THE LEACHATE TREATMENT PLANT IN KASHI: ENVIRONMENTAL IMPACT

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ABSTRACT: Dohuk city in Iraq produces 2000 tons of solid waste per day and it is disposed in a landfill. Waste disposal is one of the biggest problems that the Dohuk city is faced, the government searched for finding the most effective waste disposal that suitable with their weather and amount of solid waste. The municipality of Dohuk found the landfill in Kashi is the solution for the solid waste problem, Kashi is region far away from the center of Dohuk by 20 km nearly; receives about 2000 tons of solid waste per day only from the center of Dohuk and Sumel. The process of landfill as we know is confined area and covered with layers of soil it is required by liner at the bottom of the pit to prevent the leachate or the liquid from solid waste to contaminate the groundwater and the soil. The objective of the manuscript is an environmental impact study on waste disposal. Landfill in Kashi has negative impact on environment such as after a while or may be now producing toxic gases which are released to the air and ground because the waste cannot rot and lead to effect on environment, organization intends to construct a leachate treatment facility to help improve the quality of life for those who live in the region and are directly affected by the effluent from the plant, through effective treatment technologies and waste-management practices. The environmental impact study focused on environmental monitoring plan which must include procedures on carrying out the necessary activities to monitor the effluent discharge such as the conditions of leachate (quantity and quality), gaseous emissions, groundwater and surface water, etc No findings are presented.

KEY WORDS: *Waste disposal, Landfill*, *EIA*, *leachate*.

1. INTRODUCTION

The community solid waste disposal is a global concern especially in developing countries, and as urbanization continues to advance, the administration of solid waste is becoming a public health and environmental concern in urban areas [1]. For some countries like Iraq, landfilling is the most frequent method of waste disposal, with almost 90% of waste disposed at landfills. It is the "simplest, cheapest and most effective technique of disposing waste" in several parts of the world [2].

Leachate coming from landfills built without engineered liners and leachate collection systems could impact negatively on surface water and groundwater standard with critical consequences for human and environmental health [3]. A lot of effects could arise from gas and leachate formation if it's not well controlled. These impacts include fires and

explosions, vegetation damage, unpleasant smells, landfill settlement, groundwater pollution, air pollution and global warming [4].

1.1 The Purpose of the Environmental Monitoring

The environmental monitoring plan should include procedures on carrying out the necessary activities to monitor the effluent discharge such as the conditions of leachate (quantity and quality), gaseous emissions, groundwater and surface water, etc.By testing the regular samples, the result of these samples should carry out and analyzed to assess the quality of the samples as well as, minimizing the negative effects on the environment.

1.2 Potential Environment Impact

Landfills have been identified as one of the major warnings to groundwater resources [5] not only in Iraq but all around the world (United States Environmental Protection Agency US EPA [6]. Most of the Municipal Solid Waste (MSW) generated in Dohuk region is directly dumped on land in a disappointing manner. The solid junk placed in landfills or open dumps are subjected to either groundwater underflow or infiltration from precipitation or any other possibility of infiltration of water. throughout rainfall, the dumped solid junk receivers' water and the by-products of its decomposition move into the water through the junk deposition (7). The liquid restraining countless organic and inorganic compounds is called 'leachate'. This leachate gathers at the bottom of the landfill and percolates through the soil and reaches the groundwater [8].

Areas near landfills have a considerable possibility of groundwater contamination because of the potential pollution origin of leachate emerge from the nearby dumping site. Such contamination of groundwater results in a substantial threat to local groundwater resource user and to the natural environment. The impact of landfill leachate on the surface and groundwater has given a greater number of studies in recent years and gained major importance due to drastic increase in population, [9]. There are many proposals that can be used to assess the groundwater and surface water contamination. It can be rated either by their experimental determination of the impurities or their estimation through mathematical modeling [10].

Many developing countries operate landfills without proper leachate collection and treatment facilities with unfortunate impacts on the environment [11]. The area of the influence depends on the nature of the leachate [12]. Leachate composition differ widely and depends on factors such as the composition and depth of junk, availability of moisture and oxygen, landfill design, operation, and age [13]. The leachate contamination of soils has a significant influence on the quality of the soil. conforming to Magaji [14], soil in most cases is the most polluted part of the ecosystem around landfills, because chemical elements are shifted and spread when water leaks through it. Several pollutants, including heavy metals, polyaromatic hydrocarbons, and pharmaceutical compounds accumulate in the soil [15]. The implication associated with these pollutants, particularly heavy metal contamination, is of concern in agricultural production systems [16].

