, small amounts of mercury are found in the brine purge and miscellaneous sources, which include floor sumps and cell wash water. Most mercury bearing streams are segregated from non-mercury bearing streams. Prior to treatment, sodium is used to precipitate mercuric sulfide. Mercuric sulfide is removed before the water is discharged.

12.3.3 Land and Soil Resources

i Inorganic Chemicals

Solid wastes generated consist primarily of solids produced during the brine purification process. Solid waste also includes scrapped cell parts, including cell covers, piping and membranes or diaphragms.

ii For the Mercury Cell Process, solid wastes that contain mercury include solids generated during brine purification spent from decomposer cells, spent graphite from decomposer cells, spent caustic filtration cartridges from the filtration of caustic solution, spilled mercury from facility sumps, mercury cell “butters”, which are amalgams of mercury with barium or iron formed from an excess of barium is used during purification.

iii Organic Chemicals

Solid wastes generated consist primarily of spent catalysts, spent filters, sludge, wastewater treatment biological sludge, contaminated soil, old equipment/insulation, packaging material, reaction by-products, spent carbon/resins, drying aids.

The types of pollutants a single facility will release depend on the feedstock, processes, and equipment in use as well as maintenance practices.

CHAPTER 13

PULP, PAPER AND WOOD PROCESSING

13.0 PULP AND PAPER

Pulp and paper are manufactured from raw materials containing cellulose fibres, generally wood, recycled paper, and agricultural residues. In developing countries, about 60% of cellulose fibres originate from non-wood raw materials such as bagasse (sugar cane fibres), cereal straw, bamboo, reeds, esparto grass, jute, flax, and sisal.

13.0.1 Main Steps

i The main steps in pulp and paper manufacturing are raw material preparation, such as wood debarking and chip making, pulp manufacturing, pulp bleaching, paper manufacturing, and fibre recycling. Pulp mills and paper mills may exist separately or as integrated operations. Manufactured pulp is used as a source of cellulose for fibre manufacture and for conversion into paper or cardboard.

ii Each stage of paper, pulp and wood manufacturing will generate wastes that must be properly managed; however the significant environmental impacts result from the pulping and bleaching processes.

13.1 ENVIRONMENTAL IMPACTS

The major environmental impacts from the pulp, paper and wood processing industries will be caused during the operation of these facilities. In most cases, the levels of pollutants are dependent on the process used.

The following paragraphs provide details on the impacts of the pulp, paper and wood processing industry on the environment, which should be considered in environmental assessment for these projects.

13.1.1 Air Quality

In some processes, sulphur compounds and nitrogen oxides are emitted to the air, including hydrogen sulphide, which can be toxic at certain levels.

13.1.2 Water Quality

i Process wastewater is a major source of pollutants. A licence to discharge to the environment will need to be acquired for each point of discharge and type of discharge to the environment.

ii Wastewaters are high in biochemical oxygen demand (BOD), total suspended solids chemical oxygen demand (COD), and chlorinated organic compounds, which may include dioxins, furans, and other absorbable organic halides. In some processes, nutrients and metals are discharged to the wastewaters.

iii Phosphorus and nitrogen are also released into wastewaters. The main source of nutrients, nitrogen and phosphorus compounds is raw material such as wood.

13.1.3 Land and Soil Resources

i Soil erosion can be a major issue during construction and care should be taken to minimise this impact. Damage to soil quality can occur through excavation and compaction and other construction activities. If construction is to occur on previous industrial sites, the developer should determine whether or not the land is contaminated and if any remediation is necessary.

ii The principal solid waste of concern is wastewater treatment sludge. Solid materials that can be reused include waste paper, which can be recycled, and bark, which can be used as fuel. Lime sludge and ash may need to be disposed of in an appropriate landfill.

CHAPTER 14

PETROLEUM PRODUCTION, REFINERY, STORAGE AND STOCKPILING

14.0 PETROLEUM PRODUCT

Petroleum product means a product distilled from petroleum, used or useful in the production of light, heat, power, or for the purpose of lubrication, and includes heating fuel and motor fuel and any other liquid product, whether or not distilled from petroleum and used for one or more of those products. Some products include unfinished oils, liquefied petroleum gases, kerosene and motor gasoline.

14.1 PETROLEUM PRODUCTION

Petroleum production involves the use of drilling rigs, associated equipment such as casing and tubing, large quantities of water, and drilling mud. In the process, oil and gas are moved to the surface through the well bore either through natural means (if the reservoir has enough pressure to push the oil and gas to the surface) or through induced pressure by means of a pump or other mechanism. At the surface, oil, gas, and water are separated. Crude oils associated with hydrogen sulphide are normally classified as "sour crude." The crude oil may require further processing, including the removal of associated gas. Oil produced at the wells is transported (pipes, ships) for use as feedstock in petroleum refineries.

14.2 PETROLEUM REFINING

In the petroleum refining process, useful products, such as gasoline, motor oil and petrochemicals are manufactured from crude oil, which is generally unsuitable for direct use.

Crude oil is fractionated into liquefied petroleum gas (LPG), naphtha (used to produce gasoline by blending with octane boosters), kerosene/aviation turbine fuel, diesel oil, and residual fuel oil. Catalytic cracking and reforming, thermal cracking, and other secondary processes are used to achieve the desired product specifications. Certain refineries also produce feedstock for the manufacture of lubricating oils and bitumen.

14.3 PETROLEUM STORAGE AND STOCKPILING

A petroleum storage facility can be defined as one or more stationary tanks, including any associated intra-facility pipelines, fixtures, or other equipment. A facility may include aboveground tanks, underground tanks or a combination of both. Pipelines that enter or leave the site and non-stationary tanks are not part of the facility. Petroleum can be stored so as to accumulate a supply or stockpile.

14.4 Environmental Considerations

In addition to the general environmental considerations associated with the stages of implementation of industrial projects, the following are applicable to the petroleum industry.

14.4.1 Site Selection and Planning

i Petroleum Production

The choice of sites for petroleum production projects is restricted because minerals have to be extracted where they occur. Particular care therefore needs to be taken with mitigation measures, which should be identified early in the project cycle.

ii A good detailed site investigation and design and the use of appropriate technologies can substantially reduce the impact on the environment. Important factors to consider during petroleum production project development are:

- Ground conditions: to minimise unproductive excavation tailings, proximity to sensitive surface and groundwater bodies, availability of sites for spoils, ease of access to site and transport impacts, and possibility for post-operation rehabilitation;
- Location: proximity to local communities, impacts on the natural environment and land use conflicts;
- Design: minimise site disturbance, use of appropriate material and production, use of appropriate technology to reduce emissions and contain tailings and wastes.

14.5 Construction

Construction often entails large-scale works including access and the installation of heavy machinery. For these projects, it will often be phased, with development of new parts of the operation over many years.

14.5.1 Construction Phases

The length and complexity of individual construction phases will depend on the total quantity or rate of production fuel extracted and on the scale and complexity of the operation and the nature of the environment (particularly the geological structure).

14.5.2 Construction Works

Construction works may include, but not be limited to, the following activities:

i Site preparation, including clearance of vegetation;

ii Installation of site compounds and storage facilities;

iii Foundations;

iv Installation of services to provide electricity, water supply and waste management;

v Construction of buildings; and

vi Landscaping and site restoration.

14.5.3 Environment Impacts from Construction

Construction can have several types of environmental impacts, including:

i Soil erosion, degradation, contamination, disturbance of old contamination;

ii Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;

iii Generation of dust from earthmoving and stockpiled soil or from construction activities;

iv Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;

v Solid waste generation;

vi Noise and possible odour from construction activity, including traffic that is generated;

vii Added traffic and related impacts during and after construction.

14.6 Operation

Typical major concerns of petroleum operations include:

i The performance of mining equipment in terms of causing pollution or generating accident risks,

ii The disposal of wastes generated from extraction and refining of product,

iii The risks associated with the storage of mined and refined products,

iv The secondary impacts of non-process wastes, and

v The secondary impacts of the transport of products.

14.7 Post Operation

Once a site has been decommissioned, site rehabilitation will occur. This would be made easier if the initial designs have taken this aspect into account. The most difficult issues to be dealt with relate to the ground or water contamination risks where:

i Materials have been inefficiently used and ground or water pollution has followed,

ii Contaminated or otherwise dangerous machinery has been left,

iii Stored wastes contain polluting or dangerous elements, especially where water sources are at risk, and

iv The collapse of poorly supported workings can lead to surface fractures, voids, and collapses.

14.8 ENVIRONMENTAL IMPACTS

The following paragraphs detail the impacts on the environment that should be considered in environmental assessment for these projects.

14.8.1 Air Quality

i Petroleum production

Degradation of air quality may be caused by particulates from

- Blasting, excavation and earth moving,
- Transport and material transfer,
- Wind erosion of loose soil during surface mining and other surface operations.

These effects are usually local, although finer particles can be transported over considerable distances.

ii Petroleum refining

Boilers, process heaters and other equipment are responsible for the emission of particulates, carbon monoxide, nitrogen oxides and sulphur oxides.

Air pollution may also be caused by operational and processing emissions, including carbon dioxide and associated gases from flaring, gas discharge from well heads and complex, sometimes cancer-inducing, compounds from burning of wastes.

Refineries will also need to take into account the noise produced during operations and noise abatement measures that would be required for these facilities.

iii Petroleum Storage and Stockpiling

Volatile organic compounds (VOCs) are released from storage, product handling and separation systems. Vapour recovery systems may be used to reduce the impact on the environment.

14.8.2 Water Quality

i Petroleum Production

Discharge from dewatering of surface or underground mines, without adequate neutralisation or treatment, may be highly acidic and contaminate local surface waters and shallow groundwater with nitrates, heavy metals and oils. This reduces the quality of local water supplies or even makes them unusable, and can cause erosion of drainage channels.

ii Petroleum Production Operations

- Petroleum production operations use large volumes of water particularly in the extraction process. In some instances, the production water can be a significant percentage of oil extracted. This water will have treatment needs. Use of water for production purposes can reduce local sources of water, affecting local population and the natural environment.

- Accidents such as well blow-outs, spills at transfer or loading points or pipeline failure can result in local to widespread severe contamination of ground and surface waters.

- Petroleum production can result in the degradation of surface and ground waters from improper handling of drilling fluids and production water.

iii Petroleum Refining

Processing of crude oil in the field will generate several waste streams. These include contaminated wastewater, emulsions, hydrocarbon residues, contaminated soils, used oils and spent solvents. Wastewaters typically contain suspended solids. Typically, a biocide is used prior to disposal of the water so as to control the growth of micro organisms.

Petroleum refineries also use relatively large volumes of water, especially for cooling systems. If cooling waters were discharged into the environment at temperatures higher than ambient, then thermal pollution would be an issue for consideration.

Surface water runoff and sanitary wastewaters are also generated. Refineries generate polluting wastewaters containing BOD, COD, oil and grease, benzene, heavy metals, and other pollutants.

iv Petroleum Storage

Leakage from pipelines, storage tanks, whether aboveground or underground, as well as stormwater runoff in these facilities can result in the degradation of surface and ground water.

14.9 LAND AND SOIL RESOURCES

14.9.1 Petroleum Mining and Extraction

Petroleum mining/extraction requires land for waste disposal, storage of products, and siting of ancillary facilities. Mining may result directly in the loss or modification of topographic features and drainage patterns, soils, vegetation, natural habitats agricultural areas, cultural and historic resources.

14.9.2 Drilling Wastes

Drilling wastes may contain drilling muds, borehole cuttings, lubricants, diesel oil, emulsifying agents, and various other wastes specifically related to drilling activities. Waste-solids from the drilling process typically include drill cuttings, weighting materials and any other additives.

14.9.3 Indirect Effects

Indirect effects from air or water pollution and from wind blown dust may include temporary or permanent loss of land productivity or the contamination of soils by minerals materials toxic substances.

14.9.4 Petroleum Refining

Refineries generate solid wastes and sludge, which may be considered hazardous because of the presence of toxic organics and heavy metals.

14.9.5 Accidental Discharges

Accidental discharges of large quantities of pollutants can occur as a result of abnormal operation in a refinery and potentially pose a major local environmental hazard.

CHAPTER 15

OFFSHORE DRILLING FOR EXTRACTION OF OIL, NATURAL GAS OR MINERALS

15.0 OFFSHORE DRILLING

Offshore drilling is used in the search for petroleum, natural gas or minerals. Offshore drilling operations are performed either from jack-up drilling rigs, which are stationed on the seabed; floating units that contain semi-submersibles and drill ships and permanent production platforms. Regardless of the type, drilling rigs intrinsically are high-horsepower operations where the sizeable generators used for power become principal sources of air pollution.

15.1 DRILLING FLUIDS

i Drilling fluids (commonly known as drilling muds) are an important component in the drilling process. A fluid is required in the well-bore to:

- To cool and lubricate the drill bit;
- Remove the rock fragments, or drill cuttings, from the drilling area and transport them to the surface;
- Counterbalance formation pressure to prevent formation fluids (i.e. oil, gas and water) from entering the well prematurely, and
- Prevent the open (uncased) well-bore from caving in.

ii Different properties may be required of the drilling fluid, depending upon the drilling conditions. Drilling fluids consist of a continuous liquid phase to which various chemicals and solids have been added.

15.2 ENVIRONMENTAL CONSIDERATIONS

The choice of sites for petroleum production projects is restricted because minerals have to be extracted where they occur. Particular care therefore needs to be taken with mitigation measures, which should be identified early in the project cycle.

15.3 OPERATION

15.3.1 Offshore Operations

Offshore operations may impact the area immediately surrounding the platform if produced water effluents are not properly treated and discharged. The concentration of metals, radio nuclides, residual oily materials and high biochemical oxygen demand in the produced water may be higher than the surrounding water.

15.3.2 Major Concerns

Typical major concerns of offshore drilling operations include:

i The performance of equipment in terms of causing pollution or generating accident risks,

ii The disposal of wastes generated,

iii The risks associated with the storage of extracted products, and

iv The secondary impacts of the transport of extracted products.

15.4 POST OPERATION

15.4.1 Offshore Drilling

For offshore drilling, the structure itself must be decommissioned in addition to plugging the well. One of the following options will be used in this process:

i Complete removal of the structure and disposing of the structure onshore,

ii Removing the structure and placing it in an approved location in the ocean,

• Reuse of the structure elsewhere.

15.4.2 Methods Used

The method used will vary with the type of structure and water depth, but the most common approach is the complete removal of the structure.

Other approaches are less expensive and less intrusive to the existing environment, but can be more dangerous for other marine interests – such as commercial ships, fishing trawlers, and recreational boaters.

15.5 Environmental Impacts

The following section details impacts on the environment that should be considered in environmental assessment for these projects.

15.5.1 Air Quality

There are several sources of air pollution in the production process. When natural gas produced from the well is not used it is usually flared, thereby releasing carbon monoxide, nitrogen oxides, and other gases. Additionally, the use of machinery, which involves fuel combustion, will also generate air emissions such as nitrogen oxides, carbon monoxide, sulphur oxides, ozone and particulates.

15.5.2 Water Quality

i Offshore oil and gas development causes disturbance to the seafloor that increases particulate dispersion in the water column. In coastal areas, disturbed sediments may contain heavy metals and other contaminants which affect fish but particularly shellfish. Production waters are usually more saline than seawater, have little or no dissolved oxygen, and may contain heavy metals, sulphur, sulphides and organic compounds including hydrocarbons.

ii Discharged drilling muds and additives are contaminated with formation waters and release hydrocarbons, heavy metals, and other contaminants into the water column. Routine production activities result in chronic, low-level hydrocarbon contamination of the water in the areas around platforms.

iii Non-routine occurrence such as oil spills at transfer or loading points, pipeline failure, tanker spill, or well blow-outs may result in local to widespread severe contamination of the water column.

15.5.3 Seafloor

Offshore oil and gas operations result in disturbance of sea floor. They also cause contamination of bottom features from discharge of drilling muds, cuttings, and solid wastes. Oil spills result in contamination of the sea and coasts. Secondary effects include coastal pollution from inappropriate waste disposal practices, bilge waters or wastes from pipeline landings and oil depots.

15.5 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Stack Emissions (for those facilities with stacks) (Appendix 6)
- Noise (Appendix 7)
- Trade Effluent (Appendix 8)
- Sewage Effluent (Appendix 9)

15.6 PETROLEUM STORAGE FACILITIES

NRCA Guidelines for Petroleum Storage Facilities and the Installation and operation of aboveground, underground and liquid petroleum gas (LPG) storage tanks.

15.6.1 Tank Size

i Underground Storage Tanks (USTs)

Underground storage tanks exceeding a capacity of Five Thousand (5,000) litres (1,100 gallons) require a permit for installation and operation.

ii Aboveground Storage Tanks (ASTs)

Aboveground storage tanks exceeding a capacity of Four Thousand (4,000) litres (880 gallons) require a permit for installation and operation.

iii Liquid Petroleum Gas (LPG) Tanks

Liquid Petroleum Gas (LPG) tanks exceeding a capacity of Three Thousand (3,000) litres (660 gallons) require a permit for installation and operation.

15.6.2 Requirements

The following summarises the requirements of the NRCA for the installation and operation of Petroleum Storage Facilities:

i All petroleum storage tanks shall be equipped with some form of secondary containment to ensure that all leaks are effectively contained.

ii All USTs shall have a leak detection system to ensure that no leak goes undetected.

iii All USTs shall be equipped with a line leak detection system to ensure that there is no further pumping of product once a leak has developed in the pipeline.

iv All storage tanks shall have properly functioning overfill protection devices.

v Spill protection shall be in place at all facilities to ensure that there is no spillage to the environment during the transfer of product.

vi All USTs shall have corrosion protection.

vii All ASTs shall have a bund constructed to contain at least 120 % of the maximum volume of product being stored in the tank.

viii Structural integrity (pressure) tests shall be conducted on all storage tanks and pipelines as follows:

- at installation,
- six (6) months after commencement of operation, and
- annually thereafter.

A Precision Test shall be conducted on all tanks and pipelines once every five (5) years.

ix Monitoring activities involving leak detection and structural integrity tests shall be undertaken and reports submitted to the NRCA, with copies to the Water Resources Authority and the Environmental Health Unit of the Ministry of Health as follows:

- Half yearly during the first year of operation, and
- Annually after the first year of operation

x Corrective measures shall be undertaken immediately once a leak or spill is detected and the NRCA informed within twenty-four (24) hours of the incident.

xi All petroleum storage installations shall have appropriate fire defence systems, which have been inspected and approved by the Fire Department, before any product is received in any tank.

xii All petroleum production, refinery, storage and stockpiling projects will require the submission of an emergency response and contingency plan.

xiii A Closure Plan is to be submitted to NEPA (see Guidelines below)

15.7 GUIDELINES FOR A CLOSURE PLAN

15.7.1 Definitions

i ‘Closure’ is the process of decommissioning and decontaminating an area or structure, which could possibly result in the release of contaminants to air, soil or water.

ii ‘Closure Plan’ describes the procedures for the removal of all the possible contaminants to air, soil and water, equipment decontamination, sampling and laboratory analysis and closure to the satisfaction of the relevant standards and regulations stipulated by the National Environment and Planning Agency.

The following outlines the proposed guidelines for preparing Closure Plans.

15.7.2 General Guidelines

i The activities to be undertaken in the Plan should be clearly listed, with target dates for completion.

ii Waste produced due to closure activities must be both classified and quantified and the method of treatment and/or disposal stated.

iii The Plan should include soil (and groundwater, if accessible) testing for the presence of contamination. The test methods used for analysis of the soil and groundwater samples should be indicated.

15.7.3 Background Information

This should include:

i The nature of the probable/ possible contamination including list of chemicals used on site

ii Any published or otherwise known information in order to establish whether adjacent property owners are or have been potential sources of contamination

iii Present zoning of the site and details of the zone categories of properties surrounding the site

iv Contour or topographic maps

v Likely future use of the site

vi Risk Assessment

vii The results of any previous investigations of the site or surrounding land

viii Locations of surface water bodies, particularly where these may be adversely affected by contaminated groundwater or surface drainage from the site

ix Hydro-geological information which should include:

- The extent and use of aquifers in the area
- Estimated depth to groundwater
- Probable direction of groundwater flow and gradient
- Soils and soil properties (soil type, porosity and hydraulic conductivity)
- Location of any springs
- Sources of local municipal water supply and the location of registered private or industrial wells or bores

x Solid waste disposal

xi Security of facility/area scheduled for closure. This should include the postage of relevant signs.

15.8 REMEDIAL PLAN

The NRCA may require remediation for sites found with significant levels of contamination. In such cases a Remedial Plan shall be submitted for review and approval.

15.9 POST CLOSURE MONITORING

Post Closure Monitoring must be conducted for an agreed period for any contamination that may be present on site. The parameters to be monitored, the frequency of monitoring, the test methods used for the analyses and the end points to be achieved must be clearly stated.

15.10 INTERIM STANDARDS FOR PETROLEUM IN GROUND WATER AND SOIL DEVELOPED BY NRCA AND WRA- DECEMBER 1998

Parameter	Ground Water	Soil
TPH	**50 ppm**	**1000 ppm**
BTEX	1000 ppb	135 ppm
Benzene	200 ppb	5 ppm
Toluene	nc	30 ppm
Ethyl Benzene	nc	50 ppm
Xylene	nc	50 ppm

Note:
BTEX [1] = Benzene [2] + Toluene + Ethyl Benzene + Xylene
TPH [3] = Total Petroleum Hydrocarbon
nc = no criteria set for this parameter
ppm = parts per million
ppb = parts per billion

15.11 SOURCE DOCUMENTS

i <u>TAB #11 – Site Assessment and Clean-up Technology</u>, Environment Canada Environmental Protection Branch – Ontario Canada, Federal Programme Division. (Internet Link)

[1] BTEX – This standard is additive for the components involved. This was set at 1000 ppb. Benzene is included in this value hence the other components should add up to 800 ppb.

[2] Benzene – This was set at 200 ppb as it was recognised that benzene being carcinogenic should not be arbitrarily included in the standard set for BTEX.

[3] TPH – This is similar to the gasoline range organics which is the nomenclature used by the USEPA to refer to petroleum products within the range C1 – C10 of the carbon chain. Source document #2 has set this value at 50 ppm taking into account the quality and use of the water.

NRCA – Natural Resources Conservation Authority
WRA – Water Resources Authority

ii Dasch, R., (1990) - Leaking Petroleum Product Underground Storage Tanks, Benzene Clean up for Ground Water – Texas Hazardous and Solid Waste Division Evaluating LPST Clean-up Guidelines.

CHAPTER 16

FOOD PROCESSING PLANTS

16.0 Definition of Food Processing Plants

Food Processing Plants include Confectionary, Syrup Manufacturing, Fish and Meat Processing Plants

16.0.1 Confectionery Manufacturing

Confectionery manufacturing comprises a wide range of sweet products including chocolate, toffee, boiled sweets and syrup. The manufacturing process will vary depending on the nature of the product.

16.0.2 Meat Processing Industry

The meat processing industry includes the slaughter of animals and fowl (See Prescribed Category – Slaughterhouses and Abattoirs), processing of the carcasses into cured, canned, and other meat products.

16.0.3 Fish Processing

Fish processing includes both the canning of fish for human consumption and the production of fish by-products such as meal and oil. Either a precooking method or a raw pack method can be used in canning. In the precooking method, the raw fish are cleaned and cooked before the canning step. In the raw pack method, the raw fish are cleaned and placed in cans before cooking. The precooking method is used typically for larger fish such as tuna, while the raw pack method is used for smaller fish such as sardines.

The by-product manufacture segment of the fish industry uses canning or filleting wastes and fish that are not suitable for human consumption to produce fish meal and fish oil.

16.0.4 The Dairy Industry

The dairy industry involves processing raw milk into products such as consumer milk, butter, cheese (natural and processed), yogurt, condensed milk, dried milk (milk powder), and ice cream, using processes such as chilling (refrigerated storage), pasteurization/ sterilization, homogenization, separation and packaging. Typical by-products include buttermilk, whey and their derivatives.

16.1 Environmental Impacts

The major environmental impacts from these industries will be caused during the operation of these facilities.

The following paragraphs detail the impacts on the environment of each type of industry, in terms of wastes generated and energy use, which should be considered in environmental assessment for these industrial projects.

16.1.1 Confectionery/Syrup Manufacturing

i Liquid raw materials and effluent produced during the confectionery manufacturing process are likely to have high sugar content, giving potential for water pollution through spillage of raw materials or product or insufficient treatment of effluent.

ii Wastewater from chocolate production presents a pollution risk due to effluent with a high organic content notably fats, high alkalinity, depending on the type of equipment cleaning materials used, solvents and oils used in maintenance and operation of equipment.

iii Pollution risks to watercourses and soil may arise from spillages of: industrial chemicals, oils and other materials such as hydrochloric acid, caustic soda and ethylene glycol, raw materials including sugar, colours and flavouring products.

iv Processes involving heating, such as cooking and canning, are very energy-intensive. Thermal energy, in the form of steam and hot water, is used for cleaning, heating water and sterilizing.

v Solid waste generated must be disposed of properly, however recycling and reclaiming materials wherever possible must be a priority.

16.1.2 Meat Processing

i The primary environmental issues associated with meat processing are water use, high-strength effluent discharge, and energy consumption.

ii Meat processing plants will usually have large cold storage facilities. The release of ammonia into the atmosphere, due to leaks from cooling equipment, is a health and safety concern. For operations that use refrigeration systems based on chlorofluorocarbons

(CFCs), the fugitive loss of CFCs to the atmosphere is an important environmental consideration, since these gases are recognized to be a cause of ozone depletion in the atmosphere. For such operations, the replacement of CFC-based systems with non- or reduced-CFC systems is important. In some cases offensive odours may occur.

iii Processes involving heating, such as cooking and canning, are very energy-intensive, whereas filleting requires less energy. Thermal energy, in the form of steam and hot water, is used for cleaning, heating water, sterilizing.

iv Wastewaters generally have high organic loads and are also high in oils and grease, salt, nitrogen and phosphorous. A wide range of pesticide residues may be present from treatment of animals or their feed.

v Solid waste generated must be disposed of properly, however recycling and reclaiming materials wherever possible must be a priority (this can be done through rendering).

16.1.3 Fish Processing

i The primary environmental issues associated with fish processing are water use, high-strength effluent discharge (waste handling), energy consumption and odour.

ii Although smoke and particulate may be a problem, odours are the most objectionable emissions from fish processing plants. The fish by-products segment results in more of these odorous contaminants than canning, because the fish are often in a further state of decomposition, which usually results in greater concentrations of odours.

iii Generally, the precooked method emits fewer odorous gases than the raw pack method. In the precooked process, the odorous exhaust gases are trapped in the cookers, whereas in the raw pack process, the steam and odorous gases typically are vented directly to the atmosphere.

iv Processes involving heating, such as cooking and canning, are very energy-intensive, whereas filleting requires less energy. Thermal energy, in the form of steam and hot water, is used for cleaning, heating water and sterilizing.

v Solid waste generated must be disposed of properly, however recycling and reclaiming materials wherever possible must be a priority (this can be done through rendering).

16.1.4 Dairy Industry

i Dairy effluents contain dissolved sugars and proteins, fats, and possibly residues of additives. The key parameters are biochemical oxygen demand (BOD) chemical oxygen demand (COD), which is normally about 1.5 times the BOD level; total suspended solids, total dissolved solids: phosphorus, and nitrogen Cream, butter, cheese, and whey production are major sources of BOD in wastewater. The wastewater may contain pathogens from contaminated materials or production processes.

ii A dairy often generates odours and, in some cases, dust, which need to be controlled. Most of the solid wastes can be processed into other products and by-products.

iii Large volumes of water are needed for cleaning, sanitary, cooling and production purposes. The pasteurization/sterilization process requires significant heat generation capacity. Many large dairy facilities have on site boilers to meet these high temperature requirements.

CHAPTER 17

AQUACULTURE FACILITIES

17.0 AQUACULTURE FACILITIES INCLUDING PONDS AND INTENSIVE FISH FARMING

Aquaculture fisheries involve the growing of animals and plants in water at higher densities than those found naturally, where measures are taken to directly influence the natural stock.

17.0.1 Culture Fishery Projects

Culture fishery projects operate in either coastal waters or inland waters. Coastal water operations generally use cages to pen the fish. Common locations for coastal water operations include mangrove forests, wetlands and estuaries where there is protection from the natural elements. Inland water operations use either artificially created areas such as ponds, reservoirs or flooded natural depressions, or natural water bodies such as lakes or lagoons.

17.1 ENVIRONMENTAL IMPACTS

Success in aquaculture generally requires a clean environment; however, intensive aquaculture practices themselves may pollute the environment. The main environmental impacts of aquaculture are:

i Habitat loss, particularly of mangroves

ii Soil and water contamination

iii Erosion and siltation

iv Spread of disease from the introduction of exotic species, which may affect human health via consumption of fish/shellfish

v Competition between exotic species and natural populations

vi Contamination of wild genes

vii Competition of ponds for water and land resources by other users

The following paragraphs detail the impacts on the environment that should be considered in environmental assessment for these projects.

17.1.1 Air Quality

Aquaculture related air impacts are relatively minor, but can include odour, noise, dust and air pollutants.

17.1.2 Land and Soil Resources

The main potential environmental impacts associated with land and the development of aquaculture sites are likely to be related to:

i competing uses for the land;

ii loss of valuable coastal wetland habitats, for example, mangroves;

iii loss of forests and woodlands for use in making cages and pens etc.;

iv erosion and siltation of soils

v potential land contamination (e.g. by fish wastes and chemicals);

vi mobilisation of existing contaminants during construction activities, leading to further soil contamination and possibly water pollution, caused by contaminated runoff;

vii Creation of high acidity soil. In mangrove areas converted to aquaculture sites, the soils often become acid sulphate, due to the oxidation of pyrites contained therein. This causes high levels of acidity in the water, which can leach out toxic heavy metals. In general it results in decreased growth rate and mortality of organisms such as shrimps;

viii salinisation of soils and the water table due to excessive groundwater abstraction and where major coastal land clearance is undertaken. Salt water intrusion can have major adverse affects on nearby agricultural productivity and on local domestic supplies of freshwater.

ix land subsidence due to excessive groundwater abstraction

17.1.2 Water Quality and Resources

i Fishponds

Fishponds can effect local hydrology by altering water flow and affect groundwater recharge. If located in an area subject to flooding, water diverted from the ponds by dikes can cause flooding elsewhere.

ii Wastewater

The wastewaters from pond drainage water can pollute nearby aquatic environments. The pollution arises from the natural nitrogenous and phosphate fish wastes, as well as from uneaten food, fertilizers, pesticides, antibiotics and other chemicals added. The extent of the pollution will depend upon the quality of the pond water as well as the characteristics of the receiving waters. The type and intensity of pond management (i.e. frequency of water exchange and amount of inputs) will determine the water quality in the ponds. Pond water is almost always more nutrient rich than surrounding waters, but it will be even more so if fertilisers and feeds have been added to the pond to increase fish productivity.

iii Chemicals

Chemicals used in aquaculture (e.g., for pond sterilisation, weed, insect, and disease control, water quality regulation and control of undesirable fish) can also contaminate local surface and ground waters. The quality of the receiving waters at the time of release from the ponds, and their dilution and dispersion capabilities will determine the effect of pond effluent on the nearby aquatic environment;

iv Intensive Culture

Intensive culture involving raising fish in nets and cages may restrict water circulation, and diminish water quality if the construction of pens is very dense;

v Pumping Fresh Water

As mentioned above, pumping of freshwater can cause loss of freshwater for agricultural and domestic purposes, and can lead to salt water intrusion, again affecting freshwater supplies and agricultural productivity.

17.1.3 Biodiversity

i Coastal Wetlands

In widespread areas of coastal wetlands there is a tendency to practice "shifting" aquaculture if production decreases due to degradation of pond water quality. Since the surrounding land is perceived to be "unused" more land is then cleared as existing ponds become unproductive and a cycle is initiated. In the long term, such pond operations often prove to be less productive than the natural ecosystem, which has been lost.

ii Uncontrolled Aquaculture

Uncontrolled aquaculture expansion and resulting habitat conversion causes the loss of important habitats, reducing biodiversity and potentially reducing the natural reproduction potential of species used in aquaculture.

iii Exotic Species

The use of exotic species in pond aquaculture can cause adverse impacts upon the wild native species. The exotics may escape and can introduce disease and parasites into local aquatic environment. They are liable to compete with native species for food resources and may even be predators of indigenous species. Although exotics are introduced to increase fisheries productivity, they may be responsible for a net loss in fishery production by reducing the populations of native species.

iv Selective Breeding

Selective breeding also has the potential for long term impact by reducing genetic diversity within fish populations.

v Ponds

Ponds are often stocked with larvae and juveniles captured locally. This practice can result in depleting wild fish populations, erode capture fishery operations in the area, reduce genetic diversity in the wild, and in extreme cases decrease the number of fish species in an area.

vi Sea-cages

Intensive sea-cages and excessive use of chemicals, food and fertilizers etc. can result in the substrate below becoming completely barren of life.

17.2 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)
- Trade Effluent (Appendix 8)
- Standards for effluent to be used as irrigation. (Appendix11)

CHAPTER 18

TANNERIES

18.0 Tanning

In the tanning process, hides and skins are sometimes preserved by drying, salting or chilling so that raw hides and skins will reach tanneries in an acceptable condition. Hides and skins are treated to remove hair, proteins and fats. The hides are preserved by the impregnation of tanning agents. Leather production usually involves three distinct phases: preparation, tanning and finishing (including dyeing and surface treatment). A wide range of processes and chemicals is used in the tanning and finishing processes.

18.0.1 Tanning and Finishing Processes

The tanning and finishing processes generally consist of:

i Soaking and washing to remove salt, restore the moisture content of the hides, and remove any foreign material such as dirt and manure,

ii Removal of excess tissue, hair or wool from the hide by mechanical or chemical means,

iii Bating and pickling to delime the skins and condition the hides to receive the tanning agents,

iv Tanning to stabilize the hide and impart basic properties to the hides,

v Re-tanning, dyeing, and fat-liquoring to impart special properties to the leather, increase penetration of tanning solution, replenish oils in the hides and impart colour to the leather,

vi Finishing to attain final product specifications.

18.1 Environmental Impacts

i The major environmental impacts from tanning will be caused during the operation of these facilities. Wastewater, solid wastes and sludges, as well as air emissions will need to be managed to reduce the impact on the environment.

ii The following paragraphs detail the impacts of tanneries on the environment that should be considered in environmental assessment for these projects.

18.1.1 Air Quality

i Decaying organic matter (e.g. tissue from hide) produces strong odours. Hydrogen sulphide (smell of rotten eggs) is released during de-hairing and ammonia is released during de-liming. Air quality may further be degraded by release of solvent vapours from spray during application, degreasing, and finishing (e.g. dye application).

ii Odour controls should be implemented to reduce the impact on nearby residents. Noise abatement measures should achieve local noise standards.

iii Use of techniques such as water-based paints and roller coating can help to reduce the production of volatile organic compounds (VOCs). Good ventilation and minimisation of solvent release can prevent the need to collect and treat vapours.

18.1.2 Water Quality

i Untreated wastewater from operations of tanneries is turbid, coloured and foul smelling. Wastewaters often contain acidic and alkali fluids, chromium, chlorides, sulphides, nitrogen, chlorides and high levels of fats. Suspended solids usually account for half of the chloride levels in the wastewater. Preliminary screening of wastewater is recommended because of the large quantities of solids present.

ii Wastewater may also contain residues of pesticides used to preserve hides during transport, as well as significant levels of pathogens.

iii The biological and chemical oxygen demand levels of the wastewater are also significant as this affects the environment of the receiving water body.

18.1.3 Land and Soil Resources

i Soil erosion can be a major issue during construction and care should be taken to minimise this impact. Damage to soil quality can occur through excavation and compaction and other construction activities. If construction is to occur on previous industrial sites, the developer should determine whether or not the land is contaminated and if any remediation is necessary.

ii Significant volumes of solid wastes are also generated during the operations of tanneries. This includes trimmings, degraded hide, and hair. In addition, large quantities of sludges are generated. Solid wastes and sludges must be disposed of in an approved landfill.

iii The environmental management plans for tanneries should consider the recovery of hide trimmings for use in manufacture of glue and gelatin, recycling of wastes to whatever extent is feasible, control of odour problems through good housekeeping methods and recovery of heat from the drying process to heat process water. Methods to reduce water consumption should also be considered.

CHAPTER 19

SOAPS AND DETERGENTS

19.0 Detergents Manufacturing Including Manufacturing of Soap

Soaps and detergents are substances that, when dissolved in water, give it the ability to remove dirt from surfaces such as the human skin, textiles and other solids. Detergents and soaps come in three principal forms: bars, powders and liquids.

19.1 Selection of Materials

The first step in manufacturing is the selection of raw materials. Raw materials are chosen according to many criteria, including their human and environmental safety, cost, compatibility with other ingredients and the form and performance characteristics of the finished product. The major raw materials for soap and detergent manufacture are fat and alkali (such as sodium hydroxide). Other substances such as optical brighteners, water softeners and abrasives are often added to obtain specific characteristics.

19.1.1 Alkali

Sodium hydroxide is used most often as the alkali for manufacture of soap and detergents. Potassium hydroxide may also be used. Potassium soaps are more soluble in water than sodium soaps, and as such are produced in various liquid concentrations for use in combination with sodium soaps in shaving products and the textile industry.

19.1.2 Fats and Oils

Fatty raw materials for soap and detergent manufacture include animal and vegetable oils and fats or fatty acids as well as by-products of the cellulose and paper industry (such as resin and tallow). Depending on the raw materials used, different types of soaps (slow lathering, fast lathering, and soft soaps) will be produced.

19.1.3 Optical brighteners

Optical brighteners are dyestuffs absorbed by textile fibers from solution but not subsequently removed in rinsing. They convert invisible ultraviolet light in visible light on the blue side of the spectrum causing the fibre to reflect a greater proportion of visible light and making it appear brighter.

19.1.4 Sequestering or chelating agents

This combines with certain metal ions to form a molecular complex that locks up the calcium ion so that the water is effectively softened.

19.1.5 Abrasives

Water-insoluble minerals (quartz, chalk, sand, silica, etc.) are often powdered and added to synthetic detergent formulations.

19.2 Production Processes

While actual production processes may vary from manufacturer to manufacturer, there are steps, which are common to all products of a similar form. Several techniques are used in making soap, most of which involve heat. The processes can be either continuous or on a batch basis.

19.2.1 Bar Soap

i Traditional bar soaps are made from fats and oils or their fatty acids, which are reacted with inorganic water-soluble bases. The main sources of fats are beef and mutton tallow, while palm, coconut and palm kernel oils are the principal oils used in soap making. The raw materials may be pre-treated to remove impurities and to achieve the colour, odour and performance features desired in the finished bar.

ii Both continuous and batch processes produce soap in liquid form, called neat soap, and a valuable by-product, glycerine. The glycerine is recovered by chemical treatment, followed by evaporation and refining. Refined glycerine is an important industrial material used in foods, cosmetics, drugs and many other products.

iii The next processing step is drying which is used to convert the neat soap into dry soap pellets. The moisture content of the pellets will vary depending on the desired properties of the soap bar.

iv In the final processing step, the dry soap pellets pass through a bar soap finishing line. The first unit in the line is a mixer, called an amalgamator, in which the soap pellets are blended together with fragrance, colorants and all other ingredients. The mixture is then homogenized and refined through rolling mills and refining plodders to achieve thorough blending and a uniform texture. Finally, the mixture is continuously extruded from the plodder, cut into bar-size units and stamped into its final shape in a soap press.

19.2.2 Powders

i Powder detergents are produced by spray drying, agglomeration, dry mixing or combinations of these methods.

ii In the spray drying process, dry and liquid ingredients are first combined into a thick suspension in a tank. The suspension is heated and then pumped to the top of a tower where it is sprayed through nozzles under high pressure to produce small droplets. The droplets fall through a current of hot air, forming hollow granules as they dry. The dried granules are collected from the bottom of the spray tower where they are screened to achieve a relatively uniform size.

iii After the granules have been cooled, heat sensitive ingredients that are not compatible with the spray drying temperatures (such as bleach, enzymes and fragrance) are added. Traditional spray drying produces relatively low-density powders.

iv Agglomeration consists of blending dry raw materials with liquid ingredients. Helped by the presence of a liquid binder, rolling or shear mixing causes the ingredients to collide and adhere to each other, forming larger particles. Dry mixing or dry blending is used to blend dry raw materials. Small quantities of liquids may also be added.

19.2.3 Liquids

i Both batch and continuous blending processes are used to manufacture liquid and gel cleaning products. Stabilisers may be added during manufacturing to ensure the uniformity and stability of the finished product.

ii In a typical continuous process, dry and liquid ingredients are added and blended to a uniform mixture using in-line or static mixers.

19.3 PACKAGING

The final step in the manufacture of soaps and detergents is packaging. Bar soaps are either wrapped or cartoned in single packs or multipacks. Detergents, including household cleaners, are packaged in cartons, bottles, pouches, bags or cans. The selection of packaging materials and containers involves considerations of product compatibility and stability, cost, package safety, solid waste impact, shelf appeal and ease of use.

19.4 ENVIRONMENTAL IMPACTS

The major environmental impacts from soap and detergent manufacturing will be caused during the operation of these facilities. Typical major concerns include:

- The disposal of wastes generated,
- The risks associated with the storage of raw materials, and
- The control of emissions.

19.4.1 Household Cleaning Products

Most household cleaning products are formulated to be used with water and "go down the drain" into wastewater treatment systems (municipal sewage treatment plants or septic tank systems). To assure that products are safe for the environment, manufacturers should evaluate the impacts of product ingredients in wastewater treatment systems and natural water bodies (streams, rivers, lakes and estuaries).

19.4.2 Types of Pollutants

The types of pollutants a single facility will release depend on the raw materials, processes, and equipment in use and maintenance practices.

The following paragraphs details the impacts on the environment that should be considered for these industrial projects.

19.4.3 Air Quality

i Potential sources of air pollution include:

- Dust emissions during construction works,

- Noise and odour from construction activity, including from the additional traffic generated,

- Emissions from air conditioning systems for administrative buildings,

- Emissions from solvents used during maintenance activities and painting.

ii Soap Manufacturing

- The main air pollution problem in soap manufacturing is odour. The storage and handling of liquid ingredients and sulphates are some of the sources of this odour. Vent lines, vacuum exhausts, raw material and product storage, and waste streams are all potential odour sources.

- Blending, mixing, drying, packaging, and other physical operations may all involve dust emissions. The production of soap powder by spray drying is the single largest source of dust in the manufacture of synthetic detergents.

iii Detergent Manufacturing

- The exhaust air from detergent spray drying towers contains 2 types of air contaminants: fine detergent particles and vaporised organics.

- Dust emissions are generated during the batching and mixing of fine dry ingredients to form slurry. Conveying, mixing, and packaging of detergent granules can also cause dust emissions. The dust emissions principally consist of detergent compounds, although some of the particles are un-combined phosphates, sulphates, and other mineral compounds.

- In addition to particulate emissions, volatile organics may be emitted when the slurry contains organic materials with low vapour pressures. The VOCs originate primarily from the surfactants included in the slurry. The amount vaporised depends on many variables such as tower temperature and the volatility of organics used in the slurry.

- Noise abatement measures should be taken to reduce the impact on the neighbouring communities.

19.4.2 Land and Soil Resources

i Soil erosion can be a major issue during construction and care should be taken to minimise this impact. Damage to soil quality can occur through excavation and compaction and other construction activities. If construction is to occur on previous industrial sites, the developer should determine whether or not the land is contaminated and if any remediation is necessary.

ii Solid wastes may be generated from the packaging stage of the manufacturing process. These may include plastic and paperboard. All solid wastes should be disposed of in an approved waste disposal facility.

19.4.3 Water Quality

i Numerous organic and inorganic chemical compounds are used in the manufacture of soaps and detergents. As the reactions are carried out, some of these materials and their derivatives enter the wastewaters from the processing steps.

ii Production of soaps and detergents result in numerous wastewater streams and several types of contaminants that are of special concern. Synthetic surfactants not only create a high biological oxygen demand (BOD) and chemical oxygen demand (COD) but also cause water to foam and in high concentrations can be toxic to fish and other organisms. Nutrients, particularly phosphates, are of concern because of their contribution to eutrophication of water bodies.

iii Soap production leads to wastewaters with high alkalinity, high salt and high oxygen demand. Spills of raw materials contribute to oil and grease levels. Most of the suspended solids come from organics i.e. calcium soaps and many are of the volatile rather than the non-volatile type. Since strong acids and strong alkalis are used, pH can be very high or very low in wastewaters.

CHAPTER 20

DRY CLEANING OPERATIONS

20.0 THE DRY CLEANING INDUSTRY

The dry cleaning industry provides garment-cleaning services and in most cases will provide related services such as clothes pressing and finishing. The dry cleaning process is physically very similar to the home laundry process, except that clothes are washed in dry cleaning solvent instead of water.

20.0.1 Fabric or Garment Cleaning

Fabric or garment cleaning consists of three basic functions: cleaning, drying and finishing. Garments are pre-treated for stains, and then machine-washed in a solution of a solvent, soaps and detergents. The solvent is extracted by first draining and then spinning the clothes. Finally, the garments are dried through a combination of aeration, heat and tumbling, and then they are pressed.

These functions are the core of any fabric cleaning process, although the details vary and steps may be minimized or even omitted. All three functions are readily recognizable in the full-service dry cleaning process. Dry cleaners will also "refresh" a garment, concentrating mainly on finishing.

20.0.2 Liquid Chemical Solvents

Liquid chemical solvents are used to remove stains from fabrics. The primary chemicals of concern are perchloroethylene, also known as PCE or "Perc," and tetrachloroethylene (TCE). Perc is a colourless liquid with a sharp, sweet odour that evaporates quickly.

20.1 ENVIRONMENTAL IMPACTS

The potential environmental impacts from the dry cleaning industry are significant and its primary releases affect the following:

- Air, through both fugitive emissions and direct release at the end of the cycle,

- Water, from water that was contained in the clothes and from regenerating carbon absorbers[1], and

- Solid waste, the residue remaining after contaminated solvent is filtered and carbon from absorbers.

The following paragraphs detail the impacts that should be considered in environmental assessment of these projects.

20.1.1 Air Quality

i Dry cleaning emissions to air occur either as fugitive emissions or direct release at the end of the process. These emissions are associated with:

- Solvent spills,
- Leaks from piping,
- Vapour release while transferring or removing clothes from machines,
- Vapour release from clothes dryers, and
- Residual vapour release from clothes after they are removed from the dryer

ii Perc is suspected to cause cancer and is considered toxic. It also causes dizziness, nausea, headaches, nose and eye irritation, loss of coordination, respiratory failure, and lack of muscular control. Perc vapours are most easily taken in via inhalation and can impact the liver and kidneys; in this light, emission to the air must be controlled.

20.1.2 Water Quality

i Wastewater from the dry cleaning industry includes water from separators used in condensers, carbon absorbers, stills, vacuums, washing machines, compressors, boiler blow-down and mop water from floor cleaning.

ii Improperly disposed wastewater containing perc and other

[1] Carbon absorbers recover solvent by sending contaminated air through a bed of activated carbon that then adsorbs the solvent vapours. The adsorbed solvent may be recovered by passing low-pressure steam or hot air through the carbon bed.

solvents from dry cleaners will have an adverse effect on water quality. Perc is denser than water and sinks quickly through soils into the water table until it reaches an impermeable layer such as clay or rock. It then dissolves very slowly into the ground water. Perc can persist in the environment for long periods, continuing to dissolve into the groundwater for many years.

20.2 LAND AND SOIL RESOURCES

i Soil erosion can be a major issue during construction and care should be taken to minimise this impact. Damage to soil quality can occur through excavation and compaction and other construction activities. If construction is to occur on previous industrial sites, the developer should determine whether or not the land is contaminated and if any remediation is necessary.

ii Improper storage, handling, and disposal of perc, along with other volatile organic compounds used in dry cleaning, such as trichloroethane and trichloroethylene, may result in significant contamination of soil and groundwater. Perc does not bind well to soil, so it may move rapidly through soil and into groundwater, where it does not dissolve completely.

