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الجامعة الأميركية في بيروت

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Mr. Ayman Abdallah
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Jinah Region of Beirut
El Moubarak Building- Third floor
Beirut Lebanon

**Reference: Environmental Impact Assessment (EIA) Review
Zahle landfill site
EARTH Program**

Dear Mr. Abdallah,

In accordance with the Agreement between Cooperative Housing Foundation (CHF) and the American University of Beirut (AUB), a review of the previous 1998 EIA at the Zahle landfill site¹ has been conducted. It is our understanding that a more recent update of this EIA to expand the existing facilities was conducted through the Council of Development and Reconstruction (CDR) at the request of the Council of Ministers. Having been closely involved in the preparation of the update (referred to as a pre-design EIA report) and based on information released by the Government of Lebanon (GoL) about its proposed National Solid Waste Management Plan, the Zahle landfill was targeted for expansion to serve the caza of Zahle. Within the context of the GoL Plan, several activities were proposed for the Zahle facility which currently comprises a simple sorting plant and a landfill. Under the Plan, the facility would be upgraded to house a larger materials recovery facility, a compost plant, a larger sanitary landfill (with increased height and a new cell), and an upgrade of leachate treatment which is currently collected in an evaporation pond or recirculated within the landfill. In this respect, the EARTH Program is consistent with the Plan and will contribute to the development of several elements of this Plan, namely: sorting, composting, and leachate treatment.

¹ CDR. 1998. Etude d'Impact de la decharge controlee de Zahle, Solid Waste Environmental Management Project (SWEMP), LibanConsult, Beirut, Lebanon. In the case of the Zahle landfill, site investigations (geotechnical and hydrogeologic) have been conducted and design specifications for various facility systems (gas collection and management, leachate collection, liner, surface drainage, cover, odor control, and sorting plant) have been developed since 1998 during the design and implementation phases of the facility. These specifications have constituted the foundation for implementing the Zahle landfill and associated elements. Performance of current operations is being monitored by an independent consultant (Globex) commissioned by CDR for this purpose. Globex is currently assisting the municipality in the design of the various components funded under the EARTH Program and is part of its Management Unit. Therefore, the EARTH Program is benefiting from site-specific knowledge of potential constraints which ensures its implementation with awareness and consideration of potential environmental impacts.

The scope of work implemented in the preparation of the pre-design EIA report included a description of the proposed National Solid Waste Management Plan, identification of activities currently taking place at the facility and highlight of major problems encountered, definition of the existing legal and administrative framework, description of the environment surrounding the project site, identification of potential environmental impacts associated with the construction and operation of the Zahle facility with emphasis on the proposed upgrading activities, analysis of alternatives and corresponding environmental management plans (mitigation, monitoring, and institutional strengthening).

Based on the pre-design EIA report, the analysis of impacts revealed that limited adverse environmental impacts would occur during the short-term construction phase (which has in common with the EARTH Program the construction of the materials recovery facility, compost plant, and leachate treatment plant). During operation and post-closure, the facility may be associated with adverse impacts due mainly to leachate generation with potential surface and/or groundwater contamination, and gaseous/odorous emissions. Other less serious impacts of concern include soil, noise, visual intrusion, biodiversity, traffic, waste management, socio-economics, and health and safety. These impacts can be eliminated or minimized by proper planning and staging of construction activities, adopting proper management practices during operation and post-closure, and relying on effective environmental monitoring and training to support management decisions. A mitigation plan was developed and monitoring activities were defined with corresponding location and frequency of monitoring (see Annex A for summary guidelines).

In the context of the EARTH initiative as well as the overall National Plan, appropriate environmental management dictates that construction, operation, and post closure activities be implemented in accordance to the current state of the art and knowledge regarding environmental protection. This can be accomplished by hiring competent personnel with the appropriate educational and professional background, instituting periodic training programs, and developing site-specific plans that are adequate for protecting the general public and the environment as well as contributing to the mitigation of potential environmental impacts. The latter have or are being developed / implemented through the design components and supervision activities associated with the EARTH Program. Annex A provides summary guidelines that were developed in the pre-design EIA report. To the extent applicable and feasible, these guidelines are being followed to ascertain proper environmental management during the implementation of the EARTH Program and will be similarly adopted by the Zahle municipality during operations and post-closure.

