NAM DINH PEOPLE'S COMMITTE

VINATEX INVESTMENT JOINT STOCK COMPANY

ENVIRONMENTAL IMPACT ASSESSMENT OF PROJECT CONSTRUCTION CENTRALIZED WASTEWATER TREATMENT STATION IN BAO MINH INDUSTRIAL PARK, PHASE 1 - WITH CAPACITY OF 5000 M^3/DAY

LOCATION: VU BAN DISTRICT, NAM DINH PROVINCE

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PROJECT OWNER
VINATEX INVESTMENT JOINT STOCK COMPANY

CONSULTANT

NAM DINH, 11/2013

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ABBREVIATION

BOD:	Biological Oxygen Demand
COD:	Chemical Oxygen Demand
CPC:	Commune People's Committee
HW:	Hazardous waste
DO:	Dissolved Oxygen
EIA:	Environmental Impact Assessment
EMP:	Environmental Management Plan
CETP:	Centralized Effluent Treatment Plan
IP:	Industrial Park
IZMB:	Industrial Zone Management Board
ND:	Not detected
RC:	Reinforced Concrete
SS:	Total Suspended Solids
SE:	Society and economic
QCVN:	Vietnam Regulations
TCVN:	Vietnam Standard
WTP:	Wastewater Treatment System
WW:	Wastewater

ENVIRONMENTAL IMPACT ASSESSMENT SUMMARY

VINATEX Investment Joint Stock Company is the investor of Bao Minh Industrial Park with an area of 165.17 ha located in Nam Dinh province. The Centralized Effluent Treatment Plant (CETP) is located in an area of 1.56 ha in Bao Minh Industrial Park, and is designed for a capacity of 5000 m^3/day as part of phase 1 investment (overall capacity being planned for 10,000 m^3/day to be constructed in two phases) .

1. PROJECT CONTENTS

1.1. Description

In order to attract secondary investors to invest in the industrial zone, Bao Minh IZMB have deciding to buid CETP with capacity designed for a capacity of 5000 m^3/day as part of phase 1.

Some information about project owner:

- Owner: VINATEX INVESTM ENT JOINT STOCK COMPANY
- Address: Lot L1, D1 stress, Bao Minh industrial zone, 10th kilometer 10 Natioanl high way, Lien Minh commune, Vu Ban District, Nam Dinh Province.
- Scope: Investment, construction, infrastructure for industrial parks and urban areas.

1.2. CETP technology

Entire wastewater in industrial parks has raw waste separated at discharge source of each plant, and then they are collected by the sewage system to the centralized treatment of CETP. Wastewater is treated under the following steps:

1st step (facilities own treatment): The WW from private companies will be eliminated raw rubbish at discharge source, then collected the sewage system of CETP.

2nd step (centralized treatment): Preliminarily treated WW is collected into the centralized treatment facility of the industrial park for further treatment (and meet the QCVN 40:2011/BTNMT – National Technical regulation on industrial WW, column A) prior discharging into the environment.

WW of Bao Minh's CETP can be described as below:

- Primary Treatment

Step 1: Use automate raw waste separation equipment to separate impurities in the raw water to avoid clogging the pump and piping due to Bao Minh Industrial Park's production characteristics which focus on dyeing, textile with much fiber, yarn flowing in the wastewater collection system.

Step 2: Using an air conditioning tank with H_2SO_4 lit system to adjust the neutral pH environment, and cooling towers to stabilize the flow, effluent concentration and decrease in temperature before processing in the next stages.

- Chemical treatment

Handling the physical and chemical is the processes in which flocculation and coagulation support are mixed with wastewater to form the coagulation of the mixed wastewater after which the pollutants in wastewater will settle at the bottom of the tank and separated in the form of sludge. These following parameters/substances will be removed from wastewater in this process: COD, SS, coloring compounds and suspended colloids in wastewater.

- Bioremediation

Using anaerobic and aerobic microorganisms to destroy pollutants in wastewater. The process of anaerobic filter will be the first step in the bioremediation to break down the organic compounds and decompose pollutants. Next, the bioremediation phase using aerobic methods (activated sludge) with external air fed into the system to maintain the concentration of dissolved oxygen in the water and ensuring proper internal environment (this will complete the oxidation of organic pollution).

- Disinfection

Chlorine is used as a strong oxidizer that its effect is sterilization. When chlorine is inserted into water, its molecules will diffuse through the cell wall of microorganisms, prevents the metabolism of microbial cells. Chlorine is introduced into disinfection tank before WW running out Ecological-pond, it is guaranteed for reaction time of about 15 minutes before WW running out Ecological-pond. The amount of chlorine put in disinfection tank will be adjusted based on the actual situation and the results of monitoring of residual chlorine concentration in WW after treating.

- Sludge Treatment

Biological sludge and chemical sludge generated from the wastewater treatment process will be pumped in slurry tank compressor. At compression tank, sludge will be compacted, the humidity lowered and then pumped to the sludge treatment system (drying). In this system, sludge is pressed to squeeze and dewater before being landfill or used for agricultural purposes based on components in sludge analyzed.

1.3. Sludge treatment technology

Sludge treatment technology of CETP of Bao Minh Industrial Park - Phase 1: Excess sludge from the primary clarifier and secondary clarifier will be pumped periodically to the compressed sludge tank. At the compressed sludge tank, sewage sludge is concentrated by gravity sedimentation method, sludge is collected into the

bottom by the system of brushers. Depending on the concentration of biomass in the sludge tank that total dissolved solids (DS) ranging from 2-3% are in the sludge dewatering process before being pumped into compressor, then sludge in the form of bread will be packaged in a container and stored in house containing dry sludge before in process of sanitary landfills. Excess wastewater from sludge tank and compressor will be circulating pump for retreating process.

1.4. CETP characteristics

After being treated at centralized plant, water will be collected on the open ditches and led to Huong river to Chuoi Bridge and then pumped to T10 canal to direct to Nam Dinh (Dao River in particular) by Coc Thanh and Chanh River pump stations.

Discharge flow rate is 208 m^3/h (up to 312 m^3/h).

1.5. CETP implementation schedules

The progress of project activites including construction time estimated is 12 months (360 days) that is 2 months to survey and design techniques; 6 months to construct; import, and manufacture equipment; 3 months to transport, instal equipment; 1 months to run pilot, tranning, and technological transfer.

2. CHARACTERISTICS OF WW RECEIVING

2.1. Discharge points

Discharge point are Dao river at Nam Dinh city.

2.2. Current environment status

- *Air quality:* The analyzed results show that all parameters meet QCVN 05:2009/BTNMT, and are in the threshold.

- *Water quality:* The results show that all parameters meet all of required regulation in QCVN 08:2008/BTNMT between column B1 for agricultural purposes and column B2 for water traffic and other purposes.

- *Soil quality:* Based on the results comparing to the national regulations on heavy metals in soils, it's concluded that soil in the project area is not polluted.

- *Noise quality:* Noise level in the project area is 50 dBA which meet national regulation on noise for both specific and normal area.

- *Ecology quality:* Aquatic resources in the lake region and agricultural irrigation canal are poor, low economic value.

3. ALTERNATIVE SOLUTION

3.1. The project location

The project area surveyed is not in historical monument or possibly founding antiques during construction, so there is only one position selected to build CETP as approved plan.

3.2. Wastewater technology

After carefully considering the options and technological process of wastewater treatment plant of Ningbo 1 and Sunrise, owner and design consultant decide to choose the construction of CETP presented in the feasibility study report.

4. ENVIONMENTAL IMPACT ASSESSMENT

4.1. Source, subjects, and affected scale

4.1.1. Construction phase

Sources of impact related to wastes

Local aesthetics is affected by activity of construction, storage of construction materials, Solid wastes from labor activities, construction wastes.

Workers are affected by noise and vibration from mining, leveling by construction machinery and transport, dusts from construction, leveling and storage of mining and construction materials, air pollution from construction and material transport, wastewater from living activities of labors, construction wastes, lacking of safety equipment.

Air environment is affected by material transport during construction.

Local residents are affected by construction wastes, solid wastes from labor activities.

Soil, surface water quality is affected by hazardous waste.

Transportation is affected by increasing traffic jam from increasing transportation trips.

Ecology, biodiversity is affected in Low, sort-term and can be minimized.

Sources of impact unrelated to wastes, including:

- Social evils, labor safety and traffic safety,
- Spreading communicable diseases.

4.1.2. Operational phase

Sources of impact related to wastes

Workers, residents are affected by WW tank, wastes.

Surface water is affected by the leakage of WW, rainwater running off, solid waste

Solid waste has also influence on workers, community, soil.

Sources of impact unrelated to wastes, including:

- Social evils, labor safety and traffic safety,
- Spreading communicable diseases.

4.2. Computing, forecasting pollution and evaluating the impact of the project on the environment

Construction Phase

Exhaust fumes, odor: In addition to the means of transportation, the use of soldering equipment for construction also emits dust, emissions, which impacts on the air environment and directly affects the people living along the road. Scope of this effect is not large and local due to the population by roadside is few.

Noise: During the construction process, the construction equipment making noise is used, and the collision of the equipment, metal materials, ... also cause noise.

Wastewater in this period is mainly domestic sewage of workers, wastewater from construction process and rainwater running off through the construction area.

Solid waste includes domestic wastes and construction wastes if not being collected they will cause unsanitary, impact on landscape and health of construction workers.

Operational phase

Gas emissions, odor: In untreated domestic wastewater there are many pollutants, under the impact of the natural bacteria, these will cause biochemical reactions that cause the change of the properties of water, cause the unpleasant smells; the chemical reactions in the wastewater treatment processes (anaerobic - aerobic - anoxic) will generate a large number of gases that are compounds of nitrogen, sulfur, phosphorus and carbon.

Odor emission occurs in the sewers leaked or in the septic tanks due to open design. Exhaust gases are products of the biologic – chemical treatment process.

Odor and exhaust gases greatly affect ambient atmosphere and environment and health of the operators and workers in the surrounding shops.

Wastewater is mainly from dyeing with high COD and BOD contents and suspended sediments which keep long, generate unconformable smell and change into black. Through many phases of the waste water treatment process, wastages in the water will be gradually eliminated and discharged to the environment until they meet standards. Waste water is generated because the system is leaked and damaged in the operation process and therefore, water is not treated according to standards. This waste water will be brown to black and smelly; partly penetrated into soil to pollute land and underground water environment and partly discharged into small ponds and lakes to pollute surface and domestic water source of the local people. Leaked waste water flow depends on failure of the system.

Noise in the operation phase is mainly from pumps and air blowers. Noise of these equipments ranges 55-70dB (in a distance of 5m) and 47-69dB (200m). In comparison with QCVN 26:2010/BTNMT: National Technical Regulation on Noise,

the noise is not within the allowable limit from 6:00 to 22:00 and does not affect residential area or activities of the industrial zone.

Solid waste is generated from two main sources: Wastes collected from trash racks include fibers, packing, rag, gloves and nylon, sludge.

4.3. Cumulative impacts

The water quality and flow of C9, C9-5 canal and Day river will be affected after discharge flow of CETP of Bao Minh IZ. The influence is not significant for Day river because of small flow and water quality that meets national standard.

To analyse the accumulated impacts of the project toward C9, C9-5 canal and Day river, we will have to analyse the discharge receiving capacity of C9, C9-5 canal and Day river. The assessment will be based on Circular 02/2009/TT-BTNMT dated 19/3/2009 of the MONRE.

5. ENVIRONMENTAL MEASURES TO MITIGATE

5.1. Mitigate adverse impacts in the construction phase

During construction process, the Project Owner coordinates with the contractors in complying with regulations on labor safety and environmental sanitation. The following measures will be taken to limit harmful impacts on the surrounding environment.

- Mitigate dust and exhaust gases,
- Mitigate impacts on traffic safety upon transporting building materials,
- Mitigate water pollution,
- Mitigate emission of solid wastes,
- Mitigate other impacts,

5.2. Measures to mitigate adverse impacts in the operational phase

The operators of the waste water treatment plant are basically trained about operating the system and remedying some simple incidents.

It is required to check and maintain equipment every 02 years. Pipeline system is checked to avoid being broken and leaked due to impacts of external factors. The whole close treatment system without leaked pipeline will not emit exhaust gas and smells.

After being treated, water quality must be periodically analyzed to monitor stability of the treatment system and ensure water quality to meet standard.

Sludge: Sludge is collected and periodically treated 3 months for one time following the current standard.

6. ENVIRONMENTAL MANAGEMENT PLAN

6.1. Methods of measuring water pollution mitigation

Industrial waste water

- The waste water treatment plant of Bao Minh Industrial Zone is a concentrated one. Thus, before directly connecting water discharge from the plants to common pipeline, it is necessary to require the plants to use the trash racks to separate raw large size garbage from waste water.

Domestic waste water

Domestic waste water from the WCs for the employees of the concentrated waste water treatment plant is collected and treated by the septic tank.

Rain water

Rain water is collected into the storm water drainage system of the industrial zone through the storm water manhole arranged in sidewalks.

6.2. Methods of measuring air pollution mitigation

General measures to limit air pollution and impacts on the workers' health are taken by the Project Owner during the project operation.

Measures to mitigate air pollution in the waste water treatment plant: CETP have to be constructed in accordance with regulations on safety, industrial hygiene, it is maintained the necessary ventilation by natural ventilation and cooling fans locally;

Using bio-products: In the event that the concentrated waste water treatment plant emits bad smells, the Project Owner will use bio-products (GEM-P, GEM-K, GEM, CTA-T) to mitigate bad smell generated from the waste area, waste water treatment area and sludge yard …

Oxidizing odorous substances*:* Odorous substances are decomposed by strong oxidants such as H_2O_2 or ozone. Thus, the Company periodically uses H_2O_2 solution in the odor emitting areas or installs some ozone generators to treat bad smells. At present, ozone generators are used to treat bad smells in Vietnam.

The Project Owner takes appropriate measures to limit air pollution to the maximum caused by transport.

To fit anti-vibration pads for high noise machinery and equipments, especially air blowers placed in the acoustic enclosure for mitigating noise pollution.

6.3. Methods of measuring sludge management reduction

The Project Owner will contract with the environment company to collect, transport and treat sludge generated from the concentrated waste water treatment plant.

6.4. Methods of measuring solid waste reduction

The Project Owner will contract with the environment company to collect, transport and treat domestic and hazardous solid wastes.

6.5. Public information program and community relation

During the construction and operation of the CETP of Bao Minh IP, Phase 1, the project owners will publish all of the EMP information toward the People's Committee of Kim Lien, Kim Thai, Lien Minh, and nearby residents so the public can monitor/ supervise the project.

The EMP includes these key points:

- The organization and activities of project environmental department;

- Training, awareness promoting of environmental issues and measures relating to the project;

- Responsibilities of project owners in implement measures, impact mitigation activities in the situation of environmental catastrophic during both the construction and operation phases of the project;

- Plans to operate environmental protection facility;

- Plans to monitor wastes/emissions/ discharges sources and surrounding environment during both the construction and operation phases of the project.

7. COMMUNITY CONSULTANCY

Experts conduct community consultancy in the People's Committee and Vietnamese Fatherland Front Committee in 3 communes of Kim Thai, Lien Minh and Lien Bao, Vu Ban district. The contents are as follows:

Characteristics of the project;

Impacts on natural and socio-economic environment;

Measures to mitigate adverse impacts for the project; and

Other matters if any.

The Employer carries out consultancy for the following subjects:

- People's Committee of Kim Thai commune, People's Committee of Lien Minh commune and People's Committee of Lien Bao commune where the project is deployed

People residing in the project area and affected by activities of the project.

The People's Committees of Kim Thai communes reach a high consensus of assessing adverse impacts of the project on natural and socio-economic environment in the brief EMP.

The People's Committees of Lien Minh communes reach a high consensus of assessing adverse impacts of the project on natural and socio-economic environment in the brief EMP.

The Lien Bao commune People's Committee agrees with adverse impacts of the project as defined in the EMP. The commune People's Committee recognizes that the project has positive impacts on natural environment and creates jobs for local workforce.

Results of collecting the local people's opinions about the concentrated CETP Most of the: local people agree with construction of the concentrated waste water treatment plant in Bao Minh Industrial Zone while some have no opinion and objection about construction of CETP.

CHAPTER 1 PROJECT SUMMARY DESCRIPTION

1.1. PROJECT ORIGIN

Bao Minh Industrial Park covers an area of 165.17 hectares in area 3, Kim Thai commune, Lien Minh, Lien Bao, Vu Ban district, Nam Dinh in which the area of industrial parks in the approved plan is 156.13 ha.

Among the wastewater from the plant in Bao Minh Industrial Park, textile dyeing wastewater will be paid special intention due to complex chemical composition and expected large proportion of wastewater flow. If wastewater treatment system meets the textile wastewater treatment, it will surely meet other investors' requirements in other industries.

In phase 1, Chinese textile dyeing factories are the main industry with needs of wastewater treatment (see more proportion % of type production in table 1-1)

Based on the rent progress of secondary investors, the investment in wastewater treatment plant (CETP) is divided into two phases in which phase 1 has a capacity of 5000 m^3/day, located in the lot area of 1.56 hectares in Bao Minh Industrial Park.

The fact that Bao Minh Industrial Zone has a centralized waste water treatment contributes to protect the ecological environment and will provide an opportunity to attract other secondary investors to continue to invest in the industrial park.

1.2. INVESTOR

Investor: VINATEX investment JSC

Address: Lot L1, D1 stress, Bao Minh industrial zone, 10^{th} kilometer 10 National high way, Lien Minh commune, Vu Ban District, Nam Dinh Province.

Tel: (0350) 8621666 Fax: (0350) 3821666

Representative: Mr. Tran Dang Tuong Position: Chairman

Scope of activities of Company: Investment, Construction, Business in infrastructure of industrial zone and urban.

1.3. LOCATION OF PROJECT

Location: Bao Minh IZ, Vu Ban District, Nam Dinh Province.

Type of investment: New construction

Capital: 25% expected to use equity and 75% debt

1.4. INFRASTRUCTURE STATE IN BAO MINH INDUSTRIAL PARK

1.4.1. The second industries in industrial park

- The second industries in industrial park

The total construction area in Bao Minh IZ is 154,5 ha. The area of the factory from 1 ha to 5 ha which are as most industrial sectors, light industry.

Orientation of the type of production of Bao Minh Industrial Park will be the mechanical assembly and electronics, agricultural products processing, textiles and construction materials production.

Table 1-1. Orientation of the type production of Bao Minh IP

No.	Items	Proportion (%)
1	Enterprises of mechanical assembly, electronics	7
2	Enterprises of agriculture and food production	15
3	Enterprises of textile, dyeing, sewing	60
4	Enterprises of construction materials	10
5	Enterprises of other light industries	8
	Total	**100%**

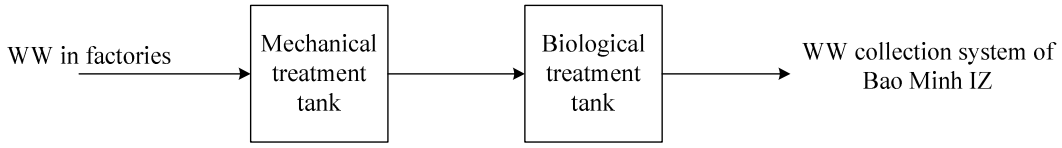
- *The companies are already in operation in the industrial zone:*

The total area of leasing land and investors building plants in operation is 37.32 ha (to be listed in Table 1.2).

- *Capacity of wastewater pretreatment and standards*

Capacity of wastewater pretreatment: Wastewater of factories and enterprises in Bao Minh IP is separated raw rubbish at discharge source, then collected the sewage system of CETP.

Each factory in Bao Minh IZ before going into operation has environmental commitment approved by IZMB, which businesses committed quality wastewater pretreatment ensuring separation of the raw waste at source and reducing BOD concentrations in the effluent. Process technologies applied including 2 level are mechanical treatment and biological treatment. Effluent from the plant is collected in mechanical tank and separated raw wastes with a sieve size of 5mm, then concentration of suspended solids is reduced by gravity. Water from the mechanical tank flows to the biological treatment tank . Here BOD concentration is decreased by the process of aerobic and anoxic. The technological process is shown in the diagram below :



Sludge from mechanical treatment tank will be treated according current regulations.

Pretreatment standards: Wastewater of factories in the IP before discharged is connected to the wastewater collection system to ensure separation of the raw waste, avoiding congestion of collection system and reducing BOD concentration in WW.

- *The schedule of industrial activity:*

The schedule of companies and enterprises in IP must be followed by IP management: 6 day/week, the units that need to do more overtime in Sunday have to seek the opinion of the IP management.

- *Wastewater management system:*

Wastewater of factories discharged out the general collection system of IP is managed by flow, concentration, and discharge schedule. Wastewater of factories are calculated by demand of input water and by 80-90% of its (depending on the manufacturing with consent between director and IP management). The concentration of pollutants will be monitored periodically every 3 months 1 time. In the case concentration of pollutants exceeds manhole registered with IZMB, the factories will be administratively sanctioned. The discharge schedule of each factory depends on each production stage that registered with IP management but must be discharged before 4.30 pm daily.

1.4.2. The sewerage system

The drainage system: The drainage system is designed to use channel C9 and C9-5 in the southeast and northwest in the middle of IP. All drain water runoff will be collected on the C9 and C9-5 chanels and then leaded to the Chanh river and pumped to T10 channel by 2 pumping station: Chanh river and Coc Thanh pumping station.

The wastewater sewer: the wastewater sewer separated from the drainage system. The sewer lines are located on the sidewalk along the route close to the factory's wall. The manholes are located at a distance of 30 meters to collect and test water quality network. The sewer line with diameter less than or equal to 300 mm will use PVC pipe to reduce the slope, pipe burial depth and for easy installation.

1.4.3. Wastewater treatment system

The wastewater treatment system in IP is invested with capacity of 10.000 m^3/day. This system is divided into many stages depending on the amount of factories in IP. CETP ensures that water after treating is meeting with national standards of QCVN 40:2011/BTNMT, column A (K_q = 1.1, K_f = 1.0) in some parameters such as heavy metals, COD, BOD, pH, Coliform,…

1.4.4. The system of industrial waste management, hazardous waste:

Solid wastes and hazardous wastes of the member companies will be collected and temporarily stored at the companies. The companies will sign all hazardous wastes in accordance with current regulations and contract with service companies having function to collect and transport to disposal according to regulations. The storage of

solid waste, hazardous waste at each company to apply control measures appropriate and having separating waste storage area, standard containers with tablets, label.

Solid waste generated during the construction phase of CETP will be collected and transported daily by the functional company. Sludge generated during the plan operation in the form of bread will be in the store bagging dried mud before bringing sanitary landfills.

In addition, IP arranges storage and transfer station:

- Temporary: In the northern area of the Industrial Park (located next to centralized wastewater treatment station), this location is convenient for transportation, not impede traffic operations generally, do not adversely affect the environment and beauty agencies;
- Area of 500 m^2, surrounded by a wall, the good drainage system, covered trash temporary area, small drainage ditch surrounding temporary to prevent water leaked out. This waster is collected and treated at CETP of Bao Minh IZ.

There are two main areas that are the solid waste storage and common storage areas of hazardous waste

The member companies can register with IP management to be used storage and transfer station of common solid wastes and hazardous wastes. IZ Management Board will contract with functional units to collect and treat these wastes periodically.

1.4.5. Transportation system

External transportation system: National Highway 10 passing through the southern industrial zone is now complete, it will be important routes connecting Nam Dinh - Thai Binh - Hai Phong, the main transport routes of Bao Minh Industrial Park.

Internal transportation in industrial zones will be separated from the national highway 10 by a route running along Highway 10. Internal traffic network in IP is organized like chess board with the main road towards the North South - East West. The herringbone lines perpendicular to the main axis forming traffic network, provides convenient transportation and infrastructure routes along the road to the plot of land for construction of the plant.

1.4.6. Risk management

Risk Management for processing system may affects on the quality of treated water: Operating staffs of the wastewater treatment plant have to be trained for technology transfer, with documentation in Vietnamese.

Risk management of natural disasters due to the incident: It is reasonable flooding incidents in the rainy season, natural disasters, thus they can damage the

collection system - sewer. Therefore, the collection system - Sewage have to be reinforced periodically especially before the rainy season.

Road in Industrial zone

Location of effluent sewer in industrial zone

Landscape lake in industrial zone

Sewerage network after processing in industrial zone

1.5. DESCRIPTION OF CETP IN BAO MINH INDUSTRIAL PARK

1.5.1. Treatment Technology, Influent and Effluent Characteristics

1.5.1.1. Treatment technology

Some of investors in Bao Minh IZ – phase 1, investors in textile industry have the biggest amount of WW as well as complex composition and impurities. So WW should be separated raw waste at source discharging and be reduced concentration of BOD by biological method, which is then collected by sewerage system to CETP of Bao Minh IZ. After consultation and comparison WW treatment technology of two factories of Ningbo and Sunrise – China, Bao Minh IZMB decided to choose technology applied for Bao Minh CETP that is biological treatment combining chemical-physical process (detail in Chapter 3). The main steps are presented below:

- Primary Treatment

Step 1: Use automate raw waste separation equipment to separate impurities in the raw water to avoid clogging the pump and piping due to Bao Minh Industrial Park's production characteristics which focus on dyeing, textile with much fiber, yarn flowing in the wastewater collection system.

Step 2: Use an air conditioning tank with H_2SO_4 lit system to adjust to the neutral pH environment, and cooling towers to stabilize the flow, effluent concentration and decrease in temperature before processing in the next stages.

- Chemical treatment

Handling the physical and chemical is the processes in which flocculation and coagulation support are mixed with wastewater to form the coagulation of the mixed wastewater after which the pollutants in wastewater will settle at the bottom of the tank and separated in the form of sludge. These following parameters/substances will be removed from wastewater in this process: COD, SS, coloring compounds and suspended colloids in wastewater.

- Bioremediation

Using anaerobic and aerobic microorganisms to destroy pollutants in wastewater. The process of anaerobic filter will be the first step in the bioremediation to break down the organic compounds and decompose pollutants. Next, the bioremediation phase using aerobic methods (activated sludge) with external air fed into the system to maintain the concentration of dissolved oxygen in the water and ensuring proper internal environment (this will complete the oxidation of organic pollution).

- Disinfection

Chlorine is used as a strong oxidizer that its effect is sterilization. When chlorine is inserted into water, its molecules will diffuse through the cell wall of microorganisms, prevents the metabolism of microbial cells. Chlorine is introduced

into disinfection tank before WW running out Ecological-pond, it is guaranteed for reaction time of about 15 minutes before WW running out Ecological-pond. The amount of chlorine put in disinfection tank will be adjusted based on the actual situation and the results of monitoring of residual chlorine concentration in WW after treating.

- Sludge Treatment

Biological sludge and chemical sludge generated from the wastewater treatment process will be pumped in slurry tank compressor. At compression tank, sludge will be compacted, the humidity lowered and then pumped to the sludge treatment system (drying). In this system, sludge is pressed to squeeze and dewater before being landfill or used for agricultural purposes based on components in sludge analyzed.

