

Environmental Best Management Practices for Building Contractors



ENVIRONMENTAL PROTECTION DEPARTMENT

Government of Barbados

Environmental Best Management Practices for Building Contractors

Environmental Protection Department
Ministry of the Environment and Drainage

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Glossary of Terms

Ambient air –the surrounding outside air

Aquifer – an underground layer that stores that stores or transmits water

EPD— Environmental Protection Department

IAQ – Indoor Air Quality

Off-gassing – release of volatile organic compounds from building materials

Leach – to drain

Toxic – poisonous

Photosynthesis – This is a light dependant process which converts water, carbon dioxide and minerals into oxygen and energy-rich organic compounds.

US EPA – United States Environmental Protection Agency

Negative Pressure – The enclosed area has lower pressure than the area around it. Air would flow into this area.

Positive Pressure – The enclosed area has a higher pressure than the area around it. Air would flow from this area to the surrounding area.

Return vent – Cold air returns via this vent to the air conditioning system.

Special Waste – This is any waste with hazardous properties which may render it harmful to human health or the environment.

Vibration – very rapid movement to and fro or up and down

1.0 Introduction

The construction industry is a significant economic sector in Barbados with several projects being completed in the last five to ten years. These projects have included residential, commercial, industrial, tourism-based and public road works, an example of which is the expansion of the ABC highway.

Construction occurs inland, on the nearshore and next to existing buildings such as residences, schools and offices. With this comes the potential for construction activities to impact not only the environment but also the occupants of nearby buildings.



Construction at a seaside location

Over the years, the Environmental Protection Department (EPD) has received numerous complaints from residents and staff of various establishments affected by construction activities. Examples of complaints include increases in dust levels, paint odours and increased noise levels.

This booklet was developed with the aim of improving the awareness of building contractors and other persons in the construction industry with regards to the impact of construction activities on the environment and best practices which can reduce those impacts.

2.0 How do construction activities impact the environment?

Construction involves the alteration of the natural environment. Negative effects may occur due to significant changes to these natural processes. Impacts may be on the outdoor and indoor air, groundwater, surface water drainage or marine environment.

2.1 Ambient (Outdoor) Air Quality

Construction activities can have various impacts on ambient (outdoor) air quality. The impact depends on the types and sources of the air pollution, the level of exposure and also on the individuals exposed.

Ambient air quality is the condition of air in the outdoor environment.

2.1.1 Sources of Air Pollution

Construction activities can produce a number of air pollutants such as dust, vehicle exhaust and volatile organic compounds.

Air pollution — the presence of gases and particles in the air in such quantities that affect health and the environment.

Dust is produced from:

- Action of wind on exposed construction sites and exposed land
- Wind action on uncovered stockpiles of materials such as sand and grit
- Vehicle movement on paved or unpaved roadways
- Road works and construction
- Demolition activities
- Crushing, grinding, blasting, sanding and sawing



Wind action on this pile of grit can cause air pollution.

Vehicle exhaust is produced from vehicles idling and in motion.

Vehicles include on-road sources such as trucks and non-road sources such as asphalt pavers and excavators. Vehicle exhaust consists of pollutants such as carbon monoxide, nitrogen oxides and particulate matter.



Vehicle exhaust is released from this ride-on roller/compactor

Smoke is also an air pollutant which is produced during the burning of waste materials. The use of adhesives and asphalt/tar roofing can cause the release of volatile organic compounds (VOCs) which is another type of air pollutant.

2.1.2 Effects of Poor Ambient Air Quality

Particulate matter e.g. dust and smoke can be a nuisance and cause adverse health effects.

Dust is all matter up to 75 microns in diameter and it can be suspended or deposited.

Human health effects are mostly caused by particles less than 10 microns in size. (The width of an average human hair is 70 microns which makes it seven times larger than a 10 micron size particle.)

Human health effects include heart disorders e.g. irregular heart-beat, non-fatal heart attacks and aggravation of existing respiratory illness such as sinusitis, allergies and asthma.