CHAPTER 21

DISTILLERY, BREWING AND FERMENTING FACILITIES

21.0 Definitions

A distillery is a process plant where distilled beverage alcohols are produced, concentrated or otherwise processed, and includes facilities on the same site where the concentrated products may be blended, mixed, stored or packaged.

A brewery is an establishment for the manufacture of malt liquors, such as beer and ale. Beer is a fermented beverage with low alcohol content made from various types of grain. Barley predominates, but wheat, maize, and other grains can be used.

Fermentation is the process by which yeast acting upon sugar, produces alcohol and carbon dioxide. Fermentation industries include distilleries and breweries.

21.1 Environmental Impacts

The following paragraphs detail the impacts on the environment, in terms of wastes generated, water and energy use for each industry, which should be considered in environmental assessment for these industrial projects.

21.1.1 Distillery

i As with most distilling operations water is used extensively for cleaning of floors, washing of bottles and equipment. The distillery generates liquid effluent that contains a high concentration of cleaning and sanitizing agents.

ii The wastewaters originating from the process are highly concentrated and contain a high level of total dissolved solids as well as organic matter. Character of wastewaters varies with production application, which affects the treatability characteristics.

iii The factory's solid waste stream is of packaging materials, cardboard containers used for packing bottles and broken bottles, which should be properly disposed.

iv The principal emission from the production of distilled spirits is ethanol, and occurs primarily during aging/warehousing. In addition to ethanol, other volatile compounds produced in trace quantities during aging may include acetaldehyde (a HAP), ethyl acetate, glycerol, fusel oil, and furfural.

v A comparatively small source of ethanol emissions also results from fermentation. Carbon dioxide is also produced during fermentation; in addition, trace quantities of ethyl acetate, isobutyl alcohol and isoamyl alcohol are also produced. Particulate matter (PM) emissions may result from the grain receiving, grain handling, grain cleaning, milling and grain drying processes. Other emissions, including SO2, CO2, CO, NOx,VOC, and PM, may be generated by fuel combustion from power production in a typical distilled spirits plant.

21.1.2 Brewery

i Untreated effluents typically contain suspended solids, biochemical oxygen demand (BOD), chemical oxygen demand (COD) and nitrogen. Phosphorus can also be present.

ii Effluents from individual process steps are variable. For example, bottle washing produces a large volume of effluent that, however, contains only a minor part of the total organics discharged from the brewery. Effluents from fermentation and filtering are high in organics and BOD but low in volume, accounting for about 3% of total wastewater volume but 97% of BOD. Effluent pH averages about 7 for the combined effluent but can fluctuate from 3 to 12 depending on the use of acid and alkaline cleaning agents. Effluent temperatures average about 30°C.

iii Solid wastes for disposal include grit, weed seed, and grain of less than 2.2 millimetres in diameter removed when grain is cleaned, spent grain and yeast, spent hops, broken bottles or bottles that cannot be recycled to the process and cardboard and other solid wastes associated with the process.

iv Breweries do not discharge air pollutants, other than some odours.

CHAPTER 22

CEMENT AND LIME PRODUCTION

22.0 CEMENT

Cement is a basic material for building and civil engineering construction. The preparation of cement involves mining, crushing, and grinding of raw materials (principally limestone and clay), calcining the materials in a rotary kiln, cooling the resulting clinker, mixing the clinker with gypsum and milling, storing and bagging the finished cement.

22.1 LIME

Lime or calcium oxide (CaO) is a material with wide-ranging uses in the chemical, manufacturing and construction industries. Lime is produced by calcining, or heating limestone ($CaCO_3$) and burning off carbon dioxide gas (CO_2). The resulting lime is a reactive material that has become essential in many industrial processes.

22.2 ENVIRONMENTAL IMPACTS

The major environmental impacts from the cement and lime processing industries will be caused during the operation of these facilities. The following paragraphs detail the impacts on the environment, in terms of wastes generated and energy use that should be considered in environmental assessment for these industrial projects.

22.2.1 Air Quality

i Cement Production

The burning of clinker is the most important part of the process in terms of the key environmental issues for the manufacture of cement, energy use and emissions to air. The key environmental emissions are nitrogen oxides (NOx), sulphur dioxide (SO_2) and dust. The process is very energy-intensive. Carbon dioxide is produced in cement making, as a result of the production of the process ingredient called 'Clinker'

Heavy metals may also be present in the raw materials, fuel used and are released in kiln gases.

ii Lime Production

The lime burning process is the main source of emissions and is also the principal user of energy. The secondary processes of lime slaking and grinding can also be of significance. The key environmental emissions are dust, nitrogen oxides (NOx), sulphur dioxide (SO_2) and carbon monoxide (CO).

22.2.2 Water Quality

For both cement and lime production, effluents requiring treatment will be generated from the cooling operations or as stormwater. Since water is used for cooling, thermal pollution is a concern.

22.2.3 Land and Soil Resources

A large amount of dust is generated in cement production and a large portion is recovered and recycled in the process. However when the raw materials have high alkali or chloride content, a portion of the collected dust must be disposed of as solid waste, to avoid alkali build-up.

CHAPTER 23

THE TEXTILE INDUSTRY

23.0 MANUFACTURE OF TEXTILES

The textile industry uses plant fibres such as cotton, animal fibres such as wool and silk and synthetic materials such as nylon and polyester. The stages of textile manufacture include fibre processing, yarn preparation, fabric production, bleaching, dying and printing and finishing. Each stage of textile manufacturing will generate wastes that must be properly managed, however the most significant environmental impacts occur with the 'wet processes' – i.e. washing, bleaching, dyeing, printing and finishing.

23.1 ENVIRONMENTAL IMPACTS

The major environmental impacts from the textile industry will be caused during the operation of these facilities. The following paragraphs detail the impacts on the environment that should be considered in environmental assessment of these projects.

23.1.1 Air Quality

Textile production involves processes that may use solvents. Emissions of volatile organic compounds (VOCs) arise from various stages of the production process and their release should be controlled. Additionally, air emissions may include dust, oil mists, odours and boiler exhausts.

23.1.2 Water Quality

i The textile industry utilises water in many of their processes. The quantity of water used in processes should be a consideration during operations.

ii Process wastewater is a major source of pollutants. Wastewater is typically alkaline and with high biochemical and chemical oxygen demand (BOD & COD) levels. It may also contain suspended solids, oils and organics. Wastewater from the dyeing process may contain heavy metals, such as copper and chromium.

iii Pesticides are sometimes used in the protection of natural fibres. These pesticides are transferred to wastewater during the washing process. Wastewater should be tested for metals such as mercury, arsenic and copper.

23.1.3 Land and Soil Resources

i Soil erosion can be a major issue during construction and care should be taken to minimise this impact. Damage to soil quality can occur through excavation and compaction and other construction activities. If construction is to occur on previous industrial sites, the developer should determine whether or not the land is contaminated and if any remediation is necessary.

ii Residues or sludges often contain toxic organics and metals. These should be properly managed with final disposal in a government-approved disposal site (secure landfill). Residues or sludges with toxic compounds should be properly treated (such as incineration) before final disposal.

CHAPTER 24

HAZARDOUS AND TOXIC SUBSTANCES

24.0 MANUFACTURING OF PESTICIDES OR OTHER HAZARDOUS OR TOXIC SUBSTANCES

Pesticides are toxic substances used to kill animals or plants that cause economic damage to crops or ornamental plants or are hazardous to the health of domestic animals or man. All pesticides interfere with normal metabolic processes in the pest organism and often are classified according to the type of organism they are principally intended to control.

24.1 MANUFACTURING STEPS

The principal manufacturing steps for pesticides are:

i preparation of process intermediates;
ii introduction of functional groups;
iii coupling and esterification;
iv separation processes, such as washing and stripping; and
v purification of the final product.

Each of these steps may generate air emissions, liquid effluents, and solid wastes. The formulation of pesticides from the active ingredients is not covered in this document.

24.2 MAJOR CHEMICAL GROUPS

The major chemical groups manufactured include:

i Carbamates and dithiocarbamates (carbofuran, carbaryl, ziram, and benthiocarb)

ii Chlorophenoxy compounds (2,4-D, 2,4,5-T, and silvex)

iii Organochlorines (dicofol and endosulfan)

iv Organophosphorus compounds 5 (malathion, dimethoate, phorate, and parathion methyl)

v Nitro compounds (trifluralin)

vi Miscellaneous compounds such as biopesticides (for example, Bacillus thuringiensis and pherhormones), heterocycles (for example, atrazine), pyrethroids (for example, cypermethrin), and urea derivatives (for example, diuron).

24.3 Production Proposals

Production proposals for the following pesticides should be carefully evaluated because of their extremely hazardous nature: hexachlorobenzene, toxaphene, chlordane, aldrin, DDT, mirex, dieldrin, endrin, and heptachlor.

24.4 Environmental Impacts

The major environmental impacts from pesticide manufacturing will be caused during the operation of these facilities. Air emissions, wastewater and solid wastes will need to be managed in order reduce the impact on the environment.

The potential environmental impacts from pesticide manufacturing are significant. The following paragraphs detail the impacts on the environment that should be considered in environmental assessment for these industrial projects.

24.4.1 Air Quality

i Potential sources of air pollution include:

- Dust emissions during construction work,
- Noise and odour from construction activity, including from the additional traffic generated,
- Emissions from air conditioning systems for administrative buildings,
- Emissions from solvents used during maintenance activities and painting.

ii The principal air pollutants produced during the manufacturing of pesticides are volatile organic compounds (VOCs) and particulate matter (PM). Stack gas scrubbing and/or carbon adsorption (for toxic organics) and baghouses (for particulate matter removal) are applicable and effective technologies for minimizing the release of significant pollutants to air.

iii Noise abatement measures should be taken to reduce the impact on the neighbouring communities.

24.1.2 Land and Soil Resources

Major solid wastes of concern include process and effluent treatment sludges, spent catalysts, and container residues. Contaminated solid wastes may be incinerated, and the flue gases are scrubbed. Contaminated solid wastes should be treated to reduce toxicity before final disposal in an approved waste disposal site.

24.1.3 Water Quality

i Liquid effluents resulting from equipment cleaning after batch operations contain toxic organics and pesticide residues. Cooling waters are normally re-circulated. Chemical oxygen demand, oil and grease, total suspended solids are parameters of concern for wastewater.

ii Reverse osmosis or ultrafiltration may be used to recover and concentrate active ingredients. Effluent treatment normally includes flocculation, coagulation, settling, carbon adsorption, detoxification of pesticides by oxidation (using ultraviolet systems or peroxide solutions), and biological treatment.

CHAPTER 25

PAINT MANUFACTURE

25.0 THE PAINT MANUFACTURING INDUSTRY

The paint manufacturing industry produces a variety of products that preserve, protect and beautify the objects to which they are applied. Paint manufacturing can be classified as a batch process and generally involves the blending/mixing of resins, pigments, solvents and additives. Traditional paint manufacturing consists of four major processes:

i Pre-assembly and Premix
ii Pigment Grinding, Milling and Dispersing
iii Product finishing and Blending
iv Product filling and Packaging

25.0.1 Pre-assembly and Premix

i In the pre-assembly and premix step, liquid raw materials are assembled and then mixed in containers to form a viscous material to which pigments are added.

ii For solvent-based paints, the raw ingredients include resins, organic solvents, plasticisers, dry pigments, and pigment extenders. For water-based paints, raw materials used in the pre-assembly and premix step include water, ammonia, dispersant, pigment and pigment extenders. Many of these materials are, or contain, pollutants.

25.0.2 Pigment Grinding, Milling, and Dispersing

Pigment grinding or milling entails the incorporation of the pigment into the paint to yield a fine particle dispersion. The three stages of this process are wetting, grinding and dispersion, which may overlap in any grinding operation.

25.0.3 Product Finishing and Blending

Final product specification for colour, viscosity, and other coating characteristics are achieved in the product-finishing step. This process normally consists of thinning, coating, and blending. Most of the solvents, tints, and shades are added during this operation.

25.0.4 Product Filling and Packaging

The final step in the paint manufacturing process is the product filling operation. During the filling operation, filtration is performed to remove impurities and to catch small particles of grinding media. Once the material has been filtered, it can be transferred into pails, drums, tank wagons, or other smaller containers for shipment.

25.1 Environmental Impacts

The major environmental impacts from the paint manufacturing industry will be caused during the operation of these facilities. The major wastes that the paint industry must manage are empty raw material packages, dust from air pollution control equipment, off-specification paints, spills, and equipment cleaning wastes.

The following paragraphs detail the impacts on the environment that should be considered in environmental assessment of these projects.

25.1.1 Air Quality

i Paint manufacturing affects air quality in two ways. First, the raw materials required to produce a finished product contain Volatile Organic Compounds (VOCs). These VOCs, are emitted into the air during transfer, blending, settling or any other time the material is exposed to air.

ii Secondly, the pigment dust that may be generated during the manufacturing process, known as particulate matter emissions (or PM-10 emissions), can also have an adverse effect on air quality and workplace health. This particulate matter is emitted into the air during transfer and blending of the materials, and is mostly associated with fugitive dust and baghouse emissions.

25.1.2 Water Quality

i Paint manufacturing affects water quality in a variety of ways. Most contamination of waterways occurs either from stormwater run-off or process (cleaning/cooling) wastewater discharge. Stormwater is affected mainly from storing raw materials and hazardous wastes outside.

i Process wastewater and other controlled discharges of cleaning and process wastewater often are contaminated with solvents and heavy metals.

25.1.3 Land and Soil Resources

i Hazardous Waste

- Paint manufacturers generate a number of wastes from their processes. The raw materials required in the manufacturing process contain VOCs and heavy metals, as do many of the by-products of the process, such as off-specification paint that is unusable, or material from the cleanup of spills and equipment.

- If the presence of VOCs and heavy metals in the resulting waste stream exceeds allowable levels, the paint manufacturer is required to handle the waste as a hazardous or dangerous waste.

ii Solid Waste

Paints manufacturers generate solid waste in a number of ways. Examples include used containers, spent filters, dried paints, pallets, and packaging materials. These materials, if not determined to be a dangerous waste, should be disposed of in an approved waste disposal site. The improper disposal of wastes can result in pollution of groundwater, surface water and air.

CHAPTER 26

BOXING PLANTS

26.0 Boxing Plants

Boxing plants are used to package mainly food such as fruits and vegetables for transport. In some cases, they are stored before or after packaging. These holding areas may be refrigerated.

It should be noted that boxing plants do not only package food and that many environmental issues associated with an industrial project could arise in this type of plant.

26.1 Environmental Impacts

The major environmental impacts from these industries will be caused during the operation of these facilities.

The following paragraphs detail the impacts on the environment, in terms of wastes generated that should be considered in an environmental assessment for boxing plants.

26.1.1 Air Quality

The refrigerants used may be ozone-depleting chemicals, such as CFCs, the production of which is being phased out under the Montreal Protocol. Ammonia, which has no such restriction, is also used as a refrigerant. The release of ammonia into the atmosphere, due to leaks from cooling equipment, is primarily a health and safety concern. Refrigeration applications also contribute to greenhouse gas emissions such as Carbon, Nitrogen and Sulphur Oxides.

26.1.2 Water Quality

i Some produce are washed and dried before packing. In this regard, excessive water use may be an issue.

ii Some boxing plants /commercial packing houses use sanitizers in packing line water to kill the fungi, bacteria and yeast that might otherwise cause spoilage. Sodium hypochlorite (liquid laundry bleach) is the most readily available of these sanitizers. As a result, there may be a high concentration of bleach in the wastewater, which will require proper treatment. Possible pesticide pre-treatment may also affect wastewater quality.

26.1.3 Land and Soil Resources

Solid waste may include plastic packaging material and damaged/discarded boxes and cartons. All solid waste generated must be properly disposed.

CHAPTER 27

CONTAINERS AND PACKAGING MATERIALS

27.0 CONTAINERS AND PACKAGING MANUFACTURE

Glass, plastic, metal (steel and aluminum), cardboard, polystyrene (Styrofoam) and corrugated board are used in the manufacture of containers and packaging materials. containers include cans, bottles, boxes and cartons.

27.0.1 Glass

New glass is made from a mixture of four main ingredients: sand, soda ash, limestone and other additives (for colouring). Glass can be recycled indefinitely. If recycled glass is used to make new bottles and jars, the energy needed in the furnace is greatly reduced.

27.0.2 Plastics

The production of plastic materials (generally termed “resins”) is achieved by chemically combining relatively simple organic feedstock molecules (“monomers”) into much longer molecules (“polymers”). Depending on the combination, different types of plastic are produced - PVC, PET, HDPE, etc.

27.0.3 Cans

Cans are made of either steel or aluminium. Generally, the manufacturing process consists of metal being cut to size, formed into the correct shape and welded. Packaging may be coated or printed, for example, metal packaging used for food and drink purposes may be coated with an organic material to stop chemical reactions.

27.0.4 Cardboard

Cardboard is manufactured in a similar process to paper (See Pulp, Paper and Wood Processing Prescribed Category). Source materials for the paper and cardboard production are different hardwoods and softwoods. Cardboard differs from paper in such a way that it consists of several layers.

27.0.5 Polystyrene

Polystyrene is produced by the polymerisation of styrene monomer. It is a derivative of benzene and ethylene, both by-products of the production of oil and gas, which are non-renewable resources.

27.06 Corrugated Board

Corrugated board is made from papers made up from cellulose fibres, which are virgin or recycled. This makes corrugated a renewable natural resource.

27.1 Environmental Impacts

Please note that the environmental impacts of container and packaging material manufacture are looked at from raw material production. It is recognised, however, that some industries may obtain the finished material and specialise in shaping and moulding into the desired product. This process is achieved with the use of numerous equipment and technologies and will not be discussed here.

The major environmental impacts from these industries will be caused during the operation of these facilities. The following paragraphs detail the impacts on the environment, in terms of wastes generated, water and energy use that should be considered in environmental assessment for these industrial projects. Whenever water is used for cooling in the following manufacturing processes thermal pollution is a concern.

27.1.1 Glass (bottles) Manufacture

The manufacture of glass uses energy in the extraction and transportation of the raw materials, and during processing, as materials have to be heated together to a very high temperature. Large amounts of fuel are used and the combustion of these fossil fuels produces carbon dioxide - a greenhouse gas. Furnaces for glass melting can be coal, natural gas, heavy fuel oil, oil etc. The choice of fuel affects the pollutants (primarily NOx, SOx, CO and hydrocarbons).

Large volumes of water are needed for cooling and production purposes. Main wastewater sources from glass finishing processes - washing, quenching, grinding, polishing, direct contact with glass. Some processes may include machine cutting, alkali washing, acid polishing, and acid etching. Major pollutants of concern: suspended solids, oil, pH, BOD5, total phosphorus, temperature, fluorides, and lead.

27.1.2 Plastic (containers/ bottles) Manufacture

i The following pollutants are produced as a result of plastic manufacturing:

- Air emissions of monomer and volatile solvent
- Wastewater bearing solvent residues from separation processes, and from wet scrubbers
- Slow release into the environment, for example, by leaching slowly into water, of small molecules (plasticisers, stabilizers, etc.) incorporated into product. Plasticisers in particular have been implicated in human health and environmental impacts by their action as endocrine mimics and reproductive abnormalities.

ii PVC is the most environmentally harmful plastic. The production of PVC requires the manufacture of raw chemicals, including highly polluting chlorine, and cancer-causing vinyl chloride monomer (VCM) and ethylene dichloride (EDC).

27.1.3 Metal (can) Manufacture

(See Metal Processing Chapter 40, for information regarding the environmental impacts of aluminium and steel manufacture)

27.1.4 Cardboard (boxes and cartons) Manufacture

(See Pulp, Paper and Wood Processing Chapter 13, for information regarding the environmental impacts of cardboard manufacture)

27.1.5 Polystyrene (cartons) Manufacture

The manufacture of polystyrene results in the following impacts:

- Energy Use: Because it involves high temperature processes polystyrene requires high energy inputs
- Water Use: Water is used primarily for flushing and cooling purposes during the manufacture polystyrene. Discharges

may include biological oxygen demand, chemical oxygen demand, suspended solids, dissolved solids, oil and grease, sulphides, and various metals including lead, mercury, iron, and aluminium.

- Air Emissions: Dust, Nitrogen Oxide, Sulphur Dioxide, Carbon Monoxide hydrocarbons and Volatile Organic Compounds (VOCs) among others.

- Hazardous Waste: Hazardous waste generated from polystyrene production includes cleaning and flushing solutions, solvents, lubrications, and inks.

27.1.6 Corrugated Board (boxes and cartons) Manufacture

See Pulp, Paper and Wood Processing Chapter 13, for information regarding the environmental impacts of corrugated board manufacture.

CHAPTER 28

EDIBLE FATS AND OIL

28.0 MANUFACTURING OF EDIBLE FATS, OILS AND ASSOCIATED PROCESSES

Edible fats and oils are foodstuffs composed of glycerides of fatty acid of vegetable animal or marine origin. Vegetable oil and butter (see Food Processing Prescribed Category – Dairy Industry) are the most commonly used edible oils. Others in this category include margarine, lard (animal fats), and fish oil. Edible fats and oils produced from animals are done so in the 'rendering' phase of meat/fish processing, where inedible and discarded remains are used to produce useful by-products.

The vegetable oil processing industry involves the extraction and processing of oils and fats from vegetable sources. Vegetable oils and fats are principally used for human consumption but are also used in animal feed, for medicinal purposes, and for certain technical applications. The oils and fats are extracted from a variety of fruits, seeds, and nuts. The preparation of raw materials includes husking, cleaning, crushing, and conditioning.

28.1 ENVIRONMENTAL IMPACTS

The major environmental impacts from the edible fats and oils manufacturing industry will be caused during the operation of these facilities. Trade effluent and sludge as well as air emissions will need to be managed to reduce the impact on the environment.

The following paragraphs detail the impacts on the environment that should be considered in environmental assessment for these industrial projects.

28.1.1 Air Quality

i In vegetable oil processing, dust is generated in materials handling and in the processing of raw materials, including in the cleaning, screening and crushing operations.

ii Meat rendering is an evaporative process that produces a condensate stream with a foul odour.

28.1.2 Water Quality and Resources

i The wastewater generated from the manufacture of vegetable oil is high in organic content, resulting in a biochemical oxygen demand (BOD) and a chemical oxygen demand (COD). In addition, the wastewaters are high in dissolved solids, oil and fat residues, organic nitrogen, and ash residues emissions.

ii Rendering wastewater typically has a very high organic (resulting in a high BOD and COD) and nitrogen load.

28.1.3 Land and Soil Resources

Solid waste from the production of vegetable oil is not necessarily a threat as most are mainly of vegetable origin and can be processed into by-products or used as fuel.

CHAPTER 29

FOOD PROCESSING

29.0 FOOD PROCESSING

This chapter deals with Citrus, Coffee, Cocoa, Coconut, Sugarcane Processing Factories.

29.0.1 Citrus Processing

The steps for this include, the preparation of the fruit (cleaning, trimming, and peeling) followed by cooking, canning or freezing. Products of citrus processing include juices, jams and jellies.

29.0.2 Coffee Processing

Two different techniques can be employed when processing coffee. In the wet process the fresh fruit is pulped by a pulping machine and in the dry process the fruits are immediately placed to dry either in the sun or in hot air dryers. In the manufacture of the products, the coffee may be roasted, ground and packaged.

29.0.3 Cocoa Processing

This refers to the converting of cocoa beans into liquor, butter, cake and powder through a variety of steps depending on the desired product. It is separate from chocolate manufacturing even though a large portion of cocoa is used to produce chocolate.

29.0.4 Coconut Processing

This is comprised of several stages, depending on the desired product, including de-husking, de-fibring, de-shelling, paring, flesh-grating and milk extracting. The coconut industry is capable of providing an endless list of products and by-products derived from its various parts. These include food, beverages, fibre, oil, timber, charcoal, chemicals and other products.

29.0.5 Sugarcane Processing

This is also a multi-stage process and is focused on the production of cane sugar (sucrose) from sugarcane. Other products of the processing include bagasse and molasses. Bagasse, the residual woody fibre of the cane, is used for several purposes: fuel for the boilers and lime kilns, production of numerous paper and paperboard products and reconstituted panel board, agricultural mulch, and as a raw material for production of chemicals.

29.1 Environmental Impacts

The major environmental impacts from these industries will be caused during the operation of these facilities. Trade effluent, sludge and air emissions will need to be managed to reduce the impact on the environment.

The following paragraphs detail the impacts on the environment of each type of industry, in terms of wastes generated, water and energy use that should be considered in environmental assessment for these industrial projects.

29.1.1 Citrus Processing

The citrus processing industry typically generates large volumes of effluents and solid waste. The effluents contain high organic loads, cleansing and blanching agents, salt, and suspended solids. They may also contain pesticide residues washed from the raw materials. The main solid wastes are organic materials, including discarded fruits wastes for production of by-products. Odour problems can occur with poor management of solid wastes and effluents.

29.1.2 Coffee Processing

i Significant environmental impacts relate to excessive consumption of energy, water, and firewood, as well as to the production of large volumes of organic waste (pulp) and highly organically polluted wastewater. The latter impact is only significant in the wet process technique as the main pollution in coffee wastewater stems from the organic matter released during pulping. The resulting wastewater is highly acid and release into the surrounding environment without treatment will be very detrimental to plants and animals.

ii Air emissions may include particulate matter, carbon dioxide, carbon monoxide, nitrogen oxide and sulphur oxide.

29.1.3 Cocoa Processing

Emissions from the diesel fired roasters and boilers include hazardous gases such as carbon monoxide and dioxide, nitrogen oxide and sulphur dioxide. Solid waste is generated in the form of cocoa shells. Although the factory uses very little water in the production process, the consumption for floor washing and domestic uses is very high. Wastewater contains a high level of pollutants (and BOD) and must be treated.

29.1.4 Coconut Processing

i Since coconut processing may be employed by many methods as well as part of other industries (e.g. confectionery), the environmental impacts in terms of wastes generated and energy use are numerous.

ii It should be noted, however, that if the industry is properly integrated, the generation of solid waste could be very limited as all parts of the coconut are useful.

29.1.5 Sugar Cane Processing

i One of the main environmental problems associated with sugar processing is the management of effluent. All stages in sugar processing and refining produce wastes that collectively are very rich in organic content, high in suspended solids and may also be coloured. Wastewater will need to be treated on-site before release to sewer or surface water. The release of untreated wastewaters to surface waters will cause extensive enrichment, stripping oxygen from the water and killing aquatic life.

ii Particulate matter (PM), combustion products, and volatile organic compounds (VOC) are the primary pollutants emitted from the sugarcane processing industry. Combustion products include nitrogen oxides (NO), carbon monoxide (CO), and sulphur oxides (SO). Odour from the waste lagoons and from processing may result.

CHAPTER 30

SOLAR SALT

30.0 Solar Salt Production

A solar salt works is a series of interconnected artificial ponds in which the high evaporation of seawater makes it possible to produce sodium chloride or table salt.

The evaporation rate is influenced most by a high sunshine rate and air temperature, which are usually interrelated. It will be beneficial if the site is subject to a hot inland or desert air. If the hot air is also dry it will further improve evaporation. Wind, which is considered the least significant factor, occasionally assumes importance. It helps in the removal of air saturated with water vapour from the surface of the evaporating body and bringing in contact with it fresh unsaturated layers of the atmosphere thus increasing evaporation.

A good solar salt works consists of a series of ponds with eastern embankments into the first of which saline water from the sea, or any other source, is drawn. The function of these concentrating ponds is to increase the salinity of the brine that is slowly flowing through them, to the point where salt will crystallize. At this point, the saturated brine is transferred to crystallization ponds where the salt deposits as a uniform layer and is ready for harvest. The salt is harvested manually or by mechanical means then washed and stored.

30.1 Environmental Impacts

The major environmental impacts from these industries will be caused during the operation of these facilities. Typical major concerns of operations include:

- The disposal of wastes generated,
- The risks associated with the storage of products.

The following paragraphs detail the impacts on the environment that should be considered for these projects.

30.1.1 Air Quality

Degradation of air quality may be caused by dust particulates during, excavation and earth moving, transport and material transfer and wind erosion of loose soil.

30.1.2 Land and Soil Resources

Although brine is found in nature, there is great concern because of its toxicity. Brine in solar saltworks has a concentration that may be up to 10 times higher than that of normal seawater (salt crystallizing ponds). Brine drain-off or leakage will therefore affect the salinity of the soil and its productivity, should reclamation occur after closure.

30.1.3 Water Quality

Brine drain-off or leakage, common events at saltworks, has been known to contaminate aquifers and groundwater systems. This becomes important if it affects water supply for communities.

30.1.4 Biodiversity

i Solar saltworks by their sheer size and disruptive dike systems cause physical alteration of the ecosystems within which they are placed. This alters habitats and endangers the life in the estuaries and coastal waters.

ii Following brine drain-off or leakage, some animal species are unable to adapt to the increased salinity of the water. Furthermore, the release of brine onto land, deposits various salts that are toxic to many plant species and to microorganisms in the soil.

iii Solar salt ponds are problematic in themselves. Fish, algae and other organisms rarely survive in these ponds as the salinity increases. Fish reproductive levels may fall due to the increased salinity level. In addition, some birds are attracted to the brine shrimp in salt-water ponds; as a result, the elevated salinity may cause reproductive problems and damage their feathers.

iv The frequent construction of dikes near mangrove systems alters the drainage and freshwater flushing of mangroves, thereby threatening mangrove survival. Unfortunately, mangrove habitats coincide with the most ideal salt production conditions.

30.2 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)
- Trade Effluent (Appendix 8)
- Sewage Effluent (Appendix 9)
- Standards for effluent to be used as irrigation. (Appendix11)

CHAPTER 31

AGRO PROCESSING AND PROCESSING OF AGRICULTURAL WASTE

31.0 AGRO-PROCESSING

A common and traditional definition of agro-processing industry refers to the subset of manufacturing that processes raw materials and intermediate products derived from the agricultural sector. Agro-processing industry thus means transforming products originating from agriculture, forestry and fisheries.

A very large part of agricultural production undergoes some degree of transformation between harvesting and final use. The industries that use agricultural, fishery and forest products as raw materials comprise a very varied group. They range from simple preservation (such as sun drying) and operations closely related to harvesting to the production, by modern, capital-intensive methods, of such articles as textiles, pulp and paper.

31.1 PROCESSING AGRICULTURAL WASTE

31.1.1 Agricultural Waste

Agricultural Waste is a broad category which includes all types of farming by-products and wastes. Agricultural waste is composed of organic wastes (animal excreta in the form of slurries and farmyard manures, spent mushroom compost, soiled water and silage effluent) and waste such as plastic, scrap machinery, fencing, pesticides, waste oils and veterinary medicines.

31.1.2 Recovery and Disposal

Agricultural waste may be recovered or disposed depending on the type of waste. Hazardous waste such as waste oils and veterinary medicines would have to be properly disposed. Alternatively, fish processing waste could be recovered for food and feed products. In addition residues from the sugar processing industry can be easily converted into fuel alcohol through fermentation.

31.1.3 Animal Waste

"Animal waste processing" means processing of animal waste and by-products, including but not limited to animal manure, animal bedding waste, and similar by-products of an animal raising agricultural operation, for use as a commercial fertilizer or soil amendment and including composting operations

31.2 Environmental Impacts

The major environmental impacts from these industries will be caused during the operation of these facilities. Trade effluent, sludge and air emissions will need to be managed to reduce the impact on the environment.

The following paragraphs detail the impacts on the environment that should be considered in an environmental assessment for agro-processing projects.

31.2.1 Agro-processing

Despite their important contribution to overall and agricultural development, agro-processing industries can also give rise to undesirable environmental side effects. Left unchecked, like any other industry, agro-industry can create environmental pollution or hazards in various ways such as the discharge of organic or hazardous wastes into water supplies, the emission of dust or gases that affect air quality and produce toxic substances; and the use of dangerous machinery that can put the safety and health of workers at risk.

31.2.2 Pollution Problems

The seriousness of the pollution problems created by agro-industrial activity greatly varies, but it appears that food transformation activities are generally less energy-intensive and release less carbon dioxide and metal residues than most other industrial activities.

31.2.3 Pollution Risks

The risks of pollution are relatively smaller at the initial stages of preservation and transformation, but they may increase with the level of physical and chemical alteration, particularly in the industries using dated equipment and technology (new technologies are less polluting than old ones in terms of wastes and emissions per unit of output).

31.2.4 Information on Prescribed Categories

For detailed information see the following Prescribed Categories:

- Pulp, Paper and Wood Processing
- Food processing plants including confectionary and syrup manufacturing, fish and meat processing plants
- Tanneries
- Manufacture of textiles
- Manufacturing of edible fats, oils and associated processes
- Citrus, coffee, cocoa, coconut, sugarcane processing factories.

31.2.2 Agricultural Waste Processing – Impacts and Benefits

i Application of manure and organic food-processing waste (damaged fruits and vegetables, peelings, stems, leaves and pits) not only disposes of waste material but also can improve crop production by increasing the supply of nutrients in the soils where the material is applied. The manure and food-processing waste can be solid, slurry, or liquid.

ii On the contrary, however, the land spreading of manures and slurries can cause nutrient and organic pollution of soils and waters, if relevant guidelines are not followed or applications are inappropriately timed or excessive. If livestock slurries and animal manures are disposed of in rivers very rapid and severe oxygen depletion of the water can result leading to the death of fish and other organisms for many kilometres downstream. They are also a source of pathogens and can be associated with the microbiological contamination of surface and ground waters and give rise to potential health risks if insufficient precautions are taken.

iii The waste products some agricultural industries can be used in other industries, for example, bagasse from sugarcane processing for use in paper mills and as fuel.

iv Agricultural fuel oil is poisonous and spillages into watercourses and onto land can have serious implications for plant and animal life. Oil is a highly polluting substance and its escape has serious implications for soil and water environments.

v For further information on agricultural waste see the following chapters dealing with:

- Pulp, Paper and Wood Processing
- Food processing plants including confectionary and syrup manufacturing, fish and meat processing plants
- Citrus, coffee, cocoa, coconut, sugarcane processing factories.

CHAPTER 32

POWER GENERATING PLANTS

32.0 POWER GENERATING PLANTS

Power generating plants include hydroelectric plants and installation for the harnessing of wind power for energy production, thermal power stations and nuclear power stations

32.0.1 Hydroelectric Power

Hydroelectric power (HEP) is derived from generators turned by falling water. HEP has many advantages. It is continuously renewable and requires neither fuel nor cooling water, and creates no thermal pollution. Their maintenance is relatively easy and their plants, often located at remote sites, can be designed for automatic operation. Their water-turbine generating units are more reliable than steam-electric units because they operate at relatively low speeds and are not subject to temperature stresses.

32.0.2 Wind Power

Wind can be harnessed using "windmills" and turbines. These "windmills" consist of blades mounted on a rotor, inclined at an angle to the horizontal. The wind would turn these blades, and a turbine would be used to convert this energy into mechanical energy. Similar to HEP, wind power is a renewable resource and requires neither fuel nor cooling water and creates no thermal pollution.

32.0.3 Steam Power

On the other hand, steam power is not dependent on water availability and can supply power during all seasons of the year. Site selection is much more flexible, and consequently the transmission from the plant is usually shorter.

32.0.4 Fuel Power

In the generation of power from fuel, the heat energy of the fuel is first converted into mechanical energy and then into electrical energy by a generator.

32.0.5 Nuclear Power Generation

Like fossil-fuel-fired plants, nuclear power stations generate heat to produce steam to drive turbine generators. The difference is that, whereas conventional thermal plants use heat produced by the combustion of fossil fuels, nuclear plants produce heat by fission of nuclear fuel in a reactor.
In general, a nuclear power plant has a higher construction cost and lower fuel cost than a thermal power plant of comparable size.

32.1 ENVIRONMENTAL CONSIDERATIONS

32.1.1 Hydroelectric Development Possibilities

The possibilities of hydroelectric development depend on weather conditions and geographical features. Mountainous regions subject to heavy rainfall close to industrial regions are most favourable for hydroelectric development.

32.1.2 Wind Power Possibilities

The possibilities of wind power development depend on geographical features and wind channels. Areas with significant wind are most suitable for installations for harnessing wind.

32.1.3 Power Generation Concerns

Typical concerns for power generation plants include:

i The performance of equipment being used in terms of causing pollution or generating accident risks,

ii The disposal of wastes generated, including radioactive wastes from nuclear power plants,

iii The risks associated with the storage of fuels (nuclear and fossil fuels),

iv Air emissions,

v Thermal pollution of surface water bodies.

32.2 Environmental Impacts

The following paragraphs detail the impacts on the environment that should be considered in environmental assessment for power generation plants.

32.2.1 Air Quality

i The main construction impact on air is dust generated by excavation, materials storage and transfer and traffic. It will normally be a local nuisance, acting as a respiratory irritant to humans, covering plants and windows, impairing visibility, and possibly resulting in a reduction or loss of crops.

ii Low-carbon content coals produce large amounts of ash and dust on combustion, which may contain heavy metals presenting a risk to the natural environment and to human health.

iii Fossil-fuelled power stations are the largest point-source emitters of atmospheric pollutants. Emissions can cause atmospheric acidification and acid precipitation where sulphur-bearing coal or oil is used. This affects vegetation (forests in particular) and some aquatic flora and fauna by changing the pH of water.

iv The combustion of fossil fuels results in the large-scale release of carbon dioxide and nitrous oxides which are greenhouse gases. Inefficient oil and gas combustion will lead to the release of carbon monoxide and of a range of hydrocarbons and particulates, many of which are toxic and some carcinogenic.

v Air pollution problems also pose severe limitations in locating large plants. Special studies must be made of atmospheric conditions in the area, the sulphur content of the fuel burned, and the degree of development in the area.

vi The trace amounts of radiation emitted from a nuclear power station are extremely small, and are subject to tight limits. The increase in local radiation levels above natural background is much smaller than the variation observed in the normal background levels. Consequently, the routine radiation emissions from a nuclear power station have no significant impact.

32.2.2 Water Quality

i Site preparation and construction of a power plant can affect surface and groundwater conditions and quality. Potential impacts include increased surface runoff and sedimentation from removal of vegetation cover, contamination from fuel spillage, or changes in regime from watercourse diversions. The significance of these impacts will depend on site-specific hydrological characteristics and the nature of the work carried out.

ii Fossil fuel power plants require a large amount of water for operation but especially for cooling. Where heat is also generated, significant additional amounts are needed. Recycling and reuse are important.

iii The abstraction of water for power generation can have severe resource implications. River and groundwater levels may be reduced faster than they are replenished, especially in dry seasons. This has implications for competing industrial, agriculture and domestic users, and for the aquatic ecology and water-based industries such as fishing and fish farming. Lowering river flows also reduces the discharge dilution potential and can lead to the need for higher (and more expensive) levels of wastewater treatment. The secondary effects can include the need to increase the treatment level and costs of water subsequently abstracted for other purposes, especially for drinking.

iv Discharged cooling or district heating waters can raise ambient water temperatures (thermal pollution) and consequently alter plant and animal communities. The new communities are then vulnerable to the opposite effect, following plant shutdown for scheduled maintenance or because of failure. Used process and district heating waters are polluted and need treatment before discharge.

v In addition, surface and groundwater can be contaminated by polluted runoff and by the leaching of wastes or raw materials as well as by atmospheric fallout.

vi It is not physically possible to convert all of the heat energy into electrical energy, about two thirds of it goes into the cooling water. This water is warmer when it is discharged than it was when it entered the power station. At some stations, excess heat is discharged into the atmosphere from cooling towers. The increase in the water temperature and the discharge of (non-radioactive) steam from the cooling towers are the only significant effects on the environment from routine nuclear power reactor operation. Exactly the same effects occur from nuclear power stations burning fossil fuels.

vi Hydropower projects have significant effects on the hydrology and limnology of their river system. Sediments carried by watercourses entering reservoirs are deposited. These gradually fill the retention areas, reducing water volume and thus power generation capacity. The reduction of flow and sediment transport can have significant effects on the downstream river and even coastal ecosystems.

32.2.3 Land and Soil Resources

i The principal impact of power generation on land is soil contamination. This may occur as a result of atmospheric fallout leading to soil acidification, hydrocarbon (oils) and other chemical spills, or the leaching of solid wastes, especially ash. These can poison soil and surface or ground water, reach the food chain and have an adverse effect on human health.

ii Impacts are likely to be local, although the spread of acid rain fallout will depend on a range of factors, including wind direction, amount of pollutant emitted and particulate characteristics, such as its density.

iii Radioactive wastes are the principal environmental concern for nuclear power. Most nuclear waste is low-level nuclear waste. It is ordinary trash, tools, protective clothing, wiping cloths and disposable items that have been contaminated with small amounts of radioactive dust or particles.

iv On the other hand, the irradiated fuel assemblies are highly radioactive and must be stored in specially designed pools resembling large swimming pools (water cools the fuel and acts as a radiation shield) or in specially designed dry storage containers. The older and less radioactive fuel should be kept in the dry storage facility, which would be sealed in special concrete reinforced containers.

v Land take is particularly important in the category of wind generation, as large areas of land will be required for development. Conflicting land use will need to be considered in this development. Access to the site will also need to be planned, as these developments may be located in somewhat isolated areas.

CHAPTER 33

SLAUGHTERHOUSES AND ABATTOIRS

33.0 SLAUGHTERHOUSES AND ABATTOIRS

The major activities involved in the operation of slaughterhouses and abattoirs are:

- receiving and holding of livestock
- slaughter and carcass dressing of animals
- chilling of carcass product
- carcass boning and packaging
- freezing of finished carcass and cartoned product
- rendering processes
- drying of skins
- treatment of wastewater
- transport of processed material.

33.1 ENVIRONMENTAL IMPACTS

The major environmental impacts from slaughterhouses and abattoirs will be caused during the operation of these facilities. Air emissions, trade effluent and solid wastes will need to be managed to reduce the impact on the environment. The potential environmental impacts from slaughterhouses and abattoirs are significant. The following paragraphs detail the impacts on the environment that should be considered for these projects.

33.1.1 Air Quality

i Odours

Potential sources of odours in slaughterhouse and abattoir operations are:

- the cooking and rendering process
- waste effluent treatment plants
- slaughterhouses
- product storage and handling areas
- material drying areas
- waste disposal techniques such as burning dead stock
- animal holding pens
- livestock transport vehicles

- holding of carcasses before disposal
- odours from skin handling
- odours from skin sheds

ii Sources of odours in the rendering plant include stale materials and fugitive emissions from cookers. Odours in animal holding pens are produced by manure and urine. Slaughterhouse odours come from solid wastes such as paunch contents and blood residues.

iii Anaerobic waste treatment ponds may produce gases such as methane, ammonia and hydrogen sulphide, which give rise to objectionable odours. Livestock transport vehicles entering the abattoir through residential areas may cause odour problems.

iv Dust

Potential sources of dust emissions at a slaughterhouse or abattoir are:

- unsealed roads
- paddocks, sale-yards and holding pens
- stockpiled products and materials
- construction activities

v Fuel burning emissions

Fuel burning gives rise to atmospheric emissions. Materials burned at an abattoir may include:

- coal or gas fuel for boilers and steam production
- diseased animals
- sludge
- packaging
- unusable skins

vi Greenhouse gases

The amount of fuel used should be minimised by heat conservation and re-use strategies to limit the emission of greenhouse gases. In existing abattoirs, a strategy needs to be adopted to replace ozone-depleting gases.

vii Noise

In abattoirs, noise can be generated by several sources, including:

- animals, especially when in concentrated groups
- processing activities within the slaughterhouse
- plant machinery
- plant and service vehicles

Noise from the slaughterhouse and by-products area is generated by mechanical plant (such as conveyors), ventilation plant, air conditioning, stunning boxes, compressed air equipment, pumps and rendering plant. Some of this equipment may need to operate 24 hours a day. An abattoir is serviced by a variety of vehicles including trucks and forklifts.

33.1.2 Water Quality

i Hygiene

- For hygienic reasons, abattoirs use large amounts of water in animal processing operations. This produces large amounts of wastewater that must be treated.

- Effective primary treatment before secondary treatment will increase the overall effectiveness and efficiency of wastewater treatment systems, as it is cheaper to remove physically the fat and solids than to treat later in secondary and tertiary treatment facilities.

ii Effluent salinity

- Skin preservation by dry salting is a common procedure at small abattoirs that are remote from tanning operations and often export their hides and skins for tanning. After salting, the hides are hung to dry for a minimum of 5 days. During this period, the salt draws the moisture out of the hide, together with the protein-filled fluids contained in the attached flesh.

- The effluent from drying sheds is therefore highly saline and has a very high biochemical oxygen demand (BOD). It may contain high levels of fluoride. This may lead to salinity problems if the effluent is irrigated, and also to fluorosis problems with vegetation, including tree death. This waste stream should be segregated and diverted to an evaporation pond for conversion to a solid waste for potential recycling.

iii Wastewater

Wastewater produced in animal slaughter areas typically has a high BOD. It is also very saline and has high levels of nutrients, suspended solids and bacterial contamination. Pond systems may be used for the secondary treatment of effluent from meat works.

iv Stormwater

Stormwater can become contaminated when it comes into contact with animal holding pens, sludge stockpiles and treated wastewater irrigation areas. This contaminated stormwater can have detrimental environmental effects on surrounding ecosystems.

33.1.2 Land and Soil Resources

i Solid wastes

Sources of solid wastes generated at abattoirs include:

- animal holding areas
- slaughterhouse and processing areas
- waste treatment plant
- unwanted hide or skins and pieces, and unwanted carcasses and carcass parts

Manure is generated in animal holding areas. Materials not suitable for rendering, such as unwanted carcasses, come from the processing areas, along with paper, cardboard and plastics. Primary and secondary effluent treatment sludges are generated in the treatment ponds.

ii The need for a mass disposal area

A mass animal disposal area may need to be identified in case there is an outbreak of exotic disease. This area should be away from watercourses and groundwater. The soil should be suitably friable for digging but also as impermeable as possible.

CHAPTER 34

TRANSMISSION LINES AND SUB STATIONS

34.0 ELECTRICAL TRANSMISSION LINES AND SUBSTATIONS GREATER THAN 69KV

Electric power transmission and distribution systems include the transmission lines and supports, their rights of way, switchyards, substations, and access or maintenance roads. Line voltage and capacity dictate their size. They are primarily overland systems but can span or cross wetlands, rivers, lakes or bays. Underground transmission lines are feasible but costly, especially at high voltage.

34.1 ENVIRONMENTAL CONSIDERATIONS

The environmental considerations associated with these development projects can be looked at based on the stages of implementation – route selection and planning, construction, operation and post-operation.

34.1.1 Route selection

i In project development, particular attention needs to be given to the choice of voltage and route and to the location of switching equipment, especially in areas of landscape value, because of the visually intrusive nature of power lines and their long life. In specific sites of cultural or historic significance, for example, it may be desirable to bury sections of line.

ii Good detailed route analysis and design of power lines can substantially reduce visual impacts. An environmental impact assessment (EIA) may be needed to cover these aspects, especially where high voltage lines are liable to run through sensitive areas. The EIA should include the analysis of reasonable alternatives, which may lead to a more environmentally, economically and socially sound solution for:

- Sources of electricity, including smaller local power facilities as an alternative to bulk transmission,
- Voltage, line and substation sites,
- Rehabilitation and modernisation of existing lines,

- Underground lines,
- Design and method of construction,
- Maintenance and access requirements.

34.1.2 Construction

i Construction of towers and substations will take land out of other uses. Vegetation needs to be cleared; chemical clearance procedures can lead to water and soil pollution. Habitats may be fragmented, especially in forested areas where breaks are created. Construction sites and access roads can affect hydrological regimes.

ii Construction can have several types environmental impacts, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;
- Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;
- Generation of dust from earthmoving and stockpiled soil or from construction activities;
- Loss of flora and fauna in cleared areas;
- Waste generation and disposal;
- Noise and possible odour from construction activity, including traffic that is generated;
- Added traffic and related impacts during and after construction.