1.5.1.2. Actual CETP Influent and the Required Effluent Characteristics

The quality of actual influent has components and properties that are similar to actual datas supplied by Ningbo – China textile wastewater plan, follow as:

+ pH: 8-12

+ COD: 700-900 mg/l

+ BOD_5: 250-500 mg/l

+ Colour: 220-400 Pt-Co

+ SS: 80-150 mg/l

+ Other parameters are listed in Table 1.3

The effluent characteristics have to meet the national regulation QCVN 40: 2011/BTNMT, Column A, Kq=1,1; Kf=1,0 in such parameters as pH, SS, BOD_5, COD, DO, NH_4^+, NO_3^-, Fe, Pb, As, Hg, Cd, Coliform,…

1.5.2. Characteristics of CETP and sluice-gates

1.5.2.1. Characteristics of wastewater

(1). Wastewater profiles

+ Industrial wastewater

Among the wastewater from the plants in Bao Minh Industrial Park, textile dyeing wastewater effluent will be of special concern due to complex chemical composition as well as large expected proportion of wastewater flows.

In particular, textile dyeing wastewater is divided into various stages with different components of waste water, high BOD and COD concentration as well as high color temperature. As there is a clear difference between the stages of the production process, it is necessary to split the waste stream within each production line in each pre-treatment site before WW is treated.

Table 1-2. List of Businesses in Bao Minh Industrial Park - Phase 1

No.	Business name	Business line	Area (ha)
1.	Thien Nam Sunrise Textile Joint Stock Company	Textile, dyeing	12.8195
2.	Sunrise Spinning Company	Yarn spinning for textile industry	7.52
3.	Nam Dinh Forest Products Joint Stock Company	Production of furniture exports	7.5582
4.	Hoi An Contruction Company	Services, travel, hospitality	0.58
5.	Sumi Wiring	Production of automotive electrical cables	5.42
	Sum		33,87

Table 1-3. Textile wastewater components

No	*Parameters*	*Unit*	*Designed value*
1	pH	-	8-12
2	COD	mg/l	700-900
3	BOD_5	COD	250-500
4	Colour	Pt-Co	220-400
5	SS	mg/l	80-150
6	N Total	mg/l	5-15
7	Fe	mg/l	7-9
8	Pb	mg/l	0.5-1
9	As	mg/l	0.1-0.5
10	Cd	mg/l	0.01-0.5
11	Coliform	MPN/100ml	≥ 5000

[Source: Actual data provide by Ningbo – China textile wastewater plan (one of primary investor in IP)

Table 1-4. Textile wastewater components

No	*Parameters*	*Unit*	*Designed value*
1	pH	-	3 – 8.5
2	BOD	mg/l	800 – 3,000
3	COD	mg/l	600 – 5,000
4	SS	mg/l	350 – 1,800
5	Nitrogen	mg/l	12 – 120
6	Phosphorus	mg/l	2.5 – 6.5
7	Grease	mg/l	1 – 3.5
8	Heavy metal	mg/l	0.1 – 0.9

9	Colour	Pt - Co	200 – 1,000

[Source: Nguyen Van Phuoc, Domestic and Industrial wastewater treatment by biological method, 2006]

In Bao Minh Industrial Park, there are some secondary investors with different business lines such as Nam Dinh Forest Products Joint Stock Company trading in manufacture of furniture exports, Sumi Wiring trading in production of automotive electrical cables. Therefore, besides textile dyeing wastewater, wastewater inputs also include furniture wastewater with high color temperature, concentration of suspended solids and large persistent organic compounds.

Table 1-5. Wastewater components of Furniture manufacturing

No	***Parameters***	***Unit***	***Concentration***
1	pH	-	6 – 7.5
2	BOD_5	mg/l	600 – 900
3	COD	mg/l	500 – 1,200
4	SS	mg/l	500 – 1,300
5	Nitrogen	mg/l	4.5 – 15
6	P total	mg/l	1 – 3.5
7	Heavy metals	mg/l	0.1 - 0.5

[Source: Nguyen Van Phuoc, Domestic and Industrial wastewater treatment by biological method, 2006]

+ Domestic wastewater

Domestic wastewater in the industrial zone mainly comes from workers with the average load of 120 – 150l per day per person. In phase 1, the covered area is 93 ha in the industrial zone with the estimated workers of 120 - 150 persons/ha, thus the number of workers in Bao Minh Industrial Park in Phase 1 is estimated at 12,000.

Table 1-6. Forecast the pollution load in waste water of labors (estimated volume of 12000 people)

No	**Prameter**	**Unit**	**Volume calculated by WHO**	**Total volume**
1	BOD	g/person/day	45 - 54	540-648
2	COD	g/person/day	85 - 102	1020 - 1224
3	TSS	g/person/day	70-145	840 - 1740
4	N-T	g/person/day	6 - 12	72 - 224
5	N- NH_4	g/person/day	3.6 – 7.2	43.2 – 86.4
6	P-T	g/person/day	0.6 – 4.5	7.2 - 54
7	Total bacterial	MPN/100ml	10^9 - 10^{10}	-
8	Coliform	MPN/100ml	10^6 - 10^9	-
9	Fecal Stemorela	MPN/100ml	10^5- 10^9	-

No	Prameter	Unit	Volume calculated by WHO	Total volume
10	Worm egg	-	10^3	
11	Virus	-	10^2 - 10^4	

(Source: WHO)

(2). Influent profiles

The treated wastewater have to meet the national regulation QCVN 40: 2011/BTNMT, Column A, Kq=1,1; Kf=1,0 in such parameters as pH, SS, BOD_5, COD, DO, NH_4^+, NO_3^-, Fe, Pb, As, Hg, Cd, Coliform,…

(3). Predicting the flow of wastewater to CETP

Average flow: 208m^3 / h

Maximum flow: 312m^3 / h

Unable factor: K = 1.5

(4). Assess the wastewater characteristics based on available standard

To be sure that WW quality in each factory in Bao Minh IP is not suitable for requirements for the discharge standards stipulated by QCVN 40:2011/BTNMT, column A, K_q = 1.1; Kf = 1.0.

1.5.2.2. Characteristics of CETP

(1). Description of wastewater collection system, drainage system

Wastewater collection system

Domestic wastewater and industrial wastewater generated in the production process are collected by a separate pipe to the drainage system leading to the centralized wastewater processing which follows the wastewater treatment standards QCVN 40:2011/BTNMT, column A (Kq = 1.1; Kf = 1.0) before being discharged into the environment.

The sewer line with diameter less than or equal to 300mm will use uPVC pipe to reduce the slope, pipe burial depth and for easy installation. The pipeline with a diameter greater than or equal to 400 mm, or the pipeline crossing the road will use reinforced concrete pipe.

Drainage system

Drainage system is designed separately with sewer systems. Drainage network is designed as self-gravity flows to reduce the buried culvert and to construct arrangement in drain lines of the pavement. Reinforced concrete box culvert to be used in the cross sections.

(2). Wastewater Treatment Technology

Diagram of wastewater treatment technologies

From the analysis, assessment of advantages – disadvantages of the available waste water treatment technologies, we select the centralized wastewater treatment technology for Bao Minh Industrial Park as the following:

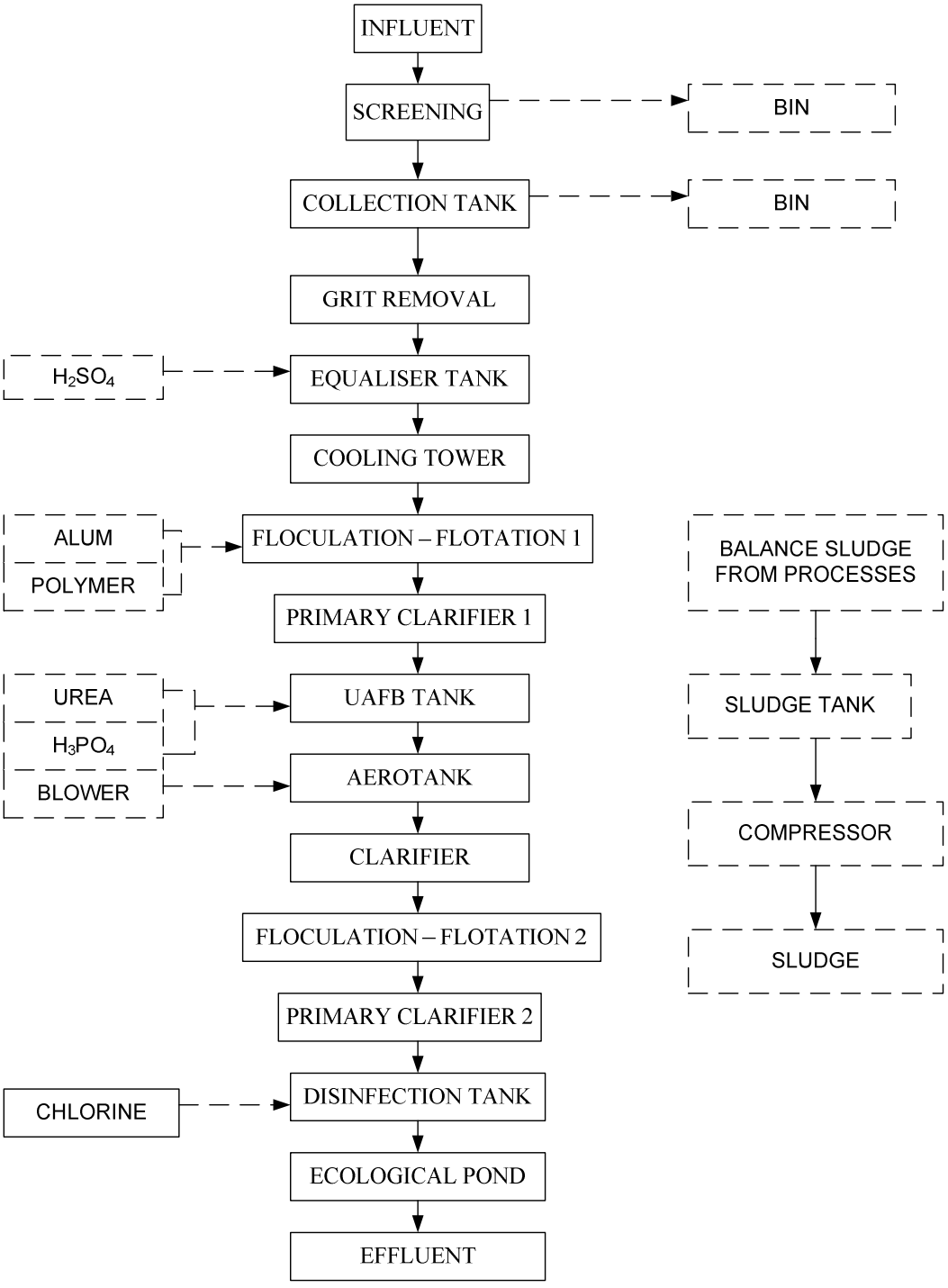


Figure 1-1. CETP diagram

Technology description

Wastewater from textile facility in Bao Minh IZ flows the drainage system into manhole consisting of the rough screen. Slit of the rough screen with size of 5 mm is responsible to remove large pieces such as fibers, packaging, rags, glove, plastic…to avoid damaging pump or clogging the works behind. Wastewater is pumped the fine screen to remove small pieces such as thread, fibers,…, then flow into equalizer tank.

Function of the equalizer tank is to equal flow, component and characteristic of wastewater to avoid overflow in the peak hours and help facility in stability. Aerator is in the equalizer tank to avoid sedimentation and anaerobic decomposition process, reduce heat and a part of organic in wastewater. H_2SO_4 is added to neutralize of wastewater. Then the wastewater is pumped the cooling tower to reduce heat before flowing next unit.

The textile wastewater with high colour flows to the Flocculation-Flotation tank-Primary clarifier 1 to reduce the amount of residue, colour before flowing to next biological treatment cluster. PAC is be added as flocculation at the flocculation tank. Motor speeds 50-100 r/min in order to make good contact between chemical and water, distribute evenly residual cotton. Next step, polymer is be added to the flotation tank as flocculation aids. Motor speeds 15-20 r/min to avoid disruption of residual cotton.

Next, the wastewater flows automatically the anaerobic biological tank in order to cut complex organic compounds to be simple compounds, to facilitate aerobic decomposition process followed.

In the aerobic biological tank, activated sludge, dissolved and dissoluble organic substances are converted into bio-cotton – aerobic microbial that is able to settle under the gravity effluence. Wastewater continuously flows to biological tank in the same time air is mixed into the activated sludge (DO > 2 mg/l) which provides oxygen for microorganism to decompose organic. Under this condition, microorganism growth and increase in cotton sludge. The mixture of activated sludge and wastewater is called as disturbance that continues to flow to the clarifier tank.

In the clarifier tank, sludge is separated from wastewater. Sludge in sedimentation has content of SS = 8,000 – 10,000 mg/l, a part of this sludge will return the aerobic tank (about 25-75% of volume) to stabilize high density of microorganism to decompose quickly organic, as soon as keep stability of MLSS = 2,500-4,000 mg/l. Equipments in the clarifier are center pipe to distribute water, brushed sludge bars – motor and water collection serrated trough. Moisture of sludge is arranged of 95-98%. Residual sludge is pumped compressor every day.

The wastewater after being treated with the aerobic process, will be run through the flocculation – Flotation 2 to remove absolutely colour and residual cotton.

The discharged water meets the type A of national regulation - QCVN 40:2011/BTNMT and then is pumped into biological pond to settle it before releasing into the environment.

Biological sludge arising from clarifier is pumped into compressor. Sludge after decreasing moisture at the compressor is pumped through sludge dewatering. Function of the sludge dewatering is to dry sludge which is collected in the prescrible place. The water separated from sludge is run out collection tank to treat.

(3). Chemicals used for CETP

Chemicals used in CETP are carefully kept in storage, clarified by bracket or tank. After the chemicals used in the operation, containing shells, containers will be classified and handled as current regulations.

Table 1-7. Chemicals used for CETP

No	Chemical	volume (g/m^3)	capacity (m^3/day)	Average of day (kg)	Average of year (kg)
I	For the flocculation – flotation 1				
1	H_2SO_4	30	5000	150	54,750
2	Alum	150	5000	750	273,750
3	Polymer	5	5000	25	9,125
II	For UAFB and Aerotank				
4	Ure	40	5000	200	73,000
5	H_3PO_4	12	5000	60	21,900
III	For the flocculation – flotation 2				
6	NaOH	20	5000	100	36,500
7	Alum	170	5000	850	310,250
8	Polymer	5	5000	25	9,125
IV	For disinfection				
9	Chlorine	5	5000	25	9,125
V	For compressor				
10	Polymer	10	5000	50	18,250

1.5.2.3. Characteristics of wastewater discharge

(1). Technical characteristics of drainage system, sewer

The drainage system is designed as self-gravity flow, using reinforced concrete close ditch at the road crossing section.

Sewer system: The sewer line with diameter less than or equal to 300mm will use uPVC pipe to reduce the slope, pipe burial depth and for easy installation. The pipeline with a diameter greater than or equal to 400 mm, or the pipeline crossing the road will use reinforced concrete pipe... Manholes with H <2m will use brick structure and reinforced knit cap. Manholes with H ≥ 2 m will use the bottom structure of less than 1.5 m or less as concrete while the upper one uses brick, reinforced knit cap.

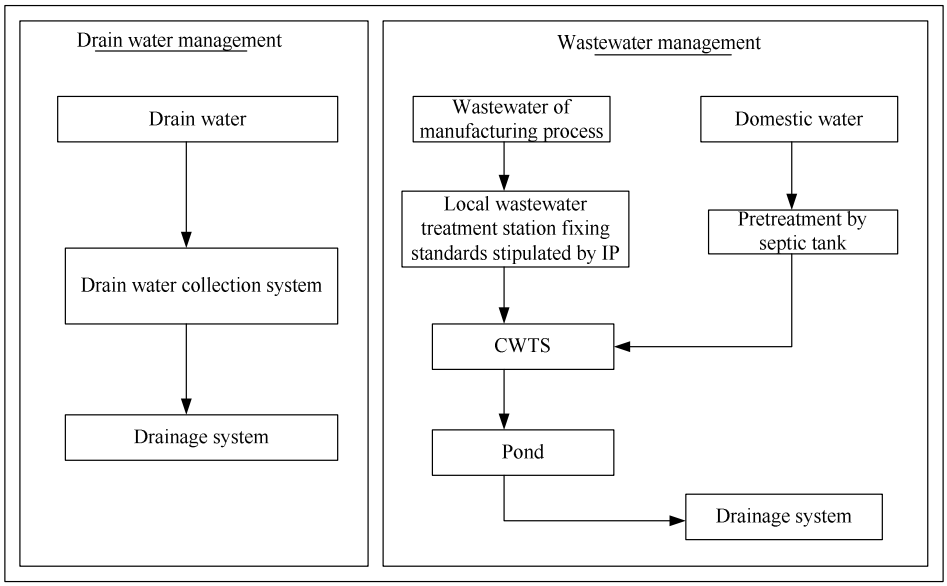


Figure 1-2. The operation diagram of drainage system and sewer

(2). Discharge method

Wastewater treated will be leading to the open canal system by concrete sewer system with gravity flowing. The pump stations are arranged at discharge outlet of C9 and C9-5 channel.

(3). Discharge Schedule

The wastewater treatment plants used the automatic combination of chemical and biological treatment methods, so wastewater treatment system is operated 24 hours a day.

(4). Discharge flow rate

- Maximum discharge flow rate is 4500 m^3/day;

- Averaged discharge flow rate is 3370 m^3/day.

1.5.3. Sludge treatment technology

Sludge treatment technology of CETP of Bao Minh Industrial Park - Phase 1: Excess sludge from the primary clarifier and secondary clarifier will be pumped periodically to the compressed sludge tank. At the compressed sludge tank, sewage sludge is concentrated by gravity sedimentation method, sludge is collected into the bottom by the system of brushers. Depending on the concentration of biomass in the

sludge tank that total dissolved solids (DS) ranging from 2-3% are in the sludge dewatering process before being pumped into compressor, then sludge in the form of bread will be packaged in a container and stored in house containing dry sludge before in process of sanitary landfills. Excess wastewater from sludge tank and compressor will be circulating pump for retreating process.

The whole of this sludge will be transferred and treated in accordance with provisions of the current law by Tan Thuan Phong Co., Ltd (address: Km 8, National Highway 5, Nam Son, An Duong, Hai Duong) in a contract with Bao Minh IZMB. Tan Thuan Phong Co., Ltd. commits to comply with the technical process of collection, transportation, storage and preservation of sludge. The sludge treatment process done by Tan Thuan Phong Co.,Ltd is shown as below figure:

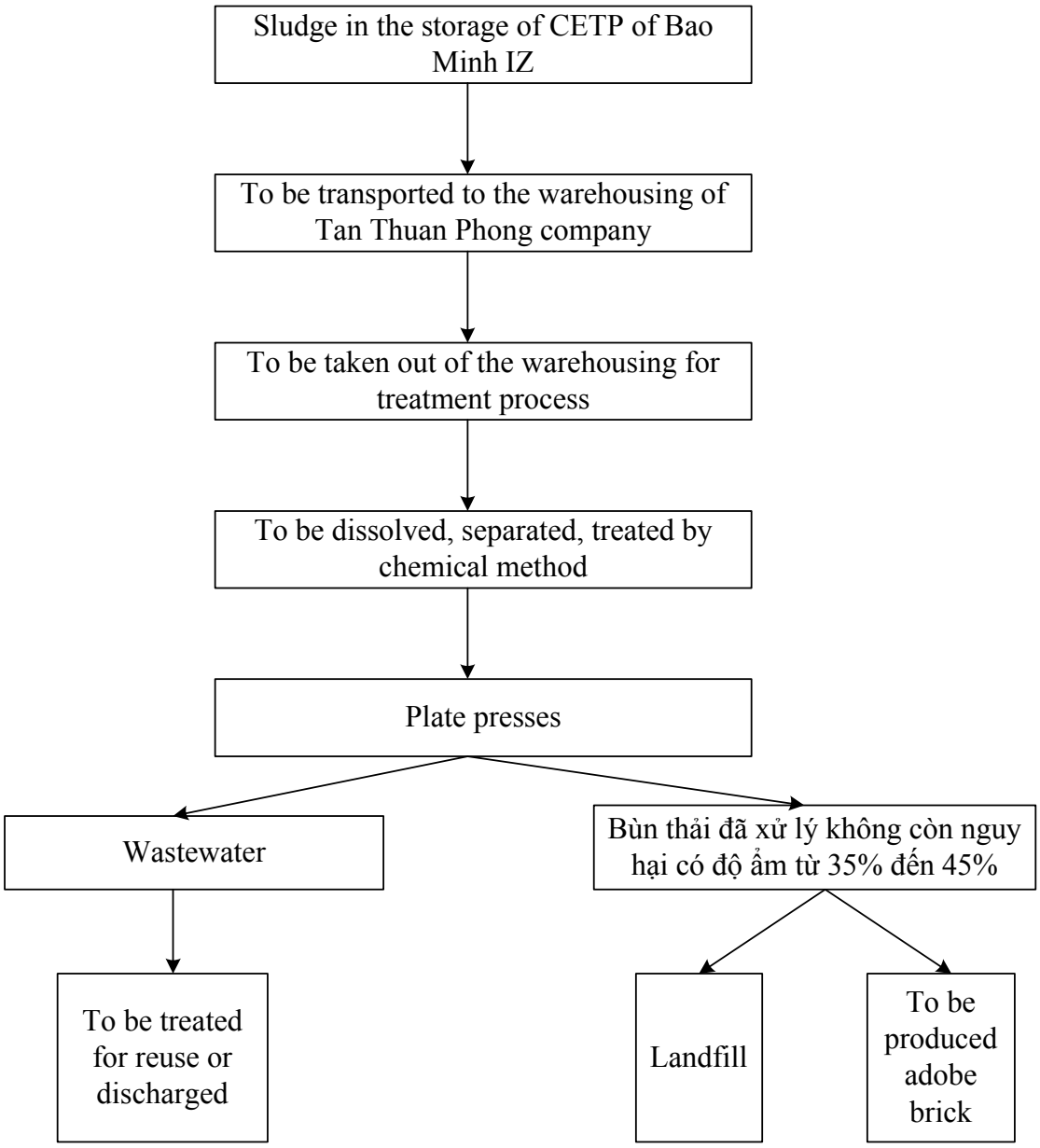


Figure 1-3. The sludge treatment process done by Tan Thuan Phong Co.,Ltd

1.5.4. The investment and treatment cost of waste water treatment plant

1.5.4.1. Total investment cost

Total cost of the construction works is presented in the following table:

Table 1-8. Total investment of Bao Minh Industrial Park wastewater treatment plant, phase 1 – capacity of 5000 m^3/day

No.	Cost item	Net cost (vnd)
I	Construction	40.757.455.857
II	Equipment	27.364.495.000
III	Other cost	2.343.894.855
IV	Provision for expenses	3.523.292.286
	TOTAL	73.989.137.999

(In words: seventy-three billion, nine hundred and eighty-nine million, one hundred and thirty seven thousand, nine hundred and fifty-six dongs)

1.5.4.2. Operating cost of the CETP

From data caculated by depreciation, repair, labor, sludge colection, chemicals, monitoring cost , power operation cost, other costs, interest rate, the treatment cost for each m^3 of treated wastewater will be 14,238 vnd/m^3.

1.5.5. The progress of project activites

The progress of project activites including construction time estimated is 12 months (360 days), including:

- To survey and design techniques: 02 months;
- To construct; import, and manufacture equipment: 06 months;
- To transport, instal equipment: 03 months;
- To run pilot, tranning, and technological transfer: 01 months.

1.5.6. The demand of human resource

Labor for operation of CETP is 12 people, including:

- Environmental staff: 03 people;
- Operational staff: 06 people;
- Security Guad: 03 people.

CHAPTER 2 PROJECT AREA CHARACTERISTICS

2.1. GENERAL CHARACTERISTICS OF PROJECT AREA

Wastewater treatment plant is located in the Lot area of 1.56 ha in Bao Minh Industrial Park. Followings are some brief introductory information on Bao Minh Industrial Park:

Located on Highway 10 and North-South rail line connecting Nam Dinh City and Ninh Binh, Bao Minh Industrial Park's planned land covers an area of 165.17 hectares in area 3 of Kim Thai commune, Lien Minh and Lien Bao, Vu Ban district, Nam Dinh. The area in the approved plan is 156.13 ha, the total industrial area that can be leased is 154.5ha, the area rented by units is 37.12 ha that now occupied 35,65% of fill land (detail is table 1.2). Bao Minh IZ has the following boundaries:

- North: Adjacent to farmland in Lien Bao and Kim Thai.

- South: Adjacent to Highway 10

- East: Adjacent to the armor cemetery (To Cau Village) and the cultivated fields in Kim Thai commune.

- West: Bordering on road to the commune and cultivated fields in Lien Bao commune (Road to Dong Duc Cemetery).

Bao Minh Industrial Park is 10 km away from Nam Dinh City, 100 km from Hanoi, 80 km from Hai Phong Port and near waterways connecting the 3 provinces of Nam Dinh, Thai Binh and Hai Phong. Conveniently located for transport, urban and residential areas, Bao Minh Industrial Park meets all the necessary conditions to attract foreign and domestic investors.

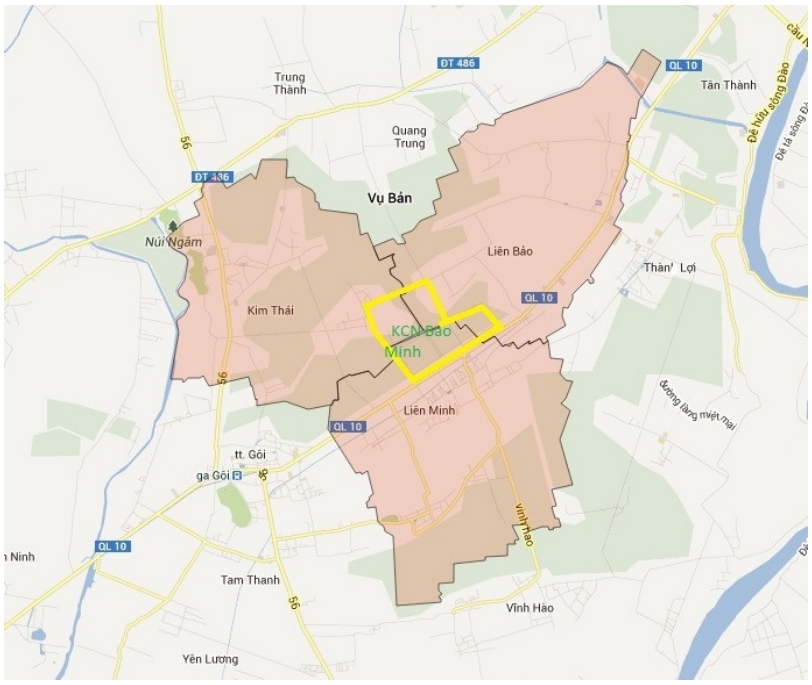


Figure 2-1. Boundary map of Bao Minh IZ

2.1.1. Natural characteristics

2.1.1.1. Climate

The area of project is in tropical monsoon climate and the northern plains. The data about climate characteristics are measured at meteorological station in Nam Dinh for over 20 years.

