

# **BELIZE SOLID WASTE MANAGEMENT PROJECT ENVIRONMENTAL IMPACT ASSESSMENT REVISED**

## **10.0 Recommendations**

In order for the landfill at Mile 22 to be effective, an MSW waste transfer station is required to be established concurrent with the landfill construction at the Mile 3 Western Highway location, for wastes originating in the Belize City area and disposed at the Mile 22 sanitary landfill. In addition, MSW transfer stations are contemplated for Ambergris Caye and Caye Caulker, with wastes being barged to the mainland and then trucked to the Mile 22 site. Another MSW transfer station is anticipated to be constructed at the existing Western Landfill site to serve the Benque - San Ignacio area in the near future. Sorting of the waste to remove and divert environmentally hazardous materials and recyclable items should be carried out at the transfer stations.

The following recommendations concerning the new Regional Landfill are put forward, based on the findings of the Environmental Impact Assessment.

1. The disposal component of the SWMP can proceed with a regional MSW sanitary landfill disposal facility established at the Mile 22 Western Highway site, as outlined in this Report.
2. The sanitary landfill should be designed and operated with all of the mitigative features outlined in this Report, including surface water management, leachate collection and treatment, a buffer zone, landfill gas collection management, wet weather operations area, storage for recyclables with adequate containment and other design features that will protect the surrounding environment.
3. The mitigation measures proposed in the Environmental Mitigation Plan of this EIA Report should be implemented in full.
4. The monitoring measures proposed in the Environmental Monitoring Plan of this EIA Report should be implemented in full.



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5. The institutional requirements outlined in this EIA Report should be addressed, including staffing and training needs, and legislative refinements.
6. The existing disposal facilities that are converted to MSW transfer stations should be suitably reclaimed, using soil materials to cap and seal the sites.
7. A Community Advisory Committee should be established, to facilitate involvement of neighbouring communities in the operations and monitoring of the Mile 22 disposal facility. The Committee should participate in monitoring programs and have full access to the monitoring data.
8. Discussions should be held with the Belize River Association towards developing downstream monitoring of water quality in the Belize River.
9. Consideration should be given to engage members of the local community in employment opportunities at the disposal facility, or in assisting in the cleanup of existing solid waste in unauthorized locations concurrent with the development and operation of the disposal facility.
10. A scheme should be considered to employ scavengers who presently operate at the Mile 3 disposal site, in the sorting of solid waste at the MSW transfer station to be constructed at that location. Similar initiatives should be taken at the other transfer stations.
11. The buffer zones should have additional trees and shrubs placed within them to provide a uniform vegetation barrier for visual observations. In addition, the importance of the upkeep of the treed buffer to attenuate landfill gas is required.
12. The establishment of an Interpretive Centre at or near the Mile 22 sanitary landfill is highly recommended for the future. This would increase public



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awareness of (i) environmentally acceptable solid waste disposal practices; (ii) the mitigation and monitoring programs employed at the Mile 22 Sanitary Landfill facility, including the final reclamation plan; and (iii) the role and importance of solid waste reduction and recycling in achieving environmental sustainability.

The following Schedule of Environmental Mitigation Measures (Table 10.1) summarizes the previous components of the Plan with each being presented as follows;

- general parameters,
- impact,
- mitigation measure,
- residual impacts,
- costs, implementation issues, and training requirements.

This matrix format summarizes the various potential impacts and proposed mitigation measures described in this document.

