Malaysian Journal of Science **30** (1): 59-65 (2011)

ENVIRONMENTAL MANAGEMENT STRATEGY FOR SHAH ALAM SOLID WASTE TRANSFER STATION, MALAYSIA

Firuza B. M [1] & Nather Khan I.[2]

[1]Department of Geography, Faculty of Arts and Social Sciences, University of Malaya, 50603 Kuala Lumpur, Malaysia. firuza@um.edu.my, [2]Ecotone Environmental Management Sdn. Bhd., Suite 912, Block A, Kelana Jaya Centre Point, Kelana Jaya, 47301 Petaling Jaya, Malaysia. ecotonemalaysia@yahoo.com
*firuza@um.edu.my (corresponding author)
Received on 3rd February 2011, accepted in revised form 22rd March 2011.

ABSTRACT Waste Transfer stations are the integral part of municipal solid waste management. They essentially function as transit waste collection centres enroute to the landfill facility**.** The Shah Alam solid waste transfer station (SATS) is the first such transfer station to be established at the industrial zone in the city of Shah Alam. The SATS will be designed to receive approximately 1500 tonnes of municipal solid waste daily. The station will have the capacity to expand its waste reception to approximately 2500 tonnes/day. The key environmental components of concerns during implementation of SATS were air quality, odour, noise, vibration, river water quality, aquatic ecology, socio-economy and traffic and transportation issues around the project area. The baseline data has been collected for the above environmental component and discussed in detail in the existing environmental section of EIA report. Subsequently, the potential environmental impacts arising from the construction and operational phases of the SATS are evaluated based on prevailing regulatory requirements and environmental best management practices. Finally, an Environmental Management Plan (EMP) for the SATS was necessary to effectively manage all the potential impacts identified in this report and monitor the activities at the project site during construction and operational phases of the project. This is to ensure that the environmental objectives are met and all activities relating to the implementation of the project are carried out in an environmentally sustainable manner.

ABSTRAK Stesen pemindahan merupakan sebahagian daripada aspek pengurusan sisa pepejal di bandar. Stesen ini pada dasarnya berfungsi sebagai pusat transit sisa pepejal sebelum dibawa ke pusat pengumpulan sampah. Stesen Pemindahan Sisa Pepejal Shah Alam (SATS) merupakan stesen transit yang pertama seperti itu dibina di kawasan perindustrian di Seksyen 2, di bandar Shah Alam. SATS direka untuk menerima sekitar 1,500 tan sisa pepejal setiap hari. Stesen tersebut dijangka mampu untuk mempertingkatkan kapasiti penerimaan sisa pepejal sekitar 2,500 tan sehari. Kompenan persekitaran seperti kualiti udara, bau, bunyi, getaran, kualiti air sungai, ekologi sungai, sosio-ekonomi dan isu lalulintas dan pengangkutan di sekitar kawasan projek menjadi fokus utama dalam kajian ini. Data-data asas mengenai komponen persekitaran di atas telah dikumpulkan dan dibincangkan secara terperinci dalam bahagian alam sekitar laporan Penilaian Kesan Persekitaran (EIA). Selain itu, kesan persekitaran yang berpotensi wujud semasa fasa pembinaan dan operasi SATS dinilai berdasarkan keperluan peraturan-peraturan tertentu dan amalan pengurusan persekitaran yang ditetapkan. Hasilnya, Pelan Pengurusan Persekitaran (EMP) diwujudkan memastikan pengurusan yang efektif bagi semua kesan persekitaran yang dikenalpasti berpotensi wujud dalam kajian ini dan pemonitoran di lokasi projek juga perlu dilakukan sepanjang fasa pembinaan dan operasi berlangsung. Ia untuk memastikan semua objektif alam sekitar dapat tercapai dan semua aktiviti berkaitan dengan pelaksanaan projek dilaksanakan menurut prinsip pembangunan lestari.

INTRODUCTION

With the economic advancement and population growth, the generation of solid waste is also increased tremendously in Malaysia. The need for proper waste disposal infrastructures such as Sanitary Landfills (SL), Transfer Stations (TS), Materials Recovery Facilities (MRF) and Incinerators are becoming more important and crucial. Currently, there are no sanitary landfills within the city of Kuala Lumpur upon closure of Taman Beringin sanitary landfill. As a result of it, the wastes from Kuala Lumpur have now been sent to Bukit Tagar Landfill via Taman Beringin Transfer Station. Upon closure of Air Hitam Landfill in 2006, the wastes so far buried there, need to be diverted to the Bukit Tagar or any new landfills in the region. Currently the existing landfills are located far from the major waste catchment areas in Selangor. Due to scarcity of suitable land near the city centres, the distance between sanitary landfills and city centres getting increased. Therefore establishment of transfer stations at each major waste catchment area is inevitable to make waste management more effective and efficient. These transfer stations need to be located at strategically located regional centres to serve the municipal solid waste catchments areas within the central, southern and northern districts of Selangor State.