- Temperature:
  - + The average temperature in summer: 27.8^0C;
  - + The average temperature in winter: 19.5^0C;
  - + The average annual temperature: 23.7^0C;
- Humidity:
  - + The average annual humidity: 84%
  - + The highest humidity: 94%
  - + The lowest humidity: 65%
- Rainfall:
  - + The annual rainfall: 1,829.7 mm;
  - + The highest rainfall at day: 350 mm;
  - + The amount of 10%: 270 mm.
- Wind:
  - + The highest speed: 48 m/s;
  - + The average speed: 2.4 m/s.
- Wind direction:
  - + In summer: South West;
  - + In winter: North ward.

2.1.1.2. Hydrological Conditions

Hydrology of the project area is affected mainly by Đay river in part through the province of Nam Dinh, with a length of 82 km. The flood season is from June to October, with average water level is above 1 meter, highest months as the July, August, September, maximum in August (1.68 meter). Dry season is from November to May, the average water level is less than 1 meter, lowest months as February, March, April, minimum in March (0.40 meter). If the water level at the absolute highest is able to overcome 1st alarming rate from June to October that, and 3th alarming rate from the July August, September.

Terrain: Generally, the project construction area has relatively flat topography. The surface topography is mainly loam and sandy loam soil. The topography is of accumulation plains type. The formation of this type of terrain is mainly river

sediments, sea sediments and river marine sediment mixture. The entire area is wide and convenient for road transportation and collection of construction materials to the work items.

Geology: The project area is located in the relatively complex geological and stratigraphic region including mixed soil layer with relatively low load capacity. The good soil bearing high load capacity is 24m-30m deep from the field.

Based on the survey results of drilling on the field as well as the experimental and analytical results in laboratories, the land in the project construction area is divided into layers from top to bottom as follows:

- Layer 1: Farmland layer (gray brown, yellow gray clay mixed with roots, plants). This is a layer of wide distribution over the entire project surface area with thin thickness of heterogeneous components varies from 0.2 m to 1.5 m. As this soil layer does not make much sense in terms of construction geology, it should be removed or replaced.

- Layer 2: Gray-brown and gray-yellow clay, soft plastic state.

  - This is the layer of soil beneath farmland with a narrow and discontinued distribution in the project area with ingredients including mostly gray-brown and gray-yellow clay with soft plastic state..
  - The thickness of this layer is quite thin, ranging from 0.4 m to 1.2 m.
  - This is the soil layer bearing low load capacity with R '= 0.8 kg/cm^2; E_0 = 60 kg/cm^2

- Layer 3: Dark gray clay mud.

  - It is derived sediment layer consisting of dark gray sludge and widely distributed within the project area. Layer 3's thickness varies from 1.4 m to 6.7 m.
  - + After conducting sampling and testing, the results are as follows: Shear strength C = 0.06 Kg/cm^2; Ø = 7^{o}11 '; subsidence compression ratio a1-2 = 0.1078 cm^2/kg; Conventional load capacity R '= 0.5 kg/cm, deformation modulus: E_0 = 30 kg/cm^2.

- Layer 4: dark gray sand, liquid state.

  - It is derived sediment layer, consisting of dark gray sand, liquid state, and widely distributed within the project area. Layer 4's thickness varies from 2.8 m to 7m.
  - Experimental results of the physical and mechanical soil are as follows: Shear strength C = 0.14 Kg/cm^2; Ø = 15^{o}31; subsidence compression ratio a1-2 = 0.0415 cm^2/kg; Conventional load capacity R '= 0.9 kg/cm, deformation modulus: E_0 = 30 kg/cm^2.

- Layer 5: Dark gray clay mud.

  - It is derived sedimentary layers with components mainly dark gray silt loam and is widely distributed in the project area. Thickness varies from 2.3 m to 23.9 m.
  - Experimental results of the physical and mechanical soil are as follows: Shear strength C = 0.07 Kg/cm^2; Ø = 7^{o}6; subsidence compression ratio a1-2 = 0.0727 cm^2/kg; Conventional load capacity R '= 0.6 kg/cm, deformation modulus: E_0 = 40 kg/cm^2.

- Layer 6A: dark gray sand granules, saturated water, and porous structure.

  - It is derived sediment layer, with components of small dark gray sand, saturated with water, and has medium structure.
  - This soil is widely distributed in the project area and has undefined thickness because the drilling depth (25m) hasn't touched this layer.
  - This is a relatively good soil, the experimental results are as follows: Dry angle of repose α_c= 31^{0}17 '; Wet angle of repose α_w= 21^{0}03'; Maximum void ratio €max = 1.38; Minimum void ratio €min= 0.62; Conventional load capacity R' = 1.2 Kg/cm^{2,} deformation modulus: E_0= 80 Kg/cm^2

- Layer 6B: dark gray sand granules, water saturation, and medium structure.

  - It is derived sediment layer, with components as small dark gray sand, with components of small dark gray sand, saturated with water. It has medium structure and is locally distributed within the project area.
  - The thickness of the layer is not determined by the end boreholes (30m) which are still in this layer.
  - This is a relatively good soil, the experimental results are as follows: Dry angle of repose α_c= 29^{0}59 '; Wet angle of repose αw= 20^{0}02'; Maximum void ratio €max = 1.47; Minimum void ratio €min= 0.66; Conventional load capacity R' = 2 Kg/cm^{2,} deformation modulus: E_0= 150 Kg/cm^2.

Based on the drilling results and geological survey as well as experimental results of the physical and mechanical soil, the project area can be assessed broadly as follows:

- For works with small and medium loads (factories, low buildings under 3 stories) can put foundation in layer 6A and 6B.
- In case of lying in layers 2, 3, 4, 5, there must be measures to reinforce the land appropriate to ensure the stability of the building.
- For projects with large loads, it is necessary to have additional drilling options at the necessary positions to be able to properly assess geological conditions and has specific foundation design.

The geological structure of the region as above, the foundation of Bao Minh CETP can be put in layer 6A and 6B. In this layer, safety coefficient as well as the load capacity is suitable for the weight of CETP. However, Owner still choose method to reinforce the building foundation with concrete allergic - power pile length of 30 meter.

2.1.2. Socio-economic Conditions

Vu Ban locates in the northern of Nam Dinh province. The northern of this district is adjacent to Ha Nam province and My Loc district, the eastern and southern is adjacent to Y Yen district. Vu Ban has a total of 17 communes and 1 town including: Goi town, commune: Hien Khanh, Minh Thuan, Tan Khanh, Hop Hung, Trung Thanh, Quang Trung, Dai An, Kim Thai, Minh Tan, Tam Thanh, Lien Minh, Thanh Loi, Lien Bao, Vinh Hao, Tan Thanh, Cong Hoa, Dai Thang. Among them, 3 communes that are Lien Minh, Lien Bao, Kim Thai are located adjacent to Bao Minh IP.

To assess economic-social condition of 3 communes Lien Minh, Lien Bao, Kim Thai, investor and consult unit refer to report of performing economic-social tasks of 6 month in the end of 2012 of 3 communes. The general report is follow as:

2.1.2.1. Socio-Economic condition of Lien Minh

(1). Production Situation of Agriculture - Livestock - professional development

Cultivation, in the first 6 month of 2012, the area for rice and farm produce is 628 ha, in there, area for rice is 498 ha, peanut are is 127 ha, and vegetable planning area is 3 ha. According to statistics, the average yield of rice is 55 quintal/ha, total rice output reaches 27,390 tons. Peanut average yield reaches 36.1 quintal/ha, total peanut output is 4,585 tons.

For livestock, domestic fowls and cattle in Lien Minh were listed until 2012 June, 30 as follows:

- Total number of pig was 1,832;

- Total number of cattle was 682;

- Total number of domestic fowls was 42,500.

Lien Minh CPC with others organized seasonal vaccination for domestic fowls and cattle. Veterinary group often have method to prevent the spreads of disease.

For traditional crafts, locality encourages to maintain and develop traditional crafts such as lacquer, rattan, embroidery. Local government encourages co-operatives to open courses for local workers, to contribute to traditional villages.

(2). The new rural construction

For the construction of new rural, the commune authorities built house of culture of team 2 with area of 70 m^2 and a total budget of 299,917,000 vnd. The main

road of village has length of 130 m with a total budget of 32,000,000 vnd. To built Trung Nghia village road, widen is 3.5 m, length is 100 m, total budget is 300,000,000 vnd.

For the farmland consolidation, the Executive Committee Resolution has given No. 25 on 2012 March, 30 to establish farmland consolidation Board to implement resolutions of 15 villages. Conferences were organized to lobby people to donate land for building traffic, irrigation.

(3). Traffic, irrigation, flood prevention

- For irrigation transportation

Lien Hoa co-operative repaired canal N86 with length of 200 m, built 4 new sewers, built new cannal N84 with length of 690 m, dredged 766 m^3 of sediments under the canals.

Hao Kiet co-operation dredged 2,835 m of canal with a total weight of 1,283 m^3.

Luong Kiet co-operation solidified canals with a length of 215 m, renewed 4 sewers, maintained N1b channel with a length of 214 m, dredged a volume of 2000 m^3, widened to drainage flow before the rainy season.

- The prevention of flooding, storm

Board of the prevention of flooding and storm was established in 2012 to built detail project, and develop for the unit, co-operation, school, health center, and village. To perform controlling, clearing away surface of Chanh river were done to drainage water in the rainy season.

2.1.2.2. Socio-Economic conditions of Lien Bao Commune

(1). Agricultural production

- Cultivation

The area of winter crops cultivated in Lien Bao Commune is 306 ha, increased by 25 ha in comparison with 2011. The total area of planted rice as the investigation achieved 1,200 hectares meeting the set out plan. The summer crop yield was 65.98 kg / ha, the total rice output was 2,850 tons, increased by 8.4 tons.

Area of farming crops: the area of peanut was 238 ha with the yield of 1,435 kg / ha, total production reached 406.2 tons.

- Breeding, veterinary

Total herd of cattle and poultry of the commune decreased in comparison with 2011, specifically, the herd of pigs had 2350 ones, herd of buffalo had 465 ones.

The tasks of preventing the disease for pigs, cattle, poultry were held regularly. In the province, in the first 6 months, there was no epidemic disease for livestock and poultry. Vaccination for pigs, achieved 70%, 75% for cattle as planned.

- The infield irrigation

Having organized to dig, bank the multifield dam, the edge of ricefield with a volume of 93 m^3, the task of dredging canals was accepted with the volume of 7,758 m^3; building and repairing 5 culverts and dams of all types.

(2). Industry - Handicraft - Trade and services

To continue to implement the program of industrial - handicraft development in period 2010 - 2020 People's Committee of Vu Ban District. To promote propaganda to encourage industrial - handicraft development in period 2010-2020. To encourage all economic sectors in society to develop small and medium trade and services to serve the actual needs of the local people. In the commune now having 258 business households in the field of construction, transportation, trade and services. The 6 months revenues reached 7 billion dong.

(3). Social Culture

- Culture and Information – Sports

To do well the propaganda such as: painting hoardings, posters, propaganda slogans on radio system.

To perform well the land consolidation and field change in the commune.

The commune has 03 villages certified as cultural units.

To gain the first prize when participating in the human chess competition at Van Cat District; to gain the third prize when participating in the cross-country running competition of the district.

- Education – Training

Preschool: Maintaining the good parenting mode. In academic year 2011 – 2012, all schools of commune reached the advanced and excellent title.

Primary school: 100% of the primary schools completed the primary school program.

Secondary school: The graduation results of students in grade 9 of secondary schools reached 100%. The students participating in the excellent student competition at district level gained the achievements of: the first prize in mathematics, the third prize in English.

- Health – Population

To train on the winter and spring disease prevention. To train on summer disease prevention. To train on prevention from scarlet fever, mumps, chicken pox, hand – foot – mouth disease, acute diarrhea, food poisoning.

To train on professional work for medical officials in the village bases.

To coordinate and organize to consult, examine freely for the elderly people.

To organize the Vietnamese Doctor's Day Celebration, to summarize the work of Health - Population, Family Planning 2011.

The local hygiene at station is organized regularly.

2.1.2.3. Socioeconomic conditions of Kim Thai Commune

(1). Agricultural production

Cultivation

Total planted area reached 614 ha, 100% of the set plan, of which the area of rice field reached 503.4 hectares, the average yield was 60 quintals / ha, total rice output reached 3,021 tons, decreased by 252 tons in comparison with the fifth-month crop 2011. The area of peanut reached 110.6 ha peanuts with the average yield of 43 quintals / ha, total production output reached 476 tons, increased by 36 tons compared to 2011. The total output including farming crops was estimated as 4,687 tons.

Breeding

Veterinary work is always concerned, maintained to ensure both quantity and quality. The result of organizing to vaccinate cattle, poultry in spring 2012 was as follows:

Total cattle herd reached 274 ones, of which 23 buffaloes, 251 cows;

Total pig herd: 17,000 ones;

Total poultry herd: 42,260 ones;

Total dog herd: 1,570 ones.

(2). Basic construction

To continue implementation of Sai market, and strive to complete and put into use in the quarter 3, 2012. To invest to construction of gates, guard houses, toilets, boundary walls of secondary schools were about more than 1 billion dong.

(3). Transport and irrigation

To implement well the campaigns for infield irrigation; to repair works of bridges, culverts, canals, irrigation pumping stations of two agricultural cooperatives to meet timely the irrigation demand for agricultural production.

The results of the first 6 months in 2012 of the transportation and irrigation sector of the commune achieved as follows:

To maintain the internal commune roads with the volume of 500m^3 volume valued more than 50 million. To focus on measuring and counting and clearing more than 700 m length under the tours from the Afternoon market of Goi town to the Bridge hamlet and from the Commune People's Committee to Van Cat District in order to hand over to the construction company.

Maintaining, dredging canals: 4,754 m^3

Clearing flow: 44.000 m

Reinforcing canals: 861 m

Newly building and maintaining bridges with total value of over 50 million dong.

(4). Land Management

To regularly propagandize for people to implement the land law well.

To positively strengthen the land management work. 9 cases of land violation were detected handled. 01 case of violation was organized to enforce.

2.2. RECEIVING WATER CHARACTERISTICS

2.2.1. Discharge location

Individual wastewater treatment plants from factories in the industrial park will discharge their effluents in the pipe system to centralized wastewater treatment plant. The sewer lines are located on the sidewalk along the route close to the factory's wall. The manholes are located at a distance of 30 meters to collect and test water quality network. The sewer line with diameter less than or equal to 300mm will use uPVC pipe to reduce the slope, pipe burial depth and for easy installation. The pipeline with a diameter greater than or equal to 400 mm, or the pipeline crossing the road will use reinforced concrete pipe... Manholes with H <2m will use brick structure and reinforced knit cap. Manholes with H $\geq$ 2 m will use the bottom structure of less than 1.5 m or less as concrete while the upper one uses brick, reinforced knit cap.

After being treated at centralized plant, water will be collected on the open ditches C9, C9-5 and led to Chanh river to Chuoi Bridge and then pumped to T10 canal to direct to Nam Dinh (Dao River in particular) by Coc Thanh and Chanh River pump stations. Coc Thanh and Chanh river has 3 pumps, capacity of each pump is 36,000 m^3/h.

Dao River is located in the heart of Nam Dinh dividing the city into two regions - South and North, connecting the Red River and Day River. Both sides of the river have two solid dykes. Its main function is to regulate water in the city and neighborhoods during the flood season, in addition to provide water for daily activities, create significant economic resources, landscape and ecosystems for the region. Thus, Dao River has always been taken care and protected; only receive qualified water for domestic water supply.

Table 2-1. Surface water quality of Dao river

No	Parameter	Unit	Results	QCVN 08:2008/BTNMT	
				A1	A2
1	pH	-	6.9	6.0-8.5	6.0 – 8.5
2	DO	mg/ l	5.2	≥ 6	≥ 5
3	BOD_5	mg/ l	5.4	4.0	6.0
4	COD	mg/ l	11.5	10	15
5	TSS	mg/ l	28.2	20	30
6	Mn	mg/ l	0.2	-	-
7	NH_4^+	mg/ l	0.16	0.1	0.2
8	As	mg/ l	<0.05	0.01	0.02
9	Fe	mg/ l	0.8	0.5	1.0
10	PO_4^{3-}	mg/ l	0.2	0.1	0.2
11	Cu	mg/ l	0.4	0.1	0.2
12	Cl-	mg/ l	300	250	400
13	Hg	mg/ l	Not detected	0.001	0.001
14	Coliform	MPN/100ml	2,260	2,500	5,000

Source: Department of Natural Resources of Nam Dinh province

Note: *QCVN 08:2008/BTNMT: National regulation on surface water quality*

Table 2-2. Surface water quality of Chanh river

No	Parameter	Unit	Results	QCVN 08:2008/BTNMT	
				B1	B2
1	pH	-	6.5	5.5 – 9	5.5 – 9
2	DO	mg/ l	5.2	≥ 4	≥ 2
3	TSS	mg/ l	53.4	50	100
4	COD	mg/ l	29.6	30	50
5	BOD_5	mg/ l	12	15	25
6	NH_4^+	mg/ l	0.4	0.5	1
7	NO_3^-	mg/ l	12	10	15
8	PO_4^{3-}	mg/ l	0.3	0.3	0.5
9	As	mg/ l	0.01	0.05	0.1
10	Fe	mg/ l	1.6	1.5	2
11	Coliform	MPN/100ml	8200	7500	10000

Source: Department of Natural Resources of Nam Dinh province

Some images of Chanh River and Dao River:

Figure 2-2. Chanh River

Figure 2-3. Chanh River Drainage Pumping Station

Figure 2-4. Sewer discharge to Dao River

Figure 2-5. Dao River – flow of 832 m^3/s

Figure 2-6. A part of Dao River crossing Bao Minh Industrial Park

2.2.2. Natural characteristics

2.2.2.1. Hydrological condition at discharge source

The entire planned area in the industrial park is located in the areas being affected of the river system such as Chanh River and Sat River, most of which are Inland River impacted by the Red River and Day River system, take a role of irrigation and drainage for the surrounding areas.

The entire rain water is collected on the dragline and led to Perfume River to Chuoi Bridge and then pumped to T10 canal to direct to Nam Dinh by Coc Thanh and Chanh River pump stations... The two main local canals are C9 canal (Perfume River) and C9 – 5 canal in which C9 – 5 canal collects water for the watershed of 459 ha in width and flow out to C9 canal. C9 canal has designed bottom width of 3 m, reinforced bottom of 0.7 m, roof coefficient of 1.5, flow rate of 4.3 m^3/s. C9 – 5 canal has bottom width of 2.5 m, reinforced bottom of 0.5 m, roof coefficient of 1.5, flow rate of 2.67 m^3/s. According to data from Vu Ban Irrigation Company, the average reinforced flooding in the area is 1.5 m.

The quality of the groundwater in receiving source area in particular and the Nam Dinh province in general is divided into 2 floors. Due to geological tectonic history, the distribution of groundwater between the different tectonic faults west through Goi mountainous drops hollow and deep in eastern parts. Effect of tidal influence the direction of the river flow and the high-low level of water levels in flood-tide.

2.2.2.2. The sediment environment

The sources of waste water receiving of the sewage treatment system are Dao River Training and Sat River. One head of Dao River connects to Red River, the other head connects with Day River. Sat River connects the Chau River with Day River. The bottom mud layer is transferred by Red River and Day River with a relatively thick sediment of 15-20 cm.

Composition of organic sediment accounts for 25% -30% of powder, clay, sand accounts for 45% -50%, the fine sand, physical scrap accounts for 30%. Chemical compositions of SiO_2, Al_2O_3, Fe_2O_3, kaolinite clay, montmorilonit clay, a little feldspar, rock fragments and gotit; the heavy metal elements such as Cu, Zn, Cd, As, Pb, Hg, Cr, Sb, Mn account for a small amount.

2.2.2.3. Aquatic ecosystem

Aquatic resources in the lake region and agricultural irrigation canal are poor, low economic value. Ecosystem in the canals in the industrial zone is mainly green algae and sili algae. System of protozoa, crustaceans (zooplankton) is mainly Cladocera group, Rotatoria, Copepada which are also found in agricultural irrigation canals in the IP. There are no endemic species. In general, biodiversity in receicing area is low, there is no economic value, and no species listed in Vietnam's Red Book.

2.3. CURRENT ENVIRONMENT STATUS

2.3.1. Air quality

Taking 4 samples to evaluate the current air quality status, sampling condition is as time of day, light wind, temperature of about 27^0C. Location of the samples is determined at the fourth corner of the project area.

Table 2-3. Analyzing methods

No	Parameters	Sampling methods
1	NO_2	TCVN 6137 : 2009
2	SO_2	TCVN 5971 : 1995
3	CO	52 TCN 352 – 89
4	Suspended dusts (*)	TCVN 5067 : 1995

Note: parameter accepted by Villas

Table 2-4. Results of air quality (April 19th, 2013)

Samples	Results			
	CO (mg/m^3)	NO_x (mg/m^3)	SO_2 (mg/m^3)	Dusts (mg/m^3)
K1	20,5	0,08	0,21	0,22
K2	20,3	0,12	0,24	0,14
K3	19,1	0,13	0,19	0,18
K4	19,8	0,16	0,24	0,24

QCVN 05:2009/BTNMT	30	0,2	0,35	0,3

Note: QCVN 05:2009/BTNMT: The national technical regulation on hazardous substances in ambient air

Comments:

The analyzed results show that all parameters meet QCVN 05:2009/BTNMT, and are in the threshold.

2.3.2. Water quality status

To evaluate the water quality status, s samples are taken at the location as follows:

- Sample 1 (N1): At C9 canal (Chanh river) near Bao Minh IZ
- Sample 2 (N2): At C9-5
- Sample 3 (N3): Surface water of Day river in position of intersection between Dao river and Day river that is boundaries between Yen Nhan commune and Y Yen district.
- Sample 4 (N4): Dao river, sample position is far 3 meters from river bank

Table 2-5. Results of surface water quality (April 19th, 2013)

No	Parameter	Units	N1	N2	N3	N4	QCVN08:2008/BTNMT		
							A2	B1	B2
1	pH	-	6	7,8	6,9	6,9	6-8,5	5,5-9	5,5-9
2	SS	mg/l	48	46	29	24,2	30	50	100
3	BOD_5	mg/l	12	13	5	4,6	6	15	25
4	COD	mg/l	28	31	13	11,5	15	30	50
5	DO	mg/l	5	7	9	5,2	≥5	≥4	≥2
6	NH_4^+	mg/l	0,5	0,6	0,15	0,14	0,2	0,5	1
7	NO_3^-	mg/l	9,5	8	5	5	5	10	15
8	Fe	mg/l	1,3	1,2	0,9	0,8	1	1,5	2
9	Pb	mg/l	0,04	0,04	0,01	0,01	0,02	0,05	0,05
10	As	mg/l	0,03	0,04	0,03	0,03	0,02	0,05	0,1
11	Hg	mg/l	0,001	0,001	0,001	0,001	0,001	0,001	0,002
12	Cd	mg/l	0,006	0,008	0,004	0,003	0,005	0,01	0,01
13	Coliform	MNP/100ml	7200	7600	4900	2260	5000	7500	10000

Note: QCVN 08:2008/BTNMT: National technical regulation for surface water

Comments:

The results show that surface water quality in the project area is in allowed limit between column B1 – water for agricultural purposes and column B2 – water for traffic and other purposes.

2.3.3. Soil status

The project soil is agricultural soil, mainly planned rice and vegetables. To take 3 samples, their location are the following position:

- Sample 1 (D1): At the center of the project land
- Sample 2 (D2): At the position that is far 200 meter southwest from sample 1
- Sample 3 (D3): At the position that is far 200 meter northeast from sample 1

Table 2-6. The results of soil quality in the project area (April 19th, 2013)

No	Paraeter	Unit	D1	D2	D3	QCVN 03:2008/BTNMT
1	pH		6,9	7,2	7,3	-
2	NO_2^-		0,24	0,20	0,22	-
3	Fe	mg/kg	8,82	8,96	8,92	-
4	Mn	mg/kg	0,86	0,89	0,82	-
5	Pb	mg/kg	10,26	12,82	13,01	**120**
6	Cd	mg/kg	1,12	0,18	0,22	**5**
7	As	mg/kg	1,14	4,26	3,18	**12**
8	Cu	mg/kg	13,86	7,92	9,36	**70**
9	Zn	mg/kg	29,42	38,30	42,17	**200**

Note: QCVN 03:2008.BTNMT – National technical regulation on the allowable limits of heavy metals in the soils.

Comments:

Based on the results comparing to the national regulations on heavy metals in soils, it's concluded that soil in the project area is not polluted.

2.3.4. Noise status

To measure the noise of the project area at time that is the biggest noise of the day. Time of biggest noise is 8 to 10 am. The monitoring results are summarized in the following table:

Table 2-7. Noise status (April 19th, 2013)

Sample	Location	Noise (dBA)
T1	At center project	50
T2	At entrance of Bao Minh IZ, far 500 m from Highway 10	60
T3	At location of Nam Dinh Forest Product JSC	75

Table 2-8. Allowed maximum limits of noise (dBA)

Following QCVN 26:2010/BTNMT - national technical regulation on noise

No	Area	From 6 am to 21 pm	From 21 pm to 6 am
1	Specific area	55	45
2	Normal area	70	55

Comments:

Noise level in the project area is 50 dBA which meet national regulation on noise for both specific and normal area. At T2 sample location, noise level of 60 dBA is slightly high for standard of specific area because of near Highway 10 having participant of traffic vehicles. The result of noise of sample at T3 is slightly high comparing with national regulation because it is affected by noise of the furniture manufacturing factory.

2.3.5. Ecological environment status

2.3.5.1. Terrestrial animals

The fauna at Bao Minh Industrial Park has been changed completely and very poor. The vertebrate animals are mainly rats, frogs, geckos. In the neighbouring fields, excepting water snakes, birds can be found, bet very little.

2.3.5.2. Aquatic ecosystem

Aquatic resources in the lake region and agricultural irrigation canal are poor, low economic value. Ecosystem in the canals in the industrial zone is mainly green algae and sili algae. System of protozoa, crustaceans (zooplankton) is mainly Cladocera group, Rotatoria, Copepada which are also found in agricultural irrigation canals in the IP.

CHAPTER 3 ANALYSIS OF ALTERNATIVES

3.1. CRITERIA FOR SELECTING ALTERNATIVES

- Any of the alternative solutions still have to meet the national regulation QCVN 40:2011/BTNMT.

- The discharge point have to ensure the discharge need, while avoid the negative impacts toward the environments and the local public.

- Sludge from the treatment system has to be treated as hazardous wastes, and avoid impacts toward the environment.

3.2. THE PROJECT LOCATION

The project area surveyed is not in historical monument or possibly founding artiques during construction, so there is only one position selected to build CETP as approved plan.