1.3 Impact of air and odor quality

Landfilling is one of the most used methods of disposing of municipal and industrial junk in the world. Apart from the potential threats landfill sites pose to soil and groundwater, gases and smells/odors are also released [17]. The released gases and odor are majorly generated from the biodegradation of organic matter contained in the junk [18]. Methane (CH_4) and carbon dioxide (CO_2) are surrounded by the major Greenhouse Gases (GHGs) released from landfills [19]. gases and odor which released from the landfill have negative

significances on the environmental health. The proximity of landfill sites to the residential environments has decreased in recent decades due to high-speed urbanization and urban sprawl. Dincer, Odabasi [20] posited that most of the released pollutants from the landfill are odorous and have significant impacts on the nearby communities. Increase in odour thresholds from landfills are associated with an increase in landfill gases emission, and low wind speed which may obstruct pollutants dispersion specifically in complex terrains [21].

The greatest source in landfill is methane (CH_4), followed by wastewater CH_4 and nitrous oxide (N_2O); following, minor emissions of carbon dioxide (CO_2) outcome from incineration of junk containing fossil carbon (C) (plastics; synthetic textiles) There are large uncertainties with respect to direct emissions, indirect emissions and mitigation potentials for the junk sector. The amount of methane production relies on junk characteristics, moisture content, quantity, age, and oxygen availability [22]. The release of junk is heavily affected by the actions of the economic and consumers of the society, and they are distinct from other emissions (i.e., SO_2, PM) which are production- and activity-based. Lee et al. [22]. The municipal solid junk management operation usually contains many sequential activities after generation, which embrace collection, transportation, and treatment [23,24]. All these activities from generation to treatment are important sources of GHG emission [25]. Biodegradable organics, which occupies a significant segment of MSW, could increase GHG emissions. Globally, the junk management sector generates around about 1.3 Gt CO_2 e every year. This sector is accountable for about 2.8% of total emissions of GHG [26]. Organic components in the lower layers of open dumps and landfills are broken down by the anaerobic process, generating landfill gas (LFG) carrying about 50–60% methane [27].

Solid junk management facilities can generate a complex range of process odors under conditions. Generally, a skillful and trained odor observer can point out these odors by process type. The following describes some of the specific odor causing compounds and conditions that can arise from solid junk handling in Maine [28]:

1-Waste Transportation

2-Transfer Stations and Storage Facilities

3-Waste Processing Facilities

4-Incineration Facilities

5-Compost Facilities

6-Landfills

Landfill operation is commonly associated with contamination of surface and groundwater by leachate from the landfill (mostly if the landfill requires adequate liners), powerful odor, loud annoying noise from landfill bulldozers, bio aerosol emissions; tense organic compounds [29].

1.4 Health and safety

Landfills are a major contributor to the world's anthropogenic greenhouse gas (GHG) emissions because a huge amount of CH_4 and CO_2 are generated from the degradation process of deposited junk in landfills [30]. Landfills generate unalike kinds of trace dangerous elements which include carbon monoxide, hydrogen sulfide, xylene, dioxin, etc. dangerous organic micro pollutants which are all called dioxins and polycyclic aromatic hydrocarbons (PAHs). Dioxin can be formed from the attendance of chlorine-containing substances in the landfill and from landfill fire which is harmful to human health [31].

The constant inhalation of CH_4 by humans can cause loss of coordination, nausea, vomiting and high concentration can be fatal [32]. Acidic gases like nitrogen dioxide, Sulphur dioxide, and halides have damaging effects on the health and environment when presented [33]. junk management has been closely associated with biological hazards. The decomposition of junk materials in the landfill; vehicle drains fumes and favorable weather condition can guide to the formation of bio aerosols and biological agents such as fungi, bacteria and tense compounds (like endotoxins, β (1-3)-glucans and mycotoxins) [34]. The reason of the health problems is because of the constant exposure to chemicals; inhaling of toxic fumes and dust from the landfill sites. Also, a review on the "residential proximity to environmental hazards and adverse health outcomes" revealed a significant correlation between residential proximity to environmental hazards and adverse health outcomes specifically threats for central nervous system defects, congenital heart defects, oral defects, cancer, leukaemia, asthma, chronic respiratory symptoms, etc. the studies show that although residents living closer to the landfill appear to be more prone to adverse effects of health outcomes, the closeness does not equate to the individuals' level of exposure [34].