Should you have any questions about this review, please do not hesitate to contact me.

Sincerely yours,



Dr. Mutasem El-Fadel
Environmental Engineer
Project Manager

Annex A. Environmental Management Guidelines at the Zahle facility

Table A-1. Construction phase mitigation guidelines

<i>Impact</i>	<i>Mitigation measures</i>
Surface and groundwater quality	<ul style="list-style-type: none"> • Direct surface run-off into storm drains via adequately designed sand/silt/debris removal facilities • Provide channels, earth bunds or sand bag barriers on-site to properly direct stormwater to silt/debris removal facilities • Regularly maintain silt/debris removal facilities • Discharge rainwater pumped out from trenches or foundation excavations into storm drains via silt removal facilities • Cover open stockpiles of construction materials with tarpaulin or similar fabric during rainstorms events • Prepare guidelines and procedures for immediate clean-up actions following any spillages of oil, fuel or chemicals • Compact earthworks as soon as the final surfaces are formed to prevent erosion • Contain sewage from toilets, kitchens and similar facilities in sanitary cesspools before being transported by trucks to a nearby wastewater treatment plant
Soil quality	<ul style="list-style-type: none"> • Proper storage of chemicals on site • Limiting accidental spillage • Prohibiting the open disposal of spent oils in the surrounding environment
Odor generation	<ul style="list-style-type: none"> • Inform the public about excavation activities • Aerate excavated wastes prior to landfilling • Conduct excavation activities in the shortest possible time frame
Air quality	<ul style="list-style-type: none"> • Water surfaces • Use chemicals to treat exposed surfaces • Install windbreaks or source enclosures (such as trees, fences, plastic mesh, etc.) to reduce surface wind speed • Pave heavily-used roads • Cover the road surface with a new material of lower silt content • Maintain roads regularly • Maintain good housekeeping practices • Properly maintain trucks and on-site equipment • Adopt a traffic management plan while avoiding congested routes • Ensure quality of diesel fuel used with on-site equipment • Turn off all equipment when not in use
Health and safety	<ul style="list-style-type: none"> • Restrict access to the construction site by proper fencing • Establish buffering areas around the site • Provide guards on entrances and exits to the site • Install warning signs at the entrance of the site to prohibit public access • Provide training to a dedicated staff about the fundamentals of occupational health and safety procedures • Provide appropriate personal protective equipment • Keep uniforms and PPE clean and in good condition and replace them at least on a semi-annual basis • Provide personal ID cards for all employees • Provide adequate loading and off-loading space • Develop an emergency response plan • Provide on-site medical facility/first aid • Provide appropriate lighting during night-time works • Implement speed limits for trucks entering and exiting the site and from the highway • Follow CDR guidelines for health and safety • Provide environmental friendly fire-fighting equipment such as dry powder extinguishers within the premises of the plant • Conduct annual fire-fighting and leak checks training drills for the operating staff • Prohibit smoking as well as litter or weed build-up in the area as these may pose fire risks