3.3. WASTEWATER TREATMENT TECHNOLOGY

In Phase 1, the textile factories of Chinese investors are organizations that they have demand to treat WW Bao Minh IZ, therefore Bao Minh IZMB decided to focus on surveying WW treatment system of Ningbo1 factory - China and Sunrise factory - China to identify input parameters and suitable project. Here are the results of the actual survey in China:

3.3.1. Diagram of textile WW treatment technology of Ningbo factory – China, capacity of 10,000 m^3/day

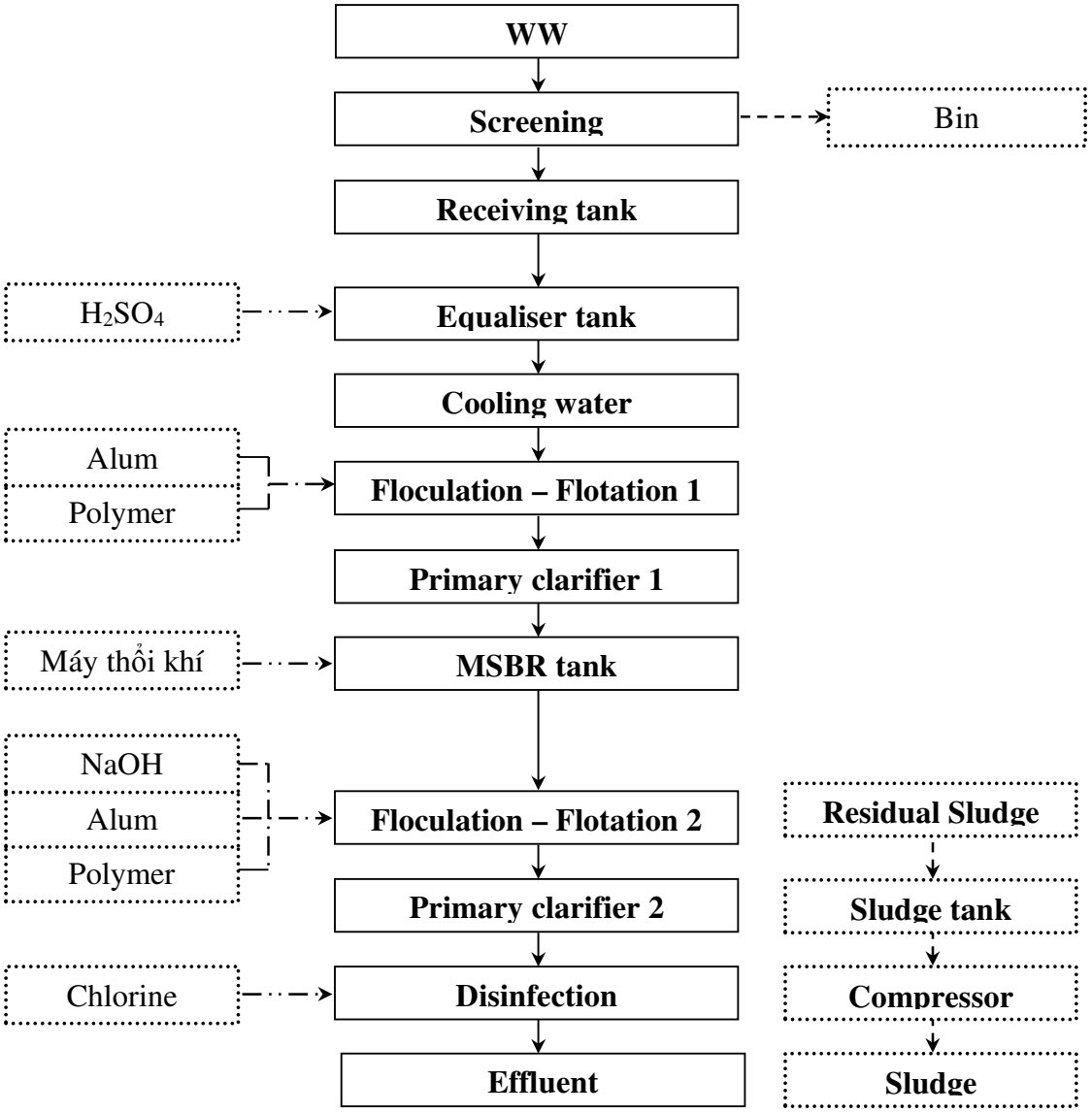


Figure 3-1. Diagram of textile WW treatment technology of Ningbo factory – China, capacity of 10,000 m^3/day

Process technology assessment:

- Designed capacity Q_{tk} = 12,000 m^3/day, reality operational capacity Q_{tt} = 10,000 m^3/day. It is stable for this system to operate with this capacity.
- Operational process is simple, odor arises slightly, output water quality is stable in some parameters as COD = 44-66 mg/l, color <40 Pt-Co, pH = 7.3 to 7.5

Conclusion: This technology process may be applied for Bao Minh IZ. However, area of CETP is large, and the size of tanks is also big. In the case system operated in maximum capacity, WW quality after treating may not be meeting the national standards of QCVN 40:2011/BTNMT, column A

3.3.2. Diagram of textile WW treatment technology of Ningbo factory – China, capacity of 10,000 m^3/day, divided into two CETPs, each CETP has capacity of 5,000 m^3/day

CETP 1:

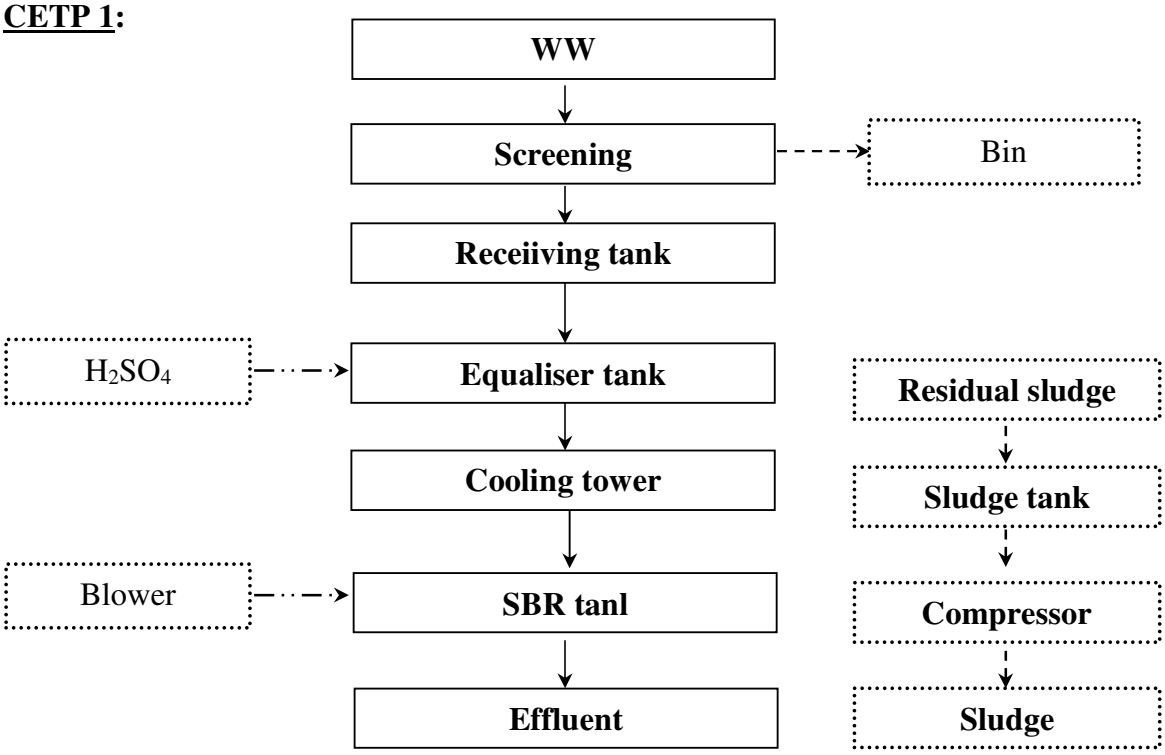


Figure 3-2. Diagram of textile WW treatment technology of Ningbo factory – China, CETP 1, capacity of 5,000 m^3/day

Process technology assessment of CETP 1:

Treatment process is simple, odor arises slightly and the size of CETP is small. Discharged water quality is not meeting national standards for industrial WW, type C.

Conclusion: This process can't be applied for CETP of Bao Minh IZ

CETP 2:

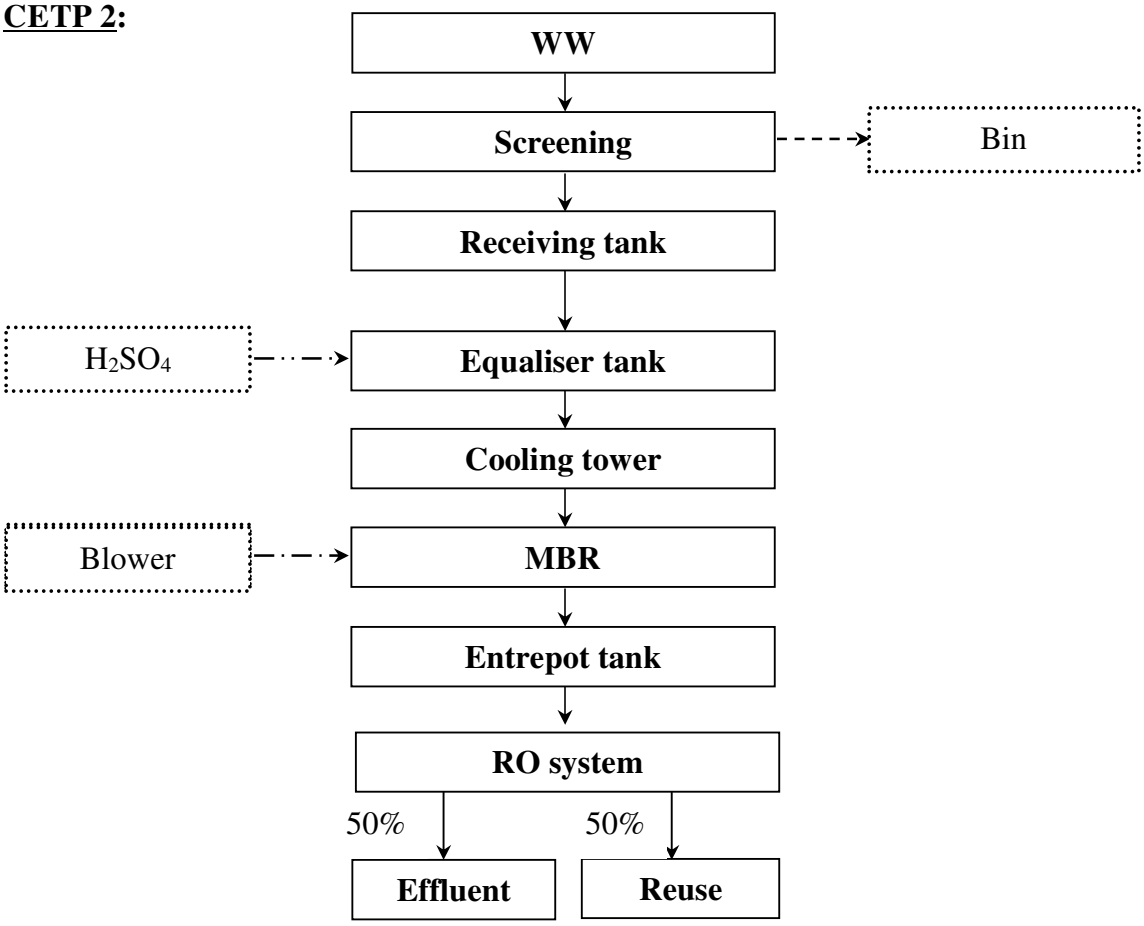


Figure 3-3. Diagram of textile WW treatment technology of Ningbo factory – China, CETP 2, capacity of 5,000 m^3/day

Process technology assessment of CETP 2:

The size of CETP is small, odor arises slightly, and chemical is not be used. Discharged waster quality is not meeting national standards for industrial WW, type C. Treatment process is complicated, water quality after treating is good to reuse for phase 1, not good and higher color and COD than requirement stipulated in QCVN 40:2011/BTNMT, column B.

Conclusion: This process can't be applied for CETP in Bao Minh IZ. However, it can be applied RO technology to reuse for WW of Bao Minh IZ (one of the requirements of secondary investors.

Assessment for requirement of reuse:

Table 3-1. Comparison of treated water quality no re-use and 50% reuse

No	Parameter	Unit	Value	
			No re-use, QCVN 40:2011-A	Reuse with 50%
1	Temperature	^oC	40	40

2	Colour	Pt/Co	50	20
3	pH	-	6 - 9	6 - 9
4	BOD_5 (20^oC)	mg/l	30	15
5	COD	mg/l	75	35
6	SS	mg/l	50	25
7	As	mg/l	0.05	0.025
8	Hg	mg/l	0.005	0.0025
9	Pb	mg/l	0.1	0.05
10	Cd	mg/l	0.05	0.025
11	Cr^{6+}	mg/l	0.05	0.025
12	Cr^{3+}	mg/l	0.2	0.1
13	Cu	mg/l	2	1
14	Zn	mg/l	3	1.5
15	Ni	mg/l	0.2	0.1
16	Mn	mg/l	0.5	0.25
17	Fe	mg/l	1	0.5
18	Total CN^-	mg/l	0.07	0.035
19	Total phenol	mg/l	0.1	0.05
20	Total oil	mg/l	5	2.5
21	Sulfua	mg/l	0.2	0.1
22	Flouride	mg/l	5	2.5
23	Ammonium (as N)	mg/l	5	2.5
24	Total N	mg/l	20	10
25	Total P	mg/l	4	2
26	Chloride (does not apply to the discharge of water into brackish)	mg/l	500	250
27	Residual Chlorine	mg/l	1	0.5
28	Total plan protection chemicals of organic-chlorine	mg/l	0.05	0.025
29	Total plan protection chemicals of organic-phosphorus	mg/l	0.3	0.15
30	Tổng PCB	mg/l	0.003	0.0015
31	Coliform	vi khuẩn/100ml	3000	1500
32	Total radioactive activity δ	Bq/l	0.1	0.05
33	Total radioactive activity γ	Bq/l	1.0	0.5

In terms of engineering - technology, the use of RO technology for wastewater reuse of Bao Minh IZ can be done. In terms of economy, solution of 50% reuse is not feasible for Bao Minh IZ because of some reasons such as:

- When reuse 50% the amount of WW, other 50% amount of the WW effluent discharged into the environment is difficult to meet the national standard QCVN 40:2011/BTNMT, column A (COD ≤ 75 mg/l), even for column B because pollution parameters will increase 50% -60% due to WW will become more dense when the reverse osmosis technology is applied.
- It must be more cost for re-treating remaining 50% WW to be discharged into the environment. Meanwhile, operational cost can be increased more from 7000-10,000 vnd/m^3.
- If RO can be used for WW in Bao Minh IZ, total investment will increase more 50 billion vnd (5 billion vnd for per 1,000m^3 reuse).

3.3.3. Selection of WW treatment technology for Bao Minh IZ

Technology selection for wastewater treatment Bao Minh Industrial Park

After carefully considering the options and technological process of wastewater treatment plant of Ningbo 1 and Sunrise, owner and design consultant decide to choose the construction of CETP presented in the feasibility study report.

CHAPTER 4 ENVIRONMENTAL IMPACT ASSESSMENT

4.1. SOURCE, SUBJECTS, AFFECTED SCALE

4.1.1. Construction phase

4.1.1.1. Impact sources

(1). Sources of impact related to wastes

The impacts in the construction phase of CETP are mostly negligible because this building is insulated and separated from the residential area by surrounded walls. The main impacts are listed in the below table:

Table 4-1. Sources of impact related to wastes in the construction phase

No	Field	Impact source	Description	Affected subjects	Evaluation
1	Landscape	Storage of construction materials	Lack of management of material exploitation , formation of open landfills However, impacts are insignificant because CETP is separated from surrounding area by shielding barriers.	Local aesthetics	Short-term, small-scale, insignificant
		Construction activities	Construction activities cause dusts that affect on vision. Similarly, small mass of construction and CETP isolated from residential area, these impacts are not significant.	Local aesthetics	Short-term, small-scale, insignificant
2	Pollution of air and noise	Noise and vibration from mining,	The noise level is in threshold because of	Worker	Short-term, small-scale, insignificant

No	Field	Impact source	Description	Affected subjects	Evaluation
		leveling by construction machinery and transport	construction area isolated from residential area.		
		Dusts from construction, leveling and storage of mining and construction materials	Dusts are generated from exploitation materials. However, this small building, exploitation materials are not significant.	Worker	Short-term, small-scale, insignificant
		Air pollution from construction and material transport	Mainly pollutants are dust, SO_2, NOx, CO_2. This impact is also negligible.	Worker , air environment	Short-term, small-scale, insignificant
3	Pollution of water				
	Surface water	Wastewater from living activities of labors	Domestic wastewater can be generated by activities of workers in the construction phase. Thus, wastewater contains amount of nutrition, organic substances and coliform.	Surface water	Low, sort-term and can be minimized
		Runoff water	Mainly component is SS, oil of hazardous wastes generated by improper management.	Surface water	Low, sort-term and can be minimized
	Underground	Exploiting	Underground	Underground	Low, sort-

No	Field	Impact source	Description	Affected subjects	Evaluation
	water	activities	water can be polluted if underground operations are necessary for construction.	water	term and can be minimized
4	Solid wastes	Solid wastes from labor activities	Wastes includes food, polymer bag, wood, metal, glass,.., In addition, there is leachate, odor and favorable environment for insects and disease vectors.	Local aesthetics, worker, local residents	Low, sort-term and can be minimized
		Construction wastes	Construction wastes are cement, bricks, sand, stone, wood, scrap metal, and other spilt materials.	Local aesthetics, worker, local residents	Low, sort-term and can be minimized
		Hazardous wastes	They are containers of oil, gasoline, grease and solvents. However, it is expected that amount of these wastes are very small.	Soil, surface water quality	Low, sort-term and can be minimized
5	Traffic safety	Increasing traffic jam from increasing transportation trips	Impact is negligible because they are in industrial parks.	Transportation	Low, sort-term and can be minimized
6	Occupational safety	Lack of safety equipments	Incident or accident occurs in the absence of	Worker	Low, sort-term and can be

No	Field	Impact source	Description	Affected subjects	Evaluation
			safety equipment and lack of upper management in the construction sector.		minimized
7	Living activities	labors	Construction site is away from residential areas. The number of workers here is just not much for small-scale construction of CETP.	Local residents	Low, sort-term and can be minimized
8	Ecology and landscape		IP has no evaluation of ecology and landscape.	Ecology, biodiversity	Low, sort-term and can be minimized

(2). Sources of impact unrelated to wastes

❖ Social evils, labor safety and traffic safety

Construction process, the environmental factors, the labor intensity, pollution levels are likely to badly affect the health of workers, such as causing fatigue, dizziness.

Construction phase may occur incidents about labor safety if the worker and contractor do not comply with regulations on labor safety, fire prevention.

Construction of the main components of the project is not complicated; the terrain is flat. If the mean of transportation gets in trouble about technique or the mean of transportation is too old, it can lead to the traffic accidents for vehicle drivers, people living both sides of the road.

❖ Spreading communicable diseases

During the construction works phase, many people come from other places, the clash with the local people, communicable diseases spreading or social evils such as: gambling, prostitution can happen.

4.1.1.2. Subjects and affected scale

Subjects and affected scale in the construction phase of this project are divided into 3 mainly groups as below:

- Physical environment :
  - + Air ;
  - + Surface water ;
  - + Underground water ;
  - + Soil.
- Biological environment:
  - + Terrestrial flora ;
  - + Terrestrial fauna ;
  - + Aquatic systems.
- Socio-economic Environment

Details about the objects affected by the activities of the project development presented specifically in below Table:

Table 4-2. Subjects and affected scale in the construction phase

No.	***Affected objects***	***Agents***	***Affected scale***
1	**Socio-economic environment**	Clash between the local people and construction worker	Impact is at average, short-term, controllable level
2	***Physical Environment***		
	Air	Dust diffused from the process of excavation, construction	Impact is at average, medium-term, controllable level
		Dust and emissions from means of transportation	Impact is at low, medium-term, controllable level
		Noise of the construction equipment, machinery and vehicles	Impact is at low, medium-term, controllable level
	Surface water	Domestic waste water	Impact is at average, medium-term, controllable level
		Solid domestic waste	Impact is at average, medium-term, controllable level
		Construction waste	Impact is at average, medium-term, controllable level
		Waste oil	Impact is at high, medium-term, controllable level

No.	*Affected objects*	*Agents*	*Affected scale*
	Soil and groundwater	Domestic waste water	Impact is at average, medium-term, controllable level
		Solid domestic waste	Impact is at average, medium-term, controllable level
		Construction waste	Impact is at average, medium-term, controllable level
		Waste from the grave relocation process	Impact is at high, medium-term, controllable level
		Waste oil	Impact is at high, medium-term, controllable level
1.3	***Biological Environment***		
	Aquatic systems	Domestic waste water	Impact is at average, medium-term, controllable level
		Solid domestic waste	Impact is at average, medium-term, controllable level
		Construction waste	Impact is at average, medium-term, controllable level
		Waste oil	Impact is at high, medium-term, controllable level

4.1.2. Operational phase

4.1.2.1. Sources of impact

(1). Sources of impact related to waste

CETP is separated from residential area, therefore, the impact of the operational phase of CETP doesn't affect the surrounding residential area. The main impacts of CETP are listed in the below table:

Table 4-3. Source of impact and affected objects in the operational phase

No	Field	Source of impact	Description	Affected object	Evaluation
1	Odor and air pollution	Wastewater tank	Odor from wastewater	Workers, residents	Average, significant, can be minimized
			Air polluted by anaerobic tank, especially greenhouse		

No	Field	Source of impact	Description	Affected object	Evaluation
			gas		
			Microorganisms and bacteria in the air		
			Odor from oil, gasoline, lubricant…		
2	Noise and vibration	Machine and vehicle moving	Caused by explosive activity and vehicle moving, away from residential areas	Public area, nearby industries	Low, significant, can be minimized
3	Water pollution	wastewater	Consisting of high concentration of SS, COD, nutrition, metal waste, toxic chemicals and pathogens	Surface water	Average, can be minimized
		Leakage	Consisting of high concentration of SS, COD, nutrition, metal waste, toxic chemicals and pathogens	Surface water	From low to average, can be minimized
		Rain water	Having SS, oil, evil pathogens	Surface water	From low to average, can be minimized
		Wastewater	Wastewater of workers	Surface water	From low to average, can be minimized
4	Domestic	Rubbish	Solid wastes, rubbish from many stage.	Worker	From low to average, can be minimized
		Sludge	Sludge will be treated and disposed properly upon sludge quality	Community	Average, can be minimized
		Domestic solid waste	Solid wastes will be collected to transport to landfill	Soil, surface water	Low, can be minimized
		Hazardous waste	Oil, floating scum components from water tank	Soil	Average, can be minimized

(2). Sources of impact unrelated to wastes

In the operational phase of this project, sources of impact unrelated to waste are considered in these below sites:

❖ Occupational safety

Wastewater treatment system that is operated using electrical equipment in the incident conditions can cause electrical leakage, lead to fire explosion or result in casualties. In addition, health of operational staffs are affected by machine operation in CETP such as noise, vibration from pumps, agitator, blower, surplus heat from machine operation and equipment.

❖ Spreading communicable diseases

The needed number of personnel operating wastewater treatment system when the project goes into operation is just 1-3 people, not as a crowded place such as in factories, the production zones, so the social evils and communicable diseases spreading do not happen.

4.1.2.2. Objects and affected scale

Table 4-4. Objects and affected scale in the operational phase

No.	*Affected objects*	*Agents*	*Affected scale*
1	***Physical environment***		
	Air	Dust and gas emissions from the operation of the plant	Impact is at average, long-term, controllable level
		Dust and emissions from means of transportation	Impact is a low, long-term, controllable level
		Odor from the centralized wastewater treatment station	Impact is at average, long-term, controllable level
		Aerosol emissions from centralized wastewater treatment station	Impact is at average, long-term, controllable level
		Odor from the wastewater collection system	Impact is at average, long-term, controllable level
		Noise and vibration from the operation of the plants	Impact is at average, long-term, controllable level
		Leakage of chemicals used for centralized waste water treatment stations	Impact is at average, short-term, controllable level
		Treatment performance of centralized waste water treatment stations does not meet designed standards	Impact is a low, short-term, controllable level
		Explosion Incident	Impact is a high, short-term, controllable level

No.	*Affected objects*	*Agents*	*Affected scale*
	Surface water	Domestic and production waste water	Impact is a high, long-term, controllable level
		Solid waste from living activities and production	Impact is a high, long-term, controllable level
		Excess sludge from centralized wastewater treatment stations	Impact is a high, long-term, controllable level
		Hazardous waste	Impact is a high, long-term, controllable level
		Leakage of chemicals used for centralized waste water treatment stations	Impact is a low, short-term, controllable level
		Treatment performance of centralized waste water treatment stations does not meet designed standards	Impact is a low, short-term, controllable level
		Explosion Incident	Impact is a high, short-term, controllable level
	Soil and underground water	Domestic and production waste water	Impact is a high, long-term, controllable level
		Solid waste from living activities and production	Impact is a high, long-term, controllable level
		Excess sludge from centralized wastewater treatment stations	Impact is a high, long-term, controllable level
		Hazardous waste	Impact is a high, long-term, controllable level
		Leakage of chemicals used for centralized waste water treatment stations	Impact is a low, short-term, controllable level
		Treatment performance of centralized waste water treatment stations does not meet designed standards	Impact is a low, short-term, controllable level
		Explosion Incident	Impact is a high, short-term, controllable level
2	***Biological Environment***		
	Aquatic systems	Domestic and production waste water	Impact is a high, long-term, controllable level
		Solid waste from living activities and production	Impact is a high, long-term, controllable level

No.	*Affected objects*	*Agents*	*Affected scale*
		Excess sludge from centralized wastewater treatment stations	Impact is a high, long-term, controllable level
		Hazardous waste	Impact is a high, long-term, controllable level
		Leakage of chemicals used for centralized waste water treatment stations	Impact is a low, short-term, controllable level
		Treatment performance of centralized waste water treatment stations does not meet designed standards	Impact is a low, short-term, controllable level
		Explosion Incident	Impact is a high, short-term, controllable level
3	***Culture - Society***		
		Obstructing traffic and walking path of the people	Impact is a low, long-term, controllable level
		Accommodation and living activities of workers	Impact is a low, long-term, controllable level
		Inundation	Impact is a low, short-term, controllable level

4.1.3. Computing, forecasting pollution and evaluating the impact of the project on the environment

4.1.3.1. Construction Phase

Land for the project area is relatively flat. Construction phase does not have the compensation and ground clearance stage. The impact of the construction phase is mainly due to the transportation of building materials and construction works execution.