Transfer stations are the integral part of municipal solid waste management. They essentially function as transit waste collection centres enroute to the landfill facility. The concept of a transfer station is based on the fact that when the final disposal site is remote from the collection area, it will be more cost effective to transport the waste in larger load vehicles or trailers more suited for the long journey to the final disposal site, rather than to be disposed off by small collection vehicles (waste collection trucks or refuse collection vehicles or RCV as commonly called) designed for house-to-house collection of municipal solid waste. In addition, transfer stations can also serve as collection points for recyclable wastes and materials.

The Shah Alam solid waste transfer station (SATS) is the first such transfer station to be established at the industrial zone in Section 2, in the city of Shah Alam. The subject site is geo-referenced at approximately 3°04’ N, 101°33’ E. The earmarked site is a parcel of undeveloped open land previously used as a plant nursery. The total land area of the project site is 10.56 acres and the proposed SATS will occupy the entire area. The built-up area is estimated to be 20,400 m^2. The SATS will be designed to receive approximately 1500 tonnes of municipal solid waste daily. The station will have the capacity to expand its waste reception to approximately 2500 tonnes/day. The SATS will serve the municipal solid waste catchment areas of Majlis Bandaraya Shah Alam (MBSA), Majlis Perbandaran Petaling Jaya (MPPJ), Majlis Perbandaran Subang Jaya (MPSJ) and Majlis Perbandaran Klang (MPK) in Selangor.

TRANSFER STATION DESIGN CONCEPT

The transfer station design concept selected for the SATS is the compactor type. Typically, the compactors are installed in level two transfer stations where waste collection vehicles drive to the upper floor and tip directly into small hoppers built over the silos. This is essentially a very clean operation with excellent control of most potential environmental effects. Specifically, the compactor system that will be employed for the SATS is the vertical compression principle. Here, the waste containers (silos) will be filled from a platform in a vertical position. The system is considered a simpler, more efficient and more economical than the horizontal compactor system, mainly because of the need for fewer silos, compactors and transportation trucks.

Moreover, lighter construction, less maintenance of the equipment and less building space and infrastructure requirement likewise contribute to minimize the investment and operational costs per ton of waste. In order to minimise these costs, efforts have been made to reduce the material costs and to increase the transfer volume of waste to a maximum. For vertical system, the main transfer station building will be split-levelled and the waste containers will be unloaded into a silo that is placed in a vertical position.

The waste is dumped into the silo directly from the waste collection vehicles (WCV) from the upper floor and compressed vertically by means of a mobile compactor. The energy generated by the refuse collection vehicle when unloading, is used to fill the silo. This free power provided by gravity will partly aid in the compacting process - both in the filling and the waste compression. The silos will be manufactured (locally, based on design and imported materials from the system provider) with a round section of approximate 2.3 m diameter and a length of approximate 7.5 m. At the stages of feeding and waiting for haulage, the silo will stand on a square frame at the base. The door on the top of the upraised silo, together with a fixed plate, will serve as a full hopper around the silo section.

The silos are produced with a mild traverse from the square section to the round section to prevent waste to remain in the feeding section after unloading. For optimal use of the haulage trailers, hereby improving the transportation economy, the silos will be handled by transfer station trucks, equipped with silo handling systems for transferring to the haulage trailers. The entire transfer process will be performed under cover, isolated from rain water (to limit pollution and water accumulation in the waste) and wind (to limit littering due to blowing paper and plastic).

The Multi Compact System combined with its transportation solution meets all environmental requirements. During the transfer the waste is exposed to the open air only for a very short time, which limits stench to a minimum. The silos are 100% water tight, which prevents leakage during loading and transportation. Upon arrival to the landfill the silo will be transferred from the haulage trailer to a specially designed landfill truck. The landfill truck will empty the contents of the silo onto the dumping site. Due to the special designed rear-axle, the landfill truck is able to drive on the unstable grounds in the dumping area of the landfill and its operation will save valuable time for the transportation truck.

ENVIRONMENTAL IMPACT ASSESSMENT

The key environmental components of concerns during implementation of the project were air quality, odour, noise, vibration, river water quality, aquatic ecology, socio-economy and traffic and transportation issues around the project site. The baseline data has been collected and discussed in detail in the existing environmental section of EIA report. Subsequently, the potential environmental impacts arising from the construction and operational phases of the SATS are evaluated based on prevailing regulatory requirements and environmental best management practices.

