YMCA- Lebanon

ENVIRONMENTAL IMPACT ASSESSMENT REPORT

WASTEWATER TREATMENT PLANT IN Al-HOUCH, RASHAYA CAZA, LEBANON

M.E.E.A. Ltd.

Consulting Environmental Engineers

Beirut, Lebanon

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ANNEXES

1- Executive summary

Introduction:

In Al-Houch town, Rashaya Caza of Lebanon, wastewater disposal is the main environmental issue that has created unsanitary conditions, odor and mosquito problems within the town, which causes nuisance to the residents and affects their health. This is due to the overflow of the septic tanks of houses.

Therefore, it is planned to establish a Wastewater Treatment Plant (WWTP) in Al-Houch town, which will treat the wastewater generated from the households of the town. The proposed WWTP will achieve a secondary level treatment. After that, the effluents will be discharged into the dry valley, a runoff channel, adjacent to the project site.

The Al-Houch WWTP will have a capacity of treating up to 100m3 of raw sewage everyday, generated by the residents of the town.

Al-Houch town is located in an agricultural area, at an elevation of 1100m from the sea level. The proposed WWTP will be established at the elevation of 1000m.

The present winter population of the town does not exceed 300 people, which reaches to 1000 people in summer months. Due to the high rate of migration during the last 30 years, it is expected that the population will remain low, increasing slightly within the next 20 years. According to the Municipality, the projected population of the town for the year 2020 is 1500.

Recently, the Ministry of Energy and Hydraulic Resources has agreed to establish the sewer network of the town. Once it is established, the town will be connected to the WWTP. The residents of Al-Houch are very keen to have the project implemented as soon as possible. They are suffering from the current situation, which has contaminated their three small springs.

The construction of the plant is supposed to start in 2005. YMCA-Lebanon is supporting the Municipality technically and financially for the materialization of

this WWTP. YMCA will cover 90% of the total expenses of the WWTP. The Municipality will contribute 10% towards the total expenses of the project, which are in fact the VAT taxes.

MEEA Ltd. - Consulting Environmental Engineers- undertook the preparation of this Environmental Impact Assessment (EIA) Report of the Project, which will be presented to the Lebanese Ministry of Environment (MoE), for obtaining the license for the establishment of the WWTP.

Brief Description of Project Size, the Process, and Location

The wastewater treatment plant of Al-Houch town will be located at a distance 800m from the nearest house and 100m below its level. The land to be used for the project is part of a large public property, belonging to the Municipality of Al-Houch. The land lot number is 486. Wastewater from the town will gravitationally reach the proposed WWTP.

The wastewater treatment technology to be used at the WWTP is the International Business Consultant's (IBC) Advanced Integrated Wastewater Pond Systems (AIWPS) technology. This WWTP will consist of two anaerobic digesters, an aerobic pond, and a network of aeration channels, through which the wastewater flows gravitationally and is treated by the action of anaerobic and aerobic bacteria found in the wastewater stream, without any specific maintenance and electric power use. AIWPS process provides secondary level treatment to wastewater. It significantly reduces the coliform bacteria, BOD, nitrogen, phosphorous, toxic substances and other pollutants found in the wastewater. AIWPS digesters and ponds can be tailored to site-specific conditions with high loading capacities.

The treated wastewater, the effluent, would be discharged in the winter course adjacent to the site. The plant will treat wastewater to a level of BOD less than 25mg/l, phosphorus less than 10mg/l, nitrogen less than 15mg/l and suspended solids less than 600mg/l. This level of treatment will comply with the regulation of the Ministry of Environment Decision 8/1, 2002. This makes it safe for irrigation, or discharge in the nature.

The plant is self-operational (gravitation flow) and needs minimum maintenance and no mechanical input. The lifetime of the plant is at least 20 years, before any clean up of accumulated sludge takes place in the main anaerobic reactor. The WWTP is modular and can be expanded in the future; to meet the wastewater treatment needs of larger populations.

Importance of the Project for the Local Community

Wastewater disposal is the pressing environmental issue for the inhabitants of Al-Houch town, which is going to be solved by the establishment of the WWTP, capable of accomplishing secondary level treatment of wastewater.

Currently households discharge their wastewater in their septic tanks, which often overflow due to the impermeability of the soil, and create unhealthy conditions in the town. It has already created nuisance and social problems among the inhabitants.

The residents of the town are keen to have an environmentally sound solution to their wastewater disposal problem. Clean environment will improve the health standards of the local people.

The establishment of a sewer network in the town and treatment of wastewater in the proposed WWTP will eliminate the spread of diseases, prevent risks of contamination of the three small springs that are found in the town proper and contribute in the preservation of the quality of the environment. The treated wastewater might be used for forestation and agricultural purposes. The Municipality is considering this option.

All of the residents of the town welcome the project. No households will be disadvantaged by the implementation of the project. There are no houses near the proposed site of the WWTP. Nevertheless, there are some minor agricultural activities, mainly one olive groove next to the project site. Owner of this land looks forward for the project, because, he will have the chance to irrigate his groove with treated wastewater.

Objectives of the Project

The WWTP project of Al-Houch town aims at environmentally safe disposal of its wastewater, for upgrading the sanitary and health standards of the inhabitants.

The long-term objectives of WWTP project are to:

- Prevent the spread of diseases, including the limitation of the mosquito population,
- Prevent the prevalence of conditions offensive to sight and smell,
- Control the contamination of water resources,
- Prevent and control soil and groundwater pollution.

The specific objectives of the project are to:

- Establish a dependable WWTP, which is cost effective and requires the minimum maintenance.
- Manage the pathogenic risk inherent in wastewater to meet the effluent discharge standards set by the Lebanese Ministry of Environment.
- Manage the safe disposal of sludge.

Wastewater Treatment Process of the Proposed Project

The treatment technique for WWTP of Al-Houch town will be based on the Advanced Integrated Wastewater Pond Systems (AIWPS) technology of IBC Co. This is a biological treatment system based primarily on anaerobic digestion and to some extent on aerobic digestion of biowaste found in the wastewater. Both anaerobic and aerobic fermentation of wastes are natural biologic processes, which are suitable in rural areas.

Description of the AIWPS Process

Wastewater is conveyed from the sewage network of the town to the grease and sand trap by a 150mm gravity sewer line, which extends 1400m, from the town to the site of the plant. An energy dissipater is installed before wastewater reaching to grease and sand trap.

1- Grease and Sand Trap is a two-compartment structure that receives the inflow from the sewage network and passes it through after retaining the grease and the sand. Heavy metal and sand will sink to the bottom sump and the flow will pass through the submerged pipe connected to the Anaerobic Digester.

2- The Anaerobic Bio Digester (or the set of two digesters) is the main reactor of the WWTP, which retains the sewage for a specified period to allow the growth of anaerobes that multiply in the absence of oxygen. The anaerobe organism digests the organic component of the sewage and produces the biogas, a mixture of Methane Gas (about 70%), carbon dioxide (about 20%), and other gases. The released biogas will be flared intermittently with an automatic torch.

3- The Aeration Pond followed by the aeration Channel provides aerobic treatment. This follows the anaerobic phase. These two open structures expose the anaerobic effluent to light and air. In here, the anaerobic microorganisms die and the aerobic bacteria overtake which further digests and purifies the wastewater. Air, sun and wind are the main factors that help to the aerobic process. In this aerobic phase, no noxious odors are produced.

4- The final effluent wastewater from the aeration channel is discharged in the dry valley. At this stage, the final effluent would have undergone secondary level treatment, which complies with the standards set by MOE.

5- The local community will not experience any odor problem or any other sort of nuisance, when the WWTP of Al-Houch is operated. This is because of the proper choice of the treatment technology, the distance (800m) of the WWTP from the town, and the prevailing west-to-east direction of the winds.

Advantages of the AIWPS Process

The AIWPS technology is environmentally friendly, as it has no negative impact. The system has no mechanical or electrical components. It does not generate noise, odor, and noxious gases, or effluents that may contaminate the soil and the water resources. The AIWPS system operates gravitationally and produces a treated wastewater, which can be safely disposed in nature. Even this might be used for irrigation purposes, provided that the crops are not eaten in row state.

Moreover, the AIWPS plant does not need full time attendance, as it is self-operational. However, the only need is to do testing and report any changes that might be caused by external factors.

The AIWPS process is innovative in the fact that it does not continuously generate sludge, except once in 20 years, when the bio-digester needs cleaning.

This technology is of particular interest in rural areas, where low-cost technology and minimum maintenance is needed.

Description of the Surrounding Environment of the Project:

The town of Al-Houch is located in the Caza of Rashaya, 110km from Beirut, at an elevation of 1100m above the sea level. The town is built on a flat volcanic plateau. However, most of the remaining lands of the town have a mountainous topography, which are not volcanic but calcareous in origin. The eastern mountain range is covered with oak trees. Even the site of the WWTP contains some oak and other types of forest trees. The western hills are devoid of forest trees.

The proposed WWTP will be located on the eastern side of the town, 800m from the nearest house and 100m below it. The site is in a narrow valley and has a total surface area of 1200m^2.

An earthen road of 1400m length connects the town to the proposed WWTP site. The Municipality will be involved in asphalting this road.

There are no permanent surface water sources in the project area, including the project site, except for the three small springs in the town proper, which are contaminated from the overflow of some cesspits located near the springs.

At the proposed site in the narrow valley, there is a dry channel where surface runoff passes during the rainy season. This water course remains dry for more than eight consecutive months per year.

The proposed WWTP will be located just besides this dry channel and the treated effluents of the plant will be discharged in it. However, the Municipality assures that the final effluent will be utilized for afforestation purposes near the project site.

There are no industrial activities in the town and there are no other types of structures near the proposed site and its surroundings.

Households of the town get their fresh water supply from distant sources, such as *Chamsin* source or from *Luci* source. However, these sources are not reliable, so the Municipality has decided to drill a well for extracting fresh water for domestic consumption. Already a 500m deep well is installed and 2 inch of water can be withdrawn. However, so far the pipes that will carry the pumped water to the town are not installed yet. This well is located 150m west of the proposed site and upstream in the same valley. That is, the discharged effluents of the plant will flow southeast direction, i.e., opposite of the well direction. The geologic structure of the location indicates that the effluent wastewater cannot reach the groundwater level within a period of less than 15 years and by this time; the effluent would be completely purified by natural processes and soil microorganisms.

The **climate** of the project area is Mediterranean, with 7 to 8 dry months and relatively wet winters of 4-5 months duration. In winter months, the area might face freezing conditions for some days. The prevailing wind direction in the area is from South-West to North-East. Some northerly also overtakes the area. The average annual **rainfall** in the area exceeds 650mm.

The Project area, including the proposed site, has a moderately rich biodiversity. The wild fauna and flora are rich with evergreen forest trees, where oak trees dominate. Other tree species include Common oleanders, Hawthorn (Zaarour), Sumac. Shrubs that cover the area include bellan, capers, Spartium junceum and others. Foxes, hedgehogs, chacals and others are the main mammals living in the area. Western and northern hills of the town are partly covered with olive grooves and vineyards. There are no forest trees on the hills of the western side of the town.

The Project site can be considered as a sensitive spot, since it is near to the natural forest, however, it contains neither springs nor it is near to surface water. The main river of the area, *Hasbani* River, originates some 15 km south of the proposed site.

Likely Significant Environmental Effects of the Project and Their Mitigation

Establishment of the WWTP will have positive environmental impacts, even if minimum maintenance is applied. It is unlikely that it will pollute the surface waters, the soil, or contaminate the aquifers in the area. However, if the WWTP is not established, the wastewater from the septic tanks of Al-Houch will continue discharging raw sewage into the nature and this will exert negative effects on the local environment and continue to create health problems.

The overall environmental effects of the project will be insignificant. Nevertheless, there is the chance of minor soil erosion incidents, caused by runoff during the wet season of the construction phase. In addition, a minor visual inconvenience can be experienced due to the physical existence of the plant, about 800m far from the town. However, the presence of trees around the WWTP will hide the structures.

Impacts of the project on the environment will consist of four sources namely:

1- Site Specific Factors:

The choice of the site is based on the fact that it is the convenient low spot from the town, where wastewater from all houses can reach gravitationally. Actually, it is the only available single valley where the wastewater can be collected gravitationally.

The treated effluent of WWTP will be discharged in the same valley, (or used for afforestation purposes), which usually stays dry during May to November period. In here, the effluent will be further purified by natural factors, such as sun, soil, bacteria and other microorganisms. After that stage, there is no probability that a significant environmental hazards might occur.

2- Process-Technology Related Effects:

The AIWPS technology of IBC Co. is an environmentally friendly and low-cost technology, which can be applicable in rural areas where the availability of skilled labor is scarce.

Compared to other similar wastewater treatment technologies, it is dependable, because of absence of mechanical equipments, which often can go out of order. The system operates gravitationally. Water pumping requirements are minimal in the plant. On the other hand, the sludge is kept in the anaerobic digesters for 20 years. There are no odorous gas emissions from the plant. In order to eliminate the release of greenhouse gases in the atmosphere, the generated biogas inside of the digester is periodically flared with an automatic torch.

These features make the treatment system easily applicable in the rural areas without significant environmental impacts.

However, there is a chance of mosquito breeding in the open aeration area of the plant. This might create nuisance to the people, but since mosquitoes do not travel for more than 500m from their breeding sites, the chance of mosquito reaching the town is very low.

3- Effects Created During Construction and Earth Moving:

During the construction phase of the project, which will last for 3 to four months, a few trees of the site will be cut, moderate quantities of earth will be excavated (maximum of 2m depth) and soil disturbance will take place. If this soil is not utilized for landscaping, during the wet season soil erosion will result at the site. On the other hand, if the excavated soil is haphazardly dumped, this will cover trees and will block canals in the downstream direction and create unsightly scenes at the project site.

4- Effects Created During the Operation of the Treatment Plant:

No significant environmental effects will take place during the operation of the plant. The influent wastewater will be treated to secondary level, as required by MOE standards, and then released in the dry valley. The sand and grease of the influent wastewater will be properly managed. The sludge of the plant will be cleaned and dried once per 20 years.

The accumulated biogas in the anaerobic digester will be released periodically and ignited by an automatic torch. This will eliminate the methane gas emissions to the atmosphere. Nevertheless, there is a low probability that the relief valve of the digester might be clogged and the pressure in the anaerobic chamber increase and this may disrupt the system, or if the automatic torch does not function, a lot of greenhouse gases might be released into the atmosphere.

Mitigation Measures

The main mitigation means will concentrate on careful designing and use of locally available construction material. For instance, the excavated soil from the site will be utilized in landscaping. E.g. construction of terraces for planting forest trees at the site. The Municipality of Al-Houch will undertake tree-planting campaigns around the WWTP, and awareness raising of the community will be done for minimizing biowaste introduction in their kitchen sinks.

In addition, a proper drainage system for the rain runoff will be established at the site. In addition, measures will be taken to buffer shock flows of wastewater, such as accidental entry of rainwater runoff into the sewage network and then to the WWTP.

The caretaker of the plant will practice good housekeeping measures, which will lead into the containment of any incidental pollutant release, proper maintenance of drainage system around the plant, optimized wastewater treatment operation and any other related measures that will mitigate the side effects of the overall operation. The sand and grease from the grease and sand trap will be regularly cleaned, properly stored, and then disposed periodically with the municipal solid waste.

Monitoring and Supervision Programmes

MONITORING

The AIWPS plant does not need full time attendance, as it is self-operational. But it will be subjected to continuous monitoring. Actually, the only need is to do testing for the final effluents and report any changes that might be caused by outside factors.

Monitoring activities will also cover the odor, mosquito and other nuisances that might be resulted at the plant site. This will ensure that all of the mitigation measures are within the safe limit and that they do not have environmental effects.

SUPERVISION

The Municipality of Al-Houch will be in charge of the supervision of the WWTP operation. The operational manual of the Plant gives detailed instructions as what to do weekly, monthly and yearly. The only attention the plant needs is the clean up of the grease and sand trap. The operator has to check the grease and the sand trap weekly and remove the floating grease and the submerged sand. Testing must be done at least once a month to check the pH and BOD.

The process does not need full time attendance. For the removal of grease and sand, one laborer can periodically open the manhole cover and remove the floating grease and other floating material, as well as remove the sand basket and empty it.

Also proper periodic check-ups will be done for the gas relief valves to ensure their proper functioning.

The system does not require any power consumption because it relies on gravitational flow.

Once in every 20 years the digesters will be cleaned from the accumulated sludge, which will be dried on sight and then used for afforestation purposes.

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2-Project Identification

2.1- Project Specifications:

Project Title: Wastewater Treatment Plant (WWTP) in Al-Houch Town

Location: Al-Houch,Rashaya Caza, Lebanon.