Table 4-5. Materials for the project

NO.	ITEMS	AMOUNT (TON)
1	Types of stone (Stone 1x2; Stone 4x6; ashlar)	1788.71
2	Particulate asphaltic concrete	111.5
3	Sand	1788.71
4	Steel	28
5	Bituminous tar	29.8
6	Spiral plastic HDPE 1 layer D300mm	7.285
7	Steel	28
8	Cement PC30	142

9	Lime	1.74
10	Other material (Plastic pipe, equipment,..)	30
TOTAL		**3955.745**

Total construction materials provided for the project by some local enterprises is 3955.745 tons, the estimated time of work construction is 06 months. In the construction phase, the means of materials transportation will run on National Highway 10 which is the route with high traffic density, this will increase the traffic density on Highway 10 – the section going through the project location. Therefore, this will have a large influence on other traffic participants. On the other hand, the process of transporting building materials can cause environmental problems such as sand, stone, gravel strewn on the road (if using the vehicle without cover), dust generated in construction process, spread by the wind.

(1). Exhaust fumes, odor

In addition to the means of transportation, the use of soldering equipment for construction also emits dust, emissions, which impacts on the air environment and directly affects the people living along the road. Scope of this effect is not large and local due to the population by roadside is few.

Table 4-6. Pollutant coefficient for trucks with a capacity of 3.6 – 10 ton

No	**Parameter**	**Value (Kg/1000km)**
1	Dust	0.9
2	SO_2	2.075S
3	NO_x	14.4
4	CO	2.9
5	Total organic substances	0.8
Source: WHO, Rapit Environment Asessment, 1993		
Note: S is sulfur in Do oil (%)		

Table 4-7. Ratio of pollutants in the welding (mg/ 1 welding rod

No	**Pollutants**	**Diameter of welding rod, mm**				
		2,5	3,25	4,0	5,0	6,0
1	Welding smoke (consisting of pollutants)	285	508	706	1.100	1.578
2	CO	10	15	25	35	50
3	NO_x	12	20	30	45	70

(Source: National Institute of Labour Protection)

Influence of dust on humans and animals depends on their chemical nature. They can irritate the respiratory diseases, eye and skin diseases ... at a fixed level:

asthma, allergic inflammation, chronic diseases and lung diseases. The studies indicate that the small particles with a size of 5-10 μm are remained inside the hilus of lungs and windpipe, the particles that are capable of affecting the lungs have the size of 0.5 μm. Silica particles contained in the sand has a huge impact, if continuously contacting with this dust will cause the Asbestosis.

Due to the external factor of the large traffic density, the traffic participants and people living near the project area will be subjects bearing the direct impact of the construction process. However, the construction process is only within 6 months, this affects the short-term impact.

(2). Noise:

During the construction process, the construction equipment making noise is used, and the collision of the equipment, metal materials, ... also cause noise.

Table 4-8. The noise intensity of a number of equipment

Equipment	The noise level from 1.5 m (dBA)	The noise level from 5m (dBA)
Bulldozer	87	
Borer	93	-
Concrete pile driver 1,5T	75	-
Air compressor	-	110
Concrete mixer	75	

(Source: National Institute of Labour Protection)

The ability to spread the noise of the construction site to the surrounding area is determined as follows: **$Li = Lp - \Delta L_d - \Delta Lc$ (dB_A)**

Of which:

- Li: The noise level at the calculation time from the noise source at the distance d (m)

- Lp: The noise level measured at the noise source (from 1.5 m)

- **ΔL_d**: The noise levels decrease according to the distance d at frequency i

$\Delta L_d = 20 \lg[(r_2/r_1)^{1+a}]$ (dB_A)

r_1: Distance to the noise source with the Lp (m)

r_2: Distance calculating the noise level reduction according to the distance correlative with Li (m)

a: Coefficient including the effect of noise absorbing of the surface topography (a = 0)

ΔLc:: The noise level reduction over obstacles. Getting ΔLc at the project area = 0

From the above formula, we can calculate the noise levels of construction equipment to the surroundings at a distance of 200m and 500m as follows:

Table 4-9. The noise level of the equipment according to the distance

No.	Construction equipment	The noise level from 1,5m	The noise level from 200m	The noise level from 500m
1	Bulldozer	87	65	57
2	Borer	93	71	63
3	Diezel compressor	80	58	50
4	Concrete pile driver 1,5 T	75	53	45
5	Concrete mixer	75	53	45

Noise and vibration often cause a direct effect in the human auditory system. Their effects are at different levels: causing fatigue, headache, neurological disorders, ...

According to the calculations in the table above, the noise only affects in a narrow range of 200m radius, therefore the objects bearing the greatest impact is the construction workers. However, the level of impact is small, only causing fatigue when working continuously about 12 hours per day

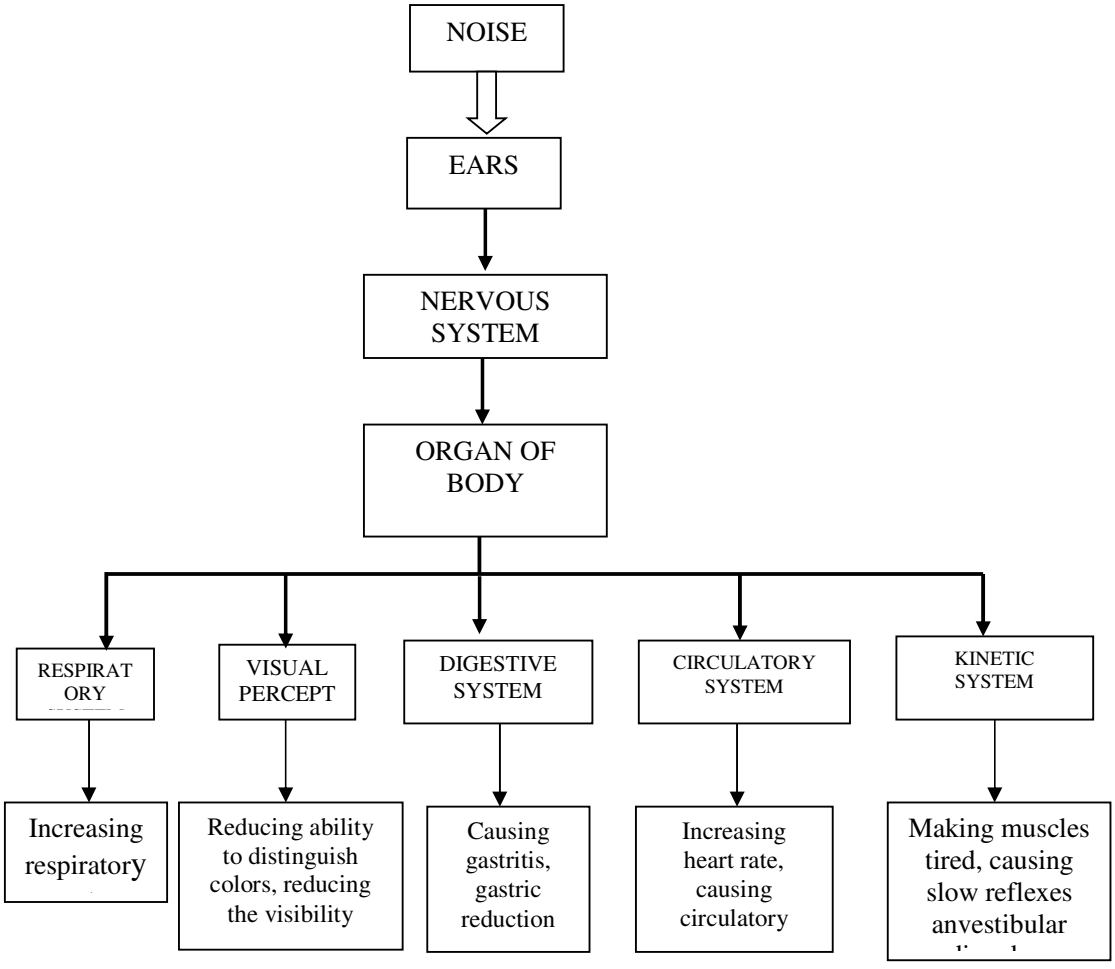


Figure 3 1. The impact of noise on people

(3). Wastewater

Wastewater in this period is mainly domestic sewage of workers, wastewater from construction process and rainwater running off through the construction area.

+ Wastewater of workers: Wastewater average is 120 - 150l/person/day-night, the total amount of waste water of on-site workers at the peak of 20 workers is: 2400 liters – 3000 liters equivalent to 2.4 to 3.0 m^3 per day-night.

Table 4-10. Forecast the pollution load in waste water of labors (estimated volume of 20 person)

No.	Parameter	Unit	Volume calculated by WHO	Total volume (Kg)
1	BOD	g/person/day	45 - 54	0,9 – 1.08
2	COD	g/person/day	85 - 102	1,7 – 2,04
3	Suspended Solid	g/person/day	70-145	1,4 – 2,9
4	N-T	g/person/day	6 - 12	0,12 – 0,24
	N- NH_4	g/person/day	3,6 – 7,2	0,072 – 0,14
5	P-T	g/person/day	0,6 – 4,5	0,012 – 0,09
6	Total bacterias	MPN/100ml	10^9 - 10^{10}	-
7	Coliform	MPN/100ml	10^6 - 10^9	-
8	Fecal Stemorela	MPN/100ml	10^5- 10^9	-
9	Worm eggs	-	10^3	-
10	Virus	-	10^2 - 10^4	-

(Source: WHO)

If the number of workers increases, the total amount of pollution (KLON) was calculated using the formula:

Total KLON (Kg) = KLON (g / person / day) × number of employees (people)

Construction workers are mostly from other localities, so all personal living activities such as eating, bathing, ... are in place so even though the flow of wastewater is small but if we cannot collect to treat, this will affect much on the environment landscape.

Wastewater is from the process of construction, concrete curing, cleaning construction equipment, coolers, etc… This wastewater contains the contents of suspended solids, typical parameters of construction wastewater presented in the table.

Table 4-11. Pollutant concentration in wastewater of construction phase

No.	Parameter	Unit	Construction wastewater	QCVN 24:2009/BTNMT Column B
1	pH	-	6,99	5,5 - 9
2	Suspended solid	mg/l	663,0	100
3	COD	mg/l	640,9	100
4	BOD_5	mg/l	429,26	50
5	NH_4^+	mg/l	9,6	10
6	Total N	mg/l	49,27	30
7	Total P	mg/l	4,25	6
8	Fe	mg/l	0,72	5
9	Zn	mg/l	0,004	3
10	Pb	mg/l	0,055	0,5
11	As	mg/l	0,305	0,1
12	Oil	mg/l	0,02	5
13	Coliform	MPN/100ml	53.10^4	5000

(Source: Center of Urban and Industrial Environmental Engineering)

QCVN 24:2009/BTNMT: National Technical Regulation on Industrial Wastewater, column B.

+ Construction wastewater:

Construction of wastewater has pollutant concentrations of BOD, COD and suspended solids are many times greater than QCVN 24:2009/BTNMT, if the waste water is discharged directly to the discharging source and this will cause local sediment and pollution. Therefore, this wastewater must be treated by sedimentation method before discharging to the flow sources, which will significantly limit the impact.

+ Rainwater running off:

According to the World Health Organization (WHO), the concentration of pollutants in rainwater running off has the typically range from 0.5 to 1.5 mg N / l, from 0.004 to 0.03 mg P/l; 10-12 mg COD / l and 10-20 mg TSS / l. Stormwater running off is relatively clean, if flowing through the construction area, it will entail soil, sand, Packages, ... it will increase the SS contents, if there is any trash rack to separating trash before flowing to the discharging sources, its influence on water quality will be not significant.

Calculating the flow of rain water:

- The total project layout area is 1560 m^2,

- The largest daily rainfall (mm / day): 9.32 mm / day

→ The amount of rainwater running off (max) with the assumption that 100% of rainfall is involved in the running off process:

1560 (m^2) x 9.32 (mm / day) x 10^{-3} = 14.54 m^3

With flow as calculated above, the rain water running off can cause the local flooding for the area surrounding the project. However, the level and scope of impact is low.

The rain water running off in the maximum cases will spill out the drainage system of Bao Minh Industrial Park - channels C9 and C9-5 and then flow to Huong River as the terrain, go through pumping stations of Chanh River and Coc Thanh River to Dao River. Below is the diagram of the rain water drainage of Bao Minh Industrial Park.

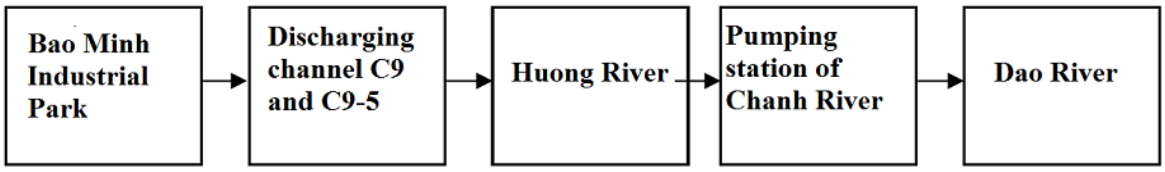


Figure 4-1. Diagram of rain water drainage of Bao Minh Industrial Park

(4). Solid waste

+ Domestic Waste: Average volume of domestic waste calculated for a person per day: 0.5 kg / person / day × 20 people = 10 kg / day, mainly organic substances from the left food, plastic bags, cardboard.

+ Construction waste: mainly construction material spilled or damaged packages of materials, machinery. Due to the construction nature of just using some simple materials such as cement, steel, bricks, stones, the construction waste volume is small, estimated to average of about 20-30 kg / day. This waste can be reused.

→ The total amount of waste (domestic and construction): 30-40 (kg / day).

+ Hazardous solid waste: Lubricants of construction equipment, oiled mops and gloves, broken bulbs, adhesive waste, other chemical containers ..., estimated about 3-5 kg / day.

Solid waste and hazardous waste if not being collected will cause unsanitary, impact on landscape and health of construction workers.

Table 4-12. Total estimation of assessment of project in construction phase

Environmental components	**Project's actions**		
	Transportation of materials	Construction of works	Labors
Air Environment	The severe negative impact	The average negative impact	The average negative impact

Environmental components	**Project's actions**		
	Transportation of materials	Construction of works	Labors
Surface water environment	No impact or negligible impact	Mild impact	The average negative impact
Underground water environment	No impact or negligible impact	Mild impact	No impact or negligible impact
Biodiversity	Unclear impacts	No impact or negligible impact	No impact or negligible impact
Landscape	Mild impact	Mild impact	Mild impact
Cultivated	No impact or negligible impact	No impact or negligible impact	No impact or negligible impact
Citizen land	No impact or negligible impact	No impact or negligible impact	No impact or negligible impact
Transportation	The severe negative impact	No impact or negligible impact	No impact or negligible impact
Jobs	No impact	Positive impact	Very positive impact
Public health in project area	Mild impact	Mild impact	Mild impact
Social evils, infectious disease	No impact or negligible impact	The average negative impact	The average negative impact
Historical monument	No impact or negligible impact	No impact or negligible impact	No impact or negligible impact

Conclusion:

The above analysis shows that the impact of the construction process on the environment and surrounding landscape is not large with small scale of influence, and only for a short time. The greatest impact at this stage is the process of transporting material impacting on traffic safety, emissions and dust discharge, which affects people living on both sides of the road.

4.1.3.2. Operational phase

When the project is put into operational phase, the treatment stations will handle the water for all plants in the industrial park, solve a major problem of pollution from wate source, at the same time, the treated water will be reused or received into the surface water sources for irrigation in agriculture. This has a very significant meaning on environment and economic value.

However, during the operation process of water treatment plants, it can also generate a number of wastes causing environmental pollution. The impact of the operational phase is mainly due to technical fault of the treatment system, which leads to odor emissions, gas emissions (due to pipeline leakage) or the treatment station gets in trouble, which leads to the fact that the sewage treatment is unable to achieve standards.

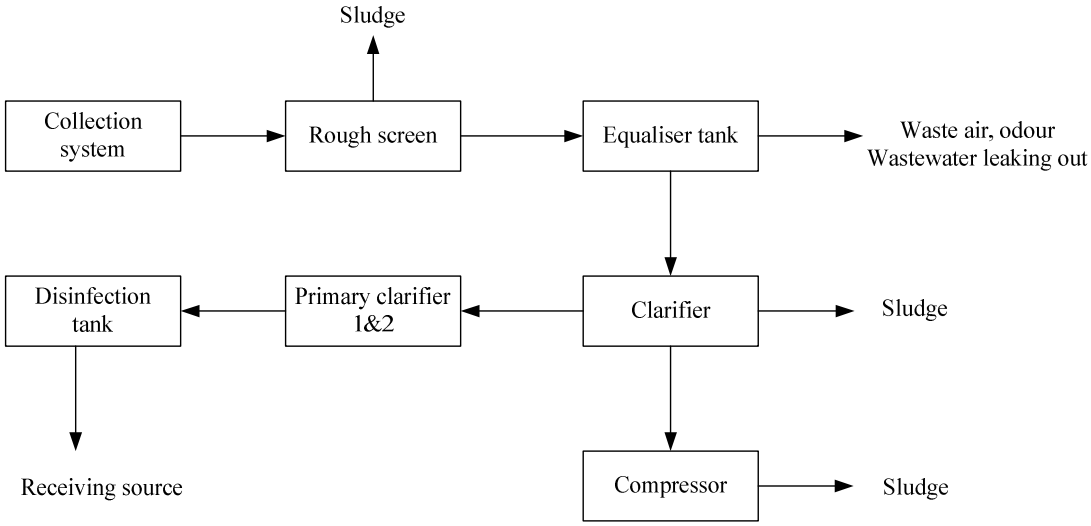


Figure 4-2. Wastewater treatment technology and emission source

All stages of the processing cycle are designed ongoing and closed. In the technology cycle, the emissions are mainly: gas emissions, odor, waste water, solid waste and hazardous waste (sludge, waste), in which the gas emissions and waste water can be minimized by technical methods when designing and building the system; solid waste and hazardous waste must be collected for processing.

(1). Gas emissions, odor

In untreated domestic wastewater there are many pollutants, under the impact of the natural bacteria, these will cause biochemical reactions that cause the change of the properties of water, cause the unpleasant smells; the chemical reactions in the wastewater treatment processes (anaerobic - aerobic - anoxic) will generate a large number of gases that are compounds of nitrogen, sulfur, phosphorus and carbon.

Odor emission occurs in the sewers leaked or in the septic tanks due to open design. Exhaust gases are products of the biologic – chemical treatment process.

Odor and exhaust gases greatly affect ambient atmosphere and environment and health of the operators and workers in the surrounding shops.

(2). Wastewater

Wastewater is mainly from dyeing with high COD and BOD contents and suspended sediments which keep long, generate unconformable smell and change into black. Through many phases of the waste water treatment process, wastages in the water will be gradually eliminated and discharged to the environment until they meet standards. Waste water is generated because the system is leaked and damaged in the operation process and therefore, water is not treated according to standards. This waste water will be brown to black and smelly; partly penetrated into soil to pollute land and underground water environment and partly discharged into small ponds and lakes to pollute surface and domestic water source of the local people. Leaked waste water flow depends on failure of the system.

(3). Noise

Noise in the operation phase is mainly from pumps and air blowers. Noise of these equipments ranges 55-70dB (in a distance of 5m) and 47-69dB (200m). In comparison with QCVN 26:2010/BTNMT: National Technical Regulation on Noise, the noise is not within the allowable limit from 6:00 to 22:00 and does not affect residential area or activities of the industrial zone.

(4). Solid waste

Solid waste is generated from two main sources:

+ Wastes collected from trash racks include fibers, packing, rag, gloves and nylon.

+ Sludge, before being treated, is put into the sludge digester to reduce volume. Sludge contains parasitic microorganisms, parasitic worms and chemicals from the weaving and dye process which are in a list of hazardous wastes according to Decision No.23/2006/QD-BTNMT. The sludge not collected, treated and transported to the designated place will affect the receiving source. The sludge of the waste water treatment process has high organic content and low metal concentration. Thus, if pathogenic microorganisms are treated, the sludge may be used to produce fertilizer or supplement soil for the crops.

Calculation of sludge:

According to the report calculated in the environmental impact assessment report of the project: Investment in construction and infrastructure business Bao Minh industrial park, the total water flow of the entire industrial park is Q_{thai} = 18,000 m^3/day.

And the amount of sludge is calculated as follows:

Residual sludge is wasted everyday which calculated by the formula of Metcalf & Eddy

Observed yield coefficient (Y_{obs}) is calculated as follow:

$$Y_{obs} = \frac{Y}{1 + k_d * \theta_c} = \frac{0.6}{1 + 0.04 * 10} = 0.43\ mg / mg$$

Of which:

Y : Observed yield coefficient, Y= 0.6 kg SS/ kg COD

k_d: Intracellular degradation coefficient, k_d= 0.04 day^{-1}

θ_c: Sludge retention time, θ_c = 10 day.

S_0-S = 3,000 – (50 x 68% x 65% x 1.42) = 3,000 – 31.38

Where:

BOD input, S_o = 3,000mg/l.

BOD output, S= 50 mg/l.

The amount of activated sludge generated by the COD removal (as MLVSS)

$P_x(VSS)$= Y_{obs}xQ x(S_0 – S)= 0.43 x 20,000 x (5,000-31.38)x10^{-3}= 25,530.132 kgVSS/day.

Total supended solid generated in 1 day

$$\frac{MLVSS}{MLSS} = 0.8 \Rightarrow \text{MLSS} = \frac{MLVSS}{0.8}$$

$$P_{xl}\ (SS) = \frac{P_x(VSS)}{0.8} = \frac{25,530.132}{0.8} = 31,912.665\ \text{kgSS/day}$$

Excess sludge to be treated every day:

The amount of residues discharged daily:

$P_{xa} = P_{xl} – Q \times SS_{ra} \times 10^{-3}$ = 31,912.665 kgSS/day – 20,000 m^3/day×50 g/m^3×10^{-3} kg/g = 30,912.665 kg/day

Excess sludge having biodegradation ability to be treated:

$M_{du(VSS)}$ = 30,912.665 kgSS/day * (0.8) = 24,730.132 kgSS/day

To suppose that the activated sludge after through sludge compression tank has solids content of 3% and specific weight is 1.008 kg / liter. The amount of excess sludge must to be treated every day that is:

$$Q_{du} = \frac{30,912.665 kgSS/day}{0.03x(1,008 kg/l).1000} = 1,022.24 \quad m^3/day$$

Capacity of CETP of Bao Minh IP phase 1 is 5000 m^3/day

>> The amount of sludge needed treating are 1,022.24*5,000/18,000 = 283m^3/day

This volume, the average of 3 months, should be handled 1 times. Currently the industrial park management board has contacted the functional units to collecte and treat that is T.P JSC (17 Nguyen Van Huyen address, Cua Bac Ward, Dist. Nam Dinh Nam Dinh province).

(5). Impacts on biologic diversification

This waste water treatment project for Bao Minh Industrial Zone has positive impacts on ambient environment. However, because the scope of project is not large, impacts on ecology and biologic diversification are insignificant.

Table 4-13. Assessment of detailed impacts of the project on environmental quality

Factors	**Origins**	**Affected objects**	**Impact level**	**Time of impact**
A. In the construction phase				
Dust, CO_2, NO_x, SO_2, hydro carbide …	Means of transport for building materials	- Air environment - Health of the workers - Landscape	Light impact due to diffusion in the large environment with many green trees	Short and discontinuous (it only occurs in some steps of the construction phase)
Noise	Construction equipments	- Workers	Average within a radius of 200m	Short and discontinuous
Waste water	- Daily activities of the workers - Clean construction tools - Overflow storm water	- Air environment - Health of the workers - Landscape	Light and local impact	Short, in the construction phase
Solid waste	Domestic waste of the workers Construction activities	- Soil, water and air environment - Landscape	Average	Short, in the construction phase
B. In the operation phase				
Exhaust gas, CO_2, H_2S, SO_2,	Chemical reactions in the waste water treatment system	- Air environment	Light impact because if the collection and treatment system has fully closed	Long-term, during the operation of the waste water

Factors	Origins	Affected objects	Impact level	Time of impact
NO_x, odor			design, exhaust gas and odor shall not be emitted to the environment.	treatment plant
Waste water	Leakage from the collection system and treatment tank	- Water environment - Soil environment - Landscape	Average	Long-term
Solid waste	- Domestic garbage collected in the trash racks - Sludge	- Soil and water environment and landscape	Large	Long-term
Noise	- Pumps and air blowers		Insignificant	Long-term

4.1.4. Environmental incident sources

4.1.4.1. Environmental incidents due to malfunctioning

The treatment system may have technical incidents for many reasons such as choked pumps, automatic errors of the machines and no maintaining machines for a long time. These incidents make water, after being treated, unsatisfied with standards on waste water upon being discharged to the receiving environment. These incidents prolonged without taking remedial measures will cause serious and direct impacts on water quality of the receiving source (receiving environment) and indirect impacts on the eco-system.

4.1.4.2. Environmental incidents due to natural disasters

In the wet season, incidents of flood and natural disasters may occur and damage the waste water collection – drainage system. Waste water untreated will be leaked to the surrounding environment and cause pollution of water and soil environment on a large scale along the flow direction.

4.2. Detailed level and reliability of assessments

Methods of assessment and reporting are common methods in environmental impact assessment such as figure listing method, catalogue method and mathematic formula using method … Because its nature is an environmental treatment project, but is not the production factory; its scope is small and volume and nature of emissions are not complicated, methods of reporting such as network diagram method and map joining method are unused.

Detailed level and reliability of assessing possible environmental impacts, risks, environmental incidents upon deploying and not deploying the project are objectively presented in Table 3.12.