The Environment Management Plan is a key tool in establishing procedures to minimise such impacts.

34.1.3 Operation

i Operation produces few environmental impacts. However, the maintenance of rights of way can involve the destruction of vegetation and the fragmentation of habitats throughout the life of the infrastructure.

ii Some risks of coolant or other chemical spills occur at transformer sites in particular and these can pollute soil and water locally. Line maintenance and repair may need cross-country access by heavy vehicles, which can damage habitats.

iii Good management procedures rooted in a sound Environmental Management System will minimise risks. The principal mitigation measures include:

- Maintenance of naturally low-growing vegetation along Right of Way
- Preferential use of mechanical cleaning techniques for maintenance of rights of way
- Selective chemical use only where unavoidable,
- Proper maintenance of transformers and disposal of coolant oils
- Monitoring of rights of way is required to assure proper vegetation control methods, which minimise impacts on wildlife.

34.1.4 Post operation

Power lines can be removed, leaving virtually no traces. Switchyards and other infrastructure elements can be cleared but the risk of pollution from process or servicing chemicals can persist and site rehabilitation may be needed.

34.2 ENVIRONMENTAL IMPACTS

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for these development projects.

34.2.1 Air Quality

Potential sources of air pollution include dust emissions during construction works, and noise and possible odour from construction activity, including traffic that is generated.

34.2.2 Land and Soil Resources

Construction generally involves large areas of land and generates large amounts of spoil, which if not properly protected may be subject to soil erosion.

34.2.3 Water Quality

Environmental effects associated with electrical transmission lines and substations could include the following:

- Surface runoff into surrounding water bodies,
- Pollution of local water bodies and groundwater due to contaminants carried during surface runoff (coolants or other chemical spills may occur at transformer sites)
- Increased sediment loading into surrounding water bodies.

34.2.4 Socio-economic and Human Health Effects

Low-slung lines near to settlements increases the risk of electrocution, especially where there is a tendency to try to make illegal connections to low voltage transmission lines to avoid payment.

Tower and transmission lines can disrupt aeroplane flight paths in and near airports and endanger low flying aeroplanes, especially when carrying out agricultural management activities. Work-related accidents are a risk in all maintenance operations, especially in live maintenance procedures.

34.3 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices,*

procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

34.4 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

CHAPTER 35

PIPELINES AND CONVEYORS

35.0 Pipelines and Conveyors

Pipelines and conveyors are used for the transport of gas, oil or chemical and other infrastructure such as underground/underwater cables with diameter of 10cm or over. Pipelines carry gas, oil, chemicals and other substances from production to consumption site, usually under pressure. These substances are often volatile, hazardous and highly polluting. Underground/underwater cables are usually used in the transmission of electricity and telephone services.

35.1 Environmental Considerations

The possible environmental impacts of construction and operation are established during the early phases of site selection and project planning. Reducing the environmental impact of the development will be best achieved through investigation at the project preparation stage.

Pipelines and conveyors are an important type of infrastructure, which present specific risks needing proper assessment including an analysis of design, construction and operation options. This should include, but not be limited to, the following:

- i Alternative transport of substances,
- ii Route alignment possibilities, including consideration of access issues for construction machinery,
- iii Vertical alignment options (elevated, buried),
- iv Design and materials alternatives,
- v Rehabilitation and replacement of existing lines,
- vi Location and design of pumping stations and transfer points,
- vii Operating schedules to ensure that regular pressures are maintained and avoid contaminants liable to reduce material integrity.

The environmental issues associated with implementing these types of development projects are described below.

35.1.1 Construction

i The distances involved in pipeline construction as well as the need to move construction equipment into and out of often environmentally sensitive areas are some of the most important issues.

ii Construction can have several types environmental impacts, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;
- Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;
- Generation of dust from earthmoving and stockpiled soil or from construction activities;
- Loss of flora and fauna in cleared areas or as a result of pollution or disturbance from construction activities and wastes;
- Solid waste generation;
- Noise and possible odour from construction activity, including traffic that is generated;
- Access for equipment and materials - through road, river or port with associated traffic and infrastructure development (particularly if new facilities are required) with potential habitat loss or severance and safety risks;
- Added traffic and related impacts during and after construction;

iii Developers should consider instituting an environmental management plan to help minimise damage during construction. Although particular care needs to be taken to identify the best construction and operational options, attention also needs to be paid to mitigation measures including

- Accident and emergency response plans, including accessibility,
- Leak and spill mitigation measures,
- Clean-up procedures, especially in sensitive environments and close to built up areas. Particular attention needs to be paid where there are risks of water pollution (pipelines through wetlands, under-sea lines, etc.).

35.1.2 Operation

i The major environmental impacts caused in operation of pipeline projects relate to the contamination from accidental releases of gases or liquids from leaks or breaks. The environmental impacts of pipeline operations broadly depend on:

- Location of the infrastructure (offshore or onshore, surface or underground),
- The distances involved, including remoteness (and therefore the response time in case of accidents),
- The technologies in use and the products carried.

ii Typical major concerns include:

- The performance of pipes (corrosion and other failures, welding weaknesses) and associated equipment, accident-generating failure risks and rates,
- Accident types, including explosions, fires and spillages, but also harmful gas releases (hydrocarbons),
- Wastes generated at pump and transfer stations or during routine pipe maintenance operations,
- The clean-up and disposal of wastes generated by spillages or during normal operations,
- The secondary impacts of the transport of equipment and materials to accident sites and the evacuation of products from them.

35.2 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessments for these development projects.

35.2.1 Air Quality

Seepage of gases cannot be totally eliminated from transport operations. Even well-managed pipelines represent a significant contribution to greenhouse gas emissions. Accidental releases will add to this and may also create severe fire hazards. Additionally, burning may release toxic compounds and contribute to acid rain.

35.2.2 Water Quality

i The impacts of pipeline construction depend on the size and length, but more importantly on its vertical alignment. The impact on the environment is more severe when buried because the trenches affect the groundwater systems, and disturbed soils can enter watercourses thereby increasing the amount of sediment in suspension or solution.

ii Wetland and river crossings pose particular difficulties of foundation but also of risks of water pollution (including the special difficulties of access for maintenance and in case of accident), while offshore construction can lead to some special complications, such as the disturbance and dispersal of sediments created during drilling.

iii The major operational risks are those of corrosion and sudden failures. Corrosion may result from water contained in transported products or where sulphur content in the product is high. Corrosion weakens pipes, wells and pumping equipment and reduces their life expectancy, resulting in leaks and spills. Sudden failures can also arise from a number of intrinsic or of extraneous factors. Changes in pressure can cause weak welds to fail.

iv The effects of spills on the natural environment can be severe, especially where they last a long time in remote areas with difficult access.

35.2.3 Land Issues

The impacts of these projects on land are similar to those described for water, with the added concern of vegetation and habitat loss along disturbed rights of way and of the barriers that surface lines create to animal movements.

35.3 ENVIRONMENTAL MANAGEMENT SYSTEMS

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

35.3.2 Implementing an EMS

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS early in the project cycle to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

35.3.3 Mitigation Measures

For these development projects, the identification and implementation of mitigation measures should form part of an environmental management plan, which may be an output of the Environmental Impact Assessment. Implementation of the plan is undertaken through an Environmental Management System.

35.3.4 Reopening and Redevelopment of Pipeline

For projects where the reopening or redevelopment of a pipeline is involved, an environmental audit should be conducted to review pollution and liability for the facility, as well as any other environmental issues and the effectiveness of mitigation procedures.

N.B. *For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"*

35.4 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

[6] For information on Biodiversity, please see Appendix 4 Biodiversity.

CHAPTER 36

DEVELOPMENT OF PORTS AND HARBOURS

36.0 PORTS AND HARBOURS

Ports and harbours encompass a wide range of operations including shipping, loading/unloading cargo, cargo storage, ship refueling and maintenance. Port and harbour projects are usually part of a wider economic development objective such as the creation of export facilities (mining and industry for example), improvement in the fishing industry, tourism or passenger transport.

36.1 ENVIRONMENTAL CONSIDERATIONS

The environmental considerations associated with such development projects can be looked at based on the stages of implementation – site selection and planning, construction, operation and post-operation.

36.1.1 Site Selection and Planning

i The environmental impacts of construction and operation are established during the early phases of site selection and project planning. Reducing the environmental impact of a port and harbour development or expansion will be best achieved through investigation at the project preparation stage.

ii Appropriate siting and design of port and harbour developments are fundamental to minimising environmental impacts. In siting a new port or harbour, and in the expansion and rehabilitation of an existing facility, consideration should be given to:

- The environment where the development will occur,
- The impact on the biodiversity of the area,
- Land/coastal area conflicts - where land needs to be taken for new harbour areas, land reclamation, waterfront facilities or secondary development potentially involving resettlement, loss of agricultural land and loss of coastal or estuarine habitats,
- Coastal hydrology - potential changes in deposition of sediment along coastline or coastline erosion,

- Coastal marine ecology - potential loss and damage to fisheries, coral reefs, salt marsh, mangrove,

- Recreational and tourism conflicts - loss or pollution of beaches and effects on the setting of recreational areas,

- Management and processing of waste and wastewater from port facilities and waterfront industries. The production of waste management plans in ports and harbours presents the most effective means of minimising and avoiding the potential effects of operational and illegal discharges of oil and garbage from ships on the marine environment,

- Loss of fisheries, shell fisheries and tourism affecting local livelihoods.

N.B. *For information on planning standards for Port Facilities, see Volume1: Section 1- Chapter 2 - Planning Standards relating to different types of Development*

36.1.2 Construction

i Construction works for port and harbour projects require similar inputs as other major construction works:

- Raw materials (gravel, rock, sand, concrete and steel)
- Earth moving equipment
- Dredging operations
- Water and energy supply
- Storage and disposal of wastes and dredged materials
- Use of natural resources

ii Aggregate and other construction materials from the sea bed or beaches may be a low cost source, but dredging in these environments can damage local fisheries and recreational bathing areas, and lead to loss of biodiversity.

iii Construction can have several types of environmental impacts, including:

- Soil erosion, degradation, contamination, disturbance of old contamination of the site;

- Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;

- Generation of dust from earthmoving and stockpiled soil or from construction activities;

- Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;

- Solid waste generation

- Noise and possible odour from construction activity, including traffic that is generated;

- Access for equipment and materials - through road, river or port with associated traffic and infrastructure development (particularly if new facilities are required) with potential habitat loss or severance and safety risks.

- Added traffic and related impacts during and after construction.

36.1.3 Operation

i Key sources of environmental impact from port and harbour operations are:

- Shipping movements and the discharge of wastewater and solid waste – a particular problem is the illegal discharge of bilge and ballast outside and within the port area

- Accidental oil and fuel spillage

- Cargo - unloading, loading, storage, handling and transport from the port

- Ship maintenance and ship building

- Oil and fuel storage and transport

- Wastewater treatment and discharge - bilge and ballast, sewage

- Solid waste from ships, port and ship maintenance, cargo residues, office waste

- Dredging and dredged material disposal.

ii Maintenance dredging is required to ensure the depth conditions are maintained in approach channels and harbour basin for safe passage of vessels to and from the port. Dredging can have a significant effect on the environment associated with disposal of contaminated spoil, disturbance of benthic flora and fauna, and reduction in water quality affecting aquatic habitats.

36.1.4 Post Operation

i The post-operation of ports and harbours facilities may include:

- Deterioration of structures (degradation or collapse)
- Removal of structures (demolition)
- Contamination (long-term pollution of soil, water or sediment)
- Disposal of residues (contaminated land).

ii Before a port site, or part of it, can be redeveloped, the presence of contaminated land and water must be established and remediation measures taken where required to prevent risk to human health and the environment.

36.2 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for port and harbour development projects.

36.2.1 Air Quality

Sources of air pollution from port construction and operations include:

- Construction works (earthmoving and rock drilling)

- Traffic on unpaved roadways, fugitive dust emissions from outdoor storage and movement of raw materials such as cereal grains, ores, and particulate refined products

- Heating boilers, diesel generators, waste oil fired generators/heaters – gaseous and particulate emissions

- Motorised vehicles - exhaust emissions of gases and particulates

- Ship maintenance such as grid blasting and use of solvents for cleaning metal surfaces

- Odour from wastes, cargo and waterfront industries.

36.2.2 Land and Soil Resources

i Land take - development and expansion of port and harbours result in land loss to other uses such as agriculture, residential, local water front business

ii Erosion and siltation - as a result of site preparation works and changes to coastal hydrology with possible implications for coastline outside the immediate port and harbour area.

iii Damage from sand/gravel excavation, which can destabilise an entire shoreline, leading to erosion and reshaping of the wider coastal region

iv Solid wastes - ranging from ship waste, medical waste, and domestic and office waste to hazardous industrial materials and construction rubble, and posing serious disposal problems even for smaller port and harbour communities. These wastes can contribute to contamination of land and water, be unsightly, and create health risks

v Dredging and disposal operations - dredged material from maintenance dredging tends to be more contaminated than material dredged during construction because it contains a higher level of contaminants accumulated from polluted harbour water (from discharge of sewage, oils and heavy metals). Key issues are:

- Land disposal of contaminated dredged materials may reduce soil quality, harm terrestrial and aquatic ecosystems, and damage current land uses. In addition, land disposal may bury potential archaeological areas of interest

- Disposal of dredged materials can contaminate underlying groundwater, and surface runoff, thus affecting future land-use options and damaging wetlands.

36.2.3 Water Quality

Impacts on water quality include:

i Discharges from maritime traffic - such as cargo spills, and accidental and illegal discharges of oily bilge, ballast, anti-fouling materials and sewage can have impacts on water quality. These discharges can be harmful to marine or estuarine life and can also render fish and shellfish unfit for human consumption. Pollution within harbour basins is often poorly dispersed and tend to have long residence times leading to high pollution concentrations in the harbour area.

ii Discharges from port activities - waterfront development contributes to the discharge of sewage, industrial process and cooling waters, as well as spills and leakages from accidental releases.

iii Solid waste - is a major source of water pollution in a port and its environs - from direct dumping of ship and port waste in the water or as a result of leaching from storage areas and landfill disposal sites.

iv Flooding and groundwater impacts - removal of wetland areas for port development can affect flood storage reservoirs and groundwater recharge and can increase frequency and severity of floods, lower water tables and cause biodiversity loss.

v Construction and maintenance dredging and spoil disposal - can have short and long-term impacts on water quality such as:

- Increased turbidity at the dredging site and turbidity plumes can decrease light penetration and photosynthetic activity

- Release of nutrients from recent sediment can result in eutrophication and cause algal growth

- Partitioning of toxic contaminants and reintroduction to the water column

- Short-term depletion of dissolved oxygen levels
- Modified bathymetry causing changes in circulation, possible saltwater intrusion to groundwater and inland surface water
- Fluctuations in water chemistry and
- Land disposal of dredged materials can affect underlying groundwater and contaminate surface runoff.

36.3 ENVIRONMENTAL MANAGEMENT SYSTEMS

i An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

ii An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

NB For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

36.4 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Stack Emissions (Appendix 6)

- Noise (Appendix 7)
- Trade Effluent (Appendix 8)
- Sewage Effluent (Appendix 9)
- Sludge (Appendix 10)
- Standards for effluent to be used as irrigation. (Appendix 11)

36.4.1 Other Standards

Other standards applicable to this category are those related to the treatment and disposal of waste generated during operation. Refer to NRCA Guidelines Pertaining to Marinas and Small Craft Harbours, July 1996 - sections 6, 7 and 8. Where there is a gap in local regulations and/or standards MARPOL 73/78 is applied. This is implemented by the Maritime Authority.

36.4.2 Applicable International and Regional Conventions and Protocol

The most important legal instrument is the International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 (MARPOL 73/78), which controls the discharge of harmful substances into the sea from ships.

In addition regionally, the Protocol to the Cartagena Convention concerning Pollution from Land-Based Sources and Activities in the Wider Caribbean Region is also applicable, in respect of the land-based aspect of the port. Jamaica is a signatory to MARPOL 73/78 except it has not ratified Annex 4 and it is in the process of ratifying the Protocol to the Cartagena Convention concerning Pollution from Land Based Sources and Activities in the Wider Caribbean Region.

36.5 Environmental Degradation

The possibilities for environmental degradation are considerable and consist primarily of the following:

36.5.1 Waste Water- Clubhouses, Kitchens, Restaurants, Bars and Bathrooms

Waste water from the clubhouses, kitchens, restaurants, bars and bathrooms must be collected and treated prior to disposal. Depending on ground elevation, local hydrology and geology, the disposal can be: lagoons, tile farm (which work extremely well under certain soil and climate conditions); soak-away pits; trucking away by cesspool emptiers or a long sea outfall. Proper initial design, construction and maintenance of these systems are key requirements to avoid contamination of the adjacent coastal waters in the short and long term.

36.5.2 Waste Water from Boat Maintenance Areas

Waste water from the boat maintenance areas contains highly toxic materials resulting from the removal and application of anti-fouling paints. It also contains small quantities of glass fibres, chemicals, metals, grease, fuel and oils. It should under no circumstances be allowed to flow into the marina or the coastal waters.

The working area must be surrounded by a low height impervious wall or curb to contain the liquid, which drains to one or two central points where it can be pumped to a storage tank to allow for the treatment of pollutants. The overflow liquid from the tank must not be allowed to flow into the marina or coastal waters but be disposed of ashore in a tile farm or soak-away. At intervals the sludge from the tank must be removed and taken to the appropriate land-fill to be disposed as toxic material.

36.5.3 Waste Generated on Board Small Crafts and Yachts

Wastes generated on board small craft and yachts: Jamaica has ratified the international IMO MARPOL 1973/78 Convention and as a consequence must enforce the requirements of the Convention. For small craft and yachts, Annex I (oily wastes) and V (garbage) are applicable. Annex 8 (sewage) to the MARPOL Convention is not yet in force internationally but soon will be. The Wider Caribbean has been declared a "special area" by IMO (International Maritime Organisation) and this implies that nothing can be thrown overboard except food wastes and only then when a certain distance offshore. Thus any vessel arriving in a marina or small craft harbour will wish to dispose of its waste soon after arrival and the marina must be prepared to accept it.

36.5.4 Disposal of Oily Wastes

For Annex I Oily Wastes of the IMO MARPOL Convention, adequate numbers of suitable covered containers must be placed in the marina to receive the waste oils from engine and gearbox oil changes, oily bilge water and spilled fuel. Normally, by arrangement, this waste oil will be collected regularly by JPSCo, PETROJAM or one of the major oil companies such as SHELL, or TEXACO. The service is normally free of charge but the used oil must not contain rags, used oil filters or rubbish. Some water is permissible. Oily rags and filters are regarded as garbage by IMO and should be land-filled or incinerated.

The wire basket drops into the filling opening (fitted with a hinged lid) and collects rags, used oil filters and rubbish.

36.5.5 Garbage Disposal

For Annex V Garbage of the MARPOL Convention, adequate numbers of suitable receptacles are to be placed around the berths and docking areas. These receptacles should have lids, which will not blow off but will prevent the ingress of rats and birds. The design of the receptacles should be such that they cannot be stolen, blown over by the wind and yet be easily emptied. Sturdy heavy plastic bins with a pair of wheels are probably the best but make sure that they are the right size and there are enough of them.

Garbage is to be collected regularly and disposed at an authorized land-fill site. At present, a Government decision remains to be made if garbage from foreign visiting yachts must be incinerated to avoid the importation of infected or contaminated fruit and meats. If this does become law, then special containers for this waste will have to be provided both in the marina and for transport to the land-fill site.

36.5.6 Sewage

For Annex IV Sewage of the MARPOL Convention, comminuted (ground up) sewage will only be permitted to be discharged when 12 miles offshore from small craft and yachts. Holding tanks on board the boats are mandatory requirements enforced through the boat building industry. Thus the marina or small craft harbour will have to provide adequate pump-out facilities to service incoming vessels (the waste water pumped out will enter the marina's own waste water treatment facility which must be sized to receive this additional quantity). Normally, such a pump-out facility is located adjacent to the fuel dock. A special dedicated fresh water line should be installed to flush out vessel holding tanks. Persons on board vessels berthed in the marina or small craft harbour must use the shore based toilet and bathroom facilities and not those on board the vessel. Living aboard a berthed vessel is not permitted in most marinas and should be discouraged with the exception of short term foreign visiting yachts.

36.5.7 Boat Washing

Regular washing down of boats using detergents should not be permitted.

CHAPTER 37

BOAT YARDS AND MARINAS

37.0 BACKGROUND

Ports and harbours encompass a wide range of operations including shipping, loading/unloading cargo, cargo storage, ship refueling and maintenance. Port and harbour projects are usually part of a wider economic development objective such as the creation of export facilities (mining and industry for example), improvement to the fishing industry, tourism or passenger transport.

37.1 ENVIRONMENTAL CONSIDERATIONS

The environmental considerations associated with these development projects can be looked at based on the stages of implementation – site selection and planning, construction, operation and post-operation.

37.1.1 Site Selection and Planning

i The environmental impacts of construction and operation are established during the early phases of site selection and project planning. Reducing the environmental impact of a port and harbour development or expansion will be best achieved through investigation in the project preparation stage.

ii Appropriate siting and design of port and harbour developments are fundamental to minimising environmental impacts. In siting a new port or harbour, and in the expansion and rehabilitation of an existing facility, consideration should be given to:

- The environment where the development will occur
- The impact on the biodiversity[7] of the area
- Land/coastal area conflicts - where land needs to be taken for new harbour areas, land reclamation, waterfront facilities or secondary development potentially involving resettlement, loss of agricultural land, and loss of coastal or estuarine habitats

[7] For information on Biodiversity, please see Appendix 4 Biodiversity

- Coastal hydrology - potential changes in deposition of sediment along coastline or coastline erosion

- Coastal marine ecology - potential loss and damage to fisheries, coral reefs, salt marsh, mangrove

- Recreational and tourism conflicts - loss or pollution of beaches and effects on the setting of recreational areas

- Management and processing of waste and wastewater from port facilities and waterfront industries. The production of waste management plans in ports and harbours presents the most effective means of minimising and avoiding the potential effects of operational and illegal discharges of oil and garbage from ships on the marine environment

- Loss of fisheries, shell fisheries and tourism affecting local livelihoods.

N.B. *For information on planning standards for Port Facilities, see Volume1: Section 1- Chapters dealing with Planning Standards relating to different types of Development*

37.1.2 Construction

i Construction works for port and harbour projects require similar inputs as to other major construction works:

- Raw materials (gravel, rock, sand, concrete and steel)
- Earth moving equipment
- Dredging operations
- Water and energy supply
- Storage and disposal of wastes and dredged materials
- Use of natural resources

ii Aggregate and other construction materials from the sea bed or beaches may be a low cost source, but dredging in these environments can damage local fisheries and recreational bathing areas, and lead to loss of biodiversity.

iii Construction can have several types of environmental impacts, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;

- Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;

- Generation of dust from earthmoving and stockpiled soil or from construction activities;

- Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;

- Solid waste generation;

- Noise and possible odour from construction activity, including traffic that is generated;

- Access for equipment and materials - through road, river or port with associated traffic and infrastructure development (particularly if new facilities are required) with potential habitat loss or severance and safety risks;

- Added traffic and related impacts during and after construction.

37.1.3 Operation

i Key sources of environmental impact from port and harbour operations are:

- Shipping movements and the discharge of wastewater and solid waste – a particular problem is the illegal discharge of bilge and ballast outside and within the port area

- Accidental oil and fuel spillage

- Cargo - unloading, loading, storage, handling and transport from the port

- Ship maintenance and ship building

- Oil and fuel storage and transport
- Wastewater treatment and discharge - bilge and ballast, sewage
- Solid waste from ships, port and ship maintenance, cargo residues, office waste
- Dredging and dredged material disposal.

ii Maintenance dredging is required to ensure that the depth conditions are maintained in approach channels and harbour basin for safe passage of vessels to and from the port. Dredging can have a significant effect on the environment associated with disposal of contaminated spoil, disturbance of benthic flora and fauna, and reduction in water quality affecting aquatic habitats.

37.1.4 Post Operation

i The post-operation of ports and harbours facilities may include:

- Deterioration of structures (degradation or collapse)
- Removal of structures (demolition)
- Contamination (long-term pollution of soil, water or sediment)
- Disposal of residues (contaminated land).

ii Before a port site, or part of it, can be redeveloped, the presence of contaminated land and water must be established and remediation measures taken where required to prevent risk to human health and the environment.

37.2 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for port and harbour development projects.

37.2.1 Air Quality

i Sources of air pollution from port construction and operations include:

- Construction works (earthmoving and rock drilling)
- Traffic on unpaved roadways, fugitive dust emissions from outdoor storage and movement of raw materials such as cereal grains, ores, and particulate refined products
- Heating boilers, diesel generators, waste oil fired generators/heaters – gaseous and particulate emissions
- Motorised vehicles - exhaust emissions of gases and particulates
- Ship maintenance such as grid blasting and use of solvents for cleaning metal surfaces
- Odour from wastes, cargo and waterfront industries.

37.2.2 Land and Soil Resources

i Land take - development and expansion of port and harbours result in land loss to other uses such as agriculture, residential, local water front business,

ii Erosion and siltation - as a result of site preparation works and changes to coastal hydrology with possible implications for coastline outside the immediate port and harbour area,

iii Damage from sand/gravel excavation, which can destabilise an entire shoreline, leading to erosion and reshaping of the wider coastal region,

iv Solid wastes - ranging from ship waste, medical waste, and domestic and office waste to hazardous industrial materials and construction rubble, and posing serious disposal problems even for smaller port and harbour communities. These wastes can contribute to contamination of land and water, be unsightly, and create health risks.

v Dredging and disposal operations - dredged material from maintenance dredging tends to be more contaminated than material dredged during construction because it contains a higher level of contaminants accumulated from polluted harbour water (from discharge of sewage, oils and heavy metals). Key issues are:

- Land disposal of contaminated dredged materials may reduce soil quality, harm terrestrial and aquatic ecosystems, and damage current land uses. In addition, land disposal may bury potential archaeological areas of interest

- Disposal of dredged materials can contaminate underlying groundwater, and surface runoff, thus affecting future land-use options and damaging wetlands.

37.2.3 Water Quality

Impacts on water quality include:

i Discharges from maritime traffic - such as cargo spills, and accidental and illegal discharges of oily bilge, ballast, anti-fouling materials and sewage. These discharges can be harmful to marine or estuarine life and can also render fish and shellfish unfit for human consumption. Pollution within harbour basins is often poorly dispersed and tend to have long residence times leading to high pollution concentrations in the harbour area.

ii Discharges from port activities - waterfront development contributes to the discharge of sewage, industrial process and cooling waters, as well as spills and leakages from accidental releases.

iii Solid waste - is a major source of water pollution in a port and its environs - from direct dumping of ship and port waste in the water or as a result of leaching from storage areas and landfill disposal sites.

iv Flooding and groundwater impacts - removal of wetland areas for port development can affect flood storage reservoirs and groundwater recharge and can increase frequency and severity of floods, lower water tables and cause biodiversity loss.

v Construction and maintenance dredging and spoil disposal - can have short and long-term impacts on water quality:

- Increased turbidity at the dredging site and turbidity plumes can decrease light penetration and photosynthetic activity
- Release of nutrients from recent sediment can result in eutrophication and cause algal growth
- Partitioning of toxic contaminants and reintroduction to the water column
- Short-term depletion of dissolved oxygen levels
- Modified bathymetry causing changes in circulation, possible saltwater intrusion to groundwater and inland surface water
- Fluctuations in water chemistry
- Land disposal of dredged materials can affect underlying groundwater and contaminate surface runoff.

37.3 ENVIRONMENTAL MANAGEMENT SYSTEMS

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

37.4 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Stack Emissions (Appendix 6)
- Noise (Appendix 7)
- Trade Effluent (Appendix 8)
- Sewage Effluent (Appendix 9)
- Sludge (Appendix 10)
- Standards for effluent to be used as irrigation. (Appendix 11)

37.4.1 Other Standards

Other standards applicable to this category are those related to the treatment and disposal of waste generated during operation. Refer to NRCA Guidelines Pertaining to Marinas and Small Craft Harbours, July 1996 - sections 6, 7 and 8.

Where there is a gap in local regulations and/or standards MARPOL 73/78 is applied. This is implemented by the Maritime Authority.

37.4.2 Applicable International and Regional Conventions and Protocols

The most important legal instrument is the International Convention for the Prevention of Pollution from Ships 1973, as modified by the Protocol of 1978 (MARPOL 73/78), which controls the discharge of harmful substances into the sea from ships. In addition regionally, the Protocol to the Cartagena Convention concerning Pollution from Land-Based Sources and Activities in the Wider Caribbean Region is also applicable, in respect of the land-based aspect of the port. Jamaica is a signatory to MARPOL 73/78 except it has not ratified Annex 4 and it is in the process of ratifying the Protocol to the Cartagena Convention concerning Pollution from Land Based Sources and Activities in the Wider Caribbean Region.

37.5 Environmental Degradation

The possibilities for environmental degradation are considerable and consist primarily of the following:

37.5.1 Waste Water - Clubhouses, Kitchens, Restaurants, Bars and Bathrooms

This must be collected and treated prior to disposal. Depending on ground elevation, local hydrology and geology, the disposal can be: lagoons, tile farm (which work extremely well under certain soil and climate conditions); soak-away pits; trucking away by cesspool emptiers or a long sea outfall. Proper initial design, construction and maintenance of these systems are key requirements to avoid contamination of the adjacent coastal waters in the short and long term;

37.5.2 Waste Water from Boat Maintenance

This waste water contains highly toxic materials resulting from the removal and application of anti-fouling paints. It also contains small quantities of glass fibres, chemicals, metals, grease, fuel and oils. It should under any circumstances be allowed to flow into the marina or the coastal waters.

The working area must be surrounded by a low height impervious wall or curb to contain the liquid, which drains to one or two central points where it can be pumped to a storage tank to allow for the treatment of pollutants. The overflow liquid from the tank must not be allowed to flow into the marina or coastal waters but be disposed of ashore in a tile farm or soak-away. At intervals the sludge from the tank must be removed and taken to the appropriate land-fill to be disposed as toxic material;

37.5.3 Waste Generated on Board Small Craft and Yachts

Jamaica has ratified the international IMO MARPOL 1973/78 Convention and as a consequence must enforce the requirements of the Convention. For small craft and yachts, Annexes I (oily wastes) and V (garbage) are applicable. Annex IV (sewage) is not yet in force internationally but soon will be. The Wider Caribbean has been declared a "special area" by IMO and this implies that nothing can be thrown overboard except food wastes and only then when a certain distance offshore. Thus any vessel arriving in a marina or small craft harbour will wish to dispose of its waste soon after arrival and the marina must be prepared to accept it.

37.5.4 Disposal of Oily Wastes

i For Annex I of the MARPOL Convention Oily Wastes, adequate numbers of suitable covered containers must be placed in the marina to receive the waste oils from engine and gearbox oil changes, oily bilge water and spilled fuel. Normally, by arrangement, this waste oil will collected regularly by JPSCo, PETROJAM or one of the major oil companies such as SHELL, or TEXACO. The service is normally free of charge but the used oil must not contain rags, used oil filters or rubbish. Some water is permissible. Oily rags and filters are regarded as garbage by IMO and should be land-filled or incinerated.

ii The wire basket drops into the filling opening (fitted with a hinged lid) and collects rags, used oil filters and rubbish.

37.5.5 Garbage Disposal

i For Annex V of the MARPOL Convention Garbage, adequate numbers of suitable receptacles are to be placed around the berths and docking areas. These receptacles should have lids, which will not blow off but will prevent the ingress of rats and birds. The design of the receptacles should be such that they cannot be stolen, blown over by the wind and yet be easily emptied. Sturdy heavy plastic bins with a pair of wheels are probably the best but make sure that they are the right size and there are enough of them.

ii Garbage is to be collected regularly and disposed at an authorized land-fill site. At present, a Government decision remains to be made if garbage from foreign visiting yachts must be incinerated to avoid the importation of infected or contaminated fruit and meats. If this does become law, then special containers for this waste will have to be provided both in the marina and for transport to the land-fill site.

37.5.6 Sewage

For Annex IV of the MARPOL Convention Sewage, comminute (ground up) sewage will only be permitted to be discharged when 12 miles offshore from small craft and yachts. Holding tanks on board the boats are mandatory requirements enforced through the boat building industry. Thus the marina or small craft harbour will have to provide adequate pump-out facilities to service incoming vessels (the waste water pumped out will enter the marina's own waste water treatment facility which must be sized to receive this additional quantity). Normally, such a pump-out facility is located adjacent to the fuel dock. A special dedicated fresh water line should be installed to flush out vessel holding tanks. Persons on board vessels berthed in the marina or small craft harbour must use the shore based toilet and bathroom facilities and not those on board the vessel. Living aboard a berthed vessel is not permitted in most marinas and should be discouraged with the exception of short term foreign visiting yachts.

37.5.7 Boat washing

Regular washing down of boats using detergents should not be permitted.

CHAPTER 38

ECOTOURISM AND NATURE TOURISM PROJECTS

38.0 DEFINITIONS

The following are the definitions for Ecotourism and Nature Based Tourism:

38.0.1 Ecotourism

i Ecotourism is the controlled use of protected natural areas, historical sites and cultural heritage, ensuring economic and social benefits for the nation as a whole and individual communities in particular while guaranteeing the integrity and conservation of these areas and educational encounters between visitors and locals, as well as natural and cultural phenomena. (Source: Office of the Prime Minister – Tourism)

ii Ecotourism is a tourism market based on an area's natural resources that attempts to minimize the ecological impact of the tourism

38.0.2 Nature Based Tourism

Nature Based Tourism is the non-consumption enjoyment of natural habitats or visits to undeveloped green environment. It does not necessarily operate in harmony with, nor ensures the sustainability of the physical environment, and cultural characteristics of a local community. (Source: Office of the Prime Minister – Tourism)

38.1 ENVIRONMENTAL CONSIDERATIONS

The environmental considerations associated with ecotourism and nature tourism projects can be looked at based on the stages of implementation – project planning and operation.

38.1.1 Planning and site selection

i Background information should be obtained prior to, and during the planning of tourism projects, particularly the type of tourist the project is aimed at and the likely number of tourists that will be attracted. This information will allow an assessment of the range of options available to be undertaken and provide an understanding of the significance of the associated environmental impacts. Where small-scale tourism centres on unique natural ecosystems or wildlife it may be necessary to undertake research on the impact of tourism on these features, to identify potential environmental impacts and how they can be mitigated against.

ii As with other forms of tourism, it is important to carry out an assessment of the area's carrying capacity as part of the site selection and planning process. Any decisions on locating tourism development projects should meet the requirements of national and local tourism planning strategies. The carrying capacity assessment should include:

- biophysical carrying capacity assessment, the threshold level above which irreversible damage is done to the biodiversity of an area;
- impacts on the local communities - loss of land, increased prices, better employment opportunities, effects on local traditions and customs;
- provision of sewerage facilities (for disposal of liquid waste) and other services (e.g. power supply);
- proximity to sensitive surface or ground water bodies (e.g. water used for drinking);
- geological conditions (e.g. permeability and uniformity of strata);
- transport links;
- potential current and future land use conflicts (e.g. agriculture or urban development);
- provision of appropriate materials, technology and skilled labour for construction and
- management (during operation and post-operation).

iii Particular attention should be paid to potential impacts caused during land clearance (if required) and the ability of the local infrastructure to absorb the increased pressure placed on it by the proposed development.

iv Operation

Operation of a tourist development will require the transportation of the tourists from their point of arrival to the site and possibly also around the site. There may be the requirement for goods to be brought in from outside the immediate area, which also require transportation, although this is unlikely to be significant as, in general, small-scale tourism projects utilise the goods available locally. There will be increased quantities of liquid and solid waste that require proper management to avoid pollution. There is also likely to be increased demand for local services, such as water supply and power. Where there is insufficient supply, it may be necessary to bring water and power generators into the area. This should be considered at the planning stage.

38.2 Environmental impacts of small-scale tourism

Tourism developments have similar impacts on the natural and socio-economic environment whether they are large self-contained resorts purpose built for the package tour industry or small developments to cater for backpackers in more isolated areas.

Impacts from small-scale tourism projects include:

- Smaller groups are more able to reach less developed, and more remote areas. This can lead to problems such as damage and disturbance of sensitive environments.

- There is the potential, as with all forms of tourism, for contamination of water and land from waste disposal sites, soil erosion due to over exploitation of natural resources etc.

- There may be some impact on biodiversity due to disturbance natural vegetation, physical destruction, or activities such as hunting, plant collecting etc.

- Tourism to less developed areas may put pressure on local services (water and sanitation) and result in water contamination and potable water shortages for the local community.

38.3 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for ecotourism and nature tourism projects.

38.3.1 Air Quality

The potential impacts on air quality from small-scale tourism likely to be minor and localised, mainly associated with increased dust generation (during construction activities of any required facilities) and exhaust fumes (from traffic).

38.3.2 Land and Soil Resources

Potential impacts on land in relation to small-scale tourism projects during construction activities will be minor, but may include:

- soil erosion (e.g. due to land clearing, increased runoff or earth movement);
- compaction of the soil due to vehicle movements (causing reduced infiltration of water and difficulty of penetration by plant roots);
- ground contamination from spillage of materials (e.g. vehicle fuel) or release of contaminants present in the soil (caused by physical disturbance of soils); and
- disturbance of geological strata during excavation activities.

During operation, land contamination can result from poor environmental management of tourist facilities and their associated service developments. This includes the storage of potential hazardous substances (such as oil, petrol and diesel) and disposal of increased levels of solid and liquid wastes generated. Accumulation of waste can also lead to the spread of disease and a reduction in the aesthetics of a region.

38.3.3 Water Quality

i Impacts on water are likely to be localised and are listed below:

- During construction - sediment runoff as a result of excavation and earth movement activities. This may impact surface and groundwater quality.
- Due to the remote location of some small-scale tourism operations hazardous materials (such as gas, petrol) may need to be stored on site. There may be potential impacts caused by inappropriate fuel storage and handling, and accidental spillage.
- Poor environmental management of tourist facilities, such as on site sewage disposal, can lead to water contamination as well as land.
- There may be localised contamination of surface water from inappropriate use of non-biodegradable soap or detergent.

ii These impacts may have serious implications (e.g. for surface drainage, recharge of groundwater supplies and suitability of surface and groundwater for drinking purposes) and may cause some secondary effects, such as loss of fish species or crop failure and associated economic and human health impacts.

38.3.4 Biodiversity

Small-scale tourism can be both beneficial and also have negative impacts on biodiversity.

i Beneficial impacts in biodiversity may include:

- Raising awareness, and educating people on conservation issues. This may also lead to increased funding and support for conservation projects.
- Provision of protected conservation areas and rehabilitation of habitats to enhance areas of particular interest.
- Provision of an area for undertaking research on natural resources, rare or endangered species.

ii Potential negative impacts on biodiversity may include:

- Removal or alteration of natural vegetation during construction. This may result in the isolation of natural habitats, the destruction of ecosystems and even the elimination of rare animals and plants with loss of biodiversity.

- Contamination of surface watercourses may adversely affect aquatic ecology, and potentially other wildlife drinking the water.

- Some tourism activities such as walking, driving, camping and the practice of sports can damage plants, disturb nesting birds and displace animal populations.

- Some ecotourism activities may lead inadvertently to a reliance on human populations (e.g. feeding of dolphins to swim closer to a boat for tourists)

- There is the potential loss of coral reefs, marine and freshwater biodiversity from sedimentation, physical destruction, chemical poisoning from materials spillages and bacteriological and chemical contamination from wastewater.

- Solid and liquid waste discharges, physical destruction, and spillages of materials can also affect terrestrial ecosystems.

(If there are plans to conduct river based eco-tourism attractions or river rafting activities please consult NEPA's Guidelines relating to river based eco-tourism attractions below. In addition, request the Water Resources Authority's Guidelines and Criteria for Assessing the Suitability of a Site for River Rafting from NEPA)

38.4 NEPA's Guidelines Relating to River Based Eco-Tourism Attractions

i River Rafting Authority

Applicant must send a letter of enquiry to the River Rafting Authority in the offices of Tourism Planning and Development Company (TPDCo) to address the following:

- Is the proposed river gazetted for this type of attraction?
- Does the River Rafting Authority have any issues with the proposed attraction?

Applicant must submit a copy of the River rafting Authority's approval.

ii Water Quality Test Results.

The applicant is to submit the results of six continuous weekly water quality samples, which must be taken at the start and end of the proposed reach (distance of tour) of the river.The tests should be done for feacal coliform.

iii Project Description

The applicant is to provide a detailed description of the project to be undertaken and should include but not be limited to the following.

- . A map (scale 1:50,000) delineating the proposed reach to be used.
- Actual distance of the river to be used.
- State any existing uses of the river which should include the proposed reach (distance of tour), and upstream and down stream of this reach.(Uses should include but not be limited to dams, wells, hydro power plants, residential, commercial, agricultural and any other attractions).

iv Property

Where the applicant seeks to have the proposed attraction established, proof of ownership (land title or lease agreement) must be submitted.

v Buildings and sewage system

- A proper description of existing facilities and the current type of sewage system used if any. This is to be accompanied by a schematic layout.

- For sewage system, applicants must note that septic tanks and absorption pits will not be permitted within 100 meters of the river or any other water body.

- In cases where holding tanks will be used to store sewage, applicant must state what is the storage capacity, frequency at which it will be emptied, who is the contracted cesspool emptier and in which sewage treatment plant it will be emptied.

- A copy of the letter from the National Water Commission stating whether or not permission is granted for the above is to be submitted.

- If permission is denied and also the attraction is less than 100 meters from the river bank, then the applicant will need to submit approved designs for a sewage treatment system. (Suggested system can be constructed wetlands, which provide tertiary treatment).

vi Solid Waste

Applicant should indicate how the solid waste generated will be treated and disposed of. A letter from National Solid Waste Management Authority must be submitted indicating whether or not permission is given to have it placed in the municipal dump.

vii Local Approvals

Applicant must submit a copy of any local (Local Planning Authority & Local Health Department) approval.

38.5 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS early in the project cycle to reduce the potential environmental impacts associated with construction and operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

Note: All nature and eco-tourism operations will require the submission of a management/operation plan prior to the issuance of a permit.

CHAPTER 39

MINING AND MINERAL PROCESSING

39.0 DEFINITIONS

The definitions include Bauxite, Minerals – including aggregate, construction and industrial minerals, Peat, Sand, Metallic, and Non-metallic.

39.0.1 MIning

Mining is the extraction of valuable minerals or other geological material from the earth.

39.0.2 Mineral Processing

Mineral Processing is crushing and separating ore[8] into valuable substances or waste by any of a variety of techniques.

39.0.3 Bauxite

i Bauxite, Jamaica's main mineral resource, is a vital element of the country's economy. Jamaica's bauxite total reserves are estimated at two billion tons. More than one billion tons, enough to last 100 years at current rates of production, are easily accessible.

ii Bauxite is typically mined in open-pits and either processed into alumina near the mining operation, or shipped to smelting markets around the world for processing. Jamaica is a major bauxite producing country.

39.0.4 Other Mineral Resources

Other mineral resources include gypsum, limestone, marble, silica sand, clay peat, and to a lesser extent, lignite and black sands containing titanium, copper, lead, zinc and phosphates.

39.0.5 Peat

Peat is an accumulation of partially decayed vegetable matter. Peat forms in wetlands, marshes and other waster saturated environments. It is considered an early stage or rank in the development of coal.

8 A mineral or an aggregate of minerals from which a valuable constituent, especially metal can be profitably mined or extracted.

39.0.6 Classes of interrelated minerals

The following classes of minerals are interrelated:

i Aggregate minerals are composed of a mixture of minerals separable by mechanical means. These are mineral materials, such as sand or stone, used in making concrete.

ii The term 'construction minerals' is used to describe all minerals used by the construction industry, for example in road making, in concrete and in house construction. Aggregate minerals are therefore very important to the construction industry.

iii Industrial minerals are a group of minerals that are important sources of raw materials for the chemical, metallurgical, construction, agricultural, and related industries.

39.1 ENVIRONMENTAL CONSIDERATIONS

Most mining activities are of limited duration temporary by nature, but can cause permanent damage to the environment through irreversible disruption. The most significant effect of any mining activity is that it exploits a non-renewable resource, which once extracted cannot be replaced.

Although many of the environmental effects resulting from surface and underground mining are generic, they impact the environment in different ways. Surface mining, for example, requires the complete removal of surface strata (and any vegetation), creating quite significant landscape and visual impacts. Underground mining, on the other hand, has less of a direct impact on the surface environment, apart from the disposal of waste material, but more of an impact underground where it can affect groundwater flow and quality and disrupt rock structure causing subsidence. In addition, the impact on the miners who work in underground mines can be significant, as a result of accidents or longer term health effects.

39.1.1 Environmental Effects

Environmental effects that may result from mining operations include:

- Degradation of air quality due to airborne dust from road traffic, blasting and excavation.

- Contributing to acid rain, which can contaminate surface water, groundwater and land.

- Noise and vibration.
- Ground instability or subsidence.
- Modification of local topography, disturbance of soil and vegetation and loss of natural habitat.
- Discharges of contaminated mine water which can affect surface water quality and hydrology.
- Disruption of groundwater movement and potential contamination of aquifers.
- Loss of cultural heritage or religious sites
- Effects on visual amenity.
- Loss of agricultural land or forestry resources and conflicts with other land users.
- Work related injuries.
- Impact on the local community, including pressure on services (infrastructure, power, water etc.)
- Fire hazards from spontaneous combustion of coal residues and waste dumps

39.2 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for mining and mineral processing projects.

39.2.1 Air Emissions

i Surface mining can cause the following:

- Airborne particulates that result from blasting, excavation and earth moving, transportation, material transfer, wind erosion of loose soil during surface mining.
- Nitrates from blasting and combustion products from operation of diesel equipment may be present at both

surface and underground mines.

- Acid rain as a result of sulphur compound and particulates, in particular from coal operations.
- Any exposed coal (e.g. in waste dumps, open mine site) - has the potential to catch on fire due to spontaneous combustion.

ii Underground mining

- Underground mining can result in elevated dust levels.
- Coal dust is explosive and can result in mine fires, further affecting air quality.
- Low oxygen levels in the mine working area due to the constricted area.
- Gases that are released during the mining process (e.g. methane, hydrogen sulphide, carbon dioxide) can contribute to acid rain, contamination of water, be poisonous or cause asphyxiation of mine workers.
- Any surface operation at underground mines will also contribute to dust levels e.g. from initial construction activities, blasting, transportation, material transfer, or wind erosion of loose soil.

iii Mineral Processing

- Large amounts of dust can be generated from the transportation of materials to and from the site and the unloading and loading of raw material. Transportation/ truck movements will also generate particulate and gaseous emissions from exhaust fumes.
- Decreased air quality may result from smoke and gases (mainly sulphur dioxide, carbon monoxide and dioxide, and the oxides of nitrogen) produced as a result of spontaneous combustion, in particular from coal, coal discard, and other carbonaceous material.
- Localised acid rain may be generated from sulphur compounds and particulates released during ore processing

operations.

- Increased dust levels may be generated from residue/waste deposits.

39.2.2 Land and Soil Resources

The environmental effect of mining on land is closely associated with the mining method used. In general, mining can result in the loss or modification of soils, vegetation, wildlife habitat, drainages, wetlands, cultural and historic resources, survey markers, topographic features, temporary or permanent loss of land productivity or contamination of soils from mineral materials and toxic substances. Similar impacts, but on a smaller scale, can result from exploratory activities.

i Surface mining

- In surface mining, the impacts on land are generally more significant than underground mining, as it requires the complete removal of overburden and vegetation completely modifying the nature of the landscape. Other effects include disruption or blockage of streams, drainage systems, wetlands or coastal areas, and extensive modification of the topography over the entire mining area. Vibrations during blasting operations can result in fracturing and subsidence with effects on movement of underground water. Near shore extraction and deep sea extraction can alter the ocean floor morphology and cause coastal erosion.