Project Site: Public land lot No.486 of Al Houch town

(See map in Annex 2.3)

Population:

Town	Summer	Winter	Projection 2020
Al-Houch	1000	300	1500 to 2000

Technology to be used: Advanced Integrated Wastewater Pond Systems (AIWPS) of IBC Co.

Size of the Plant:

Total Leveled land area: 1200m^2

Total area of the plant: 1200m^2

Volume of one digester: 500m^3

Total volume of 2 digesters: 1000m^3

Volume of grease trap: 3m^3

Area of Open Ponds: 142m^2

Area of aeration channels: 120m^2

Load processed daily: 100m^3/day of untreated wastewater.

Local Stakeholders: Municipality of Al-Houch

Sewers to be done by: Jointly by YMCA and Municipality

Connection to WWTP: Ministry of Energy & Hydraulic Resources (MEHR)

Plant to be built by: International Business Consultants (IBC) Co.

Plant to be financed by: Joint partnership between YMCA/USAID (90%) and the Municipality of Al-Houch (10%).

Plant to be managed by: The Municipality of Al-Houch

Construction to start: After receiving the approval of Ministry of Environment and then building the WWTP in 6 months.

2.2- Brief Description of Project Size, the Process, and Location:

The Municipality of Al-Houch town of Rashaya Caza has taken the decision to establish a wastewater treatment plant (WWTP) in its territories, which will operate with AIWPS technology of IBC Company of USA/Lebanon, to treat the generated wastewater of the town, which is estimated at $100m^3$/day for a maximum population of 1000. The WWTP will treat the influent wastewater to a **secondary level**, that is, equivalent to BOD level of less than 25mg/l. This makes the final effluent compatible with the standards of MOE and therefore, safe for discharging it into nature.

Location of the WW treatment plant:

The WWTP will be constructed on a public land lot. It is lot number 486 of Al-Houch Municipality, as indicated on the map of Annex. 2.3. The WWTP project site will be located at a level about 100m below Al-Houch town, on the South Eastern side of it, and at a direct distance of about 800m far from the nearest house.

The plant will have the capacity of treating up to $100m^3$ of municipal wastewater everyday. This will guarantee the wastewater treatment of the town for the next 15 to 20 years. The present maximum population being 1000 people. The WWTP would be modular in design, which can be expanded whenever the population increases.

<u>The Project site presents the following characteristics:</u>

- A land area of 1200 m^2 is allocated for the construction of the WWTP.
- The WWTP will be located at a 100m lower spot on the south-eastern side of the Al-Houch town and about 800m from the nearest house.

- Once the WWTP starts operating, wastewater from the households will reach the plant gravitationally. After the establishment of the sewage network in Al-Houch, all households will be connected to it and a long pipeline of 1400m in length will connect the network to the WWTP. This pipeline will gravitationally lead the sewage to the WWTP.
- The site of the WWTP is in a narrow valley and it is an ideal location for wastewater treatment operation. Alternatives of this site would be other points in the same valley, either before the present site or after it. No other valley or location has the required favorable characteristics of this same valley for establishing a WWTP for the town.
- The Ministry of Energy and Hydraulic Resources (MEHR) has already agreed that the Municipality of Al-Houch can start constructing its sewage network. MEHR has agreed also to take care of the 1400m long pipeline for leading the sewage of the town to the WWTP.
- Already an earthen road of 1400m in length is opened, which leads to the proposed WWTP site. The long pipeline will be constructed along this road. This will be asphalted once the excavation and construction work ends.
- Land leveling and excavation of rocks and soil will take place at the WWTP site. The excavated soil will be used for landscaping and the rocks for construction of retaining walls.
- The secondary level treated effluent of the WWTP will be discharged into the dry valley, which is the rain runoff course that is located next to the proposed plant site.
- The quality of the discharged effluents of the WWTP would be suitable for irrigation.

2.3- Importance of the Project for the Local Community:

In Al-Houch the households traditionally dispose their wastewater in septic tanks, which often overflow due to the impermeability of the volcanic soil of the town. This creates public health problems in the town and tensions among neighbors. Seepage from the septic tanks also contaminate the two small springs of the town, which together discharge about 30m3 of freshwater for household use.

Therefore, the local community is keen to have an environmentally sound solution to their wastewater disposal problem. Clean environment will improve the socio-economic and health standards of the inhabitants.

The establishment of the WWTP will enable proper treatment of wastewater and will significantly limit the spread of diseases, reduce the mosquito problem of the town and preserve its environmental quality. In addition, the treated effluent wastewater can be safely reused for forestation purposes at the project site.

2.4- Objectives of the Project:

The WWTP project of Al-Houch town aims at environmentally safe disposal of its wastewater, for upgrading the sanitary and health standards of the inhabitants.

The long-term objectives of WWTP project are to:

- Prevent the spread of diseases, including the limitation of the mosquito population,
- Prevent the prevalence of conditions offensive to sight and smell,
- Control the contamination of water resources,
- Prevent and control soil and groundwater pollution.

The specific objectives of the project are to:

- Establish a dependable WWTP, which is cost effective and requires the minimum maintenance.
- Manage the pathogenic risk inherent in wastewater to meet the effluent discharge standards set by the Lebanese Ministry of Environment.
- Manage the safe disposal of sludge.

2.5- The EIA Study Executing Company:

The Environment Impact Assessment (EIA) study of the project and the preparation of the EIA Report have been carried out by the Middle East Engineers and Architects (MEEA) Ltd., Consulting Environmental Engineers, based in Beirut since 1979.

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For further information on background of the executing company and the research and study team, please refer to Annex-4.

3- Legal and Administrative Perspectives and Policies:

In Lebanon, policies of wastewater management is centrally planned in cooperation between the Council for Development and Reconstruction (CDR), Ministry of Environment (MOE) and Ministry of Energy and Hydraulic Resources (MEHR).

Ministry of Environment of Lebanon is the highest authority in charge of environmental matters in the country. Already the Law #444 for the Protection of the Environment is promulgated in 29/7/2002. Chapter 4 of this Law, in items # 21-23, refer to the need for conduction of EIAs for development projects.

Since 1995 activities are being carried out by MOE for establishing the EIA procedure in Lebanon. In this respect, a separate draft EIA Law has been prepared by MOE and adopted by the Council of Ministers on 25/7/2000. This EIA law awaits ratification by the Lebanese Parliament. Draft EIA Law stipulates that, establishment of wastewater treatment plants is subject to full EIA studies. And already now an EIA Unit operates at MOE.

On the other hand, the Decision 8/1, 2002 of MOE has set National Standards for water, air and soil, standards for urban wastewater and allowed standards for discharging liquid waste in surface and underground water bodies, and into the sea. The table here below describes the effluent specifications of wastewater treatment plants based on MOE Decision 8/1, 2002.

Effluent specifications of wastewater treatment plants based on MOE Decision 8/1, 2002.

pH	6 to 9
Temperature	< 35ºC
Salmonellae	Absent (Zero)
BOD_5	< 25 mg/l
COD	< 125 mg/l
Total Phosphorous	< 10 mg/l
Total Nitrogen (TN)	< 15 mg/l
Suspended Solids	< 600 mg/l
Oil and Grease	< 50 mg/l
Total Organic Carbon (TOC)	< 750 mg/l
Coliform Bacteria 37ºC in 100ml	< 2000
Ammonia	< 10 mg/l
Odor	Absent (Zero)

Address of Ministry of Environment of Lebanon

Al-Azarieh Building,
Beirut Central District, Beirut, Lebanon
Tel: 01-976555, Fax: 01-976534

4- Public Contribution/ Cooperation:

4.1- Public Agencies:

The Ministry of Energy and Hydraulic Resources of Lebanon is in charge of water and wastewater management issues in the country and Ministry of Environment is in charge of setting environmental standards and guidelines for proper treatment of municipal wastewater. The general issue of wastewater management is centrally planned in cooperation between the Council for Development and Reconstruction (CDR), Ministry of Environment and Ministry of Energy and Hydraulic Resources.

Wastewater management in Lebanon is still in its early phases. In 1995, a Damage Assessment Report was prepared to formulate a policy framework for the wastewater sector (Khatib & Alami, 1995). Implemented over three phases, the resulting National Emergency Response Program (NERP) launched two major programs:

- Coastal Pollution Control Program (CPCP); and
- Water Resources Protection Program (WRPP).

CPCP is proceeding with alternative funding from various sources. Works under the WRPP include the rehabilitation of wastewater treatment plants and water sources (springs and wells), as well as the rehabilitation and construction of transmission and distribution networks. 35 wastewater treatment plants of various sizes have been planned for 2001 or were already under construction. 9 big plants are planned for the coastal cities.

In the field of wastewater management, so far little has been implemented in **rural areas** of Lebanon. Less than 10% of rural areas have sewerage systems, but very few municipalities in those areas have and operate wastewater treatment plants. Most of the municipalities that have already installed sewerage networks in their towns dispose of their raw wastewater directly to nature, without any treatment. **This practice contaminates the fresh water resources and creates other negative environmental**

impacts. A case in point is the pollution of Litani River by raw sewage. In general, surface and ground water are being polluted, lands are being contaminated by sewage, unsightly conditions are created and deterioration of health is taking place because of the irrational disposal of the untreated wastewater.

Since 1998 municipalities in rural areas have taken the initiatives to establish sewerage networks and treatment plants. At least 20 small-scale wastewater treatment plants were supported by the USAID by 2005. Currently more than 30 plants are being supported by USAID in rural areas. The WWTP of Al-Houch is one of these.

In case of Al-Houch WWTP Project, the Municipality has asked for the establishment of the WWTP. This plant will achieve a **secondary level** treatment for the wastewater generated from the households of the town.

The sewerage network of the town will be constructed by the assistance of the Ministry of Energy and Hydraulic Resources (MEHR). The MEHR will also shoulder the establishment of the 1400m long pipeline which will connect the network to the WWTP. This pipe line will lead the wastewater of all houses into the WWTP. The contribution of the Municipality towards the establishment of the WWTP is 10% of the total cost of the project, which corresponds to the value added tax (VAT).

4.2- Groups Disadvantaged by the Project:

There are no groups that are disadvantaged by the project. There are no houses and farms in the vicinity of the proposed WWTP site. The nearest house is 800m far from the plant. There is one olive grove facing the WWTP, which is above the level of the plant. In case the farmer wishes to irrigate the olive trees, he should use a pump.

All of the householders of the town are happy about the project, because this will bring a real solution to their wastewater disposal problem. Households currently discharge their wastewater in open bottom septic tanks, which often overflow and create unsanitary conditions in the town and create breeding sites for mosquitoes.

MEEA/MECTAT expert visited the Project site on the 25th of June 2005 and assessed the local conditions at the proposed site. He met with the Mayor of Al-Houch and 4 villagers, including members of the Municipal Council and discussed with them issues related to the WWTP and the local environmental issues. No objection or criticism was raised on the project. On the contrary, all of them have welcomed and praised the project. He was informed by the Mayor that so far two public meetings were organized during the past 6 months. One of the meetings has taken place in the church hall and the second one in the church. In both events the project of the WWTP has been presented to the community members, who have welcomed the project. No body has objected or criticized the Project.

5- Project Description

5.1- Status of Wastewater Management in the Project Area:

Disposal of wastewater:

The state of wastewater disposal in Al-Houch presents the following situation:

- In Al-Houch, wastewater disposal is the main environmental issue that has caused unsanitary conditions, odor and mosquito problems within the town, which causes nuisance to the residents. This is due to the overflow of the septic tanks of houses.

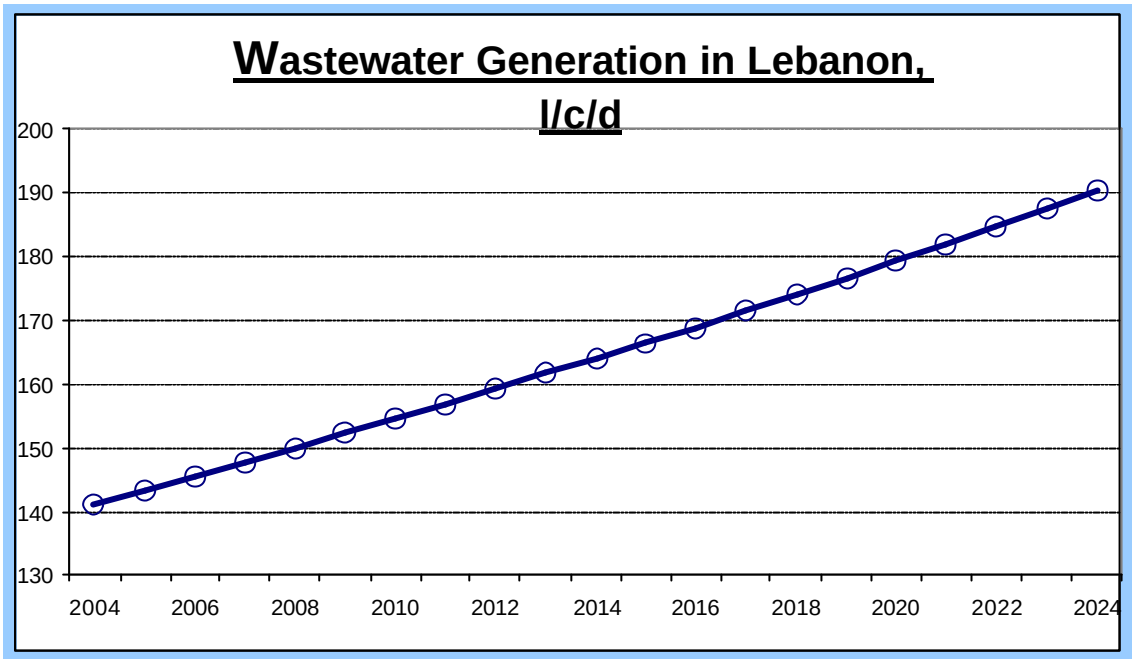
- As indicated earlier, households discharge their wastewater in open bottom cesspits or septic tanks. And since the soil of the town is derived from volcanic parent material, it is impermeable and does not absorb the generated wastewater. So, most of these septic receptacles overflow and create unsanitary conditions. They also pollute the scarce water resources that are available in the town.

- There are three small springs in Al-Houch proper. Typical discharge of the strongest spring does not exceed 30m^3/day. Water of those springs are used only for irrigation purposes, because they are contaminated by sewage of the open bottom septic tanks.

Wastewater generation rates in the Project area*:*

The present average rate for wastewater generation commonly used for all Lebanon is about 140 liter/capita/day. This average is expected to increase with time. A likely increase rate of 1.5% will bring the average wastewater generation rate to 190 liter/capita/day for the year 2024. Nevertheless, in rural areas the current water consumption rates ranges from 80 to 100 l/c/d. In case of Al-Houch town, water consumption rate is estimated at 150 l/c/d, including irrigation in the gardens. Consequently wastewater generation rate

is something in between 75 and 100 liters per capita per day. A rate of about 80 l/c/day would be a fair estimate.



Source: MoE, Climate Change Report

The current total population in Al-Houch is estimated at 1000 persons in summer months, which declines to less than 300 persons in winter.

It is not easy to predict the demographic behavior of the population of the town, since the town was completely abandoned from its residents during the years of war in Lebanon (1975-1990). During this period, many people were either relocated in other regions of Lebanon or migrated to other countries. Since 1995 some families returned back to resettle in the town. The municipality feels that within the next 20 years the summer population of the town might not reach to the maximum of 1500.

Therefore, the maximum quantity of wastewater generation in the project area by year 2020 is estimated as follows:

1500 person x 80 l/person/day = *120,000 1/day*

= ***120 m^3/day***

The maximum quantity of the current wastewater generation rate is: 100 x 80 l/person/day = 8000 litres/day or **80 m^3/day**.

The actual capacity of the proposed WWTP is 100m^3/day. It would be modular and can be easily expanded in the future, to meet the wastewater treatment needs of larger populations.

It should be noted that, there are no industries in the town. Therefore, influent wastewater stream of the WWTP will just contain wastewater from domestic origin.

Composition of Wastewater influent:

Tests performed on samples of wastewater from various rural towns of Lebanon and particularly in the project area (Ain Hersha plant of IBC Co.) have revealed the following characteristics of the influent wastewater.

Influent wastewater characteristics

pH (pH Units)	7.37
Influent BOD_5	422 mg/l
COD	822 mg/l
Total Dissolved Solids (at 25^oC)	436 mg/l
Total Suspended Solids	45 mg/l

The wastewater treatment plant in Al-Houch will deliver final effluents that comply with Ministry of Environment Decision 8/1, 2002. Effluent specification list of MOE is presented in Chapter 3 of this Report.

5.2- Proposed Wastewater Treatment Process of the Project:

The selected wastewater treatment process is the Advanced Integrated Wastewater Pond Systems (AIWPS) technology represented by the International Business Consultants (IBC) Co. of Lebanon. The central unit of the process is the anaerobic reactor, where biowastes are digested, sludge stored and biogas produced.

