3.3.3 Existing Infrastructure

Electricity

The Dalling Street area is presently supplied with electricity by the Jamaica Public Service Company Limited. The capacity of the light and power company to supply electricity to Savanna-la-mar and environs is adequate. The Paradise substation provides electricity for the town of Savanna-la-mar including the Dalling Street area where power is supplied through a 24 kV line.

Telephone, Potable Water

Cable and Wireless adequately meets the demand for telephone service within Savanna-la-mar and would be able to supply the cemetery as demanded. The sources of potable water to the town are the National Water Commission's treatment plants at Roaring River, Carawina and Bulstrode. The main source of water for the Dalling Street area is the Plant at Roaring River which has the capacity to supply 1.5 million gallons (6,818,181.81 litres) of water per day. Water supply is reliable with little need for major water management measures.

3.3.4 Housing

Overall, the town of Savanna-la-mar had a total housing stock of 39,691 as recorded in the 2001 Population Census. Houses built by informal settlers and other residents west of the Property are a mixture of board and concrete. The ownership structure of other residential units adjacent to the Property to the North appears formal and units are generally concrete structures in fair to good condition.

3.3.5 Recreational Facilities

Savanna-la-mar is inadequately supplied with parks and play fields. The two community centres in the town at New Market Oval and Hatfield are multifunctional. These are in addition to the 14 publicly owned open spaces which range from ¼ - ½ acre. These open spaces that are mainly located in subdivisions serve an approximate population of 5,000 persons. The Independence Park located at the corner of Great George's Street and Barracks Road is the town's most central open space but requires a maintenance programme like most open spaces in the town. The proposed cemetery site would also perform open space functions. The

Memorial Garden design in the proposed development plan would also render it a functional open space.

3.3.6 Roads, Transportation and Traffic

The road network within the town is in relatively fair condition but requires upgrading as Savanna-la-mar is linked to the rest of the island by its main road network. One of those in urgent need of repair is Dalling Street that runs adjacent to the development site. The need for sidewalks for pedestrian generally in the town also exists. The roads and walkways within the development would be designed to accommodate pedestrian traffic given the nature of the proposed action.

Transportation within the development area like most of Savanna-la-mar is by shared taxis. Private vehicles including chartered buses usually provide transportation to funeral services the absence of public transportation in the area would, therefore, not be a major consideration. The volumes of traffic generated would be the factor to be considered. However, the main concern would be on traditional burial days, such as, Saturdays and Sundays when burials could be in progress at all three adjacent burial sites in addition to this proposed facility.

Table 3.8 presents traffic survey information on Dalling Street that was obtained on Tuesday, 2005 October 25, which reveals no unusual incidents of traffic congestion along that road. Members of the Jamaica Constabulary Force normally provide escorts for these funeral processions and would adequately monitor traffic movement along this thoroughfare. In addition, access to the proposed cemetery would be off Dalling Street adequate parking would be provided within the cemetery.

The figures, nevertheless point to the expected trend. The highest volume of traffic (148) was headed northward in the direction of Negril, of these, there were fifty-two (52) private motorcars, the most common form of transportation. The second highest volume of transportation type was route taxis (61), which culturally has become a popular form of transport.

Table 3.8: Composition of Road Traffic, Savanna-la-mar, Westmoreland

DATE 25.10.05	MINI BUSES	ROUTE TAXIS	PRIVATE MOTOR CARS	MOTOR CYCLES	BICYCLES	TRUCK	PICK-UPS	SUVS	TOTAL
Northward 4.30 -5.00 p.m.	13	32	52	1	19	3	19	9	148
Southward 4.30-5.00 p.m.	2	29	39	1	9	1	18	7	106
TOTAL	15	61	91	2	28	4	37	16	258

3.3.7 Community Services

Community services are expected to be affected positively by the cemetery project because currently limited services are supplied to the existing cemetery sites, such as, water, sanitary facilities and parking. The main local services that would be provided after the cemetery is developed would be police and fire protection.

3.3.8 Cultural Resources

Archaeological and other historical resources are not known to be located on the property. Development of the site would alter the current cultural use of the site from informal use to passive pursuits associated with cemetery visitation.

3.3.9 Aesthetics

A landscape architect would best carefully approach the need for a harmonious relationship between the two potentially dominant uses of the site. A system of landscaping using burms and green areas would contribute to a generally pleasant environment.

Construction design intent is to create a cemetery that is modern in an environment that evokes feelings of peace, tranquillity and reverence. Construction materials would be employed in a manner sensitive to the natural context. They would compliment the environment in harmony with its scale, colour and form in a way that enhances the quiet dignity of the Property.

Although assessment of aesthetics is highly subjective, development of the site would appear to enhance it by converting the land from relatively sparse vegetation to a cemetery in harmony with the surrounding environment. The design and management of the cemetery ensures its blending into the area while emphasising visual appeal that should enhance the present land use pattern.

3.3.10 Potential for Generating Substantial Controversy

Development of the cemetery is generally favoured in the community as an asset to the local economy. Issues that may arise are the potential impacts to the total water budget in the area and potential short term increases in traffic during ceremonies at the proposed cemetery. However, the actual projected usage of water by the cemetery is expected to have an insignificant impact once the recommended mitigate actions are implemented. Mitigation actions are discussed in Section 4.0. Without the widening of the Dalling Street main road there would be the need to ensure adequate police escort to assist in managing short term traffic flow increases at the commencement and the end of funeral ceremonies as ample parking will be provided on site. This measure would avert the potential major impact on traffic flow in the vicinity of the proposed cemetery especially given the potential for conflict between the vehicles of mourners, from the various cemeteries in the area.