- The space requirements for a surface mining operation can be quite substantial. Land is required for the quarry itself, for dumps for the overburden, for tailings dams and for any associated infrastructure facilities.

ii Underground mining

- Underground mining is less obtrusive on the surface than surface mining, as it requires less land. Underground mining does require some land for waste rock disposal, storage of fuel and low-grade material, and siting of ancillary surface facilities. Construction of these facilities will require land and vegetation clearance. Soil contamination may occur from leaching material or if there is an accidental spill from the hazardous material stored on site.

- The land over underground workings may become unstable, which can result in fracturing and subsidence. Such effects may continue for a considerable length of time after completion of mining operations and must be planned for in the initial studies. Collapsing shafts, for example, allow air to get into the mine, causing fires to start and weakening pillars even more, resulting in more collapses. Vibrations from underground blasting may also result in subsidence.

iii Mineral Processing can result in

- Land clearance and disturbance of soil, vegetation, habitat etc. in construction of the ore processing plant and any access roads.
- Soil contamination from acid rain and leachate from waste dumps and tailings dams (acid rock drainage).
- Potential soil contamination from chemicals used during the ore processing process and discharged in wastewater.
- Changes to the natural landscape as a result of waste dumps/ tailings dams.

39.2.3 Water Quality

i Surface mining

- This type of mining can result in potential contamination of surface water and groundwater from tailings dams and waste dumps.
- Discharges from dewatering of surface mines, without adequate neutralisation or treatment, may be highly acidic and contaminate local surface waters and shallow groundwater with nitrates, heavy metals and oils from equipment. They may reduce local water supplies, or cause erosion of drainage and stream channels.
- Near shore extraction or deep sea mining can contaminate receiving water bodies e.g. from fuel spillage's, mobilisation

of contaminants such as heavy metals or sediments.

- Filling up of open pits with rain water can lead to mobilisation of contaminants to surface water or groundwater.

ii Underground mining

- Improperly cased or poorly sealed drill holes, which may permit interchange and contamination between aquifers.

- As with surface mining, discharge from dewatering of underground mines, without adequate neutralisation or treatment may be highly acidic and contaminate local surface waters and shallow groundwater with nitrates, heavy metals and oils from equipment, or they may reduce local water supplies or cause erosion of drainage's and stream channels.

- Removal of rock strata which can disrupt local aquifer continuity and can lead to interconnections and contamination between aquifers; backfill material can alter hydraulic characteristics and water quality.

- Like surface mining, underground mining requires the provision of waste dumps and tailings[9] dams for waste material. Leachate from these sources may contribute to both groundwater and surface water contamination.

iii Mineral Processing

There may be potential contamination of groundwater and surface water from acid rain or acid rock drainage. Impacts on surface water and groundwater can have secondary effects, for example, detrimental impact on aquatic ecosystems or making groundwater resources unsuitable for potable supply.

- There is also potential for water contamination from chemicals/hazardous materials stored and used within the ore processing plant, either by accidental spillage or through inappropriate disposal of wastewater to nearby surface water bodies.

9 Mining Waste left after mechanical or chemical separation of minerals from crushed ore.

39.2.4 Biodiversity

i Mining

- The main impact on biodiversity from mining operations is from disturbance to habitats, vegetation removal and land clearance. Surface mining will have a greater impact in this respect than underground mining.

- Contamination of surface watercourses may occur from leachate, acid rain or acid rock drainage as a result of either surface or underground mining. This can affect fish and other aquatic fauna and flora. High acidic levels in surface water bodies make them uninhabitable for most plant and animal species. This has secondary impacts on terrestrial animals, such as waterfowl, which are dependent on aquatic ecosystems for food.

- Impacts from acid rain will also affect terrestrial ecosystems. Natural vegetation and crops can be affected by lowering disease resistance, inhibiting plant germination and reproduction, accelerating soil weathering and removing nutrients from soils. Impacts on terrestrial animals include causing population decline through stress (because of decreases in available resources) and lower reproductive success.

- High dust levels generated in surface mining operations may also affect both aquatic and terrestrial ecosystems, e.g. by smothering plants.

- Near shore marine mining and deep sea mining may result in the destruction of stationary marine life (e.g. coral) and impair spawning grounds.

ii Mineral Processing

- There maybe some habitat disturbance during land clearance operations for the construction of a processing plant and any required access roads.

- Contamination of surface watercourses may occur from leachate, acid rain or acid rock drainage, which can detrimentally affect fish and other aquatic fauna and flora. High acidic levels in surface water bodies make them uninhabitable for most plant and animal species. This has secondary impacts on terrestrial animals, such as waterfowl, which are dependent on aquatic ecosystems for food.

- Impacts from acid rain will also have significant impacts on terrestrial ecosystems. Natural vegetation and crops can be affected by lowering disease resistance, inhibiting plant germination and reproduction, accelerating soil weathering and removing nutrients from soils. Impacts on terrestrial animals include population decline through stress (because of decreases in available resources) and lower reproductive success.

- High dust levels generated in the ore processing operation may also detrimentally affect both aquatic and terrestrial ecosystems, e.g. by smothering plants.

iii Bauxite Mining and Processing

- The principal environmental issues facing Jamaica's second largest industry are caustic soda contamination of water supplies, bauxite and alumina dust, and eco-system dislocation.

- The processing of bauxite for extraction of alumina results in the production of slurry known as red mud. Jamaica's alumina capacity is approximately three million tons per year. Thus, approximately one ton of red mud waste or residue waste will be produced from each ton of alumina. Jamaica's land mass is limited, and therefore cannot accommodate the disposal of such high volumes of waste material. This problem is intensified by the fact that the residue leaves the plant in association with large volumes of weak caustic soda solution.

- Also, the escape of caustic soda (which is used to extract alumina from raw bauxite) into the groundwater supply significantly increases sodium concentration of domestic well water mostly in the rural areas. Sodium is associated with a higher incidence of hypertension.

- Bauxite mining also severely affects the water retention capability of the soil.The Jamaican Mining Act of 1947 requires mines to remove topsoil before mining, and restore it as part of the reclamation process. However, due to the enlargement of the surface area after mining, and the extraction of much bauxite, the soil is less capable of retaining water.

- Refineries and port facilities, besides handling bauxite and alumina, handle an enormous amount of fuel oil, caustic soda, lime, and other chemical inputs. Storage bunkers are situated close to the shore line and are relatively exposed generally resulting in spills occurring at the ports. The refineries are also subject to spills and other incidental releases. One of the major sources of air pollution is oil combustion for power generation and alumina calcining.

- Two other environmental impacts of great concern is dust and caustic soda contamination.The particularly small size of both raw bauxite and alumina very often affect areas downwind of mining, transport, calcining, and ship loading operations.

- It has been argued that the dust is chemically inert; however it adversely affects the respiratory system, pollutes the residential cisterns, and defaces property.The degradation of Jamaica's delicate coral reefs along its south coast is as a result of alumina spilling during ship loading.

39.2.5 Post Closure & Decommissioning

Mining is a temporary, short-term land use, due to the finite nature of the mineral resource. Planning of post closure/decommissioning activities needs to be undertaken at the early stages of a mining development.This will help minimise environmental impacts associated with the closure of a mine, and ensure that the land is reinstated as near as possible to its former condition.

39.3 Environmental benefits

Mine reclamation must be an ongoing programme to restore the physical, chemical and biological quality or potential of air, land and water regimes disturbed by mining to an acceptable state.The objective of mine reclamation is to prevent or minimise adverse long term environmental impacts, and create a self-sustaining ecosystem as near as practicable to what existed before the mining activity.

Benefits of effective post closure/decommissioning activities include:

- Making the land suitable for another land use type following closure of the mining development;
- Ensuring that the abandoned mine site is safe;
- Minimising erosion and weathering of the residual/waste deposits; and
- Preventing contamination of ground and surface water from leachate and tailings dams.

39.4 ENVIRONMENTAL IMPACTS

Potential environmental impacts associated with the decommissioning of a site include:

- Erosion and weathering.
- Failure of remaining steep highwalls and waste pile slopes.
- Surface fractures, voids and collapses due to collapse of poorly supported workings.
- Abandoned operations can create an attractive safety hazard especially for children.
- Potential ground or surface water contamination where hazardous materials have been inefficiently used and ground or water pollution has followed.
- Stability of retention structures for tailings, waste dumps etc.
- Spontaneous combustion resulting in fires (e.g. in improperly sealed or reclaimed coal seams or waste dumps).
- Unemployment as a result of the mine closing.
- Acid rock drainage and acid rain, which can result in contamination of surface water, groundwater, soil and detrimental effect flora and fauna.

39.5 ENVIRONMENTAL MANAGEMENT SYSTEMS

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

N.B. *For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"*

39.6 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that their activities are compliant:

Ambient Air Quality (Appendix 5)
Stack Emissions (Appendix 6)
Noise (Appendix 7)
Trade Effluent (Appendix 8)
Sewage Effluent (Appendix 9)
Sludge (Appendix 10)
Standards for effluent to be used as irrigation. (Appendix 11)

CHAPTER 40

METAL PROCESSING

40.0 METAL PROCESSING

This includes Non-Ferrous metals, Ferrous metals, Foundry operations and metal plating. This process involves metal manufacturing using smelters, foundries, forges or electroplating, or any combination of these. Ferrous metals are those metals that include iron and all iron derivatives including steel. Non-ferrous metals include aluminium, copper, nickel, lead and zinc.

40.0.1 Iron and Steel Manufacturing

Steel is manufactured by the chemical reduction of iron ore[10], using an integrated steel manufacturing process or a direct reduction process. In the conventional integrated steel manufacturing process, the iron from the blast furnace is converted to steel in a basic oxygen furnace (BOF).

40.0.2 Aluminium Manufacture

The production of aluminium begins with the mining and beneficiation[11] of bauxite. Bauxite is refined into alumina and then electrolytically reduced into metallic aluminium.

40.0.3 Copper Smelting[12]

Copper can be produced either pyrometallurgically[13] or hydrometallurgically[14], the latter being much less common.

The traditional process of copper production is based on roasting, smelting in reverbatory furnaces (or electric furnaces for more complex ores), producing matte (copper-iron sulphide), and converting for production of blister copper, which is further refined to cathode copper.

10 A Mineral or an aggregate of minerals from which a valuable constituent, especially a metal, can be profitably mined or extracted.
11 Crushing and separating ore into valuable substances or waste by any of a variety of techniques.
12 The process of removing metals, such as iron, from rocks through melting. Smelting may result in the unwanted release of metals to the environment
13 Pertaining to metallurgical operations that involve processing at temperatures substantially above ambient conditions, generally involving chemical reactions as distinct from metal casting which involves only a physical transformation, i.e. solidification
14 Pertaining to metallurgical operations that involve processing in which the principal phase is water, can be at temperatures and pressure substantially above ambient conditions when autoclaves are used, generally involves chemical reactions.

40.0.4 Lead and Zinc Smelting

Lead and zinc can be produced pyrometallurgically or hydrometallurgically, depending on the type of ore used as a charge. In the pyrometallurgical process, ore concentrate containing lead, zinc, or both is fed, in some cases after sintering[15], into a primary smelter.

In the most common hydrometallurgical process, the ore is leached with sulphuric acid to extract the lead/zinc.

40.0.5 Nickel Smelting and Refining

i Primary nickel is produced from two very different ores, lateritic and sulphidic. Lateritic ores are normally found in tropical climates where weathering, with time, extracts and deposits the ore in layers at varying depths below the surface. Lateritic ores are excavated using large earth-moving equipment and are screened to remove boulders. Sulphidic ores, often found in conjunction with copper-bearing ores, are mined from underground.

ii Lateritic ore and Sulphidic ore processing employ more than one method which depends on different factors. These methods include the nickel-flash smelting processes, which have been upgraded within the last ten years because of the requirements of energy savings and of pollution control.

iii Various processes are also used in nickel refining. The most common technology is the use of electrical cells equipped with inert cathodes.

40.0.6 Foundries

In foundries, molten metals are cast into objects of desired shapes. Castings of iron, steel, light metals (such as aluminium), and heavy metals (such as copper and zinc) are made in units that may be independent or are part of a production line.

40.0.7 Metal Plating

Metal Plating is the method of applying a metallic coating to another material. There are many reasons to plate objects. They can be applied to almost any coarse material. The most common surfaces that are plated are metals and plastics. Plating can be used for different reasons. Some objects

15 The bonding of adjacent surfaces of particles in a mass of powder.

are plated to increase their sturdiness and provide a hard shell for whatever it is plated on. Some are plated to avoid corrosion and a few are plated just to give an attractive finish. The most common method of metal plating is electroplating.

40.1 Environmental Considerations

The environmental considerations associated with these metal processing can be looked at based on the stages of implementation – project planning, construction, operation and post-operation.

40.1.1 Site Selection and Planning

i The environmental impacts of construction and operation are established during the early phases of project planning. Reducing the environmental impact will be best achieved through investigation in the project preparation stage.

ii When choosing a site, it is important to consider the following factors:

- The environment where the development will occur,
- The impact on the biodiversity[16] and habitat loss due to construction and operations,
- Compatibility with national planning, policy, legal and regulatory framework,
- Land use in the surrounding areas to be affected by the development, especially local communities, and
- Availability of appropriate materials, construction labour force and transport to site.

iii The major potential environmental impacts that should be considered during design are:

- Types, sources and transportation of construction materials,
- Use of construction methods that will limit disruption to adjacent communities,

16 For information on Biodiversity, please see Glossary of Terms Appendix 1 Biodiversity.

- Waste management options, including cleaner production methodologies,
- Water supply and sanitation and the efficient use of the resource,
- Energy use and efficiency, and
- Surface water runoff and drainage.

40.1.2 Construction

i Construction works on these projects will include, but not be limited to, the following activities:

- Site preparation, including clearance of vegetation;
- Installation of site compounds and storage facilities;
- Foundations;
- Installation of services to provide electricity, water supply and waste management;
- Construction of buildings; and
- Landscaping and site restoration.

ii Construction can have several types of environmental impacts, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;
- Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;
- Generation of dust from earthmoving and stockpiled soil or from construction activities;
- Loss of flora and fauna in cleared areas, or as a result of pollution or disturbance from construction activities and wastes;

- Solid waste generation;

- Noise and possible odour from construction activity, including traffic that is generated;

- Access for equipment and materials - through road, river or port with associated traffic and infrastructure development (particularly if new facilities are required) with potential habitat loss or severance and safety risks,

- Added traffic and related impacts during and after construction.

40.1.3 Operation

The major environmental impacts from metal processing will be caused during the operation of these facilities. Trade effluent and sludge as well as air emissions will need to be managed to reduce the impact on the environment.

40.1.4 Post Operation

i The post-operation of these facilities may include:

- Deterioration of structures (degradation or collapse)
- Removal of structures (demolition)
- Contamination (long-term pollution of soil, water or sediment)
- Disposal of residues (contaminated land).

ii Before a site, or part of it, can be redeveloped, the presence of contaminated land and water must be established and remediation measures taken where required to prevent risk to human health and the environment.

40.2 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for these projects.

40.2.1 Air Quality

The following are the principal air pollutants, which may be produced at various levels, at various phases, in most cases, depending on the method used. Emissions listed here can be detrimental to human health and/or the environment, some more hazardous than others.

i Iron and Steel Manufacturing

- Dust
- Particulate matter (may contain toxic metals)
- Sulphur oxides
- Nitrogen oxides
- Hydrocarbons
- Carbon monoxide
- Dioxins
- Hydrogen fluoride

ii Aluminium Manufacture

- Dust (bauxite dust, limestone dust, burnt lime dust, alumina dust, red mud dust, coke dust)
- Sulphur dioxide
- Nitrogen oxide
- Caustic aerosols
- Gaseous and particulate fluorides
- Carbon dioxide
- Carbon oxide
- Tar vapour
- Carbon particulates
- Polynuclear aromatic hydrocarbons (PAHs)
- Carbon tetrafluoride (CF4) and carbon hexafluoride (C2F6), which are greenhouse gases, of concern because of their potential for global warming
- Hydrogen chloride
- Methane
- Chlorine

iii Copper Smelting

- Sulphur dioxide
- Particulate matter (may contain toxic metals)
- Mercury (metal and/or vapour)
- Arsenic
- Arsine
- Acid vapours

iv Lead and Zinc Smelting

- Sulphur dioxide
- Particulate matter (may contain toxic metals)
- Arsenic *(volatile impurities)*
- Mercury *(volatile impurities)*
- Fluorine *(volatile impurities)*
- Acid vapours
- Arsine
- Chlorine
- Hydrogen chloride

vi Nickel Smelting and Refining

- Sulphur dioxide
- Ammonia
- Hydrogen sulphide
- Nickel carbonyl (highly toxic)
- Dust
- Volatile impurities

vii Foundries

- Particulate matter (may contain toxic metals)
- Volatile organic compounds (VOCs)
- Dust (containing lead, zinc, cadmium)

viii Metal Plating

- Volatile organic compounds (VOCs)
- Toxic organics

40.2.2 Water Quality

i Iron and Steel Manufacturing

In the conventional process without re-circulation, wastewaters, including those from cooling operations, are generated. Major pollutants present in untreated wastewaters generated from pig iron manufacture include total organic carbon, total suspended solids, dissolved solids, cyanide, fluoride, chemical oxygen demand, or COD and zinc.

Major pollutants in wastewaters generated from steel manufacturing using the BOF include total suspended solids, lead, chromium, cadmium, zinc, fluoride and oil and grease. The process generates effluents with high temperatures leading to thermal pollution[17].

ii Aluminium Manufacture

Although alumina plants do not normally discharge effluents, heavy rainfalls can result in surface runoff that exceeds what the plant can use in the process. The excess may require treatment.

iii Copper Smelting

Wastewater from primary copper production contains dissolved and suspended solids that may include concentrations of copper, lead, cadmium, zinc, arsenic, and mercury and residues from mold release agents (lime or aluminium oxides).Fluoride may also be present.

iv Lead and Zinc Smelting

Wastewater may contain lead/zinc, arsenic, and other metals. Other pollutants include dissolved and suspended solids, metals, and oil and grease.

v Nickel Smelting and Refining

Pyrometallurgical processes for processing sulphidic ores are generally dry, and effluents are of minor importance, although wet electrostatic precipitators (ESPs) are often used for gas treatment, and the resulting wastewater could have high metal concentrations.

vi Foundries

Wastewater may contain oil and suspended solids, metals and surfactants. The exact characteristics of the wastewater will depend on the type of metal used as feed to the process.

vii Metal Plating

Any or all of the substances used in this process (such as acidic

17 Industrial discharge of heated water, a body of water (e.g. river or ocean) causing a rise in temperature that endangers aquatic life.

solutions, toxic metals, solvents, and cyanides) can be found in the wastewater. The mixing of cyanide and acidic wastewaters can generate lethal hydrogen cyanide gas, and this must be avoided. Generally, the wastewater stream is usually high in heavy metals, including cadmium, chrome, lead, copper, zinc, and nickel, and in cyanides, fluorides, and oil and grease, all of which are process dependent.

40.2.3 Land and Soil Resources

i Solid Waste

Solid waste, residues or sludges often contain toxic organics and metals. These should be properly managed with final disposal in a government-approved disposal site (secure landfill). Residues or sludges with toxic compounds should be properly treated (such as incineration) before final disposal. On the other hand, some waste can be re-used and/ or provide a source of metal recovery.

ii Soil Erosion

Soil erosion can be a major issue during construction and care should be taken to minimise this impact. Damage to soil quality can occur through excavation and compaction and other construction activities. If construction is to occur on previous industrial sites, the developer should determine whether or not the land is contaminated and if any remediation is necessary.

iii Iron and Steel Manufacturing

A small percentage of the process of solid waste from the conventional process may be considered hazardous depending on the concentration of heavy metals present.

iv Aluminium Manufacture

The main solid waste from the alumina plant is red mud (as much as two tons of mud per ton of alumina produced), which contains oxides of alumina, silicon, iron, titanium, sodium, calcium, and other elements.

v Copper Smelting

The main portion of the solid waste is discarded slag from the smelter, which can be used in construction or sandblasting. Some metals can be recovered.

vi Lead and Zinc Smelting

The larger proportion of the solid waste is discarded slag from the smelter, which can be used as a fill or for sandblasting. In some cases, metals can be recovered.

vii Nickel Smelting and Refining

The smelter contributes a slag that is a dense silicate. Sludge generated requires disposal.

viii Foundries

A large portion of waste sand (used in process) is generated as well as sludge and slag. The primary hazardous components of collected dust are zinc, lead, and cadmium but the composition also varies greatly depending on the type of metal used.

ix Metal Plating

The treatment of wastewaters can generate substantial quantities of wet sludges containing high levels of toxic organics or metals.

40.3 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

40.4 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Stack Emissions (Appendix 6)
- Noise (Appendix 7)
- Trade Effluent (Appendix 8)
- Sewage Effluent (Appendix 9)
- Sludge (Appendix 10)
- Standards for effluent to be used as irrigation. (Appendix 11)

CHAPTER 41

NEW HIGHWAYS

41.0 Construction of New Highways

This includes arterial roads, new roads on slope greater than 20 degrees, major road improvement projects, railways, tramways, cableways, causeways and multiple span bridges

41.0.1 Roads

Roads provide an open way for travel or transportation for passengers and goods. These will be linked, thereby connecting destinations, have a prepared surface (paved or smoothed) and allow for motorised or non-motorised traffic.

41.0.2 Railways, Tramways and Cableways,

Railways, tramways and cableways may have an important function providing commuter services to urban centres, essential access to remote areas and communities and for transport of freight. In addition to access provision, they are often important to local communities as centres of retail activity.

Railways comprise infrastructure (tracks, stations, maintenance depots, marshalling yards, oil storage and refueling stations, boilers, unloading and loading platforms, bridges, tunnels and signaling equipment), rolling stock (locomotives and wagons) and operations (passenger and freight services, scheduling and maintenance activities). There are also specific environmental issues associated with the transport of some cargo such as the risk of spillage during unloading, loading and storage. Tramways and cableways will have similar infrastructure, rolling stock and operations but may not have issues of transport of cargo.

41.1 Environmental Considerations

41.1.1 Roads

Environmental impacts will arise from all aspects of road construction and use, and the developer should take appropriate measures to reduce these negative effects. The main sources of environmental impacts from roads are:

- Fragmentation of human and wildlife communities, as well as the displacement and associated resettlement of populations due to route selection,

- Potential loss of valuable habitats,

- Changes to hydrology if stream or river flows are altered, as well as change in drainage patterns due to paved surfaces,

- Soil erosion, dust, sedimentation in water bodies, noise and disturbance, and the associated health and safety impacts of construction,

- Pollution of surface and ground water from contaminants associated with vehicles,

- Increased air pollution, including noise and vibrations, and

- Increased traffic generated.

41.1.2 Railways, tramways and cableways

Environmental impacts arise from all aspects of rail construction and operation including:

- New railways, tramways and cableways ranging from the addition of new lines to new networks

- Terminals and support facilities, such as maintenance and cleaning depots

- Rehabilitation, upgrading and modernisation.

The potential environmental impacts of construction, operation/maintenance and post-operation must be considered fully during route selection, planning and design.

41.1.3 Route Selection and Planning

i The extent of environmental impacts in construction, operation and post-operation is largely determined during planning and route or site selection. Early consultation and determination of alternatives (usually in an environmental impact assessment) can substantially reduce the potential environmental impacts of these projects. New roads and lines should preferably use existing alignments and infrastructure where possible, or be aligned parallel to existing linear transport links. Consideration should then be given to the combined effects of such schemes.

ii Railways, tramways and cableways

The major factors in design with environmental implications are:

- Choice of route corridor and detailed alignment,
- Linkage with other transport modes - integration can reduce environmental impacts
- Locomotive energy source (diesel or electricity), electrification
- Level, or change in level, of service - local, regional, national or international - speed and frequency of each type of train
- Types of construction and construction materials required and sources of materials, such as timber for sleepers and ballast, steel rails and track bed
- Predicted change in rail traffic and railway capacity
- Future maintenance requirements and predicted lifetime of equipment and infrastructure

iii The environmental effects of a particular development is highly dependent on the type of land use along the line or nearby such as, dense urban areas, rural areas, natural habitat or farmland or forestry and topography.

iv Environmental risks to structures may need to be considered such as flooding, subsidence, landslips and earthquakes.

41.1.4 Construction

i Road construction can involve considerable amounts of raw materials, and machinery and numbers of construction workers. The main environmental impacts are likely to arise from:

- Site preparation such as clearance of natural vegetation, demolition of structures, and large earthworks which could lead to soil erosion,
- Loss of natural habitats, and loss of private property,
- Construction of culverts, river crossings, bridges and viaducts with implications for river and wetland habitats,
- Sourcing of raw materials from quarries and borrow pits, and bitumen or concrete and cement supply,
- Waste generation and removal, including spoil from earthworks, and from construction machinery and camps,
- Transport of materials to construction sites, and
- Construction and site camps for the workforce, and the necessary facilities such as water supply and sanitation, temporary accommodation and waste facilities.

Although road works are temporary, site preparation and construction work can have significant and long-lasting effects on local resources and communities.

ii Construction can have several types environmental impacts, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;
- Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;
- Generation of dust from earthmoving and stockpiled soil or from construction activities;
- Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;
- Solid waste generation;

- Noise and possible odour from construction activity, including traffic that is generated;

- Access for equipment and materials - through road, river or port with associated traffic and infrastructure development (particularly if new facilities are required) with potential habitat loss or severance and safety risks;

- Added traffic and related impacts during and after construction.

iii Railways, tramways and cableways

In general, construction of these will involve similar activities as road construction - site preparation (including vegetation clearance), laying of track bed, installation of lines, signaling and other equipment, and commissioning. However, to obtain appropriate vertical and horizontal alignments (railways, tramways and cableways are constrained by a maximum 2% vertical gradient), site preparation may require significant cutting into hills and slopes, or construction of embankments or tunnels. These activities can generate large amounts of spoil or require borrow pits. Ancillary services, such as marshalling yards, maintenance depots, stations and goods yards, may be need to be constructed.

41.1.5 Operation/Use and Maintenance

i Roads

The main sources of environmental impact from road use and maintenance are:

- Motorised vehicles and change in traffic flows,

- General maintenance of a road and supporting infrastructure,

- Drainage maintenance, such as clearing ditches,

- Vegetation maintenance for roadside bank stability and aesthetics,

- Lack of road maintenance resulting in poor road surfaces and increased wear and tear on vehicles and increased emissions and pollution

ii Changes in traffic flows because of new and upgraded roads will have an impact on air quality and noise levels. The extent of the environmental impact depends on the scale of the road scheme, the quality of the road surface (affecting noise, adhesion/safety and type of traffic), the traffic volume (affecting noise and air pollution), and the sensitivity of the surrounding area, particularly the proximity of communities and valuable natural areas and cultural heritage.

iii The deposit of contaminants on roads from exhaust emissions and mechanical wear and tear causes pollution. Pollution may also be caused from spillages and accidents, and these will affect the surrounding vegetation, drainage systems and waterways.

iv Improvement to access can result in changes to trade and social communication links and the opening up of areas to new development pressures such as mining, logging and tourism. These indirect impacts can often have more significant effects than the road itself.

v Railways, tramways and cableways

Elements of a railway system that can have environmental implications include:

- Frequency, speed and load, noise and vibration of system
- Track infrastructure and maintenance – materials used and waste generation
- Rolling stock - different wagons for different types of goods (for example, dry goods such as agricultural produce or coal, or liquids such as chemicals fuels and oils)
- Locomotives (for railways) - sources of air emissions
- Marshalling yards, maintenance depots, locomotive and wagon/tank cleaning facilities, refueling areas and goods yards - sources of pollution and waste;
- Passenger stations and terminals - sources of pollution and generating waste

- Freight loading and unloading points and stopping points - risk of pollution from leaks and spillage

- Energy supply - greenhouse gas emissions and climate change implications

- Emergency and spill response systems - disposal of contaminated material.

vi Effective environmental management of railway operations and property can contribute significantly to reducing environmental impacts and risks. Adequate maintenance of railway infrastructure, rolling stock and equipment will also contribute to minimising environmental effects (such as noise, vibration and water pollution) and ensuring safe and effective operation.

41.1.6 Post-Operation/Decommissioning

i Roads

Some roads may become disused or be abandoned when alternative routes or transport modes are made available or when the community populations relocate. Structures are usually left in place, but these may need to be demolished and removed. The land may then be returned to its original state or redeveloped for other purposes.

The environmental impacts for decommissioning are similar to those of road construction but a major issue will be disposal or reuse and recycling of waste. Consider the reuse of demolition materials such as rubble, bricks and concrete in other developments (for example, as aggregate).

N.B. For additional information on roads, please see Volume 3, Infrastructure, Utilities and Communication- Section 1

ii Railways, tramways and cableways

Decommissioning or closure of a railway involves dismantling the track, ancillary buildings and other infrastructure and the removal of track beds and ballast. Some tracks may be reclaimed or used in the maintenance of other Railways, tramways and cableways, while material from demolition (such as bricks and concrete), and clean (non-contaminated) ballast can be re-used in the construction of other developments (for example, as aggregate).

iii Environmental impacts associated with railway line decommissioning or dispersal of railway land are most likely to be related to contaminated ballast from beneath the tracks and contaminated soil on railway land. Groundwater beneath railway sites may also be at risk of contamination as ballast and soil may contain oils, heavy metals, solvents and asbestos requiring appropriate treatment or disposal.

iv As railways, tramways and cableways are restructured or rationalised, operations are often streamlined leaving surplus property and facilities to be sold-off. The potential presence of contamination should be considered in any planned re-development of former railway land.

41.2 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for these development projects.

41.2.1 Air Quality

i Roads

The major impacts of road construction on air quality are associated with increased dust generated from excavation, cement batching, materials extraction, preparation and storage and construction traffic. Emissions from machinery can also affect local air quality.

ii The most significant impact result from vehicle exhaust emissions and on unpaved roads, dust when the road is in use and these can be harmful to human health, animals, soils vegetation, water bodies and the climate.

iii Vehicle emissions can have a wide range of environmental and health effects. Spatially, exhaust pollutants rapidly disperse and dilute, and heavier particles are deposited on the ground. The local effects, therefore, occur along the immediate road corridor.

iv Vehicle emissions may also play a part in global warming, as the carbon dioxide emitted during fuel combustion will contribute to the greenhouse gas effect.

v The level of air emissions are related to, but not limited to the following factors:

- Traffic volume and speed
- Composition of the vehicle fleet
- Fuel quality
- Road surface - dust from traffic using unpaved roads.

vi While road use may cause an increase in emissions, a road project may well have beneficial environmental effects for local communities. The project may re-route traffic to relieve pollution in the most sensitive locations where the beneficial effects will be felt by most people.

vii The balance of benefits and adverse air quality effects need to be carefully assessed and the extent to which roads will encourage additional traffic needs to be considered.

viii Railways, tramways and cableways

Sources of air pollution from operations include:

- Diesel engines from railways (carbon monoxide, hydrocarbons, nitrogen oxides, sulphur dioxide and particulate emissions)

- Boilers and generators at maintenance and cleaning depots (especially those using coal and heavy oils)

- Electricity generation at power stations for electric traction, maintenance and lighting (nitrogen oxides, sulphur dioxides and particulate emissions)

- Hot metal working, for example, welding in maintenance depots (mainly a very local issue for worker health and safety)

- Fugitive dust from open wagons carrying coal, aggregates or soil at loading and unloading points, goods yards and in transit

- Fugitive emissions of volatile organic compounds (VOCs) from freight transport, storage, loading and unloading of light fuel oils (such as petrol)

ix The main source of air pollution from railways is likely to be diesel trains. Air emissions from diesel engines are directly related to fuel consumption, engine efficiency, and the quality of fuel and level of engine maintenance.

x Air emissions can contribute to local air pollution (particulates, hydrocarbons, carbon monoxide), regional air pollution (ozone - particulates and hydrocarbons, acid deposition - SOx, NOx) and climate change (greenhouse gas emission - CO2 and VOCs).

41.2.2 Land and Soil Resources

i Roads

The impact of a road project on the land will depend on ground conditions, land use, and the natural habitats along the route. One of the main impacts of new road projects is the land take and fragmentation of natural habitats and of land used for agriculture, forestry, residential areas and industry. A road project will directly change the physical landscape, and affect its aesthetic quality.

ii Soil erosion can be a major issue during construction and care should be taken to minimise this impact. Damage to soil quality can occur through excavation and compaction and other construction activities. If construction is to occur on previous industrial sites, the developer should determine whether or not the land is contaminated and if any remediation is necessary.

iii Pollutants may be released into the environment as a result of:

- Wear on vehicles (tyres, brakes, clutch pads) which may give off toxic substances
- Oil leakages from poorly maintained vehicles,
- Accidental spills or leaks from vehicles transporting chemicals.

These pollutants can affect the soil directly or via surface runoff.

iv Railways, tramways and cableways

Railway infrastructure development may involve extensive earthworks and generate large amounts of spoil, particularly during tunneling. Spoil storage and disposal can cause significant environmental problems (e.g. pollution of water courses and loss of habitat) and must be carefully planned. As in any major construction works, exposed areas can be subject to soil erosion. Stability of rock and soil material at cut slopes or tunneling can cause environmental problems such as landslips and erosion.

v The extent of land take depends on the structure. Ancillary buildings can occupy substantial areas of land and further land loss can occur in development of open quarries and sandpits for construction materials. The overall effects of land loss to railway infrastructure depends on the type of land use lost - whether agricultural, forestry, wildlife habitats, urban amenities or cultural sites.

vi New railways and roads can open up access to otherwise inaccessible areas. This may lead to increased exploitation - for example, use of the line for timber transport leading to deforestation or increased tourist pressure in sensitive areas.

vii Linear structures such as a railway lines and roads can create barriers in the landscape with greater environmental impact than the loss of land itself. These can sever farms and other holdings, potentially restricting access and leaving small areas of land no longer economically viable thus affecting farm incomes and viability. This can also affect habitats and wildlife.

41.2.3 Water Quality

i Roads

Road construction activities such as excavation and earth movement may have an impact on surface and ground water quality. Alterations made to surface flows may increase the risk of flooding in the area. Other potential impacts include surface water contamination by fuel spillage, surface runoff and sedimentation (turbidity) and contamination of ground water.

Road use can also contribute to pollution of surface water and groundwater quality as a result of fuel spillages, particulate fall out from vehicle exhaust, erosion and sedimentation. Water collecting along roadways can provide a breeding ground for pests, which would have an impact on the health of surrounding communities.

ii Railways, tramways and cableways

Infrastructure works may interfere with surface drainage and groundwater movement, particularly where the line crosses or runs alongside rivers. This could have a detrimental effect on wetland and aquatic habitats and their flora and fauna.

Operations can cause water pollution as a result of spillage and leakage of materials and wastes used or transported, and wastewater generated in maintenance and cleaning activities.

41.2.4 Biodiversity

i Roads

A road project may have impacts on the ecology of an area, directly or indirectly by causing:

- Loss of wildlife habitat and biodiversity due to change in land use,
- Fragmentation of wildlife habitats and territories,
- Increased risk of road traffic accidents on local wildlife,
- Changes in water quality, soil profile, noise, light, and air pollution, which may affect the nature and character of habitats,
- Pressure on habitats and wildlife as a result of increased access provided by roads.

ii Railways, tramways and cableways

- Land take for railways, tramways and cableways can lead to a direct loss of valuable wildlife habitats and protected areas. Often, land severance or fragmentation can have greater widespread and significant effects on habitats and wildlife corridors. Railways, tramways and cableways can form barriers to movement, particularly for mammals with large territorial ranges and migratory patterns of movement, or animals with breeding cycles involving movement across habitats. Land severance or fragmentation may be a particularly important issue where wildlife movement is already confined to narrow corridors because of habitat loss to agriculture and urban development. Habitat fragmentation can leave small areas vulnerable to loss of species, reducing the viability of ecological units.

- Changes in surface drainage patterns caused by railway construction may result in loss of wetland or aquatic habitat and flora and fauna near the railway line.

- Trackside vegetation can be controlled by thinning/cutting back shrubs and trees, grass cutting, burning off vegetation and the use of herbicides and other chemical treatments. These activities may result in adverse effects including loss of flora and fauna, changes to soil chemistry or cause soil erosion or surface water pollution if not carried out with adequate care.

iii Surface Water Pollution

Surface water pollution from roads and railway activities can adversely affect aquatic ecosystems especially chronic long-term pollution from heavily contaminated areas or polluted wastewater discharge or the use of certain herbicides and pesticides.

vi Significance of Ecological Impacts

The significance of ecological impacts from the construction and operation of these projects depends on factors such as the reversibility of impacts, sensitivity of habitat and species, surrounding land use, habitat size and quality and previous disturbance.

41.3 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

"that part of the overall management system that includes

organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

The most effective means of limiting environmental effects is to prepare and implement an Environmental management plan based on the recommendations of an EIA. This would work for all project types in this category.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

41.4 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

CHAPTER 42

RIVER BASIN DEVELOPMENT

42.0 RIVER BASIN DEVELOPMENT PROJECTS

River basin development projects are geared at river management, which needs to be done for several reasons. Boats may travel up and down the rivers daily and therefore the rivers need to be deep enough to facilitate this. Secondly for flow control, meaning the risk of floods are essentially managed and decreased. Thirdly erosion control, mainly along river banks, therefore saves the loss of land to rivers. Fourthly urbanisation has played a major role in river management, as the lives of many are at risk from floods, therefore the river course is changed.

Development projects include river training, river channel diversion works, transfer of water resources between river basins.

42.0.1 River Training

River training works ensure that the flow paths of rivers are kept on course. River channelisation (straightening of water courses) encompasses those methods of engineering which modify river channels for the purpose of flood control, land drainage, navigation, or the prevention of erosion. River channelisation may be achieved by the following techniques:

i Resectioning - This technique is used for flood control and land drainage. It involves the widening and/or deepening, increasing the capacity of the channel. Natural course of the river is retained.

ii Channel straightening/channel realignment - Used for land drainage, to reduce the effects of river erosion and for navigation purposes. It is designed to reduce flood levels by increasing flow velocity.

iii Construction of diversion channels - Used for flood control purposes, a new channel is constructed on open land. This technique is usually used in urban areas, doubling channel capacity.

iv Construction of embankments/levees - Built in order to prevent flooding. Artificial banks adjacent or set back to increase channel capacity.

v Building of culverts - Used for flood protection. Route is built under the ground in a pipe.

vi Bank protection works - a technique used to prevent bank erosion, can also benefit flood control. Two categories: (i) Flow deflection structures- built structure which deflects flow from banks that are eroding, reducing velocity. For example, groynes/dykes, encouraging deposition. (ii)Direct armouring of the bank - revetments.

42.0.2 River Diversion

This refers to the following:

i The change in character, location, direction, or quantity of flow of a natural drainage course (a deflection of flood water is not a diversion).

ii Draft of water from one channel to another.

iii Interception of runoff by works which discharge it through unnatural channels.

42.0.3 WATER CONVEYANCE

Water resources may be transported from regions where it is plentiful to regions where it is scarce. Among the most common water conveyance methods are tanker trucks, rural aqueducts, and pipelines. In some cases, this involves the transfer of water from one portion of a river basin to another, or between river basins.

42.1 ENVIRONMENTAL CONSIDERATIONS

Most river basin development projects involve activities that disturb the environment and therefore the associated impacts must be considered. The types of activities involved can include:

- Site preparation, including clearance of vegetation;
- Excavation, land leveling and other ground work;
- Installation of site infrastructure;
- Structural and civil engineering work;

- Addition, modification or restoration of external and internal features (including mechanical and electrical engineering);

- Landscaping and site restoration.

42.1.1 Environmental impacts of construction

Construction can have several types of direct environmental impact, including:

- on land - soil erosion, degradation, contamination, disturbance of old contamination;

- on water - increased turbidity and potential contamination caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;

- on air - generation of dust from earthmoving and stockpiled soil or from construction activities involving cutting, blasting, cleaning of surfaces for example;

- on biodiversity - loss of flora and fauna in cleared areas, or as a result of pollution or disturbance from construction activities and wastes;

- clearance, demolition and some construction activities generate wastes which need to be disposed of;

- noise and possible odour from construction activity, including traffic that is generated;

- access for equipment and materials - through road, river or port with associated traffic and infrastructure development (particularly if new facilities are required) with potential habitat loss or severance and safety risks.

42.2.2 Environmental impacts of river channelisation

i Channelisation has great impact on a river because it disrupts the existing physical equilibrium of the watercourse; to compensate for the alteration in one or more of the hydraulic parameters, and to establish a new, stable equilibrium, other parameters will change. Because straightening of a river increases its slope, the energy in the moving water has to be dispersed over a smaller surface; as a result the water is able to move larger particles and sediment discharge increases through bank erosion.

ii If the river is not repeatedly manipulated or stabilised by culverting, lining etc, this will eventually lead to widening of the river channel and to a subsequent reduction in water velocity.

iii River channelisation generally changes a heterogeneous system into a homogeneous one so that flow becomes uniform, pools are lost and the substrate becomes uniform throughout the channel.

iv Channelisation can also have great impact on riparian vegetation; trees are often logged to allow channel maintenance (e.g., machine dredging) and scrubs are cut to ensure sufficient drainage. This increases solar radiation at the stream surface, thereby increasing the water temperature, reducing the concentration of dissolved oxygen, and increasing the in-stream primary production. In nutrient-rich watercourses this results in enhanced growth of benthic algae and macroalgae.

v Another effect of the channelisation of rivers may be increased nutrient and organic matter loading of rivers and the marine environment. The reason is that while the annual nitrogen removal capacity of natural rivers can be as much as several hundred kg/ha, that of channelised rivers may be negligible.

vi The uniform and often unstable sediment found in channelised watercourses is suitable for few, if any, plant species. Furthermore, as the uniform water flow precludes areas with little or no flow, resting sites for fish and invertebrates are virtually absent. The general effect of channelisation is therefore a reduction in habitat number and diversity and a consequent reduction in species number and diversity. The latter may be further reduced by the above-mentioned decrease in oxygen concentration. Hence, the biomass of organisms such as fish and invertebrates is usually lower in channelised watercourses.

vii It is not only animals and plants living within the watercourse that are affected by channelisation, however. Thus animal species which depend on the bank for foraging and/or breeding decline in number, with the consequence that species diversity on the river banks also decreases. In addition, a number of plant species that are confined to the more or less water saturated soil adjacent to the river are also affected.

42.2.3 Environmental impacts of inter-basin transfers

i The concern with transfers of water from one river basin to another is that the water transferred can upset the established balance of water uses upstream and downstream. Environmental problems can be created downstream for aquatic life and water users, and can result in the transfer of nuisance species from one basin to another, exacerbating water quality problems throughout a country.

ii Inter-basin transfers also can impact the overall ecological health of the donor and receiving systems. If the water transported is of poor quality, it will contaminate the water resources of another basin where the necessary treatment to rectify the problem may not be available or affordable. In addition, the transportation of large quantities of water can deplete the resources available within the supplying basin.

iii Any proposed transfers need to be carefully scrutinized to ensure the long-term sustainability of the water resource as well as the protection of public health, safety and the environment. Impacts from an inter-basin transfer can occur not only at the extraction point but also in tributary reservoirs or streams hundreds of miles away.

42.2 ENVIRONMENTAL MANAGEMENT SYSTEMS

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS early in the project cycle to reduce the potential environmental impacts associated with construction and operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

42.3 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

CHAPTER 43

IRRIGATION

43.0 IRRIGATION OR WATER MANAGEMENT AND IMPROVEMENT

Irrigation can generally be defined as the application of water to the soil for the purpose of supplying the moisture essential for plant growth. Irrigation schemes range in size from a few hectares to several million hectares.

Irrigation projects may include some or all of the following components:

- Distribution canals,
- Surface drainage systems,
- Land grading,
- Surface water diversions,
- Irrigation wells,
- Subsurface drainage systems,
- Pipelines,
- Pumping stations,
- Control structures,
- Water recovery systems,
- Agricultural extension services,
- Monitoring programmes, and
- Erosion control.

43.1 ENVIRONMENTAL CONSIDERATIONS

The environmental considerations associated with these development projects can be looked at based on the stages of implementation – planning, construction, and operation.

43.1.1 Site Selection and Planning

i Planning and site selection form an important stage in the development of an irrigation scheme and will determine its environmental impact throughout its construction, operation and post-operation. Appropriate site selection and investigation can substantially reduce impacts caused by irrigation.

ii Important factors for consideration during site selection that may help to predict and possibly mitigate potential environmental effects include:

- Quantity, quality and source of water for the irrigation scheme (e.g. abstraction from rivers, surface water reservoirs, groundwater);

- Hydrological and climatic factors;

- Topography of the land;

- Land suitability and soil properties including type, drainage, salinity;

- Crops to be grown and projected yields;

- Proximity to the market place and transport links;

- Socio-economic issues.

iii Consideration of the above factors may highlight opportunities for the implementation of mitigation and monitoring measures (e.g. design and operational measures to minimise the possibility of salinisation).

43.1.2 Construction

i The construction of irrigation schemes requires inputs common to the majority of construction projects. Irrigation projects will require a source of water, either from a surface water body or from groundwater sources. Construction works may include the following activities:

- Site preparation, including clearance of vegetation;

- Installation of site compounds and storage facilities;

- Installation of services to provide electricity, water supply and waste management;

- Landscaping and site restoration.

ii The length of the construction phase will depend on the complexity of the irrigation scheme, the nature of the topography and the source of water. Construction of an irrigation scheme may include the construction of dams, boreholes, pumping stations, irrigation canals, weirs, land grading, drainage systems, sprinkler systems, access roads, housing and social infrastructure such as schools, water supply, sanitation and health services.

iii Construction can have several types environmental impacts, including:

- Soil erosion, degradation, contamination;
- Increased water turbidity and potential contamination of waterways;
- Dust generation from earth works and construction activities;
- Loss of flora and fauna in cleared areas;
- Solid waste generation;
- Noise and possible odour from construction activity;
- Added traffic and related impacts during and after construction.

43.1.3 Operation

i The operation of an irrigation scheme may cause some significant environmental impacts. Impacts during the operational phase will depend on the type of irrigation scheme and the operational management practices adopted, among other factors.

ii An important output associated with irrigation schemes is an increase in crop yield. Other outputs include:

- Polluted wastewaters produced due to over-irrigation;
- Sediment produced by erosion due to poor agricultural practices; and
- The contamination of soil and water from pesticides and fertiliser residues.

ii Operation of an irrigation scheme involves water abstraction, water distribution, field application, and drainage and re-utilisation of irrigation water. Irrigation schemes can often lead to a deterioration in water quality in watercourses downstream of the scheme, due to the poor quality of the drainage water. This can lead to a reduction in aquatic species and the contamination of groundwater sources.

43.2 WATER ABSTRACTION (EXTRACTION)

43.2.1 Abstraction - Ground Water

Where the water supply for irrigation is groundwater there is a limit to the rate at which water can be extracted. This limit depends on the diameter of the well or borehole, the permeability of the water bearing strata and the capacity of the pumping mechanism. Seasonal fluctuations may also affect the quantity of water abstracted.

43.2.2 Over Abstraction- Ground Water

Over abstraction and poor management of groundwater sources will lead to the lowering of the water table and the possibility of wells or boreholes drying up. Groundwater sources should be tested to establish the levels of safe yield of the water source that would allow water abstraction at a sustainable rate. By ascertaining and operating at this rate, groundwater levels will be allowed to recharge.

43.2.3 Abstraction - Watercourse

Where the source of water is a watercourse, there are two principal constraints to the rate at which flow can be abstracted. These are:

- The lowest base flow in the river, and
- The demands on the available water supply from other users, both human and aquatic.

42.2.4 Over Abstraction- Watercourse/River

Over abstraction of water from rivers can have serious effects on the ecology of a river, as well as impacting upon users downstream. Water should be abstracted from rivers at a sustainable rate in order not to have an adverse effect on the downstream environment. Where the quality of the irrigation wastewater is sufficiently high it should be reused.