Dust on glass louvers

Nuisance effects are normally associated with particle sizes of 20 microns and larger. Nuisance effects include the deposition of dust on cars, windows and property. This results in persons having to perform repeated cleanings in a short space of time. It may even prevent persons from enjoying their surroundings, which results in them becoming aggravated and annoyed. As a result their quality of life is reduced.

Residents, neighbours and even construction workers themselves may be affected by vapours released by paints, adhesives, stains and varnishes. Symptoms which may be experienced after short term exposure to vapours include eye, throat or lung irritation, headaches, vision problems and loss of memory. Long term exposure may result in liver and kidney effects.



2.2 Indoor Air Quality

Indoor air quality (IAQ) refers to the state of the indoor environment in any building. Construction activities which are conducted within and/or outside of an occupied building can have an impact on its inhabitants.

2.2.1 Types and Sources of Indoor Air Pollutants

There can be impacts on the indoor air quality of the building during remodeling of buildings. Particulate matter (e.g. dust) and **irritants** such as mould spores may be released during demolition.



Signs of poor IAQ are stuffy air, dirty air systems and dust on hard surfaces e.g. filing cabinets.

Activities such as sawing of wood and painting release **dust and odours** into the atmosphere.

Completed renovations could also lead to the disruption of the building's ventilation system. For example, partitions built to ceiling height can impede the movement of air through the return vents which can create areas of stagnant air, which may result in **odours** in the room. There may also be **off-gassing** from new building materials and products.

2.2.2 Effects of Bad Indoor Air Quality (IAQ)

Health effects from exposure to indoor air pollution can be immediate or long-term. Examples of immediate effects include but are not limited to irritation of the eyes, nose and throat, headaches and dizziness. There may also be the onset of symptoms from diseases such as asthma. Long term effects consist of respiratory disease, heart disease and cancer.

2.3 Ambient Noise and Vibrations

Construction activities generate noise and vibrations due to the use of mechanical equipment and manipulation of the earth e.g. excavation.

Noise is any unwanted sound.



2.3.1 Sources of Noise and Vibrations on a Construction site

Noise on construction sites can be caused by the use of machinery and equipment e.g. power tools, compressor and generators and the movement of vehicles across the site (Table 1 below). Vibrations can be caused by demolition and other activities such as pile driving and compacting.

Table 1: A list of equipment and the sound levels emitted

Equipment	Decibels
Jack hammer	103-111
Portable saw	88-102
Bulldozer	93-96
Crane	90-96
Front-end loader	86-94

These sound levels can be compared with those commonly experienced in Figure 1 on the following page.