3.3.11 Attitudes

The need for a cemetery to serve the Greater Savanna-la-mar Area and the Region is urgent. The general attitude of all stakeholders in the development is, therefore, positive due to the special circumstances being experienced by the town with the lack of public cemetery space. The town of Savanna-la-mar experienced a population growth of 2.17% between 1991 and 2001 and accounted for 14.31% of the parishes' population, with developments in the area it is expected the population will increase in the future.

Based on interviews with residents in Dalling Street and adjacent areas in Savanna-la-mar opinions are generally favourable partially due to the fact that there are existing cemeteries in the immediate environs.

The siting of a cemetery requires careful planning in determining possible compatible land uses. One of the major concerns is the lowering of property values, that may be a concern of

residents located in closest proximity to the proposed site. The community meeting required by NEPA should assist in a greater understanding of the need for the project and the planned measures to minimize or negate any adverse impacts.

3.3.12 Risk Analysis

"A cemetery is not an all-weather pitch, neither is it simply a nature reserve: It is a complex, historical and social culture legacy of great emotional meaning"
(Ken Worpole).

Research shows that poorly sited cemeteries can pose a number of risks. This assumes that there are certain hazards to which a population may be vulnerable. The associated risks can be analysed by hazard assessment and vulnerability analysis. In the risk analysis of the proposed project it is first appropriate to prepare a risk inventory and make an assessment of these risks. The potential risks are:

- Health implications if groundwater and soil becomes polluted/contaminated
- Overheating of the cremation chamber
- Risk of explosion if cremation equipment is not properly maintained
- Risks associated with the storage of fuels – possibility of fires
- Occupational health risks
- Road accidents
- On site flooding
- Effects on health and the environment posed by emissions from the crematory

These risks are further highlighted as impacts in Section 4 and mitigation measures proposed to remove or mitigate them where they are treated as potential development impacts. Other hazards and vulnerability analyses to determine associated risks are treated below.

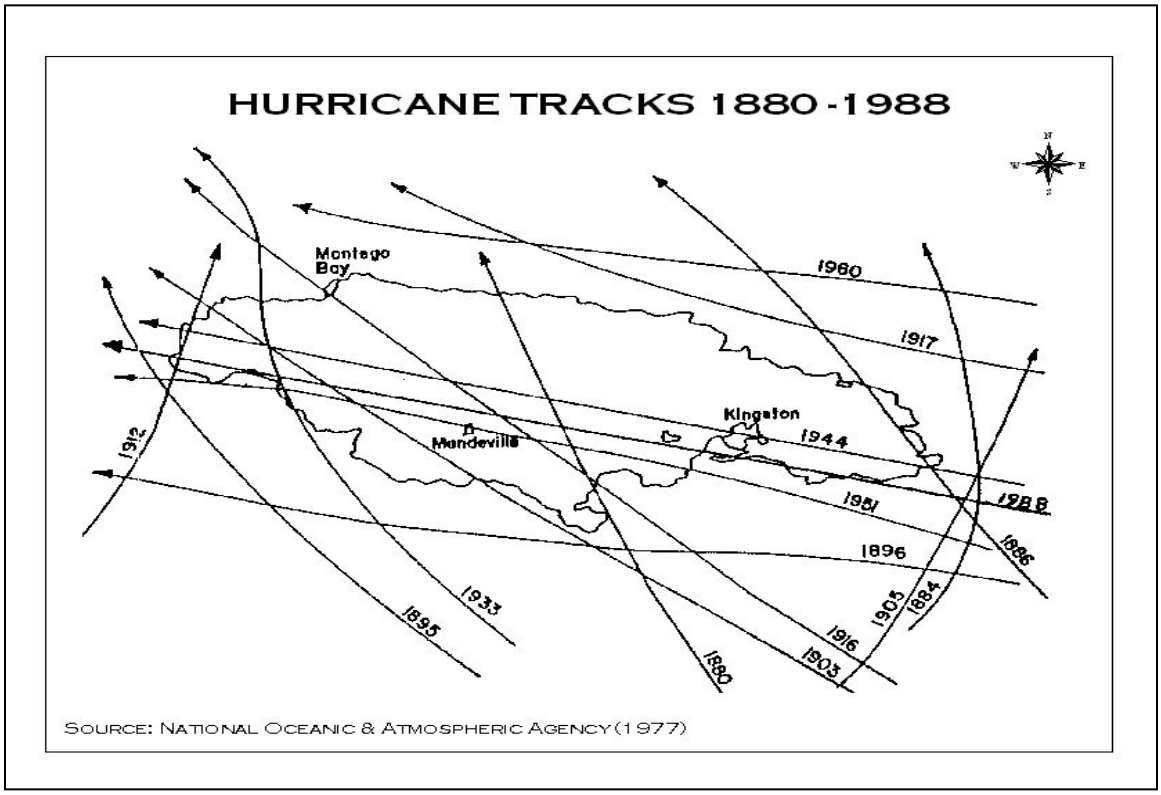
Hurricanes and Storm Surge

Hurricanes, tropical storms and tropical depressions are frequent occurrences in Jamaica. From the record of hurricanes affecting the island over the past 300 years, the south coast lies within the track of major hurricanes and tropical storms. Hurricanes and tropical storms may generate storm surge and cause coastal flooding.