Detailed explanations of the WWTP components and the treatment process are described as follows:

1- **Grease and Sand Trap** is a two-compartment structure of about $3m^3$ in volume that receives the inflow from the sewage network and passes it through, after retaining the grease and the sand. The intake pipe delivers the wastewater below the water level. As the wastewater flows from submerged spout of the delivery pipe, grease will rise to the top of the structure. Then the wastewater will pass through the bottom opening to the sand trap compartment. Heavy metal and sand will sink to the bottom sump and the flow will pass through the submerged pipe connected to the Anaerobic Digester.

   a- The Grease Trap compartment is fitted with a cast iron manhole cover that can be opened and the floating grease removed and properly disposed. Weekly inspections must be made until the characteristic of the sewage network are determined and sequence of timing is regulated.

   b- The Sand Trap compartment is fitted with a cast iron manhole and a sand sump at the bottom. Sand and heavy metals will sink and collected in the sump. Care is taken not to contaminate the surroundings with the sand and heavy metals.

2- **The Biological Reactor** is also called Anaerobic Digester and simply Bio-Digester. The influent wastewater after passing from the Grease and Sand Trap enters the Bio-Digester. In Al-Houch, Two digesters of size $500m^3$ each will be installed instead of one big digester of size 1000 m^3. These two reactors will be connected in series, which will provide a residence time of 10 days for anaerobic treatment of wastewater.

   The Digester is an airtight structure that collects the sewage for 10 days, to allow the growth of anaerobes that multiplies in the absence of oxygen. The anaerobe organism converts the organic component of the sewage and release biogas, a mixture of methane, CO_2 and other gases. Care is taken to provide the correct and convenient environment for such anaerobe growth.

   a- The inflow pipe coming from the Grease and Sand Trap is connected to deliver the sewage through 15cm pipe connection from the bottom of

the reactor. If the available sewage at the startup of the reactor is not sufficient to fill the reactor during the design residency period, then an incubator becomes necessary to insure the right environment for the anaerobic process to be validated.

b- The biological environment is conditioned as to keep the Bio-digester airtight at all times and provide the needed residency time for the bioconversion of the organic substances found in the sewage.

c- A gas pipe is connected to the top of the digesters to collect the produced biogas. The gas with positive pressure inside the digester will allow the flow of gas upward to a self igniting torch. The manhole covers on the top of digesters are airtight and must not be removed except under severe conditions and with the written approval of the consultants. Safety regulation must be applied carefully in case permission is given to open the cover.

d- The Effluent outlet collects the digested effluent from level 15cm below the top wastewater level inside the digester. The effluent will fall inversely into the air and be collected at the Aeration Open Pond below. This fall will allow effluent to absorb some oxygen from the air for the first time since its arrival at the Grease and Sand Trap. Up to this point, the wastewater stream would have undergone a treatment level of between primary and secondary treatment.

6- The Open Ponds have a total area of 140m^2. These are shallow basins where aerobic treatment takes place. The flow of wastewater in it is gravitational. Air, sunlight, wind and other natural factors contribute in further purification of the wastewater.

7- The Aeration Channels: these are open structures that further expose the effluent of the digester to light and air. It has a total area of about 120m^2. These are rectangular shape shallow channels of 150cm in width. In here aerobic treatment process of wastewater continues. At the end of these channels, the effluent wastewater will have the characteristics of secondary level treatment.

8- The water coming out of the Aeration channels, the final effluent, will have the following characteristics: a pH value between 6 and 9; BOD not

exceeding 25mg/l; and, no pathogenic organisms. This treated wastewater comply with the standards of MOE and is considered safe to be delivered to the nature or used in agriculture.

9- In general, AIWPS system is self-operational by gravitational flow. Once it is balanced and certified it will operate according to its designed specifications. Installing a mirror image copy of the same anaerobic digester, or smaller size, next to the one existing, can provide future expansion of the WWTP.

The Operation and Maintenance of the WWTP is very simple. It is based on gravitational flow without any use of electricity and pumps. The system as designed is self-operational. However, it needs continuous testing of wastewater at the Grease and Sand Trap, the effluent from the Digester and the final outflow from Aeration channel. These samples must be tested for pH, BOD and other parameters as required.

For additional information on AIWPS wastewater treatment process, please refer to Annex-3.

Annex-3.4 presents the most recent lab test results of wastewater samples taken from a similar AIWPS plant, at Ain Hersha in west Bekaa, which is built and operated by the IBC Company since 2003. This small-scale wastewater treatment plant is operating satisfactorily during the last year, after its refurbishment in 2004. The laboratory test results of wastewater effluents produced at the plant indicate that the constituents of the effluents are within the acceptable limits of MOE Decision 8/1, 2002, when the influent BOD is less than 1000mg/litre. The treatment plant in Al-Houch will operate on the same principle as that of Ain Hersha, but the retention time for the wastewater would be longer, in order to achieve the BOD discharge limit of less than 25mg/litre.

The proposed WWTP will be managed and operated by the Municipality of Al-Houch, under the supervision of IBC Co. This would be an advantage for attaining high environmental standards at the WWTP.

Environmental Pollution Issue:

The outputs of the plant would be **effluent wastewater**, **gaseous emissions (biogas), oil and sand** from the grease and sand trap, and **sludge.**

The effluent wastewater will have the characteristics that comply with the Ministry of Environment Decision 8/1, 2002. The **gaseous emissions** (biogas) will be periodically flared and the products would be the natural components of the atmosphere. I.e. vapor, CO_2 and other minor gases. On the other hand, the **oils and sands** of the grease trap will be properly handled and disposed with the solid waste of the village. Therefore, the WWTP will not create water, soil and air pollution problems. It will neither create health or nuisance problems. This implies that the project will not have an impact on the surface and ground water resources.

The AIWPS plant will not generate any **sludge** except once in 20 years, which will be dried properly at the site and used in forestry projects.

5.3- Required Equipment and Construction Work:

Equipment to be used at the wastewater treatment plant:

The plant will not have any equipment except its concrete structures. Hand implements will be available for manual works.

Required Construction Work:

The plant will be established on a land area of 1200m^2. It will occupy part of land lot No. 486, which is a large piece of public land.

Required construction work involves the following:

1. Leveling of the ground: Clearing of an area of 1200 m^2.

2. Construction of the two chambered grease and sand trap of capacity 3 m^3, with concrete, in an area of 3m^2. The chambers are fitted with cast iron manholes.

3. Excavating an area of 460 m^2, at a depth of 2 meters, for building the 2 concrete Digesters, the Aeration Ponds and Aeration Channels.

4. Construction of the 2 concrete digesters of size 500m^3 each that will occupy an area of 200 m^2. Both digesters will be connected in series.

5. Constructing a rectangular open pond (length: 12m, width: 12m) subdivided into two ponds, to provide maximum aeration for the effluent of the bio-digester.

6. Constructing a rectangular Aeration Channels (length: 19.2m, width: 10.0m) subdivided into twelve 150 cm wide shallow channels, to provide maximum aeration for the effluent of the open Aeration ponds.

7. Construction of drainage canals around the WWTP, to collect incidental runoff (Total length: 300m, depth: 30 cm, width: 40 cm.)

8. Putting a fence around the plant.

9. Putting a main gate at the entrance of the site.

10. Planting trees around the site.

11. Make arrangements against fires.

12. Landscaping with excavated soil and sand.

Maps of Annex- 2.1 indicate the details of construction work to be carried out at the site. Proper canalization will be done in order to avoid water flooding, erosion and pollution around the plant. These measures will be completed during the construction of the treatment plant.

5.4- Advantages of the AIWPS Wastewater Treatment

- The AIWPS technology is environmentally friendly,
- It is not land intensive,
- No surface or ground water pollution or soil contamination takes place, because the effluent wastewater is treated to the specified standards,
- No air pollution results,
- It can be constructed with locally available building material. No high technology is involved.
- The AIWPS system needs the minimum maintenance during its operation,
- The process is based on the dependable biological (anaerobic and aerobic) digestion, replicating the natural phenomena,
- The system has no mechanical or electrical equipment,
- It does not generate noise, odor, and harmful gases,
- The AIWPS system operates gravitationally and provides secondary level treated wastewater, which might be used for irrigation,
- Moreover, the AIWPS plant does not need full time attendance, as it is self-operational.
- The AIWPS process is innovative in the fact that it does not continuously generate sludge, except once for 20 years, when the digester is cleaned.
- Future expansion of the plant capacity can be done easily, by installing additional anaerobic digesters.
- This technology is of particular interest for rural areas, both for large and small communities, where low cost systems and their maintenance is required.

However, the only need is to do testing and report any changes that might be caused by external factors.

6- Description of the Environment

6.1- General Setting

Two parallel mountainous ranges, Mount Lebanon and Anti Lebanon, separated by the Bekaa plain are the dominating topographic features of Lebanon (Figure 0-1). These topographic features extend in a NNE-SSW direction. The study area is located in the Caza of Rashaya, on the Eastern slopes of South-West Bekaa. The territories of Al-Houch town have elevations ranging between 800m and 1200m above sea level.

The town of Al-Houch is located in the southern edge of the Bekaa Province, approximately 16 km south of the city of Rashaya. A generally good road network exists in the region (Figure 6-2) connecting the towns and villages to each other. In the study area, agricultural roads connect the farms to the main road. However, the agricultural road that connects the main road to the proposed site of the WWTP is an earthen road of length about 1400m, which will be asphalted in the near future. This is the only access road to the farms of project site and does not lead to any other inhabited area.

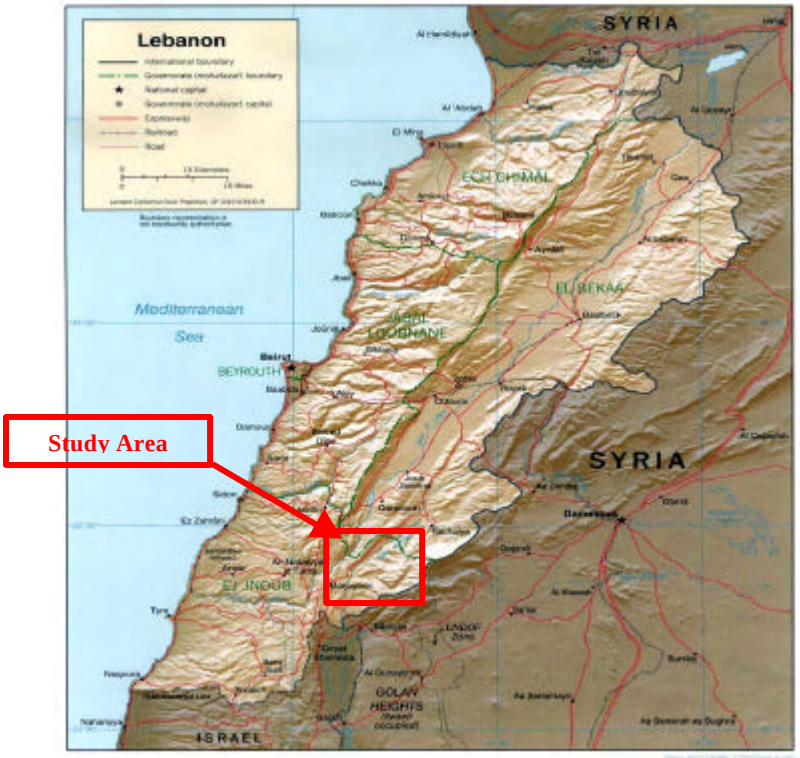


Figure 6-1. Topographic Map of Lebanon

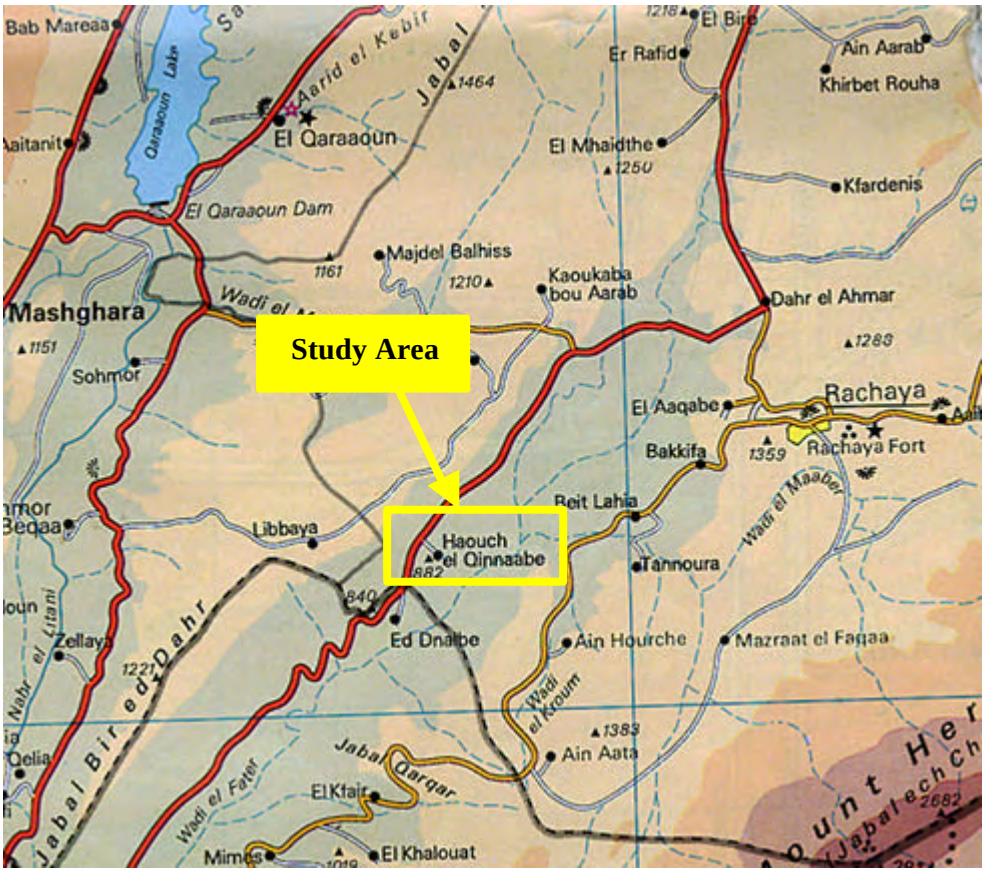


Figure 6-2. Map showing the road network of the project area

The project area has an impressive natural view of forests on the eastern side.

Al-Houch town is located on a flat plateau, which extends from the main road of the region to the town proper. The width of this plateau is about one km and its length is more than 3 km. For the rest of the territories hilly topography prevails. Around the project site there are hill slopes that are covered with forest trees or planted with olive trees.

Terraced lands are planted mainly with olive, grape and almond trees. There is one olive groove on the neighboring land, above the level of the WWTP.

Air Quality

Given the fact that the project area is quite rich in natural forests and that there are no industries, no large-scale agricultural projects and no heavy car traffic in the area, the air quality in the town is good.

Soils

The soil of the project site is shallow and red in color, mainly composed of clay. It is considered fertile and very convenient for agriculture. Nevertheless, at some spots they are partially eroded, due to rainwater action, specifically wherever the forest cover is absent. The soil cover in the town proper is derived from basaltic parent material.

6.2- Meteorological Setting

The topographic features of Lebanon, in general, influence largely the climate of the country. The climate of the Lebanese coast is of Mediterranean subtropical type, where summers are hot and humid; and winters are mild and wet. On the other hand, snow covers the mountains of the two ranges at times for several months per year. The two mountain ranges tend to have a cool and wet climate in contrast to that of the coastal zone.

Meteorological information including precipitation, ambient temperature, as well as wind direction and speed, are essential data for adequately assessing environmental impacts. Unfortunately, meteorological records are seldom available, except for few locations in the country where stations were operating, in particular a couple of stations of the Service Meteorologique and the American University of Beirut (AUB) stations.

Precipitation

The two mountain ranges of Lebanon intercept humidity and receive high rainfall compared to areas with similar locations. The project area has annual precipitation ranging from 800 to 900mm. More than 80 percent of the annual rainfall occurs between November and March. The average number of rainy days range from 60 to 70 per year. Mount Hermon, (2,814m in elevation), which is at a distance of 10km east of Al-Houch, receives more than 1000mm of annual rainfall.

Temperatures

The annual average temperature in the project area is 15 °C. The warmest months are July and August, when mean daily temperatures in this period can reach a maximum of 33 to 35 °C, while the minimum temperature falls to -5 °C for

a couple of days in winter. Figure 6-3 depicts average temperature distribution for the project area by the Service Météorologique du Liban (1977).