43.3 Distribution of Irrigation Water

Where possible most irrigation schemes utilise the force of gravity to distribute the water around the site. On large irrigation schemes, canals are commonly used as a means for transferring water, although in some schemes pipe networks are used. In order to minimise wastage of water and as a consequence environmental impacts, evaporation of water during its distribution should be minimised. This can be achieved by, where possible, using trickle irrigation systems.

43.4 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for these development projects.

43.4.1 Air Quality

i Potential impacts on air quality from construction of irrigation schemes will mainly be associated with increased dust generation (due to excavation activities, materials storage and traffic) that may have socio-economic and human health implications. Dust can cause a local nuisance, impair visibility, result in a reduction or loss of crops (substantial amounts of dust may reduce photosynthesis) and act as a respiratory irritant to humans.

ii Irrigation schemes are some times associated with industrial processing plants such as sugar cane refineries and canning plants. Such industrial plants may contribute to air pollution as well as producing green house gases.

43.4.2 Land and Soil Resources

i Impacts to ground conditions caused by the construction of irrigation schemes will vary widely, depending on the geological conditions and the size of the scheme. These impacts will be largely related to excavation activities and may include:

- Soil erosion (e.g. due to increased runoff or earth movement);
- Compaction of the soil due to vehicle movements (causing reduced infiltration of water and difficulty of penetration by plant roots);

- Land slips and slides (e.g. due to poor embankment grading);

- Ground contamination from the spillage of materials (e.g. vehicle fuel, pesticides) or release of contaminants present in the soil (caused by physical disturbance of soils);

- Disturbance of geological strata during excavation activities.

- Salinisation of soils.

ii Irrigation projects can lead to the progressive accumulation of salts in the soils of the project area leading to salinisation and as a consequence reductions in crop yields. Changes in land gradient and vegetative cover can lead to soil erosion and sedimentation of canals, hydraulic structures and dams.

43.4.3 Water Quality

i Construction of an irrigation scheme can impact surface and groundwater quality and hydrological conditions (such as alteration of surface flows). These impacts are likely to arise mainly during excavation and earth movement activities. Potential impacts include surface water contamination caused by fuel spillage, increased surface runoff and sedimentation with the associated water quality impacts such as increased turbidity, and contamination of groundwater supplies by the percolation of contaminants, such as spilled fuel.

ii These impacts may have serious implications on surface drainage, recharge of groundwater supplies and suitability of surface waters for drinking purposes, and may cause some secondary effects, such as loss of fish species or crop failure and associated economic impacts.

iii The magnitude of impacts on water conditions will depend on a range of factors, including the water's current condition, purposes for which it is used and its proximity to the construction site. Hydrological impacts will also depend on several factors, such as current conditions and the extent to which these are altered.

iv The following hydrological impacts should be considered during the design and construction of an irrigation scheme:

- Low flow regime of the river from which water is being abstracted;
- Flood regime of the river;
- Operation of dams[18]
- Saline intrusion into groundwater sources;
- Changes to groundwater levels.

v If the project significantly changes the low flow and flood regime of the river, the impact on the aquatic ecosystem should be assessed. Changes to groundwater levels should also be assessed. A fall in groundwater levels can increase the potential for groundwater recharge and improved land drainage. However, falls in the water table can also affect water levels in wells and water supply boreholes, as together with wetlands. A rise in the water table due to seepage from canals and a poor drainage system can lead to the water logging of agricultural land.

43.4.4 Biodiversity

Irrigation schemes can cause substantial change to the natural habitat, to areas of special scientific interest and also to biological diversity. Biological and ecological impacts include:

- Loss of sensitive and valuable ecosystems;
- Reduction in species diversity;
- Changes to wetland habitats;
- Changes to the regulatory functions of natural ecosystems such as soil stability, watershed hydrology regulation and protection against floods.

43.5 ENVIRONMENTAL MANAGEMENT SYSTEMS

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices,

[18] For information on dams, please see chapter 10 on Water Treatment Storage.

procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS early in the project cycle to reduce the potential environmental impacts associated with construction and operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the <u>"Guidelines for a NEPA-Acceptable Environmental Management System"</u>

CHAPTER 44

LAND RECLAMATION AND DRAINAGE

44.0 LAND RECLAMATION AND DRAINAGE PROJECTS

Land reclamation is making land capable of more intensive use by changing its general character, as by drainage of excessively wet land, irrigation of arid or semiarid land, or recovery of submerged land from seas, lakes, and rivers. Land reclamation is also (commonly) used to refer to creating dry land from an area covered by water (sea, lake, swamp)

44.1 ENVIRONMENTAL CONSIDERATIONS

i Although there are certain advantages to the reclamation of land, there are also negative impacts to the environment. This is especially true when land reclamation is conducted in or near to a fragile environment, for e.g. a wetland or coastal area.

ii The main environmental issues associated with land reclamation in coastal areas include the loss of natural habitat and the subsequent potential reduction in biodiversity, erosion of the coastline and pollution of the marine environment especially from acid sulphate soils. Acid sulphate soils are those that contain iron sulphides. They are found in low-lying coastal areas, such as mangrove forests, salt marshes, estuaries and coastal floodplains. These soils are waterlogged and if remain undisturbed do not pose a threat to the environment. However, if this soil is exposed to the air it reacts with oxygen to produce sulphuric acid which has detrimental effects on marine and freshwater environments.

iii Other harmful leachates can be produced when water comes into contact with contaminated fill materials. This is most commonly caused by infiltration of stormwater into the fill material and percolation of seawater into an exposed reclamation face.

iv Water quality may also be affected by erosion. Siltation of waterways can occur as a direct result of erosion of soil from the reclamation site. In addition, construction activities associated with reclamation may cause indirect siltation. For example, wharves and breakwaters can affect the hydrodynamics of the marine environment which may lead to erosion of adjacent foreshores and siltation of waterways. Excessive siltation may impact on local marine life.

v Reclamation materials must be solid, inert and non-hazardous. Materials may include uncontaminated soil, rocks and building demolition rubble such as bricks and concrete.

vi Pollution of the sea and waterways can be caused by water borne and windblown debris escaping from a reclamation site. Dust should be suppressed on reclamation and construction sites.

vii Impacts of Drainage

The following are a few of the environmental impacts of draining:

- Drainage can either increase or decrease erosion.
- An area reclaimed by drainage is usually lower than the surrounding areas and is therefore prone to flooding. As a result it has to be filled with materials like sand and rocks/gravel.
- Leaching from the soil of nutrients, pesticides, and other elements.

44.2 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS early in the project cycle to reduce the potential environmental impacts associated with construction and operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable

Environmental Management System"

44.3 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

CHAPTER 45

WATERSHED DEVELOPMENT AND SOIL CONSERVATION

45.0 WATERSHED DEFINITION

A watershed can be defined as the drainage basin or catchment area of a particular stream or river. It refers to the area from where the water flows to a particular drainage system, like a river or stream. Every stream, tributary, or river has an associated watershed..

45.0.1 WATERSHED DEVELOPMENT

Watershed development refers to the conservation, regeneration and the judicious use of all the resources – natural (land, water, plants, and animals) and human - within a particular watershed. This comprises the following:

- Soil and land management
- Water management
- Crop management
- Afforestation[19]
- Pasture development
- Livestock management
- Rural energy management
- Farm and non-farm value addition activities

Watershed developments can also include check dams and retaining walls.

45.0.2 Soil Conservation

Soil conservation refers to techniques used to prevent soil being lost or harmed by overuse, erosion, salinisation etc. Soil conservation works include:

- graded banks and waterways
- gully control structures and flumes
- flood and sediment detention basins
- gully filling and shaping
- tree planting and re-establishment of vegetative cover
- structural and land management fencing

[19] Planting of new forests on lands that have not been recently forested

45.0.3 Check Dams

Check dams are generally used in concentrated-flow areas. Check dams are not used in streams or channels. They can either be permanent or temporary barriers that prevent erosion and promote sedimentation by slowing flow velocities and\ or filtering concentrated flows.

45.0.4 Retaining Wall

A retaining wall is a structure that holds back a slope and prevents erosion.

45.1 ENVIRONMENTAL CONSIDERATIONS

The environmental considerations associated with most watershed development and many soil conservation projects can be looked at based on the stages of implementation – project planning, construction, operation and post-operation.

45.1.1 Site Selection and Planning

i The environmental impacts of construction and operation are established during the early phases of project planning. Reducing the environmental impact will be best achieved through investigation in the project preparation stage.

ii When choosing your site, it is important to consider the following factors:

- The environment where the development will occur,
- The impact on the biodiversity[20] and habitat loss due to construction and operations,
- Compatibility with national planning, policy, legal and regulatory framework,
- Land use in the surrounding areas to be affected by the development, especially local communities, and
- Availability of appropriate materials, construction labour force and transport to site.

iii The major potential environmental impacts that should be

[20] For information on Biodiversity, please see Glossary of Terms Appendix 1, Biodiversity

considered during design are:

- Types, sources and transportation of construction materials,
- Use of construction methods that will limit disruption to adjacent communities,
- Waste management options, including cleaner production methodologies,
- Water supply and sanitation and the efficient use of the resource,
- Energy use and efficiency, and
- Surface water runoff and drainage.

45.1.2 Construction

i Construction works on these projects will include, but not be limited to, the following activities:

- Site preparation, including clearance of vegetation;
- Installation of site compounds and storage facilities;
- Foundations;
- Installation of services to provide electricity, water supply and waste management;
- Construction of buildings; and
- Landscaping and site restoration.

ii Construction can have several types of environmental impacts, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;
- Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or

waste water from construction techniques involving physical or chemical processes;

- Generation of dust from earthmoving and stockpiled soil or from construction activities;

- Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;

- Solid waste generation

- Noise and possible odour from construction activity, including traffic that is generated;

- Access for equipment and materials - through road, river or port with associated traffic and infrastructure development (particularly if new facilities are required) with potential habitat loss or severance and safety risks,

- Added traffic and related impacts during and after construction.

45.13. Operation

Many environmental impacts from these projects will be caused during the operation of these facilities. All wastes generated will need to be managed to reduce the impact on the environment.

45.1.4 Post Operation

The post-operation of the industry facilities may include:

- Deterioration of structures (degradation or collapse)
- Removal of structures (demolition)
- Contamination (long-term pollution of soil, water or sediment)
- Disposal of residues (contaminated land).

45.2 Environmental Impacts

Specific impacts of watershed development are varied and are dependent on the type of project planned.

The following paragraphs give an overview of the negative impacts on the environment that should be considered in environmental assessment for these projects.

In most cases development involves the creation of impervious surfaces which have a variety of negative impacts on local watersheds. Besides significantly altering the natural water cycle, some of the most recognized specific impacts are:

- Decreased vegetative cover and stream shading. Damaged riparian zones provide minimal habitat and stormwater management functions.

- Increased water volume, erosion and flash-flooding during storms – Rainfall on impervious surfaces is swiftly conveyed through natural channels and stormwater pipes. This increased volume causes flooding during large storm events. Furthermore, the increased volume and speed of the water in the channel will cause stream bank erosion, which adds sediment to the water, destroys wildlife habitat, washes away property, and destabilises the stream banks causing safety threats.

- Heat absorption by stormwater runoff that flows over impervious surfaces, resulting in increased surface water temperature

- Pollution – Runoff from impervious surfaces picks up pollutants, such as oil, pesticides, toxic metal particles, sediments, and trash. The runoff is then channeled directly into waterways, degrading water quality, increasing acidity and raising water temperatures.

- Decreased biodiversity and degraded wildlife habitat – As pollutants, nutrients and sediment from development enter waterways, the numbers and types of species that can survive in this altered environment change significantly. Changes in water temperature and pH as well as decreased dissolved oxygen in the water add stress to organisms and their habitats.

- Decreased groundwater recharge – When storm water is rapidly conveyed to waterways, the water can not filter into the ground to recharge aquifers, or underground water sources. Reduced water levels in aquifers lead to lower sustained flows in streams and rivers, reducing supplies of drinking water and flow in streams

45.3 ENVIRONMENTAL MANAGEMENT SYSTEMS

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS early in the project cycle to reduce the potential environmental impacts associated with construction and operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

45.4 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

CHAPTER 46

WETLANDS AND RIVERINE AREAS

46.0 DEFINITIONS

Wetlands and Riverine projects include the Modification, Clearance or Reclamation of Wetlands, and the Dredging, Excavation, Clearing, Reclamation of Riverine Areas

i A wetland is a land area with high amounts of moisture in the soils and characterized by plant communities that prefer that moist environment. Marshes, bogs, mangroves and swamps are examples of wetlands.

ii Wetlands are important elements of a watershed because they serve as the link between land and water resources.

iii Wetland and Riverine area reclamation means filling and conversion to uplands. Wetlands and riverine areas (low-lying lands) can be reclaimed by draining out the excess water through the construction of dykes and drainage canals. This may be done for agricultural use.

iv Agricultural reclamation includes activities such as drainage, in-filling, construction of dykes, and also cultivation.

46.1 ENVIRONMENTAL CONSIDERATIONS

The following paragraphs describe the negative environmental impacts associated with the abovementioned activities which must be considered in the planning stages of these activities.

i Human development in floodplains or riparian areas can degrade riverine habitat. River or stream-front development without sufficient buffers may impact water or habitat quality in the stream or river. The impacts of development include potential problems associated with direct input of contaminants and sediment, alteration of hydrologic patterns and processes, temperature regimes, and loss of critical habitat adjacent to aquatic habitat. Dredging disturbs the riverine ecosystem and causes silting that can kill aquatic life.

ii The values and benefits of wetlands are many and diverse. When wetlands are degraded or destroyed, they lose some or all of their functions. The consequences can be disastrous.

iii Changes to wetlands such as draining and in-filling of swamps and floodplains, and the destruction of coastal mangroves and tidal flats can greatly reduce the ability of wetlands to absorb floodwaters. This means that extreme events such as cyclones and storms can result in more serious flooding, storm surge damage, loss of life and infrastructure.

iv Destruction of mangroves and other coastal wetlands also results in declining harvests of fish, mud crabs and other food species. Firewood, timber and other mangrove products also disappear. This impacts on local and regional economies as people's livelihoods are affected.

v The role of wetlands in filtering water, absorbing wastes and pollutants, and reducing flood peaks is impaired. Slowly, over time, river systems become degraded and primary production declines. Downstream, where the rivers flow into the sea, poor water quality and altered flow regimes impact on marine wetlands such as seagrass meadows and coral reefs.

vi It is important to note that riverine areas and wetlands should not be modified without comprehensive environmental impact studies being undertaken as prerequisites to any decisions. Modifications should only be undertaken in accordance with a management plan drawn up for the whole of the river or wetland system, including the catchment area. This plan should be coordinated with local and regional land use plans and should be prepared in consultation with all appropriate government authorities and the public.

46.2 Environmental Management Systems

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An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS early in the project cycle to reduce the potential environmental impacts associated with construction and operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

46.3 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

CHAPTER 47

SOLID WASTE

47.0 SOLID WASTE STORAGE, TREATMENT AND DISPOSAL FACILITIES

47.0.1 Facility for Solid Waste Incineration

i Incineration is the controlled burning of waste and is an expensive alternative disposal method to landfill. Various types of waste can be incinerated, including municipal, clinical industrial wastes and hazardous wastes. The process breaks down organic components to gases, water (vapour) and ash. The wastes may need to be screened and shredded before incineration and such facilities are required at or near the incinerator.

ii Issues of special consideration are the creation of harmful substances such as dioxins, odour and smoke control, incomplete combustion of some wastes, increase in concentrated heavy metal presence, the release of pollutants through the incinerator stack. Attention should be given to possible temperature changes.

47.1 ENVIRONMENTAL CONSIDERATIONS

The environmental considerations associated with implementation phases of incineration projects, site selection, construction and operation/maintenance and post-operation are described below.

47.1.1 Site Selection and Planning

i The major factors to be considered during site selection are:

- The characteristics of the proposed design, needing particular care where hazardous wastes are to be treated;
- Air quality status, including the impacts of other air polluters in the area;
- Proximity to local communities;
- Proximity to sensitive areas;

- Impacts on existing and potential economic activities such as tourism;

- Availability of facilities for ash disposal or re-use;

- Adequacy of transport links;

- Site-specific conditions (for example, prevailing weather conditions, particularly wind direction);

- Availability of appropriate materials, technology and skilled labour for construction and management.

ii It is important to avoid locating an incinerator upwind of residential areas, in enclosed air-basins or in areas where the air quality is already poor. Attention must be given to potential impacts on human health, which can be long-lived.

iii The major factors to be considered in design are:

- The environment where the development will occur;

- The impact on the biodiversity[21] and habitat loss due to construction and operations;

- Relevant legislative requirements and standards;

- The nature of the waste to be incinerated and its variability so as to enable site design and operation that minimises the environmental risks;

- Prior separation and recovery of reusable materials prior to final disposal, where relevant;

- Design and installation of best available pollution abatement technology to reduce air and water pollution resulting from the incineration process;

- Minimising the risk of nuisance from noise, smell and blown ash;

- Providing adequate space for delivery and operational vehicles; and

[21] For information on Biodiversity, please see Glossary of Terms Appendix 1, Biodiversity

- Designing appropriate measures to enable site restoration and reuse after closure.

iv There may be the opportunity for providing energy and heat from the incineration process. Where this is envisaged, this should be a part of the siting and design process, rather than retrofitting which can be expensive and less efficient.

47.1.2 Construction

i Construction of an incinerator involves the same activities as any other large industrial building - site preparation, foundations, construction work, installation of equipment and commissioning.

ii Construction can have several types of direct environmental impact, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;
- Increased turbidity and potential contamination of water bodies caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;
- Generation of dust from earthmoving and stockpiled soil or from construction activities;
- Loss of flora and fauna in cleared areas, or as a result of pollution or disturbance from construction activities and wastes;
- Solid waste generation from some construction activities;
- Noise and possible odour from construction activity, including traffic that is generated.

iii In addition, construction may generate secondary and cumulative environmental impacts:

- Impacts resulting from the construction of access or other infrastructure needs;

- Loss of amenity from change in land use;
- Added traffic and related impacts after construction;
- Severance effects on habitats from new construction;
- Socio-economic impacts from migrant labour.

47.1.3 Operation

i An incineration facility typically consists of the following:

- A holding area for waste waiting to be incinerated;
- Equipment to reduce the size of waste items to allow effective combustion;
- The incinerator, including a chimney for waste gases, where equipment may be needed to ensure clean emissions;
- An after-burner to complete the process of eliminating toxic or dangerous elements, in some cases;
- Wastewater treatment and outfall, where necessary;
- Storage and disposal facilities for ash.

ii The length of time necessary for the waste to be in the furnace (residence time) and the furnace temperature depends on the type of waste to be burnt. Provided the residence time is adequate and the post-combustion temperature is high enough, gases emitted from the incinerator are normally completely combusted.

47.1.4 Post Operation

i The decommissioning of an incineration plant involves dismantling the building, removing the furnace and dismantling the stacks. Some of the demolished materials may be re-used in other development. Those materials unsuitable for re-use will require disposal and are most likely to be land filled. Decommissioning may generate some special or hazardous wastes (such as ash contaminated with heavy metals).

ii The potential environmental impacts associated with this phase are most likely to be related to the escape of contaminated materials mainly from ash, as the building and furnace are dismantled. These types of wastes will require appropriate disposal and reuse of the site may require decontamination action.

iii Before a site, or part of it, can be redeveloped, the presence of contaminated land and water must be established and remediation measures taken where required to prevent risk to human health and the environment.

47.2 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for these development projects.

47.2.1 Air Quality

i Incinerator operations result in the emission of gases including carbon dioxide, sulphur dioxide, nitrogen oxides, hydrogen fluoride, hydrogen chloride and steam. Pollutants such as chlorinated furans and dioxins, and heavy metals such as mercury and cadmium may also be emitted. These are the products of incomplete combustion and are formed during the burning of certain types of waste, such as plastics.

ii These emissions fall to the ground and may enter the food chain through plant or animal absorption. Some of the gases contribute to acid rain and subsequent damage to forests and crops and can affect biodiversity.

47.2.2 Land and Soil Resources

i The fallout of pollutants such as chlorinated furans, dioxins or heavy metals may cause contamination of top soils. This will affect the food chain as the fallout may then be absorbed by plants and the animals that eat them; this may have potential impacts on human health.

ii Furans and dioxins are cancer-inducing compounds. Heavy metals can have detrimental effects on humans leading to pregnancy complications, mental retardation, damage to the nervous system and heart failure.

47.2.3 Water Quality

The impacts on human health of water pollution from atmospheric fall out or wastewater contamination can be more direct since it can enter drinking water. There are similar food chain implications through the poisoning of aquatic species. Where incineration ash is disposed or stored, there may be the potential for leachate to enter the groundwater or nearby surface watercourses if not appropriately contained.

47.2.4 Biodiversity

Biodiversity can be affected by direct loss of habitat from construction of the site as well as a result of any increase in pollutants. Certain species can be particularly sensitive to increased pollution levels.

47.3 ENVIRONMENTAL MANAGEMENT SYSTEMS

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> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

The most effective means for limiting environmental effects is through the implementation of an environmental management plan based on the recommendations of the EIA.

N.B. *For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"*

47.4 Standards

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Stack Emissions (Appendix 6)
- Noise (Appendix 7)

47.5 Solid Waste Storage, Treatment and Disposal Facilities-Landfills or Systems for the Destruction, Reprocessing or Recycling of Wastes

47.5.1 Landfills

Landfills are the physical facilities used for the disposal of residual solid wastes in the surface soils of the earth. Solid wastes including organic or bio-degradable wastes, and inert wastes from domestic, industrial or clinical sources are disposed in these facilities.

47.5.2 Land Filling

Land filling usually involves depositing waste in some kind of pit (although the waste can also be piled up and later covered as in land raising). It includes monitoring of the incoming waste stream, placement and compaction of the waste and installation of landfill environmental monitoring and control facilities. In the past, the term sanitary landfill was used to denote a landfill in which the waste placed in the landfill was covered at the end of each day's operation. Today, sanitary landfill refers to an engineered facility for the disposal of municipal solid waste designed and operated to minimise public health and environmental impacts.

47.5.3 Process Used

The process relies on decomposition by naturally occurring bacteria to neutralise wastes. This can take many years and certain types of waste such as glass and metals may never be completely degraded. Decomposition generates methane and other gases.

47.6 Environmental Considerations

The environmental considerations associated with the implementation phases of landfill projects, site selection and planning, construction and operation/maintenance and post-operation are described below.

47.6.1 Site Selection and Planning

i A good detailed site investigation, selection and design can substantially reduce impacts caused by landfill. Important factors for consideration include:

ii Ground conditions

- Geological conditions (such as the permeability and uniformity of strata);
- Proximity to sensitive surface or ground water bodies (including drinking water sources);
- Desirability of having clay to prevent seepage of gas or leachate.

ii Location

- The environment where the development will occur,
- The impact on the biodiversity[22] and habitat loss due to construction and operations;
- Proximity to local communities, with the aim of not being so remote as to induce excessive transport costs and impacts;
- Proximity to houses and structures due to the risk of landfill gas accumulation, fires and explosions;
- Proximity to good transport links;
- Availability of sites sterilised by other uses, such as quarries or brick pits;
- Availability of appropriate materials (such as cover material),

[22] For information on Biodiversity, please see Glossary of Terms Appendix 1 Biodiversity

technology and skilled labour for construction and management;

- Optimisation of potential economic value from waste recovery or from methane extraction, for example;

- Consideration of potential current and future land use conflicts (such as tourism).

iv Design principles

- Determine the nature of waste to be disposed and its variability so as to enable site design and operation that minimise the environmental risks;

- Enable, where feasible, the separation and recovery of re-usable materials prior to final disposal;

- Eliminate risks of ground and surface water contamination from leachates by utilising a lining (artificial liners where local clay is not available);

- Provide gas barriers to control movement of gas, where necessary;

- Provide wastewater treatment or sewerage facilities for leachate;

- Minimise the risks of nuisance from noise, smell or blown rubbish;

- Provide adequate space for delivery and operational vehicles;

- Consider measures that enable site restoration and reuse after closure.

v There may be an opportunity for recovering methane as a heat or power source and this will affect siting and design. Where methane recovery is envisaged, this must be included as part of the initial project design as retrofitting is expensive and less effective.

vi Particular attention should be paid to potential impacts on human health, such as hazards from landfill gas production and contamination of soil and water, some of which can be cumulative and long-lived.

47.6.2 Construction

i Construction of a landfill normally entails large-scale excavation, followed by the installation of leachate management and monitoring facilities and the creation of access and on-site roads. It may include temporary waste storage facilities or handling areas (for example for materials recovery) or the installation of methane recovery and possible heat/power plant.

ii Construction can have several types of direct environmental impact, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;
- Increased turbidity and potential contamination of water bodies caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;
- Generation of dust from earthmoving and stockpiled soil or from construction activities;
- Loss of flora and fauna in cleared areas, or as a result of pollution or disturbance from construction activities and wastes;
- Solid waste generation from some construction activities;
- Noise and possible odour from construction activity, including traffic that is generated;

iii In addition, construction may generate secondary and cumulative environmental impacts:

- Impacts resulting from the construction of access or other infrastructure needs;
- Loss of amenity from change in land use;

- Added traffic and related impacts after construction;
- Severance effects on habitats from new construction
- Socio-economic impacts from migrant labour.

47.6.3 Operation

i The extent and nature of environmental impacts during this phase will depend on the scale of the site, the design, the sensitivity of surrounding areas, the types of waste deposited and the management practices being used.

ii Typical issues include:

- Collection and transport of waste from sources of production to the landfill, directly or via on or off-site recovery facilities;
- Compaction of waste to maximise space in the landfill;
- Treatment of waste surfaces to improve rate of decomposition and avoid nuisances normally filling cells, applying a daily cover;
- Satisfactory operation of leachate removal and treatment systems;
- Vermin control - such as birds, rats mosquitoes;
- Environmental monitoring;
- Satisfactory operation of methane recovery, where relevant.

47.6.4 Post Operation

i Landfills usually operate over many years and during this time it may be possible to restore parts of the site. Completed sites and parts of sites may be used for a number of purposes such as recreation, agriculture or construction.

ii With the long time frames involved in operations, it can be difficult to secure funding for the phased and final restoration unless provision is made at the outset. Implementation of a restoration plan should form part of any contract with operators. Where decomposition is slow and levels of organic matter in the fill are high, methane can continue to be produced for some years, making reuse, and especially construction even some distance from the site, inadvisable.

47.7 ENVIRONMENTAL IMPACTS

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for these development projects.

47.7.1 Air Quality

The main impact on air quality during landfill operation is the generation of methane and carbon dioxide as a by-product of the decomposition of biodegradable waste. These gases may continue to be generated for years after the disposal of waste ceases. The effects of these gases include asphyxiation (choking) and the risk of explosions and subsequent fires. These gases can be contained by capping and the use of gas barriers but will often migrate along natural rock fissures or through the leachate evacuation pipes.

47.7.2 Water Quality

i During landfill construction and operation, excavation and earth movement can cause pollution of surface and groundwater. There are also potential effects during the final stages of capping and restoration, where natural topography of the area may be altered. The main source of pollution from these activities is increased surface runoff and soil erosion from exposed ground causing high turbidity (suspended solids) and sedimentation in water bodies.

ii Other potential sources of pollution are surface and ground water contamination from fuel or oil and chemical spillage from maintenance and storage areas. Water pollution can affect its suitability for drinking purposes as well as have an adverse effect on aquatic ecosystems. The scale or severity of these effects will depend on factors such as the water's current condition, the purposes for which it is used and its proximity to the landfill.

iii The main potential impact on surface and groundwater quality is the discharge of leachate, which will be produced wherever wastes degrade or decompose. Leachate is the term used for water that contains contaminants from waste, either in suspension or in solution. Typical contaminants are metals, organic acids and ammonia; these pollute groundwater beneath the landfill by percolation and surface water by seepage and runoff.

iv Leachate usually has a high biological and chemical oxygen demand. Untreated leachate in water will have human health effects and will damage agricultural production and the natural environment. Fish and other aquatic life can be severely affected by leachate pollution surface water bodies. Where the nutrient content of leachate is high, eutrophication of water bodies may also arise, making the waters uninhabitable for aquatic life and unusable for irrigation or drinking water purposes.

47.7.3 Land and Soil Resources

The main impacts on land from landfill activities occur mainly during construction and earthworks during operations and site restoration. These include, but are not limited to:

- Soil erosion due to increased runoff or earth movement. This may be important for topsoil stored for use in site restoration;

- Compaction of soil due to vehicle movements, causing reduced infiltration of water and difficulty of penetration by plant roots;

- Land slips and slides due to poor embankment grading;

- Ground contamination from the spillage of materials such as vehicle fuel or the release of contaminants already present in the soil;

- Contamination of vegetation and crops by waste from the landfill and leachate, possibly leading to transfer of heavy metals into the food chain;

- Risks of collapse and the associated human injuries and loss of development land if landfill has not been properly filled or capped.

47.7.4 Biodiversity

The main potential impacts on biodiversity will be through the polluting effect of leachate to aquatic and wetland habitats. This can be minimised by collection and treatment systems, including biological processes such as reed-beds.

Landfill gas may also be toxic to plants where it migrates to the soil surface. There could also be effects from contamination of the soil from waste and leachate, and from the introduction of exotic species and pests to the area.

47.8 Environmental Management Systems

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An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

The EMS must allow for monitoring of leachates and gases for as long as they risk being produced after site closure and restoration.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

47.9 Standards

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)

- Stack Emissions (Appendix 6)
- Noise (Appendix 7)

47.10 FACILITY FOR CHEMICAL TREATMENT OF SOLID WASTE

The most commonly used chemical transformation process is combustion, which can reduce the organic fraction of municipal solid waste (MSW) by up to 95% of the original volume. Chemical transformation processes also include a number of hydrolysis processes.

47.10.1 Combustion

i Combustion can be defined as the thermal processing of solid waste by chemical oxidation with exact or excessive amounts of air.

ii The process begins when solid wastes are unloaded into a storage pit. Large or non-combustible items are removed from the wastes, and the combustibles are fed onto grates where they are mass-fired. Several different types of mechanical stokers are commonly used.

iii Air may be introduced to control burning rates and furnace temperature. Because most organic wastes are thermally unstable, various gases are driven off as the combustion process takes place in the furnace. These gases and organic particles rise into the combustion chamber and burn at very high temperatures. Heat is recovered from the hot gases using water-filled tubes in the walls of the combustion chamber and with a boiler that produces steam. This steam may be converted to electricity by a turbine-generator.

iv Solid waste combustors can be designed to operate with unseparated MSW (mass-fired combustors) or processed MSW, known as refuse-derived fuel (RDF).

47.10.2 Hydrolysis

i These processes may be used to recover compounds such as glucose and a variety of other compounds such as synthetic oil, gas and cellulose acetate. Methanol, an alternative fuel, can also be produced.

ii These processes are not used routinely in the transformation of organic municipal solid waste as the compounds can also be manufactured from other wastes, such as sugar cane bagasse.

iii Acid hydrolysis involves treating a finely divided suspension of cellulose-containing waste (such as newsprint) with a weak organic acid. The suspension is heated and slight pressure is applied. Under these conditions, the cellulose in the waste is converted to glucose and other sugars.

47.11 Environmental Considerations

The environmental issues associated with the implementation phases of these projects: planning and site selection, construction, operation/maintenance and post-operation are described below.

47.11.1 Site Selection and Planning

i Planning, site selection and design form an important stage in the development of chemical treatment facilities, and will determine its environmental impact throughout its construction, operation and post-operation.

ii The major factors to be considered during site selection are:

- The characteristics of the proposed design;
- Air quality status, including the impacts of other air polluters in the area;
- Proximity to local communities;
- Proximity to sensitive areas;
- Impacts on existing and potential economic activities such as tourism;
- Availability of facilities for disposal of residues;
- Adequacy of transport links;
- Site-specific conditions (for example, prevailing weather conditions, particularly wind direction).

iii Extreme care must be taken in their operation if they are to be environmentally and aesthetically acceptable. Ideally, to minimise the impact of the operation of combustion facilities, they should be sited in remote locations with adequate buffer zones surrounding the facility.

iv The major factors to be considered in design are:

- The environment where the development will occur,
- The impact on the biodiversity[23] and habitat loss due to construction and operations;
- Relevant legislative requirements and standards;
- The nature of the waste to be transformed to minimise the environmental risks;
- Design and installation of pollution abatement measures;
- Providing adequate space for delivery and operational vehicles and
- Designing appropriate measures to enable site restoration and reuse after closure.

47.11.2 Construction

i Construction of a facility for the chemical treatment of solid waste involves the same activities as any other large industrial facility - site preparation, foundations, construction work, installation of equipment and commissioning.

ii Construction can have several types of direct environmental impact, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;
- Increased turbidity and potential contamination of water bodies caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;
- Generation of dust from earthmoving and stockpiled soil or

23 For information on Biodiversity, please see Glossary of Terms Appendix 1 Biodiversity

from construction activities;

- Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;

- Solid waste generation from some construction activities;

- Noise and possible odour from construction activity, including traffic that is generated.

iii In addition, construction may generate secondary and cumulative environmental impacts:

- Impacts resulting from the construction of access or other infrastructure needs;

- Loss of amenity from change in land use;

- Added traffic and related impacts after construction;

- Severance effects on habitats from new construction

- Socio-economic impacts from migrant labour.

47.11.3 Operation

Typical concerns for these facilities include:

- The performance of equipment being used in terms of causing pollution or generating accident risks;

- The disposal of wastes generated;

- Air emissions and possible thermal pollution.

47.11.4 Post Operation

i The post-operation of these facilities may include:

- Deterioration of structures (degradation or collapse)
- Removal of structures (demolition)
- Contamination (long-term pollution of soil, water or sediment)

- Disposal of residues (contaminated land).

ii Before a site, or part of it, can be redeveloped, the presence of contaminated land and water must be established and remediation measures taken where required to prevent risk to human health and the environment.

47.12 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for these development projects.

47.12.1 Air Quality

Combustion facilities will result in the production of various gases and particulate emissions. Many of these are thought to have serious health impacts. Under ideal conditions, the gaseous products would include carbon dioxide, steam, nitrogen and small quantities of sulphur dioxide. Air emissions, therefore, will depend on the composition of wastes being combusted.

47.12.2 Land and Soil Resources

i Several solid residuals are generated from these facilities. These include bottom ash, fly ash, and scrubber product. Management of these residuals is an important factor in pollution prevention.

ii Typically, bottom ash is disposed of by landfilling. The primary concern with landfill of the ash is that it may, under certain conditions, leach contaminants to the groundwater. Consequently, ash should be disposed of in an approved waste disposal site.

47.12.3 Water Quality

i Liquid emissions from combustion facilities can arise from one or more of the following sources:

- Wastewater from ash removal facilities;
- Effluent from wet scrubbers, (air pollution abatement measure);
- Wastewater from pump seals, cleaning and general

housekeeping activities;

- Wastewater from treatment systems;
- Cooling tower blow down.

ii The proper handling and disposal of these liquid emissions are also important parts of the design of these facilities.

47.13 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

The most effective method for limiting environmental effects is through the implementation of an environmental management plan based on the recommendations of the EIA.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

47.14 Standards

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Stack Emissions (Appendix 6)
- Noise (Appendix 7)
- Trade Effluent (Appendix 8)

- Sewage Effluent (Appendix 9)
- Sludge (Appendix 10)
- Standards for effluent to be used as irrigation. (Appendix11)

CHAPTER 48

HAZARDOUS WASTE

48.0 HAZARDOUS WASTE FACILITIES

These facilities can include Storage, Transportation, Treatment or Disposal. A facility may be defined as the contiguous land, structures and other improvements used for storing, recovering, recycling, treating or disposing of hazardous waste. This chapter will examine storage, treatment and disposal of hazardous wastes, as well as their transportation.

48.0.1 Transportation

Wastes are usually transported in vehicles suitable for the waste type. The wastes may be transported as bulk liquids in a tank truck, containerised liquids or sludges in drums, bulk shipments of contaminated soil in dump trucks, or by a number of other methods.

The mere "unloading" of a vehicle can pose a difficult challenge if the waste has separated, a container has leaked, or if the waste has solidified during transport. Facilities should be prepared to deal with these eventualities, having whatever equipment and infrastructure required.

48.0.2 Storage

i Storage is the holding of waste for a temporary period of time. At the end of the storage period, the waste is treated, disposed of, or stored elsewhere. Storage facilities represent a temporary management technique where the waste has not yet reached its final destination. Storage facilities hold waste prior to its shipment for treatment.

ii Hazardous waste, in many cases, is stored prior to treatment or disposal. The most common hazardous waste storage practices are container storage, storage in tanks, and storage in containment buildings. Other land-based storage facilities include surface impoundments such as pits, ponds and lagoons.

iii The objective of storage and preparation is to:

- Store the waste safely before treatment and disposal processes;

- Provide adequate accumulation time during periods when treatment and disposal process systems are out of service;
- Facilitate mixing, blending and repackaging of waste; and
- Allow staged input of various wastes with reagents (for treatment process).

iv A key issue in providing safe storage is compatibility. This can be described as:

- The compatibility of the waste with the material used to construct the container or liner.
- The compatibility of the waste with other waste stored together.

48.0.3 Treatment

i Treatment is any process that changes the physical, chemical, or biological character of a waste to make it less of an environmental threat. Treatment can neutralize the waste, recover energy or material resources from a waste, render the waste less hazardous, or make the waste safer to transport, store, or dispose of.

ii Hazardous waste generally must be treated before it can be disposed of. Hazardous waste can be treated using any of a number of processes. Treatment methods fall into four categories:

- Phase separation (e.g. sedimentation and steam stripping)
- Component separation (e.g. ion exchange, electrodialysis)
- Chemical transformation (e.g. chemical oxidation and incineration)
- Biological transformation (e.g. aerobic treatment)

iii Each waste treatment process produces gaseous emissions, wastewater effluents or residuals requiring subsequent management if not additional treatment. An incinerator, for example, produces combustion gases that require scrubbing that in turn produces an acidic washwater requiring wastewater treatment. Incineration also produces fly ash and bottom ash requiring disposal, if not treatment.

iv The unit treatment processes are not the only operations that generate residuals. Spillage and runoff from storage areas require treatment. The opening of containers may need to be done under negative atmospheric pressure with the fumes collected and treated. A full-service facility can usually provide all necessary treatment of residuals. Smaller facilities may have to collect the residuals and transport them as hazardous waste to another facility capable of treating them.

48.0.4 Disposal

i Disposal is the placement of waste into or on the land. Disposal facilities are usually designed to permanently contain the waste and prevent the release of harmful pollutants to the environment.

ii The most common disposal technology is landfilling. Landfills are waste management structures where waste is placed into the land. Landfills usually have liner systems and leachate collection systems to prevent contamination of the groundwater under the landfill. Groundwater monitoring is also generally required along with corrective action if releases of hazardous pollutants occur. Once the landfills stop receiving waste they are required to close by putting an impermeable cover on the landfill to prevent rainwater from entering.

iii Landfills may have high volume of surface runoff depending on rainfall events, the integrity of the cap, and the slope of the landfill and stormwater retention capacity. The risk of contaminants in runoff is minimal, nil if the landfill is capped.

iv Another disposal technology that is commonly used to manage liquid hazardous waste is injection wells. Hazardous waste injection wells are used to dispose of liquid wastes deep underground. The waste is usually injected under high pressure thousands of feet underground. The wells must be properly designed and operated to prevent waste from escaping the underground confinement area.

48.1 Environmental Considerations

The environmental considerations associated with implementation phases of these projects: site selection and planning, construction and operation/maintenance and post-operation are described below.

48.1.1 Site Selection and Planning

A good detailed site investigation, selection and design can substantially reduce the impacts. Important factors for consideration include:

i Ground conditions

- Geological conditions such as unstable terrain, karst terrain[24] and earthquake zones;
- Proximity to sensitive surface water or groundwater bodies (including drinking water sources);

ii Location

- The environment where the development will occur,
- The impact on the biodiversity[25] and habitat loss due to construction and operations,
- Proximity to local communities, with the aim to avoid sensitive populations or densely populated areas;
- Proximity to good transport links;
- Consideration of weather conditions, as unfavourable weather conditions may lead to stagnant air pollutants and affect sensitive populations; and
- Consideration of potential current and future land use conflicts (such as tourism).

iii Design principles

- Determine the nature of waste so as to enable site design and operation that minimise the environmental risks;

24 Karst Terrain consists of rock (eg limestone, gypsum) that slowly dissolves when water passes through it. The dissolving rock leaves underground tunnels/voids which may collapse to form sink holes.

25 For information on Biodiversity, please see Glossary of Terms Appendix 1 Biodiversity

- Eliminate risks of ground and surface water contamination from leachates by utilising a lining (artificial liners where local clay is not available);

- Provide adequate space for delivery and operational vehicles;

- Consider measures that enable site restoration and reuse after closure.

Particular attention should be paid to potential impacts on human health, some of which can be cumulative and long-lived.

48.1.2 Construction

i Construction can have several types of direct environmental impact, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;

- Increased turbidity and potential contamination of water bodies caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;

- Generation of dust from earthmoving and stockpiled soil or from construction activities;

- Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;

- Solid waste generation from some construction activities;

- Noise and possible odour from construction activity, including traffic that is generated.

ii In addition, construction may generate secondary and cumulative environmental impacts:

- Impacts resulting from the construction of access or other infrastructure needs;

- Loss of amenity from change in land use;
- Added traffic and related impacts after construction;
- Severance effects on habitats from new construction;
- Socio-economic impacts from migrant labour.

48.1.3 Operation

i The extent and nature of environmental impacts during this phase will depend on the scale of the site, the design, the sensitivity of surrounding areas, the types of wastes received (or that the facility is designed to receive) and the management practices.

ii Typical issues include:

- Transport of waste from sources of production to the treatment, storage and disposal facility;
- Satisfactory operation of treatment systems;
- Operational practices (e.g. how long an incinerator is allowed to burn or how well a technology destroys or treats a waste);
- Leachate management and monitoring;
- Environmental management and monitoring.

48.1.4 Post Operation

Closure of a storage or treatment facility requires the removal of ALL remaining waste to another facility. All equipment and structures that had been in contact with waste must be decontaminated. This may entail removal of concrete pads used to hold waste containers as well as contaminated soil where leaks had occurred.

The closure of land disposal facilities, where waste has been emplaced, involves the containment of wastes. This requires the installation of cover systems plus implementation of a long-term plan for leachate management and monitoring, maintenance, security and other measures.

48.2 ENVIRONMENTAL IMPACTS

The types of pollutants a single facility will release depend on the hazardous wastes received, and the treatment and disposal methods employed.

48.2.1 Air Quality

i Air emissions may occur in a variety of forms as point, line, area, volume or puff sources. A point source is a well-defined location typically emitting contaminants on a continuous basis. Line, area, volume sources are considered fugitive in nature. Fugitive emissions are those that could not reasonably pass through a stack, chimney or vent. A puff release is a fugitive emission that occurs instantaneously from spills or other accidental releases. Examples of these are as follows:

Point	Incinerator stack or landfill gas vent
Line	Dust from road, vehicle emissions from roadway
Area	Volatile emissions from a lagoon
Volume	Volatile or particulate emissions from a building with open windows and doors
Puff	Volatile emissions from an accidental spill

ii Waste treatment options generate particulate matter. Fugitive particulate matter emissions generally originate from materials handling and surface areas such as roadways, open waste piles, staging areas, landfills, and land treatment operations. Fugitive dust is usually a key concern at inactive hazardous waste sites as the dust has the same contaminants as those adsorbed to the soil.

48.2.2 Water Quality

i Controlled releases to surface water are one source of water pollution. The varieties of aqueous waste streams with direct discharge to surface water are nearly endless. This could include effluent from treatment works, cooling water scrubber blowdown from incinerators, and treated leachate from landfills.

ii A properly designed landfill will provide for leachate collection and removal. However, even the most engineered landfills may leak occasionally. The contaminants released into groundwater will depend on the wastes in put into the landfill, as well as any reactions between wastes that may have occurred.

48.3 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

An environmental management plan should consider spill prevention procedures, contingency plans, emergency response and training programmes. It should also document a method for record keeping, as facilities will need to conduct post-closure monitoring.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

48.4 Standards

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Stack Emissions (Appendix 6)
- Noise (Appendix 7)
- Trade Effluent (Appendix 8)

CHAPTER 49

CEMETERIES AND CREMATORIA

49.0 CEMETERIES AND CREMATORIA

Cremation and burial are the main ways of final disposition of the dead. A cemetery is a place, usually an enclosed area of land, in which dead bodies are buried.The term cemetery implies that the land is specifically designated as a burial ground and may or may not be attached to a church.

i Cemeteries utilise a lot of valuable urban space, which could become a problem specifically if a change of use is proposed. Different cultures have different attitudes to the destruction of cemeteries and use of the land for construction.

ii Prior to burial, a body is embalmed and placed in a casket, made from a variety of materials. Embalming involves filling the arteries and body cavities with formaldehyde. This chemical is suspected of causing cancer.

iii Cremation was introduced in response to the ever-increasing use of land for burial. It is the practice of disposing of a corpse by burning. This often takes place in a crematorium. During cremation, the body is place in a chamber (the retort), which is lined with special bricks to help retain the heat. The body is placed in a container, which can be a simple cardboard box or a wooden casket.

iv The cremation oven is capable of reaching high temperatures to ensure the disintegration of the corpse. The ovens use a number of different fuel sources, such as natural or propane gas. Modern cremation ovens include control systems that monitor the conditions inside the oven while a cremation is taking place.

v After the burning is completed, the bone fragments are swept out of the retort, and the operator uses a grinder to process them into a consistent powder, ashes. The ashes are placed in a container, which can be anything from a simple cardboard box to a fancy urn. An unavoidable consequence of cremation is that a tiny residue of bodily remains is left in the chamber after cremation and mixes with subsequent cremations.

49.1 ENVIRONMENTAL CONSIDERATIONS

The environmental considerations associated with these development projects can be looked at based on the stages of implementation – site selection and planning, construction and operation.

49.1.1 Site Selection and Planning

i When choosing a site, it is important to consider the following factors:

- The environment where the development will occur;
- The impact on the biodiversity[26] and habitat loss due to construction and operations;
- Proximity to local communities;
- Provision of affordable water supply, sanitation and sewage collection;
- Proximity to sensitive surface or ground water bodies (e.g. water used for drinking);
- Compliance with land zoning policy;
- Compatibility with national planning, policy, legal and regulatory framework;
- Ability to meet relevant local and international standards;
- Geological conditions (for excavations processes);
- Green building basics[27];
- Provision of appropriate materials, technology and skilled labour for construction and management (operation and post-operation);

ii Particular issues of potential concern relating to the design include:

26 For information on Biodiversity, please see Glossary of Terms Appendix 1 Biodiversity
27 Green buildings are designed to meet certain objectives such as protecting occupant health; using energy, water and other resources more efficiently; and reducing the overall impact to the environment

- Construction materials to be used in view of the potential landscape impact and sensitivity of location;
- Types, sources and transportation of construction materials;
- Use of construction methods that will limit disruption to adjacent communities;
- Waste management options (solid waste treatment and/or disposal, sewage and wastewater treatment and/or disposal);
- Scope for the provision of on-site wastewater treatment facilities;
- Water supply and sanitation and the efficient use of the resource;
- Energy use and efficiency;
- Surface water runoff and drainage;
- Potential pollution control technologies (particularly land and water-related), feasibility and effectiveness;
- Prevention of traffic noise (heavy machinery used on construction phase);
- Capacity to accommodate future sector demands;
- Constraints to future expansions – physical, environmental and planning.

N.B. *For information on planning standards for Cemeteries and Crematoria, see* ***Volume1: Section 1- Chapter 2 Planning Standards relating to different types of Development.***

49.1.2 Construction

i Construction works on these projects will include, but not be limited to, the following activities:

- Site preparation, including clearance of vegetation;
- Installation of site compounds and storage facilities;

- Foundations;
- Installation of services to provide electricity, water supply and waste management;
- Construction of buildings; and
- Landscaping and site restoration.

ii Construction can have several types environmental impacts, including:

- Soil erosion, degradation, contamination, disturbance of old contamination;
- Increased water turbidity and potential contamination of waterways caused by surface runoff or spillage of fuels or waste water from construction techniques involving physical or chemical processes;
- Loss of flora and fauna in cleared areas; or as a result of pollution or disturbance from construction activities and wastes;
- Solid waste generation;
- Noise and possible odour from construction activity, including traffic that is generated;
- Added traffic and related impacts during and after construction.