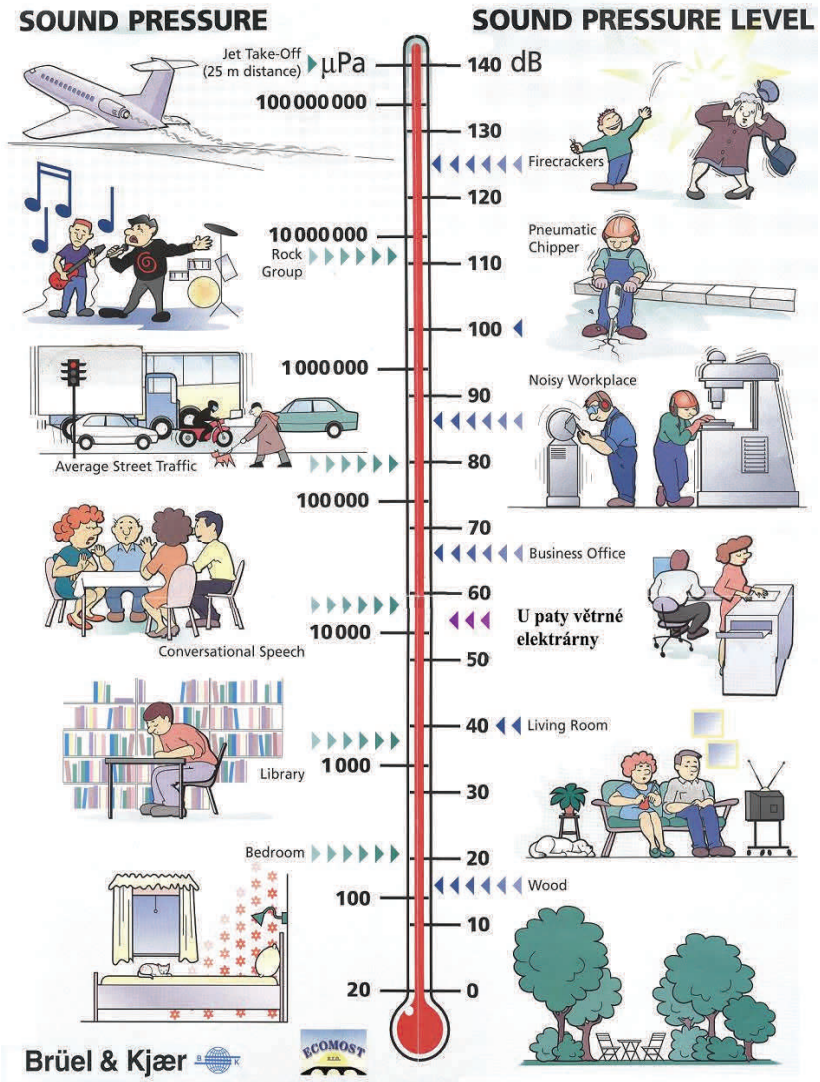


Figure 1 :Noise scale showing the different sound levels experienced everyday (Brüel & Kjær)

2.3.2 Effects of Increased Noise levels

Noise can have different effects on people. Examples include annoyance, sleep disturbance, interference with communication, effects on social behaviour and hearing impairment.



2.3.3 Effects of Increased Vibration levels

Vibrations can affect persons' visual perception, concentration and respiratory system. Vibrations can also result in property damage.

Property damage can be cosmetic or structural in nature. Hair-line cracks or growth of existing cracks in plaster, drywall surfaces or mortar joints are classified as cosmetic damage. Structural damage refers to any damage to structural elements of the building such as the foundation of the building.

2.4 Water Quality



Our main source of tap water is groundwater

Construction activities can affect the quality of water which is the “physical, chemical, biological and aesthetic (appearance and smell) characteristics” of water.

2.4.1 Types and Sources of pollutants

The United States Environmental Protection Agency (USEPA) defines storm water as “runoff water resulting from precipitation.” As runoff moves across the construction site, it collects several types of materials within it. These materials include sediment, solid waste and pollutant discharges e.g. metals, nutrients, pesticides and construction chemicals.

Contaminated storm water could impact on the quality of ground and surface waters since the storm water may travel from the construction site into a gully or into a well which leads to an aquifer. Storm water can also contaminate seawater when it flows to the sea via the storm drains and gullies.



Water flowing into the sea from storm drains.

The amount of the runoff may increase due to a reduction in the infiltration rates (speed of water entering the soil). Infiltration (the process by which water enters the soil) is reduced due to an increase in the amount of hard surfaces such as concrete driveways.

Groundwater may also become polluted because of the improper handling, storage and use of fuels and/or chemicals on construction sites. Leaks and spills of fuels or chemicals could leach into the aquifer from contaminated soils.



A storm drain leading to the coast.

Coastal construction may introduce leaks and spills directly to the marine environment where it can adverse effects for both humans and wildlife.

2.4.2 Contamination of storm water

Contaminated storm water can negatively impact the health of marine and freshwater plants and animals.

Reduced storm water quality can:

1. Disrupt photosynthesis by sediment blocking light from reaching the plants.
2. Reduce oxygen levels due to large amounts of decaying plant materials.
3. Clog fish gills due to increases in sediment levels.
4. Destroy coral reefs as a result of smothering caused by increased sediment loads.



Bleached or dead coral.

Any damage to the near shore fish stock could be economically detrimental to the local fishing industry. The damage to the ecosystem will also be a problem for the tourism industry which relies on the crystal clear waters, sandy beaches and marine life such as turtles of our island as a marketing tool.

Contamination of groundwater is a serious problem as groundwater is the main source of potable water in Barbados. Human health may be affected when persons are exposed to food and drink which used contaminated water in their preparation. The costs to clean any contamination will also be extremely high.