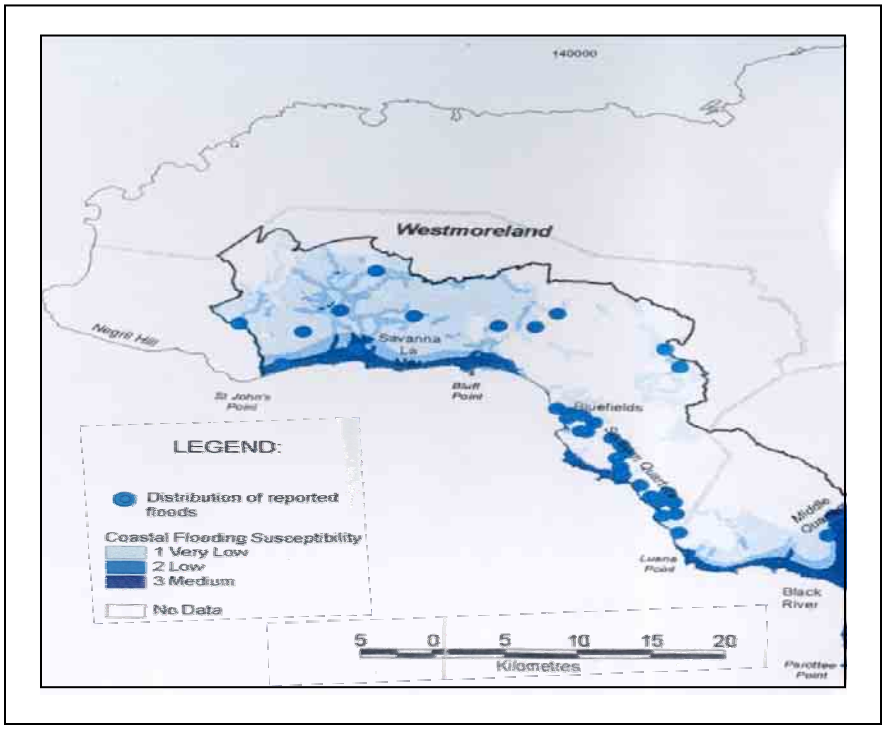
A storm surge is an abnormal rise of water generated by a storm along a coastal region. Under severe conditions, coastal areas up to 5 or 6 metres elevation from the coastline may be affected by a storm surge. There is no measured data for storm surge events on the south or south-western coast of Jamaica, however, two eyewitness accounts are documented on storm surge events affecting Savanna-la-mar and surrounding areas. These events occurred in 1781 and 1912 (Halcrow, Geology and Natural Hazard: South Coast Sustainable Development Project 1999) in which eyewitness accounts estimated 1.8 metres (6 feet) high waves causing severe and destructive damage to houses, shipping port and sugar estate as well as loss of lives during the storm of 1912.

Whereas there are no direct measurements of storm surge on the island, in general, coastal areas below 6.0 metres above mean sea level are considered to be at risk to storm surge. Whereas the site is below 6.0 m above mean sea level it is sufficiently far from the coast and, therefore, hazard relating to storm surges is not considered to be very significant.

Jamaica experiences hurricanes and tropical cyclones (directly or indirectly) on a regular basis and the bathymetric conditions offshore along the south coast (shallow shelf environment extending several kilometres seaward) increases the risk of surge events affecting the south coast of Jamaica (Map 8). Map 9 is a flood hazard susceptibility map for Westmoreland showing Savanna-la-mar and surrounding coastal areas having moderate coastal flood susceptibility.



Map 8 - Map of Jamaica showing hurricane tracks 1880 – 1988



(Source: Halcrow, South Coast Sustainable Development Study)