**Table 10.1  
of Environmental Mitigation Measures for Adverse Impacts**

	RESIDUAL IMPACTS	COSTS IMPLICATIONS	IMPLEMENTATION ISSUES		
			STAGE	RESPONSIBILITY	TRAINING/HUMAN RESOURCES
in ees ma  tored	<ul style="list-style-type: none"> <li>- Landfill gas exits to atmosphere through cover materials until a collection or venting system is required</li> </ul>	<ul style="list-style-type: none"> <li>- Monitoring wells installed during construction after year 5 and again after year 10</li> <li>- Annual monitoring costs as part of operating budget</li> <li>- Hand held monitoring equipment for atmospheric observations.</li> </ul>	<ul style="list-style-type: none"> <li>- Operating and post completion</li> </ul>	<ul style="list-style-type: none"> <li>- Designers and subsequent site operators with data submitted to DoE to include designs and specifications</li> <li>- Construction to properly construct and provide protection to wells</li> <li>- Operators to ensure the wells are properly maintained and protected</li> <li>- Additional trees to be planted in buffer areas.</li> </ul>	<ul style="list-style-type: none"> <li>- Operators to be trained in using gas sniffers and other air monitoring equipment.</li> </ul>
to be ble the  plied for  all to fts of	<ul style="list-style-type: none"> <li>- Good cover protocols will greatly reduce odors</li> <li>- Odors should be very localized</li> </ul>	<ul style="list-style-type: none"> <li>- Part of daily operational costs</li> </ul>	<ul style="list-style-type: none"> <li>- During site operational life</li> </ul>	<ul style="list-style-type: none"> <li>- Site operator to provide daily interim and final cover on an as required basis with monitoring from SWMA and DoE</li> </ul>	<ul style="list-style-type: none"> <li>- Staff training in landfill operations</li> </ul>
d in hal ary roads vealed ency tal	<ul style="list-style-type: none"> <li>- Short periods until remedial action taken</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>	<ul style="list-style-type: none"> <li>- During site construction and operational life crews are to maintain site roads and fill areas</li> <li>- Equipment to be serviced on regular basis</li> </ul>	<ul style="list-style-type: none"> <li>- Design and construction engineers, SWMA, and DoE</li> </ul>	<ul style="list-style-type: none"> <li>- Staff training in landfill construction and operations</li> </ul>

**Table 10.1  
Schedule of Environmental Mitigation Measures for Adverse Impacts**

MEASURE	RESIDUAL IMPACTS	COSTS IMPLICATIONS	STAGE	RESPONSIBILITY	TRAINING/HUMAN RESOURCES
<p>landfill and surface channels to be surface water around site</p> <p>slopes to be natural pre-sets</p> <p>debris and storm 1-hour 1-in 100-yr event during dry conditions to direct surface water to areas where in progress is designed to be reasonable</p> <p>trap to be used on in drainage</p> <p>no-contact areas storm pond</p> <p>steep slopes and ice area to be large retention pond with controlled outflow</p>	<ul style="list-style-type: none"> <li>- Some erosion of slopes in extreme events</li> <li>- Need to maintain erosion control devices</li> <li>- Construction of large retention pond with controlled outflow</li> </ul>	<ul style="list-style-type: none"> <li>- Part of ongoing capital and operational costs</li> </ul>	<ul style="list-style-type: none"> <li>- Operator required to follow designs and not to exceed grades established in landfill design</li> <li>- Design drawings to reflect grades and facilities to provide drainage control over the entire site</li> </ul>	<ul style="list-style-type: none"> <li>- Site operators and monitoring by SWMA and DoE</li> </ul>	<ul style="list-style-type: none"> <li>- Staff training in landfill construction and operations</li> </ul>
<p>not to discharge water storm</p> <p>in cells of lined, managed</p> <p>leachate released from operation area suitable for</p> <p>mitigation measures in leachate areas</p>	<ul style="list-style-type: none"> <li>- Small amount of contact water may escape</li> </ul>	<ul style="list-style-type: none"> <li>- Increased treatment costs for power (aeration of lagoon)</li> <li>- Possible dedicated person in later stages to manage leachate system</li> </ul>	<ul style="list-style-type: none"> <li>- During site life both operational and post closure</li> </ul>	<ul style="list-style-type: none"> <li>- Site operator with monitoring from SWMA and DoE</li> <li>- Design to provide details for stages of construction</li> <li>- Stages to be monitored for proper timing of needs</li> </ul>	<ul style="list-style-type: none"> <li>- Staff training in landfill operations</li> <li>- SWMA to develop design and operational experience in collection and treatment systems</li> </ul>
<p>prevent system to impermeable landfill cell paving of clay taken if is exposed areas to be lined</p> <p>insulating in each leachate pond</p> <p>prevent system to biotic and aerobic to be capped to production</p>	<ul style="list-style-type: none"> <li>- Leachate collection and treatment must stay operational post closing of site to provide ongoing mitigation</li> </ul>	<ul style="list-style-type: none"> <li>- Part of ongoing operating and laboratory expenses</li> <li>- Installation of monitoring wells as part of construction (\$650,000)</li> </ul>	<ul style="list-style-type: none"> <li>- All including post closure</li> </ul>	<ul style="list-style-type: none"> <li>- Site operator with monitoring from SWMA and DoE</li> <li>- Design and specification of monitoring wells and their protection, along with trained supervision during construction</li> </ul>	<ul style="list-style-type: none"> <li>- Staff training in operations and analytical sampling and results</li> <li>- Access to expertise from a hydrogeologist</li> </ul>