Table 2: Summary of pollutants and potential effects on health and other

Pollutant	Effects	
	Health	Other
Particulate Matter e.g. dust	Respiratory Ailments, Irregular heart beat	Deposition of dust on property e.g. cars
Vapours	Lung/ Throat Irritation	cancer
Noise	Annoyance, sleep disturbance	High blood pressure
Vibrations	Visual perception, concentration	Cosmetic or structural damage to property
Contaminated storm water	Possible contamination of potable water	Disruption of ecological processes

3.0 What legislation exists?

Health Service Nuisance Regulations

Dust and Other Impacts

Construction activities can cause nuisances for persons living nearby. A nuisance is prohibited under the Health Services (Nuisance) Regulations, 1969 and is defined as:

Any place, matter, thing, deposit or accumulation of liquid or solid matter that is full, in such a state or so place, made or left, as to be insanitary, injurious or dangerous to health or likely to become so;

A nuisance may be caused by dust emissions or improper disposal of waste which may adversely affect persons living nearby.



Dust being ejected into the air due to construction.

Workplace Conditions

The Health Services (Nuisance) Regulations also stipulate that a work environment should be provided which is free from any pollutants. With regards to renovations within the workplace the Regulations for example can relate to dust emissions and paint odours. Paragraph 3 section 16 states that it is an offence to have:

“any workplace - not ventilated so as to render harmless to the workers employed therein all gases, vapours, dust or their impurities generated in the course of the work carried out therein; or so overcrowded as to be injurious to the health of the persons employed therein;”

The removal of certain trees falls under the Trees Preservation Act CAP. 397 in which a permit must be granted for said removal.

Penalties

With regard to penalties under the Health Services (Nuisance) Regulations, it states the following:

“6. A person guilty of an offence under these regulations is liable under summary conviction to a fine not exceeding five thousand dollars or imprisonment for a term not exceeding twelve months or both, and, in the case of a continuing offence, to a further fine not exceeding two hundred dollars for each day or part thereof during which the offence continues after conviction is first obtained.”

Marine Pollution Control Act

The Marine Pollution Control Act, 1998-40 (MPCA) is “An act to prevent, reduce and control pollution of the marine environment of Barbados from whatever source”.



Paragraph 3 section (1) of the MPCA states that:

“No person shall release or cause to be released any pollutant into the environment which is in violation of any applicable standards, conditions or requirements specified under this Act or regulations”

This act therefore covers the intentional and accidental release of petroleum products and any other pollutants from construction activities into the environment.

The penalties are as follows:

First conviction - fine of \$200,000 or 5 years imprisonment or both.

Second or subsequent - fine of 400,000 or 5 years or both on indictment

Summary conviction - fine of \$ 5,000 or 2 years imprisonment or both.

Second or subsequent summary conviction - 20000 or 2 years or both

4.0 What are Best Management Practices?

According to the US EPA(2008), “Best management practices are methods that have been determined to be the most cost effective and practical at preventing or reducing pollution.”

4.1 The Benefits of Best Management Practices

The use of best management practices is not only beneficial to the building contractor but also to the wider community. These benefits may include:

- A **reduction of energy** usage due to the implementation of best management practices. For example if you prohibit vehicles from idling on site you can reduce the cost of fuel, thereby increasing profits.
- **Increased worker productivity** since workers would not be dissatisfied with their work conditions. Workers may be affected by excessive noise and dust levels.
- Decreasing pollution levels which may in turn can result in **reduced complaints from the community** and an improved company image which may translate into increased business.
- A consequence of not reducing pollution levels is increased interaction with regulatory agencies. Action may be taken according to the legislation as mentioned in Section 3.0.



5.0 What are some of the best management practices for the construction industry?


There are different measures which can be used to reduce the impacts of construction activities on workers and sensitive receptors such as residences and hospitals among others.

5.1 Dust Control

The following are some measures which can be taken to control dust:

"Dust control reduces the surface and air transport of dust" EPA (1999)

Commencement of Work

- Erect physical barriers along site boundaries. These barriers should be at least six feet high. Barriers include vertical barriers such as fencing and screening material of 50% or less porosity.
- 
- A well constructed dust barrier.**
- ◆ Wind barriers can be positioned:
 - * At right angles to the prevailing winds spaced at intervals of 10 to 15 times the height of the fence or
 - * Around or over dust sources.