Map 9: Flood Hazard Susceptibility Map, Westmoreland

Earthquake Hazard

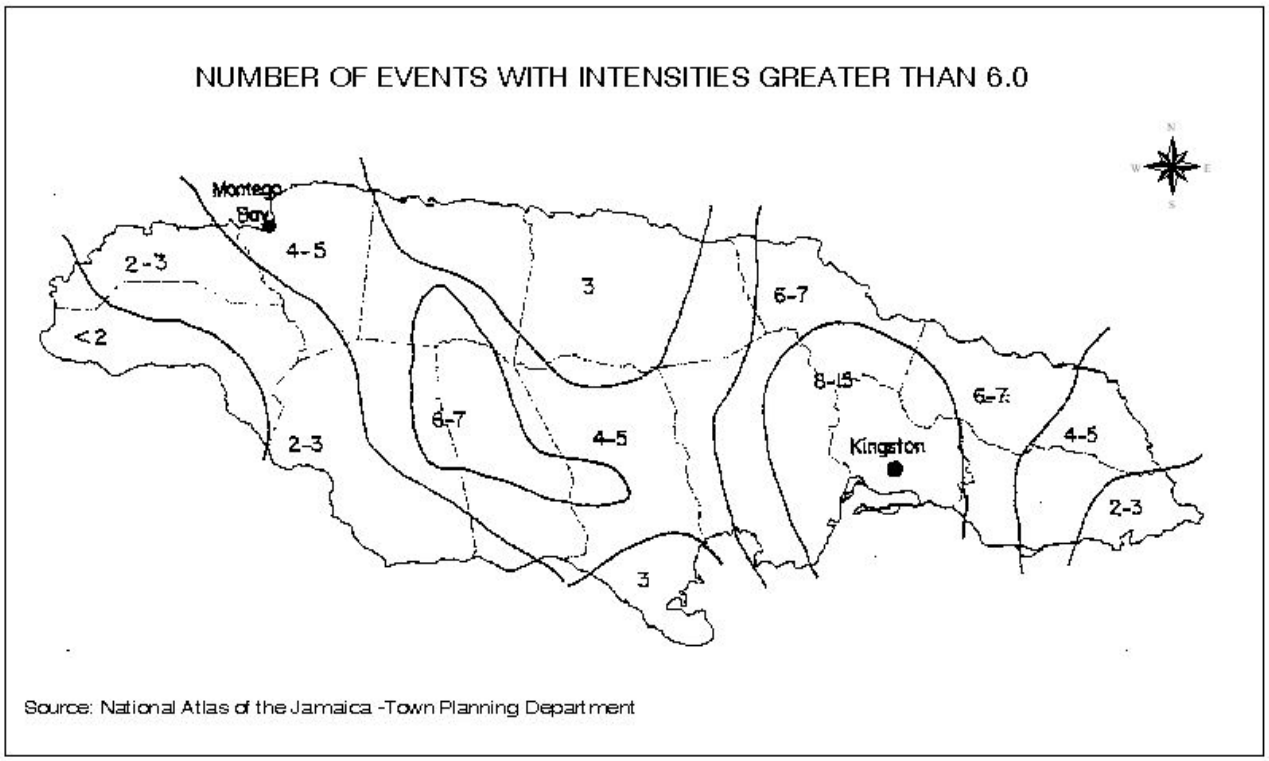
Jamaica is located in a seismic active zone, but the parish of Westmoreland falls outside of the major seismic risk zones. Earthquakes occur along these seismically active geological faults; however, there are no known active faults in the study area. The major earthquake source zone on land is the Wagwater Belt in the western Blue Mountain area. The proposed site is more than 200 kilometres from this source zone and therefore earthquakes in this area is not expected to cause significant damages at the site.

From the catalogue of earthquakes impacting Jamaica over the past 300 years, most of the larger earthquakes recorded/reported were offshore. The earthquakes occurring on land tend to be of low magnitude. From a historical seismic perspective, the site is no more prone than any other area on the island.

Data on historical seismicity covering the period 1880 – 1960, indicates that the south western section of the island including Dalling Street and surrounding areas has a damage frequent-cy rate of less than five (5) per century for earthquakes of Modified Mercalli Intensity (MMI) of VI or greater. The data further indicates that areas around Savanna-la-mar including Dalling Street have the lowest damage frequency rate in Jamaica (Shepherd and Aspinnall, 1980), an indication that the study area has relatively low to moderate levels of seismicity (Map 10). One such event was the earthquake of March 1, 1957, which affected western Jamaica and did significant damage to Westmoreland and in particular, the town of Savanna-la-mar. The Daily Gleaner of March 7, 1957 reported that damage to personal property caused by the earthquake was extensive in Westmoreland. The Savanna-la-mar Parish Church, Anglican Church merchant shops and residential homes suffered severe damage. The Methodist Church was beyond repair and electricity went out for about half an hour.

Recent seismic ground motion studies for Jamaica (Shepherd 1999) suggests that there is a ten percent probability that an earthquake ground acceleration of 15 percent gravity (0.15 g) is likely to be exceeded in 50 years in the study area. This implies that ground acceleration for the cemetery site and surrounding areas is relatively low in bedrock. This along with the low permeability clay below the site eliminates the risk of soil liquefaction or excessive ground acceleration and therefore this impact is not considered significant.

To minimize earthquake impact it is recommend that the buildings at the site be designed and built to withstand moderate to large earthquakes.



Map 10: Map of Jamaica showing seismic zones across the island

Landslides

The area is generally flat and low lying; therefore landslides are not expected to occur at the project site.

Carrying Capacity

To ensure that the carrying capacity of the site is not surpassed 8 acres (3.24 hectares) are allocated for interment purposes, this is subdivided among single, double and triple vaults. The elevation of the site will determine the location of the vaults, with the triple vaults been placed on the higher elevations. Final site elevation will be a function of the height of fill material introduced at a cost of approximately Five Million Dollars ($ 5,000,000.00). This material would also serve the function of improving the hospitability of the site for the proposed land use.

It is estimate that approximately 1,200 vaults will be constructed, based on a ratio where 11/6 acre is prepared for every 100 vaults. With less that 5 metres above mean sea level for much of the site 4 acres will be delineated for single vaults and would provide approximately 344 vaults, 2 acres for double – 344 and 2 acres 3- 517. The average measurement of each space would be length 7'6", width 3'3" and depth 4'.