49.1.3 Operation

The major environmental impacts during the operations of cemeteries and crematoria will depend on:

- The performance of the crematorium and the release of air emissions;
- The disposal of wastes generated and the decomposition bodies;
- The secondary impacts of pesticide for cemeteries.

49.4.1 Post-Operation

Based on the very nature of cemeteries, post-operation of these facilities are unlikely. On the other hand, the post-operation of these crematoria may include:

- Deterioration of structures (degradation or collapse)
- Removal of structures (demolition)
- Contamination (long-term pollution of soil, water or sediment)
- Disposal of residues (contaminated land).

49.2 Environmental Impacts

The following paragraphs look at the impacts on the environment that should be considered in environmental assessment for these development projects.

49.2.1 Cemeteries

i Burial is sometimes suggested as a more environmentally acceptable alternative to cremation as no air pollution is created. However, this does not take into consideration the impact of herbicides and petrol mowers routinely used in cemeteries, often over long periods of time.

ii The long-term effects of the decomposition of bodies on water are unknown. It has been suggested that chemicals from corpses seep from cemeteries and contaminate nearby water. Feacal streptococci, and bacteria found on the skin have been found in underground water. This suggests that cemeteries can pollute groundwater.

iii Another environmental concern is that traditional burial takes up a great deal of space. Often the casket is placed inside a concrete vault or liner before burial in the ground. While individually this may not take much room, combined with other burials it can cause serious space concerns.

49.2.2 Crematoria

i Almost all cremators use gas. The use of gas, a finite reserve, and the creation of air pollution are criticisms of this process. Possible pollutants released during this process are carbon monoxide and pollutants. Mercury from dental fillings are also an issue for pollutants arising from the process.

ii These emissions fall to the ground and may enter the food chain through plant or animal absorption. Some of the gases contribute to acid rain and subsequent damage to forests and crops and can affect biodiversity. Biodiversity can be affected by direct loss of habitat from construction of the site as well as a result of any increase in pollutants. Certain species can be particularly sensitive to increased pollution levels.

49.3 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

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An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS. The EMS may be implemented early in development to reduce the potential environmental impacts associated with construction, operation and post-operation activities.

The most effective means for limiting environmental effects is through the implementation of an environmental management plan based on the recommendations of the EIA.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

49.4 Standards

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)

- Stack Emissions (Appendix 6)
- Noise (Appendix 7)
- Trade Effluent (Appendix 8)

CHAPTER 50

INTRODUCTION OF SPECIES

50.0 INTRODUCTION/IMPORTATION OF SPECIES

The introduction/importation of species may include Flora, Fauna, Genetic Material and Genetically Modified Organisms. An introduced species (also known as an exotic species) is an organism that is not native to the place or area where it is considered introduced and has been accidentally or deliberately transported to the new location by human activity. This could also include the introduction of genetic material[28] and genetically modified organisms[29].

50.0.1 Introductions and Transfers

Introductions and transfers (hereafter referred to as introductions) may be associated with transport, trade in living organisms (commercial and recreational animals, horticulture and agricultural plants, etc.), and genetic material. Many of these activities have increased in the last decade and are likely to continue on this trend.

50.0.2 Reasons for Introductions

The main reasons for deliberate introductions include production of protein, employment, generation of foreign exchange, biological control and recreation. It should be noted that introductions might be deliberate or unintended, such as by means of ballast water (ships). However, some intended and many unintended introductions may result in significant and serious impacts.

50.0.3 Management of Introduced Species

For a precautionary approach to the management of introduced species, irreversible changes in the time scale of human generations and other undesirable impacts should be avoided. Species introductions, either deliberate or unintended, may have such undesirable effects. Once a species has been introduced, it cannot usually be eradicated and is expensive and difficult where possible. It may be possible, however, to mitigate its undesirable effects.

28 Any materialof plant, animal, microbial or other origin containing functional units of heredity

29 Organism whose genetic characteristics have been altered by the insertion of a modified gene from another organism using the techniques of genetic engineering

50.1 ENVIRONMENTAL CONSIDERATIONS

i Ecosystems are continuously changing as a result of human activities and natural processes. Selective pressures on populations are created by recreational and commercial activities. Introducing and transferring organisms can also affect the stability of these ecosystems.

ii The difficulty in reversing an introduction and its adverse effects should figure prominently in the decision process on whether to allow an introduction.

iii Introduced organisms may cause major changes in ecosystems, especially in partly enclosed or enclosed areas, such as lagoons. Such introductions may result in changes in the productivity of local species. Monitoring of introduced organisms in these areas may provide useful information as a basis for modifying management techniques.

iv Unintended introductions are inherently unprecautionary because they can rarely be evaluated in advance. A precautionary approach would aim to reduce the risk of such unintended introductions and minimize their impact.

v Deliberate Introductions

The research activities that should be conducted in advance of an introduction are as follows:

- Desk assessment of the biology and ecology of the intended species;
- Preparation of a risk assessment (detailed analysis of potential environmental impacts);
- Examination of the species within its home range and possible impact of accidental release.

vi Unintended introductions

Unintended introductions may arise from several sources, such as fouling organisms, removal of natural barriers and trade, and ballast water. Often invasive species may interact with one another to generate a problem where either species alone would be harmless.

vii Keeping potentially damaging species out is the most cost-effective way of dealing with introduced species. Targeting common pathways can slow or stop the entry.

viii Several technologies can control invasive species at acceptably low levels.

- Biological control entails introducing a natural enemy that often limit their density in their native habitats
- Chemical control involves using a pesticide such as an herbicide or insecticide
- Ecosystem management subjects the entire ecosystem to regular treatment that favours adapted native species over introduced species.

50.2 Environmental Impacts

50.2.1 Major Biological Concerns

The three major biological concerns with the introduction or transfer of organisms are:

i Ecological effects such as competition for food, and space with native species, alteration of habitat, and predation on indigenous organisms.

ii Genetic changes that will lessen the ability of local populations to survive; and,

iii Transfer of disease agents, parasites and other accompanying organisms that will affect native species and their habitats.

50.2.1 Impact of Introductions

Potential impacts of some introductions include changes in the distribution and abundance of resources through disease, changes in predator-prey relationships, changes in competition, mixing of bad (maladapted) genes, and habitat modification. Additionally, introduced species may eliminate native species by breeding with them and thereby altering the gene pool.

50.2.2 Reducing Risks

It should be ensured that the introduced population, in the case of the pet trade, has an adequate genetic resource base, i.e., genetic diversity, low inbreeding, etc. This may reduce the need for additional introductions, which might otherwise be necessary to increase the genetic resource base. In addition, consideration should be given to the use of gametes, e.g., eggs, frozen sperm, as import material instead of whole organisms to reduce the risk of introducing disease or unintended organisms.

50.3 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS early in the project cycle to reduce the potential environmental impacts associated with construction and operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

Note

In addition to the environmental permit, some Introduction/importation of alien species enterprises/activities will require a CITES Import Permit if the species that are listed in the Endangered Species Act, see section 2.5.

CHAPTER 51

FELLING TREES AND CLEAR CUTTING

51.0 FELLING OF TREES AND CLEARING OF LAND

The felling of trees and clearing of land of 10 hectares or over for Agricultural Development requires approval.

Land clearing is the development of land with potential for agricultural use. Land clearing requires the removal of native cover, including trees (by felling), bushes and boulders from the land surface. The land must then be broken in order to get a workable seedbed into which a crop can be seeded. Land breaking includes the removal of roots, stumps and rocks.

Land clearing methods will vary depending on the type and density of the native cover. It includes burning, manual and mechanical methods, as well as the use of chemicals.

51.1 ENVIRONMENTAL CONSIDERATIONS

The following paragraphs look at some information that should be considered during the planning stages of these types of projects.

51.1.1 Impacts on Natural Environments

i Changes in resources critical to the wilderness area - water quality, freshwater flow, tidal flushing, ambient air quality, nutrient cycles etc.

ii Reduction in numbers, diversity and productivity of plant and animal species

iii Loss of natural services (e.g. waste absorption capacity, erosion control, and groundwater recharge)

iv Reduction in social benefits and services (e.g. recreation, aesthetic enjoyment, conservation education, medical research)

v Secondary impacts resulting from improved access to wilderness areas (e.g. tourism, poaching, disturbance to wildlife, illegal conversion to other land" use, illegal harvesting).

51.1.2 Impacts on Wetlands

i Wetland clearing leading to salinity intrusion, loss of functional goods and services produced by wetland, reduced habitat for aquatic and migratory birds

ii Drainage of wetland causing reduced freshwater fisheries production, reduced river baseflows and water supplies

iii Mangroves clearing causing adverse impact on estuarine fisheries, reduction in wildlife habitats, loss of a natural barrier against flooding and erosion

51.2 ENVIRONMENTAL IMPACTS

The following paragraphs look at the impacts on the environment that should be considered for these development projects.

51.2.1 Air Quality

i The three main disturbances mentioned are odour, noise and dust. Of particular concern to land clearing practices is dust.

ii Dust is generated by a variety of activities that require the use of equipment. It may also be generated as 'fugitive dust' when fine particulate is lifted from fields, roads, buildings and yards by the stirring action of air. Most land clearing equipment generates some dust.

iii Dust in the air is defined as fine-grained suspended particulate. The perception of dust as a nuisance will depend on the frequency, intensity and duration of the dust-generating event.

51.2.2 Salinity, Soil Erosion and Water Quality Decline

i Removal of deep-rooted native vegetation upsets the natural balance of rainwater infiltration versus plant water use. The reduction in water usage when native vegetation is cleared may cause salty groundwater to rise towards the surface soils, leading to dry land salinity and rising salinity levels in rivers.

ii Land clearing also causes water quality decline as a result of soil erosion, sedimentation and nutrient loading in rivers and streams. Salinity trends relate to a range of factors including type of vegetation and cover, climate history, rainfall, topography, geology and hydrogeology.

iii Depending on local and regional circumstances, the hydrological balance may change such that salinisation of land and water resources may result at some stage in the future.

51.2.3 Loss of Native Plants and Animals

When native bushland is destroyed, birds, mammals and other wildlife lose their food and shelter. The displaced wildlife either dies immediately or soon after land clearing, from starvation, predation or stress. The size and connectivity of remnant areas of vegetation are therefore, extremely important for wildlife conservation. Sediment and nutrient run-off from cleared land may also be damaging the marine environment.

51.3 Environmental Management Systems

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS early in the project cycle to reduce the potential environmental impacts associated with construction and operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

51.4 Standards

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)

- Noise (Appendix 7)

51.5 Clear Cutting of Forested Areas and Clearing of Trees

This activity requires permission when it is to be carried out on land 3 hectares and over or on slopes greater than 25 degrees. Clear cutting is the removal of the entire standing crop of trees. In practice, it may refer to exploitation that leaves much unsaleable material standing (e.g. a commercial clear-cutting).

51.6 Environmental Considerations

51.6.1 Planning Considerations

The following information should be considered during the early planning of these types of projects.

i Changes in resources critical to the wilderness area - water quality, freshwater flow, tidal flushing, ambient air quality, nutrient cycles etc.

ii Reduction in numbers, diversity and productivity of plant and animal species

iii Loss of natural services (e.g. waste absorption capacity, erosion control, and groundwater recharge)

iv Reduction in social benefits and services (e.g. recreation, aesthetic enjoyment, conservation education, medical research)

v Slope stability and soil erosion potential.

51.6.2 Assessment of Fauna

Special care should be given to the assessment of fauna that inhabit the area to be deforested or cleared. It should be noted whether the area proposed for clearance houses any species that depends solely on that habitat for survival.

51.6.3 Considerations when Clear Cutting

When clear cutting, the following should be considered:

i Saline intrusion,
ii Loss of functional goods and services produced by wetlands,

iii Reduced habitat for aquatic and migratory birds,

iv Drainage of wetland causing reduced freshwater fisheries production, reduced river baseflows and water supplies.

51.6.4 Clear Cutting Mangroves

The clear cutting of mangroves will also cause:

i Adverse impacts on estuarine fisheries,

ii Reduction in wildlife habitats,

iii Loss of a natural barrier against flooding and erosion.

51.7 ENVIRONMENTAL IMPACTS

The following paragraphs look at the impacts on the environment that should be considered for these development projects.

51.7.1 Air Quality

The main concern of clear cutting is dust. Dust is generated by a variety of activities that require the use of equipment. It may also be generated as 'fugitive dust' when fine particulate is lifted from fields, roads, buildings and yards by the stirring action of air. Dust in the air is defined as fine-grained suspended particulate. The perception of dust as a nuisance will depend on the frequency, intensity and duration of the dust-generating event.

51.7.2 Water Quality

Water quality may be affected by clear cutting as follows:

i Destabilisation of the local hydrology, both for surface and groundwater (e.g. increased flooding and flood frequency, dry streams, reduced/increased base flows),

ii Logging operations and access roads causing increased runoff, sedimentation of surface watercourses, reduced water supply and quality,

iii Increased sediment in aquatic environments causing increased Biological Oxygen Demand (BOD), placing fish and aquatic flora under oxygen stress,

iv Temporary or permanent covering of benthic organisms, v Sediment of high nutrient content carried to still water bodies (e.g. lakes, lagoons) resulting in a high BOD.

51.7.3 Biodiversity

When native forests are destroyed, birds, mammals and other wildlife lose their food and shelter. The displaced wildlife either dies immediately or soon after land clearing, from starvation, predation or stress.

Additionally, clear cutting may lead to the following:

i Siltation of reservoirs, thereby causing a reduction in capacity, reduction in power generation and shortening of project's life span;

ii Physical damage to historical artifacts and landforms;

iii Changes to the micro-climate (e.g. humidity, precipitation).

51.8 ENVIRONMENTAL MANAGEMENT SYSTEMS

An environmental management system (EMS), as defined by the International Organisation for Standards (ISO), is

> *"that part of the overall management system that includes organisational structure, planning activities, responsibilities, practices, procedures, processes and resources for developing, implementing, achieving, reviewing and maintaining the environmental policy."*

An EMS is seen as an important tool in reducing and controlling the negative impacts of man's activities on human health and the environment. Every developer should consider the implementation of an EMS early in the project cycle to reduce the potential environmental impacts associated with construction and operation activities.

N.B. For additional information on Environmental Management Systems, please contact NEPA. For information on implementing EMS, the developer should consult the "Guidelines for a NEPA-Acceptable Environmental Management System"

51.9 STANDARDS

There are standards that are pertinent to the permit application for this category of development. In relation to environmental management, developers must take the following standards into account to ensure that activities are compliant:

- Ambient Air Quality (Appendix 5)
- Noise (Appendix 7)

CHAPTER 52

BEACH LICENCES

52.0 BEACH LICENCES

The following are the general guidelines for beach licence applications.

52.0.1 The Beach Control Act

52.0.2 Main Provisions

The Beach Control Act was promulgated in 1955 and the Beach Control Regulations in 1956 to ensure the proper management of Jamaica's coastal and marine resources by a system of licensing of activities on the foreshore and the floor of the sea[30]. The operative terms in the Act are the foreshore and the floor of the sea. The foreshore is the area of the coastline that can be defined as "The part of the shore, lying between the berm crest and the ordinary low water mark, which is ordinarily traversed by the up-rush and backrush of the waves as the tides rise and fall[31] "

The Act was amended in July 2004 to include jurisdiction over the water column. The "floor of the sea" means the soil and the subsoil off the coasts of the Island between low water mark and the outer limits of the territorial sea of the Island and shall be deemed to include the water column above/super-adjacent to the floor of the sea and the natural resources therein and the Exclusive Economic Zone[32].

52.0.3 Other Provisions

The Act also makes provisions for the preservation of access to the foreshore that has been enjoyed by traditional users, such as fishermen. Additionally, it also seeks to preserve rights of access to the foreshore for members of the public, who can demonstrate that they have had access to the foreshore for recreational uses without any hindrances or requirements for receiving permission over a prescribed period of time.

30 Jamaica's Commitment to the Conservation and Management of Natural Resources Ten Years in Retrospect; Unpublished Paper, National Environmental and Planning Agency; Kingston, Jamaica (March 2002)
31 Web based definition
32 Amendment to the Beach Control Act July 2004, Section 2

52.1 Geographical Scope

The Beach Control Act governs activities on the foreshore and the floor of the sea and its geographical scope of influence extends from the shoreline to the limit of the island's territorial and contiguous maritime zones.

52.2 REGULATED ACTIVITIES

Generally speaking, commercial activities occurring on the foreshore or the floor of the sea are regarded as encroaching on these areas and licences will be required in order to permit these encroachments. Such encroachments include the following:

i Person interactions, such as the traversing of the foreshore and the floor of the sea for water sports and recreational bathing (licences would be only applicable where it is used in conjunction with commercial use – persons who are using the foreshore and the floor of the sea (bathing and watersports activities for private use would be exempted under the Beach Control Act from applying for a licence).

ii The deployment of physical structures such as:

- Groynes
- Breakwaters
- Boat docking facilities
- Pipelines
- Cables
- Moorings
- Anchored Rafts
- Waterslides
- Boat Ramps
- Pilings
- Artificial Reefs

iii Coastline reclamation (Land creation on or dredging from the seafloor)
iv Seawall
v Pylons
vi Flight of steps
vii Enclosed pool
viii Pump
ix Building
x Plume
xi Duct

52.3 METHODS OF REGULATION - APPLICATIONS

Permission to use or encroach on the foreshore or the floor of the sea is granted upon the receipt and processing of an Application for Licence. This application has two parts, or more appropriately, forms.

52.3.1 Application for Licence Form A (See Appendix 12)

The Application for Licence also known as "Form A" facilitates the provision of information on the nature of activities, whether it is just for the use of the foreshore and the floor of the sea for commercial/recreational activities in regard to hotels, guesthouses, dwelling houses or building. It should be noted that there are four major types/ classes of beaches:

i commercial recreational, this is used for public uses, proprietary and members' club, e.g. Dunn's River;

ii beaches used in connection with dwelling places, etc.

iii Industrial beach – (wharves), Kingston Wharves, Port Esquivel etc); and

iv Fishing beaches.

52.3.2 Information Required

It also provides information on land access to the foreshore. This is important because one would have to demonstrate that he or she has legal access to the land adjoining the foreshore and the floor of sea (submission would include a copy of Registered Title (if applicable) or any other document which shows ownership of the beach property. A sketch or site plan of the area to be licensed must be submitted. If the applicant is not the owner, the Agency would request the following information a letter from the owner, signed by a Justice of the Peace that the owner has given permission to the applicant to use the foreshore and the floor of the sea adjoining the owner's property in connection with the activity. Documentation, which proves ownership of the property is also required.

52.3.3 Encroachment

The type and location of the encroachment and the length / dimensions of the foreshore or floor of the sea upon which the encroachment will be conducted. If the encroachment is one involving physical alterations of or additions to the foreshore or the floor of the sea, diagrams illustrating the design of the alterations or additions will be required for submission along with the application. Additionally, a description of the methods to be used to deploy or construct the structures or features will be required, inclusive of diagrams and supporting photographs of the area.

The Beach Control Act makes provision for the maintenance of encroachments for which licences have been issued –maintenance should be done under the professional supervision of trained personnel who are qualified and competent to carry out coastal engineering works.

52.4 Application for Licence Form B (See Appendix 13)

The Notice of Application is also called Regulation 4 of the Beach Control Act. Form B is a standardized method of informing the public and neighbours adjoining the area on which an encroachment or recreational activities is intended, that the applicant intends to conduct activities in these areas. The Notice of Application usually accompanies the Application for Licence. It must not be returned to the Agency, but the applicant should comply with the requirements as outlined on the form.

i Exhibition of Notice

Every applicant for a licence shall exhibit for a period of at least one month after the application has been received by the Authority, notices in the Form B set out in the First Schedule to these Regulations in a conspicuous place on that part of the foreshore mentioned in the application and on any land adjacent thereto and under the control of the applicant.

ii Placement of Notice

The notice on the foreshore shall face and be visible from the sea and that on the adjacent land shall be placed on the verge thereof which is nearest to a main or parochial road or path used by the public and shall if possible face and be visible from such road or path. This allows for passers by to be aware of the intentions of the applicant.

iii Serving of Notice

The applicant shall serve, either personally or by registered post a copy of the notice on every person, who is the owner of any land adjacent to the area defined in paragraph 2 of the application, so, however, that failure to comply with the provisions of the paragraph shall not be deemed to invalidate any licence granted by the Authority.

52.5 Notice of Application and Inspection

After the notices have been posted, the applicant must notify the National Environment and Planning Agency in order that an inspection can be conducted at the site to verify compliance. A photograph of the notices is taken as a record for the physical file. It should be noted that an application is only complete when the applicant has complied with the Notice of Application.The application should not be presented to the Natural Resources Conservation Authority's meeting if this is not done.

52.6 Where to obtain forms

The application forms may be accessed on NEPA's website at:

www.nrca.org/business/guidelines/general/Guidelines for Project Proponents.pdf

They can also be obtained from NEPA's main office and the regional offices.

52.7 Concerned Persons Comments

Once the notification signs and letters have been issued and posted, concerned persons have 30 days within which to make comments, concerns and objections known to the regulating Agency. The processing of an application will not be completed until the notification period has expired, since comments, concerns or objections tendered by neighbours or the public are vital as contributions to the application review process.

52.8 Methods of Regulation – Processing

52.8.1 Commercial Recreational use

Applications for the use of the foreshore and the floor of the sea for commercial recreational use are scrutinized primarily for their treatment of water safety matters and the Beach Control Act Safety Regulations provide a list of the safety equipment that will be required at each activity site. Such equipment would include:

i Lifeguard stands and appropriate numbers of trained and certified lifeguards

ii Life Rings

iii First Aid Kit

iv Demarcated swimming areas

v Demarcated boat access areas, which are isolated from swimming areas.

52.8.2 Examination of area and Type of Activity

Additionally, the proposed activity area would have to be examined to ensure that the seafloor and oceanographic conditions present at the location are conducive to safe recreational use and any hidden danger identified (deep holes, sharp rocks or rip currents) would have to be clearly identified using signs. Additionally the proposed activity is examined to ensure that it will not result in any deleterious effect on the environmental public health.

52.8.3 Area May be deemed unsafe

Note that if the locations of hidden dangers outnumber the locations of safe areas for swimming within the area being applied for, then it is very likely that the entire area will be deemed unsafe for recreational use.

52.8.4 Physical Encroachments

For physical encroachments, such as groynes or dredging, a screening of the application is conducted, using an analysis of the possible environmental impacts that could occur as a result of the construction and operation of the encroachment. If the screening process reveals the possibility for negative environmental impacts, then an environmental impact assessment is requested. Standard terms of reference will be submitted to the proponents to guide the EIA preparation process and a decision is then made based on the mitigation measures provided by the EIA process.

52.8.5 Contents of Written Submission

In both application cases outlined above, written submissions will be prepared for presentation to NEPA's Internal and Technical Review Committee Meetings. These meetings are held in order to review and formulate recommendations on applications to the Natural Resources Conservation Authority board for final ratification.

Submissions will include:

i Name and Address of Applicant

ii Address of proposed encroachment

iii Description of Encroachment

iv Environmental Considerations / possible impacts / stated mitigation measures

v Recommendation for or against approval

vi Recommended Conditions of approval

In addition, the application will also cite relevant technical documents that will be used to provide guidance for reviews and conditions for the implementation of specific encroachments. An example of these guides is located on NEPA's website at:

www.nrca.org/publications/guidelines/index.htm

They can also be viewed at NEPA's offices.

52.9 THE APPELLANT PROCESS

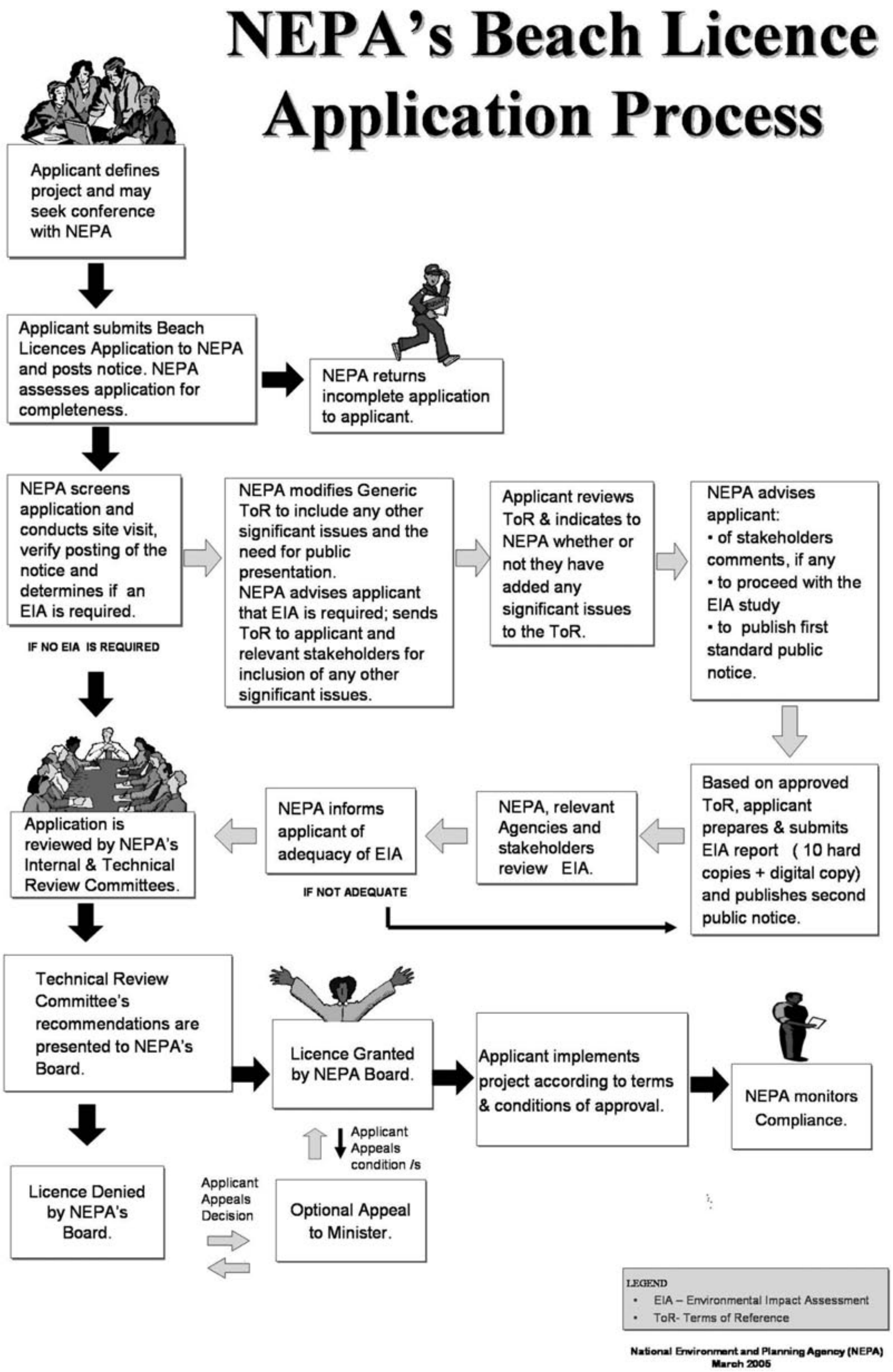
Section 55 of the Beach Control Act states that any person aggrieved by the decision to grant or refuse a licence under the Beach Control Act may appeal to the Minister in writing within six weeks after publication in the Gazette of the grant or refusal of the licence.

Note -All licences issued under the Beach Control Act must be gazetted.

52.9.1 Beach Licence Application Process

NEPA's Beach Licence Application process can be seen at figure 2.

Figure 2 Flowchart for the processing of the application for Beach Licence is outlined below.



52.10 THE BEACH CONTROL ACT (THE BEACH CONTROL AUTHORITY LICENSING REGULATIONS, 1956)

(Licence under the Beach Control Authority for any modification to the Foreshore and Floor of the Sea).

52.11 BEACH LICENCE APPLICATION CHECKLIST

The following is the beach licence application checklist.

i Beach Licence Application Form (must be signed by Applicant and Justice of the Peace)

ii Completed Permit Application Form (if the project which falls within any of the prescribed categories).

iii Completed Licence Application Form (if there will be a discharge of Trade or Sewage and or Poisonous or Harmful Substances into the environment).

iv Completed Project Information Form (if the project falls within any of the prescribed categories).

v Location Map (Drawn to Scale)

vi Layout Plan of the area and encroachments to be licenced (including dimensions)

vii Detail Design of Project (including the proposed method of sewage treatment and disposal, if applicable)

viii Proof of Ownership of Property (Registered title or information on land ownership) or Permission letter/lease supported by Proof of Ownership.

ix Project Brief

x Application Fee of $1000.00

xi TRN

xii Contact information - Telephone, Cellular phone, Fax, Email xiii Indication that Form B, NOTIFICATION REQUIREMENTS have been carried out

- Indication that signs have been posted
- Indication that neighbours have been notified by registered mail

52.12 REQUIREMENTS FOR PROCESSING APPLICATION FOR BEACH LICENCE

i The Application for Licence (Form A-See Appendix 12) must be properly completed, signed and returned with the prescribed application fee of $1,000.00 *(this fee is subject to change)*. Applicants are required to submit a sketch plan or site plan of the area to be licensed and a copy of the Registered Title (if applicable) or any other document which shows ownership of the beach property. The site plan must illustrate clearly the locations where the encroachments will take place and designs that will describe any structure for which an application is being sought.

ii The Applicant is encouraged to furnish any technical information that will aid in the interpretation and processing of the application, inclusive of encroachment functions and rationale, dimensions, construction methods etc. This is to be submitted along with the application form.

iii If the applicant is not the owner, he/she must submit along with the application form a letter from the owner, signed by a Justice of the Peace that he/she has given permission to use the foreshore and the floor of the sea adjoining his/ her property in connection with the activity. Also documentation must be submitted, which confirms that he/she is the owner of the property.

iv If the form is not properly completed then the application will not be processed. The applicant's TRN, telephone and Fax Numbers (if any) and mailing and e-mail addresses should be clearly written.

v The applicant is required to comply with the requirements of the Notice of Application (Form B). This must be in the form of a Notice. Copies of this Notice shall be posted on the landward and seaward sides of the property and copies of said Notice served on the adjoining neighbors by registered mail. Copies of the notifications submitted to adjoining neighbours must also be submitted to the Authority as proof of written notification.

Additionally, when the applicant has posted the notices, he/she should inform NEPA in order that a site inspection can be conducted to verify compliance.

vi The Notice of Application (Form B See Appendix 13) shall be exhibited for a period of at least one month after the application has been received by the Authority.

CHAPTER 53

CITES PERMIT APPLICATION

53.0 GENERAL GUIDELINES FOR CITES PERMIT APPLICATIONS

The international trade in a number of species of plants and animals is governed by the Convention on International Trade in Endangered Species 1973 (CITES) and the Endangered Species (Protection, Conservation and Regulation of Trade Act), 2000.

CITES is an international convention that regulates trade and ensures sustainable utilization of wild fauna and flora. The Endangered Species (Protection, Conservation and Regulation of Trade) Act enables Jamaica to fulfill its obligations as a Party to the Convention and provides for the protection, conservation and management of endangered species of wild fauna and flora and gives the mandate for regulation of trade in such species to be exacted.

53.1 APPLICATION FOR EXPORT PERMIT (SEE FIGURE 3 CITES EXPORT PERMIT APPLICATION PROCESS, AT PAGE 326)

The application for an export permit is also subject to:

i The requirements outlined in Individual Export Quota.

ii The submission of a completed Export Permit application on the prescribed form and accompanied by the prescribed fee.

iii a Health Certificate from the Veterinary Services Division, Ministry of Agriculture and the Ministry of Health.

53.2 TIMING

Length of processing of application for species other than Queen Conch will be dependent on the CITES schedule under which the species is listed.

i Schedule I species are endangered due to international trade. Their exchange is permitted only in exceptional circumstances.

ii Schedule II species are subject to strictly regulated trade based on: quotas and/or permits to prevent their unsustainable use and controls to maintain ecosystems and prevent their unsustainable use and controls to maintain ecosystems and prevent species from becoming eligible for Appendix 16.

iii Schedule III species are subject to regulation by a Party who requires the cooperation of other Parties to control international trade.

iv Schedule IV species are Jamaican species not under Schedules I to III which the countries believe should be regulated.

53.3 EXPORT PROCEDURES FOR OTHER SPECIES

To export plants or animals listed under the Endangered Species Act:

i An export application form shall be submitted to NEPA and the requisite fee paid. The application shall be accompanied by a health certificate from the Veterinary Services Division (animals) or a Phytosanitary Certificate from the Plant Quarantine Division, Ministry of Agriculture.

ii The species to be exported is taken to NEPA for inspection. Where the quantity to be exported is large, the NEPA facilitates by visiting the location where the species for exportation are kept.

iii Minimum processing time is 24 hours.

iv The permit is issued once the requisite fee is paid and documentation is received.

v There are instances when the Scientific Authority may review the application for export.

53.4 EXPORT PROCEDURES FOR QUEEN CONCH

To export Queen Conch meat, persons:

i Must apply, on the prescribed form, for Individual export quota to the CITES Management, Natural Resources Conservation Authority, 10 Caledonia Ave. Kingston 5.

ii Each application must be accompanied by the requisite application fee, a Fisheries Division Certificate of Inspection and a Veterinary Division Certificate Certifying the Quality of Conch in storage.

iii Must have an Individual conch quota pursuant to the Fishing

Industry (Conservation of Conch (Genus Strombus) Regulations, 2000.

iv Have already harvested the Conch allocated to him/her in his/her Individual Conch Quota.

53.5 Import Procedures
Please See Figure 3 CITES Import Permit Application Process

To import either plant or animal:-

i Applicant must submit the application form and pay the requisite fee. This shall be accompanied by a copy of the export permit from the country of origin.

ii The application is reviewed and if approved the applicant is informed to pay the requisite permit fee.

53.6 Re-export Procedures
Please See Figure 3 CITES Re-export Permit Application Process

To re-export either plant or animal:

i Applicant must submit copy of import permit and pay the requisite fee.

ii The application should be accompanied by either a Health Certificate from the Veterinary Division or Phytosanitary Certificate from the Plant Quarantine Division of the Ministry of Agriculture.

iii Normal processing time is 24 hours.

iv Permit is issued if application is approved and the requisite fee paid.

53.7 Exemption for the Keeping of Protected Species

Persons who wish to keep protected animals:

i Must complete the requisite application form.

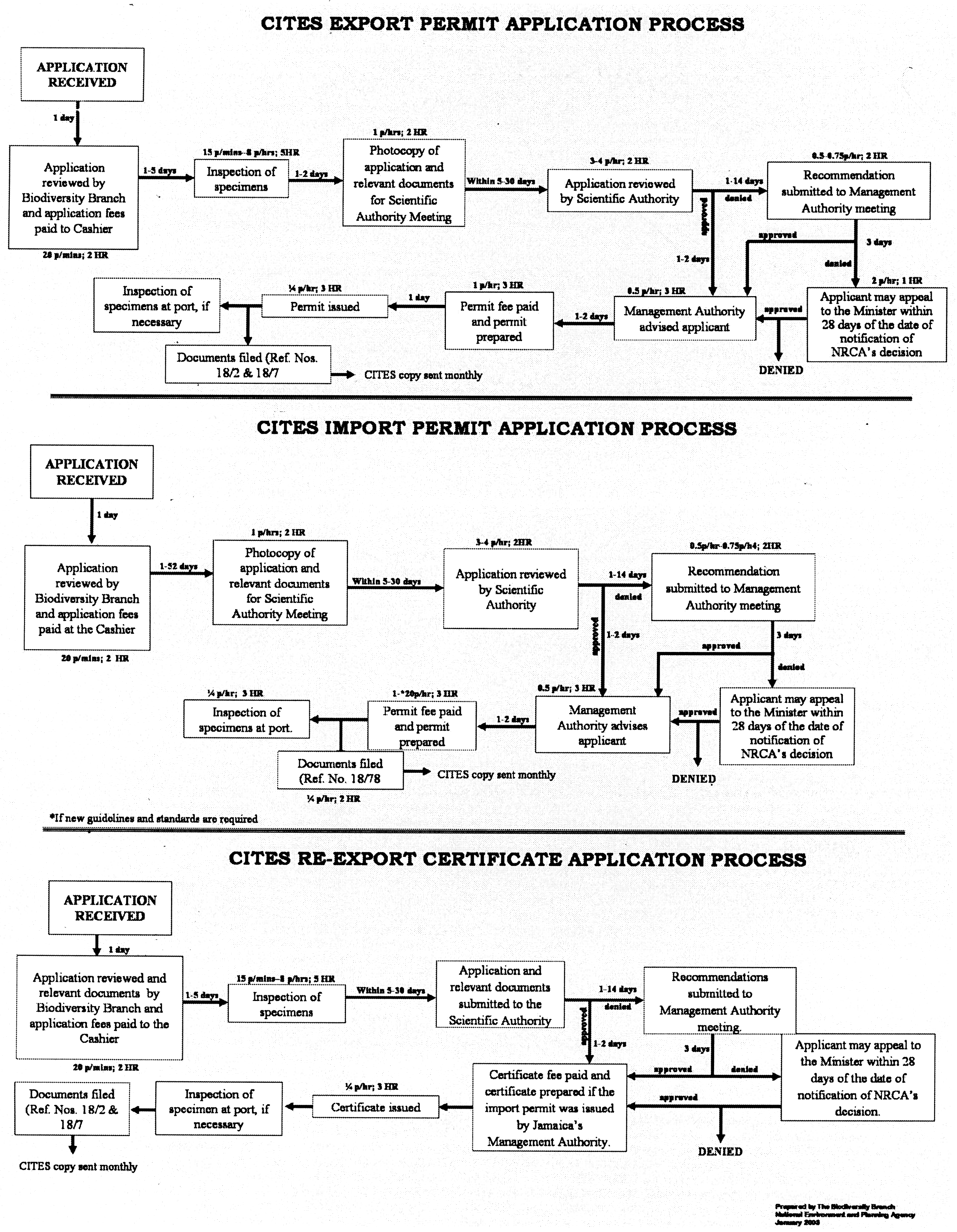
ii The area/enclosure in which the animal is to be kept is inspected.

iii The application is submitted through the International Review Committee(NEPA) Technical Review Committee of the National Resource Conservation Authority and then to the National Resource Conservation Authority.

iv The conditions are reviewed by the Legal Branch

v The certificate is prepared for the Ministry of Local Government and Environment if the application is approved by NRCA.

Figure 3 Flowchart for the processing CITES applications are outlined below:



CHAPTER 54

GENERAL ENVIRONMENTAL INFORMATION

54.0 GENERAL

This chapter provides additional general information to augment that provided in the previous sections on Environment and Planning. This covers themes such as Coastal and Riverine Areas, Wetlands, Watersheds, Protected Areas, Biodiversity and Global Warming and Climate Change.

54.1 COASTAL AND RIVERINE AREAS

Critical areas of concern for developments in coastal and riverine areas include :- setback from the high water mark; sewage treatment and disposal; construction along beachfront riverbank, or the floor of the sea; public access.

54.1.1 Setback

i Setbacks from the shoreline are important, since it has been determined that there is a direct link between building proximity to the shoreline and shoreline stability during storms.

ii The planning guidelines for setbacks from the shoreline allow for variable distances from the shoreline, depending on the slope of the shoreline. This distance varies from 7.6m (25feet) setback from cliffs (1:1-1:3 slopes), 15.2m (50ft) setbacks from moderately sloping shorelines (1:4-1:20 slopes) and 30.4m (100ft) setbacks from minimally sloping shorelines (>1:20 slopes). However, recent storm events have shown that these setbacks are not adequate.

The KSAC and NEPA have jointly proposed new minimum setbacks of 50 metres for residential developments with coastal St. Andrew, following the passage of Hurricane Ivan, since the extent of maximum damage resulting from storm surge influence occurred within this distance of the shoreline. This extent of storm surge was not consistent for the entire island. The Portland Cottage area of Clarendon had storm surge influences ranging in excess of a kilometre inland from the shoreline during Hurricane Ivan. Also, during Hurricane Allen in 1980, storm surge influence in Galina St. Mary, extended in excess of 100 metres inland.

iii It is therefore clear that setbacks will have to be developed for each parish, based on past storm experiences. In the interim, it is proposed that either a minimum development setback of 50 metres be advocated Islandwide, or that engineering solutions be implemented to promote an unimpeded movement of storm waves inland. The construction of buildings on stilts or columns, designed for a predictable storm waves height, is an example of such an engineering solution.

54.1.2 Sewage Treatment and Disposal

i Sewage disposal to rivers and the sea introduces nutrients (nitrates and phosphates) into an environment that is naturally devoid of these components. Such nutrients result in the overgrowth of both attached and free-floating plants, which out compete naturally occurring riverine and marine species for space. It is therefore vital that sewage be treated to a standard of quality that will ensure that these nutrients are kept from these environments.

ii Nitrate contributions to the marine environment can be derived from sewage and riverine discharges, since nitrate bearing compounds are quite common in the natural environment. Phosphate contributions, however, are derived from detergents and soaps and will be introduced into the environment through the discharge of sewage effluent. Since plant growth requires both the contribution of nitrates and phosphates for successful growth, the adoption of the use of phosphate-free detergents will effectively negate against such growths. In any instance, direct discharge to the marine environment or surface water bodies is generally discouraged. See Volume 3 Section 4 Wastewater Treatment and Excreta Management for details.

54.1.3 Construction of Structures along the Shoreline

i No fence, hedge, wall or any other structure should be erected on or below the High Water Mark without prior approval of the Natural Resource Conservation Authority under the Beach Control Act. This applies also to land reclamation.

ii Structures above the High Water Mark should be located behind the natural beach berm in order to achieve the following:

- Maintenance of public access along beaches.

- Maintaining the natural ability of the coastline to recover from storm events (see comments under setback).

- Maintaining natural beach and beach vegetation conditions to promote Turtle nesting where these exist.

iii Specific planning is required for the deployment of structures below the High Water in order to ensure that such structures are not deployed on sensitive resources residing on the seafloor, such as Coral Reefs and Seagrass beds.

54.1.4 Public Access

Where developments along the coast are proposed, the existing uses by the public shall be taken into account. In such a case, the developer shall be required to provide at least one lot of suitable size to be designated as a public beach. This lot should not represent an area considered unsuitable for development or land left over after development, but must be incorporated and presented as part of the original subdivision proposal.

54.2 WETLANDS

54.2.1. Definition of Wetlands

A wetland is any land saturated with water long enough to promote wetland or aquatic processes as indicated by poorly drained soils, hydrophytic vegetation, and various kinds of biological activity that are adapted to a wet environment[33]. Wetlands are classified based on:

i Acting as nursery and breeding areas for commercially exploitable species of aquatic life

ii Species diversity

iii Structure

iv Ecological functions and potential for economic exploitation

33 Entrix Inc., Pacific Watershed Associates, Circuit Rider Productions Inc., Navarro Watershed Community Advisory Group, and D.T. Sicular. 1998

54.2.2 Development/Subdivision of Wetlands

The development or subdivision of these areas must not be undertaken without consultation with the Natural Resources Conservation Authority.

In cases where the proposed development will significantly impair the functions of a particular wetland, the developer will be required to conduct an EIA detailing the potential environmental consequences of the development. The terms of reference for the EIA will be developed by the NRCA who will also be responsible for its review. Development or subdivision approval will be contingent on NRCA's recommendation resulting from the review.

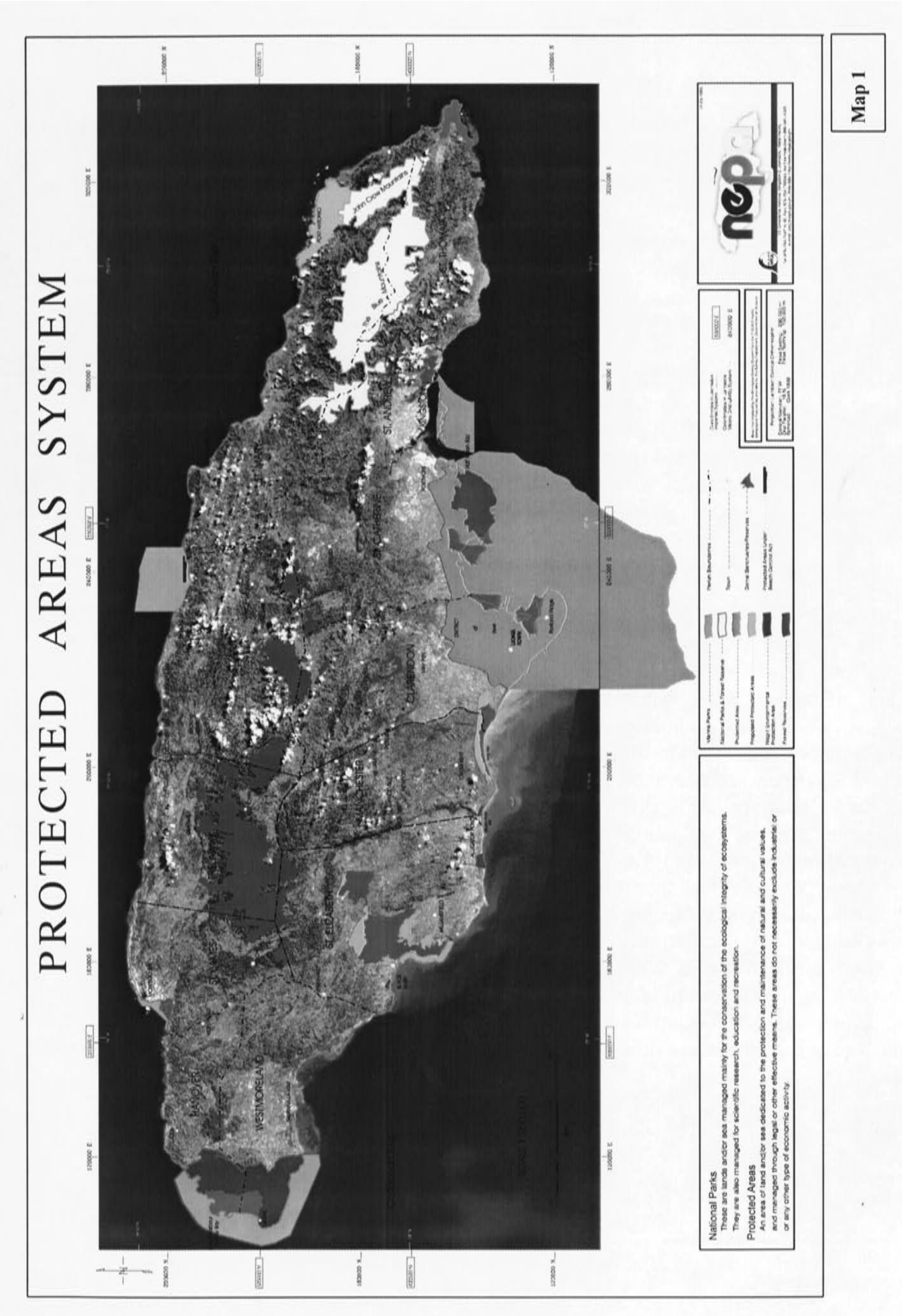
54.3 PROTECTED AREAS

A protected area is defined in the Policy for Jamaica's System of Protected Areas (1997) as an "...area of land or water that is managed for the protection and maintenance of its ecological systems, biodiversity and/or specific natural, cultural or aesthetic resources". Protected areas include those declared under the Beach Control, Wild Life Protection, Forest, Fishing Industry, Natural Resources Conservation Authority and Jamaica National Heritage Trust Acts. Protected areas include public and private lands. Developments in these areas will be required to conform to and be compatible with the protected area's overall management objectives and associated regulations. See Maps 1 and 2.