Roads

- Select specific routes for haulage and access.
- Restrict public access to site.
- Set and enforce a maximum speed limit e.g. 10 km/hr onsite for vehicular traffic.
- Regularly inspect and repair onsite haul routes.
- Regularly wash or dampen down haul routes both inside and outside the site throughout the day.
- Reduce dust levels by using wet methods or mechanical road sweepers to remove dust from roadways.
- Clean or wash all vehicles before leaving the site if they are dirty. A wheel and vehicle wash can be used to clean the vehicles.
- Vehicle exhaust should be turned upwards, to the side or straight. Avoid having them point downwards.

Transporting Materials on and off site

- Cover trucks carrying loads at all times.
- Check that materials are adequately covered and that the covering does not need repairs.
- Wash tyres and the sides of vehicles so as to remove any debris.



A truck with an uncovered load.

Excavation and Earthworks

- Enclose large scale demolition and blasting. However if it is not possible then intensive sprinkling or water curtains could be used to control the dust
- Remove vegetative cover such as trees in phases so as to avoid erosion. This reduces the area of disturbed soil which can be impacted by rainfall.
- Replant and stabilize completed earthworks e.g. landscape as soon as possible.
- Ensure all materials are adequately covered .
- Seal storage mounds to reduce erosion. Examples of sealing methods include:
 1. Seeding,
 2. Surfacing with vegetation and
 3. Covering with tarpaulin.

Others

- Use chutes to move debris from upper levels of the building into skips/dumpsters.
- Use curtains around the construction area.
- Pre-demolition surveys should be carried out on structures to be demolished (especially old buildings) to determine possible sources of airborne hazards.



Chute being used to remove debris from upper floors to the ground.

5.2 Reducing other emissions

- Do not allow vehicles to idle unless carrying out necessary activities such as lifting.
- Operate plant and equipment like compressors away from residences, hospitals and other sensitive areas.
- Service vehicles routinely.
- **DO NOT BURN** trash. Place waste in a skip to dispose of at the approved disposal site and remove frequently when the skip is full.



Open burning is NOT recommended.

5.3 Working in occupied buildings - Protecting Indoor Air Quality

The following best practices have been developed due to the impacts which can occur during the remodeling or renovation of commercial offices :

- Conduct remodeling or renovations on weekends or outside office hours.
- Erect barriers to separate offices from remodeling
- Use exhaust ventilation (extractor fans) to remove dust and/or chemical vapours.
- Avoid creating dust. Carry out vacuum sanding instead. Use drop cloths to cover the ground under the work area so that dust can collect on it. This will allow the area to be easily cleaned.

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- Dry wet areas within 24 to 48 hours to stop mould growth.
- Promptly fix all sources of excess moisture e.g. leaky pipes.
- Contact an environmental professional if a large area (more than 10 square feet) is covered in microbial growth.
- Properly seal and store paints and adhesives after use.
- Follow the manufacturers' instructions for all products such as paints and adhesives with regards to:
 - * Proper use,
 - * Dilution,
 - * Ventilation requirements and
 - * Other health & safety guidelines.
- Whenever possible, select materials and products which are designed to reduce off-gassing such as a low volatile organic compound (VOC) sealant.
- Keep the inside and outside of the building clean.
- Thoroughly clean all renovated areas prior to reoccupation of the office space and, where appropriate, allow to ventilate for minimum of 48 hours before occupation.
- Ensure that occupied spaces are under positive pressure relative to the outside.



Fix leaking pipes ASAP.

5.3.1 Ventilation and Air-Conditioning System

- Maintain the construction zone under negative pressure. Stop the supply air to the area under construction if necessary.
- DO NOT ALLOW contaminants to enter the ventilation and air-conditioning (VAC) system. Seal all return ducts.
- KEEP ALL supply and return ducts clean. This should be part of the routine maintenance programme.
- DO NOT ALLOW exhausted contaminants to re-enter the building through open windows or the air intake of the (VAC) system.
- Ensure that occupied spaces are under positive pressure relative to the outside.