4.0 ENVIRONMENTAL IMPACT AND MITIGATION MEASURES

This section of the environmental assessment speaks to impacts of the action in the context of current and foreseeable future actions and trends in the area and region of influence. The proposed cemetery project could result in environmental effects to soils, site drainage, water budget, noise, air quality, human health and safety and the economy.

Construction of the Cemetery in Phase I would cause short term effects to surface soils, noise, and aesthetic effects stemming from construction and traffic traversing the cemetery grounds. Similar, short-term effects are expected for the construction portions of Phase II to IV.

Constructional and Preparatory Phase

4.1 Physical Environment

4.1.1 Flooding Impact

The proposed land use changes at the site would result in a reduction of infiltration and consequently increase surface runoff from the site. The global physical change would be insignificant as the present vegetated (grass) surface would be changed to lawns and paved surfaces while some increase in surface run off would occur actual increase is not expected to exceed 30 per cent.

The proposed development would not significantly increase the risk of flooding on the site or to areas downstream of the site**. (Direct, negative, long term impact)**

Measures Incorporated by Design and Mitigation Measures

Reserve the area of the location of the central pond for parking lots and channel storm water into drainage channels that lead to on site detention areas. The project design also allows for percolation of runoff.

4.1.2 Groundwater Contamination

Any negative impact on ground water quality would be insignificant due to the following local characteristics:

- Physically, clay is of low permeability
- The groundwater at the location is potentially saline

Additionally, there is no domestic use of groundwater at or downstream of the proposed site.

Measures Incorporated by Design and Mitigation Measures

- There would be no subsurface disposal of effluent at the site.
- The vaults would be completely lined with concrete.
- Surface runoff should be diverted from the burial area to prevent ponding of surface water.
- Site drainage and grading would be designed to minimized storm drainage run-off with cross drains, culverts and drainage channels maintaining a pond to the north east of the property designed to enhance groundwater recharge, minimize runoff and promote vegetative growth

4.1.3 Water Supply and Demand

Assuming 100 funerals per year and an average 150 persons in attendance, a per capita water consumption of 0.1 cubic metres (25 gallons), the average annual domestic water demand is 1,419.69 cubic metres (375,000 gallons) or 3.89 cubic metres (1,027.39 gallons) per day. The water demand on weekends would be higher given the fact that more funerals are held at that time of the week. The domestic water demand could be met from the existing domestic supply in the area.

It is not a good water management practice to use domestic water for irrigating such a large area neither is it economically feasible. (**Direct, negative impact)**

Measures Incorporated by Design and Mitigation Measures

Treated waste water would be available for irrigating lawns. Additionally, rainwater could be harvested and stored in an underground cistern for use in the irrigations of the memorial garden.

4.2 Ecological Impacts and Mitigation Measures

4.2.1 Storm Water Runoff from adjacent properties

This site is down gradient of the adjacent residential properties to the north and north east and therefore, storm water flows naturally onto the property. During field investigation there was evidence of water collected in the depressions on the property as it acts an important escape route for storm waters after heavy rains. The historical use of the property as a pasture meant that no major drainage considerations needed to be contemplated as both the natural and manmade depressions sufficed.

Measures Incorporated by Design and Mitigation Measures

Fill materials would be used to level areas of depression and to facilitate the construction of vaults and other capital facilities. The objective of the plans for drainage is to avoid excessive storm water runoff onto Dalling Street. Drainage structures would transport storm water runoff primarily to onsite retention areas, such as, perimeter trenches packed with river shingle to allow for easy infiltration.

4.2.2 Decreased Biodiversity

The site is already species impoverished; therefore, the impact on the vegetative cover would be negligible resulting, in the fact, that there would be limited destruction and/or displacement of vegetation cover. None of the species of plants or animals found are currently considered threatened or endangered.

Measures Incorporated by Design and Mitigation Measures

There would be replanting of trees during the landscaping of areas, such as, the parking lot and around the Chapel, morgue and administrative buildings. Grasses, such as, Bermuda grass would be used in the establishment of the Memorial Garden. Trees that are now located on the periphery would be retained as part of a buffer between adjacent residential properties. In addition, while there are specific planning guidelines for set back, a buffer zone between adjacent residential properties would be created for areas earmarked for vault construction based on conditions established by the Westmoreland parish Council.

4.3 Socio-economic Impact Assessment

4.3.1 Employment Impacts

Within the Dalling Street area on the average, the rate of unemployment appears to be on par with that of the parish average as the unemployed who also includes housewives and retirees accounts for approximately 30 percent of the sample population[3]. The rest of the population were employed in a variety of jobs, as dressmaker, plumber, welder, police officer, clerk, labourer and persons who were self employed. This was confirmed when residents were asked about the most urgent community needs, where over sixty per cent (61%) cited unemployment as a concern (Appendix I). During this stage of the proposed development at least twenty-five (25) persons would be employed in the construction of the facility's capital assets.

4.3.2 Transportation and Parking

The proposed cemetery property is located on the main road that originates in the Central Business District to the South in Savanna-la-mar and currently is one of the main arterial connecting the town to the more westerly communities, such as, Little London and Negril. If projected traffic movement at maximum build-out of the cemetery facilities, would increase significantly in along the main road.