Impact	Mitigation measures
Noise	<ul style="list-style-type: none"> • Erect noise barriers along active work sites • Install vegetative screens • Operate on-site well-maintained mechanical equipment only • Shut down equipment that may be intermittent in use between work periods or throttle them down to a minimum • Utilize silencers or mufflers on construction equipment • Properly maintain construction equipment during construction works • Use material stockpiles and other structures to screen noise from on-site construction activities • Schedule noisy activities during daytime periods • Construct noise barriers along roadside • Provide noise enclosures or semi-enclosures • Provide earth berms • Install noise reducing road surfaces such as quiet pavements
Waste generation/ management	<ul style="list-style-type: none"> • Use to the extent possible the generated construction debris in filling activities or stockpile and store for future use as daily cover within the landfill • Reduce or eliminate over-ordering of construction materials • Store chemical wastes in a separate area that has an impermeable floor, adequate ventilation and a roof to prevent rainfall from entering • Clearly label chemical wastes in English and Arabic • Every effort should be made to arrange for the recycling of any chemical waste generated on-site • Store general refuse generated on-site in enclosed bins or compaction units separate from construction and chemical wastes • Draft an agreement between the contractor and the solid waste collector to identify collection sites and schedule the removal • Prohibit burning of general refuse • Promote reusable rather than disposable dishware • Fence the construction site to intercept litter scattering
Landscape and visual intrusions	<ul style="list-style-type: none"> • Enclose site with non-transparent fencing to minimize visual impacts • Prohibit vehicles from parking outside the fenced boundary of the site • Preserve existing floral cover when feasible • Select appropriate paint colors for the exterior of the buildings to blend with surroundings • Select construction materials that will blend with the background • Select architectural designs that will blend with the surrounding features of the milieu • Incorporate underground utilities (to the extent possible) to house electrical, storage, and operational equipment • Comply with building codes of the area and reduce construction of elevated structures • Open areas adjacent to the erected structures of the facility should be grassed and planted with shrubs, trees and ground covers • One row of tree seedlings with at least 1 m of height, one per 3m, should be planted along the fence line of the site • Dedicate an area corresponding to at least 10 percent of the total site area for landscaping and greenbelt
Biological environment	<ul style="list-style-type: none"> • Schedule construction work to avoid breeding and nesting periods of sensitive species • Secure fencing of areas not required for land-take prior to commencement of work • Route temporary site drainage away from water courses
Socio-economics	<ul style="list-style-type: none"> • Give priority to the local community in the immediate vicinity of the site in terms of providing job opportunities
Traffic	<ul style="list-style-type: none"> • Dissemination of information regarding the construction schedule • Providing alternate routes when needed and when feasible • Proper planning and development of a traffic control plan that takes into account the reservations and inputs of residents • Adequate warning, signing, delineation and channeling at least 500 m down and up-gradient from the construction site • Restrict movement and transportation of construction machinery outside the site to off-peak traffic hours and during nighttime • Independent access road to the site accommodating for heavy duty vehicles of up to 40 tonnes brut weight