Table 4-14. Assessment of reliability of the EIA methods applied

No.	***Content of assessment***	***Detailed level and reliability***
1	**In the construction phase**	
1.1	Assessing impacts caused by dust and exhaust gas from the means of transport	High detailed level and high reliability thanks to sufficient figures about the means of transport
1.2	Assessing impacts caused by noise from construction equipments, machines and means of transport	High detailed level and high reliability thanks to figures collected from results of actual studies in the world, specific calculations for the project and comparison with the Standard on noise in working place by the Ministry of Public Health
1.3	Assessing impacts caused by vibration from construction equipments, machines and means of transport	High detailed level and high reliability thanks to figures collected from results of actual studies in the world, specific consideration for the project and comparison with criteria of vibration impact assessment applied in the world for the projects/subjects specifically affected in the area
1.4	Assessing impacts caused by overflowed storm water and temporary inundation	High detailed level and high reliability thanks to the overflowed storm water discharge calculated specifically for the project conditions
1.5	Assessing impacts caused by domestic solid waste (waste water and solid waste)	High detailed level and high reliability thanks to waste mass/ discharge calculated separately for the project on a basis of figures provided by the Employer and reference figures of the projects implemented in the area
1.6	Assessing impacts caused by construction wastes	Low detailed level and relative reliability thanks to lack of construction waste studies in Vietnam
1.7	Assessing impacts caused by waste grease	High detailed level and high reliability thanks to grease studies conducted in Vietnam and specific calculations for the project in compliance with Vietnam's applicable regulations
1.8	Assessing social impacts (traffic obstruction, contradiction between workers and local people and industrial accidents)	High detailed level and relative reliability thanks to identity and assessment of these impacts on a basis of considering specific conditions of the project and experience in social impact assessment of the industrial zone construction projects as well as other projects conducted by the experts

No.	*Content of assessment*	*Detailed level and reliability*
2	**In the operation phase**	
2.1	Assessing impacts caused by exhaust gas from activities of the waste water treatment plant	High detailed level and high reliability thanks to reference and inheritance of studies in the world, use of WHO's pollution coefficient, inheritance of industrial zone studies in Vietnam, comparison and collation with a list of business lines permitted to invest in the project and separate calculation for the project
2.2	Assessing impacts caused by bad odor from the concentrated waste water treatment plants	High detailed level and high reliability thanks to reference of figures and studies about bad odor from the waste water treatment plants in the world and separate calculations and assessments for the project
2.3	Assessing impacts caused by aerosol emitted from the concentrated waste water treatment plants	High detailed level and high reliability thanks to reference of figures and studies about aerosol from the waste water treatment plants in the world and separate assessments for the project
2.4	Assessing impacts caused by waste water	High detailed level and high reliability thanks to reference of figures and different studies about industrial and domestic waste water and separate calculations of pollution discharge and load for the project
2.5	Assessing impacts caused by solid waste	High detailed level and high reliability thanks to reference of figures and studies from real surveys and separate calculations and assessments for the project
2.6	Assessing impacts caused by hazardous wastes	High detailed level and high reliability thanks to reference of figures and different studies about hazardous wastes in conditions of the industrial zones in Vietnam
2.7	Assessing impacts caused by sludge from the concentrated waste water treatment plants	Relative detailed level and high reliability thanks to forecast of sludge discharged daily for the concentrated waste water treatment plants
2.8	Assessing impacts caused by environmental incidents	Relative detailed level and high reliability thanks to assessments based on specific conditions of the project
2.9	Assessing impacts on environmental components	High detailed level and high reliability thanks to assessments based on other contents of assessment, use of rapid environmental

No.	*Content of assessment*	*Detailed level and reliability*
		assessment matrix (RIAM) with support of computer software

4.3. EFFECTS OF WATER QUALITY

4.3.1. Pollution load

At the maximum load of 5,000 m^3/day, the pollutant load can be estimated everyday as follows:

Table 4-15. The pollutant load in CEPT of Bao Minh IZ

No	Parameter	Concentration (mg/l)	Pollutant load (kg/ngày)
1	TSS	50	250
2	BOD_5	30	150
3	COD	75	375
4	$N\text{-}NH_3$	5	25
5	Total Fe	1	5

Note: The pollutant load is measured by theory of wastewater after treatment that meet with national standard QCVN 40:2011/BTNMT, column A (K_f = 1.0, K_q = 1.1)

4.3.2. Impact Assessment of receiving source

The pollutant load will affect directly on receiving source that are C9, C9-5 canal, and Day river. Based on calculation of Table 4.15, after CEPT start operating, a flow of 5,000 m^3/day will contribute into C9, C9-5 canal, and Day river. This average load is 250 kg SS, 150 kg BOD_5. 375 kg COD, 25 kg ammonia and 5 kg total iron.

Polluted wastewater can cause the following impacts when it is discharged to the environment:

- Increase turbidity of the river flow due to SS; alter photosynthetic efficiency and reduce DO in the surface water. Suspended solid could be deposited at the outlet, altering the river flow, river depth and hydraulic conditions. Organic sludge depositing also causes oxygen deficient, forming toxic gases like H_2S, CH_4, etc. If the receiving source is not cleaned properly, the water will be changed to black and smelly.

- Increase organic pollution load (BOD_5, COD), increase organic and inorganic compound oxidization, reduce DO concentration in the water.

- Increase nutrients in the water (total N, total P), causing eutrophication

- Reduce load bearing and purifying capacity of the river.

- Affect to drinking and production water quality.

4.4. INFFLUENCE OF ENVIRONMENT AND AQUATIC ECOSYSTEM

- Increase turbidity, reduce DO to lead affecting to photosynthesis efficiency, altering number of aquatic species in the water.

- Impact on food chain of the ecosystem.

- If the river could not purified, water will be polluted by organic substance and nutrients, affecting seriously to aquatic life, reducing biodiversity (species number and density), etc. narrowing habitat of small animal species in mangrove forest.

- Pollution of nutrients: Proper nutrient content will promote algae growing adequately in the food cycle. However, if it increases significantly eutrophication will occur, causing organic pollution.

- Nitrogen Impacts:

+ Toxic to fish at high concentration

+ Small NH_3 concentration and NO_3^- are nutrients to algae growth.

+ Conversion of NH_4^+ to NO_3^- needs large volume of DO.

- Impacts of Phosphorus:

Phosphorus is an essential nutrient for algae growth. High concentration will promote algae growth. When algae died it will be organic food for bacteria, altering oxygen content, causing fish dead.

- Organic Substance Pollution: reduce DO, threatening to fish and other aquatic species.

4.5. EFFECTS ON HYDROLOGY

Following the data supplied by Department of Environmental Protection, minimum flow of Day river is around 2.8 m^3/s and maximum flow is around 145 m^3/s. The average flow of C9, C9-5 canal is around 4.3 m^3/s and 2.67 m^3/s. Flow rate in the dry season of Dao river is 1.75 m^3/s *(supplied by internet gate of Nam dinh News).*

The wastewater volume of CEPT of Bao Minh IZ is about 5,000 m^3/day and night, equally to 57.87 l/s. This volume is not significant that cann't increase the water flow of change hydraulic regime of Day river.

4.6. EFFECTS ON AIR

The maximum capacity of CETP of Bao Minh IZ is 5,000 m^3/day. They could emit odor, H_2S, Hydrocarbons, Mercaptan among others affecting to areas near the outlet. However currently there is no detected odour from the Bao Minh IZ Treatment Plant's discharges, and was reflected through the surveying of residents living along project area. Hence it can be concluded that the discharge wastewater does not affect local air quality.

4.7. EFFECTS ON RISK AND ACCIDENTS

The effluent is quite large at 5,000 m^3/day of the treatment facility could cause river bank erosion. The large effluent may also disturb the river flow, affect small canoe navigation in the outlet area. However as the addition discharge is about 57.87

l/s and C9, C9-5 canal is external field and no canoe is here, therefore the ability to happening risks and accidents is not reality.

The wastewater volume and C9, C9-5 canal flow is not significant with Day river flow so the ability to happening risks and accidents is not reality.

4.8. SOCIAL - ECONOMIC AND DOWNSTREAM WATER USE IMPACT

Wastewater from the treatment facility contains organic substances (BOD_5, and COD), causing turbidity increase in Day River water, offensive odor at the outlet. The effluent discharge can affect to socio-economic as follows:

The discharge of treated waste water into C9, C9-5 canal, Day river more or less will impact on the economical activities of residents living along the river. However, with the discharge flow if 5,000 m^3/day and water quality after treating fitting national standard of QCVN 40:2011/BTNMT column A (kq=1.1; kf =1.0) that influences are not significant.

4.9. CUMULATIVE IMPACTS

The water quality and flow of C9, C9-5 canal and Day river will be affected after discharge flow of CETP of Bao Minh IZ. The influence is not significant for Day river because of small flow and water quality that meets national standard.

To analyse the accumulated impacts of the project toward C9, C9-5 canal and Day river, we will have to analyse the discharge receiving capacity of C9, C9-5 canal and Day river. The assessment will be based on Circular 02/2009/TT-BTNMT dated 19/3/2009 of the MONRE.

4.9.1. C9 and C9-5 canal pollution loads analysis

Pollution loads of C9 and C9-5 canal can be analysed by the limits of polluting parameters in C9 and C9-5 canal water. It can be presented in table below:

Table 4-16. Pollutant concentrations of C9 and C9-5

Parameter	BOD	COD	SS	As	Pb	Cd	Hg
C_{tc} (mg/l)	15	30	50	0.05	0.05	0.01	0.001

Note: Limitation value C_{tc} is based on QCVN 08:2008/BTNMT, Column B1

4.9.1.1. Max pollutant loads

The max pollution loads that surface water source can receive are calculated as below equation:

$$\mathbf{L_{td} = (Q_s + Q_t) \times C_{tc} \times 86.4}$$

When:

- L_{td}: max pollution load of that water sources with a certain pollutants;
- Q_s: Flow rate of C9-5 (the canal has less flow), Q_s= 2.67 m^3/s;

- Q_t: Wastewater flow, Q_t = 5,000 m^3/ngày = 0.058 m^3/s;
- 86.4 is the coefficiency from (m^3/s)x(mg/l) to (kg/day).

The max pollution load that nearby surface water sources can receive will be presented in below table:

Table 4-17. The max pollution load that nearby surface water source can receive

Parameter	BOD	COD	SS	As	Pb	Cd	Hg
$Q_s + Q_t$ (m^3/s)	2.728	2.728	2.728	2.728	2.728	2.728	2.728
C_{tc} (mg/l)	15	30	50	0,05	0,05	0,01	0,001
L_{td} (kg/day)	3,535.48	7,070.976	11,784.96	11.785	11.785	2.357	0.236

4.9.1.2. Current pollutant loads

The current pollutant loads in the discharge source receiving is calculated as below equation:

$L_n = Q_s$ x C_s x 86.4

When:

- Ln: Current Pollution Loads in receiving water body;
- Q_s: Flow rate of C9-5 canal (The canal has less flow), Q_s= 2.67 m^3/s;
- Cs: Max concentration of certain pollutants in the river before receives the waste water discharge;
- 86.4 is the coefficiency from (m^3/s)x(mg/l) to (kg/day).

The Current pollution loads will be presented in below table:

Table 4-18. The current pollution loads

Parameter	BOD	COD	SS	As	Pb	Cd	Hg
Q_s (m^3/s)	2.67	2.67	2.67	2.67	2.67	2.67	2.67
C_s (mg/l)	12.5	29.5	47	0.035	0.04	0.007	0.001
L_n (kg/day)	2883.6	6805.3	10842.34	8.074	9.23	1.61	0.23

Note: C_s is the average concentration of result of surface water quality of C9 and C9-5

4.9.1.3. Pollutant load from discharge source

Pollutant load from discharge source will be calculated as below equation:

$L_t = Q_t$ x C_t x 86.4

When:

- Lt: Pollution load in effluent (kg/day);
- Qt: Wastewater flow rate, Qt= 0.058 m^3/s;

- Ct: Max concentration of pollutants in wastewater;
- 86.4 is the coefficiency from (m^3/s)x(mg/l) to (kg/day).

Pollution loads from discharge sources will be presented in below table:

Table 4-19. Pollution loads from discharge sources

Parameter	BOD	COD	SS	As	Pb	Cd	Hg
Q_t (m^3/s)	0.058	0.058	0.058	0.058	0.058	0.058	0.058
C_t (mg/l)	30	75	50	0.05	0.1	0.05	0.005
L_t (kg/day)	150.33	375.84	250.56	0.25	0.50	0.25	0.025

Note: C_t was calculated in hypothesis that water quality after treating is meeting with national standard QCVN 40:2011/BTNMT, column A (Kf=1.0, Kq=1.1)

4.9.1.4. C9 and C9-5 canal pollutant load receiving capacity

C9 and C9-5 canal pollution load receiving capacity will be calculated as below equation:

$$\mathbf{L_{tn} = (L_{td} – L_n - L_t) \times F_s}$$

When:

- L_{tn}: C9 and C9-5 canal pollutant load receiving capacity (kg/day);
- L_{td}: max pollution load of that water sources with a certain pollutants;
- L_n: Current Pollution Loads in receiving water body;
- L_t: Pollution load in effluent (kg/day);
- F_s: hệ số an toàn, F_s = 0.3 – 0.7, the project choice F_s = 0.5.

C9 and C9-5 canal pollution loads receiving capacity after received the discharge from the CETP can be summarized as below:

Table 4-20. C9 and C9-5 canal pollution loads receiving capacity after received the discharge from the CETP

Parameter	BOD	COD	SS	As	Pb	Cd	Hg
L_{td} (kg/day)	3,535.48	7,070,976	11,784.96	11.785	11.785	2.357	0.236
L_n (kg/day)	2,883.6	6,805.3	10,842.34	8.074	9.23	1.61	0.23
L_t (kg/day)	150.33	375.84	250.56	0.25	0.5	0.25	0.025
L_{tn} (kg/day	250.78	-55.08	346.032	1.73	1.029	0.246	-0.01

Conclusion: C9 and C9-5 Canal, after received the treated waste water from the IZ will still be able to sustain the loads of parameters BOD, SS, As, Pb, Cd and remain within national standards. COD, Hg levels are already over the river maximum

pollution loads; thus the additional COD, Hg load will not in themselves cause a change in water quality of the canal with respect to existing standards.

4.9.2. *Dao river pollution load analysis*

Dao river pollution load can be analyzed by the limits of pollutants in Dao river. It can be presented as below table:

Table 4-21. The limitation values of pollutants in Day

Parameter	BOD	COD	SS	As	Pb	Cd	Hg
C_{tc} (mg/l)	6	15	30	0.02	0.02	0.005	0.001

Note: Limitation value C_{tc} is based on QCVN 08:2008/BTNMT, column A2

4.9.2.1. Max pollution load

Max pollution load that nearby surface water sources can receive, will be calculated using below equation:

$$\mathbf{L_{td} = (Q_s + Q_t) \times C_{tc} \times 86.4}$$

Of which:

- L_{td}: max pollution load of that water sources with a certain pollutants;

- Q_s: Flow rate of Day river in dry season, Q_s= 1.75 m^3/s;

- Q_t: Flow rate of wastewater, Qt = 2.728 m^3/s (flow rate of C9-5 + flow rate of CEPT of Bao Minh IZ);

- 86.4 is the coefficiency from (m^3/s) x (mg/l) to (kg/day).

The max pollution load that nearby surface water sources can receive will be presented in below table:

Table 4-22. The max pollution load that nearby surface can receive

Parameter	BOD	COD	SS	As	Pb	Cd	Hg
$Q_s + Q_t$ (m^3/s)	4.478	4.478	4.478	4.478	4.478	4.478	4.478
C_{tc} (mg/l)	6	15	30	0.02	0.02	0.005	0.001
L_{td} (kg/day)	2321.395	5803.488	11606.98	7.738	7.738	1.934	0.387

4.9.2.2. Current pollutant load

The current pollutant load can be calculated as below equation:

$$\mathbf{L_n = Q_s \times C_s \times 86.4}$$

When:

- L_n: The current pollutant load in receiving water body;

- Qs: Flow rate of Day river in dry season, Qs= 1.75 m^3/s;

- C_s: Max concentration of pollutants in the river before receiving the wastewater discharge;

- 86.4 is the coefficiency from (m^3/s) x (mg/l) to (kg/day).

Calculation results of the current pollutant loads are presented as below table:

Table 4-23. The current pollutant load

Parameter	BOD	COD	SS	As	Pb	Cd	Hg
Q_s (m^3/s)	1.75	1.75	1.75	1.75	1.75	1.75	1.75
C_s (mg/l)	4.6	11.5	24.2	0.03	0.01	0.003	0.001
L_n (kg/day)	695.52	1738.8	3659.04	4.536	1.512	0.454	0.151

4.9.2.3. Pollution load from discharge source

The Pollution load from discharge source will be calculated as below equation:

$$\mathbf{L_t = Q_t \times C_t \times 86.4}$$

When:

- L_t: Pollution load from discharge source;

- Q_t: wastewater flow rate, Q_t= 0.058 m^3/s;

- C_t: Max concentration of certain pollutants in discharge;

- 86.4 is the coefficiency from (m^3/s) x (mg/l) to (kg/day).

The pollution load from discharge source will be presented as below table:

Table 4-24. The pollution load from C9 and C9-5 canal into Day river

Parameter	BOD	COD	SS	As	Pb	Cd	Hg
Q_t (m^3/s)	0.058	0.058	0.058	0.058	0.058	0.058	0.058
C_t (mg/l)	42.5	104.5	97	0.085	0.14	0.057	0.006
L_t (kg/day)	212.98	523.67	486.09	0.426	0.702	0.286	0.03

Note: C_t is average concentration of pollutants in the water quality results of C9, C9-5 canal and concentration of wastewater after treating with hypothesis that they are meeting with national quality QCVN 40:2011/BTNMT, column A.

4.9.2.4. Dao river pollution load receiving capacity

Dao river pollution load receiving capacity will be calculated as below equation:

$$\mathbf{L_{tn} = (L_{td} – L_n - L_t) \times F_s}$$

When:

- L_{tn}: Dao river pollution load receiving capacity (kg/day);

- L_{td}: max pollution load of that water sources with a certain pollutants;

- L_n: The current pollutant load in receiving water body;

- L_t: Pollution load from discharge source;

- F_s: Safety coefficiency, F_s = 0.3 – 0.7, the project choice F_s = 0.5.

Dao river pollution load receiving capacity after receiving water from C9, C9-5 canal (including discharge water from CETP of Bao Minh IZ) will be presented as below table:

Table 4-25. Day river pollution load receiving capacity after receiving water from C9, C9-5 canal

Parameter	**BOD**	**COD**	**SS**	**As**	**Pb**	**Cd**	**Hg**
L_{td} (kg/day)	2321.395	5803.488	11606.98	7.738	7.738	1.934	0.387
L_n (kg/day)	695.52	1738.8	3659.04	4.536	1.512	0.454	0.151
L_t (kg/day)	212.98	523.67	486.09	0.426	0.702	0.286	0.03
L_{tn} (kg/day)	706.448	1770.509	3730.925	1.388	2.762	0.597	0.103

Conclusion: Dao River, after received the treated waste water from the IP will still be able to sustain the loads of parameters BOD, COD, SS, As, Pb, Cd and Hg.

4.9.3. *Day river pollution load analysis*

Day river pollution load can be analyzed by the limits of pollutants in Day river. It can be presented as below table:

Table 4-26. The limitation values of pollutants in Day

Parameter	**BOD**	**COD**	**SS**	**As**	**Pb**	**Cd**	**Hg**
C_{tc} (mg/l)	6	15	30	0.02	0.02	0.005	0.001

Note: Limitation value C_{tc} is based on QCVN 08:2008/BTNMT, column A2

4.9.3.1. Max pollution load

Max pollution load that nearby surface water sources can receive, will be calculated using below equation:

$$\mathbf{L_{td} = (Q_s + Q_t) \times C_{tc} \times 86.4}$$

When :

- L_{td}: max pollution load of that water sources with a certain pollutants;

- Q_s: Flow rate of Day river in dry season, Q_s= 2.8 m^3/s;

- Q_t: Flow rate of wastewater, Qt = 4.478 m^3/s (flow rate of C9-5 + flow rate of CEPT of Bao Minh IP + flow rate of Dao river);

- 86.4 is the coefficiency from (m^3/s) x (mg/l) to (kg/day).

The max pollution load that nearby surface water sources can receive will be presented in below table:

Table 4-27. The max pollution load that nearby surface can receive

Parameter	**BOD**	**COD**	**SS**	**As**	**Pb**	**Cd**	**Hg**
$Q_s + Q_t$ (m^3/s)	7.278	7.278	7.278	7.278	7.278	7.278	7.278
C_{tc} (mg/l)	6	15	30	0.02	0.02	0.005	0.001
L_{td} (kg/day)	3772.915	9432.288	18864.58	12.576	12.576	3.144	0.629

4.9.3.2. Current pollutant load

The current pollutant load can be calculated as below equation:

$$\mathbf{L_n = Q_s \times C_s \times 86.4}$$

When:

- L_n: The current pollutant load in receiving water body;

- Qs: Flow rate of Day river in dry season, Qs= 2.8 m^3/s;

- C_s: Max concentration of pollutants in the river before receiving the wastewater discharge;

- 86.4 is the coefficiency from (m^3/s) x (mg/l) to (kg/day).

Calculation results of the current pollutant loads are presented as below table:

Table 4-28. The current pollutant load

Parameter	**BOD**	**COD**	**SS**	**As**	**Pb**	**Cd**	**Hg**
Q_s (m^3/s)	2.8	2.8	2.8	2.8	2.8	2.8	2.8
C_s (mg/l)	5	13	29	0.03	0.01	0.004	0.001
L_n (kg/day)	1209.6	3144.96	7015.68	7.258	2.419	0.968	0.242

4.9.3.3. Pollution load from discharge source

The Pollution load from discharge source will be calculated as below equation:

$$\mathbf{L_t = Q_t \times C_t \times 86.4}$$

When:

- L_t: Pollution load from discharge source;

- Q_t: wastewater flow rate, Q_t= 0.058 m^3/s;

- C_t: Max concentration of certain pollutants in discharge;

- 86.4 is the coefficiency from (m^3/s) x (mg/l) to (kg/day).

The pollution load from discharge source will be presented as below table:

Table 4-29. The pollution load from C9 and C9-5 canal into Day river

Parameter	**BOD**	**COD**	**SS**	**As**	**Pb**	**Cd**	**Hg**
Q_t (m^3/s)	0.058	0.058	0.058	0.058	0.058	0.058	0.058
C_t (mg/l)	42.5	104.5	97	0.085	0.14	0.057	0.006
L_t (kg/day)	212.98	523.67	486.09	0.426	0.702	0.286	0.03

Note: C_t is average concentration of pollutants in the water quality results of C9, C9-5 canal and concentration of wastewater after treating with hypothesis that they are meeting with national quality QCVN 40:2011/BTNMT, column A.

4.9.3.4. Day river pollution load receiving capacity

Day river pollution load receiving capacity will be calculated as below equation:

$$\mathbf{L_{tn} = (L_{td} – L_n - L_t) \times F_s}$$

When:

- L_{tn}: Day river pollution load receiving capacity (kg/day);
- L_{td}: max pollution load of that water sources with a certain pollutants;
- L_n: The current pollutant load in receiving water body;
- L_t: Pollution load from discharge source;
- F_s: Safety coefficiency, $F_s = 0.3 – 0.7$, the project choice $F_s = 0.5$.

Day river pollution load receiving capacity after receiving water from C9, C9-5 canal (including discharge water from CETP of Bao Minh IZ) will be presented as below table:

Table 4-30. Day river pollution load receiving capacity after receiving water from C9, C9-5 canal

Parameter	**BOD**	**COD**	**SS**	**As**	**Pb**	**Cd**	**Hg**
L_{td} (kg/day)	2,865.715	7,164.288	14,328.58	9.552	9.552	2.388	0.478
L_n (kg/day)	1,209.6	3,144.96	7,015.68	7.258	2.419	0.968	0.242
L_t (kg/day)	212.98	523.67	486.09	0.426	0.702	0.286	0.03
L_{tn} (kg/day)	721.57	1,747.83	3,413.41	0.93	3.22	0.567	0.103

Conclusion: Dayi River, after received the treated waste water from the IZ will still be able to sustain the loads of parameters BOD, COD, SS, As, Pb, Cd and Hg.

CHAPTER 5 ENVIRONMENTAL MEASURES TO MITIGATE

To limit negative impacts of the project on environment to the maximum, the Employer will take mitigative measures during the construction and operation phase in order to eliminate potential impacts causing adverse consequences on the environment for an immediate and long time. On a basis of impacts assessed in Chapter 4, the below are mitigative measures to minimize these impacts.

5.1. Mitigate adverse impacts in the construction phase

During construction process, the Project Owner coordinates with the contractors in complying with regulations on labor safety and environmental sanitation. The following measures will be taken to limit harmful impacts on the surrounding environment.

5.1.1. Mitigate dust and exhaust gases

To reduce dust at the lowest level by watering on the lowly humid, hot and dry days, especially on strongly windy days (twice or three times a day); and clean the site upon complete any item;

To build barriers made of fiberboards or iron sheets in 2-3m height surrounding the project area to limit dust emitted to the ambient environment; well carry out construction management and supervision on the site;

To provide cleaner to clean the site at the end of day to limit solid wastes and building materials scattered on the site as well as transport roads causing dust upon wind blows;

To cover canvas on the building material stores; assign the person in charge of managing the traffic means to/out of the site and building materials transported to the designated place; conduct principle of construction and transport in the lump-sum form;

To tightly cover the means of transport for building materials emitting dust such as cement and sand.

5.1.2. Mitigate impacts on traffic safety upon transporting building materials

To contract with the transport companies to not use the out-of-date trucks as stipulated by the Ministry of Transport because these trucks often emit exhaust gas exceeding the allowable limit upon operation;

To provide trucks with appropriate load;

To transport at the time the roads have low traffic density, specifically from 10:00 to 15:00 everyday;

To detail the plans to transport building materials; stop transport on the holidays such as Saturday, Sunday, Labor International Day and Independence Day … and transport on another day.

5.1.3. Mitigate water pollution

For domestic waste water, arrange temporary waste water treatment works such as mobile WCs (120 liters) near the site huts. The mobile WCs are in the monolithic module structure by highly strong, compact, neat and easily movable composite materials suitable to the construction area or festivals. Their structure and operational principles are similar as the septic tank including 3 chambers: the first chamber contains 50-70% of the whole tank's capacity and the second and third chambers contain 30-50% of the capacity. Waste water to the first chamber causes fastidious biologic treatment process and sediments in waste water are fermented and deposited at the bottom of the tank and pure water is separated to the water collection chamber and discharged into the biolake through the drainage system of the whole industrial park. Sediments are periodically sucked and disposed in accordance with current regulations.

Figure 5-1. Portable toilet image

For construction waste water, collect and preliminarily treat waste water by depositing and eliminate garbage.

For overflowed storm water, arrange drainage along the common storm water drains of the industrial zone, paying attention to using the trash racks to avoid industrial and domestic wastes mixed into storm water blocking the sewerage system.

5.1.4. Mitigate emission of solid wastes

Solid wastes in the construction process are mainly building materials damaged such as broken bricks, sand, gravel, dead cement, scraps and domestic wastes of the workers on the site such as protective tools and cement bags … These solid wastes must be treated in a regular and concentrated manner and classified.

It is required to limit wastes in construction by calculating and using materials properly; reminding the workers to have awareness of saving and close construction management and supervision. Inert and un-hazardous wastes such as broken brick and redundant sand are used for filling the site plan. The contractors collect, continuously classify and maintain building wastes in the designated places which are convenient for the contractors to transport the wastes. To avoid losing and leaking wastes to the environment, the waste dumps must be designed with hard wall and temporary drains… The building wastes are transported during the day to return the site plan. Other wastes such as cement bags, protective tools, iron and steel pieces and welding sticks … must be collected and transported to the designated place to recycle or re-sell to the procurers. The PMU or contractors will contract with the qualified companies to transport wastes with regular and close supervision of the PMU, environment police and traffic and public works agencies to avoid throwing building waste illegally.

It is required to gather domestic waste in the 500 liter recycle bins near the site huts to ensure environmental protection and contract with the environment service suppliers in the project area to collect and treat wastes as stipulated by the law.

5.1.5. Mitigate other impacts

In the construction phase, there are many workers, including workers from other localities. This is a factor causing social evils, spreading infectious epidemic diseases and losing order and security … Labor safety incidents may occur. Some measures to mitige these impacts are as follows:

- Priority is given to the local workforce to reduce the site huts and limit wases and epidemic diseases;

- Workers are diffused site regulations, labor safety and fire and explosion prevention by the contractors. All the workers on the site are trained about regulation on labor safety – sanitation according to Vietnam's standard 5308-91, electrical accident safety, Vietnam's standard 4086-1995 and building standards. Operators are well-trained and issued with certificate of operation.