Measures Incorporated by Design and Mitigation Measures

Proposed road and intersection improvement at the entrance to the facility would minimize any potential traffic and pedestrian conflicts. The current roadway configuration near the site is shown on the Development Plan in Appendix IX.

4.3.3 Ambient Air Quality Impacts of the Crematorium

Baseline air quality at and adjacent the site is expected to fall within standards set by NEPA (Table 4.1) for air pollutants, such as, sulphur dioxide and nitrogen dioxide, lead, ozone, carbon monoxide and ozone, given the present land use at the site and adjacent areas mentioned above.

[3] It should be note that a former Grave Digger is accounted for in the unemployed.

Table 4.1: Ambient Air Quality Standards-Jamaica (1996)

Air Pollutant	Averaging Period	Standard (JA)	Standard (US)
Particulates Total Suspended Particulates (a)[2]	Maximum annual average Maximum 24-hour average	60 µg/m³ 150 µg/m³	
Particulates PM_{10} (b)[3] PM 2.5	Maximum annual average Maximum 24-hour average	50 µg/m³ 150 µg/m³	 <54 µg/m³ <15.4 µg/m³
Lead (Pb)	Per calendar quarter	2 µg/m³	<1.5 µg/m³
Sulphur Dioxide (SO_2)	Maximum annual average Maximum 24-hour average Maximum 1-hour average Maximum 3-hour average	80 µg/m³ Primary[4] 60 µg/m³ Secondary[5] 365 µg/m³ Primary 280 µg/m³ Secondary 700 µg/m³ -	80 µg/m³ Primary[4] 365 µg/m³ Primary 1,300 µg/m³
Photochemical Oxidants (Ozone) (O_3)	Maximum 1-hour average Maximum 8-hour average	235 µg/m³ (0.12 ppm) -	235 µg/m³ (0.12 ppm) 0,08 ppm.
Carbon Monoxide (CO)	Maximum 1-hour average Maximum 8-hour average	40 mg/m³ (35 ppm) 10 mg/m³	40 mg/m³ (35 ppm) 9 ppm
Nitrogen Dioxide (NO_2)	Maximum annual average	100 µg/m³	0.053 ppm

Source: The Natural Resources Conservation Authority (Ambient Air Quality Standards) Regulations, 1996 cited in: Environmental Impact Assessment for the Transportation Center, Negril Westmoreland - TPDCo

[2] Total suspended particulates include all particulates and aerosols that have an aerodynamic diameter of 100 micrometers or less.

[3] PM_{10} refers to particulates with an aerodynamic diameter of 10 micrometers or less.

[4] Primary standards set limits to protect public health; including the health of "sensitive" groups such as asthmatics, children and the elderly.

[5] Secondary standards set limits to protect public welfare; including protection against decreased visibility and damage to animals, crops, vegetation, and buildings.

The minimization of the negative impacts to air quality is a primary concern during the planning stages of the development as the potential environmental and health impacts can be significant as outlined below:

Particulate matter – *Health* - Coarse and fine particles can enter the lungs or blood stream resuting in lung function impairment and eventual heart and lung disease.

Environment- Particles may produce haze, reduce visibility and affect vegetation.

Lead – *Health* – Automobiles are our main sources of lead and exposure by ingestion and inhalation affect organs, such as, the kidneys, liver and the nervous system and may result in mental retardation, seizures and behavioural problems.

Environment - Domestic and gazing animal are at risk from contaminated plants and soil surfaces although no adverse effects have been identified.

Sulphur dioxide – *Health* **-** This pollutant is formed when fuel containing sulphur is burned and may result in respiratory and cardio vascular diseases.

Environment –This pollutant along with nitrogen oxides are the precursors to acid rain. SO_2 is also a main contributor to poor visibility and accelerates natural and manmade materials such as concrete.

Ozone - *Health* – Ozone is formed in the atmosphere by the reaction of volatile organic compounds (VOCs) and nitrogen oxides in the presence of sunlight, VOC sources include motor vehicles, factories and consumer and commercial products and from natural (biogenic sources). Ozone can result in respiratory symptoms such as coughing.

Environment – Plants and trees may be injuries resulting in a decrease in their natural beauty

Carbon monoxide – *Health* – Ambient carbon monoxide may enter the blood steam through the lungs and may reduce oxygen supply to the body's organs and tissues.

Nitrogen dioxide - *Health* – Nitrogen oxides play a major role in the formation of ozone in the atmosphere though reaction with VOCs. The main health effect is its contribution to respiratory illnesses.

Short-term loss of air quality can be expected from cemetery construction activities. Sources of air emissions (carbon monoxide) are automotive exhaust from construction equipment and trucks, particulate matter (dust) from earth moving activities, and dust from vehicles operating on exposed soil. These emissions are expected to cease upon completion of cemetery construction.

Long-term effects of cemetery development would result in loss of vegetation from the site intake of carbon dioxide and release of oxygen during photosynthesis would, therefore, be temporarily reduced with a reduction of grass cover on the property**. (Indirect, negative impact)**

Measures Incorporated by Design and Mitigation Measures

- Dust would be suppressed during construction primarily by spraying water over the working areas.
- Heavy duty equipment would be adequately maintained to reduce emissions and noise.
- As an urban area, no new major sources of emissions is acceptable at the location, the impact of this action would be determined to be *de minimis* under the Clean Air Act of the United States of America.
- A component of the construction process includes reseeding with native grasses and other native plants.