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			STAGE	RESPONSIBILITY	TRAINING/HUMAN RESOURCES
to be maintained on all landfill site around creek. Creek total	<ul style="list-style-type: none"> <li>Increased activity on site</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>All</li> </ul>	<ul style="list-style-type: none"> <li>Site operator to monitor</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
to be maintained on all landfill site around buffer zone or ation and appropriate for wildlife post-closure phase around creek. Creek total	<ul style="list-style-type: none"> <li>Access to site not controlled</li> </ul>	<ul style="list-style-type: none"> <li>More security may be needed</li> </ul>	<ul style="list-style-type: none"> <li>During operational stage</li> </ul>	<ul style="list-style-type: none"> <li>Site Operator</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
required other than in buffer on creeks	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
required other than in buffer on creeks	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
timber removed during and not visible	<ul style="list-style-type: none"> <li>Hard to reestablish trees on landfill areas, although grasses and shrubs will return</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing re-vegetation program as part of ongoing operations, especially in buffer zones</li> </ul>	<ul style="list-style-type: none"> <li>All</li> </ul>	<ul style="list-style-type: none"> <li>Site operator and local residents near site</li> </ul>	<ul style="list-style-type: none"> <li>Proper design of site closure plan</li> <li>Maintain buffers</li> </ul>
for interaction with land and recreational land in the future	<ul style="list-style-type: none"> <li>Landfill will exist and new development must be aware</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>All</li> </ul>	<ul style="list-style-type: none"> <li>Physical Planning to be responsible for subsequent approvals</li> </ul>	<ul style="list-style-type: none"> <li>Planning control to evaluate proposed use and conflicts based on other experiences</li> </ul>
to be positioned so maximized each at access point, or lanes to facility other two-way access	<ul style="list-style-type: none"> <li>Some disturbance due to a new traffic entrance and departure point along highway at mile 22</li> </ul>	<ul style="list-style-type: none"> <li>An allowance of \$680,000 has been included in project cost estimates for intersection improvements</li> </ul>	<ul style="list-style-type: none"> <li>All</li> </ul>	<ul style="list-style-type: none"> <li>Site design to include turn lanes and highway lane markings</li> <li>Mow to monitor traffic flows and patterns</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
pile of sand for in wet weather area access to wet to reduce contact	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>Included in site operation budget</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>Extra mow resources to assist with possible increase in road cleaning effort</li> </ul>
if access road by erit	<ul style="list-style-type: none"> <li>Possible some mud tracked onto highway at all stages</li> </ul>	<ul style="list-style-type: none"> <li>Included in site operation budget</li> </ul>	<ul style="list-style-type: none"> <li>During construction will be worse</li> <li>Ongoing operations of site</li> </ul>	<ul style="list-style-type: none"> <li>During construction engineer to monitor</li> <li>Ongoing monitoring both operator and mow</li> </ul>	<ul style="list-style-type: none"> <li>Extra mow resources to assist with road cleaning</li> </ul>
development approved	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>

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MEASURE	RESIDUAL IMPACTS	COST IMPLICATIONS	STAGE	IMPLEMENTATION ISSUES	
				RESPONSIBILITY	TRAINING/HUMAN RESOURCES
Operator must have 24-hour access to Performance Security	<ul style="list-style-type: none"> <li>Possible short term problems until remedial program underway</li> </ul>	<ul style="list-style-type: none"> <li>Performance Security will cost about 2% of annual operating budget</li> </ul>	<ul style="list-style-type: none"> <li>Throughout operating life of site</li> </ul>	<ul style="list-style-type: none"> <li>DoE to have sole access to Performance Security and to use SWMA as agency if desired to expedite</li> </ul>	<ul style="list-style-type: none"> <li>Legal assistance to write conditions of Performance Security</li> </ul>
Unrestricted access to road for littering	<ul style="list-style-type: none"> <li>Littering along the road</li> </ul>	<ul style="list-style-type: none"> <li>Extra time and expense to maintain and clean road right of way</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing</li> </ul>	<ul style="list-style-type: none"> <li>Government of Belize</li> </ul>	<ul style="list-style-type: none"> <li>N/A</li> </ul>
Enforcement, policy Agency operations oriented of solid waste	<ul style="list-style-type: none"> <li>Possible conflicts in roles</li> </ul>	<ul style="list-style-type: none"> <li>SWMA to have budget</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing</li> </ul>	<ul style="list-style-type: none"> <li>Government of Belize</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing technical assistance</li> </ul>
Complete the total plan is asap.	<ul style="list-style-type: none"> <li>Landfill needs wastes to operate. Without wastes, site is inefficient</li> </ul>	<ul style="list-style-type: none"> <li>Budget for landfill and ancillary functions required.</li> </ul>	<ul style="list-style-type: none"> <li>Ongoing</li> </ul>	<ul style="list-style-type: none"> <li>Government of Belize</li> </ul>	<ul style="list-style-type: none"> <li>Total system operation required</li> </ul>