Air emissions and noise during the construction phase of the project were due to land clearing, ground excavation, fill and grading operations, and construction of structures such as buildings and roads. The air and noise impacts would have very minimal impact on the surrounding areas. However, the construction runoff and drainage may cause both physical and biological effects, especially river aquatic system. The physical effects include blockage of drainage channels and increased suspended solids (SS) concentration in Damansara river. Possible biological effects to the river include toxicity caused by mixtures of hydrocarbons and grouting materials and reduction in dissolved oxygen (DO) levels caused by high suspended solids concentrations. Similarly, the flora and fauna survey at the site did not indicate the presence of any species of conservation value.

During the construction phase, machinery and vehicles such as bulldozers, excavators, graders, roller-compactors, dump trucks and pile rigs will be mobilized or will be transported by low-loaders will cause temporary disruption to the normal traffic flow. However, job opportunities, particularly in the form of manual and semi-skilled labour will be in demand creating positive socio-economic impacts. Most of the construction workers for the project may be foreign workers, with minimum labour input from locals.

During the operational phase, noise is generated by motor vehicles and machineries. As the road is not a high density road and machinery used is not heavy, they are not expected to be significant and therefore their impact would be minimal. During the operational phase, the proposed transfer station is expected to generate a moderate amount of motorised traffic. With the surfaces in the compound paved and only a moderate increase in traffic volume over the years, the air quality of the areas in the vicinity of the station is not expected to deteriorate and would generally meet the ambient air standards based on the air quality modelling results. Odour modelling study showed that the odour is only detectable during the daytime and under worst case atmospheric conditions. The maximum distance odour is detectable is 75 meters from the centre of the transfer station and also detectable intermittently.
Environmental impacts arising from the uncontrolled release of the waste effluent include soil contamination and water pollution may be significant. Since the waste effluents generated would be largely organic in nature, the escape of these effluents, untreated, into the river will increase the biological oxygen demand and the total suspended solids levels. In the operation phase, the socio economic impacts predicted from the implementation of the project are positive, with the opening of employment opportunities.

ENVIRONMENTAL MANAGEMENT PLAN

An Environmental Management Plan (EMP) for the SATS is necessary to effectively manage all the potential impacts identified in this report and monitor the activities at the project site during construction and operational phases of the project. This is to ensure that the environmental objectives are met and all activities relating to the implementation of the project are carried out in an environmentally sustainable manner.

Objectives of the EMP

The primary objectives of Environmental Management Plan are as follows:

- Allocating institutional and administrative responsibilities for planning and management of environmental requirements. The results of the EIA are to be applied to project planning, engineering design and project implementation;
- Allocating responsibility to execute mitigation actions to the project manager and or the contractors responsible for project development;
- Implementing a program of monitoring to check the effectiveness of the mitigation measures, and to modify or implement additional measures, to correct or overcome the impacts in question;
- Appointing relevant expertise or consultants to assist if in-house capability is not available;
- Ensuring that the recommended mitigation measures are incorporated in the detailed design and contract documents;
- Allocating adequate budget for implementing the EMP.

Scope of the EMP

The main elements in the EMP are:

- Legislative and contractual requirements and conditions that need to be observed and complied with;
- An administrative set-up (e.g. Environment, Safety and Health Unit) to be responsible for environmental management, with well defined organisational structure, required manpower, and the responsibilities of the personnel defined. The administration of the EMP should also include the contractors involved in the mixed development;
- Environmental monitoring programmes for ambient air quality, boundary noise, vibration, water quality, and effluent discharges;
- Actions required and sequence of reporting in response to accidents or abnormal operations during project development.

The EMP needs to be periodically reviewed and modified to include changes or other impacts that may be identified in the course of the project implementation. Elements of the EMP may constitute components of the contract agreement for contractors and sub-contractors appointed for the project.

ENVIRONMENTAL MONITORING

An integral part of the EMP is the formulation of various monitoring programmes to determine the effectiveness of the mitigating measures adopted and to monitor changes (adverse or otherwise) to the surrounding physical, chemical, biological and human environment. The monitoring programmes outlined in the EMP should cover all stages in the life-cycle of the project; from site investigation, site clearing and earthworks, construction, and operation of the completed transfer station and its associated facilities. An environmental monitoring programme, which forms an essential component in the overall EMP, is suggested in Table 1 and Table 2. The monitoring programme shall include, but not be limited to ambient air quality, boundary noise levels, vibration levels, surface water quality, groundwater quality, wastewater quality (effluent discharges) and total suspended solids from discharged from the silt trap.