4.3.4 Land Use

Replacing 4.05 hectares (10 acres) of relatively sparse vegetation with a cemetery facility would not have an adverse effect on land use in the area. **(Positive, long-term direct)**.

4.3.5 Real Property

The Property is privately owned and, as such, is subject to all local taxes. The conversion of the Property to cemetery grounds would not significantly affect land values in the area once the Dalling Street Development Plan has been implemented owing to existing parallel land uses on adjacent properties and the level of facility proposed.

Other socio-economic impacts are not anticipated to be significant. **(Indirect, long term impact).**

Measures Incorporated by Design and Mitigation Measures

The development plan for the site envisages the development of a facility that would be an asset to the receiving community. The proposed memorial gardens design would introduce an environment that will enhance the feeling of peace and tranquillity at the location. The use of

existing vegetation and new plantings and lawn grasses would be used to create the desired effect.

4.3.6 Health and Safety Impacts

a. Noise

Existing noise levels at the cemetery site are generated mostly by traffic on the adjoining roadway. Based on site observations, noise levels are generally low.

Construction activities would result in local noise disturbances caused by heavy equipment operating on the site primarily during Phase 1 subsequently, the most frequent noise sources at the cemetery would be lawn-care equipment, visitors' vehicles, and service and delivery vehicles. This would result in periodic increases in motor vehicle traffic that may generate some additional noise. However, the greatest concentration of vehicles would be during funeral ceremonies. Typically, traffic proceeds slowly during funeral processions resulting in a low level of vehicular traffic noise. **(Indirect, long term, negative impact).**

Measures Incorporated by Design and Mitigation Measures

Noise generated by construction equipment and vehicles would be well within national standards as they would be properly maintained to reduce the impact. Construction noise can achieve up to 110 dB[4] at 3 metres. Assuming an exposure of 8-hours per day for 5 days per week medical-acoustic investigations has found that 80dB is a safe limit[5] and it is not anticipated that this level would be exceeded.

b. Soil Pollution

Landscaping is proposed for the site and this can be a potential source of pollutants in surface runoff. Landscaping management chemicals including fertilizers can add nutrients to runoff. Monitoring in the United States of America has shown a significant link between the chemicals found in lawn care products and urban water quality. The amount of chemicals applied to the soil is very critical in determining the pollution load.

[4] Nath B. et al. 1993. Environmental Management, Vol. 1 The Compartmental Approach. Brussels. Page 195
[5] Ibid page 197

The construction of graves using cement concrete mixture and the parking lot for the cemetery can result in soil compaction and increase runoff. The emission of mercury during cremation might also affect the soil. **(Indirect, long-term, negative impacts)**

Measures Incorporated by Design and Mitigation Measures

- It is planned that the lawn would be cared for using harvested rainwater and there will be limited use of fertilizers and other chemicals.
- Adequate onsite provision has been made for runoff.
- Any emission of mercury will be insignificant.

Onsite Waste Disposal Facility

An onsite disposal facility utilizing the septic tank/tile field system would be constructed for use by staff and the public. Without further treatment the system would have the potential for polluting the groundwater as septic tank systems can be important sources of pathogens and nutrients.

Measures Incorporated by Design and Mitigation Measures

Treatment to be provided by the tile field would effectively reduce the microbial load.

Construction debris would be stored in designated areas and removed by a legitimate haulage contractor who would dispose of solid waste at an approved disposal site. **(Direct, long-term, negative impact).**

4.3.7 Parking Lot and Motor Vehicles

The proposed parking lot would have an impervious cover (grass crete as recommended by NWA), however, certain materials may accumulate on the surface during dry weather conditions, only to form a highly concentrated first flush during rain. **(Indirect, long-term, negative impacts).**

Developmental/Preparatory Phase

4.3.8 The Cemetery

During the construction phase occupational health and safety (OHS) concerns would be limited

to nuisance dust from excavation works and cement concrete mixing activities, intermittent noise from heavy equipment and possible exposures to chemical such as fertilizers, weedicides, etc., used in the development and maintenance of grassed areas.

OHS concerns during this phase will, in addition to those mentioned in the preparatory phase, include ergonomic hazards, as corpses will have to be manually transported from the hearse to the grave. Also routine lifting or pushing of construction aggregates will be another potential source of Repetitive Strain Injury (RSI).

4.3.9 The Crematory

OHS Hazards Associated With the Operational Phase

a. Biological

Exposure to pathogens constitutes a real risk, as handling of corpses is a normal part of this operation. The routes of infection are typically ingestion, cutaneous (touch or surface contact), or puncture of a body surface, and to a lesser degree, inhalation. Improper personal hygiene and work practices can result in the contamination of food, cigarettes, etc., with pathogens which are subsequently ingested. Mechanical transfer of pathogens to mucus membranes when rubbing the nose or eyes is a characteristic skin exposure mechanism.