Noise also another effect on health which comes from trucks and other vehicular traffic and equipment used at landfills its loudness can be damaging and disruptive to those who use properties near the landfill. Through appropriate control of landfill operations and adequate land buffers between the landfill active areas of active deposition and adjacent properties, the noise problems of landfills can be decrease to senseless levels.

2. METHODOLOGY

2.1 Project Case study

The Kashi sanitary landfill is located near the city of Kashi, in the district of Semel, and about 20 km northwest of Duhok. The area where the landfill is located consists in a mix of residential space and industrial and is the single formal facility that supplies some degree of solid junk processing for the entire governorate.

Since 2014, the population influx has placed extra burden to the landfill and expanded the negative environmental effects of its current configuration. The Directorate General of Municipalities of Duhok Governorate is the government agency accountable for the solid junk service management in the region.

Duhok Governorate repeatedly expressed the willingness to improve the Kashi landfill site. To do so, the Government has suggested several measures, which may impact the (final) design option for the leachate treatment plant. These include:

- Keeping a constant daily load of waste around 800 ton/day, respecting Kwashe's sorting designed capacity.
- The first step for decommissioning the dumping site would be simply to stop dumping unsorted waste in this uncontrolled area. This measure is contingent to the first one.
- Ensure the proper management of the sanitary cells; this will contribute to a more controlled leachate flow and reduce rainwater intrusion.
- In the medium and long term, the Government should envisage the closing of the dumping site, by capping according to the best practices.

2.2 Environmental Impact Assessment (EIA)

It is presumed that the proposed project at Kashi Landfill site would be designed and engineered with all possible safety measures and standard code of practices of engineering. Despite this, some design deficiency or operation and maintenance fault may lead to accidental events causing damage to the life and property.

This subsection presents an overview of environmental risks associated with the construction and operation of a leachate treatment plant (LTP) at Kashi landfill site. The impacts of the proposed project activities on the environment (physical, biological and human, were studied in detail in a previous report published by ACTED in April 2017.

In this report, all environmental impacts were analyzed with respect to pre-construction, construction and operation phases of the selected alternatives. Impacts identified for the whole project includes an assessment of the proposed project.

Overall, most of the environmental impacts during the construction phase are moderate. This includes the impacts on noise and vibration, soil, geology and hydrogeology, water sources, and health and safety.

The remaining environmental impacts (ambient air quality, ambient noise, biodiversity, landscape, and cultural, historical, and religious resources) are minor, given the short duration of the construction activities.

- Soil: the impact on soil is moderate. During site preparation and soil excavations there might be a possibility of soil contamination, due to the washing off the excavated soil down the slope. Additionally, there might be unwanted leachate runoff (if excavating near the landfill or buffer tanks) that could be discharged into the surroundings, inadequate disposal of the construction debris, and potential soil erosion down the slope in case the storm water drainage dikes are blocked by the excavated material.

- Water resources (surface and groundwater): the impact is moderate. The surface water contamination is due to storm water contamination, disposal of waste in unauthorized areas (leading to runoffs), and accidental spills and leaking of hazardous materials. Given that the rock structure in the area is made of limestone materials, they provide some level of filtration to most chemicals. However, the percolation of the hazardous materials is possible in areas close to the existing wells where the direct access to the groundwater is possible.

- Health and Safety: the impact is moderate, for both employees and to the public, given the circulation and operation of heavy machinery on and off-site, as well as excavation activities that may lead to accidents.

Noise and Vibration: the impact is moderate. The main sources of nose during construction phase are the noise produced by operation of the construction machinery. The levels of noise of different operating machinery are published in the table 1 below. The construction equipment inevitably produces vibration, and in some cases the vibration can be quite severe posing the health risk to the personnel managing the equipment. The impact of vibration is considered moderate. The potential impact of vibration on the structures of nearby residences is negligible.