Table 1: Suggested Environmental Monitoring Schedule during Construction Phase

	Category	Parameters	Location	Frequency	No. of Location Proposed
1	Ambient Air Quality	TSP PM_{10} Dust fall NO_2 SO_2 CO	At the vicinity of project area especially near the sensitive receptors.	Monthly	Two
2	Noise Levels	L_{eq} L_{10} L_{50} L_{90} L_{min} L_{max}	At the vicinity of project area especially near sensitive receptors.	Fortnightly	Four
3	Vibration Level	peak particle velocity (ppv)	At appropriate location at the vicinity of the project especially closer building.	Monthly	Two
4	River Water Quality	Wastewater Quality Std B.	At the vicinity of project area especially upstream and downstream of the project site.	Fortnightly	Four
5	Ground Water Quality	Drinking Water Quality Standard of JMG	At the standpipe within the project site	Quarterly	Two
6	Channel Sedimentation	Total Suspended Solid (TSS)	At the silt trap outlets.	Fortnightly	All the silt traps outlets

Table 2: Suggested Environmental Monitoring Schedule during the Operational Phase

	Category	Parameters	Location	Frequency	No. of Location Proposed
1	Ambient Air Quality	TSP PM_{10} Dust fall NO_2 SO_2 CO	At the vicinity of project area especially near the sensitive receptors.	Monthly	Two
2	Noise Level	L_{eq} L_{10} L_{50} L_{90} L_{min} L_{max}	At the vicinity of project area especially near sensitive receptors.	Fortnightly	Four
3	Vibration Level	peak article velocity (ppv)	At appropriate location at the vicinity of the project site.	Monthly	Two
4	River Water Quality	Wastewater Quality Standard B	At the vicinity of project area especially upstream and downstream of the project site.	Fortnightly	Four
5	Ground Water Quality	Drinking Water Quality JMG Standard	At the standpipe within the project site.	Quarterly	Two
6	Wastewater Quality	Wastewater Quality Standard B	At the Leachate Treatment Outlet & Retention Pond Outlet	Monthly	All Effluent outlets

Monitoring During Construction Phase

During the construction phase, the main emissions into the air would be Total Suspended Particulate (TSP), Particulate Matter (PM_{10}), Dust fall, Carbon Monoxide (CO), Sulphur Dioxide (SO_2) and Nitrogen Dioxide (NO_2). As such, it is recommended that regular monitoring of these parameters is carried out around the project site. Emphasis should be placed on built-up areas or areas of significant human population. The ambient air monitoring can be conducted every month, depending on the duration of the construction phase.

Noise monitoring is important in order to quantify the noise levels during the construction activities. This data can be used for reference in future if the needs arise. Any complaint received must be investigated promptly to avoid more serious problems from occurring in the future. The noise monitoring can be monitored monthly during construction phase of the project.

Vibration monitoring can be carried out at designated location as and when required, especially during the piling activities. The vibration monitoring equipment should be calibrated employing techniques outlined in the respective standards and guidelines. The location of the vibration sensor should be installed to the nearest structure, i.e. buildings, houses and any other structures. The baseline vibration data collected for site prior to the implementation of the project will be used as reference data for the subsequent monitoring data.

It is recommended that the water quality monitoring be carried out monthly until all earthwork and construction works are completed. Parameters to be tested during field based measurement are Temperature, Dissolved Oxygen (DO), and pH. Parameters for laboratory analysis are Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammonia Nitrogen (NH3), Total Suspended Solids (TSS), Oil and Grease, and E. coli concentration. It is important that the parameters directly related to the construction activities are constantly measured.

Additional parameters to be tested during the operation activities are Conductivity, Total Nitrogen and Total Phosphorous. Once the construction activities are completed, the monitoring frequency may be monthly or quarterly depending on the environmental performance of the site.

It is recommended that the ground water quality monitoring be carried out quarterly until all earthwork and construction works are completed. Once the construction activities are completed, the monitoring frequency may be monthly or quarterly depending on the environmental condition of the site.

During the construction phase, the total suspended solids should be monitored on monthly basis at all the silt traps and run off outlets to gauge the sediment laden run off and erosion potential of the construction site. Generally, the suspended solids in the wastewater discharged into any open drainage system which leads to any water bodies should not be more than 100 mg/l and, therefore, monitoring of suspended solids at the run off outlet is essential.