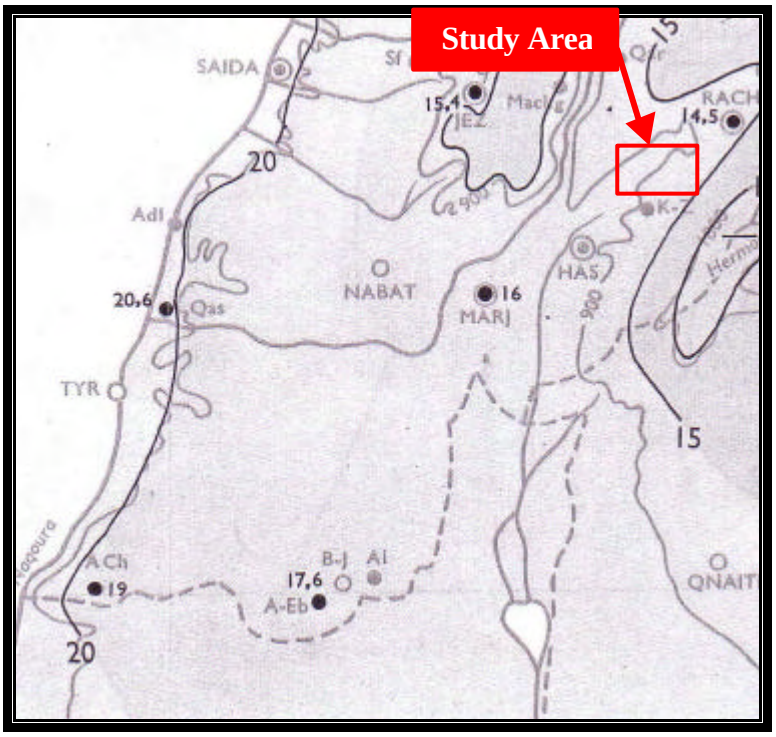


Figure 6-3. Temperature Distribution Map

Winds

Dominant wind directions are southwesterly. Continental east and southeasterly winds are also frequent. The two mountain ranges have a major impact on wind direction, and contribute to reducing the incidence and strength of the southeasterly and northwesterly winds in the Bekaa valley. Strongest winds are generally observed during the fall season. Dominant wind direction is oriented in the SW and SWW.

6.3- Site Setting

The location of the WWTP was proposed by the Municipality of Al-Houch town, which is in the narrow valley beneath the town. No other suitable valley is available in the periphery of the town. The data presented in this section was either collected through field visits, location assessments, research, and/or in consultation with the mayor.

A piece of land of 1200 m² area from the public land lot No. 486 is allocated by the Municipality for building the WWTP. The site is located at the eastern

side of the town, at a distance of 800m from the nearest house. The location is in a semi agricultural/semi natural zone (Photo 6-1). There are a few agricultural lands near the site, where mainly olives are being grown (Photo 6-2). The proposed site area is adjacent to an olive groove on the west; however on the east and southern sides, it is adjacent to natural forest (Photo 6-3). The site is 800m from the nearest house, Photo 6-4 indicates this view from the nearest house to the site. There are no rivers, streams, springs and surface water bodies in the vicinity of the site. The groundwater is at a depth of 500m.

The main asphalted road is approximately 1400m from the site, an earthen road connects the town to the site. The site contains some oak trees and other shrubs. (Photo 6-5).

The average land elevation is approximately 900m above sea level. Appendix B presents a Topographic Map of Al-Houch area showing the proposed location of the WWTP.

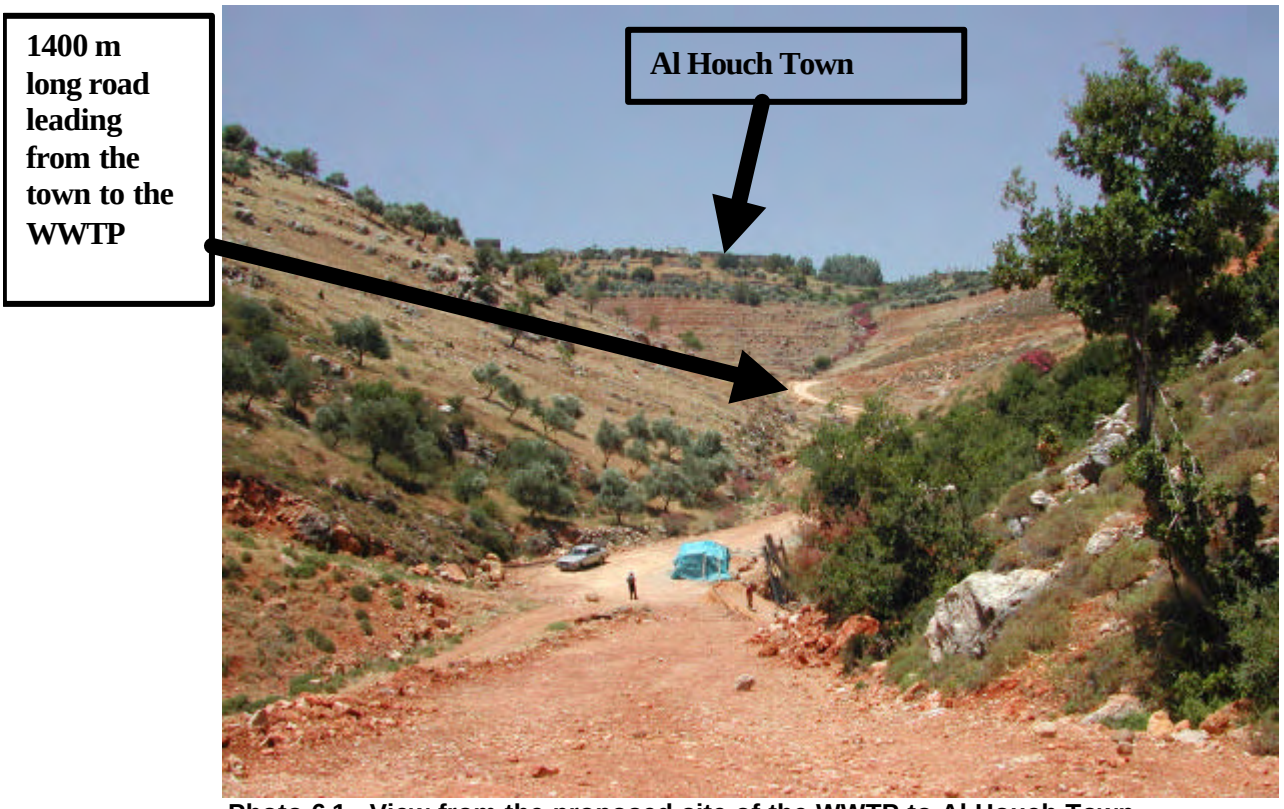


Photo 6-1. View from the proposed site of the WWTP to Al Houch Town

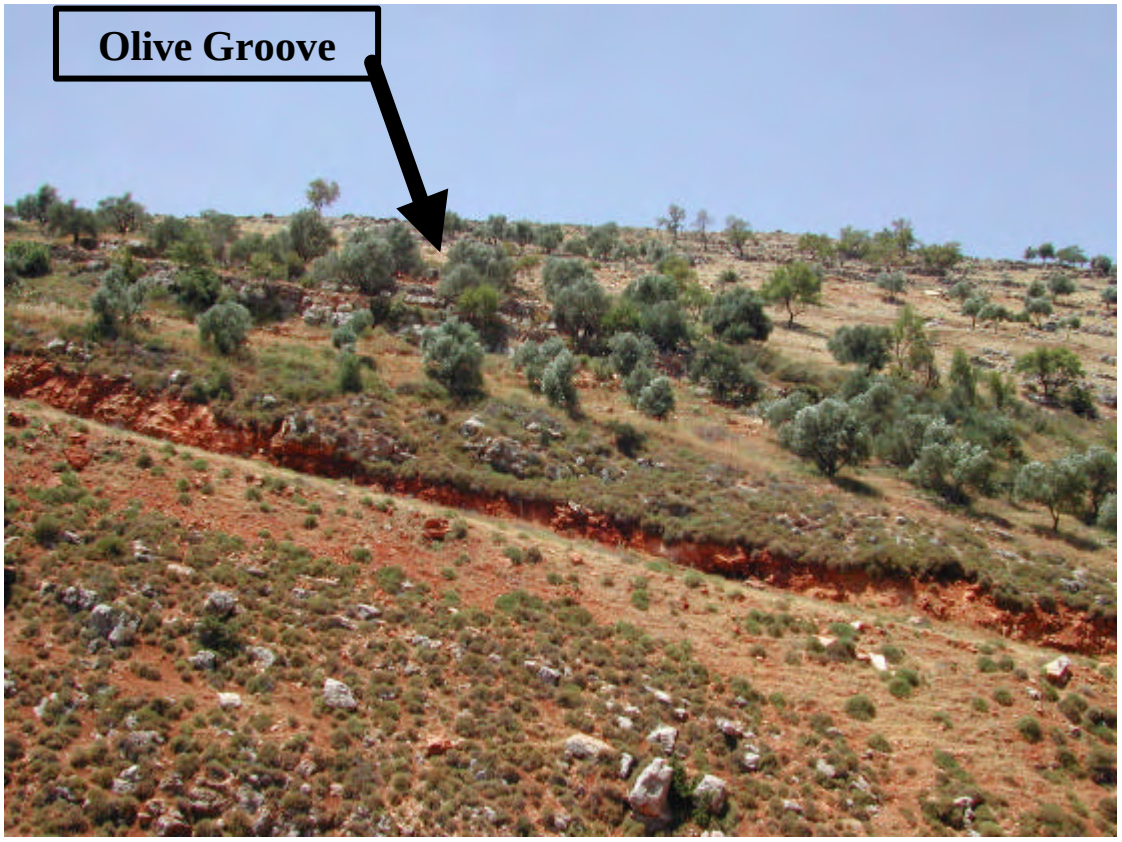


Photo 6-2. The olive groove and natural vegetation on the opposite side of the WWTP site.

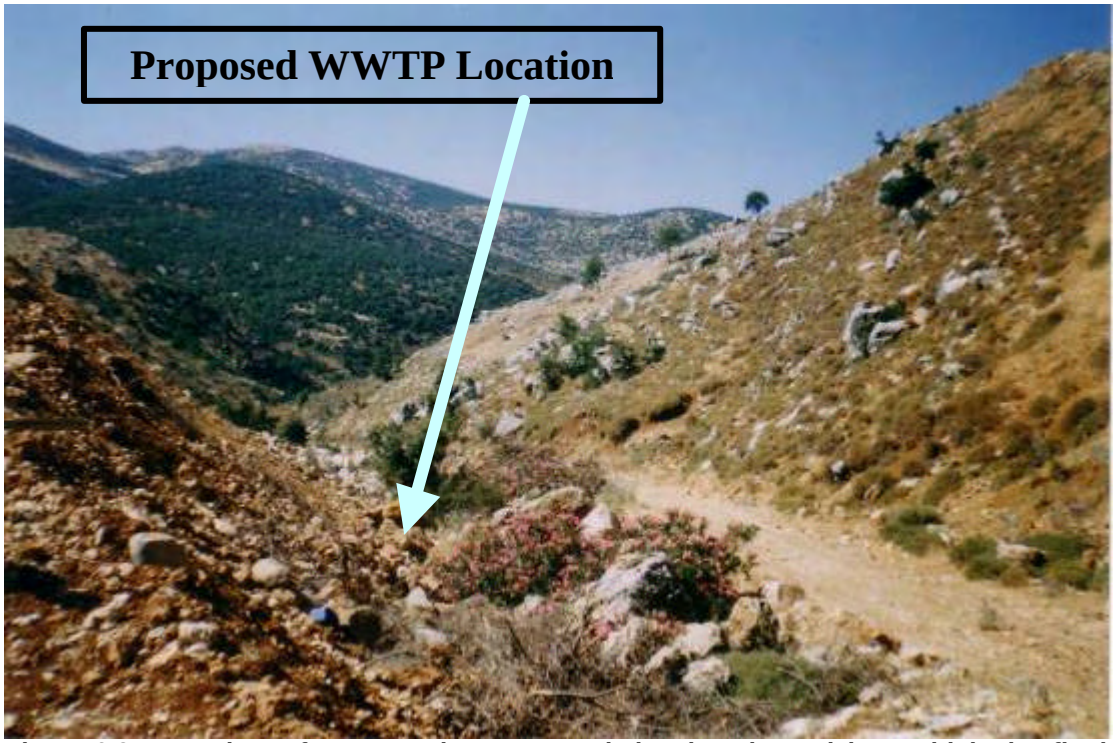


Photo 6-3. Location of Proposed WWTP, and the dry channel into which the final effluent will be discharged, or used for irrigation

Photo 6-4. Project Site viewed from the nearest house of Al Houch town.

6.4- Tectonic Setting and Seismicity

Lebanon is located along the Dead Sea Transform fault system, which has several surface expressions, represented in major faults (Yammouneh, Roum, Hasbaya, Rashaya and Serghaya faults), in uplifts as high mountainous terrain (Mount Lebanon and Anti Lebanon), and from the seismic activity record. Recent research work has categorized the Lebanese section of the Dead Sea Transform fault as being a strong seismic activity zone (Khair *et al.*, 2000)

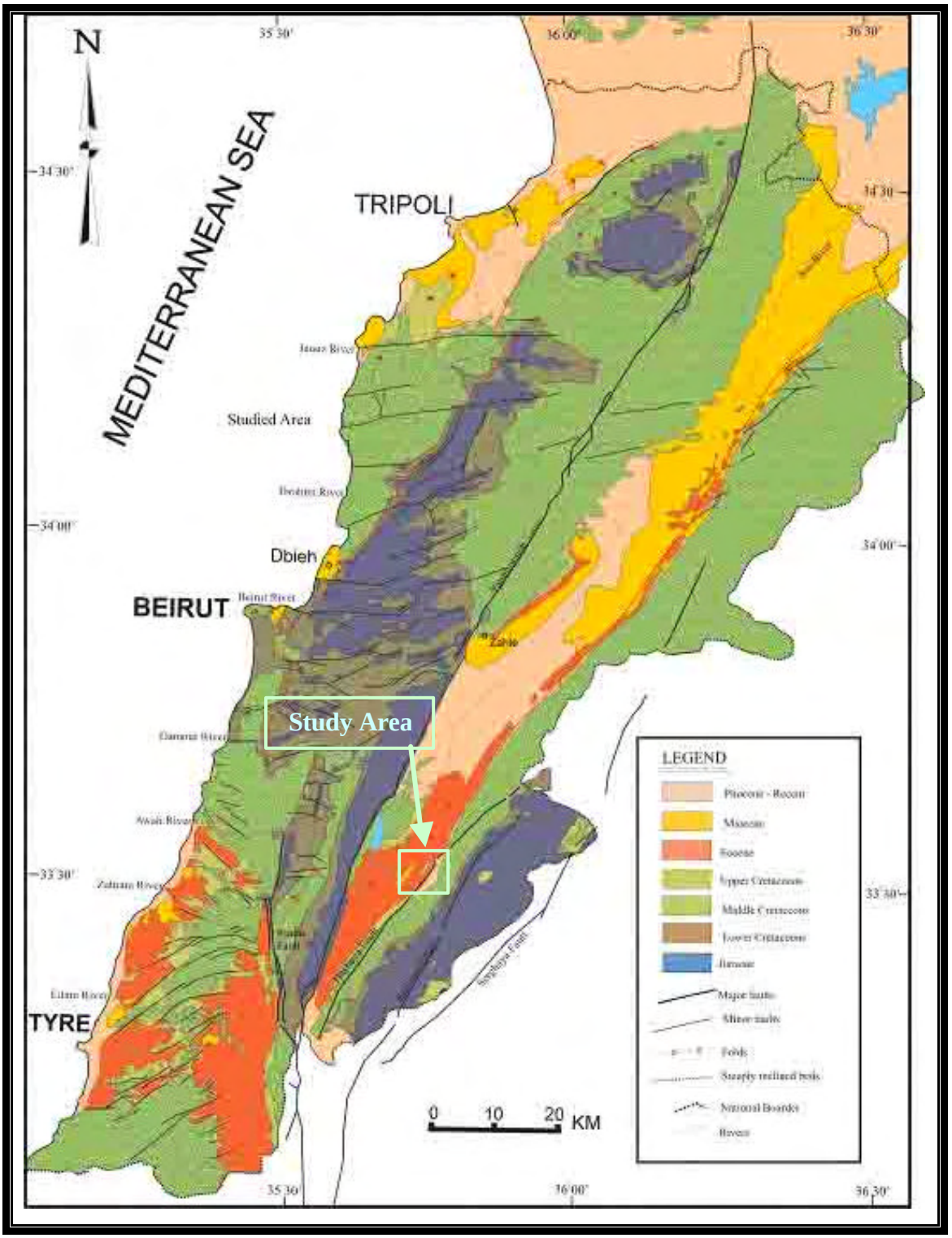


Figure 6-4. Tectonic Map of Lebanon modified by Dubértret (1966), showing the studied area.