2.3 Adverse Indirect, Cumulative, and Residual Impacts

The indirect impacts that may occur from building a leachate treatment plant in Kashi are minor and short term, in general, due to the limited duration of the construction activities

(approximately 6 months). Nevertheless, the transportation of materials, excavation works, site preparation and clearance, and vehicle/equipment operation will contribute to dust generation (resulting in high PM_{10}/$PM_{2.5}$ emissions). The resulting dust may settle on soils, and in run off valleys during dry season consequently contributing to the transport of sediments and pollutants and infiltration into the shallow aquifer. Additionally, the resulting emissions may also cause health concerns.

The main cumulative impact anticipated through implementation of this project is the increasing construction waste generation that will affect the already debilitated waste management facilities (e.g., the existing landfill, or other waste disposal locations throughout Duhok governorate). However, given the duration of the construction activities, the impact is very minor. The residual impacts are not envisioned within this project due to the limited activities and duration of the project components.

2.4 Construction Environmental Management and Monitoring Plan (CEMMP)

Given the size and scope of this project, it is imperative that potential negative environmental impacts are mitigated as far as possible and that the risk of accidents or unforeseen acts affecting the surrounding area is minimised.

The measures to mitigate adverse effects anticipated in the construction stage of the project are compiled in the Mitigation Monitoring Plant in the Figure 1 and Table 2 below.

The EMMP gives a response for each potential environmental impact (e.g., air, noise, water, soil pollution, etc.) with clear descriptions of the mitigation measures, indicating the stakeholders responsible of applying those measures as well as how it will be monitored:

Fig. 1: Project Mitigation Measure

According to the Contract specifications, Akgul Company is committed contractually to abide by the EMMP, to minimize and/or mitigate all adverse impacts described in the previous chapter.

The cooperation between ACTED and Akgul Company in the monitoring and management of these parameters can be defined as such:

- ACTED site engineers will ensure that mitigation measures are properly taken. Site engineers will visit the site daily and record all mitigation measures (whether undertaken or outstanding), and any other environmental concerns, as part of ACTED's monitoring activities. This information will be recorded on the daily monitoring report – a document that contains a section for construction activities as well as another section specifically for tracking environmental mitigation measures.

Akgul Company: Through its External Consultant, will ensure that mitigation measures are properly taken and applied within all staff. The Consultant shall constantly report to ACTED's Site Engineer about the situation on site and inform about any outstanding situation and advice on those mitigation measures can be applied in a more effective manner.

Table 2: Mitigation and Monitoring Plan

Environmental Issue	Mitigation Commitments	Monitoring Requirements	Entity Responsible for Monitoring	Timing / How often?
Soil Management Plan				
Topsoil	- Excavated soil (and/or topsoil) is appropriately stored and reused for back filling in holes or trenches whenever possible. - Marking excavation holes with physical boundaries (barriers, tape or fence) - Preventing loose material (soil and equipment) from falling or rolling into the excavation by removing this material to a minimum of 0.5 m from the edge of the excavation - Disposal of excavated soil by truck to nearest authorized landfill. - If surface drainage is disturbing the construction process, utilizing ditches, dikes and/or sandbags to divert this drainage from entering excavations. - Any water ingress encountered by removal of subsoils and bedrock during the construction phase will be intercepted and diverted to an existing drainage channel. - Any discarded or excess leachate shall not be disposed directly into the soil, without prior treatment. To avoid any soil contamination, the Contractor must ensure an appropriate disposal of any excess leachate (for further	By visual inspection and/or sampling In case of sampling: Soil samples will be analyzed for their (anions, Sulphur, Total organic carbon, heavy metals), by the Dohuk Directorate of Environment	Visual inspection: - Akgul Company (Environmental Consultant) - ACTED Site Engineer Sampling: - Akgul Company (Environmental Consultant)	Design-Build stage - Every two weeks (sampling) - Visual inspection (every day)