Monitoring During Operation Phase

During the operation phase, the main emissions into the air would be Total Suspended Particulate (TSP), Particulate Matter (PM_{10}), Dust fall, Carbon Monoxide (CO), Sulphur Dioxide (SO_2) and Nitrogen Dioxide (NO_2). As such, it is recommended that regular monitoring of these parameters is carried out around built-up areas or areas of significant human population. The ambient air monitoring can be conducted every month, onset of the operational phase.

Noise monitoring must be carried out during operation phase of the proposed project. This is important in order to quantify the noise levels during the actual operation activities. Any complaint received must be investigated promptly to avoid more serious problems from occurring in the future. The noise monitoring can be monitored monthly during operation phase of the project.

Vibration monitoring can be carried out at designated location as and when required. The vibration monitoring equipment should be calibrated and the vibration sensor installed near to building structures, i.e. buildings, houses, schools, etc.

Water quality parameters that shall to be monitored during the operational phase will include the field based measurements and laboratory analyses monitored during the construction activities: Temperature, Dissolved Oxygen (DO), pH, Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Ammonia Nitrogen (NH3), Total Suspended Solids (TSS), Oil and Grease, and E. coli concentration. Additional parameters to be tested during the operation activities are Conductivity, Total Nitrogen and Total Phosphorous. It is recommended that the water quality monitoring be carried out monthly or quarterly depending on the environmental performance of the site.

The wastewater (from trucks and washing activities) within the site will be discharge into leachate treatment plant for treatment. The wastewater before discharge into Sg. Damansara should be analysed for all the Standard B parameters on monthly basis. Monitoring data need to be compared with baseline data obtained during the pre-construction period.

The two permanent monitoring wells established within the site shall be used for long term ground water quality monitoring and compared with baseline data obtained during pre-construction period. During the operational phase, the monitoring frequency may be monthly or quarterly depending on the environmental condition of the site.

CONCLUSION

The Environmental Management Plan addressed specifically the need for an effective environmental monitoring programme. In implementing the EMP, the project proponents also need to adhere to all the terms and conditions of EIA approval and other environmental regulatory requirements. The monitoring of environmental parameters during the construction and operation phases of the project enables the project development to be implemented within safe environmental conditions.

ACKNOWLEDGEMENT

This paper is part of the Detailed EIA report prepared for the Shah Alam Transfer Station by Ecotone Environmental Management Sdn. Bhd and approved by Department of Environment (DOE), Malaysia. We are grateful to various private and government agencies including the project proponent the Worldwide Holdings Berhad while preparing the EIA report and make it available for other organizations, public and scientific community to use the information for effective management our environment.

REFERENCES

1. Anon, 1996, Preliminary EIA for the proposed Refuse Transfer Station Section 21, Shah Alam, Selangor Darul Ehsan, Report prepared by ERM-Erinco, Petaling Jaya.
2. Anon, 1996, Detailed Environmental Impact Assessment for the proposed Waste Transfer Station Section 21, Shah Alam, Selangor Darul Ehsan, Report prepared by Ecotone Environmental Management Sdn. Bhd, Petaling Jaya.
3. Department of Environment 1995, Environmental Impact Assessment Guidelines for Municipal Solid Waste and Sewerage Treatment and Disposal Projects, Department of Environment (DOE), Ministry of Natural Resources and Environment, December 1995, EG 12/95, Kuala Lumpur.
4. Department of Environment 1999, Investigation and Assessment of Municipal Landfill sites in The Federal Territory of Kuala Lumpur, Department of Environment (DOE), Ministry of Natural Resources and Environment, Kuala Lumpur.
5. Department of Environment 2004, Guidelines for Environmental Noise Limits and Control, Noise Labelling, and Emission Limits of Outdoor Sources and Vibration Limits and Control, Department of Environment (DOE), Ministry of Natural Resources and Environment, Kuala Lumpur.
6. Grover, V.I. 2002, *Globalization and Solid Waste Indicators*, Warmer Bulletin, UK.
7. Guidelines for Resource Recovery and Waste Transfer Depots, 2001, Environment Protection Authority, South Australian Government, Australia.
8. International Law Book Services 2000, Occupational Health and Safety Act 1994 (ACT 514) and Regulations and Orders, Kuala Lumpur.
9. Tchobanoglous, G., Theisen, H. and Eliassen, R. 1977, *Solid Waste – Engineering Principles and Management Issues*, McGraw-Hill, Ltd
10. Tchobanoglous, G., Theisen, H. and Vigil, S 1993, *Integrated Solid Waste Management: Engineering Principles and Management Issues*, McGraw Hill Inc, New York.
11. United States Environmental Protection Agency, 2002, *Waste transfer station: A manual for decision-making*, EPA530-R-02-002.