Table A-2. Operation phase mitigation guidelines

Impact	Mitigation measures
Surface and groundwater quality	<ul style="list-style-type: none"> • Collect leachate from landfill through the use of perforated leachate collection pipes installed on the bottom of the landfill • Design the landfill cover with a sloping surface to enhance surface runoff which is collected via drainage channels • Collect and store leachate generated within the compost plant and MRF • Leachate treatment should be conducted on-site prior to discharge • Treated leachate effluent should meet the MoE standards set for discharge into surface water bodies (Decision 8/1) • Minimize the amount of precipitation coming into contact with the waste • Pave reception area with impermeable material and equip it with a drainage system • Use a low permeability cap • Design the landform to encourage surface water runoff away from active phases • Control liquid waste inputs • Use a double or composite liner system • Perimeter and cell bunding with low permeability bund walls • Retention of sufficient unsaturated zone to provide leachate attenuation in case of a leakage • Perform monthly maintenance checks to ensure system functionality • Implement a rigorous monitoring plan • Provide appropriate training of staff about operating conditions, particularly at the leachate treatment plant and occupational health and safety • Provide the facility with an adequate MSW storage area (roofed, impermeable paving, proper drainage and ventilation) with a capacity of at least one nominal day throughput • Treat on-site the leachate collected from the storage tanks of the vehicles transporting waste, cleaning water and drainage water collected from the MRF, compost plant, and vehicle washing facilities along with the leachate collected from the landfill and the compost plant • Provide oil-water separators and sand precipitators at all workshops on-site in order to limit mixing with cleaning water • Minimize water use during cleaning of working areas and vehicles (e.g. adopting dry cleaning practices prior to water cleaning) • Adopt designs for the MRF and compost plant that accommodate for slightly inclined ground surface to ensure proper leachate drainage.
Soil quality	<ul style="list-style-type: none"> • Proper storage of chemicals on-site, limiting accidental spillage as well as prohibiting the open disposal of spent oils in the surrounding environment • Monitor the compost quality to assure compliance with MoE Compost-Ordinance • Adopt heat treatment to destroy potential pathogens present in the compost • Train and inform the farmers about the frequency and volumes of application of the compost • Issue bills of compost delivery to end-users • Send quarterly reports to the CDR, MoE, MoA, and MoPH, concerning the amounts of compost used, specific types of agricultural or other uses, and specific amounts of compost used per customer • Treat the leachate on-site prior to discharge • Install impermeable material at the landfill such as clay and geo-membrane to limit contact of any generated leachate with the surrounding soil • Provide the facility with an adequate MSW storage area (roofed, impermeable paving, proper drainage and ventilation) with a capacity of at least one nominal day throughput • Treat the leachate collected from the storage tanks of the vehicles transporting waste on-site along with the leachate collected from the landfill and the compost plant • Provide oil-water separators and sand precipitators at all workshops on-site in order to limit mixing with cleaning water
Odor generation	<ul style="list-style-type: none"> • Maintain adequate aeration rates during the composting process • Install proper odor control equipment • House the storage, sorting, and composting areas and adopt proper odor control • Ensure that all sorting activities are conducted within 12 hours following waste delivery • Provide adequate soil cover in the landfill
Air quality	<ul style="list-style-type: none"> • Collect gases from the landfill using either passive or active systems • Flare gases using either continuous flare burners or self-lighting burners • Provide the MRF plant with an air cleaning system comprising at least a fabric filter • Adopt end-of-pipe emission control measures to achieve the MoE National Standards for Environmental Quality • Use collection trucks that are no more than 10 years of age

Impact	Mitigation measures
Health and safety	<ul style="list-style-type: none"> • Site security • Site safety • Site facilities • Environmental controls • Waste transportation • Waste tracking system • Emergency/contingency plans • Workers hygiene • Personnel protection • Fire fighting
Noise	<ul style="list-style-type: none"> • Schedule collection and transport of the solid wastes either in the early morning hours or late in the afternoon • Install mufflers and noise barriers around air blowers and pumps • Enclose noisy equipment • Implement a rigorous inspection and maintenance program applicable to all equipment on-site
Waste generation/management	<ul style="list-style-type: none"> • Store collected recyclables in a dedicated area within the facility until purchase • Sell the compost or distribute it to farmers • Reuse compost as a daily cover for the landfill provided it is properly cured and low in organic and moisture content • Provide the facility with an adequate MSW storage area (roofed, impermeable paving, proper drainage and ventilation) with a capacity of at least one nominal day throughput • In case of long term unscheduled outages ensure alternative disposal of wastes in accordance with applicable regulations • Clean continuously litter within closed facilities as well as on all roads within the site including access roads • No medical wastes, industrial wastes, animal carcasses, fish waste, or other obnoxious and environmentally hazardous materials shall be accepted at the landfill. As such, inspection of incoming wastes should be conducted at weighbridges. Any load where unaccepted wastes are identified shall be rejected. The identity of the vehicle and driver as well as the identity of the rejected wastes shall be notified to CDR and MoE immediately. Concurrently, a temporary storage area (enclosed with proper ventilation) should be constructed to accommodate for wastes rejected at the landfill until further instructions are issued from CDR and MoE concerning the fate of such wastes • Record daily quantities of incoming wastes at the entrance of the facility • Maintain fences constructed to intercept litter scattering
Landscape and visual intrusions	<ul style="list-style-type: none"> • Conduct filling activities in small, well defined cells (covered daily) to minimize the areas of waste exposed visually • Maintain the buildings within the site to preserve their architectural and visual appeal • Lay top soil with minimum compaction to provide a satisfactory growing medium • Use appropriate gradients to ensure soil stability and prevent soil erosion • Ensure compatibility of final landform with surrounding ground levels and topography • Plant tree or shrub species to be compatible with the soil cover and surrounding plants
Biological environment	<ul style="list-style-type: none"> • Maintenance of a buffer zone around the landfill to minimize disturbance to animals • Minimization of litter blow by good cover, fencing and hand-picking • Use scare-crows • Implement an environmental monitoring plan for early detection of gas/leachate migration • Using topsoil for final restoration of the site • Planting flora similar to the existing flora in the area • Avoiding deep rooting plants to protect the sealing system • Replanting of woodlands and trees around the site's boundaries • Implementation of post-closure monitoring plan
Landfill stability	<ul style="list-style-type: none"> o Do not allow final cover slopes to exceed 1 in 3
Socio-economics	<ul style="list-style-type: none"> • Conduct systematic environmental awareness campaigns to introduce the public at large to the benefits of installing and operating a solid waste treatment and disposal facility • Instigate a formal complaints system which responds in a timely fashion to complaints about nuisances • Publish data and reports on environmental performance of the facility • Provide economic incentives to local communities by adopting policies to recruit locally and to hire local contractors when possible • Adopt an on-the-job training program for those that do not have adequate skills to be recruited • Examine means for potential economic benefits at the local level