- The workers are provided with labor protective tools upon excavating, handling and installing equipments and machinery. Safe measures are taken to prevent incidents. Supervisors regularly check and monitor compliance with labor safety of the workers. The works under progress must have barriers, warning signs and signal lamps on night. It is required to equip with fire and explosion fighers in emergency such as

water cabin and fire extinguishers. The site security guards are on round-the-clock duty to give instructions for site entrance and exit.

- Workers from another place must be declared with temporary residence as stipulated by the law. The PMU coordinates with the local authority in well managing the workers on the site.

Table 5-1. Assessing the feasibility and efficiency of the measures to mitigate pollution during construction phase of the project

No	Mitigation measures	extent feasible / Performance	Recommendations
1	***Mitigation of dust, odor, traffic safety***		
	- Develop specific timetable for transporting materials to the project. - Transportation vehicles ensure longer-term dating, not overloaded. - Materials are assembled in place, coved canvas in the process of transporting	Level and performance of the above solution, if they are stricted, would reach 70-75% *[Science and Technology Center and transportation Environmental Protection - Environmental Impact Assessment for construction investment projects]*	Department of Environment and Natural Resources, departments of local authorities closely monitor the construction subcontractors to implement mitigation measures.
2	***Mitigation of water pollution***		
	- Arrange the wastewater treatment works temporary (portable toilets of 200 liters) - Wastewater of construction is collected to sedimentation and removing garbage. - Use garbage parallel to separate garbage out of rainwater runoff.	During construction process, wastewater from life activities of workers, construction wastewater, rainwater running off project area unavoidable environmental impacts to water. If they are done well for mitigation measures, performance woul be 70-75% *[Science and Technology Center and transportation Environmental Protection - Environmental Impact Assessment for construction investment*	The project owner monitors the construction subcontractors to implement mititgation measures

No	Mitigation measures	extent feasible / Performance	Recommendations
		projects]	
3	***Mitigation of solod waste***		
	- Collecting, classifying, processing outsourcing - Tap to material in true pale	If it is done well for mitigation measures, performance woul be 80-95% *[Science and Technology Center and transportation Environmental Protection - Environmental Impact Assessment for construction investment projects]*	The project owner monitors the construction subcontractors to implement mititgation measures
4	***Mitigation of other impacts***		
	- Investor - the contractor shall coordinate with local governments to manage construction workers - Workers are trained safety rules, is equipped with labor protection and educated environmental sanitation, fire and explosion prevention.	Feasibility: 100% Performancet: 90% *[Science and Technology Center and transportation Environmental Protection - Environmental Impact Assessment for construction investment projects]*	The construction subcontractors report staffing plan, construction time to local authorities to coordinate implementation, observe and observe social security, sanitation, oppcutional safety, …

5.2. Measures to mitigate adverse impacts in the operational phase

This is an environmental treatment project; therefore, wastes are mostly emitted as production projects. In the operation phase, the only solid waste is sludge in the final step of the treatment system. Thus, basically, the project into operation will meet waste water treatment demand for the industrial zone. Adverse impacts on environment are considered in following factors:

- Technical errors of the system in the operation process: Technology selected in the project meets requirements of domestic water treatment. Unsatisfied treatment is due to operation and failure of equipment. Hence, measures to remedy adverse impacts in the project operation phase are technical measures to ensure effective operation of

the waste water treatment system. If the following measures are taken, adverse impacts will be mitigated to 95%.

- The operators of the waste water treatment plant are basically trained about operating the system and remedying some simple incidents.

- It is required to check and maintain equipment every 02 years. Pipeline system is checked to avoid being broken and leaked due to impacts of external factors. The whole close treatment system without leaked pipeline will not emit exhaust gas and smells.

- After being treated, water quality must be periodically analyzed to monitor stability of the treatment system and ensure water quality to meet standard.

- Sludge: Sludge is collected and periodically treated 3 months for one time following the current standard.

CHAPTER 6 ENVIRONMENTAL MANAGEMENT PLAN

6.1. ENVIRONMENTAL MANAGEMENT PLAN

This is an environmental treatment project; therefore, wastes are mostly emitted as production projects. In the operation phase, the only solid waste is sludge in the final step of the treatment system. Thus, basically, the project into operation will meet waste water treatment demand for the industrial zone. Adverse impacts on environment are considered in two following factors:

6.1.1. Methods of measuring water pollution mitigation

(1). Industrial waste water

- The waste water treatment plant of Bao Minh Industrial Zone is a concentrated one. Thus, before directly connecting water discharge from the plants to common pipeline, it is necessary to require the plants to use the trash racks to separate raw large size garbage from waste water.

- Waste water quality after being treated must be monitored according to Vietnam's Regulation QCVN 40:2011/BTNMT (Column B) before being discharged to sewers.

- The Project Owner installs automatic waste water quality observation system after processing monitoring parameters: discharge, pH, DO, TSS and COD.

(2). Domestic waste water

Domestic waste water from the WCs for the employees of the concentrated waste water treatment plant is collected and treated by the septic tank.

(3). Rain water

Rain water is collected into the storm water drainage system of the industrial zone through the storm water manhole arranged in sidewalks.

6.1.2. Methods of measuring air pollution mitigation

(1). General methods to mitigate air pollution

General measures to limit air pollution and impacts on the workers' health are taken by the Project Owner during the project operation as follows:

To build the concentrated waste water treatment plant in line with regulation on safety and industrial sanitation and ensure necessary aeration by natural ventilation and local fans;

To clean the waste water treatment area and management room after each shift;

To equip with all protective tools as stipulated for the workers and supervise use of these protective tools during working process;

To provide all information on sanitation and labor safety for the operators

(2). Measures to mitigate air pollution in the waste water treatment plant

CETP have to be constructed in accordance with regulations on safety, industrial hygiene, it is maintained the necessary ventilation by natural ventilation and cooling fans locally;

To organize hygiene of CETP, operating room after each shift;

To equip the tools for labor protection for workers under the provisions and supervise the use of personal protective equipment during work;

Provide sufficient information about hygiene, occupational safety for workers.

(3). Using bio-products

In the event that the concentrated waste water treatment plant emits bad smells, the Project Owner will use bio-products (GEM-P, GEM-K, GEM, CTA-T) to mitigate bad smell generated from the waste area, waste water treatment area and sludge yard …

(4). Oxidizing odorous substances

Odorous substances are decomposed by strong oxidants such as H_2O_2 or ozone. Thus, the Company periodically uses H_2O_2 solution in the odor emitting areas or installs some ozone generators to treat bad smells. At present, ozone generators are used to treat bad smells in Vietnam.

(5). Controlling air pollution due to transport

The Project Owner takes appropriate measures to limit air pollution to the maximum caused by transport including:

To concretize traffic roads inside the waste water treatment plant; regularly clean the roads and install automatic watering system for the roads inside the plant;

To not start the trucks upon waiting for sludge, waste and chemical transport;

To regularly check and maintain means of transport and ensure them in good technical conditions

(6). Mitigating noise pollution

The Project takes the following measures to mitigate noise pollution upon operating the concentrated waste water treatment plant:

To fit anti-vibration pads for high noise machinery and equipments, especially air blowers placed in the acoustic enclosure;

To insulate high noise source (200mm thick wall and 100mm sound insulating foam layer, windows arranged in the silencing inclining wall and doors tightly erected and made of heavy wood);

To check and maintain machinery and equipment on periodic basis; normally every 4-6 months for new equipment and every 3 months for old equipment;

To plant more green trees in the campus to limit noise transmission

(7). Mitigating residual heat pollution

On the hot days, temperature in the waste water treatment plant is often higher than the allowable standard in range of 1^0– 3^0C. Thus, the Project Owner must strengthen measures of local cooling by cold drink with sugar and mineral salt for the operators.

6.1.3. Methods of measuring sludge management reduction

The Project Owner will contract with the environment company to collect, transport and treat sludge generated from the concentrated waste water treatment plant.

6.1.4. Methods of measuring solid waste reduction

The Project Owner will contract with the environment company to collect, transport and treat domestic and hazardous solid wastes.

Table 6-1. Environmental mitigation measures applied for construction phase

Impacts	Code	Mitigation measures applied	Legal / regulations referenced	Unit responsible for implementation	Surpervisors
Air pollution	A1	The construction vehicles are regularly checked air emissions and certificated as *"Recognized certificate of compliance to quality control, technical safety and environmental protection"* according to Decision No. 35/2005 / QD-BGTVT on 21/07/2005;	• TCVN 6438-2005: Means of road transport. Maximum allowable limit of emissions; • Số 35/2005 QD-BGTVT – Decision issued regulations on quality control, technical safety and environmental protection for vehicles imported into Vietnam QCVN 05: 2009/BTNMT – National technical regulation on ambient air quality	Contractors	IZMB of Bao Minh
	A2	To maintance vehicles and equipment daily and every 6 months (or 8,000 km of road)			
	A3	No fire waste at construction area			
	A4	Monitoring air quality, exhaust emissions, dust, noise and ambient air quality			
Dust Emissions	D1	Transporting waste out of building as soon as possible	QCVN 05: 2009/BTNMT – ational technical regulation on ambient air quality	Contractors	IZMB of Bao Minh
	D2	Covering transportation vehicles to prevent dropping of soil, sand, materials or dust in the transport process			
	D3	Contractor's responsibility is to comply national regulations of ambient air quality			

	D4	Contractors ensure the amount of dust emission that is smallest and not being inconvenient for local residents. Contractor's responsibility is to carry out dust controlling plan to maintain safety working environment and mitigate the disturbance to the residential / around housing.			
	D5	Contractor's responsibility is to carry out measures to mitigate dust emission as necessary as (such as spraying car, spraying water on the construction road, covering area of material storage, ect.			
	D6	Excavated soil and material storage expanse should be covered to prevent dispersal by wind and the position of the raw materials stockpile has to be considered wind direction and the location of sensitive areas.			
The disturbance of vegetation and ecosystems	TR1	The Contractor shall prepare measures to protect vegetation outlined in the environmental management plan approved by the building construction engineer, according to relevant regulations. Clearance plan must be approved by the Construction Supervision Consultant and strict compliance by the contractor	• Law of environmental protection 52/2005/QH11	Contractors	IZMB of Bao Minh
Noise and vibration	N1	To avoid constructing in the night (10 pm to 6 am)	• QCVN 26:2010/BTNMT – National technical regulation on noise • QCVN 27:2010/BTNMT:National technical regulation on vibration		
	N2	Contractor responds compliance of Vietnam law regulations of noise and vibration			
	N3	All vehicles must have "Certificates of quality control, technical safety and environmental protection for vehicles" according to Decision No. 35/2005/QD-BGTVT to avoid excess noise emissions from the old machine, without the proper repair.			
Increasing tủbidity in	TU1	Ensuring the technical requirements for wastewater treatment and water runoff		Contractors	IZMB of Bao

water	TU2	Good management of soil erosion and sediment			Minh
Domestic wastewater from workers	WW1	Building and use temporary portable toilets in the IP (if necessary)	• QCVN 14:2008/BTNMT: National technical regulation on domestic wastewater	Contractors	IZMB of Bao Minh
	WW2	Building a septic tank (if required) and collecting wastewater and sewage when completed			
	WW3	Contractor has responsibility to comply Vietnam law relating wastewater discharged source			
	WW4	Wastewater exceeding the value allowed by Vietnam standards / laws must be collected in a septic tank and transported from the field by a unit licensed collection			
Drainage and sedimentation control	SW1	Periodic dredging of sewers	• TCVN 4447:1987 National standard on earth works, codes for construction, check and accetance. • Circular 22/2010/TT-BXD about safety in construction work • QCVN 08:2008/BTNMT - National technical regulation on surface water quality	Contractors	IZMB of Bao Minh
	SW2	To avoid water runoff containing sediment can affect water resources, it is necessary to build works decanting sludge, making slowly flow rate or changing flow direction and sediment traps to create vegetation.			
	SW3	To ensure drainage system is always maintained, no sludge and other obstructions and periodically check the condition of the drainage system			
	SW4	To maintain the current conditions and not disturb the position of the area by the construction activities			
	SW5	The excavation, digging and creating slope must be maintained with the appropriate specifications of construction for the outfall			

	SW6	The Contractor shall comply with the detailed design of the drainage system including construction plan, recommence to prevent rain caused local flooding or erosion of soil in the area protected, resulting in sediment affect local water (drainage layout of the area around the building to collect rainwater runoff or sediment deposition ditch before flowing to water source)			
Underground water caused by lack of wastewater	GW1	Leaking in the drainage system must be detected and repaired promptly	QCVN 09:2008/BTNMTNational technical regulation on underground water quality	Contractors	IZMB of Bao Minh
Solid waste management	W1	Prior to construction, process of control solid waste (storage provide bins, schedule collection and disposal, etc.) must be prepared by the contractor and the construction management plan and monitored carefully during construction.	• Decree 59/2007/ND-CP on solid waste management	Contractors	IZMB of Bao Minh
	W2	Prior to construction, all discharge permits must be passed			
	W3	Solid waste can be temporarily stored at the site in an area approved by the construction supervision and local governments and related IZMB to collect and treat through the functional units collected. In case if it is not removed from the position, solid waste or construction waste will be treated at the site determined and having the acceptability of the construction supervision consultant and including in discharge solid waste plan. In all cases, the contractor shall dispose of any materials related to sensitive areas, as well as the natural environment or water source.			
	W4	Waste storage area must be covered, waterproof, weather avoidance and the animal scavengers.			
	W5	No burning, disposal or dumping of solid waste			

Chemical and hazardous waste	HW1	Chemical waste in any form must be disposed of in appropriate landfills approved and according to the request of local authorities. The contractor must have a certificate of treatment.	• Regulation No. 23/2006/QD-BTNMT: List of hazardous waste • Circular so12/2011/TT-BTNMT: About Hazardous Waste Management	Contractors	IZMB of Bao Minh
	HW2	Using oils, lubricants, cleaning materials, etc. from vehicle maintenance and machinery will be collected in the tank and removed from the field by companies in the recycling and disposal of hazardous waste approved.			
	HW3	The relevant authorities (IZMB and the Department of Natural Resources and Environment) promptly notify the case of oil spills, chemical, or incidents. Prepare and start remedial measures after any oil spill problem or accident. In this case, the contractor shall provide a report explaining why oil spills or accidents, remedial activitydone, the consequences / damage from the spill, and proposed measures overcome.			
	HW4	Toxic chemicals stored properly and labeled and locked containers.			
	HW5	To propagate, training to raise awareness and response measures for workers about toxic chemicals in the workplace			
Traffic management	T1	Prior to construction, making the consultation with local governments, communities and the traffic police	• Road Traffic Law No. 23/2008/QH12 • Construction Law 16/2003/QH11 • Circular No.22/2010/TT-BXD: egulations on labor safety in construction work	Contractors	IZMB of Bao Minh

Temporary stop providing utility services	U1	Provide information to the affected families in work schedule as well as suspended plans (at least 5 days before).	• Decree No. 73/2010/ND-CP: The sanctioning of administrative violations in the field of security and order, social security		
Safety for workers and residents	HS1	Limiting speed at construction site	• Circular No. 22/2010/TT-BXD: Regulations on occupational safety in construction work • Directive 02/2008/CT-BXD V / v reorganize and strengthen measures to ensure occupational safety, occupational health units in the building industry • TCVN 5308-91: Technical regulations for safety in construction • Decision No. 96/2008/QD-TTg of demining.	Contractors	IZMB of Bao Minh
	HS2	Avoid transport during peak hours			
	HS3	Installation of lighting at night			
	HS4	Equip workers with protective equipment (eg equip ear plugs and use in case having noise in the work area by installation of pipe, mixing,.., to control noise and protect workers)			
	HS5	Training workers on safety regulations and ensuring their compliance			
	HS6	Ensure safety of construction site , security and order			
	HS7	Provide protective clothing or protective gloves if they expose to chemicals and sludge			
	HS8	Prepare and implement action plans to deal with risks and emergency situations (ie in complex situations, stopping construction and implementation of necessary measures) as well as preparing services emergency at construction site.			
	HS9	The Contractor shall comply with the regulations of Vietnam on labor safety.			

Communication with the local community	C1	Provide local communities and workers at the site with the ECOPs (Vietnamese) and the Environmental Protection documents related	• Decree No. 73/2010/ND-CP: The sanctioning of administrative violations in the field of security and order, social security	Contractors	IZMB of Bao Minh
	C2	Dissemination of information of the project for affected groups (such as local governments, businesses and households affected, etc.) through community meetings before starting construction, supply mode of contact from that point the interested parties can get information about the active site, project status and results of the project; Provide all the information, especially technical solutions, with understandable language for the general public and information for interested citizens and officials through the preparation of an information sheet and informed in the press while conducting the work of the project.			
	C3	To supervise community related and require information as well as the progress of the project;			
	C4	Feedback telegrams and letters by written timely and accurately			
Schedule changes (If Contractor discovers archeological sites, historical	F1	Stop the construction activities in the region; localize detected position or area; Protect position to prevent any damage or loss of the object;	• Law on Cultural Heritage (2002) • Cultural Heritage Act (2009) for additional and reform • Decree No. 98/2010/ND-CP and additional reforms	Contractors	IZMB of Bao Minh
	F2	In the case antiquities are removable or sensitive, arranged a night guard until the local government or the Department of Culture - Information receives to.			

monuments, relics and objects, including graveyards and / or individual graves during excavation and constructio n)	F3	Notify construction supervision consultant to advise informing local authorities or the competent authorities that is responsible for cultural assets of Vietnam (within 24 hours or less); Local government or involved agency will be responsible for the protection and preservation of the area before deciding on subsequent appropriate procedures. This requires making a preliminary assessment study meaning and significance of these findings is the different criteria related to cultural heritage values including aesthetic, historic, scientific, research, social and economic.			
	F4	The decision on how to be carried out by the responsible agencies. This may include design changes (such as finding a location can't to be moved but still have cultural values and archeology) the conservation, preservation, restoration and salvage;			
	F5	The decisions relating to the management of the search process will be notified in writing by the competent authority;			
	F6	The construction work can resume only after permission from the local authorities responsible for heritage protection.			

Table 6-2. Environmental measures to mitigation applied for the operational phase

No	**Impact**	**Intensity**	**Mitigation**	**Implementation Unit**	**Monitoring Unit**	**Source of Funding**	**Difficulties / barrier that must be considered**
GIAI ĐOẠN HOẠT ĐỘNG							
1	Pollution at the oulet	Long-term	- Regularly monitor - Buil up warning signs at appropriate locations - Regular dredging	Operational unit of CETP	Nam Dinh Provincial Department of Natural	The operating budget of Bao Minh Industrial	- Operational staff's awareness of CETP - factories and enterprises in IP

			manhole, sewer - Reduce the risk ofwastewater spill - Control preliminary wastewater treatment in the enterprise		Resource and Environment, IZMB of Bao Minh	Zone Management Board	
2	Undergro und water pollution	Long-term	- Monitor and control underground water quality - Prevent penetration of anaerobic tank - Prevent leaks at the connection point or transition in the sewage pipe	Operati onal unit of CETP	Nam Dinh Provincial Department of Natural Resource and Environment, IZMB of Bao Minh	The operating budget of Bao Minh Industrial Zone Management Board	
3	Problems of operation	Long-term	- Training operation and management for workers - Monitor water quality to assess operational performance of CETP - Build warning signs for people about the risks related to water environment - Notify communication - Repair immediately after the incident or accident occurred - Built biopond (if applied)	Operati onal unit of CETP	Nam Dinh Provincial Department of Natural Resource and Environment, IZMB of Bao Minh		Operational staffs are not trained oftenly
4	Odor	Long-term	- Ensure radius of buffer zone is at least 300 m	Operati onal	Nam Dinh Provincial		Lack of financial budgets for operational training and

			- Plan in buffer zone to create landscape and prevent odor emission - Regular maintenance of the processing unit - Solve problems or accidents during operation - Clearance of the environment around the pond	unit of CETP	Department of Natural Resource and Environment, IZMB of Bao Minhh		management
5	Vibration	Long-term	- Planning - Operational mode and suitable maintance	Operational unit of CETP	Nam Dinh Provincial Department of Natural Resource and Environment, IZMB of Bao Minh		
6	Waste from operation	Long-term	- Set up collection plan and treat well wastes - Training for workers - Collect sludge regularly	Operational unit of CETP	Nam Dinh Provincial Department of Natural Resource and Environment, IZMB of Bao Minh		
7	Sludge management	Long-term	- Monitor sludge quality to have suitable treatment plan - Dry up and use as fertilizer or treating at the	Operational unit of CETP	Nam Dinh Provincial Department of Natural		Lack of transport vehicles

			landfill upon sludge quality - Reducing leakage along the transport distance because dust can contain heavy metals and pathogens that cause food contamination and illness related to skin and respiratory system - Workers must be equipped with appropriate safety clothing and prevent exposing sludge with open wounds - Dried sludge will be treated in landfill or buried in case of sludge quality does not meet stadards		Resource and Environment, IZMB of Bao Minh		
8	Health and safety	Long-term, regular	- Training safety and industrial sanitation - Mornitor workers health periodically - At least two people work in shifts - Good personal hygiene - Prepare specific guidelines for operation of CETP	Operational unit of CETP	Nam Dinh Provincial Department of Natural Resource and Environment, IZMB of Bao Minh		

6.2. RISK MANAGEMENT

6.2.1. Ocupational health and working safety

Operational staffs of CETP are often trained in oppucational safety and working safety, inparticular training in fire and explosion prevention as well as mainting and using chemicals to provide wastewater treatment system.

6.2.2. Environmental incidents due to technical errors of the system

The waste water treatment system has simple incidents such as broken collection pipeline due to external force effect, damaged pump and power failure … The operators may suspend the system to repair. The operators are trained about this matter and settle it. After 12 hours, the system may operate normally and efficiency of incident remedy obtains 100%.

In the event that water quality, after being treated, is unsatisfactory (results of periodic water analysis do not meet standards and water is black and opaque) without causes, the Employer will suspend the system and ask the consultant and supplier to help. The waste water treatment equipment under the proposed technology is popular technology widely used in Vietnam and alternatives may be easily bought in the domestic market. Thus, feasibility of this solution is very high (90%).

6.2.3. Environmental incidents due to natural disasters

Incidents of natural disasters in the project area are mainly because of heavy rains causing local inundation. Basically, infrastructures of the project area and Bao Minh Industrial Zone are planned synchronously and modernly. Thus, inundation is impossible and reliability level is 99%.

Table 6-3. Measures to risk mitigation during CETP operation

No	Situation	Action plan	Responsibility
1	Complaints from the public about environmental issues of construction activities and operation	- Immediately implement remedial measures if possible - Written in diary	Contractor
		Discuss with investors, local government to fully resolve the contradictions	Contractor, IZMB
2	Incident or accident or construction operation	First aid and immediate transport to the nearest hospital if necessary	Workers and residents
		- Having table and warning led of danger - Making record of accident or accident	Contractor, IZMB
3	Inactive CETP	Storage of untreated wastewater, building bio-pond if possible	- Department of management and operation of CETP; - IZMB; - Department of Natural Source and Environment of Nam dinh Province
		Regular check, backing up data/equipment	
		There are danger signs and to report to the authorities	
		Avoid overloading pollutants from wastewater of enterprises	
		Train operational staffs in regular monitor activity	
		Monitor design	
		Prepare for an action plan to respond randomly	
4	Improper discharge of sludge	Contracts with agencies authorized properly discharged sludge if founding harmful to the environment and human health	IZMB
		Report and regularly check all the mud emissions	
		Issue stiff penalties for violations	IZMB, Department of Natural Source and Environment of Nam dinh Province
5	Fire	Notify authorities (especially the fire police). Rescue objects in the danger zone. Actively flame isolated with the existing facilities in the area (water storage areas,	Contractor, IZMB

No	Situation	Action plan	Responsibility
		fire extinguisher (if any).	
		Support under the guidance of the functional units until they are present in the field (especially in the case of mines, explosions caused by chemicals ...).	Contractor, IZMB
		Supporting the functional unit, local government to establish security belt around dangerous areas.	Contractor, IZMB industrial establishments / enterprises
		Check the condition and safety of fire or explosion in the area, make sure this problem does not continue. Suspend operations if it is the violation of fire safety conditions.	Contractor, IZMB industrial establishments / enterprises
6	Electrical accident	Disconnect the power source of the problem area and the surrounding area Immediate rescue objects in the danger zone Find out the cause of the incident or accident, check the power source, wires and contacts ...	Contractor, IZMB industrial establishments / enterprises
		Making records the incident or accident case	Contractor, IZMB industrial establishments / enterprises

6.3. PUBLIC INFORMATION PROGRAM AND COMMUNITY RELATION

6.3.1. Public consultation in EMP report preparation

During the process of doing EMP, the project owner and consultant carry out consultation of the People's Committee of Kim Lien, Kim Thai and Lien Minh, and nerby residents. The content of community consultation during executing EMP including:

- To consult scale, property of this project;

- To consult natual-socio-economic environmental impacts;

- To consult methods of measures to mitigate adverse impacts of project;

- To consult other proplems (if have).

6.3.2. Publicize information to the community

During the construction and operation of the CETP of Bao Minh IP, Phase 1, the project owners will publish all of the EMP information toward the People's Committee of Kim Lien, Kim Thai, Lien Minh, and nearby residents so the public can monitor/ supervise the project.

The EMP includes these key points:

- The organization and activities of project environmental department;

- Training, awareness promoting of environmental issues and measures relating to the project;

- Responsibilities of project owners in implement measures, impact mitigation activities in the situation of environmental catastrophic during both the construction and operation phases of the project;

- Plans to operate environmental protection facility;

- Plans to monitor wastes/emissions/ discharges sources and surrounding environment during both the construction and operation phases of the project.

6.4. TRAINING

Operational staffs of wastewater treatment system have to be trained basic knowledge to run and repair some breakdowns in operation process. The waste water treatment system has simple incidents such as broken collection pipeline due to external force effect, damaged pump and power failure … The operators may suspend the system to repair. The operators are trained about this matter and settle it. After 12 hours, the system may operate normally and efficiency of incident remedy obtains 100%.

At the same time, operational staffs have to be trained using quick test equipments to check water quality after treating. In the event that water quality, after being treated, is unsatisfactory (results of quick test or periodic water analysis, or observation by eye) do not meet standards and water is black and opaque without causes, the Employer will suspend the system and ask the consultant and supplier to help. The waste water treatment equipment under the proposed technology is popular technology widely used in Vietnam and alternatives may be easily bought in the domestic market. Thus, feasibility of this solution is very high (90%).

6.5. OBJECTIVE OF ENVIRONMENTAL MANAGEMENT PLAN (EMP)

According to Vietnam's Law on Environmental Protection, in the project formulation, construction and operation phases, the Employer and successful contractors set up and run an environmental management plan (EMP).

EMP is necessary to supervise changes in environmental parameters and timely take suitable measures to mitigate adverse impacts.