Keep all AC units clean.



A resealed return duct.

5.3.2 Painting

- Use low odour paints whenever possible.
- Paint the inside of buildings during the dry season so that windows can be opened for ventilation.
- Open windows for a minimum of two to three days after painting to allow for venting of contaminants. However, this is not advised when the rain is falling.

Do not use exterior paints indoors.



Painting without proper ventilation.

5.3.3 Roofing

- Take into consideration the position of air intakes and wind patterns when handling hot tar and hot asphalt materials.
- Close outdoor air intakes for the duration of roofing activities if necessary.
- Schedule activities during weekends or after hours.
- Notify occupants of nearby buildings of construction activities prior to the start. Occupants should be informed of the duration and the types of activities which are to be done.

5.4 Reducing noise and vibration levels

5.4.1 General

- Where possible, keep, traffic away from sensitive receptors such as dwellings, hospitals and schools.
- Locate pumps, generators and other major noise producing equipment as far as practical away from sensitive receptors.
- Enclose noisy activities or groups of equipment with shields or loaded vinyl curtains to reduce impacts.
- Avoid undertaking noisy activities after 6:00 pm and before 7:00 am in residential areas.
- Use the quietest equipment possible. Enclose air compressors. Fit all engines with mufflers. Check compressor lines to ensure that there are no leaks.

- DO NOT CONDUCT more than one activity which produces vibrations at the same time. Vibrations from each source when carried out separately has less of an impact on sensitive receptors than when carried out together. The intensity of the vibrations increases with the number of the sources.
- Use electric compressors instead of diesel or gasoline powered compressors because electric ones are quieter.
- Carry out periodic noise surveys on equipment and plant to determine any increases in noise levels. The appropriate action should then be taken to reduce the noise level to an acceptable one.

5.4.2 Piling and Dynamic Compaction

- **Only USE** impact pile drivers during daytime hours 9:00 am to 4:00 pm.
- Use the quietest possible piling or compaction system whenever practical.
- Use the minimum drop height or vibration energy when activities are sited close to sensitive receptors.
- Review and make improvements in procedures routinely and after complaints have been made.
- Inform residents and businesses that may be impacted by construction activities and obtain their input.
- Use alternatives to pile driving e.g. vibration or insertion techniques and drilled or augured holes for cast-in place piles (FHWA, 2006) if practical.

5.5 Reducing Impacts on Water Quality

A number of strategies could be used to help reduce the impacts of your operation on water quality. Strategies include the proper handling of storm water, good dewatering procedures and the proper disposal of site waste.

5.5.1 Handling Storm water

The impacts of storm water can be reduced by using various strategies in order to reduce erosion and sediment content of run off. Strategies include:

- Permanent seeding – establishing a permanent vegetative cover using perennials on disturbed areas.
- Tree preservation – protecting desirable trees from injury during cleaning or other construction.
- Water should be directed away from areas of soil disturbance such as:
 - ◆ Tops of disturbed slope and
 - ◆ Around stockpiles, material storage or other sensitive areas
- Buffer zone – a vegetated strip of land bordering a stream or surrounding a development.
- Storm drain inlet protection – a filter or impounding area around a storm drain inlet.
- Sediment barrier – temporary in nature and functions by causing the water to pond thereby resulting in the settling out of soil.



Site water being discharged to the sea

5.5.2 Site Dewatering

USEPA describes dewatering as a technique “used to remove ground water or accumulated rain water from excavated areas”. Within this booklet it also refers to seawater. Permission must be granted by the Environmental Protection Department before site dewatering if the direct discharge to sea, gully or storm drain occurs on any construction site.

Under the MPCA, 1998 it is an offence to discharge wastewater that does not meet the applicable standards.

A proposal must be submitted to the department for approval, Include the following information:

- a. The reason for the dewatering;
- b. The location of the project;
- c. The contact person (s) for the project;
- d. Details on the intended dewatering process (how will it be done; what materials will be used; disposal point, and a diagram of the process);
- e. Timeline of the project
- f. History of the site (what was on the site before current construction).