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MEASURE	RESIDUAL IMPACTS	COST IMPLICATIONS	IMPLEMENTATION ISSUES		
			STAGE	RESPONSIBILITY	TRAINING/HUMAN RESOURCES
<p>of the landfill to be extent possible be applied to the</p> <p>ver to be applied vely worked for weeks</p> <p>be applied to all been filled impacted in lifts of</p> <p>ehicles to be</p> <p>on measures to</p> <p>actics to be used me a problem</p>	<ul style="list-style-type: none"> <li>- Will still hear occasional noise when atmospheric conditions are right</li> <li>- Dust will be short lived as operator will use on-site water or leachate for dust control</li> </ul>	<ul style="list-style-type: none"> <li>- Water tank included in cost estimates</li> <li>- Landfill operating equipment in estimates includes compactor, tractor, and truck for the operation of the site</li> <li>- Other equipment and operation expertise will be included by site operator</li> </ul>	<ul style="list-style-type: none"> <li>- During both construction and operational phases</li> </ul>	<ul style="list-style-type: none"> <li>- Site operator with monitoring from SWMA and DoE</li> </ul>	<ul style="list-style-type: none"> <li>- Operational manuals and training on landfill operations</li> <li>- Landfill operational expertise exposure both to DoE and SWMA personnel</li> </ul>
<p>ne to be retained on all dffill site</p> <p>and suitable re-ast-closure phase, surrounding</p>	<ul style="list-style-type: none"> <li>- Some residual visual messages will be there</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>	<ul style="list-style-type: none"> <li>- During construction will be worse</li> <li>- Ongoing operations of site</li> </ul>	<ul style="list-style-type: none"> <li>- Site operator to maintain buffers as required</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>
<p>post a security with DoE compliance with and site operation</p>	<ul style="list-style-type: none"> <li>- Possible short period of non compliance</li> </ul>	<ul style="list-style-type: none"> <li>- Performance security will cost about one percent of annual operation budget</li> </ul>	<ul style="list-style-type: none"> <li>- During operational life of landfill</li> </ul>	<ul style="list-style-type: none"> <li>- SWMA must tailor performance security requirements to meet the site operational expectations</li> </ul>	<ul style="list-style-type: none"> <li>- Legal assistance in preparing conditions of performance security</li> </ul>
<p>archaeology to be acts of potential encountered, ation to stop to art and recovery</p>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>	<ul style="list-style-type: none"> <li>- N/A</li> </ul>
<p>of solid waste an</p>	<ul style="list-style-type: none"> <li>- Illicit dumping will always happen</li> </ul>	<ul style="list-style-type: none"> <li>- Increased cost in offsite cleanups</li> </ul>	<ul style="list-style-type: none"> <li>- Ongoing</li> </ul>	<ul style="list-style-type: none"> <li>- DoE and all municipalities involved in litter control enforcement</li> </ul>	<ul style="list-style-type: none"> <li>- Public awareness training of all persons in Belize</li> </ul>
<p>cover material at for reclaiming here odors, pests e problematic ting landfills will ed and turned tions, i.e. Cayes, it, and Belmopan</p>	<ul style="list-style-type: none"> <li>- Environmental problems will always occur, but programs aim to reduce through providing new facilities and enforcement</li> </ul>	<ul style="list-style-type: none"> <li>- Reduced costs in offsite cleanups</li> </ul>	<ul style="list-style-type: none"> <li>- Ongoing</li> </ul>	<ul style="list-style-type: none"> <li>- DoE and all municipalities involved in litter control enforcement</li> </ul>	<ul style="list-style-type: none"> <li>- Public awareness training of all persons in Belize</li> </ul>