Geographically the project site is in Al-Houch town, situated to the SSW of the Rashaya city. This site is 800m far from the town in a SE direction and is in a valley of 100m lower in altitude.

The studied area lies west of the Rashaya fault which is trending NNE-SSW and to the East of the Yammouneh and Hasbaya faults, where both of them trend NNE-SSW. (Figure -4).

The Rashaya fault has a higher influence on the region than the Yammouneh fault being closer to it. The Rashaya fault is still active which makes the region tectonically active.

The danger of earthquakes is not high regarding that no large earthquakes have been recorded on that fault.

6.5- Geologic setting

The stratigraphy of the region is composed of Pliocene Basalts and of Sannine formation.

The Pliocene Basalts as the name indicates, have been deposited during the Pliocene as the result of lava flow that occurred through fissures created by faults. The basalts extend through the entire Al-Houch town but are not present in the valley where the Project site is located.

The basalt is composed of ferromagnetic minerals such as pyroxenes and olivines and is present at the form of boulders and tuff.

The boulders are eroded pieces of black rocks of basalt. Tuff is fine grained volcanic material that deposits as ash of pyroclastics. They have a reddish purple color which is an indicator of oxidized iron along with a grayish color.

The Sannine limestone has deposited in late Cretaceous. It is composed of massive micrtic limestone with thicknesses attaining 1 km. Its color varies between creamy white to grey. It is found in the valley where the construction site is established. It is composed of carbonates that have deposited in a marine environment. The Sannine formation contains chert laminae and chert nodules along with fish and shrimp fossils. It is fine grained and can contain calcite veins or crystals.

6.6- Hydro-geological setting

There is a dried river running in the valley which occasionally collects seasonal rainfall.

A well has been drilled in that valley and reached the water table at a depth of 500m. This well is 150m north of the plant. The Project area is at an altitude of 800m to 1200m above sea level.

The basalt formation in the town, at the elevation of 900m, is an aquiclude. It is impermeable and does not infiltrate water. On the other hand, the Sannine formation where the wastewater treatment plant is going to be operated is an excellent aquifer. It has a high storability and a high transmissivity.

If any sort of contamination of groundwater is to be avoided, the treated wastewater should better be directed towards the impermeable basalt layer where it can be used for agriculture purposes. On the other hand, it is highly probable that the treated wastewater does not pose a threat for the groundwater because of the 500m depth. If this wastewater effluent is left to run through the limestone formation, it will probably reach the groundwater downstream in a few decades, and during this period the wastewater will be purified by naturally occurring microorganisms. However, precaution should be taken and the effluent can be discharged at least 100m downward in the valley.

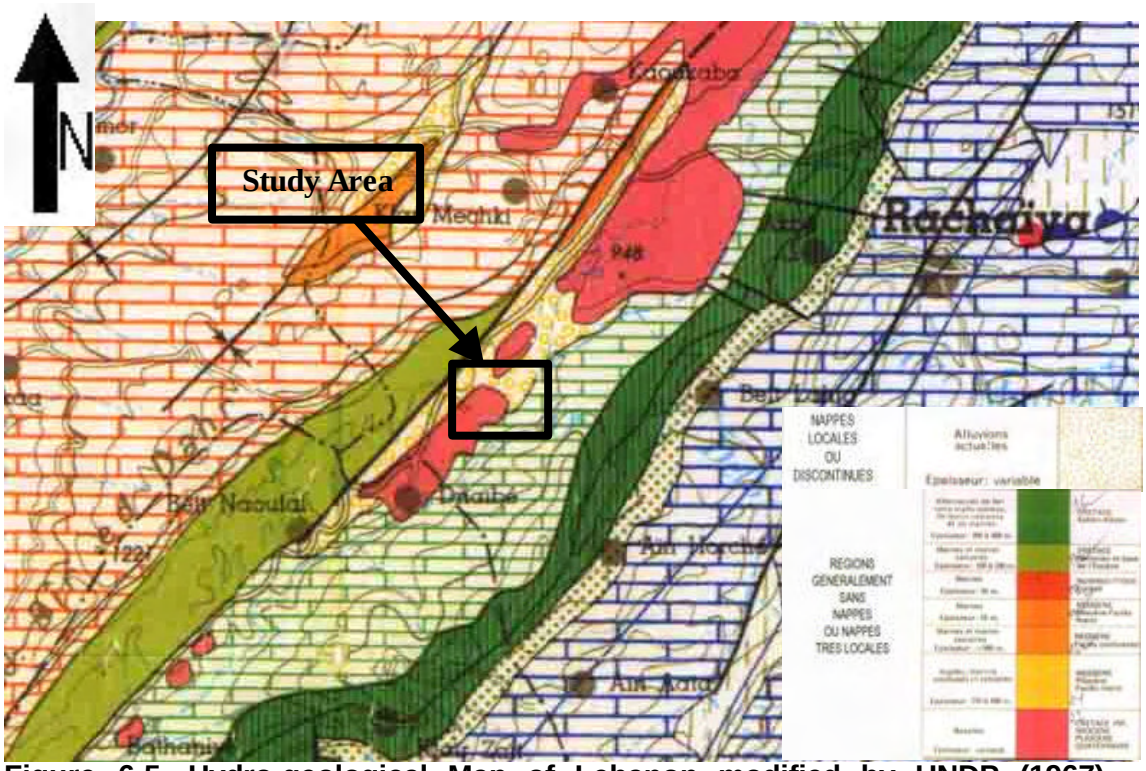


Figure 6-5. Hydro-geological Map of Lebanon modified by UNDP (1967), showing the studied area.

6.7- Ecological Context (Biodiversity)

Ecologically, the proposed location is not in an area of special concern, such as areas designated as having national or international importance (e.g. world heritages, wetlands, biosphere reserve, wildlife refuge, or protected areas). The project will not lead to the extinction of endangered and endemic species, nor the degradation of critical ecosystems, and habitats. However, the Project site can be considered as a sensitive spot, since it is near to the natural forest, but it contains neither springs nor it is near to surface water sources. The main river of the area, Hasbani River, originates some 15 km south of the proposed site.

The soil type in the proposed WWTP location is Red Mediterranean soils, with rock outcrops of Sannine limestone. The location is a part of nature land, with the main land cover of oak and other shrubs (Photo 6-5. and 6-6.). The location is not rich in herbaceous plant species. The area surrounding the site location is of similar nature however, a few olive groves are there (Photo 6-3).

Flora:

The Project area, including the proposed site, has a moderately rich **biodiversity**. The wild fauna and flora are rich with evergreen forest trees, where oak trees dominate. Other tree species include Common oleanders, Hawthorn (Zaarour), Sumac. Shrubs that cover the area include bellan, capers, Spartium junceum and others.

Some trees will be cleared at the project site while doing the excavation work. But new trees will be planted in the area. There are no forest trees on the hills of the western side of the town.

Photo 6-5. Natural Biodiversity at the Proposed WWTP Site

Photo 6-6. Natural Biodiversity at the Proposed WWTP Site

Fauna:

The wildlife in the project site is quite diverse. Reptiles and insects are common. Foxes, hedgehogs, chacals and others are the main mammals living in the project area.

Many species of local and migrating birds are available in the Project area. Even birds of prey are also found in the area, which is a sign of existence of small animals such as rabbits and mice. Illegal hunting endangers the bird life in the area.

6.8- Infrastructure Status

Infrastructure within the towns is mainly limited to road network, telephone, electricity, and water supply, which are in satisfactory condition.

Wastewater treatment plant is not available in Al-Houch town; in the near future they will establish one with the cooperation of YMCA. Also, a wastewater collection network will be established in cooperation with the Municipality and Ministry of Energy and Hydraulic resources. But there are

such plants in the neighboring towns of Ain Hersha and Marj El-Zouhour (Ad-Dnaibe) of the project area. In Al-Houch, the domestic sewage is generally disposed of into primitive and substandard septic tanks.

Regarding the municipal solid waste (MSW) issue, there is no appropriate MSW collection and management system in the town. The Municipality does not have a collection system. Householders open dump their solid wastes in several places outside of the town. But during the last year 17 municipalities of Rashaya Caza have agreed to establish a common treatment facility for the treatment of generated solid waste. This project will be co-sponsored by YMCA. Al-Houch Municipality is cooperating in this project. Implementation of the project will start in 2005.

6.9.1- Socio-Economic Status

Socio-economic information about Al-Houch was obtained during informal meetings with the Mayor and the Municipal Council members during the field visits.

***Demography*:**

The present winter population of the town is around 300 people, which reaches to 1000 people in summer months.

It is not very easy to predict the demographic behavior of this population since for last 30 years most of the inhabitants were either relocated in other regions of Lebanon or migrated to other countries. During the last decade a few families returned to resettle in the town. Local Municipality projects that, within the next 20 years the summer population of the village might rise to the maximum of 1500 people.

The economy of the area is mainly driven by agriculture, and public and private sector employments. There are no industries in the town and tourism is insignificant in this area.

***Agriculture*:**

Most of the adequate land lots of the area are terraced and where rain fed agriculture is practiced. Olives, grapes, figs and almonds comprise most of the agricultural production, olives being the main crop. Nevertheless, limited quantities of vegetables are grown in the backyards of households. Animal husbandry is not practiced in the town.

No food processing activities are carried out in the villages, except those for domestic scale consumption.

6.9.2- Heritage:

There are no archeological sites or sites of cultural significance in the immediate neighborhood of the project site. However, in the small village of Nabeh el Safa, 20km from El-Houch, there are the ruins of a Roman temple.

7- Likely Significant Environmental Effects of the Project and Their Mitigation

This section describes the probable or likely environmental impacts that might occur because of the implementation of the WWTP project, of Al-Houch town.

If the WWTP is **not established**, the pollution created by the current practice of wastewater discharge in substandard septic tanks will continue. This will exert negative effects on the local environment and intensify the existing public health problems and social tensions.

7.1- Sources of Environmental Impacts and their Mitigation

Impacts of the project on the environment will consist of three sources namely: **site** specific factors or the location of the project, the **process** or the technology that is selected, and the **activities** during the construction and the operational phases.

7.1.1- Site- Specific Factors:

The proposed site is a 1200m^2 piece of public land in Al-Houch town, which belongs to the Municipality. It is located at a distance of about 800m from the nearest house. It is a low point, 100m below the level of all houses of the town, where the wastewater can be collected gravitationally, through the sewer networks. When the sewer network in Al-Houch is completed, it will be connected to the WWTP.

The site of proposed WWTP is located at a point 800m from the town in the isolated valley beneath the town. There is quite rich biodiversity at the site. It is surrounded predominantly with oak trees and some other forest trees. An area of 1200m^2 will be cleared and leveled for establishing the WWTP. Adjacent to the site there is a watercourse, which drains the runoff of its immediate surroundings during the wet season. This would be the course

where the final effluents of the WWTP will be discharged, which will lead to the Hasbani River, 20km south of the site.

The site can be subject to erosion caused by rainfall if proper canalization, landscaping, land leveling and tree planting are not done at the site and its surroundings. Moreover, if the construction work takes place during the wet season, high rates of soil erosion will result from the exposed surfaces. The agricultural access road to the WWTP, if not asphalted during the dry season, soil erosion will take place during the following wet season and the road will be deteriorated.

7.1.2- Process-Technology Related Effects:

The proposed wastewater treatment plant will treat the wastewater and achieve a **secondary level** treatment. The Advanced Integrated Wastewater Pond Systems (AIWPS) technology of IBC Company will be applied, which is the combination of **anaerobic** and **aerobic** biologic digestion. The wastewater will reach and move through the plant gravitationally. There are no mechanical or electric equipment involved in the system.

The basic reactor of the plant is the anaerobic bio-digester, in which anaerobic digestion will take place and the organic material present in the wastewater will be digested and **biogas** generated, 70% of which being the methane gas, which will be collected inside of the dome of the digester (or digesters) and then released and flared intermittently. However, if the flaring of methane gas does not take place, it will be released in the atmosphere. Methane is a powerful greenhouse gas and it will have negative impact on the atmosphere by contributing to the phenomena of Global Climate Change.

Besides biogas, the other regular outputs of the plant are **treated wastewater**, and **grease & sand.** In addition, once in every 20 years the accumulated **sludge** is cleaned from the two digesters, which will be dried at the site and then used in afforestation projects. According to the design parameters of the plant, the IBC Co. assures that the final effluent will comply with the **standards set by MoE** for **secondary level** treatment. These

standards are indicated in Section 3 of this report. If the removed sands and greases are not handled properly, odorous and unhealthy conditions may result at the site. This can also present fire hazards and visual pollution.

In general, AIWPS technology is environmentally sound and convenient for rural areas. Any technical failures in the treatment plant can be fixed within one day by locally available manpower.

Mitigation

In order to avoid environmental impacts, YMCA has done detailed search and then selected the Advanced Integrated Wastewater Pond Systems (AIWPS) technology, as the best available and at the same time dependable small-scale wastewater treatment technology. It is made sure that at all stages of the process, proper control measures are applied in order to avoid the creation of environmental problems. During the operational phase, regular testing of the plant's effluents will take place to monitor its quality.

7.1.3- Effects Created During Construction and Earth Moving:

During the construction phase of the project, which will last 2 to 3 months, soil and rock excavation and disturbance will take place at the site. If this work coincides with the rainy season soil erosion will result at the site. On the other hand, haphazard dumping of excavated material will create soil erosion and aesthetic disturbance. This will also cover some of the trees and shrubs of the site and suffocate them.

There will be **emissions** from vehicles of VOCs, NOx, SOx, CO_2 and particulate matter to the atmosphere and thus contribute to air pollution, greenhouse gas production and global warming. Nevertheless, these emissions will be minimal because they will not occur in high frequencies or for long periods of time.

Excavating vehicles use hydraulic oils, lubricants and greases, which might be spilled accidentally. Their haphazard discharge on the ground can contaminate the natural environment.

The **noise** of the vehicles and workers at the site will cause disturbance for the wildlife, especially birds, but for a limited period of 2-3 months.

Noise will be also generated due to traffic created during the delivery of construction material. This may cause nuisance for the residents.

Dust generated during the construction phase can contribute to air pollution directly and indirectly as synergists or carriers of other pollutants. Dust can be generated at the project site because of excavations and vehicular movements, and also during the transport of material and equipment to the plant, when using the 1400m long earthen road, which connects the town to the WWTP. Dust can also affect the plants and crops of nearby farmers by covering their trees and forest trees with dust, which hinder their regular growth.

Concrete structures of the WWTP and pavements at the site can cause soil erosion due to runoff from these surfaces.

The existence of the plant will be an eye sore at the site.

Mitigation

Environmental impacts of the construction phase will be kept to a minimum by taking adequate measures at the planning and design stage. The residual impacts of the operation will be mitigated by the following measures:

- Spraying water during excavation will minimize dust generation.

- The earth moving operation will be carried out during the dry season and the piled soil will be properly used for landscaping and the excavated rocks in construction of retaining walls and terraces. Proper landscaping will lead into tree planting around the site.

- The roof and the outer walls of the treatment plant structures will be painted with a color that matches with the surrounding nature. E.g. green color. Also the 2 digesters will be partially buried, to minimize the visual pollution.

- Proper drainage canals will be constructed around the project site, in order to avoid flooding and soil erosion (by runoff).

- Decreasing the number of trips carried out by the vehicles will minimize disturbance of wildlife and minimize air pollution.

7.1.4- Effects Created During the Operation of the Treatment Plant:

Because of its wastewater treatment potential, the plant will have a **positive impact** on the environment. In other words, significant positive impacts will occur on the quality of surface and ground water, on public health, and on socio-economic development of the project area, taking into consideration that the current practices of wastewater disposal, at household and community levels, will be replaced with one controlled treatment plant. However, it will have some negative impacts, which may be seasonal or permanent, if the plant does not operate properly, as it is designed for.

Impacts

- The treated effluents will not generate significant impacts, if the plant operates according to the designed standards for the treatment of wastewater of domestic origin from the Al-Houch town. Discharge of improperly treated effluents from the plant can cause surface and groundwater contamination. The plant may also not be able to perform effectively if it is **overloaded**.

- The removed greasy material from the grease and sand trap if not properly stored and managed on regular basis, it can cause odors or catch fire.

- Rainwater run-off from the hard surfaces may create localized soil erosion problem.

- If flaring of biogas does not take place, methane gas will be released in the atmosphere, which is a powerful greenhouse gas and it will have negative impact on the Global Climate.

- If the accumulated **sludge** in the two digesters, which are cleaned once in every 20 years, is dumped haphazardly in the valley, next to the plant, this might create contamination of local water resources and the soils. Also if sludge drying is not done during the dry season, there is the possibility that part of the sludge may be driven with the runoff, which can result in the contamination of the surface water resources.