<i>Impact</i>	<i>Mitigation measures</i>
Traffic	<p>On-site measures include:</p> <ul style="list-style-type: none"> ● Independent access road to the site accommodating for heavy duty vehicles of up to 40 tonnes brut weight ● Installation of a wheelwash on-site ● Entrance and exit located so as to provide maximum turning space and sight lines ● Vehicle movement in the direction of predominant traffic flow ● Adequate off-loading and loading space to ensure vehicles can wait on-site ● Adequate off-street parking for employees ● One-way traffic within the site to prevent obstruction to vehicles entering and leaving ● Speed restrictions on vehicles entering and leaving the site <p>Off-site measures include:</p> <ul style="list-style-type: none"> ● Routing of traffic to avoid residential areas ● Scheduling of deliveries and departures such that night time movements or over-night parking are avoided ● Sheeting of vehicles delivering wastes and removing residues ● Paving or use of suppressants to mitigate dust emissions ● Ensuring that vehicles and containers are appropriate to the waste transported and that they are adequately maintained ● Use of locally designated traffic routes

Table A-3. Environmental monitoring guidelines

Impact	Monitoring means	Parameters	Phase	Location	Frequency
Air quality	Sampling	TSP/PM-10	Construction	<ul style="list-style-type: none"> • Nearest receptors 	<ul style="list-style-type: none"> • Monthly • Upon complaints
	Sampling	Landfill gas	Operation	<ul style="list-style-type: none"> • Landfill site (gas extraction wells) and compost facility proper • Perimeter landfill gas monitoring wells/probes 	<ul style="list-style-type: none"> • Monthly • Weekly in times of expected high impacts • Upon complaints
		Methane		<ul style="list-style-type: none"> • Nearest receptors 	<ul style="list-style-type: none"> • Monthly
		Combustion sources (flue gas temperature, oxygen level, combustion efficiency, flue gas concentrations of CO, NO ₂ , SO ₂ , TSP/PM-10)	Operation	<ul style="list-style-type: none"> • Stack of each combustion source 	<ul style="list-style-type: none"> • Annually
	Sampling	Landfill gas	Post-closure	<ul style="list-style-type: none"> • Landfill site (gas extraction wells) • Perimeter landfill gas monitoring wells/probes 	<ul style="list-style-type: none"> • Quarterly
Noise	Sampling	L _{eq} (dBA)	Construction	<ul style="list-style-type: none"> • 3 monitoring locations around the perimeter of the site • At nearest receptors 	<ul style="list-style-type: none"> • Monthly • Upon complaints
			Operation	<ul style="list-style-type: none"> • At MRF and compost plant • 3 monitoring locations around the perimeter of the site • At nearest receptors 	<ul style="list-style-type: none"> • Monthly • Upon complaints
Surface water, groundwater, and leachate quality	Sampling	pH, temperature, electrical conductivity, dissolved oxygen, ammonia nitrogen, chloride, COD, BOD, total oxidized nitrogen, TOC, total alkalinity as CaCO ₃ at pH 4.5, Na, K, Ca, Mg, Fe, Mn, Cd, Cr, Cu, Ni, Pb, Zn, mineral Oil, Hg, phenols, arsenic, cyanide, total coliforms	Construction	<ul style="list-style-type: none"> • Nearby Berdawni river • Existing drainage waterways • Groundwater wells around the site 	<ul style="list-style-type: none"> • Three times
	Sampling		Operation	<ul style="list-style-type: none"> • Nearby Berdawni river • Existing drainage waterways • Groundwater wells around the site • Monitoring wells within the fill • Discharge point of the leachate treatment plant 	<ul style="list-style-type: none"> • Weekly for pH, temperature, electrical conductivity • Monthly for all parameters
	Sampling		Post-closure	<ul style="list-style-type: none"> • Nearby Berdawni river • Existing drainage waterways • Groundwater wells around the site • Monitoring wells within the fill 	<ul style="list-style-type: none"> • Quarterly for 10 years