54.3.1 Areas Adjacent to Protected Areas

Areas immediately bordering protected areas are of special concern since the developments proposed for such areas will impact upon the environment of the protected area. In these situations the developer might be required to submit an EIA detailing the potential environment implications of the development especially as it affects the protected area. Generally, heavy industrial and high-density developments should not be planned for areas bordering a protected area.

Below, see a map and a list showing some of the Protected Areas in Jamaica (Map1)


PROTECTED AREAS SYSTEM
Map 1
WESTMORELAND
ST. ELIZABETH
CLARENDON
ST. ANDREW
John Crow Mountains
National Parks
These are lands and/or sea managed mainly for the conservation of the ecological integrity of ecosystems.
They are also managed for scientific research, education and recreation.
Protected Areas
An area of land and/or sea dedicated to the protection and maintenance of natural and cultural values,
and managed through legal or other effective means. These areas do not necessarily exclude industrial or
or any other type of economic activity.

PROTECTED AREAS

A Table showing Protected Areas in Jamaica.

PROTECTED AREA	DECLARATION DATE	*ACT*
Montego Bay Marine Park	June 5, 1992	NRCA
Blue and John Crow Mountains National Park	**February 26, 1993**	**NRCA**
Negril Environmental Protection Area	**November 28, 1997**	**NRCA**
Negril Marine Park	**March 4, 1998**	**NRCA**
Palisadoes/Port Royal Protected Area	**September 18, 1998**	**NRCA**
Coral Spring – Mountain Spring Protected Area	**September 18, 1998**	**NRCA**
Portland Bight Protected Area	April 22, 1999	NRCA
Ocho Rios Marine Park	**August 16, 1999**	**NRCA**
Mason River Protected Area	**November 14, 2002**	**NRCA**
Ocho Rios Protected Area	**April 7, 1966**	**BCA**
Port Royal Protected Area	**May 8, 1967**	**BCA**
Bogue Lagoon Creek Game Reserve, Montego Bay, St. James	December 12, 1963	WLPA
Kingston and St. Andrew Game Reserve	**April 15, 1971**	**WLPA**
Knapdale Game Reserve, St. Ann	**January 1963**	WLPA
Reigate Game Reserve, Manchester	**June 6, 1968**	**WLPA**
Stanmore Hill Game Reserve, St. Elizabeth	**July 19, 1988**	WLPA
Alligator Pond, Guts River and Canoe Valley Game Reserve, Manchester/Clarendon	**August 22, 1997**	**WLPA**
Amity Hall Game Reserve, St. Catherine	**August 22, 1997, amended July 28, 2004**	**WLPA**
Bogue Lagoon Creek Game Reserve, Montego Bay, St. James	**August 22, 1997**	**WLPA**
Glistening Waters Game Reserve, Falmouth, Trelawny	**August 22, 1997**	**WLPA**
The Great Morass Game Reserve, Holland Bay, St. Thomas	**August 22, 1997, amended July 28, 2004**	**WLPA**
The Lower Morass, Black River Game Reserve, St. Elizabeth	**August 22, 1997, amended in 1998**	**WLPA**

The Great Morass Game Reserve, Negril, Westmoreland/Hanover	**August 22, 1997**	**WLPA**
The Great Morass Game Reserve, Parottee, St. Elizabeth	**August 22, 1997**	**WLPA**
Upper Morass, Black River Game Reserve, St. Elizabeth	**August 22, 1997**	**WLPA**
Cabaritta Point Game Reserve, St. Catherine	**August 21, 1998**	**WLPA**
Long Island Game Reserve, Clarendon	**August 21, 1998**	**WLPA**
Mason River Savanna Game Reserve, Clarendon	**August 21, 1998**	**WLPA**
West Harbour, Game Reserve, Clarendon	**August 21, 1998, amended in 1999 and July 28, 2004**	**WLPA**
Portmore and Greater Portmore Game Reserve, St. Catherine	**July 28, 2004**	**WLPA**
Fairy Hill-Port Antonio Game Reserve, Portland	**July 28, 2004**	**WLPA**

BCA- Beach Control Act
NRCA-Natural Resources Conservation Authority Act
WLPA-Wild Life Protection Act

54.4 WATERSHED AREAS

A watershed is an area of land, which is drained by rivers and their tributaries. There are 26 declared watershed areas in Jamaica (Appendix 2). Watershed management is important to ensure adequate water supplies, good quality water, prevention of floods and associated loss of life and property, and prevention of soil erosion. As such, subdivisions and developments in declared watershed areas must conform to the provisions of the Watersheds Protection Act.

Generally subdivisions and developments in declared watersheds must be guided by the considerations set out below. These guidelines are not, however, exhaustive:

i Minimal land clearing will be allowed since every effort must be made to obtain as much vegetation cover as possible. Each developer is required to ensure that a minimum of (25%) natural vegetation cover is retained and as far possible efforts will be made to preserve trees with trunk diameter of 0.3m (1') measured at a height of 0.9m (3') above ground.

ii All exposed (vegetation cover removed) soil remaining after completion of development must be adequately re-vegetated and landscaped to the satisfaction of the Authority.

iii Where developments and sub-divisions are proposed for sloped areas and are acknowledged as having potentially deleterious effects with respect to soil erosion, the developer will be responsible for instituting erosion control methods considered adequate by the National Environment and Planning Agency.

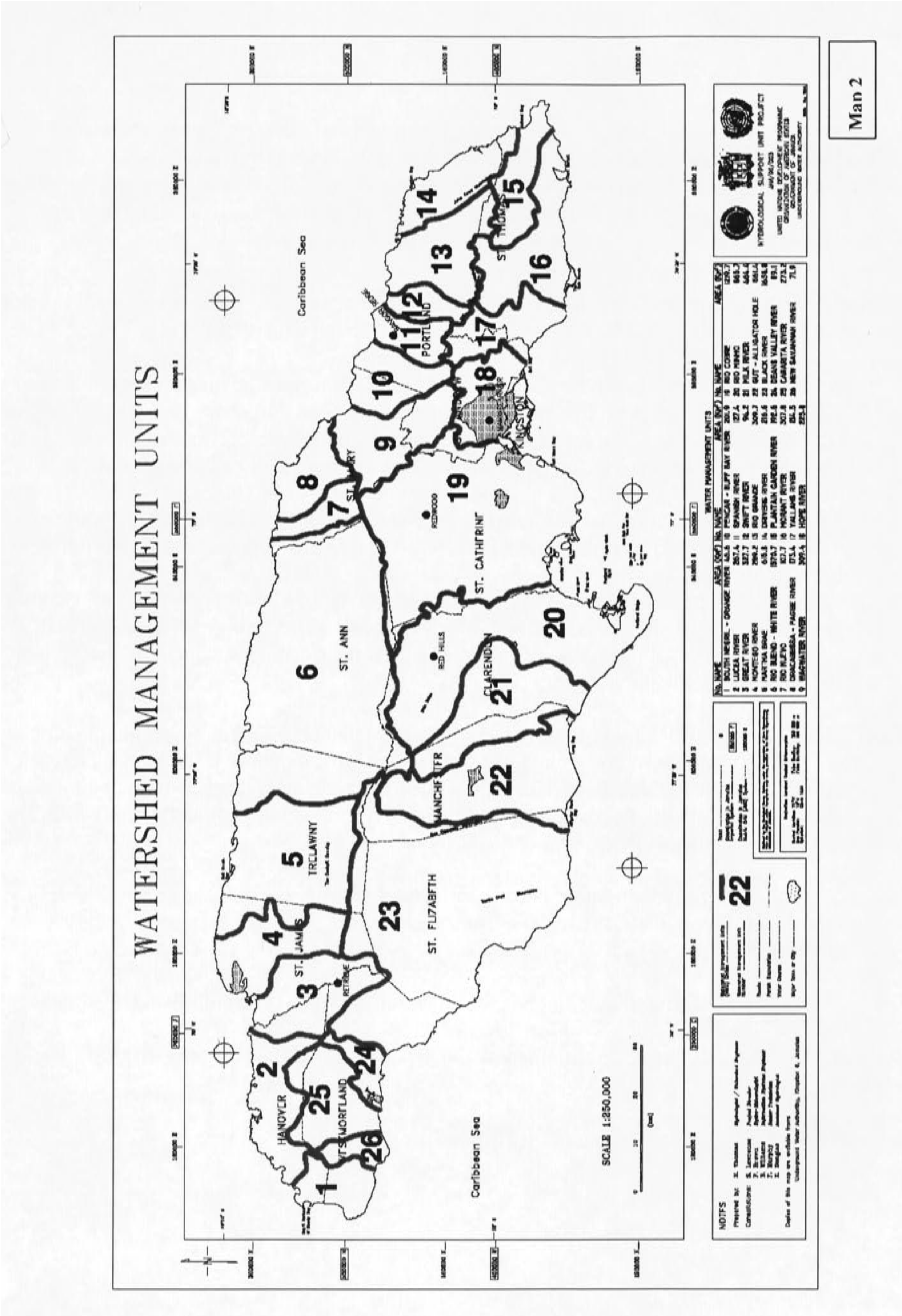
iv Developments which by virtue of their nature have potential for causing contamination or pollution of surface and/or ground water will be approved mainly if the relevant agencies are satisfied that adequate mechanisms are in place to prevent, or at least minimize to acceptable levels, the degree of contamination. The developer should comply with the discharge standards that exist.

v All gullies must remain under permanent natural vegetation, and land clearing should not take place more than 200 meters from said gullies. The same applies to rivers and streams.

vi Permanent structures should not be erected within 200 meters of gullies and or streams.

Not-with-standing the above, environmental impact assessments are usually required by the regulatory agencies.

Below is a map of Jamaica showing Watershed Management (Map 2).


WATERSHED MANAGEMENT UNITS
Caribbean Sea
Caribbean Sea
HANOVER
WESTMORLAND
ST. JAMES
TRELAWNY
ST. ANN
ST. ELIZABETH
MANCHESTER
CLARENDON
ST. CATHERINE
PORTLAND
ST. THOMAS
KINGSTON
SCALE 1:250,000
NOTES
Man 2

54.5 BIODIVERSITY

Biological Diversity or Biodiversity is a collective term, which embraces "Life on Earth" and encompasses the variety of all plants, animals and micro-organisms. Biological resources are those components of biodiversity that are either used by humans, or have potential for use in the production of food, medicines, manufactured goods and other essential products.

54.5.1 Convention on Biological Diversity

Jamaica became a party to the Convention on Biological Diversity in April 1995. The objectives are:

i Conservation of biological diversity

ii Sustainable use of its components

iii Fair and equitable sharing of the benefits arising out of utilization of genetic resources

The following information on biodiversity has been extracted from the document " Sustaining Life on Earth - How the Convention on Biological Diversity promotes nature and human well-being" produced by the Secretariat of the Convention on Biological Diversity.

"The biodiversity of the world has evolved over billions of years and shaped by natural processes and increasingly by human activities. Diversity includes the variety of plants and animals, genetic differences (crops and breeds of livestock and ecosystems (forests, wetlands, lakes, rivers and agricultural landscape). It is the combination of this and the environment (climate, geology) that has made the earth habitable for humans.

The earth is increasingly being altered by humans:-

- *from the start of agriculture, 10,000 years ago, to large scale removal of mountains by mining.*

- *old technologies and replaced with new technologies with often no control to prevent over-harvesting.*

Protecting biodiversity is in self-interest of any nation. Biological resources are the pillars upon which civilization is built. Nature's products support such diverse industries as agriculture, cosmetics, pharmaceuticals, pulp and paper, horticulture, construction and waste treatment. The loss of biodiversity threatens food supplies, opportunities for *recreation and tourism, and sources of wood, medicines and energy. It also interferes with essential ecological functions.The vast array of interactions among the various components of biodiversity makes the planet habitable for all species, including humans. People's health, and the health of the economy and human society, depends on the continuous supply of various ecological services provided by biodiversity that would be extremely costly or impossible to replace. These natural services are varied and almost infinite. For example, it would be impractical to replace, to any large extent, services such as pest control performed by various creatures feeding on one another, or pollination performed by insects and birds going about their everyday business."*

54.5.1 Goods and Services Provided by Ecosystems

These include:

- Provision of food, fuel and fibre
- Provision of shelter and building materials
- Purification of air and water
- Detoxification and decomposition of wastes
- Stabilization and moderation of the Earth's climate
- Moderation of floods, droughts, temperature extremes and the forces of wind
- Generation and renewal of soil fertility, including nutrient cycling
- Cultural and aesthetic benefits
- Ability to adapt to change

54.6 Global Warming and Climate Change

54.6.1 Definition

Global warming is the gradual increase in the temperature of the earth due to the emission of greenhouse gases. Global warming contributes to climate change. Greenhouse gases are naturally occurring and make up less than one tenth of one percent of the total atmosphere, which acts as a blanket around the earth, without which the earth's surface would be 30 degrees Celsius colder than it is today.

54.6.2 Heat Energy

Most of the sun's energy, which is mainly short wavelength radiation, passes through the atmosphere and warms the earth's surface. Heat energy, in the form of long wavelength infrared radiation, is in turn released back into the atmosphere. While some of this heat escapes into space, most of it is absorbed or held by carbon dioxide, water vapour, methane and other greenhouse gases that exist in low concentrations in the atmosphere.

54.6.3 Greenhouse Gases and its consequences

By absorbing that, greenhouse gases become warmer, and heat is sent out from the atmosphere in all directions. Some go back to earth to be stored whilst the rest passes into space. This process keeps the earth habitable. The composition of the atmosphere is however changing as the amount of carbon dioxide, methane, nitrous oxide and chlorofluorocarbons (CFCs) it contains is increasing. As a result of this, the increase in the greenhouse gases will cause less heat to be lost to space and instead be reflected back to earth causing an increase in temperature. This change in the Earth's temperature will cause changes in precipitation patterns; while some areas get wetter others will become drier. There could also be changes in storm patterns. Sea level rise could also result because of changes in the earth's temperature. If the atmospheric temperature near the land surface rises in the whole globe, there is a possibility that it will have serious effects on human life.

54.6.4 Changes due to Global Warming

The following changes may occur due to global warming:

i Desertification in dry and in semi-dry areas would increase.

ii Concentrated precipitation increases.

iii Sea level rise due to the thermal expansion of seawater (melting of ice caps), giving rise to changes in coastlines. As such there would be migration of residents near the sea coast and on the small islands, and the destruction of the port facilities.

iv More hurricanes and droughts.

54.6.5 Causes of Global Warming

i All greenhouse gas concentrations are determined by a balance between sources and sinks. There are essentially two ways in which mankind can increase atmospheric concentrations of greenhouse gases, namely:

- By increasing the strength of greenhouse gas sources (processes that produce greenhouse gases).
- By decreasing the strength of greenhouse gas sinks (processes that remove greenhouse gases).

ii Through actions such as continued deforestation (decreasing the strength of greenhouse gas sinks) and the burning of fossil fuels (increasing the strength of greenhouse gas sources) mankind is increasing carbon dioxide levels.

iii Some activities which contribute to global warming include:

- Energy use and production (57% contribution). Carbon dioxide is produced when coal, oil and natural gas (fossil fuels) are burned to produce energy. Methane is also emitted during coal mining and oil drilling and by leaky gas lines.
- Chloroflurocarbons (17% contribution)

iv Contrary to popular perception, the depletion of the ozone layer does not cause global warming. Instead depletion of the ozone layer as a result of CFC and other gases has resulted in a cooling effect.

- Agricultural practices (14% contribution)
- Activities such as rice cultivation, cattle and sheep ranching are responsible for increasing the emissions of methane
- Changes in land use (9% contribution)
- Changes such as clearing land for logging, ranching and agriculture lead to carbon dioxide emissions. Vegetation contains carbon that is released as carbon dioxide when the vegetation decays or burns. Normally, lost vegetation can be replaced by replanting with little or no net emission of carbon dioxide. However, over the past several 100 years,

deforestation and other land use changes have contributed significantly to increases in atmospheric carbon dioxide.

- Other industrial activities (3% contribution).

v These activities cause emissions of six (6) different greenhouse gases into the atmosphere - the principal one being carbon dioxide, caused from the burning of fossil fuels. These activities thicken the atmosphere and are responsible for over half of the warming effect. If emissions continue to grow at current rates, it is predicted that atmospheric levels of carbon dioxide will double from pre-industrial levels during this century and quite possibly triple by the year 2100.

55.6.6 Global Warming is Really Underway

i According to NASA, the ice sheet surrounding the earth's largest island is rapidly thinning at a rate of nearly one metre per year. The researchers estimate that there is a 98% chance that the melt is due at least in part to global warming. NASA reports that Greenland's ice sheet is losing approximately 51 cubic kilometres of ice per year, an amount sufficient to raise global sea level by 0.01cm per year.

ii Various other studies indicate that Arctic ice and mountain glaciers around the world have been reduced significantly on the past several decades and are continuing to diminish rapidly. Other evidence that global warming is underway includes rise in sea level of 10 to 25cm (about 4-10 inches), a reduction in northern hemisphere snow cover (1973 to present) and increasing sub-surface ground temperatures.

54.6.7 Climate Change

i Climate change is considered to be the most pervasive and truly global of all issues affecting humanity, and poses a serious threat to the environment as well as to economies and societies. Climate change is associated with the warming of the planet Earth as a result of emissions of carbon dioxide and other greenhouse gases.

ii The earth's climate is a complex balancing act involving the sun, atmosphere, oceans and land. Solar radiation heats the earth and provides the energy that drives atmospheric circulation. The atmosphere screens out the sun's harmful rays and as a storehouse for various gases and particles. Both air circulation patterns and the make-up of the atmosphere have a major influence on climate and weather systems.

iii Humans have altered many different aspects of this climate system through economic and social development. Industrial and agricultural emissions of carbon dioxide, methane and other greenhouse gases are contributing to this warmer planet. Reducing the output of these gases, also called climate changing gases, will require a fundamental shift in manufacturing processes, agriculture and energy production.

54.6.8 Causes of Climate Change

i Climate change is caused by both natural events and by human activities.

ii Natural events such as volcanoes and variations in ocean currents can result in climate change. Over longer time spans, tens of hundreds and thousands of years of natural changes in the geographical distribution of energy received from the sun and the amount of greenhouse gases and dust in the atmosphere have caused the climate to shift from ice ages to relatively warmer periods.

iii Tropical deforestation also contributed to climate change. Scientists theorize that if the current rate of deforestation continues, the world's rain forests will vanish within 100 years, causing unknown effects on global climate and eliminating the majority of plant and animal species on the planet. Human activities also contribute significantly to climate change, such as changes in land use (e.g. deforestation) and the burning of coal, oil and natural gases. These activities increase the amount of greenhouse gases, especially carbon dioxide that are emitted into the atmosphere. The accumulation of greenhouse gases in the atmosphere, due to human activities, will change the climate by enhancing the natural greenhouse effect, leading to an increase in the Earth's average surface temperature.

54.6.9 Impacts of Climate Change

These are some of the impacts of Climate Change

i Negative Impacts

Climate Change has the potential to negatively impact on many of the Earth's natural ecosystems and functions. It has been estimated that the loss of land, damage to fisheries, losses of agricultural and water supplies could cost the world more than US$304.2 billion per year.

ii Climate Change and Sea Level Rise

The global mean sea level may have already risen by about 15cm during the past century. According to various scientific studies, the sea has been rising at the rate of 1-2mm per year over the past 100 years.

iii Forecast of Sea Level Rise

Climate Change is expected to cause a further rise in sea level of about 20cm by the year 2030. Forecasts of rising sea levels are based on climate model results which indicate that the earth's average surface temperatures may increase by 1.5-4.5°C over the next 100 years. The warming can cause the sea to rise in two ways, namely: through thermal expansion of ocean water and through the sinking of ice caps and mountain glaciers.

iv Sea level rise has many associated impacts, including:

- Damage to coastal areas and small islands;
- Salinization of groundwater;
- Disruption of the flow of estuaries, coastal rivers as well as eroding and increasing the salinity of tidal wetlands and mangrove forests;
- Increased damage caused by floods, storms and tropical cyclones;
- Damage to Coastal Areas and small islands.

Small islands are particularly vulnerable to sea level rise.

CONTACT INFORMATION

For further information please contact:

The Chief Executive Officer
The National Environment and Planning Agency
10 Caledonia Avenue
Kingston 5
Tel:
Fax: 876-754-7595
Email: ceo@nepa.gov.jm
Website: www.nepa.gov.jm

LIST OF APPENDICES

Appendix I

GLOSSARY OF TERMS

(Source: Environmental Impact Assessment (EIA) Cutting edge for the twenty-first century by Alan Gilpin)

Agenda 21: A document adopted by the UN Conference on Environment and Development meeting in Rio de Janeiro in June 1992, representing a programme for the twenty-first century. The conference was held on the twentieth anniversary of the UN Conference on Human Environment, which met in Stockholm in June 1972.

Alternatives: In EIA, an examination of alternative locations, methods, and techniques for a particular project, includes the alternative of not proceeding. It may be demonstrated that a project is not actually needed if demand-management approaches (for example, curbing the demand for water or electricity) are adopted or strengthened. At regional and national levels, a choice of polices, plans and programmes, may be presented, with a range of environmental impacts and mitigation measures.

Applicant: The proponent or developer seeking approval or consent for a proposed activity/development, or seeking the issue of a permit or licence.

Biological diversity: Or biodiversity, an umbrella term to describe collectively the variety and variability of nature. It encompasses three basic levels of organization in living systems: the genetic, species, and ecosystem levels. Plant and animal species are the most commonly recognized units of biological diversity, thus public concern has been mainly devoted to conserving species diversity. This has led to efforts to conserve endangered species and to establish specifically protected areas. However sustainable human economic activity depends upon understanding, protecting, and maintaining the world's many interactive, diverse ecosystems with their complex networks of species and their vast storehouses of genetic information.

Biological Oxygen Demand (BOD): The amount of dissolved oxygen in water that will be consumed as the organic matter present is decomposed. High BOD means low water quality and probably the development of anaerobic waters. It usually results when waters have received organic wastes.

Chemical Oxygen Demand (COD): A quantity connected with wastewaters. It mainly serves to measure the ability of organic substances to consume oxygen in water. Often in conjunction with biological oxygen demand (BOD). Total organic carbon (TOC) = COD + BOD.

Conservation: Defined by the World Conservation Strategy of 1980 as "the management of human use of the biosphere so that it may yield the greatest sustainable benefit to present generations while maintaining its potential to meet the needs and aspirations of future generations." Conservation is, therefore, something positive embracing preservation, maintenance, sustainable utilization, restoration, and enhancement of the natural environment. This theme was further endorsed by the World Commission on Environment and Development (Brundtland Commission) in its 1987 report to the UN.

Cumulative effects: Progressive environmental degradation over time arising from a range of activities throughout an area or region, each activity considered in isolation being possibly not a significant contributor. Such effects might arise from a growing volume of vehicles, multiple sources of power generation or incineration, or increasing application of chemicals to the land. The solution is better regional planning and control.

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Decision-maker: The body or person responsible for deciding whether a project shall proceed or not, or proceed subject to conditions and constraints. The decision-maker is usually an elected body or responsible agency or minister, the decision-making being essentially a function of government.

Developer: The initiator of a project; also called the proponent, or applicant for development consent.

Development: The application of human, financial, and physical resources to satisfy human needs; inevitably, development involves modification of the biosphere and some aspects of development detract from the quality of life locally, regionally, nationally, or globally. The breadth of development is not always appreciated as the word applies not only to the growth of industry, commerce and infrastructure, but to sanitation, education, medicine, health, housing, national parks, tourist and recreational facilities.

Ecosystem: The plants and animals of an ecological community, and their environment, forming an interacting system of activities and functions regarded as a unit. There are innumerable ecosystems: for example, marine, fresh-water, terrestrial, forest, and grassland. All ecosystems together comprise the biosphere, that part of the Earth's crust and atmosphere inhabited by living things. Ecology is the study of the relationship between an animal or plant and its surrounding.

Endangered species: Fauna and flora likely to become extinct as a result of direct exploitation by humans, intrusion into highly specialized habitats, threats from other species, interruption of the food chain, pollution, or a combination of such factors.

Environment: A concept which includes all aspects of the surroundings of humanity, affecting individuals and social groupings. The EC has defined the environment as "the combination of elements whose complex inter-relationships make up the settings, the surroundings and the conditions of life of the individual and of society, as they are so as they are felt." The environment may be regarded as a parcel of things which render a stream of beneficial services and some disservices to people, though largely unpriced, and which take their place alongside the stream of goods and services rendered by real income, houses, infrastructure, transport, and other people.

Environmental Health Impact assessment (EHA): The subset of EIA, an assessment of the impacts on the environment and people of aspects of a project recognized as having potentially adverse heath effects. In 1982, WHO recommended that EHIA studies should be conducted for all major development projects. Many consider that the adverse effects of the Aswan High Dam in Egypt, such as the spread of bilharzias, were neglected in the EIA.

Environmental Impact Assessment (EIA): The critical appraisal of the likely effects of a policy, plan, program, project, or activity, on the environment. To assist the decision-making authority, assessments are carried out independently of the proponent, who may have prepared an EIS. The decision-making authority might be a level of government (local, state, or federal) or a government agency (at local, state, or federal level). Assessments take account of any adverse environmental effects on the community; any diminution of the aesthetic, scientific, or other environmental values of a locality; the endangering of any species of fauna or flora; any adverse effect on any place or building having aesthetic, anthropological, archaeological, cultural, historical, scientific, or social significance; any long term or cumulative effects on the environment; any curtailing of the range of beneficial uses; any environmental problems associated with the disposal of wastes; any implications for natural resources; and the implication for the concept of sustainable development. EIA

Appendix I

extends to the entire process from the entire process from the inception of a proposal to environmental auditing and PPA.

Environmental Management: A concept of care applied to individual premises, corporate enterprises, localities, regions, catchments, natural resources, areas of high conservation value, lifetime cycles, waste handling and disposal, cleaner processing and recycling systems, with the purpose of protecting the environment in the broadest sense. It involves the identification of objectives, the adoption of appropriate mitigation measures, the protection of ecosystems, the enhancement of the quality of life for those affected, and the minimization of environmental costs.

Eutrophication - The process by which a body of water acquires a high concentration of nutrients, especially phosphates and nitrates, which typically promote excessive growths of algae. As the algae die and decompose, high levels of organic matter and the decomposing organisms deplete the water of available oxygen, causing the death of other organisms, such as fish. Eutrophication results principally from nitrogen and/or phosphorus inputs from human activities such as sewage disposal and fertilizer use.

Habitat: Or living space; all the things, which collectively make up the place in which organisms, creatures or humans live. Habitat includes non-living influences such as soils, light, temperature, humidity and other abiotic factors; and biotic factors dependent on the activities of individuals and communities. In 1976, a UN conference on human settlements took the title "Habitat."

Hazard and risk assessment: An essential component of many EIAs. Such an assessment embraces the potentially adverse effects of a project involving fire, heat, blast, explosion or food, arising from a manufacturing plant or transportation system. An assessment reveals hazards to life and limb and property, and is expressed in the form of risk probability. Safety depends on the location of a plant, the safety precautions, back-up arrangements adopted, and the degree of training and alertness in the plant. Buffer zones and correct routing of vehicles are also essential.

Health: Defined by WHO as "state of complete physical, mental and social well-being and not merely the absence of disease or infirmity." However, most assessments of health still rely upon morbidity and mortality statistics, such as infant and child mortality rates, and average expectations of life in different countries.

Mitigation measures: Action taken to prevent, avoid, or minimize the actual or potential adverse effects of a policy, plan, programme, or project. Measures might include abandoning or modifying a proposal, or relocating it, substitution of techniques; cleaner methods; recycling; pollution control methods; closure of older plant; land-scaping and rehabilitation; acquisition of properties; and better programming.

Monitoring: A combination of observation and measurement for the performance of a project and its compliance with development consent conditions. Instrumentation might be required in relation to air, water, and land pollutants; noise and blasting; radiation; transportation movements; and land subsidence. Records might be required for materials movements, raw materials, products, wastes, complaints and investigations, instrument and analysis results.

Precautionary principle: A guiding rule in EIA to protect people and the environment against future risks, hazards, and adverse impacts, tending to emphasise safety considerations in the occasional absence of clear evidence.

Project: A proposed installation, factory, works, mine, highway, airport, or scheme, and all activities with possible impacts on the environment.

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Proponent: The proposer (or applicant) of an activity, policy, plan, program, or project in the private or public sectors; a proposal usually requires official approval or consent and during the process of obtaining this, the public have increasing opportunities to voice opinions of support and objection.

Public inquiry or hearing: An opportunity for members of the public, voluntary bodies, and government agencies, to express opinion before an independent and impartial commissioner of inquiry, to enable issues about a controversial proposed development to be fully discussed. The usual outcome is the submission of a report by the commissioner with recommendations to a decision-making body or minister, the report becoming immediately a public document. The success of the public inquiry hinges upon the choice, integrity and independence of the commissioner; and upon a political and social context, which encourages full participation by all citizens, without fear of reprisal or discrimination. The public inquiry often stands at the apex of EIA processes.

Quality of life: In current usage, a concept embracing a miscellany of desirable things not always recognized, or adequately recognized, in the marketplace. It embraces such highly relevant matters as real income, housing and working conditions, health, and education services and recreational opportunities, which might be regarded as the general standard of living. Other highly relevant matters include community relationships, race relationships, civil liberties, compassion, justice, freed on, and fair play, safety and security, law and order, and environmental conditions.

Sanitation: An important health-related branch of development embracing drainage and sewage, sewage and sullage treatment and effluent disposal, safe and adequate domestic water supplies, avoidance of public nuisances and controlled tipping, and drainage facilities for floodwater and surface run-off. Few countries renowned for high-tech achievements have been able to resolve the basic requirements of sanitation, relying on primitive methods (or none).

Scoping: A procedure, carried out as early as possible, to help ensure that an EA focuses on key environmental issues associated with a proposed activity or development; scoping involves meeting between the proponent and planning or environmental agencies, members of the public, and other interests likely to be affected. The result should determine the scope and depth of the significant issues to be examined in the forthcoming EIS.

Strategic EIA (also SEA): The application of EIA not only to individual projects, but to policies, plans, programmes, activities, and regional land-use objectives. There is a growing conviction that matters cannot be completely resolved at project level when many matters have been decided already at a higher level. Matters difficult or impossible to settle at the project level relate to the cumulative effects of other projects within the same or related programs; to transportation decisions governing the modal split between road and rail movement; to energy policies relating to power generation; to greenhouse strategies; and to natural resource conservation and management.

Thermal Pollution - The impairment of water quality through temperature increase; usually occurs as a result of industrial cooling water

Appendix 2

FORM 1

THE NATURAL RESOURCES CONSERVATION AUTHORITY ACT

The Natural Resources Conservation (Permits and Licences) Regulations, 1996

PERMIT APPLICATION

(Pursuant to section 9)

General Note to Applicants: Please read the following before completing this form

1. This form should be completed in **triplicate** in block letters and submitted along with any specified or supplemental information to:
   Applications Secretariat Branch
   National Environment and Planning Agency
   10 Caledonia Avenue
   Kingston 5.
2. The completed Form shall be accompanied by -
   (a) A completed Project Information Form;

   (b) A location map drawn to scale (a scale of: 1:12,500 for rural areas and 1:1,250, 1:2,500, 1:5,000 or 1:10,000 for urban areas); and coordinates;

   (c) a site plan of the area in which enterprise, etc. including:-
      i. the layout of the proposed enterprise or construction or development (3 copies)
      ii. boundaries of and access to the property
      iii. setbacks of structures/buildings from property boundaries
      iv. the volume and folio number of the property (if registered title)
      v. all existing physical features (natural and manmade)

   (d) any body of surface water, or any potable water supply that may be affected by any discharge.

   (e) proof of ownership (**copy of registered title or sale or lease agreement**)
      - If the applicant is not the owner, a letter of authorization witnessed by a Justice of the Peace must be provided.

   (f) a statement of the status of any required statutory approvals and applications;
   (g) an application for a licence to discharge effluent, etc., where applicable; and
   (h) the prescribed application fee of J$2,000 which is **non-refundable**.

Appendix 2

3. Please attach certified copies of all statutory approvals and planning permission granted to date and copies of all applications made and not yet determined.

4. This application form must be completed in order to avoid delay in its processing. Checklists may be provided for specific categories, which indicate additional information to be submitted. Where attached sheets and other technical documents are utilized in lieu of the space provided, indicate appropriate cross -references. Paragraphs that are not applicable to your application should be marked as N/A. The permit fee becomes payable at the time of issue of the permit.

5. If you are in doubt about any provision of this application form, please consult with an officer of the Applications Secretariat Branch, NEPA before completing the form.

A Project Types and Fees

Description of prescribed category of enterprise, construction or development for which approval is sought and related fees:
(Check as many as are applicable.)

☐ Power generation plants, including hydro-electric plants and installation for the harnessing of wind power for energy production and nuclear reaction above 1 MW ……………………………………..………………$25,000.00

☐ Electrical transmission lines and substations greater than 69 kv …..……………………………………………......$25,000.00

☐ Pipelines and conveyors, including underground cables, gas lines and other such infrastructure with a diameter of more than 10 cm, for the transport of gas, oil or chemicals ………………………………………………………………..$25,000.00

☐ Port and Harbour Development …………….…………………………………………………….……….….$25,000.00

☐ Shipyards ………………………………..……………………………………..…………………….…………..$25,000.00

☐ Marinas and Boatyards ……………………………… ………………………………………………………....$25,000.00

Development projects

☐ Subdivisions of 10 to 50 lots ……………………………………………………………………………..…..….$15,000.00

☐ Subdivisions of 51 lots or more ……………………………………………………………………………………$15,000.00 for the first 50 lots and $25 for each additional lot

☐ Housing projects of 10 – 50 houses …………………………………………………………………………......$15,000.00

☐ Housing projects of 51 houses or more ………………………………………………………………………..….. $15,000.00 for the first 50 houses and $25 for each additional house

☐ Hotel/resort complex of 12 to 50 rooms ………………………………………………………..……..……….$15,000.00

☐ Hotel/resort complex of 51 rooms or more …………………………………………………….………………...…$15,000.00 for the first 50 rooms and $40 for each additional room

☐ Airports and airfields, including runway expansion greater than 20% of the original length …………………...…$25,000.00

☐ Office complexes of 5,000 square metres or greater ……………………………………..…………………….…$20,000.00

☐ Eco-tourism and nature tourism projects ……………………………………………………………………...$20,000.00

Appendix 2

- ☐ Water treatment facilities, including water supply and desalination plants ……………………………………….....$20,000.00
- ☐ Sewage and industrial wastewater treatment facilities ……………………………………………………….…..$25,000.00

Mining, quarrying and mineral processing

- ☐ Bauxite, Peat, Sand, Minerals, including aggregate, construction and industrial materials, Metallic, Non-metallic $25,000.00

Metal processing

- ☐ Ferrous metals, Non-ferrous metals, Metal plating, Foundry operations ….….………..…………………….… $25,000.00

Industrial Projects -

- ☐ Chemical plants ………………………………..…… ……………………………………………….….…$25,000.00
- ☐ Pulp, paper and wood processing ……………………………………...…………………………………........$25,000.00
- ☐ Petroleum production, refinery, storage and stockpiling ……………………………………………………....$25,000.00
- ☐ Fish and meat processing ……………………………………………………………………………….....….$20,000.00
- ☐ Food processing plants ………………………………………………………………………………….. $20,000.00
- ☐ Water bottling facilities……………………………………………………………………………………....$25,000.00
- ☐ Detergent manufacturing, including manufacturing of soap …………………………….…………………… $20,000.00
- ☐ Manufacturing of containers and package materials, including cans, bottles, boxes and cartons ………………….$20,000.00
- ☐ Distillery, brewery and fermenting facilities ……………………………….………….….……………..…….$20,000.00
- ☐ Manufacturing of edible fats, oils and associated processes ………………..…………..…………………..…. $20,000.00
- ☐ Cement and lime products ……………………………………………………………….………..……..….$25,000.00
- ☐ Paint manufacture …………………………………………………………………………………………...$25,000.00
- ☐ Tanneries……………………………………………………………….……………………………….………$20,000.00
- ☐ Manufacturing of pesticides or other hazardous or toxic substances ..………………………..…………………….……$25,000.00
- ☐ Boxing plants ..…………………………………………………………………….…………………….….… $20,000.00
- ☐ Citrus, coffee, cocoa, coconut, sugar cane processing factories ..……………….…………………………………. $15,000.00
- ☐ Manufacturing of textiles …………………………………………………………………………………….. $20,000.00
- ☐ Solar salt production ……………………………………………………………………………………… $15,000.00
- ☐ Construction of new highways, construction of arterial roads, construction of new roads on slopes greater than 20°, major road improvement projects, including construction of a road of four or more lanes or realignment or widening of an existing road into four lanes where such road realignment or widening would be 10 km or more in continuous length ……………………………………………………………………… $25,000.00
- ☐ River basin development and improvement projects ……………………………………………………………….$20,000.00
- ☐ Irrigation and water management and improvement projects …………………………………………………….. $20,000.00
- ☐ Land reclamation and drainage projects …………… ……………………………………………………………$25,000.00
- ☐ Watershed development and soil conservation projects, including river training such as river channel diversion

Appendix 2

works and works for the transfer of water resources between river basins, check dams and retaining walls ……..$15,000.00

- ☐ Modification, clearance or reclamation of wetlands ……………………………...…………………………….. $25,000.00
- ☐ Dredging, excavation, clearing and reclamation of riverine, beach, wetlands (salt and freshwater) …... ……...…..$25,000.00
- ☐ Solid waste treatment and disposal facilities, including waste disposal installations for incineration, chemical landfills or systems for the destruction, reprocessing or recycling of such wastes ……………..…….…$25,000.00
- ☐ Cemeteries and crematoria ……………………………………………………………………………………… $25,000.00
- ☐ Importation or introduction of alien species of flora and fauna……………………………………………..…$25,000.00
- ☐ Importation or introduction of genetic material …………………………………………………………………..$25,000.00
- ☐ Introduction of genetically modified organisms ………………………………………………………………$25,000.00
- ☐ Slaughterhouse and abattoirs ……………………………………………………………………………………..$20,000.00
- ☐ Hazardous waste removal, storage, transportation, treatment or disposal …………………………….. ……… $25,000.00
- ☐ Agro-processing and processing of agricultural wastes …………………………………...………………..……$15,000.00
- ☐ Felling of trees and clearing of land of 10 hectares or more ……………………………………………………...$20,000.00
- ☐ Clear cutting of forested areas and clearing of trees on land of 3 hectares and over on slopes greater than 25° … $25,000.00
- ☐ Golf courses …………………………………………………………………………….………….……… $25,000.00
- ☐ Theme parks ..…………………………………………………………………………...…….…….…………$20,000.00
- ☐ Transportation centres for more than 10 vehicles …………………………………………..……….….…….$25,000.00
- ☐ Construction or demolition of reservoirs, dams, dykes and aqueducts …………………………….. …….……$25,000.00
- ☐ Railways, tramways and cable car operations ……………………………………………………………… $25,000.00
- ☐ Causeways and multiple span bridges ………………………………………………………………………… $25,000,00
- ☐ Hospitals ……………………………………………………………………………...…………….……$20,000.00
- ☐ Shopping centers ……………………………………………………………………………………….………. $25,000.00
- ☐ Aquaculture facilities and ponds and intensive fish farming ……………………….………………………..….$25,000.00
- ☐ Vehicle repair and maintenance facility, ……………………………………………………………………....$25,000.00
- ☐ Storage of scrap metal including derelict vehicles …………………………………………….………….. $25,000.00
- ☐ Offshore drilling for extraction of oil, natural gas or minerals …………………….…………….……………... $25,000.00
- ☐ Dry cleaning operations ……………………………………………………………………………………. $25,000.00
- ☐ Other. Please specify!

If your project falls within these categories, then a permit under Section 9 of the NRCA Act is required.

Appendix 2

B. General

1. Name of applicant:

___

2. Address of applicant:

___

___

___

3. Telephone No.: ___ Fax No.___

4. E-mail address: ___

5. Please specify name and if different from applicant registration No. of company

___

6. TRN No. ___

7. Address of registered office of company:

___

___

8. Name and address of premises where construction/development/enterprise for which approval is sought will be undertak

___

___

9. Name of Chief Executive Officer:

___

10. Name of Environmental Manager:___Contact No.___

11. Description of project or project brief for which approval is sought:

___

___

___

Appendix 2

12. Do you own the property on which you propose to carry out this development project.
Yes - No -
a) If yes, please attach certified copies of proof of ownership.
b) If no, please state the nature of your interest in this property and attach supporting documents justifying your claim

13. Names and addresses of adjoining property owners:

North

____

South

____

East

____

West

____

14. Name of local authority/ parish council in whose area the enterprise, construction or development will be undertaken:

____

15. List of attached documents comprising part of application: ______________

____

____

General Note 2: Indicate technical information or proprietary information, which contains trade secrets or other similar confidential information.

C. Statement by Applicant: I hereby certify that the information contained in this application and the attached Project Information Form is true and complete to the best of my knowledge and belief.

I understand that any misrepresentation contained in the forms shall lead to discontinuation of the processing of the application and the revocation of any permit granted and may also lead to prosecution. I further understand that the permit, if granted, may be suspended or revoked for breach of any of the terms or conditions stipulated therein.

Name and title (please print or type)______________________________

Signature of applicant______________________________ Dated this day of 20

Appendix 2

FOR OFFICIAL USE ONLY

Checklist

- ☐ Project Information Form completed and attached
- ☐ Location Map to scale
- ☐ Layout of facility/development etc
- ☐ Detailed Designs
- ☐ Proof of Ownership
- ☐ Project Brief
- ☐ Project conforms to the Development Order
- ☐ Application Fee of $2000.00 enclosed

Other information attached:

____

____

Details: ____

____

Location: ____

____

Comments: ____

____

____

____

Permit Application No.:

				-						-							

Licence Application No.:

				-						-							

Assessment Officer ______________________________ Date _______________

Appendix 3

FORM 2
(Regulation 3)

THE NATURAL RESOURCES CONSERVATION AUTHORITY ACT

THE NATURAL RESOURCES CONSERVATION AUTHORITY (PERMITS AND LICENCES) REGULATIONS 1996

PROJECT INFORMATION FORM

PLEASE READ THE FOLLOWING BEFORE COMPLETING THIS FORM

GENERAL NOTE TO APPLICANTS:

1. This form should be completed in **triplicate** in block letters and submitted along with any specified or supplemental information to: Applications Secretariat Branch
National Environment and Planning Agency
10 Caledonia Avenue
Kingston 5

2. This document is designed to provide technical information on your project to the Natural Resources Conservation Authority in accordance with section 10 (1)(a) of the Act in order to determine if the project requires the preparation of an Environmental Impact Assessment (EIA).

3. Please attach certified copies of all statutory approvals and planning permission granted and copies of all applications made and not yet determined.

4. This information form must be completed in order to avoid delays in its processing. Where attached sheets and other technical documents are utilized in lieu of the space provided, indicate appropriate cross-references. Provide a brief outline on the proposed project and/or any additional information that you believe will be useful in processing your application. Paragraphs that are not applicable to your application should be marked N/A.

5. If you are in doubt about any provision of this application form please consults with the Applications Secretariat Branch before completing the form.

6. This form is supplemental to your **permit application form** and may be subject to further verification and public review.

A. PROJECT NAME AND OWNERSHIP

1) NAME AND ADDRESS OF APPLICANT/ORGANISATION

____
(SURNAME) (FIRST NAME)

____
(STREET)

____
(TOWN AND PARISH)

Appendix 3

________________________________ ________________________________

(TELEPHONE) (FAX)

(E-MAIL)____

2) NAME AND ADDRESS OF OWNER (if different from applicant)

(SURNAME) (FIRST NAME)

____

(STREET)

____

(TOWN AND PARISH)

________________________________ ________________________________

(TELEPHONE) (FAX)

____

(E-MAIL)

3) NAME OF PROJECT AND DESCRIPTION OF PRESCRIBED CATEGORY OF ENTERPRISE, CONSTRUCTION OR DEVELOMENT (as stated on Permit Application Form)

____

____

4) LOCATION OF PROJECT: (Provide location map as well as address)

____

(STREET)

____

(TOWN AND PARISH)

4.1) Do you own the property on which you propose to carry to out this development project? ☐ No; ☐ Yes.
4.2) If yes, please attach certified copies of Proof of Ownership.
4.3) If no, please state the nature of your interest in this property and **attach supporting documents justifying your claim**

____

5) NAMES AND ADDRESSES OF ADJOINING PROPERTY OWNERS

____

____

____

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B. PROJECT DESCRIPTION

1. Provide physical dimensions and scale of the project (fill in dimensions as appropriate):
   a) Total contiguous area owned by project sponsor _______ hectares;
   b) Project area developed: hectares initially _________; hectares ultimately ________;
   c) Project area to remain undeveloped _______ hectares.

2. EFFLUENT DISCHARGE ASPECTS OF THE PROJECT

2a. Will there be any effluent discharge during construction? ▯ No; ▯ Yes
   a) Is it ▯ sewage or ▯ trade effluent?
   b) Type (s) of system proposed for treatment____
   c) Amount(s) to be discharged____
   d) State point (s) of discharge____
   e) Source(s) ____

General Note:1 A licence pursuant to the NRCA Act is required if there is any discharge of effluent on or into the ground.

General Note:2 A licence pursuant to the Beach Control Act is required if there is any structure

2b. Will there be effluent discharge during operation? ▯ No;▯ Yes
   Is it ▯ sewage; ▯ trade effluent or ▯ Both.
   a) Type(s) of systems proposed for treatment____
   b) Amount(s) to be discharged____
   c) State point (s) of discharge____
   d) Projected effluent quality____
   e) Source(s) ____

General Note: Attach detailed design of the treatment system including projected peak loadings.

3. AIR QUALITY

3a. Will there be air emissions (including fugitive dust) produced during construction?
▯ No; ▯ Yes. If yes, describe type(s), source(s) and mitigation measures.
____

____

3b. Will there be air emissions (including fugitive dust) produced during operation?
▯ No; ▯ Yes. If yes, describe type(s), source(s) and mitigation measures.
____

____

3c. During construction, will poisonous waste be:
(i) ▯ generated; ▯ stored; ▯ transported; ▯ disposed/discharged.
During construction, will noxious waste be:
(ii) ▯ generated; ▯ stored; ▯ transported; ▯ disposed/discharged.
During construction, will hazardous or polluting matter be:
(iii) - ▯ generated; ▯ stored; ▯ transported; ▯ disposed/discharged.
Describe type(s);source(s)and quantity : ____

Appendix 3

3d. During operation, will poisonous waste be:
(i) ▯ generated; ▯ stored; ▯ transported; ▯ disposed/discharged.
During operation, will noxious waste be:
(ii) ▯ generated; ▯ stored; ▯ transported; ▯ disposed/discharged.

During operation, will hazardous or polluting matter be:
(iii) ▯ generated; ▯ stored; ▯ transported; ▯ disposed/discharged.
Describe type(s) ;source(s) and quantity:
____

____

4. Will blasting occur during construction? ▯ No; ▯ Yes
If yes, state the time(s) of blasting____

5. Will project routinely produce odours (more than one hour per day) ▯ No; ▯ Yes

6. WATER
6a. Will the project have access to water during the construction? ▯ No; ▯ Yes
6b.. Will the project have access to potable water during operation? ▯ No; ▯ Yes
6c. Total water usage per day ______ litres/day: Source: ▯ Surface; ▯ Underground; ▯ Other:_________
6d.. If water supply is from wells indicate pumping capacity _______ litres per min.
7. Is surface or underground liquid waste involved? ▯ No; ▯ Yes. If yes, please indicate the type and quantity of waste (sewage, trade, including leachate,
etc.)____

____

8. If surface disposal, name receiving water body (freshwater, gully or marine) into which effluent will be discharged
____

9. Will the project use herbicides or pesticides? ▯ No; ▯ Yes. If yes, specify type(s) __________________

____

10. How many hectares of vegetation (trees, shrubs, ground cover) will be removed from the site? ____hectares
11. Will the project involve the construction of access roads? ▯ No; ▯ Yes
12. Will the surface area of existing water bodies e.g. streams, rivers, bays etc be increased or decreased by the project?
▯ No; ▯ Yes. If yes, Give
details____

____

13. Will project require relocation of: ▯People; ▯ Houses; ▯ Facilities? ▯ No. ▯ Yes; If yes, give details:
____

____

14. Does the project involve the disposal of solid waste? ▯ No; ▯ Yes;
15. Will an existing municipal solid waste facility be used? ▯ No; ▯ Yes; If yes, state name and location_________ ________________________________▯ No; If no, please specify______________ _____
____

14a. Is your project within 10 km of a municipal solid waste facility? ▯ No; ▯ Yes

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15. Indicate which of the following resources your project is likely to have an impact on.