Mitigation

Implementation of the following measures will mitigate the impacts of the project during its operational phase:

- Effluent wastewater quality will be tested on a regular basis to ensure that its characteristics are within the set standards of MoE.

- The greasy material from the grease and sand trap will be regularly removed and stored in proper barrels and then collected and disposed with the municipal solid waste.

- An automatic torch will be installed, to flare intermittently the biogas that will be generated in the two bio-digesters.

- The part-time staff of the plant will be properly trained, to enable them to handle grease and sand removal and taking samples for the lab testing.

- Proper outfit and protective clothing will be given to the staff of the plant.

- A fence will be installed around the site to keep out animals and for avoidance of vandalism at the site.

- Proper landscaping will be done at the site and trees will be planted around the plant and other locations of the project area. Those will compensate the loss of trees that were cut down at the site, during leveling operation.

- Proper measures will be taken to avoid accidental surface runoff intrusion from the manholes of the sewage network, which can overburden the plant and cause discharge of partially treated wastewater from the WWTP into the valley.

- Overdosing of the plant will not be allowed, neither other communities will be connected to the plant. Municipality of Al-Houch will control the connections to the sewage network.

- Proper handling and drying of sludge will be done in drying beds, during the summer season.

Note: Since 2002, a small scale AIWPS plant, with one digester, is operating satisfactorily in the neighboring town of Ain Hersha of Rashaya Caza.

7.2- Effects on Biological, Physical, Social and Economical Environment

7.2.1- Human beings

Impacts

- The residents of the town will experience net positive environmental benefits from the project. The public health of the community will be upgraded due to improved standard of wastewater management. Income opportunities will be created for local people during the construction and operational phases. A cleaner environment will encourage the development of eco-tourism and other projects in the project area.

- However, the workers of the plant and solid waste collectors might experience negative health impacts, particularly during the removal and collection of greases and sands from the sand & grease trap.

Mitigation

- Municipal staff responsible for the treatment plant will be trained for applying safety measures. In addition, adequate protective clothing will be provided to them.

7.2.2- Nuisance (Odor, Noise, Vermin and Fire)

Impacts

- There will not be odor, noise and vermin problems at the plant that can affect the residents. Even the worker(s) will not be affected by the odor. However, there is the possibility of mosquito breeding in the open aeration ponds and channels of the WWTP, which can cause nuisance to the people during the summer months.

- The plant will not attract flies, rodents and other animals. Occurrence of fire is not possible unless the biogas release valves do not function properly and create explosive situations.

Mitigation

- Fire extinguishing equipment will be installed at the treatment plant. Actually, the treated effluents of the plant will be used in case of fire. In addition, chemical fire extinguishers will be made available at the project site.

- Usually mosquitoes do not travel more than 500m from their breeding sites. This will minimize the occurrence of nuisance for the residents. On the other hand, during the summer months some bio-enzymes will be used for suppressing the mosquito breeding.

- The biogas release valves will be checked and maintained periodically.

7.2.3- Water

Impacts

- In general, the existence of the WWTP will have a positive impact on the surface and ground water quality of the area, because, it will treat the raw sewage currently discharged in the nature and will, as well, eliminate the existing open bottom septic tanks in Al-Houch, which cause contamination of water resources and create health problems. During the dry season, the discharged water can be used for irrigation of forest trees, or even be used by farmers for irrigating their olive trees.

- If the removed grease from the grease trap is dumped haphazardly at the plant site, it will affect the surface waters, particularly during the wet season when the rains carry them down into the watercourse.

Mitigation

- With continuous sampling and laboratory tests, the performance of the WWTP will be optimized.

- The greasy material from the grease trap will be regularly removed and stored in proper barrels and then collected and disposed with the municipal solid waste.

- Awareness campaign will be launched for the residents in order to reduce the introduction of grease and used cooking oil in their kitchen sinks.

7.2.4- Air

Impacts

- Air pollution will result during the excavation and construction phase. Dusty conditions will occur. In addition, vehicular emissions will take place. Gaseous and particulate emissions will have their impacts on the natural vegetation. However, this will occur during the construction phase, for a period of 2 to 3 months. During the operational phase of the WWTP, no such conditions will result.

- If flaring of biogas does not take place, methane gas will be released into the atmosphere, which is a powerful greenhouse gas and it will have negative impact on the Global climate.

Mitigation

- During the construction phase, water will be sprayed in order to minimize dust emission at the site and along the earthen road.
- Unnecessary vehicular trips will be controlled.
- Automatic torch will be installed at the site for flaring the generated biogas.

7.2.5- Climate

Impacts

The existence of the WWTP will not have any negative effect on the microclimate of the area. This will be improved against the climate extremities (wind and storms), by planting trees in the neighborhood of the plant. Greenhouse gases, such as methane gas, will be produced in the bio-digesters of the plant and if released, this will have negative impact on the climate.

Mitigation

- Trees will be planted around the plant and in the project area, which will improve the local climate. These will be irrigated with the effluent wastewater.

- Produced biogas will be flared automatically.

7.2.6- Soil

Impacts

Limited quantities of soil will be excavated during the construction phase of the treatment plant. If it coincides with the rainy season, this will cause soil erosion at the site. Leveling at the plant site can create soil disturbances, erosion problems and dusty conditions.

The reuse of treated wastewater for irrigation will improve the fertility of agricultural lands of the area. Nevertheless, when unsatisfactorily treated effluents are released, these might contaminate the soils.

If the grease and sludge (once in 20 years) are not properly handled and managed, they can contaminate the nearby soils and create unsightly conditions.

Mitigation

- The staff of the plant will be trained for proper management of greases, to avoid soil contamination.

- Periodic tests will be done to assure the quality of effluent wastewater, to avoid partially treated wastewater to reach the soils.

- Excavated soil will be utilized for landscaping and then tree planting purposes.

7.2.7- Landscape

Impact

The heights of the two digesters are 8 meters. Two meters would be underground and 4m above the ground. This will limit the visibility of the WWTP. It would be the only structure in the project site. However, the visual impact on the area would not be significant, because the digesters will be masked by the existing forest trees around the site, and the favorable topography of the site will keep it hidden from the public view.

Mitigation

- *The domes and external walls of the plant will be painted in a color that matches with the landscape.*
- *Additional trees will be planted around the site and along the road to beautify the landscape.*
- *The effluent wastewater of the WWTP will be utilized for planting forest trees. Even it can be used for irrigation of the trees of the neighboring farms.*
- *The bio-digesters of the WWTP will be hidden with forest trees, topography of the site, and their underground positioning.*

7.2.8- Flora

Impact

The biodiversity of the project area is moderately rich with forest tree species, shrubs and annual or seasonal grasses. In the neighboring farms olives, figs, grapes and pomegranates are cultivated. During the construction phase of the treatment plant, 1200m^2 will be constructed and the plant cover at the site will be removed. During the operational phase of the WWTP, the discharged effluents will irrigate the trees along the water course of the narrow valley.

Mitigation

To avoid loss of biodiversity, proper management of WWTP outputs will be done, as stated in various sections here above.

7.2.9- Fauna

Impacts

The fauna in the project area consists of birds, some rodents, snakes, wolves, foxes, and wild boars. During the construction phase of the WWTP, these animals will be disturbed and their habitat affected. The physical existence of the plant might scare the birds from nesting around the site.

Effluent of the WWTP will have a minor impact on the soil microorganisms, particularly beyond the immediate vicinity of the plant. In dry season, the plant effluents can become a water source for the wild animals and birds.

Mitigation

Various mitigation measures such as tree planting, proper drainage of runoff, reduction of the number of trips and working time of vehicles on site and other measures are already mentioned under different headings. All of these will contribute in the mitigation of the impact on the species that are found at the vicinity of the plant.

Tree planting will enhance biodiversity at the site. Trees will attract many bird species and other animal species.

7.2.10- Sensitive areas

There are some forest trees at the site and a dense forest on the eastern and southern sides of the site. Oak trees are the dominant tree species of the forest. Wetlands, natural reserves, rivers, springs, lakes and other sensitive areas are not available in the vicinity of the project site, when a diameter of 500m is considered.

Incidental release of untreated wastewater from the WWTP might cause pollution of surface water resources, particularly during the rainy season. The chance for the occurrence of forest fires, due to the operation of the WWTP is not probable, except in case of explosive situation that might develop due to malfunctioning of the pressure relief valves and the automatic torch, which will kindle the released biogas.

Mitigation

Various mitigation measures that are already mentioned previously, under different headings, all of them will contribute in the mitigation. The automatic torch for kindling the biogas will be properly maintained, as well as the biogas release valves.

Arrangement will be made for utilizing the effluents of the WWTP for extinguishing the forest fires that might happen around the plant.

7.2.11- Cultural Heritage

There are no archeological sites or monuments in the project area that can be affected by the project.

The project will not have interference with the traditions and customs of the people.

7.3- Summary Table of Effects of Project on Biological, Physical and Socio-Economical Environment

Description						Evaluation	
Impacts on	***Impact number***	***Character***	***Magnitude***	***Duration***	***Consequences***	***Significance***	***Certainty***
Human beings	7.2.1	Positive	All of the people except the staff of the plant	Permanent	Improvement of public health	Significant	High
Nuisance (odor, fire, noise & vermin)	7.2.2	No effect on the population but minor inconvenience at the working environment	At the plant	Permanent	Health threat to workers	Significant	Very low
Water	7.2.3	Reduction of surface water pollution	Runoff channel at the vicinity of WWTP	Permanent	Contamination of watercourse with new microorganisms	Slight	Low
Air	7.2.4	Production of methane	At the plant	Intermittent	Damage to climate	Slight	Low
Climate	7.2.5	Positive	Not known	Intermittent	Not known	Very slight	Very low
Soil	7.2.6	Soil erosion and disturbance	Vicinity of the plant	Construction phase and wet season	Loss of soil and visual impact	Slight	Low

Description						Evaluation	
Impacts on	***Impact number***	***Character***	***Magnitude***	***Duration***	***Consequences***	***Significance***	***Certainty***
Landscape	7.2.7	Loss of solitude and visibility of structure	At the plant site	Long term	Contrast with the surrounding landscape	Very slight	Very low
Flora	7.2.8	Positive, due to planting of trees	Around the plant	Permanent	Improvement of degraded lands	Slight	Law
Fauna	7.2.9	Disturbance to species due to tree cutting at the site	Around the plant	Short term	Migration of species	Significant	Low
Sensitive areas	7.2.10	Forest	Vicinity of plant	Long term	Runoff water course contamination	Slight	Low
Cultural heritage	7.2.11	None	---	---	None	---	---

7.4 – Program to Reduce the Significant Negative Effects of the Project

The *Impact rating* is calculated as follows:

Five questions are asked. A YES answer is valued as 1 and a NO answer is valued as 0. Calculation of the value (between 0 and 5) is done, which is the sum of YES answers among the following 5 questions. This is called the ***Impact rating***.

Questions that are asked:

1- Is the aspect associated with any legislation, regulations, authorizations or codes of practice? Or does the identified aspect involve the use of any hazardous, restricted or special substance?

2- Is the aspect of concern to stakeholders? I.e.

- Employees
- Neighbors
- Shareholders
- Local community

3- Is the identified aspect or impact clearly associated with any of the more serious global environmental issues?

4- Is the aspect identified is quantifiable, is the amount of use significant?

5- Is the aspect identified is quantifiable, is the amount or frequency of use significant?

Severity Rating Matrix

Rating	Severity
1	No or minor environmental effect
2	Slight environmental effect
3	Moderate environmental effect
4	Serious environmental effect
5	Disastrous environmental effect

In the **Significance Factor** column, multiplying the **impact** and **severity** ratings will indicate the **Significance** of the aspect. The Significance test will generate a **result between 0 and 25** for each of the identified aspects or impacts tested. Any aspect or impact with a value **greater than or equal to 8 is 'notable'** and any aspect or impact with a value **greater than or equal to 12 is 'significant'**.

Process step	Aspect or impact identified	Impact Description	Direct or indirect	Impact rating	Severity rating	Significance factor	Mitigation Measures
Excavation	Dust	Contribute to air pollution directly and indirectly as synergists or carriers of other pollutants. Can affect Health and local ecosystem.	Direct	1	2	**2**	Spraying water during the excavation phase
Excavation	Vehicle emissions	Emissions of VOCs, NOx, SOx, CO_2 and particulate matter to atmosphere and thus contribute to air pollution, greenhouse gas production and global warming.	Direct	2	2	**4**	Reducing number of trips and frequency of operation of the vehicles
Excavation	Soil disturbance	Heavy machinery used will cause soil compaction.	Direct	1	3	**3**	Limiting the excavation area
Excavation	Destruction of Plant cover	Plant cover present at the site will be removed leading to increased soil erosion.	Direct	1	3	**3**	Tree planting and landscaping will take place, which will reduce soil erosion.
Excavation	Disposal of excavated material	The excavated material will be used for landscaping, construction and deep rooted tree planting	Direct	1	2	**2**	Rocks and soil reused for terracing
Excavation	Noise	Excessive or prolonged exposure to noise (typically more than 8 hrs above 85-90 decibels) leads to hearing loss, which is not the case here. This will affect the workers on site.	Direct	1	2	**2**	Reduction of the frequency of noisy operation
Leveling	Dust	Contribute to air pollution directly and indirectly as synergists or carriers of other pollutants. It can affect health and local ecosystem.	Direct	1	2	**2**	Spraying water while working

Process steps	Aspect or impact identified	Impact Description	Direct or indirect	Impact rating	Severity rating	Significance factor	Mitigation Measures
Leveling	Transport emissions	Emissions of VOCs, NOx, SOx, CO_2 and particulate matter to atmosphere and thus contribute to air pollution, greenhouse gas production and global warming.	Direct	2	3	**6**	Reducing number of trips, and frequency of operation of the vehicles
Leveling	Soil disturbance	Heavy machinery used will cause soil compaction.	Direct	1	3	**3**	Limit leveling area.
Building retaining walls	Erosion	Establishment of retaining walls for terraces reduces risk of soil erosion by decreasing the speed of water runoff and maximizing water absorption by soil.	Direct	0	1	**0**	This is a positive impact.
Concrete surfaces	Erosion	Structures and pavements can cause additional discharges of runoff, which promotes soil erosion.	Direct	1	3	**3**	Proper channeling and drainage systems
Building the WWTP	Use of power equipment	Combustion of fuel leads to emission of VOCs, NOx, SOx, CO_2 and thus air pollution, acidification, greenhouse gas production and global warming.	Direct	1	3	**3**	Minimize the frequency of operation of the equipment and vehicles.
Building the WWTP	Noise	Excess noise at the construction site cause disturbance on the wildlife	Direct	3	5	**15**	Minimize the unnecessary use of vehicles and equipment.
Oil and grease trap	Soil and Water Pollution	Risk of soil and water pollution from trapped grease and oil, when these are piled openly.	Direct	2	3	**6**	Regular cleaning and proper storage in barrels and its disposal with municipal solid waste

Process steps	Aspect or impact identified	Impact Description	Direct or indirect	Impact rating	Severity rating	Significance factor	Mitigation Measures
Discharge of the effluents during the operation of the WWTP	Water & land contamination	Below standard treatment leads into soil and water resources contamination	Direct	3	4	**12**	– Regular lab test to assure proper performance of the plant – Avoidance of accidental runoff water intrusion from the manholes of network – Awareness for reducing the amounts of oil and grease intrusion from kitchens.
Final effluent discharge	Water quality	If the final effluent contains certain bacteria like salmonella, it poses a risk to contaminate the receiving stream and the food chain.	Direct	3	4	**12**	Regular testing of the effluent wastewater to ensure better quality
Effluent reuse	Health Impacts	Risk of transmission of disease to farmers reusing treated wastewater for irrigation.	Direct	2	3	**6**	Advise the farmers not to plant vegetables that can be consumed in raw state.
Collection of oil and grease removed from the grease trap	Health Impacts	Risk of injury or transmission of disease to workers removing the grease and sand from the grease trap.	Direct	2	3	**6**	Proper training of workers, and use of proper storage tanks and protective clothing
Open aeration ponds	Health Impacts	Risk of mosquito breeding in the open ponds that can cause nuisance to the inhabitants.	Direct	2	3	**6**	Monitor the proliferation of mosquito populations and use eco enzymes for controlling them.

8- Analysis of the Alternatives to the Project:

Alternatives to the project are analyzed in terms of factors related to the ***sites*** and ***technologies*** that are available, by taking into account their environmental gains and soundness. Alternatives are described at three levels namely:

- **Alternative locations** for the project site.
- **Level of wastewater treatment required**, based on the requirements of MoE Decision 8/1, 2002.
- **Alternative processes of small-scale wastewater treatment** technologies, compatible with AIWPS wastewater treatment process.