Holding tanks under construction

EPD allows the pumping of groundwater and seawater for foundation dewatering under the following conditions:

- Ensure that site discharge from your dewatering complies with Draft Table of Prohibited Concentrations.
- Allow water to settle using a series of holding tanks where water moves by overflow from one tank to the next. Obtain approval from the EPD if other methods of settlement are to be used.
- Discharge only groundwater or seawater removed from the foundation. DO NOT discharge any other wastewater.
- Ensure that contaminants such as oil or sewage are not introduced into the water being discharged .

5.5.3 Chemical Storage

Several chemicals may be stored on construction sites and these materials have a high potential to pollute the environment. Therefore:

- Place all chemicals in a secure room or in lockable containers if a secure room is unavailable.
- Obtain and keep copies of Material Safety Data Sheets.
- Train staff on the proper use and handling of chemicals.
- Identify and quickly clean up all spills and leaks.



Chemicals in a properly protected room.

- Use secondary containment when storing chemicals or fuel storage containers to hold 110% of volume in the advent of a spill or leak.

5.5.4 Disposal of Site Waste

- DO NOT BURN construction waste or any other material. It should be disposed of as soon as practical using approved methods.
- Place treated wood in a container designated only for such waste prior to disposal.
- Recycle materials such as paper, plastics and oil.
- Clean-up solid waste e.g. trash, debris, wood daily.
- Locate waste collection areas as far as possible from gutters, watercourses and storm drains. These areas should be located in close proximity to site entrances to reduce impact of traffic on disturbed soils.
- Use secondary containment to reduce the possibility of contaminated discharges being released to the environment.
- Cover and check dumpsters often.
- Place solid wastes in dumpsters of adequate size and number.
- Know the locations of designated disposal areas for the different types of waste generated on site.
- DO NOT LITTER on site.



Recyclable waste placed in drums and ready to be removed from the site.

- Place solid wastes in dumpsters of adequate size and number.
- Promptly remove full dumpsters from the site and dispose of appropriately.
- DO NOT ALLOW solid waste to come in contact with storm water.
- The site should be kept in a satisfactory manner at all times . This can reduce the multiplication of vectors such as flies and rodents.

Location of Waste Disposal Sites

Construction Debris

This includes wood, vegetation, construction and demolition debris. Contact the Sanitation Service Authority (SSA) for information regarding proper disposal. Special waste requires permission from the EPD prior to disposal at SSA facilities.

Metal

Dispose of metal waste at the Bagatelle Waste Metal Facility.

Asbestos

Dispose of asbestos and fiberglass at the facility in the Rock Hall, St. Philip.

Liquid

For wastes of this type, obtain advice from the EPD.

5.6 How should relations with the public be better handled?

Neighbours should be informed prior to commencement of any construction activities. Neighbours should be notified of the daily hours of operation the start date of the operation and the duration of the project.

Different methods of communication could be used such as flyers, email etc. Significant delays in the timeline of the project should be conveyed to nearby residents.

- Implement a complaint handling procedure.
- Log all complaints from the public.
- Investigate the complaints as a matter of priority.
- Inform the complainant of the actions which are being taken.
- Contact the complainant within 48 hours from the time the complaint was lodged to let them know the progress that has been made.

5.7 Education of Employees

The information within this booklet should also be communicated to the employees as they should be aware that activities at the site can affect themselves, other workers, nearby residences/businesses and the environment. Some methods of educating employees include posters, signage, training seminars, meetings etc.

Employers should ensure that company policies support or encourage the environmental best management practices. Also the company/employer should provide the workers with suitable personal protective equipment (PPE), train them in the correct use of PPE and encourage workers to use their PPE as they can also be affected by activities at the work site.

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Notes



ENVIRONMENTAL PROTECTION DEPARTMENT

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**Environmental Protection Department
Ministry of Environment and Drainage**

**Government of Barbados
L.V Harcourt Lewis Building
Dalkeith**

St. Michael

Phone:246-310-3600

Fax:246-228-7103

Email: enveng@caribsurf.com

Website: www.epd.gov.bb