- ☐ Water resources,
- ☐ Air quality (including noise),
- ☐ Ecological resources,
- ☐ Visual resources,
- ☐ Open space and recreation,
- ☐ Growth and character of community,
- ☐ Energy,
- ☐ Transportation,
- ☐ Public health

16. Will fuel be stored on the site? ☐ No; ☐ Yes. If yes:

a) Type(s) of Fuel ______________________________

b) Quantity of fuel to be stored______________________________

c) State type of Storage Facility ☐Above ground ☐ Underground

General Note: Provide information on leak detection, overfill prevention and spill containment.

d) Will there be any servicing of motor vehicles? ☐ No; ☐ Yes

If yes, describe the activity and the collection, handling and disposal of waste.

____

____

C. SITE DESCRIPTION (physical setting of overall project, both developed and undeveloped areas)

1. General character of land: generally uniform slope ____ or rolling ______or irregular ____
2. Approximate percentage of proposed site with slopes: ☐ 0-10%; ☐ 10-25%; ☐ 25% or greater.

2a. Is the area prone to: ☐ flooding; ☐ storm surges; ☐ landslide; ☐ erosion; ☐ bush fire; ☐severe wind forces ☐ earthquake; ☐drought. Other natural hazards______________________________

2b. Indicate which natural hazard is likely to have an impact on your project. ☐ flooding; ☐ storm surge; ☐ landslide; ☐ erosion; ☐ bush fire; ☐ earthquake; ☐drought; ☐severe wind forces. Other natural hazards______________________________

2c. Indicate what type of natural hazards have been considered in the design of your project.

____

3. What is the predominant soil type(s) on the project site? ☐ clay; ☐ alluvial soils (silt); ☐ loam; ☐ sandy loam.
4. Are there bedrock outcroppings on project site? ☐ No;☐ Yes
5. Are there any karst or limestone formations i.e. sinkhole/cave conditions on site? ☐ No; ☐ Yes
6. Is the project located in a: ☐ flood plain; ☐ coastal zone; ☐ water catchment area? If no, specify

____

7. Is the site: ☐ below sea level; ☐ at sea level; ☐ above the 10 m contour line.
8. Are there any water wells on or adjacent to the site? ☐ No; ☐ Yes. If yes, describe

____

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____

9. Are there any rivers or streams or drainage systems within or adjacent to the project site?
 No; Yes. If yes, name the water body ____

10. Are there any aquifers, lakes, ponds, wetland or wells within or contiguous to the project site?
 No; Yes. If yes, name the water body ____

11. What is the present land use: Urban; suburban; rural; industrial; commercial;
 agriculture; forest; other (please specify):______________ ______________________________

12. Is the project site presently used by the community or neighbourhood as:
(i) an open space or recreational area No; Yes;
(ii) disposal of refuse, excreta or hazardous material No; Yes.

If yes for either, please identify
____

12a. Will the proposed project conform to the zoning regulations (development orders/protected area regulations) ?
 No; Yes If yes, Please indicate ____

13. Is the project site in, adjacent to or contiguous with an informal settlement ? No; Yes

14. Is the project site in, adjacent to or contiguous with a formal settlement ? No; Yes

15. Name the watershed in which your project is being developed
____

D BIOLOGICAL RESOURCES

FLORA (Vegetation)

1. General plant ecosystem and dominant types:

Forests	Fields	Wetlands
inland	agricultural	mangroves
coastal	pasture	morass and swamps
open field	seagrasses	

 bog Any other ecosystem types: No; Yes. If yes, please indicate.
____

2. Are there exotic species present at the site? No; Yes. If yes, state the scientific and common names of these exotic species.____

____

3. Do you plan to introduce exotic species? No; Yes. If yes, state the scientific and common names of these exotic species, quantity of each species and the country of export.__________________________________

____

3a. Will there be any use or introduction of biocontrol agents? No; Yes. If yes, state the name, quantity, country of export and name of exporter.____

____

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3b. Will there be any introduction of alien invasive species? ▯ No; ▯ Yes. If yes, state the name, number of species and the country of export

____

3c. Will there be any use or introduction of genetically modified organisms? ▯ No; ▯ Yes. If yes, please specify name of organism and attach a risk assessment report _______________________

____

4. Are there any endangered/endemic species in the area where your project is to be developed? ▯ No; ▯ Yes.
If yes, state their scientific and common names and number of each species.__________

____

5. Are there other specimens of scientific or aesthetic interest in your project development area; such as

- ☐ Lignum Vitae
- ☐ Blue Mahoe
- ☐ Orchids
- ☐ Ferns
- ☐ Royal Palms
- ☐ Bromeliads
- ☐ Mahogany Feeder trees for birds
- ☐ Any others

____

6. Are there any economically valuable species in the area? ▯ No; ▯ Yes. If yes, please state their scientific and common name(s).

____

____

7. What is the degree of disturbance of the plant community?

- ☐ Pristine
- ☐ semi-degraded
- ☐ totally degraded

7a. What percentage of vegetation cover is expected to be cleared as a result of the proposed development?

- ☐ 0- 10%
- ☐ 11 – 30%
- ☐ More than 30%

<u>FAUNA (Animals)</u>

1. General types

<u>Vertebrates</u>

- ☐ Mammals
- ☐ Birds
- ☐ Fishes
- ☐ Amphibians
- ☐ Reptiles
- ☐ Invertebrates

Appendix 3

- ☐ Insects including butterflies
- ☐ Corals
- ☐ Sponges
- ☐ Crustaceans

Any others ____
____

Please provide a species list for general fauna types indicated.

2. Habitat type

Forests

- ☐ Dry limestone
- ☐ Wet limestone
- ☐ Montane
- ☐ Fields
- ☐ Agricultural
- ☐ Pasture
- ☐ Open field
- ☐ Wetlands
  -Mangroves
  -Morass and swamps
- ☐ Seagrass
- ☐ Coral reefs
- ☐ Sea (marine)
- ☐ Freshwater/brackish water
- ☐ River/stream (any flowing body of water), state the name/names
  ____
- ☐ Pond/lakes (any standing body of water), state the name/names
  ____
- ☐ Caves, state the name
  (s)____

Any others

____

3. Are there any economically valuable species in the area? ☐ No; ☐ Yes. If yes, state scientific and common names.

____

____

4. Is your project located in or adjacent to a nesting/spawning or breeding site? ☐ No; ☐ Yes

5. Are there endemic/endangered species present at the site? ☐ No; ☐ Yes. If yes, please state their scientific and common names.

____

6. Will there be any use or introduction of biocontrol agent? ☐ No; ☐ Yes. If yes, state scientific and common name, number of the agent and country of export.

____

____

Appendix 3

6a. Will there be any introduction of alien invasive species? ▯ No; ▯ Yes If yes, state scientific and common name, number of each species and the country of export

____

____

6b. Will there be any use or introduction of genetically modified organisms? ▯ No; ▯ Yes . If yes, please specify, name of organisms and attach a risk assessment report.

____

____

E. PROTECTED AREAS

1. Is your proposed project located in, adjacent to or contiguous with an existing Protected Area (game reserve, forest reserve, fish sanctuary, marine park, national park, Ramsar site, heritage site)? ▯ No; ▯ Yes.

If yes, please name the Protected Area:

____

Is your proposed project located in, adjacent to or contiguous with an existing heritage, historical or archaeological site? ▯ No; ▯ Yes

If yes, please name the site(s):

____

F. SOLID WASTE TREATMENTAND/OR DISPOSAL FACILITY

17. Where the project is a solid waste treatment and disposal facility please complete the following:
17a. Nature of waste disposal facility:-

▯ Landfill;
▯ Transfer station - incorporating also,
- ▯ static compaction;
- ▯ pulverization;
- ▯ baling;

▯ Treatment plant involving -
- ▯ pulverization;
- ▯ composting;
- ▯ incineration;
- ▯ chemical treatment;
- ▯ other treatment (please specify);____

17b. Estimated maximum quantities of general waste of the following description delivered or to be delivered daily at the facility:

	Solid (tonnes)	Liquid (tonnes)	Sludge (tonnes)
a) domestic and commercial wastes -			
(i) untreated;	______	______	______
(ii) pulverized or compost;	______	______	______
(iii) baled;	______	______	______
(iv) incinerator residues;	______	______	______
b) medical, surgical and veterinary wastes;	______	______	______
c) hazardous wastes;	______	______	______

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	Solid (tonnes)	Liquid (tonnes)	Sludge (tonnes)
d) non-hazardous industrial wastes -			
(i) potentially combustible substances;	______	______	______
(ii) inert and non-flammable substances;	______	______	______
e) wastes from the construction industry;	______	______	______
f) old cars, vehicles and trailers;	______	______	______
g) sewage, sludge etc.;	______	______	______
h) mine and quarry waste;	______	______	______
i) farm waste.	______	______	______

17c. Current or anticipated maximum rate of use of the facility. (Specify as tonnes per day of landfill sites and tonnes per hour for treatment plant.)____

17d. State capacity of treatment plant:
(i) Current capacity ____________ million litres per day (ML/d)
(ii) Total design capacity ____________ ML/d
(iii) Proposed operational capacity ____________ ML/d
How will waste be collected and stored prior to disposal?

____

____

G. PROJECT APPROVALS

1. Is there any other GOJ licence or approval required? □ No; □ Yes. If yes, list approvals with responsible department or body____

____

____

2. Has the project been given any other approvals ? □ No; □ Yes. If yes, list approvals and responsible agency.

____

____

3. Has the project been previously denied ? □ No; □ Yes. If yes, state reason(s) and responsible agency.

____

____

H. OTHER INFORMATIONAL DETAILS

Attach any other additional information as may be needed to clarify your project.

PREPARER'S NAME: ____

PREPARER'S SIGNATURE: ________________________TITLE: ____________________________________

Appendix 3

ADDRESS:____

TELEPHONE
NO:____________________FAX:________________EMAIL:___________________________

REPRESENTING: ________________________________DATE: _______________________

FOR OFFICIAL USE ONLY

Comments____

____

Licence Application No.:

				-						-							

Permit Application No.:

				-						-							

Assessment Officer ________________________________ Date ________________

Appendix 4

Form 6 **(Regulation 8)**

THE NATURAL RESOURCES CONSERVATION AUTHORITY ACT

The Natural Resources Conservation (Permits and Licences) Regulations, 1996

Application for Licence to Discharge Sewage Effluent or Trade Effluent or to Construct, Reconstruct or Alter Works for the Discharge Thereof
(pursuant to sections 4 and 12)

PLEASE READ THE FOLLOWING BEFORE COMPLETING THIS FORM

GENERAL NOTE TO APPLICANTS:

1. This Form shall be completed in **triplicate** and in block letters and submitted with any supplemental or specified information to:

   Applications Secretariat Branch
   National Environment and Planning Agency
   10 Caledonia Avenue
   Kingston 5

2. The completed form shall be accompanied by
   (i) a location map drawn to scale (a scale of 1:12,500 for rural areas and 1:1,250; 1:2,500; 1:5,000 or 1:10,000 for urban areas) and coordinates

   (ii) the layout of the proposed facility; engineer's drawings and design calculations and description of process including flow diagram (3 copies)
   (iii) proof of ownership (**copy of registered title or sale or lease agreement**)
   ∀ If the applicant is not the owner, a letter of authorization witnessed by a Justice of the Peace must be provided.
   (iv) the volume and folio number of the property (if registered title)
   (vI) any body of surface water, or any potable water supply that may be affected by any discharge;
   (viI) other permit(s) or licence(s) granted by a government department or organization in respect of the application.

3. If this application is for modification of an existing facility, please provide a copy of any existing permit, licence or other approval granted in respect thereof.

4. The attached forms and information requirements shall be answered in full in order to avoid delay in processing the application. Where attached sheets and other technical documents are utilized in lieu of the space provided, indicate appropriate cross-references. Paragraphs that are not applicable to your application should be marked as N/A.

5. A non-refundable application fee of $2000 shall be enclosed (certified cheque made payable to the Authority are accepted).

6. A licence fee of $7,500.will become payable at the time of issue of the licence.

7. The licence is to be renewed every five (5) years, two months prior to the expiration date. A fee of $6,500 will become payable for late renewal of licence in addition to an application fee of $2,000.
.
8. If you are in doubt about any provision of this application form please consults with the Applications Secretariat Branch before completing the form.

9. A separate application shall be made for each source and type of discharge and for each construction, reconstruction or alteration of works.

NOTE: An Environmental Impact Assessment may be required for the processing of the licence application.

Part A. GENERAL

Appendix 4

1. Name of applicant

______________________ ______________________

2. Address of applicant

____

______________________ ______________________

3. Tel. No. ______________________ Fax No. ______________________
Email ______________________

TRN______________________

4 If different from applicant please specify name and Registration No. of Company:______________________

5. Registered office of company:

____

______________________ ______________________

6. Name and Location where enterprise, etc. for which approval is sought will be undertaken:

____

______________________ ______________________

7. Name of Chief Executive Officer:

______________________ ______________________

8. Name of Environmental Manager:______________________

9. Name of local authority in whose area enterprise, etc. will be undertaken: ______________________

10. List of attached documents comprising part of application:

______________ ______________

______________________ ______________________

______________________ ______________________

Type of application: **Sewage** New__________ Renewal________

Trade effluent New__________ Renewal________

Modification of existing facility______ **Construction/reconstruction/alteration of work** ________

Note: **Information for Renewal of Licence**: If there has been a material change in circumstance in relation to plant, process of operation or technology or the composition of the discharge since the licence was first granted, then proceed to fill out all sections of this form. If no material change in circumstance has occurred **then go to Part F.**

Part B. DETAILED DESCRIPTION OF EFFLUENT GENERATING SOURCE

1. Description of plant facilities, outfall location(s), and production figures (projected or otherwise). Attach engineering drawings, facility layout(s) and description of process, including flow diagrams and all processes that use water and or discharge trade or sewage effluent.

____

Appendix 4

2. Plant Boundaries: a detailed drawing of the facility to be constructed clearly showing the location of all storm water drains, liquid process streams or sewage or trade effluent discharge points and proposed location for sampling points and the boundaries of any proposed treatment ponds or disposal site for sludge.

3. Indicate any other permits, approvals or licences granted in respect of date by a Government department or organization including date of issue and expiry of each.

Part C. PROCESS INFORMATION

1. List all toxic substances used or manufactured or to be used or manufactured on the location of the enterprise, etc.

2. List all raw materials, chemicals and substances used in or to be used at the enterprise, etc.

3. List the intermediate and final products derived from enterprise etc. (*including details and conditions of storage*):

Appendix 4

4. Volume of water consumption (*in litres per day*): (*in litres per year*):

5. Source of water:

6. Source of energy and, if other than natural sunlight, quantitative estimate of consumption:

PART D. SEWAGE OR TRADE EFFLUENT INFORMATION - TREATMENT AND DISPOSAL

1. Nature and composition of the trade or sewage effluent (*specify if liquid, sludge or solid and include any current monitoring or sampling results*):

2. What apparatus will be used to measure and record the nature, composition and volume of waste?

3. Maximum volume of trade or sewage effluent proposed to be discharged daily, monthly and annually:

4. Rate at which it is proposed to discharge the trade or sewage effluent:

5. Nature of wastewater treatment facility (*if any)*:

6. Treatment level to be provided:

7. Outfall information: outfall configuration and construction material:

   Length from shore ________ metres

   Elevation of discharge invert ________ metres below mean sea level (msl)

   Diameter of outfall ______centimetres

   Depth of receiving water body at point of discharge_____ metres below msl

8. A description of the receiving environment (surface waters, groundwater or

Appendix 4

sewage treatment plant) into which trade/ sewage effluent is discharged

______________________ ____

9. Please provide the following general information:

   (a) Land use requirements, including all wells and surface waters within one kilometre of the site.

   (b) Soil information, including physical characteristic of the soil at the operation.

   (c) Hydrogeologic survey providing data necessary to evaluate the effects of operation on groundwater and groundwater monitoring system proposed.
   (d) Distance from the coast

10. Additional information to be provided with applications for sewage treatment facilities:

   (a) Population - current and design year projection for the population to be served.

   (b) Description and map of area to be served and land use for the current and design years.

   (c) An assessment of the potential environmental impact of the project, including odour, noise , public accessibility, proximity to existing and proposed residential areas, flooding, and aerosol drift.

   (d) Operation and control strategies including preventive maintenance, alternative disposal methods, and system reliability features.

11. The plan of each facility should show -

   (a) the layout and construction of the facility and its ancillary equipment including information and fencing and drainage where relevant;
   (b) the storage area for liquid, sludge and solid waste awaiting treatment and residues awaiting removal for disposal elsewhere;
   (c) the provision being made for the parking, loading and unloading of vehicles at the facility.

Part E. POLLUTION CONTROL AND WASTE MANAGEMENT INFORMATION

1. Description of pollution monitoring programme (*if any*) including location of monitoring points, parameters to be analyzed, frequency of sampling and personnel involved.

____

____

2. Description of pollution abatement/monitoring equipment (*if any*), year installed and capacity.

____

____

____

2a. Description of pollution prevention, or abatement technologies applied (*specify soil pipes, ventilating shafts, underground drains, cesspools etc.*):.

____

Appendix 4

2b. A description of how any industrial or sewage sludge from any treatment process or from any other process or activity at the enterprise is formed. (if applicable)

2c. A description of how any industrial or sewage sludge from any treatment process or from any other process or activity at the enterprise is treated. (if applicable)

2d. A description of each method or process used to dispose of industrial or sewage sludge. The description must include the locations and destination off site and on site of industrial or sludge and the amount transported off site. (if applicable)

3. Safety, contingency and emergency response measures:

4. Describe any proposed or implemented conservation measures including wastewater reuse and recycling:

Part F RENEWAL OF LICENCE

1. Plant History (Date when facility was commissioned (m/y). ______________________

2. Current permit for the facility (if applicable). Identify all permits required to operate this plant.

3. Existing Licence No. ____________________ Expiry Date ____________________

4. Detail any change in process of operation, technology used, nature or composition of discharge from the date of issue of original licence.

5. Total No. of Discharge Points

6. Has the licence ever been breached? If yes,

6a. Date of Breach______________________Reason______________________

Appendix 4

____

6b. Indicate corrective actions taken

____

____

____

Part G. STATEMENT BY APPLICANT

I hereby declare that the information contained in this application is true and complete to the best of my knowledge and belief. I further agree to maintain and operate the undertaking in accordance with the Act and any regulations there under, the standards and guidelines established by the Natural Resources Conservation Authority and any conditions set out in the licence. I understand that the licence, if granted, is not transferable. I shall promptly notify the Authority upon the sale or legal transfer of the undertaking and will furnish the names and addresses of the purchaser(s) thereof to the Authority.

______________________________ Date______________________

Signature of applicant or authorized representative

____

Name and Title *(Please print or type)*

FOR OFFICIAL USE ONLY

- ☐ Project Information Form completed and attached
- ☐ Location Map to scale
- ☐ Layout of facility/development etc
- ☐ Registered title or information on land ownership
- ☐ Project Brief
- ☐ Project conforms to the Development Order
- ☐ Application Fee of $2000.00 enclosed

Other information attached:

____

Details: ____

____

Location: ____

____

Comments:____

____

____

Appendix 4

Licence Application No.:

				-						-							

Permit Application No.:

				-						-							

Assessment Officer

____

Annex 1

Appendix 5

Ambient Air Quality Standards

Air Pollutant	Averaging period	Standard
Particulates Total suspended particulates	Maximum annual average Maximum twenty-four hour average	Limit of 60 ug/m^3 Limit of 150 ug/m^3
PM_{10} (b)	Maximum annual average Maximum twenty-four hour average	Limit of 50 ug/m^3 Limit of 150 ug/m^3
Lead	Per calendar quarter	Limit of 2 ug/m^3
Sulphur Dioxide	Maximum annual average Maximum twenty-four hour average Maximum one hour average	Limit of 80; 60 ug/m^3 (c) Limit of 365; 280 ug/m^3 (c) Limit of 700 ug/m^3
Photochemical	Maximum one hour average	Limit of 235 ug/m^3 Oxidants (Ozone) (0.12 ppm)
Carbon Monoxide	Maximum one hour average Maximum eight hour average	Limit of 40 mg/m^3 (35 ppm) Limit of 10 mg/m^3
Nitrogen dioxide	Maximum annual average	Limit of 100 ug/m^3

Annex 2

Appendix 6

Stack Emission Standards

Rates of emission constituting major modification

Pollutant	Rate: Tonnes/Year
Carbon monoxide	100
Nitrogen oxides	40
Sulphur dioxide	40
Particulate matter (PM)	25
Fine particulate matter (PM_{10})	15
Volatile organic compounds (VOC)	40
Lead	0.6
Fluorides	3
Sulphuric acid mist	7
Hydrogen sulphide (H_2S)	10

Pollutant	Rate: Tonnes/Year
Total reduced sulphur (including H_2S)	10
Municipal waste combustor organics (measured as total tetra-through octa-chlorinated dibenzo-p-dioxins and dibenzofurans)	0.0000035
Municipal waste combustor metals (measured as PM)	15
Municipal waste combustor acid gases (measured as SO_2 and hydrogen chloride)	40

Annex 2

Appendix 6

Priority Air Pollutants

Chemical	**CAS No.**	**Concentrations in g/m^3**		
		1 h	24 h	Annual
1,1,2,2-tetrachloroethane	79-34-5	0.2		
1,1,2-trichloroethane	79-00-5	0.6		
1,2-dichloroethane	107-06-2	0.4		
1,3-butadiene	106-99-0	0.04		
1,3-dichloropropene	542-75-6	50	20	
2,3,7,8-tetrachlorodibenzo (p)dioxin	1746-01-6	2.3x10^{-7}		
2,4-dinitrotoluene	121-14-2	0.05		
2-nitropropane	79-46-9	50	20	
Acetaldehyde	75-07-0	1,250	500	
Acetonitrile	75-05-8	375	150	
Acrolein	107-02-8	58.75	23.5	
Acrylic acid	79-10-7	2.5	1	
Acrylonitrile	107-13-1	250	100	
Aldrin	309-00-2	0.002		
Ammonia	7664-41-7	9,000	3,600	
Aniline	62-53-3	2.5	1	
Antimony & compounds	7440-36-0	62.5	25	
Arsenic & compounds	7440-38-2	0.75	0.3	
Benzene	71-43-2			1
Benzo(a)pyrene	50-32-8	0.00275	0.0011	
Benzyl chloride	100-44-7			0.2
Beryllium & compounds	7440-41-7			0.0013
Cadmium & compounds	7440-43-9	5	2	
Calcium oxide	1305-78-8	25	10	
Carbon dioxide (process emissions)	124-38-9			
Carbon disulphide	75-15-0	1,750	700	
Carbon tetrachloride	56-23-5	6	2.4	
Chlordane (technical)	12789-03-6	12.5	5	
Chlorinated dibenzo-p-dioxins (cdds)	NA	12.5 pg TEQ/m^3	5pg TEQ/m^3	
Chlorine dioxide	10049-04-4	75	30	
Chloroform	67-66-3	1,250	500	
Chromium, hexavalent compounds	18540-29-9	3.75	1.5	
Chromium, trivalent compounds	16065-83-1	3.75	1.5	
Cobalt & compounds	7440-48-4		0.12	
Copper & compounds	7440-50-8	125	50	
Cresols	1319-77-3	187.5	75	
DDT	50-29-3			0.1
Dieldrin	60-57-1			0.002
Endrin	72-20-8			

Annex 2

Appendix 6

Chemical	CAS No.	Concentrations in g/m^3		
		1 h	24 h	Annual
Ethylene dibromide	106-93-4	7.5	3	
Ethylene dichloride	107-06-2	5	2	
Ethylene glycol	107-21-1	31,750	12,700	
Formaldehyde	50-00-0	162.5	65	
Heptachlor	76-44-8			0.008
Hexachlorobenzene	118-74-1			0.02
Hydrogen sulphide	7783-06-4	2.5	1	
Lead	7439-92-1			
Manganese & compounds	7439-96-5			119
Mercaptans (as methyl mercaptan)	74-93-1	50	20	
Mercury & compounds	7439-97-6	5	2	
Mercury alkyl	7439-97-6	1.25	0.5	
Methyl bromide	74-83-9	3,375	1,350	
Methylene chloride	75-09-2	550	220	
Mirex	2385-85-5			
Nickel & compounds	7440-02-0	5	2	
Nitric acid	7697-37-2	87.5	35	
Nitrogen oxides as nitrogen dioxide	10102-44-0	400		
Polycyclic Aromatic Compounds				
P-dichlorobenzene	106-46-7	237.5	95	
Pentachlorophenol	87-86-5	250	100	
Phenol	108-95-2	250	100	
Polychlorinated biphenyls	1336-36-3	0.375	0.15	
Polychlorinated dioxins and furans				0.02 pg/m3 #
P-xylene	106-42-3	5,750	2,300	
Quinoline	91-22-5			0.003
Selenium & compounds	7782-49-2	25	10	
Sodium hydroxide	1310-73-2	25	10	
Styrene	100-42-5	2,500	1,000	
Sulphuric acid	7664-93-9		23.8	
Sulphuric acid	7664-93-9	87.5	35	
Tetrachloroethylene	127-18-4	900	360	
Toxaphene	8001-35-2			0.03
Trichloroethylene	79-01-6	57.5	23	
Vinyl chloride	75-01-4		1	0.2
Vinylidene chloride	75-35-4	87.5	35	
Xylenes	1330-20-7	5,750	2,300	
Zinc and compounds	7440-66-6		12	

Expressed as 2,3,7,8-Tetrachlorodibenzo-p-dioxin equivalents

Annex 3

Appendix 7

Noise Standards
(Extracted from the Recommendations for National Noise Standards for Jamaica, 1999)

The Recommended Zone Limits:

ZONE	**7 a.m. to 10 p.m.**	**10 p.m. to 7 a.m.**
Industrial	75 dBA	70 dBA
Commercial	65 dBA	60 dBA
Residential	55 dBA	50 dBA
Silence	45 dBA	40 dBA

Notes
The measurements are to be made at the property line from which the sound is emitted or at the nearest point possible beyond that line. If the source of the sound is on public property then measurements are to be made at a distance of between 3 m and 4 m from the source. This excludes the mechanical noise made by moving vehicles, but includes other noise (such as music) from such vehicles.

Annex 4

Appendix 8

Trade Effluent Standards

Set out below are the limits for some selected wastewater parameters as extracted from the Draft Natural Resources Conservation Authority (Waste Water and Sludge) Regulations 2004

Parameter	Limit
Ammonia/ammonium measured as NH_4	1.0 mg/L
Barium	5.0 mg/L
Beryllium	0.5 mg/L
Biological Oxygen Demand (BOD)	<30 mg/L
Boron	5.0
Chemical Oxygen Demand (COD)	100 mg/L or 0.1 kg/1000 kg product
Chloride	300 mg/L
Cyanide (free)	0.1 mg/L
Cyanide (Total as CN)	0.2 mg/L
Faecal coliform	<100 MPN/100 ml
Fluoride	3.0 mg/L
Iron	3.0 mg/L
Manganese	1.0 mg/L
Nitrate as NO_3	10 mg/L
Oil and Grease	10 mg/L or <0.01 kg/1000 kg product
PH	6.5 – 8.5
Phenols	5.0 mg/L
Phosphate as PO_4	5 mg/L
Sodium	100 mg/L
Sulphate	250 mg/L

Parameter	Limit
Sulphide	0.2 mg/L
Temperature	2^0 of ambient
Total Dissolved Solids (TDS)	1000 mg/L
Total Organic Carbon (TOC)	100 mg/L
Total Suspended Solids (TSS)	50 mg/L (maximum monthly average)
	<150 mg/L (maximum daily average)
Total Suspended Solids (TSS)	

Trace Metals	Limit
Zinc	1.5 mg/L
Lead	0.1 mg/L
Cadmium	0.1 mg/L
Copper	0.1 mg/L
Chromium	1.0 mg/L
Total Heavy Metals	2.0 mg/L

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Appendix 9

Sewage Effluent Standards

Sewage Effluent Standards for Existing Plants

Parameter	Limit
BOD_5	20 mg/L
TSS	30 mg/L
Nitrates (as Nitrogen)	30 mg/L
Phosphates	10 mg/L
COD	100 mg/L
pH	6 – 9
Faecal Coliform	1000 MPN/100 ml
Residual Chlorine	1.5 mg/L

Sewage Effluent Standards For New Plants

Parameter	Limit
BOD_5	20 mg/L
TSS	20 mg/L
Total Nitrogen	10 mg/L
Phosphates	4 mg/L
COD	100 mg/L
pH	6 - 9
Faecal Coliform	200 MPN/100 ml
Residual Chlorine	1.5 mg/L
Floatables	not visible

These limits were established by the NRCA Water Quality Standards Subcommittee of the Interagency Environmental Standards Technical Committee based on a review of the literature and public consultations with the various stakeholders.

Annex 6

Appendix 10

Sludge Standards
Standards for Solid Waste/Industrial Sludge suitable for Landfill Leachate test results not to exceed 100 mg/l

Parameter	
Ammonia Sulphide	Maleic anhydride
Benzidine	Methylamine
Benzyl Chloride	Potassium permanganate
Diethylamine	Quinoline
Ethylamine	Strychnine
Ethylenediamine	Tetrachloroethanes

Standards for Solid Waste/Industrial Sludge suitable for Landfill (based on Leachate quality test results)

Parameter	**Concentration (mg/L)**
Arsenic	2.5
Barium	100
Cadmium	0.5
Carbon Tetrachloride	0.5
Chromium	5
Cyanide (free)	20
DDT	3
Endrin	0.02
Heptachlor + Heptachlor epoxide	0.03
Lead	5
Lindane	0.4
Mercury	0.1
Methoxychlor	10
Methyl ethyl ketone	200
Metolachlor	5
PCBs	50*
Selenium	1
Silver	5
Tetrachloroethylene	3.0
Toxaphene	0.5
Trihalomethanes	10
2,4,5-TP (Silvex)	1
Zinc	500

Annex 7

Appendix 11

Standards for Sewage Effluent Used for Irrigation

Parameter	Limit
Oil and Grease	10 mg/L
Total Suspended Solids (TSS)	15 mg/L
Residual Chlorine	0.5 mg/L
Biochemical Oxygen Demand (BOD_5)	15 mg/L
Chemical Oxygen Demand (COD)	<100 mg/L
Faecal Coliform	12 MPN/100 ml

Trade Effluent Used for Irrigation

The Authority shall approve the standards for trade effluent to be used for irrigation on a case-by-case basis. [p. 21 of the draft NRCA (Waste Water and Sludge) Regulations]

Appendix 12

(Regulation 3)

FIRST SCHEDULE

Form A

The Beach Control Authority (Licensing) Regulations, 1956

APPLICATION FOR LICENCE

Appendix 12

I,……………………………………………………………………………………………

(name of Applicant in block letters)

……………………………………………..of…………………………………………

(*occupation)*

in the parish of…………………………………….................hereby apply for a licence to use the foreshore and/or floor of the sea situate at……………………………………………...............

in the parish of……………………………………………………………………………..............

1. Location of area in respect of which licence is required. (Applicant should state name, district and parish, distance from nearest town or village, and if located at some distance from a main road should attach a sketch showing means of access to the area with distance from and location of the most convenient driving road.)

………………………………………………………………………………………………………
………………………………………………………………………………………………………
…………………………………………………………………………

2. Description of the area for which licence is required. (Applicant should state clearly the boundaries of the area, the extent of the area and should furnish a sketch to a scale sufficient to indicate the necessary details of the foreshore and/or floor of the sea and the land adjacent thereto with particular reference to the nearest main or parochial road or path used by the public)………………………………………………………………….

………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
………………………………………………………………………………………………………
……………………………………………

(Applicant should furnish a plan of any proposed or existing buildings and/or encroachments on the foreshore and/or floor of the sea).

3. Names and addresses of the owners and/or occupiers of any lands adjacent to the area referred to in paragraph 2 above………………………………………………………………………………...

EAST…………………………………………………………………………………………

WEST…………………………………………………………………………………………

NORTH...

SOUTH...

Appendix 12

4. Is Title registered?...………

By metes and bounds?...

By plan?...

Give volume and folio of the Certificate of Title…………………………………………….

………………………………………………………………………………………………

Give particulars of any encumbrances such as mortgages, leases, etc., affecting the said land

………………………………………………………………………………………………

…….…………………………………………………………………………………………..

5. Is the Title Common Law?...

By deed?...

If deed is recorded give Record Office reference…………………………………………...

By Long possession?..

Who is in actual possession of Title Deeds, Diagrams, etc.?...

..……………………………………………………………………………………………

6. If applicant is not the owner of the fee simple of the land mentioned in the Application the following information must be given:-

(a) Terms of lease or tenancy agreement; or other interest……………………………………..

…………………………………………………………………………………………………….

…………………………………………………………………………………………………….

…………………………………………………………………………………………………….

(b) Name and address if any other party or parties having any interest in the land…………....

……………………………………………………………………………………………………

7. Does the area specified in paragraph 2 above form part of enclosed land? If so by what means is the land enclosed………………………………………………………………….

………………………………………………………………………………………………

8. State type of enterprise previously carried on or now proposed (all activities must be stated)

……………………………………………………………………………………………..

………………………………………………………………………………………………

Appendix 12

…………………………………………………………………………………………………

…………………………………………………………………………………………………

9. State charges made or proposed (if any) for the use of the area specified in the application

…………………………………………………………………………………………………

…………………………………………………………………………………………………

10. State whether any right-of-way or road exists across the land adjoining the foreshore to the area for which application is made………………………………………………………………………………

…………………………………………………………………………………………………

…………………………………………………………………………………………………

I hereby declare that all the information which I give above is true to the best of my knowledge and belief.

Signed before me this ………………………..

Day of……………………………..19………

…………………………………

…………………………………

Applicant (print and sign)

………………………………………………
Justice of the Peace (print and sign)

Application fee of **$1000.00** is enclosed.

Appendix 13

Notice of Application – Form B First Schedule

1. Every applicant for a licence shall exhibit for a period of at least one month after the application has been received by the Authority notices in the Form B set out in the First Schedule to these Regulations in a conspicuous place on that part of the foreshore mentioned in the application and on any land adjacent thereto and under the control of the applicant.

2. The notice on the foreshore shall face and be visible from the sea and that on the adjacent land shall be placed on the verge thereof which is nearest to a main or parochial road or path used by the public and shall if possible face and be visible from such road or path.

3. The applicant shall serve, either personally or by registered post a copy of the notice on every person, who is the owner of any land adjacent to the area defined in paragraph 2 of the application, so, however, that failure to comply with the provisions of the paragraph shall not be deemed to invalidate any licence granted by the Authority.

4. Every such notice shall be clearly printed or painted in letters and figures not less than two and a half centimetres high.

FORM B

The Beach Control Authority (Licensing) Regulations, 1956

NOTICE OF APPLICATION

I ---

(Name of applicant in block letters)

of --- in the parish of ---

have applied to the Beach Control Authority for a licence to encroach on and/or use that use that part of the foreshore and/or floor of the sea at ---

----

(Insert description of the area)

for the purpose of ---

DATED the day of

Signature of Applicant

Appendix 14

FIRST SCHEDULE **(Regulations 2, 3, 6, 7 and 8)**

FORM 1

THE ENDANGERED SPECIES *(PROTECTION, CONSERVATION AND REGULATION OF TRADE) ACT, 2000*

Application Form for Import/Export/Re-export of Plant Specimens

Application No. ____

☐ IMPORT PERMIT
☐ EXPORT PERMIT
☐ RE-EXPORT CERTIFICATE
☐ OTHER CERTIFICATES

Name of Applicant: ______________________________
Please Print or Type

Address of Applicant: ______________________________

______________________________ TRN No. ____________

Telephone No. ____________ Fax No. ____________ E-Mail ____________

I/We hereby apply for CITES Permit(s)/Certificate(s)\ for ______________________________
Name of Consignee

____
Address of Consignee

____
City/State Zip Code Country

Indicate the name of Broker if applicable. ______________________________

Purpose of transaction: Commercial ☐ Botanical Gardens ☐ Travelling Exhibitions ☐ Scientific ☐ Educational ☐ Personal ☐ Biomedical Research ☐ Reintroduction or introduction into the wild ☐ Artificial Propagation ☐

Please describe the purpose in detail on additional sheets. P.T.O.

If the specimen(s) is living indicate provisions to house and care it in country of import, export or re-export.

Indicate the name of each specimen(s) in each shipment in the table below. If additional space is required please attach additional sheets.

Appendix 14

Common Name	Scientific Name (Genus & species)	Numbers of Specimen (s)	Description of Specimen	Indicate if Artificially propagated (A) or Collected from the Wild (W)	Country of Origin	Country of Export	Country of last Re-export	Date

Please note the following, where applicable:-

(1) This application form must be completed to commence processing. Where space is not provided attach additional sheets. Paragraphs that are not applicable to your application should be marked as N/A.

(2) If species were collected from the wild indicate name of location and parish/State/Country.

(3) A permit is required for each shipment of plants.

(4) Any Certificate of last re-export should be attached to the application form.

(5) Any import of plants shall be subject to the grant of a Permit from the Plant Quarantine Division, Ministry of Agriculture. Any export or re-export permit shall be subject to the grant of a Phytosanitary certificate from the Plant Quarantine Division, Ministry of Agriculture.

(6) For the purpose of re-export attach copies of cancelled CITES Export Permits or Re-export Certificate issued by the appropriate CITES office in the country from which the plant was imported. If you were not the importer, provide copies of the importer's documents outlined above and the invoice or receipt that shows you purchased the plant from the original importer.

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(7) For a Pre-Convention plant, an application will only need to be made for a Pre-Convention Certificate.

(8) For CITES Appendix I species, attach a copy of the CITES Import Permit issued by the Management Authority of the country to which your plan to export or re-export the wildlife (not required if specimen qualifies as Pre-Convention.)

(9) List the Jamaican port through which the export, re-export or import will occur.

(10) This application is only applicable to plant specimens for which there is no quota system.

APPLICANTS DECLARATION

I hereby certify that I have read and am familiar with the Endangered Species (Protection, Conservation and Regulation of Trade) Act.

I hereby certify that the information contained in this application is true and complete to the best of my knowledge and belief. I understand that any misrepresentation contained in this form shall lead to the discontinuation of the processing of the application and the revocation or suspension of any permit granted and also may lead to prosecution.

Signature of Applicant____________________ Date ____________________

FOR OFFICIAL USE ONLY

Date Received________________________

Registration Number of Artificial Propagation Facility ________________________

Date of NRCA Inspection ________________________

Quantity of specimens ________________________

Name of Officer ________________________

Application Fee Enclosed ________

Appendix No. ____________________

Appendix 15

NRCA

THE ENDANGERED SPECIES (PROTECTION, CONSERVATION AND REGULATION OF TRADE) ACT, 2000

CITES

FORM 2

Import/Export/Re-Export of Animal Specimens

Application No. ___________

☐ IMPORT PERMIT
☐ EXPORT PERMIT
☐ RE-EXPORT CERTIFICATE
☐ OTHER CERTIFICATES

Name of Applicant: ______________________________

Please print or type

Address of Applicant: ______________________________

TRN No.

______________________________ ______________

Telephone No. ___________ Fax No. ___________ E-Mail ___________

I/We hereby apply for CITES Permit(s)/Certificate(s) for:

____

Name of Consignee

______________________________ Address of Consignee

______________________________ City/State Zip Code Country

Indicate the name of Broker if applicable ______________________________

Purpose of transaction

Commercial ☐ Zoos ☐ Circus and Travelling Exhibitions ☐ Scientific ☐
Hunting Trophies ☐ Personal ☐ Biomedical Research ☐ Educational ☐
Reintroduction or introduction into the wild ☐ Breeding in captivity ☐

Please describe the purpose in detail on additional sheets.

If the specimen(s) is living indicate provisions to house and care it in country of import, export or re-export.

Indicate the name of each specimen(s) in each shipment in the table below. If additional space is required please attach additional sheets.

Appendix 15

Common Name	Scientific Name (Genus & species)	Number of Specimens	Description of Specimen (marks or numbers, age/sex if live)	Indicate if Captive Bred (C), Reared in Captivity (R) or Collected from the Wild (W)	Date of Birth	Country of Origin	Country of last Re-export	Country of Export	Date

Please note the following, where applicable:-

(1) This application form must be completed to commence processing. Where space is not provided attach additional sheets. Paragraphs that are not applicable to your application should be marked as N/A.

(2) If species were collected from the wild, indicate name of location and parish/state/country.

(3) A permit is required for each shipment of animals.

(4) Any Certificate of last re-export should be attached to the application form.

(5) Any import of animals shall be subject to the grant of an Animal and Importation Permit from the Veterinary Division, Ministry of Agriculture. Any export permit or re-export certificate shall be subject to the grant of a Health Certificate from the Veterinary Division, Ministry of Agriculture.

(6) If the specimens are protected animals/birds taken from the wild in Jamaica provide (a) exemption from the Minister of Environment and (b) the purpose that the specimen was removed from the wild.

(7) If the specimens are required for the purpose of re-export, attach copies of cancelled CITES Export Permits or Re-export Certificate issued by the appropriate CITES office in the country from which the animal was imported. If you were not the importer, provide copies of the importer's documents above and the invoice or receipt that shows you purchased the animal from the original importer.

Appendix 15

(8) For a Pre-Convention animal, an application will only need to be made to the Management Authority for a Pre-Convention Certificate.

(9) For living wildlife, describe the type, size and construction of any shipping container and arrangement for caring for the animal(s) during transport.

(10) For CITES Appendix I species, attach a copy of the CITES Import Permit issued by the Management Authority of the country to which you plan to export or re-export the wildlife (not required if specimen qualifies as Pre-Convention).

(11) List the Jamaican port through which the export, re-export or import will occur.

(12) This application is only applicable to animal species for which there is no quota system

APPLICANTS DECLARATION

I hereby certify that I have read and am familiar with the Endangered Species (Protection, Conservation and Regulation of Trade) Act.

I hereby certify that the information contained in this application is true and complete to the best of my knowledge and belief. I understand that any misrepresentation contained in this form shall lead to the discontinuation of the processing of the application and the revocation or suspension of any permit granted and also may lead to prosecution.

Signature of Applicant ____________________ Date ____________________

FOR OFFICIAL USE ONLY

Date Received____________

Registration Number of Captive breeding Facility ____________

Date of NRCA Inspection ____________

Quantity of specimen ____________

Name of Officer ______________________________

Application fee enclosed ____________

Appendix No. ______________________

Appendix 16

The Endangered Species (Protection, Conservation and Regulation of Trade) Establishment of Individual Export Quota (Conch, *Strombus gigas*) Regulations, 2002

Application Form for Individual Export Quota for *Strombus gigas* (Queen Conch) Annual Quota

Application No.________

Name of Exporter: ____
Please Print or Type

Address of Exporter: ____

______________________________ TRN No.: ______________

Telephone No.: ____________ Fax No.: ______________ E-Mail: ______________

I/We hereby apply for an Individual Export Quota to export___________kilograms of 50% cleaned *Strombus gigas* (Queen Conch). Fishing year_______________________ State the premises or facilities where conch is currently stored (if applicable).

____

Attach the following documents-

(1) A Certificate of the Individual Allowable Catch Quota for conch issued pursuant to the Fishing Industry (Conservation of Conch (Genus Strombus)) Regulations, 2000.
(2) A copy of a Fishing Licence granted by the Licensing Authority pursuant to the Fishing Industry Act.
(3) A Licence to operate a Fishing vessel or proof of use of a licensed vessel under the Fishing Industry Act.
(4) A Licence to operate a factory vessel, freezer vessel or carrier vessel or proof of use of such a vessel pursuant to the Aquaculture Inland Marine Products and By-Products (Inspection, Licensing and Export) Act, 1999.

APPLICATION'S DELCARATION

I hereby certify that -

(a) I have read and am familiar with the Endangered Species (Protection, Conservation and Regulation of Trade) Act and the Regulations made thereunder;
(b) The information contained in this application is true to the best of my knowledge and belief; and
(c) I understand that any misrepresentation found to be contained in this application during its processing shall lead to the discontinuation of the processing thereof.

______________________ ______________________
Signature of Exporter Date

If company, sign by authorized officer and affix seal.

Appendix 16

FOR OFFICIAL USE ONLY

Date of Management Authority Inspection (if applicable): __________

Quantity of conch in storage:_________________________________

Degree processed:____

Name of officer:____

Application Fee Enclosed:__________________________________

Date approved:____

Appendix 17

The Endangered Species (Protection, Conservation and Regulation of Trade) Act, 2000

Application Form for Export/Import/Re-export of ***Strombus gigas*** **(Queen Conch) Per Shipment**

Application No. ______

Name of Applicant: ____
Please Print or Type

Address of Applicant: ____

____ ______________

Telephone No.________________ Fax No. ________________ TRN No. E-Mail ______________

I/We hereby apply for a CITES Export/Import Permit(s) and Re-export Certificate.

Name of Consignee____

Address of Consignee ____

City/State ______________________ Zip Code___________ Country____________________

Indicate the quantity of processed *Strombus gigas* (Queen Conch) meat to be exported/imported/re-exported in each shipment.

1. ____________________ of ________________ for ____________________ kilogram
   number of cases degree processed total weight
2. ____________________ of ________________ for ____________________ kilogram
   number of cases degree processed total weight
3. ____________________ of ________________ for ____________________ kilogram
   number of cases degree processed total weight
4. ____________________ of ________________ for ____________________ kilogram
   number of cases degree processed total weight

Indicate the date of each proposed shipment: 1.______________ 2.______________3. ______________

4. ____________________

State the premises/facilities where conch is currently stored.

____

Please note that a separate application is required for each shipment of *Strombus gigas* (Queen Conch) and the application should be accompanied by the following documents:-

a) A Health Certificate issued by the Veterinary Services Division
b) A valid Individual Export Quota Certificate granted by the Management Authority

Appendix 17

APPLICANT'S DECLARATION

I hereby certify that I have read and I am familiar with the Endangered Species (Protection, Conservation and Regulation of Trade) Act.

I hereby certify that the information contained in this application is true and complete to the best of my knowledge and belief. I understand that any misrepresentation contained within this form shall lead to the discontinuation of this processing of the application, and the revocation or suspension of any permit granted and may lead to prosecution.

_____________________________ _____________________________

Signature of Exporter Date

FOR OFFICIAL USE ONLY

Documents received:

____ Health Certificate issued by the Veterinary Division

____ Individual Export Quota Certificate granted by the Management Authority

Date Received _________________

Date of Management Authority Inspection _____________________

Quantity of *Strombus gigas* (Queen Conch) in storage (if applicable) ____________________

Name of Officer __________________________

Application Fee Enclosed _________

Appendix 18

List of Acronyms

CIDA	Canadian International Development Agency
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
MLE	Ministry of Land and Environment
MOH	Ministry of Health
NEPA	National Environment and Planning Agency
NRCA	Natural Resources Conservation Authority
NWA	National Works Agency
JBI	Jamaica Bauxite Institute
SEA	Strategic Environmental Assessment
UKDoE	United Kingdom Department of the Environment
UNEP	United Nations Environment Programme
USAID	United States Agency for International Development
USEPA	United States Environmental Protection Agency
WRA	Water Resources Authority
GOJ	Government of Jamaica

Appendix 19

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