	details, please check "*Existing Leachate Management*" section).			
Subsoil (land pollution)	- Vehicle maintenance activities, such as re-fueling, and cleaning of vehicles should be carried out carefully to avoid any spills that may cause soil contamination;	Visual observation on the excavated soils	Visual inspection: - Akgul Company (Environmental Consultant) - ACTED Site Engineer	Design-Build stage - Visual inspection (every day)
Water Management Plan				
Drinking Water Resources	Drinking water protection - No construction will be engaged near existing water source unless it is for rehabilitation or for specific work mentioned in the contract (bill of quantities). - Ensure that construction materials are suitable for potable water. - If water network is disrupted during construction, a pressure test, quality test and leak detection test will be carried out after project completion to ensure safe drinking water standards. - Construction staff will be requested to have meticulous personal hygiene to prevent contamination of the water system.	Visual observation on the construction activities (if affect drinking water mains)	Visual inspection: - Akgul Company (Environmental Consultant) - ACTED Site Engineer	Design-Build stage - Visual inspection (every day)
Groundwater Resources	-Preventing work under aggressive weather conditions (rain, strong winds)	By taking sampling points:	Sampling:	Design-Build stage

	-limiting using heavy machine causing soil erosion, resulting in possible water pollution due to run-off to surface waters (causing increased turbidity)	- groundwater samples are collected from one monitoring well which is drill around the tank from which seven parameters will be analyzed (Dissolved oxygen, Biological oxygen demand, Chemical oxygen demand, Ammonium, Nitrogen, Phosphorus, and Heavy Metals).	- Akgul Company (Environmental Consultant) Analysis of samples: - Dohuk Directorate of Environment Results evaluation: - ACTED Site Engineer	The samples take monthly
Water run-off	Water run-off management (drainage plan): - The increased run-off drainage generated during the construction of the LTP shall be diverted away from the landfill (using makeshift structures, such as gabions, sandbags, etc.) to avoid additional water contamination. - Raw materials used in construction, which can be carried by water runoff, must be located and stored away from paths for water runoff. - Carry out any construction activities that could cause pollution in designated, bounded areas away from rivers, boreholes or any other relevant water sources. - Where possible or appropriate, schedule works to avoid heavy rainfall periods (i.e., during the dry season) and modify activities during extreme rainfall and high winds.	Regular observation of the construction site Training to staff on how to control drainage of water runoff	Regular inspection: -- Akgul Company (Environmental Consultant) - ACTED Site Engineer Training: - Akgul Company (Environmental Consultant)	Design-Build stage First of march

	- If surface drainage is disturbing the construction process, use retaining structures to strengthen the slopes of (e.g., Gabion meshes, sandbags, etc.)			
Leachate Management	Regular inspection of leachate collection system (cell and basins) to timely detect any failure. Existing Leachate Management: - The existing leachate at Kashi Landfill site needs to be disposed according to environmental standards. This leachate, either generated by the existing landfill cell (dumped in the existing buffer tank), sorting plant (existing pond), or dumping site (natural pool of leachate), should be disposed by the Contractor as soon as the new buffer tank is constructed. Therefore, the Contractor is responsible to pump this existing leachate to the new buffer tank (after its completion) and keep it until the LTP is operational and ready to treat it.	Regular observation during rain events and severe rainstorms	-- Akgul Company (Environmental Consultant) - ACTED Site Engineer	Design-Build stage (daily observations)
Hazardous Liquids	- All hydrocarbons and hazardous substances will be transported, stored, handled and disposed of in accordance with international standards. - Arrangements for management of all machinery and vehicles on site, including refueling and storage to minimize potential for hydrocarbon and other leaks spills to be documented and properly reported.	- Period checks carried out - Regular spot checks	- Akgul Company (Environmental Consultant) - ACTED Site Engineer	Design-Build stage-Everyday (from ACTED site)
Waste Management Plan				
General “housekeeping”	- Keeping the site clean and tidy:	Regular observation	Regular observation/inspection:	Design-Build stage