8.1- Alternative Locations:

The **proposed WWTP site**, which will occupy an area of 1200m^2 on public land lot # 486, is located in the eastern valley of Al-Houch town. This is the most convenient location for establishing the wastewater treatment plant. No other spot can gather gravitationally all wastewater effluents from all of the houses of the town. The land, on which the plant is to be built on, is managed by the Municipality. It is at 100m lower than Al-Houch town, at a distance of more than 800m from the nearest house.

An **alternative site ONE** would be 100 or 200m further below from the proposed site, in the same valley. Although this point has the same environmental and topographic characteristics, it implies the following complications:

Longer distance: additional 200m excavations of soil and rock must be done for the extension of the sewage line and building the access road.

Additional damage to the environment: as more trees would be cut in the process of excavation and road building.

On the other hand, implementation of this alternative will require **additional funds.**

Alternative site TWO is again in the same eastern valley, with the same environmental and topographic characteristics, but only 500m far from the town. It has the following obstacles.

It is a private property, and therefore funds will have to be allocated in order to buy the property. On the other hand, there is the probability of mosquito problem, which would become a nuisance for the inhabitants of the town, due to the closeness of the plant.

Therefore, the proposed site with an area of 1200m^2 is ideally placed for the implementation of the project. Photos of Chapter 6 give a clear idea on the characteristics of the site.

8.2- Technological Alternatives of Wastewater Disposal

The level of wastewater treatment depends on the financial means of the communities and municipalities and the availability of technical skills. The higher we go in the levels of treatment, i.e., from *Primary* to *Secondary*, to *Tertiary* or *Advanced* levels, costlier would be the operation. For the rural areas of Lebanon, it is always preferable to adopt simple and environmentally sound technologies that require minimum maintenance and minimum running cost. The **secondary level** treatment can attain the effluent standards that are set by MoE Decision 8/1, 2002.

The General Procedures for Wastewater Treatment

The basic function of wastewater treatment is to speed up the natural processes by which wastewater is purified. In general, there are three basic levels in the treatment of wastewaters, **primary**, **secondary** and **tertiary**, which are outlined here below. In the **primary level**, solids are allowed to settle and floatables rise

up to the surface and then both of these removed from the wastewater. The **secondary level** uses biological processes to further purify wastewater. The **tertiary level** uses advanced treatment techniques capable of removing nitrogen and phosphorous. These three levels of treatment are summarized in the diagram of Annex 3.1.

Primary level treatment

As sewage enters a plant for treatment, it flows through a screen, which removes large floating objects such as rags and sticks that might clog pipes or damage equipment. After sewage has been screened, it passes into a grit chamber, where sand and small stones settle to the bottom. A grit chamber is particularly important in communities with combined sewer systems where sand or gravel may wash into sewers along with storm water. This treatment often is referred to as *preliminary* treatment.

After screening is completed and grit has been removed, sewage still contains organic and inorganic matter along with other suspended solids, which need to be removed. These solids are minute particles that can be removed from sewage in a *sedimentation tank.* When the speed of the flow through the sedimentation tank is reduced, the suspended solids will gradually sink to the bottom, where they form a mass of solids called *raw primary biosolids (sludge).* Biosolids are usually removed from tanks by pumping, after which it may be further treated for use as a fertilizer, or disposed of in a landfill. What has been described in this paragraph is referred to as *primary* level treatment.

Primary treatment alone is unable to meet the modern standards for higher effluent quality. To meet these, cities and industries normally treat to a secondary treatment level, and in some cases, also use advanced treatment to remove nutrients and other contaminants.

Secondary level treatment

The *secondary Level* of treatment removes about 85% of the organic matter in sewage by making use of the bacteria in it. There are two basic biologic technologies for the treatment of wastewater. These are *aerobic* and *anaerobic* processes.

The principal aerobic treatment techniques used in secondary treatment are the *activated sludge* and the *tricking filter* processes.

After effluent leaves the sedimentation tank in the *primary* stage it flows or is pumped to another chamber using one or the other of these processes. A **trickling filter** is simply a bed of stones from one to two meters deep through which sewage passes. More recently, interlocking pieces of corrugated plastic or other synthetic media have also been used in trickling beds. Bacteria gather and multiply on these stones and they can consume most of the organic matter. The cleaner water trickles out through pipes for further treatment. From a trickling filter, the partially treated sewage flows to another sedimentation tank to remove excess bacteria and organic materials.

The trend today is the use of the **activated sludge** process instead of trickling filters. The activated sludge process is an aerobic process, which speeds up the work of the bacteria by bringing air and sludge into close contact with incoming sewage through mechanical means. In this process, after the sewage leaves the settling tank in the primary stage, it is pumped into and *aeration tank* where the activated sludge process takes place by introducing air and sludge loaded with bacteria and allowed to mix for several hours. During this time, the bacteria break down the organic matter into harmless by-products.

The sludge now activated with additional billions of bacteria and other tiny organisms can be used again by returning it to the aeration tank for mixing with air and new sewage. From the aeration tank, the partially treated sewage flows to another sedimentation tank for removal of excess bacteria and organic material.

To complete the secondary treatment, effluent from sedimentation tank is usually *disinfected* with chlorine before being discharged into receiving waters or in nature. Chlorine is fed into the water to kill pathogenic bacteria, and to reduce odor. Done properly, chlorination will kill more than 99% of the harmful bacteria in an effluent.

In the case of *anaerobic treatment*, wastewater is kept in an airtight and waterproof tank for several days where the anaerobic bacteria digest the wastewater found in the sewage and releases biogas, which can be used as a

renewable energy source. Anaerobic systems need less space and minimum mechanical equipment, and less maintenance. Usually the effluent from the anaerobic digester is led into an aerobic pond for further biologic treatment.

According to the WHO standards, effluents from secondary level treatment of household wastewater can be safely used for irrigation.

Tertiary level treatment

Water pollution problems have placed additional burdens on wastewater treatment systems. Today's pollutants from industries, such as heavy metals, chemical compounds, and toxic substances are more difficult to remove from wastewater. The increasing need to reuse water calls for better wastewater treatment. These challenges are being met through better methods of removing pollutants at treatment plants. This level of treatment is referred to as *tertiary* or *advanced treatment.*

To return more usable water to receiving lakes and streams, new methods for removing pollutants are being developed. ***Advanced wastewater treatment techniques*** in use or under-development range from biological treatment, capable of removing nitrogen and phosphorus, to physical-chemical separation techniques such as *filtration, carbon absorption, distillation,* and *reverse osmosis.*

These advanced wastewater treatment processes, alone or in combination, can achieve almost any degree of pollution control desired. Wastewater effluent purified by such *tertiary* treatment can be used for industrial, agricultural, or recreational purposes, or even drinking water supplies. Nevertheless, attaining tertiary level treatment costs a lot of money!

Therefore, for the Lebanese rural areas, secondary level treatment for household wastewaters can be considered satisfactory, which is suitable for use in irrigation or discharging in nature. This complies with the MOE Decision 8/1, 2002.

8.3- Alternative wastewater processes comparable with AIWPS process:

AIWPS process of IBC Co. is a favorable wastewater treatment technology for the project area because of its dependability, due to the non-mechanical (i.e. gravitational) flow of wastewater in the system and low maintenance requirements of the WWTP. During the last decade several wastewater treatment projects have failed in rural areas of Lebanon when mechanical systems were installed. This is due to the high operational costs, unavailability of funds for the replacement of equipment parts, frequent electric power cuts, and the need of skilled technicians that are often not available in the rural areas.

On the other hand, the AIWPS technology of IBC Company has the **capability of complying with the national effluent standards**, which are listed in the Decision 1/8 of MOE. **Nitrogen, carbon** and **infectious bacteria** are consumed in the process. Even the eggs of parasites are destroyed, due to the long residence time of sludge, indicated as 20 years. Accumulation of **heavy metals** like lead and others in the wastewater treatment plant is not likely to occur, because there are no industries in the area that discharge heavy metals. All of the generated wastewater is of domestic origin.

It is a well known fact that many types of wastewater treatment technologies are practiced and promoted worldwide and in Lebanon as well. Here below two innovative small-scale wastewater treatment technologies are described that achieve similar effluent characteristics as **AIWPS** process does, but which are not convenient for the project site, be cause of reasons given here .

8.3.1- Alternative 1: *EMCO Extended Aeration Waste Treatment Plant with Hopper-Type Clarifier*

The **first Alternative** is the technology provided by the EMCO group of companies. The prefabricated EMCO **Aerobic waste treatment plants** with hopper-type clarifier are engineered specially for small-scale wastewater treatment processes. These plants are based on Extended Aeration process.

In this process, raw sewage enters the plant through a comminutor or by-pass bar screen, the comminutor breaks up the sewage into finer particles for more efficient biological digestion. After passing through the comminutor, the sewage enters the aeration tank where it is mixed with living organisms (aerobic bacteria) in the presence of air. This air is introduced through an air diffusion system at the bottom along the length of one side of the tank. The tank is designed so that air introduced at this point results in a spiral roll of the liquid, thus accomplishing a complete mixing of the raw sewage with the living organisms resulting in what is known as mixed liquor.

From the aeration tank, the mixed liquor passes into the clarifier or settling tank. Trough the use of baffles, the liquid in the settling tank is maintained in a quiescent condition, which allows the aerated solids to settle in the hopper shaped bottom. The accumulated sludge is constantly being pumped from the settling tank bottom into the aeration tank. This return sludge undergoes further digestion in the aeration tank, and provides the active organisms needed to digest the incoming raw sewage.

In order to maintain optimum plant efficiency, provisions are made for diverting excess sludge into an aerated sludge holding tank. A surface skimming device is also provided in the settling tank to remove any floating scum, which may occur and return it to aeration tank.

The clarified effluent flows from the settling tank into a chlorine contact tank where it is brought into contact with chlorine in solution. The treated effluent is then discharged from the plant for final disposal.

For additional information please refer to Annex 3.2.

8.3.2- Alternative 2: *POLYTECH Bio-Process for Wastewater Treatment*

The **second alternative** for the proposed WWTP at Al-Houch is the **Bio-Process** System developed by POLYTECH Agro-Environment Technologies Company of Lebanon.

Description of the Bio-Process

The **Polytech Bio-process** is composed of four rectangular or circular shaped concrete or steel tanks, coated with epoxy to prevent corrosion and oxidation (rust). It operates through gravitational flow. The bio-products Balsam and Polyzymes are the basic enzymes that enable the process to be simple and effective.

The Process:

1. First, the main sewer system is connected to the controlled bio treatment screen system.

2. The screened water passes to the bio treatment compartment, the bio-reactor.

3. The sewage overflow to the grinder compartment for further mixing and grinding the inorganic solid wastes, below 2.5 cm size.

4. The sewage continuously flows in through a 4 inch heavy duty plastic pipe to the bottom of the bio-reactor.

5. The bio-reactor is equipped with a floating air blower giving very fine bubbles.

6. The treated sewage in the Bio-reactor overflow to the first settling tank through a V weir, passing homogeneous water slowly between the tank wall and a plastic lamella, without turbulence and turbidity.

7. From the first settling tank the water, continue overflowing to the third and fourth tank (clarifier) through V weir and lamella.

8. The treated water in the clarifier is overflown through a V weir to a gutter surrounding the lower base of the tank.

9. The collected water (final effluent) in the gutter is flown through a pipe by gravity, to be used in irrigation or discharged in nature, free of malodor and feacal coliforms. The bio-product Balsam when added in the process, it kills 98% of all pathogens. These results comply with the Decision 8/1, 2002 of MoE.

The Bio-Process System operates gravitationally. It does not produce and sludge. The Balsam/Polyzyme bio-products are added by the automatic dosing system, which inactivate the anaerobic bacteria and suppress odor generation by 95%. These bio-products also kill the coliform bacteria and sterilize the final effluent. They also dissolve the organic matter in wastewater, including tissue paper, and eliminate the accumulation of sludge. The limited quantity of settled sludge in the three settling tanks are periodically pumped and reinserted in the first tank, in the bioreactor. The system does not need continuous aeration. The automatic air blowers are operated only occasionally.

The Bio-Process System operates with minimum maintenance. A part time attendant can daily check the dosing system and operate the pumps and the blowers for a couple of hours.

For additional information please refer to Annex 3.3.

8.3.3- Comparison of Technological Alternatives:

The **summary matrix** for the characteristics and advantages of the three small-scale wastewater treatment processes are presented here below. The favorable conditions are graded on a scale from 1 to 5. Five being the highest favorable condition.

Functions	Wastewater Treatment Technologies/ Processes		
	AIWPS	***EMCO***	***POLYTECH***
Compactness	4	4	5
Reduced odors	4	4	4
Need for electricity supply	5	2	4
Local level maintainability	5	2	4
Low operational cost	5	2	3
Speed of treatment process	3	4	3
Quality of effluent	4	4	4
Convenience and aesthetics	5	4	4
Life time of the system	5	3	4
Environment friendliness of the technology	5	4	5
Performance in cold weather	4	4	3
Total Grades	49	37	42

The total grades indicate that, with 49 points the AIWPS process presents an advantage over the other two small-scale wastewater treatment processes. Actually, its low maintenance and low operational cost features make it more attractive for this project site.

8.3.4- <u>The Most Preferred Alternative to the Project:</u>

Taking the three levels of alternatives (site, suitability of technologies and wastewater treatment processes) that were discussed here above, it is obvious that the AIWPS wastewater treatment process presents an advantage over the other two processes, for this particular project and site. This advantage is in terms of capital and operational cost, siting and appropriateness of the technology. For other geographic bcations and scale of operation, the other two processes might present additional advantages.

8.4- The overall AIWPS wastewater treatment operation in brief:

The wastewater treatment procedure at Al-Houch town will include the following steps:

1- Wastewater Collection

All houses of the town will be connected to the sewage network when the WWTP is ready for operation. Next the sewage network of the town will be connected to the WWTP by establishing a 150mm gravity sewer line of 1400m long, to be installed by the Ministry of Energy and Hydraulic Resources.

2- AIWPS Treatment Process

When wastewater is conveyed from the sewage network of the town to the WWTP, in the first place, wastewater reaches at the grease and sand trap.

10- **Grease and Sand Trap** is a two-compartment structure that receives the inflow and retains the grease and the sand. Floatable oils and greases will be accumulated on the surface. Sand and metals will sink to the bottom sump. Accumulated grease and sand will be periodically removed and landfilled with municipal solid waste. The flow will next pass to the Anaerobic Digester.

11- The **Anaerobic Bio-Digesters** (or set of 2 digesters) is the main reactor where treatment takes place. It accommodates the sewage for a specified period to allow the growth of anaerobic bacteria that proliferates in the absence of oxygen. The anaerobe organisms convert the organic component of the sewage and release biogas (a mixture of methane, carbon dioxide and other gases). The biogas is flared intermittently.

12- Next, the water passes to the Open Aeration Ponds. These are shallow basins where aerobic treatment takes place. The flow of wastewater in it is gravitational. Air, sunlight, wind and other natural factors contribute in further purification of the wastewater.

13- Then, the wastewater passes to the area of Aeration Channels, which consists of open channels, where aerobic process continues. This area (or channels) is an open structure that exposes the effluent to light and air and additional treatment results. At this stage the effluent wastewater would have undergone a secondary level treatment.

14- The final effluent will comply with the Standards of Ministry of Environment, Decision 8/1, 2002.

15- Effluent is then safely released back to nature, which is considered safe for irrigation.

16- The accumulated sludge in the bio-digester is emptied once in 20 years and placed in drying beds. Dried sludge can be used in agriculture of landfilled.

9 – Environmental Management Plan (EMP)

The proper implementation of a comprehensive environmental management plan (EMP) will ensure that the proposed WWTP meet regulatory and operational performance. IBC Co. will be responsible for the operation of the proposed WWTP for two years, and are therefore responsible for implementing the mitigation measures set, and performing the monitoring procedures required in the EMP.

Objectives of the Environmental Management Plan

Environmental management/monitoring is essential for ensuring that identified impacts are maintained within the allowable levels, unanticipated impacts are mitigated at an early stage (before they become a problem), and the expected project benefits are realized. Thus, the aim of an EMP is to assist in the systematic and prompt recognition of problems and the effective actions to correct them, and ultimately good environmental performance is achieved. A good understanding of environmental priorities and policies, proper management of the facility (at the municipality level), knowledge of regulatory requirements and keeping up-to-date operational information are basic to good environmental performance.

9.1- Monitoring Schemes

Two monitoring activities have to be initiated for the proposed WWTP to ensure the environmental soundness of the project. The first is *compliance monitoring*, and the second is *process control monitoring*. Compliance monitoring provides for the control of final effluent quality, while process monitoring relates to detecting the impact of the operational activities. Together, the objective is to improve the quality and availability of data on the effectiveness of operation, equipment, and design measures and eventually on the protection of the environment.