<i>Impact</i>	<i>Monitoring means</i>	<i>Parameters</i>	<i>Phase</i>	<i>Location</i>	<i>Frequency</i>
	Measurement	Leachate volume	Operation Post-closure	<ul style="list-style-type: none"> Input to leachate treatment plant 	<ul style="list-style-type: none"> Weekly Quarterly for 10 years
Solid waste	Waste audit	Generation, storage, recycling, transport, and disposal	Construction	<ul style="list-style-type: none"> Site proper 	<ul style="list-style-type: none"> Quarterly
	Solid waste characterization	Quantity and percent composition by weight and volume	Operation	<ul style="list-style-type: none"> Incoming wastes 	<ul style="list-style-type: none"> Weighbridge Quarterly(2 samples of 500 kg each)
	Sampling	pH, Arsenic, Pb, Cd, Cr, Cu, Ni, Hg, Zn, phenols, mineral oils, Mg, Fe, Mg, Ca, K, Na, total organic carbon, Cl, moisture content		<ul style="list-style-type: none"> Incoming wastes 	<ul style="list-style-type: none"> Quarterly (2 samples of 500 kg each)
Soil and compost quality	Sampling	Salmonellae, Fecal Coliform, impurities (stones and plastics), moisture content, organic matter, pH, salt content, nutrients (nitrogen, soluble phosphate, soluble potassium, soluble chloride, soluble sodium), heavy metal content (mercury, lead, chromium, copper, nickel, zinc and cadmium)	Operation	<ul style="list-style-type: none"> Composting facility Spill locations 	<ul style="list-style-type: none"> 12 samples (5 to 10 L each) from each compost batch After spills
Odor	Olfactory test	Unpleasant/noxious smells	Operation	<ul style="list-style-type: none"> Sensitive receivers 	<ul style="list-style-type: none"> Daily
Health and safety	Health and safety surveys	Proper use of PPE, presence of signs, first aid kit, and fire fighting devices	Construction Operation	<ul style="list-style-type: none"> Site proper 	<ul style="list-style-type: none"> Continuous
Biological environment	Field surveys	Photographic documentation of present species	Construction Operation	<ul style="list-style-type: none"> Site proper 	<ul style="list-style-type: none"> Annually
Landscape and visual intrusions	Visual inspection and photographic documentation	Ensure the effective implementation of mitigation measures	Construction Operation	<ul style="list-style-type: none"> Entire area 	<ul style="list-style-type: none"> Monthly Quarterly
Socio-economics	Field questionnaires Interviews	Population perception Employment records	Construction Operation	<ul style="list-style-type: none"> Region of influence 	<ul style="list-style-type: none"> Annually