	- Ensure there is no loose materials or debris lying around the site including the perimeter; and - Vehicles are regularly checked for cleanliness (general aspect and making sure no leaks are occurring) - Burning of waste is prohibited - All staff will avoid littering. Workers must use bins for appropriate waste disposal, and on a specific location of the site - Contractor to evacuate any construction waste that is not possible to reuse, to the nearest adequate waste disposal facility, and on a regular basis to avoid accumulation: Mitigation of Excess materials: - Contractor to minimize material wastage as part of the waste management plan (ACTED has already prepared a detailed BoQ, with all quantities pre-calculated or measured as to reduce wastage).	On-site waste management training course	- Akgul Company (Environmental Consultant) - ACTED Site Engineer Training: - Akgul Company (Environmental Consultant)	- Training weekly by environmental consult - Once a week, a refreshers course (if new staff on site)
Use and storage of hazardous materials	- Provide adequate secondary containment for fuel storage tanks and for the temporary storage of other fluids such as lubricating oils and hydraulic fluids. - Use impervious surfaces for refueling areas and other fluid transfer areas. - Provide portable spill containment and clean-up equipment on site, and train staff in the safe use of it. - Provide adequate sanitation facilities serving all workers (mentioned in HSE).	Regular observation. Specific materials required proper trained staff to handle dangerous equipment.	Akgul Company (Environmental Consultant) - ACTED Site Engineer	Design-Build stage

Construction waste	-Prevent accumulation of solid waste onsite -Remove and transport the waste safely (avoiding any kind of spills), and dispose it on the sorting plant - Direct disposal on the landfill or outside the construction zone is strictly forbidden.	Regular observation After every working day, all the waste should be collected and disposed in the sorting plant	Akgul Company (Environmental Consultant) - ACTED Site Engineer	Design-Build stage - Daily checks When the construction works start the training course will be start
Air Quality Management Plan				
Gas emissions	- Limiting the use of heavy construction equipment, avoid idling of generators and vehicles on site - Checking the release of emissions from the landfill cell and dumping site (to alert the Landfill Manager)	Regular observation and occasional gas monitoring For the latter, five pollutants will be analyzed (Sulphur dioxide, Nitrogen dioxide, Carbon monoxide, and Particulate matter 2.5 and 10 microns)	Daily inspections: - Akgul Company (Environmental Consultant) - ACTED Site Engineer Sample collection/analysis: - Dohuk Directorate of Environment Interpretation of results: - ACTED Site Engineer	Design-Build stage - Daily (observation) - Every two weeks (sampling)

Dust Emissions	The construction of the LTP has the potential to create a problem in relation to dust emissions. Wind-blown dust emissions may arise during the construction phase of the LTP, although given the significant distance of at least 5 km to the nearest dwelling it is envisaged that there will not be a negative impact on these residents. Mitigation measures could include. - Minimize dust from materials (such as sand, cement) and construction activities (such as excavation) by using covers, storage, control equipment, and increasing moisture content. - Prepare concrete before going to the site to avoid movement of materials (gravel, sand, cement) if possible - Minimize dust from vehicle movements, using water sprays or appropriate. - Avoid the burning of materials on site. - Switch off any engine as soon as it is not used.	Regular observation (especially in the dry season – end of Design-Build stage) - Spraying water next to the construction site to avoid dust emissions	- Akgul Company (Environmental Consultant) - ACTED Site Engineer	Design-Build stage - Daily (or whenever the weather is relatively dry)
Noise Management and Monitoring Plan				
Noise and vibrations	Noise and vibration management: - Plan for all loud activities for times that will result in the least disturbance to the local community. - Avoid or minimize transport through community areas. - Ensure that any work which is disturbing due to loud noises is carried out at agreed times with adjoining neighbours.	Regular observation and occasional noise sampling using a sound level (procured by Akgul Company). The Consultant will be	Regular observation: - Akgul Company (Environmental Consultant) - ACTED Site Engineer	Design-Build stage Monitoring is conduct in the daytime and at night for a period of one-hour

	- Switch off any engine as soon as it is not used. - Working at night is prohibited. - Contractor to minimize unnecessary vehicle idling	responsible to measure: • Maximum noise level (Lmax) • Minimum noise level (Lmin)	Noise sampling: - Akgul Company (Environmental Consultant)	intervals of five minutes
Fire and Emergency Management Plan				
Fire Emergency Plan	- Fire extinguishers, water reservoirs and/or sand should be available at the site at all time - Daily inspection to the work premises to detect any hot spot or fire hazard potential	Regular observation to the work site Make sure the camps and worksite have fire extinguishers Training on fire prevention/fighting	Regular observation to the work site - Akgul Company (Environmental Consultant) - ACTED Site Engineer Training: Regular observation to the work site	Design-Build stage - Training must be next week - Daily observation
Emergency Plan	-Provide various warning signs onsite (e.g., safe location, dangerous equipment, emergency exits, etc.) -All flammable/corrosive/explosive liquids (e.g., fuel, solvents, etc.) should be stored in an appropriately ventilated place	Spread awareness among employees through training course	Akgul Company (Environmental Consultant)	Design-Build stage
Health & Safety Management Plan				