9.1 – Program to Reduce the Significant Negative Effects of the Project

Impact	Mitigation Measures	Phase of the Project	Party Responsible for Implementation	Environmental Effects of Mitigation Measure	Additional Costs Involved
1.Water pollution problems	- The grease and oil removed from the grease and sand trap will be stored in barrels and periodically collected with the solid waste of the town.	- Operational	- Municipality of Al-Houch	- Positive	- Included in operational costs.
	- Properly treated effluent wastewater will be discharged in the shallow runoff valley next to the WWTP or used for irrigating forest trees.	- Operational	- Municipality of Al-Houch	- Positive	- Included in operational cost.
	- Forest trees will be planted around the WWTP and in the 4 towns for reducing water pollution, improving the scenery and creating biologic diversity at the site.	- Operational	- Municipality of Al-Houch	- Positive	- Included in operational cost.
2. Soil erosion and pollution	- Earth moving operations will be carried out during the rainless season, to avoid soil erosion.	- Construction	- Contractors	- Positive	- Included in project cost
	- Excavated soils will be used for landscaping and establishing terraces at the project site. Excavated sand will be utilized for construction.	- Construction	- Contractors	- Positive	- Included in project cost
	- Rain runoff from the plants' open surfaces will be channeled properly into the nearby runoff watercourse in order to avoid soil erosion.	- Construction and operational	- Contractor	- Positive	- Included in projects cost and running cost
3. Nuisance ▪ Odors ▪ Litter ▪ Noise ▪ Vermin	- Plant attendant will be trained for proper maintenance and operation of the plant, including elimination of odors, vermin and mosquito.	- Operational	- Contractor	- Positive	- Included in project cost
	- Fencing and planting trees around the site.	- Construction and operational	- Contractor & Municipality	- Positive	- Included in running cost

Impact	Mitigation Measures	Phase of the Project	Party Responsible for Implementation	Environmental Effects of Mitigation Measure	Additional Costs Involved
4. Fires	- Arrangements will be made to use the plant effluents for controlling fires at the site and in the area.	- Construction	- Contractor	- Positive	- Included in project budget
	- Fire extinguishers will be made available at various corners of the plant.	- Construction and operational	- Contractor	- Positive	- Included in project budget
5. Health of staff	- Provision of training and safety clothing.	- Operational	- Contractor	- Positive	- Included in project running cost
6. Air pollution	- The generated biogas from the bio-digestion process will be intermittantly flared with an automatic torch in order to avoid the release of greenhouse gases in the atmosphere.	- Operational	- Contractor	- Positive	- Included in project budget
	- During construction phase dusty conditions will be minimized by spraying water on the earthen surfaces and by paving the vacant areas at the site.	- Construction	- Contractor	- Positive	- Included in project budget
7. Landscape disturbance	- The concrete structures of the plant will be painted with colors matching the landscape. Water based paints will be utilized rather than solvent based.	- Construction	- Contractors	- Positive	- Included in project budget
	- Establishment of a tree nursery at the project site for demonstrating the beneficial use of effluent wastewater.	- Operational	- Attendant	- Positive	- Included in running costs
	- Proper landscaping will be done at the site. The excavated soil and sand will be used for ladscaping. Also trees will be planted at the project site and in the project area.	- Construction	- Contractors	- Positive	- Included in project budget

9.1.1- Compliance Monitoring

In this context, compliance to the regulations set by the Ministry of Environment to limit air, water, and soil pollution shall be observed. Compliance monitoring shall be the responsibility of the WWTP administration.

For effective compliance monitoring, the following shall be assured:

- Trained staff and defined responsibilities,
- Authorized Standard Operating Protocols (SOPs) for representative sampling, laboratory analysis, and data analysis,
- Provision of safe storage and retention of records.

In the case of the proposed WWTP, the attendant of the WWTP should be able to take wastewater samples for lab. testing. Both Contractors and Consultants would be involved in knowledge transfer to the attendant and the Municipality representative.

It is noteworthy to mention that the WWTP Municipality should cooperate with the IBC Co. for a better approach in process control. A sound understanding of the treatment process and the technology will lead to better effluent quality.

Given that the plant capacity is small, it is recommended that compliance monitoring occurs once every 3 months. However, in the case of WWTP expansion, the frequency of monitoring should be increased accordingly.

It is noteworthy to mention that initial accurate characterization of the influent wastewater to be treated is necessary for proper facility design, operation, and future monitoring. The frequency of monitoring should not be reduced, even after the necessary constant recorded compliant values are obtained over a 2 year period of normal operation.

However, in case of any sudden change in the trend of influent, it is imperative to locate and correct the cause of change, and to adopt a more frequent monitoring scheme until a regular trend is re-established.

Within the framework of the quality monitoring procedure, sample-taking and analyses must be carried out by external monitoring laboratories.

The analysis should cover all of the parameters set by the MoE for wastewater effluent that is treated at secondary level. All test result should be recorded.

9.1.2- Process Control Monitoring

This course of action is needed since a precise and adapted process control strategy translates into a better process performance, and thus effluent quality compliance.

Occupational health and safety is crucial for the proper performance of the WWTP. Therefore, the Municipality must continuously observe the occupational safety standards of the part time attendant of the WWTP.

The main access roads connecting to the facility must remain in good condition to avoid vehicles accidents and erosion problems.

The WWTP attendant must also regularly check for outdoor cleanliness. This is performed weekly by a field visit to the area surrounding the facility.

Table 9-1. Process performance Monitoring Parameters

Domain	*Parameter*	*Frequency*
Health and Safety	Around the WWTP	Quarterly
	Occupational safety	Ongoing
Odor	Off site odor levels	Weekly
Pests	Open ponds and effluent discharge canal	Weekly

9.1.3- Record Keeping and Reporting

The monitoring activities at the WWTP will concentrate on: good housekeeping, awareness raising, limiting exposure of operating personnel to toxic substances, effluent testing, maintenance of drainage canals, proper management of the grease and oil waste, noise and odors that are generated at the plant site, sludge disposal once in 20 years, and extent of soil erosion problems and biodiversity loss (or gain) around the project site.

However, monitoring efforts would be in vain in the absence of an organized record keeping practice. It is the responsibility of the WWTP administration, the Municipality, to ensure the development of a database that includes a systematic tabulation of process indicators, maintenance schedules, logbook, and compliance and process performance monitoring outcomes. Such a historical database benefits both the facility operator and design engineers. Such record keeping shall be assured by the Municipality.

It should be noted that, according to the requirements set in the tender document, IBC Co. will have to perform regular and frequent maintenance check ups of the facility for two years. These preventive measures and design considerations will ensure a continuous and uninterrupted operation of the facility.

The monitoring means of specific activities, their parameters, frequencies and recording system is summarized in the following **monitoring scheme** for the project:

9.2- Institutional Arrangements

No matter how meticulously an environmental management scheme has been prepared, it will fail in the absence of predefined responsibilities and strong technical bodies. Compliance monitoring shall be the responsibility of the treatment facility administration; in this case Al-Houch Municipality, or a contracted operator, and thus its activities shall be budgeted for accordingly.

However, it is recommended that a private sector be contracted for the operation of the WWTP. In this case, IBC Co. will be in charge of the facility operation for 10 years.

In accordance with the requirements of the regulatory authority (MoE), the treatment facility should submit a periodic Compliance Monitoring Report to the enforcement authority (Municipality/ MoIM/ MoA). The assigned authority will be responsible for drawing conclusions based on the monitoring data, and deciding on specific actions to alleviate pollution impacts. The coordination with the MoE and MoA is also important since they are responsible for effluent compliance standards and reuse of treated wastewater in irrigation practices. Figure 9.1 is a typical set up of such an institutional arrangement.

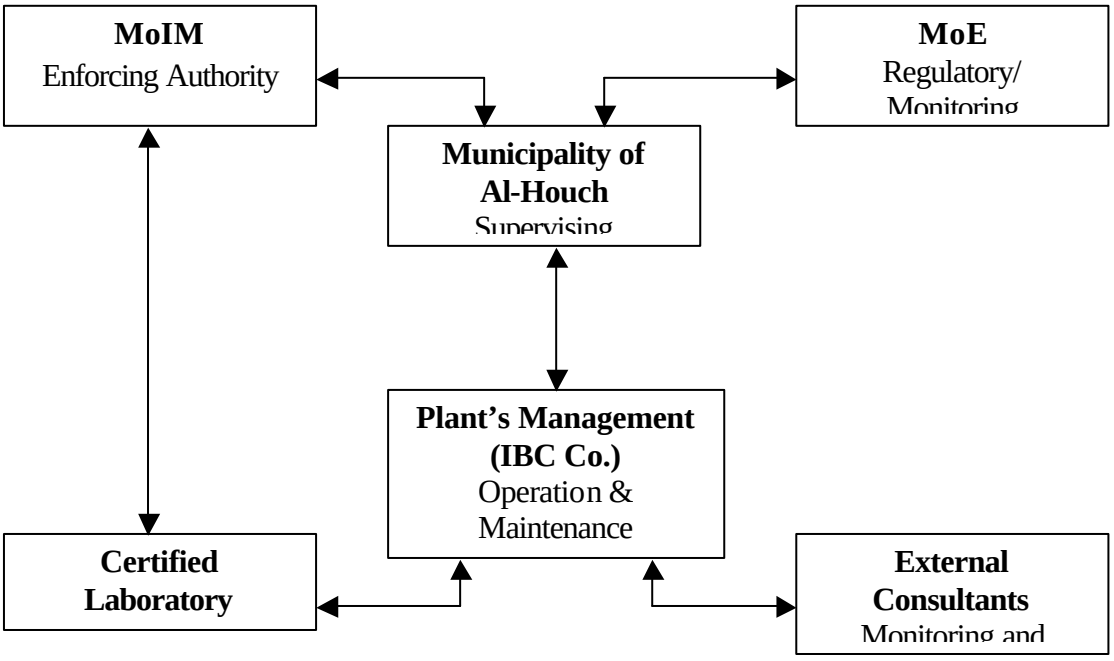


Figure 9.1- Proposed Institutional Setting for the Management of WWTP Operation

9.2.1- Institutional Roles During the Administration of WWTP:

Adequate management of the WWTP and the sewage network entails the cooperation of various parties. The parties who are going to be involved and play roles during the project implementation and operation include the following:

- Municipal Council of the Al-Houch town
- YMCA Lebanon
- Local population of the town
- IBC Company
- Ministry of Environment (MoE)
- Ministry of Interior and Municipalities (MoIM)

The role of parties pertains to their substantial contributions for effective management of wastewater in the project area, including effective operation of the WWTP. In this regard, the parties will shoulder the following tasks:

- **Municipality of Al-Houch**: It will be in charge of launching an awareness campaign for reducing waste generation at domestic level. It will be responsible for the daily affairs of the plant. It will keep the records of the lab tests of the effluents and the records of the grease and oil waste generated at the plant. It will pay the salaries of the part time staff or the attendant of the plant. The Municipality will shoulder the cost related to the arrangement of tree seedlings that will be planted in the project area.

- **YMCA**: During the planning and construction phase of WWTP, YMCA will cover 90% of the equipment, material cost, construction, and provide technical assistance. This will include the expert fees, coordination with official bodies and experts, and negotiations with suppliers and contractors. YMCA will also cooperate with the Municipality in launching awareness and tree planting campaigns in the area.

- **Local community:** will cooperate in promoting environmental awareness and cooperate during tree planting campaigns. The Municipality will coordinate these activities.

- **Ministry of Environment (MOE):** will monitor the overall performance of the WWTP and ensure that environmental standards are kept at acceptable level. MOE will also assist in launching the awareness campaign.

- **Ministry of Interior and Municipalities (MoIM):** will enforce the decisions of MoE.

- **Staff:** The part time attendant of the plant will be trained on the proper cleaning and storage of the waste grease and oil from the grease and sand trap. He will be also trained in taking samples from the plant effluents for laboratory testing. IBC Co. will do the training. These trainings will be carried out during the first month of operation of the plant.

The Municipality will select the attendant. He will be able to do the following tasks:

- Remove and store the waste grease and accumulated sand.
- Take proper samples from the effluent of WWTP and deliver it to the laboratory.
- Record keeping on the amounts of grease removed and reporting to the Municipality on accidents and malfunctioning of the plant.
- Establishing a pilot tree nursery at the plant site and irrigate it with effluent wastewater.
- Good housekeeping at the plant site.

- **IBC Co.:** It will make sure that the plant is designed and constructed properly. It will also make sure that the plant operates normally. During the first two years it would be in charge of good housekeeping, management of produced biogas, elimination of odor and control of vermin and mosquito proliferation at the plant.

9.2.2- Division of Responsibilities during the Operational Phase

Activity	Party Responsible	Executing Party	Duration
Supervision of plant operation	**- Municipality**	Designated representative of the Municipality	Throughout operation
Data keeping: - Lab. Test results of WWTP	- Municipality	Designated representative of the Municipality	Throughout operation
Awareness campaigns	- Municipality and YMCA	YMCA staff and Municipality	First year of operation
Tree planting campaigns	Municipality	Local community	3 years
Good housekeeping at the plant: - Reparations - Gardening	Municipality	- Attendant	Throughout operation
Planning for improvement and **emergency response plan**	- Municipality - IBC Co. and - YMCA	Municipality and IBC technicians	One year

9.3- Contingency Plan

Contingency and emergency plans were tackled in the design consideration of the WWTP, which will be always updated by the IBC Co. and the emergency situations will be tackled by its experts, the WWTP attendant and the Municipality: under the close supervision of the IBC company experts. IBC will do close supervision for two years and then the attendant and the Municipality will take care of the plant.

However, IBC Co. assumes all of the responsibility for complying with the national effluent standards, provided that the influent wastewater complies with the limits set by MOE.

The basic measures for **management of emergency situations** will be as follows:

- In the first place, the annual emergency response plans will be revised by IBC and proper instructions will be given regularly to the Municipality and plant attendant.

- In case of fires in the forests around the plant, the effluent wastewater will be utilized, which will be available all the time. Also fire extinguishers will be available.

- Proper drainage channels will drain the uncontaminated rain runoff from the surfaces of the WWTP to the valley.

- The storage area of the salvaged oil and grease materials will be protected from the rain.

- In case of huge quantities of surface rain runoff entering the plant through the manholes on street level, the Municipality is supposed to take immediate action to stop the flooding by applying corrective measures.

- The generated biogas release valves on top of the bio-digesters will make sure the periodic release of accumulated biogas inside of the domes of the digesters, which will be released intermittently and flared with an automatic torch. Quarterly check-ups of these valves and the torch will make sure that everything is operating fine. IBC Co. will do the checking for the first two years and then the plant attendant will do the routine check-ups and inform IBC in case of problems. In fact, the gas pressure inside of the domes would be far less than the pressure inside of bottles and cisterns containing liquefied natural gas at filling stations. But in case an accidental explosion takes place at one of the domes of the digesters and the structure is damaged, this can be repaired within one week, while the wastewater in the tank keeps on being treated: aerobically on the surface and anaerobically at lower levels. Due to the distance, this improbable

incident of explosion will not affect the houses that are at least 800m far. On the other hand, proper fencing around the plant will discourage vandalism at the plant.

- In case of structural failures caused by an earthquake to the sewerage network and to the WWTP, the spilled wastewater will be channeled properly to the runoff watercourse and the concrete structures will be repaired within a short time. Canalization at the site will take care of this incident automatically.

Additional environmental practices at the WWTP and the project area will include the following:

- A tree nursery will be established at the site of the WWTP, which will be watered with the treated effluent of the plant.

- Awareness campaigns will be carried out by the Municipality in order to raise the awareness of the households **in reducing the discharge of waste matter** in the wastewater stream. This will particularly emphasize the reduction of oil and grease and organic wastes intrusion through the kitchen sinks. It will also include campaigns on using proper screens to trap the particulate mater, in order not to overburden the BOD load of the WWTP.

10. Benefits that Justify the Implementation of the WWTP

The establishment of the WWTP in Al-Houch will bring net ecological, economic, social and health benefits for the town and its inhabitants. It will achieve a secondary level treatment for the wastewater generated at household level.

The overall benefits of the project would be the following:

1- Ecological benefits will be obtained by:

- Turning the dangerous wastewater, that are being disposed in septic tanks, into a safe effluent that complies with the standards of MOE for safe discharge in nature
- Preventing the occurrence of water pollution and nuisance, which is caused by the current use of septic tanks in Al-Houch.

2- Economic development will be attained by:

- Realizing an appropriate, dependable and affordable wastewater treatment technology, which can be replicated by other municipalities
- Encouraging ecotourism in the project area

3- Social and health benefits will be materialized by:

- Improving the health and living standards of the inhabitants, and
- Preventing the spread of diseases.

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