Aerosolisation of pathogens, for example tuberculosis, can occur when air is forced out of the corpse during handling and exhumation activities can yield airborne pathogens inclusive of fungal spores *(7)*. The re-emergence and increased prevalence of tuberculosis represents a real threat for funeral workers in this regard.

b. Chemical

The embalming process introduces a number of potent chemicals into the workspace of funeral workers, chief of which is formaldehyde. Formaldehyde is irritating to the mucous membranes, the eyes, the nasal lining and the respiratory system and has been associated with mutagenic cell changes, the development of cancers and occupational asthmas. Current time-weighted average 8-hour Permissible Exposure Limits (PEL) varies in different jurisdictions ranging from 0.5 parts per million (ppm) in Germany, Japan, Norway, Sweden and Switzerland (0.75 ppm in the USA, 1ppm in Canada, 2ppm in the UK) to 5ppm in Egypt and Taiwan. (WHO recommends 0.25 ppm. A review of the literature shows a downward trend in PELs for formaldehyde over

the years and presently there are serious concerns about the safety of workers even at the lowest PEL mentioned above (0.5ppm). The National Institute of Occupational Safety and Health (US government Agency) is recommending 0.16ppm while the American Conference of Government Industrial Hygienists (ACGIH) is recommending 0.3ppm as a ceiling value* for 8-hour exposure[6].

* A concentration that should not be exceeded at any time during the 8-hour work shifting some workers resulting in occupational asthma at concentrations well below the permissible exposure limit.

Other potentially toxic chemicals used in embalming fluids include phenols, methanol and isopropyl alcohols and glutaraldehyde. Exposure to these chemicals will occur as a result of off-gassing from the corpse, particularly formaldehyde.

c. Ambient Air Quality Impacts of the Crematorium

Emissions - Cremation emissions can contain gases, which are harmful to the environment and to humans. Toxic aerosols can form during the burning of the glue used to hold coffins together or even the burning of contents placed in the coffin. Emission of mercury vapours come from dental fillings (approximately 25% of dental filling is mercury). Other sources of emissions are listed below:

a. Particulate matter – dust. Small amounts may travel up the chimneystack into the atmosphere.

Emission (1lb/hour) at different temperature

1400^{o}F	-	0.042
1600^{o}F	-	0.118
1800 ^{o}F	-	0.245

b. Carbon monoxide - result of incomplete combustion of auxiliary fuels used to quicken the cremation.

Average emission of carbon monoxide from incomplete combustion of auxiliary fuel in ppm at 7% oxygen is as follows:

[6] Scarlett, H. 2001. *Environmental Health Impacts*, Retirement Cemetery.

1400°F	-	2.8 ppm
1600°F	-	0.4 ppm
1800 °F-		6 0 ppm
Typical limit	-	100 ppm

The table below shows NIOSH **(**National Institute of Occupational Safety and Health) minimum requirements for respiratory protection against formaldehyde where its airborne concentration exceeds 0.75 parts formaldehyde per million parts of air (0.75 ppm) as an 8-hour total-weighted average (TWA).

Table 4.2: Minimum Requirements for Respiratory Protection against Formaldehyde (NIOSH)

Condition of use of formaldehyde concentration (ppm)	Minimum respirator required[1]
UP to 7.5 ppm (10 X PEL)	Full face place with cartridge of canister specifically approved for protection against formaldehyde.[2]
UP to 75 ppm. (100 X PEL)	Full-face mask with chin style or chest or back mounted type, with industrial size canister specifically approved for protection against formaldehyde. Type C supplied air respirator, demand type, or continuous flow type, with full facepiece, hood, or helmet.
Above 75 ppm or unknown (emergencies). (100 X PEL)	Self-contained breathing apparatus (SCBA) with positive pressure full facepiece. Combination supplied-air, full facepiece positive pressure respirator with auxiliary self-contained air supply.
Firefighting	SCBA with positive pressure in full face-piece.
Escape	SCBA in demand or pressure demand mode. Full-face mask with chin style or front or back mounted type industrial size canister specifically approved for protection against formaldehyde.
[1] Respirators specified for use at higher concentrations may be used at lower concentrations [2] A half-mask respirator with cartridges specifically approved for protection against formaldehyde can be substituted for the full facepiece respirator providing that effective gas-proof goggles are provided and used in combination with the half-mask respirator.	

Source: US Department of Labour, USA, Occupational Safety & Health Administration SHA, http://www.oshaslc.gov/pls/oshaweb/owadisp.show_document?p_table=STANDARDS&p_id=10075

A slight rise in carbon monoxide may occur during funeral ceremonies but the occurrences are expected to be of short duration (less than 1 hour). **(Direct, long-term, negative impact).**

d. Noise

The decibel level of the proposed system to be used is about 55 which are well within the regulated acceptable levels.

The no-action alternative would not result in any changes to local air quality. **(Direct, long-term negative impact).**

Measures Incorporated by Design and Mitigation Measures

The widespread practice of using wood as a major material in the making of coffins in Jamaica will minimize the emission of toxic gases during cremation.

The best available technology as shown in Plates 10 and 11 would be introduced to minimize health hazards potentially inherent in the cremation process. This includes the removal of mercury, dioxins and acid gases during the process of incineration. Equipment cost is estimated in excess of US $ 50,000.00.

e. Ergonomic

Lifting and transfer of the dead body from the vehicle to the crematory is usually done manually, as a mark of respect for the dead. Also the body may be moved several times prior to cremation. This poses risk for repetitive strain injuries (RSI) Note should also be taken of the fact that RSI can occur depending on the frequency of lifting, the lifting techniques employed and the weight of the corpse.