Worker's health	Health, Safety, and Environment (H, S&E): - There is posted material indicating the nearest police station and hospital (with accident and emergency facilities). - The contractor must take reasonable steps to prevent unauthorized people accessing the site. - Avoid the burning of materials on site. - Provide a first aid kits in different places of the work site with the appropriate number of materials given the number of workers on site. The locations of the first aid kits will be provided to all workers. - Providing extinguishers on work site. - If work involving the use of flammable materials is being carried out, stop people smoking and do not allow other work activities involving potential ignition sources to take place nearby. - Providing site boundaries by installing suitable physical boundaries (barriers, tape or fence). - Marking excavation holes with physical boundaries (barriers, tape or fence) - The contractor should put up barriers or covers in openings and excavations. - Store building materials (such as pipes, manhole rings, and cement bags) so that they cannot topple or roll over.	Implement strict rules on people not used personal safety HSE Training	Occasional "spot checks": - Akgul Company (Environmental Consultant) - ACTED Site Engineer HSE Training: - Akgul Company (Environmental Consultant)	Design-Build stage - Daily (spot checks) - (DATE OF TRAINING (the company will start next week

	- Keep walkways and stairways free of tripping hazards such as trailing cables, building materials, and debris. - Everyone who works on any site must have access to adequate toilet and washing facilities, a place for preparing and consuming refreshments, and an area for storing and drying clothing and personal protective equipment (PPE). - Contractor to share a list of PPES (personal protective equipment), which ACTED will ensure is used by all workers on site. - Materials and equipment are tidily stacked, protected and covered where necessary. Additionally, there is adequate space for new materials to be stored in secured covered areas to avoid damage, theft, and to protect these items from weather conditions. - Prepare a training course for workers in basic personal hygiene and how to protect from any diseases, infections, etc.			
Community Liaison	Community liaison: - Reducing impacts on the community through community and neighbor engagement (for Kashi village residents). - In cases of where there are minority communities speaking a different language in the area or working on site, notices are printed in the common local language.	Increasing awareness by training courses for different ages	Akgul Company (Environmental Consultant	Design-Build stage 22 of February

- Community mobilizer and site engineer to inform local people on the site progress and company contact details for further concerns.

- Meeting community on a regular basis to receive feedbacks and complaints, as to complement the above

- Provide adequate signage to prevent accidental falling into open areas

- Fencing of the work areas

- Provision of the safe access ramps to residential dwellings and place of business for residents

3. CONCLUSIONS

The company is constructing a leachate treatment plant in Kwashi, Duhok Governorate and under the supervision of ACCTED Org. to improve the quality of life for those who live in the region. But during construction things are overlooked that are very important and effect negatively on the environment and land around the project. Here is a brief explanation, which are: heavy rain caused an increase in the level of leachate in the old basin, to prevent the interference of this leachate with the construction, the path of the leachate was diverted to another direction without treatment which polluted other lands excessively. There is another stream of leachate which comes from the dumping site with high concentration, and because it passed through the project they changed its path as well and it caused land pollution which had an impact on the ground water. Therefore, suitable treatment should be taken into consideration because it has a huge effect on the land surrounding the project in addition to polluting the ground water which effects the residential area.

There are some important points we need to consider before starting the construction work. Before starting any construct work, should remove all debris, grading and leveling all the ground on one level, fencing around the project, provide direction, warning, guides signs and lighting the entrance site, in the site there is leachate stream flowing on ground surface (as shown in the pictures), this leachate stream pass in the way of the leachate treatment plant. Therefore, we must solve this problem before starting construction, especially this leachate more polluted than the leachate on the pond which will treated according to the studying of the company. Use materials for construction which is friendly with environment like green concrete. This type of concrete uses less energy in its production and produce less carbon dioxide than normal concrete, also it is good thermal and fire resistant and sound insulation

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