Objective of the EMP is to give instructions for the project to ensure environmental technical regulation. The EMP includes programs on mitigating adverse impacts on environment, program on compliance with mitigative measures of the Employer, requirements of reporting, organizing and implementing the EMP and emergency response plan in possible incidents in each phase of the project. Specific objectives are as follows:

- To comply with Vietnam's applicable regulations and ordinances on environment;

- To use organizational structure in line with environmental protection in the project implementation phase to ensure that the mitigative measures are taken in all phases and supervise efficiency of the mitigative measures as proposed in the EIA report;

- To manage and supervise the mitigative measures as proposed in the EIA report for the contractors and operators.

- To provide standby plans for emergency response plans or environmental incidents upon project implementation.

6.6. ENVIRONMENTAL MANAGEMENT PROGRAM

* *In the construction phase*

+ Contractors:

- To take responsibility for complying with measures to mitigating environmental impacts as proposed in the EIA report;

- To timely report environmental incidents arisen in the construction process to the technical supervisors and the PMU's officers in charge of environment to obtain measures.

+ Project Management Unit (PMU):

In the construction process, the PMU appoints 02 officers in charge of environmental protection as follows:

Technical supervisors:

- To supervise compliance with measures of environmental protection as set in the EIA report;

- To report environmental quality observation and complicane with measures of environmental protection to be submitted to the PMU and the environmental management agencies for consideration and approval.

Officers in charge of environment:

- The PMU undertakes to give technical consultancy and measures of environmental protection to the contractors; and formulates a detailed environmental supervision and observation plan for the whole construction process;

- To take responsibility for preparing and submitting a periodic environmental report to the PMU and the environmental management agencies for consideration.

+ EMP

Construction of infrastructural structures

- Preparation, dredging, excavation and grading management in the project area;

- Dust and noise management and mitigative measures;

- Safety plan in construction;

- Sediment and domestic waste water management;

- Traffic management and means of transport;

- Management of building materials, construction equipments, stores and yards;

- Management of construction wastes and hazardous wastes

Construction and installation

- Construction plan and schedule;

- Installation plan and schedule;

- Management of motorized means of transport;

- Management of solid waste and domestic waste water areas;

- Fire and explosion prevention.

* *In the operation phase*

The PMU is responsible for complying with measures to mitigating environmental impacts as proposed in the EIA report; timely reporting environmental incidents arisen in the construction process to take measures; carrying out environmental quality observation program (self-conducted by the Project Owner or employing the qualified companies in environmental observation); and formulating and submitting a periodic environmental supervision and observation report to the competent agency for approval.

6.7. ENVIRONMENTAL SUPERVISION PROGRAM

Environmental quality supervision is a top important task in environmental management. Environmental supervision is a composition of scientific, technical and technological measures and close and systematic control and monitoring based on change in environmental quality. Environmental quality supervision is a process of "observing – measuring – recording – analyzing – processing and controlling environmental quality parameters in a regular and continuous manner".

The environmental supervision is an indispensable tool for the managers and specialists to closely manage environmental pollutants, adjust production plans and reduce costs for remedying and treating environmental pollution and environmental protection in general in the most effective manner.

Supervising environmental quality and monitoring changes in criteria are defined in physical, chemical and biologic parameters. Results of continuous and long-term environmental quality supervision are significant for not only detecting environmental changes to propose measures but also assessing accuracy of environmental impact forecasts as mentioned in this report.

Environmental quality supervision program is to continuously collect information on changes in environmental quality caused by the project to timely detect adverse impacts on environment and propose measures to prevent and mitigate pollution.

In addition, environmental quality observation in the project area is to ensure environmental technical regulations as follows:

Noise and vibration of machines, industrial production equipments should have to meet the required standards:

- QCVN 03:2008/BTNMT – National technical regulation on the allowable limits of heavy metal in soils.

- QCVN 05:2009/BTNMT – National technical regulation on hazardous substances in ambient air.

- QCVN 06:2009/BTNMT – National technical regulation on hazardous substance in ambient air.

- QCVN 08:2008/BTNMT – National technical regulation on surface water quality.

- QCVN 09:2008/BTNMT – National technical regulation on underground water quality.

- QCVN 14:2008/BTNMT – National technical regulation on domestic wastewater.

- QCVN 19:2009/BTNMT – National technical regulation on industrial emission of inorganic substances and dusts.

- QCVN 20:2009/BTNMT – National technical regulation on industrial emission of organic substances.

- QCVN 40:2011/BTNMT – National technical regulation on industrial wastewater.

- QCVN 06:2010/BXD – Vietnam building code in fire safety of buildings and structures.

Waste supervision

This is an environmental treatment project (waste water treatment) but is not the production plant; therefore, waste supervision is mainly in the construction phase. In the operation phase, the only wastes are sludge and water after being treated (checking whether the treatment system meets requirements).

Table 6-4. Waste supervision of project

No.	Environmental supervision	Supervised location	Supervised parameter	Frequency	National regulation compared
A	***Construction phase***				
1	Domestic waste solids	Collection area of domestic waste solids	Mass	Frequently	
2	Construction waste solids	Collection area of construction	Mass	Frequently	

No.	Environmental supervision	Supervised location	Supervised parameter	Frequency	National regulation compared
		materials			
3	Domestic wastewater	Collection area of labor's wastewater	pH, SS, COD, BOD, NH_4^+, T-N, T-P, oil, Coliform	Frequently	QCVN 14:2008
4	Exhaust fumes	Construction area	Dust, CO, SO_2, NO_2, noise	Frequently	QCVN 05:2009 and TCVN 5949-1998
B	***Operation phase***				
1	Hazardous wastes (Sludge)	Collection area of sludge	Mass	3month/time	
2	Wastewater	Water after treatment	pH, SS, BOD, COD, color, sulfide, temperature, NH_4^+, NO_3^-, Pb, Cr, Cd, As, Hg, coliform	3month/time	QCVN 14 : 2008/BTNMT
3	Exhaust fumes	CETP	H_2S, SO_2, NO_x, suspended dusts	3month/time	QCVN 19:2009/BTNMT

Supervision of ambient environment

Table. 6-5. Ambient environmental supervision

No.	Environmental supervision	Supervised location	Supervised parameter	Frequency	National regulation compared
A	*Construction phase*				
1	Ambient air environment	Treatment station area	Microclimate, noise, vibration, dust, CO, SO_2, NO_x, Clo, NH_4^+, H_2S	6 month/time	QCVN 05 - 2009 and TCVN 5949 -1998

No.	Environmental supervision	Supervised location	Supervised parameter	Frequency	National regulation compared
3	Surface water quality	C9 and C9-5 canal (section nearly project area)	pH, SS, BOD, COD, color, sulfur, temperature , NH_4^+, NO_3^-, Pb, Cr, Cd, As, Hg, coliform	6 month/time	QCVN 08:2008
B	*Operation phase*				
1	Ambient air quality	Treatment station area	Microclimate, noise, vibration, dust, CO, SO_2, NO_x, Clo, NH_4^+, H_2S	6 month/time	QCVN 05-2009 and TCVN 5949-1998
2	Surface water quality	C9 and C9-5 canal (section nearly project area)	pH, SS, BOD, COD, DO, NH_4^+, NO_3^-, Fe, Pb, Cr, Cd, As, Hg, coliform	6 month/time	QCVN 08:2008

Others

Settlement around the project area

+ *Objectives of settlement observation*

Particular objectives of environmental incident observation are summarized as follows:

- To observe incidents for traffic roads within the industrial zone through the project such as settlement and loading capacity of the roads;

- To observe settlement and crack of the works surrounding the project area in the industrial zone.

+ *Positions of settlement observation*

We select 04 adjacent positions in 4 directions to observe incidents due to settlement.

+ *Observation frequency*

Settlement phenomena are observed mainly by sense and portable equipments at site. Observation frequency is every 6 months in all positions.

6.8. COST ESTIMATE AND DURATION

T*able 6-6. Expenditure and duration*

No.	Environmental treatment work	Qty	Duration	Expenditure of construction/ installation	Expenditure of operation
A	***The construction phase***				
1	*200 liter mobile WC*	*4*	*To install upon project commencement* *To finish upon the septic tank is used*	*VND 100,000,000*	*VND 100,000,000/ month*
2	*500 liter domestic solid waste tank*	*4*	*To install upon project commencement* *To finish upon the septic tank is used*	*VND 500,000*	*Contract with the environmental service company* *VND 200,000/ month*
3	*200 liter domestic solid waste tank*	*2*	*To install upon project commencement* *To finish upon the septic tank is used*	*VND 250,000*	*Contract with the environmental service company* *VND 500,000/ month*
B	***The operation phase***				
1	*Storm water drainage system*	*2*	*- To build in the project construction phase* *- To operate upon the project operation*	*VND 500,000,000*	*VND 1,000,000*
2	*Domestic solid waste tank*	*4*	*To equip upon the project operation*	*VND 500,000*	*Contract with the environmental service company* *VND 200,000/ month*
3	*Waste grease tank*	*2*	*To equip upon the project operation*	*VND 250,000*	*Contract with the environmental service company* *VND 500,000/ month*
4	*Fire and explosion*	*2*	*- To build in the project construction*	*VND*	*VND 1,000,000*

No.	Environmental treatment work	Qty	Duration	Expenditure of construction/ installation	Expenditure of operation
	prevention system		*phase* *- To operate upon the project operation*	*200,000,000*	

6.8.1. Cost of environmental supervision in the construction phase:

Table 6-7. Cost of observation sample for environmental quality of domestic wastewater

No.	Parameter	Volume	Frequently (time/year)	Unit price (vnd)	Amount (vnd)
1	pH	2	2	30,000	120,000
2	SS	2	2	50,000	200,000
3	NH_4^+ (refined by N)	2	2	60,000	240,000
4	Phosphate (refined by P)	2	2	60,000	240,000
5	BOD_5	2	2	80,000	320,000
6	NH_4^+	2	2	60,000	240,000
7	Coliform	2	2	60,000	240,000
8	Animal and vegetable oil	2	2	80,000	320,000
Total					**1,920,000**

Table 6-8. Cost of observation sample for environmental quality of ambient air

No.	Parameter	Volume	Frequently (time/year)	Unit price (vnd)	Amount (vnd)
1	Microclimate	3	2	90,000	540,000
2	Suspended dusts	3	2	100,000	600,000
3	CO	3	2	300,000	1,800,000
4	SO_2	3	2	300,000	1,800,000
5	NO_2	3	2	300,000	1,800,000
6	Total organic substances	3	2	300,000	1,800,000

No.	Parameter	Volume	Frequently (time/year)	Unit price (vnd)	Amount (vnd)
7	Noise	3	2	50,000	300,000
Total					**8,640,000**

Table 6-9. Cost of observation sample for environmental quality of waste air

No.	Parameter	Volume	Frequently (time/year)	Unit price (vnd)	Amount (vnd)
1	Suspended dusts	2	2	100,000	400,000
2	CO	2	2	300,000	1200,000
3	SO_2	2	2	300,000	1200,000
4	NO_2	2	2	300,000	1200,000
5	Noise	2	2	50,000	200,000
6	Total organic substances	2	2	300,000	1200,000
Total					**5,400,000**

Table 6-10. Cost of observation sample for environmental quality of surface water

No.	Parameter	Volume	Frequently (time/year)	Unit price (vnd)	Amount (vnd)
1	pH	3	2	30,000	180,000
2	SS	3	2	50,000	300,000
3	As	3	2	80,000	480,000
4	Cd	3	2	60,000	360,000
5	BOD	3	2	80,000	480,000
6	Temperature	3	2	40,000	240,000
7	Color	3	2	50,000	300,000
8	COD	3	2	80,000	480,000
9	Hg	3	2	80,000	480,000
10	Pb	3	2	60,000	360,000
11	H_2S	3	2	60,000	360,000

No.	Parameter	Volume	Frequently (time/year)	Unit price (vnd)	Amount (vnd)
12	NH_4^+	3	2	60,000	360,000
13	Coliform	3	2	60,000	360,000
14	NO_3^-	3	2	50,000	300,000
Total					**5,040,000**

6.8.2. Cost of environmental supervision in the operation phase

Table 6-11. Cost of observation sample for environmental quality of wastewater before and after treatment

No.	Parameter	Volume	Frequently (time/year)	Unit price (vnd)	Amount (vnd)
1	pH	4	2	30,000	240,000
2	SS	4	2	50,000	400,000
3	T - N	4	2	60,000	480,000
4	T - P	4	2	60,000	480,000
5	COD	4	2	80,000	640,000
6	BOD	4	2	80,000	640,000
7	Color	4	2	50,000	400,000
8	Coliform	4	2	60,000	480,000
9	Oil	4	2	80,000	640,000
10	H_2S	4	2	60,000	480,000
11	Temperature	4	2	40,000	320,000
Total					**5,200,000**

T*able 6-12. Cost of observation sample for environmental quality of ambient surface water*

No.	Parameter	Volume	Frequently (time/year)	Unit price (vnd)	Amount (vnd)
1	pH	3	2	30,000	180,000
2	SS	3	2	50,000	300,000
3	T - N	3	2	60,000	360,000
4	T - P	3	2	60,000	360,000
5	COD	3	2	80,000	480,000
6	BOD	3	2	80,000	480,000
7	Color	3	2	50,000	300,000

8	Coliform	3	2	60,000	360,000
9	Oil	3	2	80,000	480,000
10	H_2S	3	2	60,000	360,000
11	Temperature	3	2	40,000	240,000
Total					**3,900,000**

Table 6-13. Cost of observation sample for environmental quality of ambient air

No.	**Parameter**	**Volume**	**Frequently (time/year)**	**Unit price (vnd)**	**Amount (vnd)**
1	Microclimate	3	2	90,000	540,000
2	Suspended dusts	3	2	100,000	600,000
3	CO	3	2	300,000	1,800,000
4	SO_2	3	2	300,000	1,800,000
5	NO_2	3	2	300,000	1,800,000
6	NH_4^+	3	2	300,000	1,800,000
7	H_2S	3	2	300,000	1,800,000
8	Noise	3	2	50,000	300,000
Total					10,440,000

CHAPTER 7 COMMUNITY CONSULTANCY

7.1. OBJECTIVES OF COMMUNITY CONSULTANCY

7.1.1. Appraisal agency

To help the appraisal agency have more comprehensive insight into the project on a basis of opinions of the local authority and the affected residential community and thereby help effective appraisal.

7.1.2. Project Owner

To receive feedbacks of the local authority and the affected residential community and thereby supplement assessments close to the reality and propose suitable and effective mitigative measures; take responsibility for taking mitigative measures to limit negative impacts of the project to the maximum.

Besides, to create consensus of the affected residential community for the project

7.1.3. Consulting agency

To receive feedbacks of the local authority and the affected residential community and thereby supplement assessments close to the reality and propose suitable and effective mitigative measures

7.1.4. People's Committee and Vietnamese Fatherland Front Committee at commune level

To help leaders of the People's Committee and Vietnamese Fatherland Front Committee at commune level clearer understand the project in the aspects: interests obtained upon deploying the project, environmental impacts of project implementation and possible mitigative measures for the project.

Besides, to create opportunity for the local authority to raise matters and concerns about the project

7.1.5. Affected residential community

To help the affected residential community clearer understand the project in the aspects: interests obtained upon deploying the project, environmental impacts of project implementation and possible mitigative measures for the project.

Besides, to create opportunity for the local authority to raise matters and concerns about the projects

7.2. COMMUNITY CONSULTANCY

Experts conduct community consultancy in the People's Committee and Vietnamese Fatherland Front Committee in 3 communes of Kim Thai, Lien Minh and Lien Bao, Vu Ban district. The contents are as follows:

Characteristics of the project;

Impacts on natural and socio-economic environment;

Measures to mitigate adverse impacts for the project; and

Other matters if any.

The Employer carries out consultancy for the following subjects:

- People's Committee of Kim Thai commune, People's Committee of Lien Minh commune and People's Committee of Lien Bao commune where the project is deployed

People residing in the project area and affected by activities of the project.

Methods:

For the People's Committees of communes, the Project Owner sends a written brief of the project and asks for opinions in writing from these agencies.

For the people affected by the project, the Project Owner directly interviews and collects their opinions in the available form. The questionnaire is attached in appendix of this Report.

7.3. RESULTS OF COMMUNITY CONSULTANCY

7.3.1. Consulting results of People's Committee of Kim Thai commune

7.3.1.1. Adverse impacts of the project on natural and socio-economic environment

"*Waste water treatment plant project for Bao Minh Industrial Zone, phase 1 – capacity of 5,000m^{3}/day*" is a project aiming at environmental protection and health protection for the people. Thus, it is necessary and appropriate to orientation of environmental protection in Nam Dinh province.

The People's Committees of communes reach a high consensus of assessing adverse impacts of the project on natural and socio-economic environment in the brief EMP.

7.3.1.2. Measures to mitigate environmental impacts of the project

The People's Committees of communes agree with measures to mitigate adverse impacts on environment set by the project.

7.3.1.3. Recommendations to the project owner

The Project Owner must have special concern about controlling environmental pollution matters in the project construction and operation phase.

It is required to consider regular maintenance upon operating the waste water treatment system and avoid possible incidents causing environmental pollution in the project area and life of the local people.

It is required to provide with labor protective equipments to ensure health safety and life of the workers in the construction and operation phase.

7.3.2. Consulting results of People's Committee of Lien Minh commune

7.3.2.1. Adverse impacts of the project on natural and socio-economic environment

"*CETP of Bao Minh Industrial Park, phase 1 – capacity of 5,000m^3/day*" is a project aiming at environmental protection and health protection for the people. Thus, it is necessary and appropriate to orientation of environmental protection in Nam Dinh province.

The People's Committees of communes reach a high consensus of assessing adverse impacts of the project on natural and socio-economic environment in the brief EMP.

7.3.2.2. Measures to mitigate environmental impacts of the project

The People's Committee of Lien Minh commune agrees with measures to mitigate adverse impacts set by the Project Owner; and suggests the Project Owner considering regular maintenance upon operating the waste water treatment system and avoiding possible incidents causing environmental pollution in the project area and life of the local people.

It is required to provide with labor protective equipments to ensure health safety and life of the workers in the construction and operation phase.

The Project Owner must have concerns about security and order, health and labor safety for the workers in the waste water treatment system in the construction and operation phase.

7.3.2.3. Recommendations to the project owner

The Project Owner must comply with the laws during construction process and upon operating the the waste water treatment system.

The Project Owner must take all measures to mitigate adverse impacts on environment as committed.

The Project Owner must ensure security and order and avoid possible contradiction between the workers in the concentrated waste water treatment plant, especially workers from other localities, and the local people.

7.3.3. Consulting results of People's Committee of Lien Bao commune

7.3.3.1. Adverse impacts of the project on natural and socio-economic environment

The commune People's Committee agrees with adverse impacts of the project as defined in the EMP. The commune People's Committee recognizes that the project has positive impacts on natural environment and creates jobs for local workforce.

7.3.3.2. Measures to mitigate environmental impacts of the project

The People's Committee of Lien Bao commune agrees with measures to mitigate adverse impacts set by the Project Owner; and suggests the Project Owner considering regular maintenance upon operating the waste water treatment system and avoiding

possible incidents causing environmental pollution in the project area and life of the local people.

7.3.3.3. Recommendations to the project owner

The Project Owner must comply with the laws during construction process and upon operating the the waste water treatment system.

It is required to ensure technical requirements in the project operation phase to mitigate adverse impacts on environment.

7.3.4. Results of consulting the local people

Results of collecting the local people's opinions about the concentrated waste water treatment plant are presented in Table 7.1:

Table 7-1. Public consultations

No	Name	Sex	Birth year	Address	Job	Water source	Is affected by the project				Agree on the project	Other options	Response
							Air quality	Health	Income	Others			
1	Nguyen Van Quang	Male	1969	Kim Thai Commune, Vu Ban Distric, Nam Dinh Province	Farmer	Well	No	No	No	No	Agree	The project owner should improve and reduce water pollution	
2	Nguyen Thanh Dat	Male	1956	Goi Town, Vu Ban Distric, Nam Dinh Province	Un-contracted worker	Tap-water	No	No	No	No	Agree	Treat the wastewater and reduce pollution	Reflected in project design
3	Do Quoc Kien	Male	1990	Goi Town, Vu Ban Distric, Nam Dinh Province	Police	Tap-water	No	No	No	No	Agree	No option	

No	Name	Sex	Birth year	Address	Job	Water source	Is affected by the project				Agree on the project	Other options	Response
							Air quality	Health	Income	Others			
4	Do Hung Anh	Male	1964	Lien Minh Commune, Vu Ban Distric, Nam Dinh Province	Teacher	Well	No	No	No	No	No option	Project owner should cooperate with local government to monitor and prevent solid wastes and wastewater enter the open water	Project owner will cooperate with local governme nt to solve happened problems
5	Nguyen Thi Kim Thai	Female	1969	Lien Minh Commune, Vu Ban Distric, Nam Dinh Province	Un-contracted worker	Well	No	No	No	No	No option	The project owner should be careful with the discharge during the rain, to prevent flood onto residential houses	Design of discharge and drainage system has taken into account potential flooding
6	Nguyen Thi	Fem	1955	Lien Minh Commune,	Worke	Well	No	No	No	No	Agree		

No	Name	Sex	Birth year	Address	Job	Water source	Is affected by the project				Agree on the project	Other options	Response
							Air quality	Health	Income	Others			
	Hong	ale		Vu Ban Distric, Nam Dinh Province	r							No option	
7	Tran Thi Huong	Female	1967	Lien Bao Commune, Vu Ban Distric, Nam Dinh Province	Farmer	Well	No	No	No	Odours from waste water affects the family	No option	Ensure the treated wastewater meet the standard and won't cause offensive odours	Reflected in project design
9	Nguyen Thi Hai	Female	1958	Lien Bao Commune, Vu Ban Distric, Nam Dinh Province	Un-contracted worker	Well	No	No	No	No	Agree	No option	

No	Name	Sex	Birth year	Address	Job	Water source	Is affected by the project				Agree on the project	Other options	Response
							Air quality	Health	Income	Others			
10	Phan Thi Hong	Female	1971	Kim Thai Commune, Vu Ban Distric, Nam Dinh Province	Un-contracted worker	Well	No	No	No	No	Agree	The project owner should be careful with the discharge during the rain, to prevent flood onto residential houses	Design of discharge and drainage system has taken into account potential flooding
11	Phan Thi Hoe	Female	1964	Goi Town, Vu Ban Distric, Nam Dinh Province	Civil servant	Tap-water	No	No	No	No	Agree	The project owner should be careful with the discharge during the rain, to prevent flood onto residential houses	See above

According to results of consulting the local people surrounding the project area, some main contents are as follows:

Most of the local people agree (7/10) with construction of the concentrated waste water treatment plant in Bao Minh Industrial Zone while some have no opinion (2/10) and objection about construction of this concentrated waste water treatment plant.

In addition, local people recommended Investor combining with local gorverment in controlling domestic wastes from residents that are not discharged into open ditch causing jammed when it's raining to ensure no ordor for they surrounding the project area.

Opinions of the Investor:

The Investor will fulfill commitments as stated in the EIA report, ensure waste water after being treated to meet standard, promptly remedy possible incidents and regularly check and maintain the machines in the project operation phase.

7.4. INFORMATION DISCLOSURE

The EIA report will be submitted to the local management agency to grasp and manage information.

7.5. COMMITMENTS OF PROJECT OWNER

7.5.1. General commitments:

- The Employer undertakes to comply with Vietnam's applicable law on environmental protection upon deploying and implementing the project.

- The Employer undertakes to take measures to mitigate adverse impacts of the project on environment upon planning and building infrastructural structure as well as operating the work. In the construction phase, build temporary houses, WCs and temporary waste store and take measures to collect and treat wastes as stipulated; In the operation phase, comply with measures of environmental protection as mentioned in the EIA report and take mitigative measures as stated in Chapter IV.

- The Employer undertakes that waste water, after being treated, must obtain class A according to QCVN 24:2009 and then discharged to the receiving environment.

- The Employer undertakes to collect and treat wastes without polluting surrounding environment; manage solid wastes under Decree No.59/2007/ND-CP dated 09/04/2007 of the Government on management of solid wastes.

- Management of hazardous wastes follows Circular No.12/2006/TT-BTNMT.The Employer undertakes to register the hazardous waste source owner with the Department of Natural Resources & Environment of Nam Dinh province.

- The Employer undertake to follow procedures of exploiting underground water and discharging waste water to water source in accordance with Law on Natural Resources and Decree No.149/2004/ND-CP dated 27/7/2004 of the Government on licensing, exploring, exploiting and using water resource and discharging waste water to the water source.

- The Employer undertakes to pay environmental protection fee for industrial waste water under Decree No.67/ND-CP dated 13/06/2003 of the Government. The

Company is responsible for ensuring costs of garbage and solid waste treatement services, measuring environmental supervision and operating environmental treatment system … and other relevant activities.

- The project's activities are under supervision of the environmental management agencies at central level, of Nam Dinh province and the Department of Natural Resources & Environment of Nam Dinh province for the purpose of environmental protection.

7.5.2. Compliance with the plans

- The Employer undertakes to comply with the planning under the approved investment report and strictly follow design standards for structures and landscape, green tree system, traffic system, water drainage system and functional subzones of the project.

- The Employer undertakes to ensure land use function in line with the landmark, arrange the works in the project area under the design and ensure construction density and landscape structure of the projet.

- The Employer undertakes to build manholes, observe waste water discharge and quality outside the fence before connecting to the external drainage system.

- The Employer undertakes to ensure green tree density as planned to create landscape, improve microclimate conditions and limit dust and noise in the project area.

- The Employer undertakes to ensure infrastructure system of the project including drainage system, waste water collection and treatment system, solid waste collection system, power supply system and communication system …

- The Employer undertakes to implement the functional subzone planning in the project area regarding environmental protection during the project operation process.

7.5.3. Compliance with environmental technical standards and regulations

+ The Project Owner undertakes to ensure Vietnam's environmental standards in the construction and operation phase, including:

+ Ambient environment: Pollutants emitting to the environment must ensure Standard on quality of ambient air (QCVN 05:2009/BTNMT, QCVN 06:2009/BTNMT).

+ Noise: Noise generated from the project's activities must meet standard on noise in the public and residential areas (QCVN 26:2010/BTMNT).

+ Waste water after being treated must meet QCVN 40:2011/BTNMT – National Technical Regulation on industrial waste water, colume B, Kf=1.0, Kq=1.1.

+ Solid waste: The whole volume of domestic solid waste must be collected, classified and treated by the companies employed to collect and treate wastes in the landfill as planned.

+ Sludge is pressed and transported to the treatment area as stipulated by the law.

+ Hazardous wastes are stored in the safely covered area and then a company is employed to collect and treate wastes.

+ Hazardous and unhazardous solid wastes are collected and transported to the designated place to ensure sanitation. The Employer undertakes to manage solid wastes in compliance with Decree No.59/2007/ND-CP on management of solid wastes; Circular No.12/2011/TT-BTNMT dated 14/4/2011 of the Ministry of Natural Resources & Environment on management of hazardous wastes.

The Project Owner undertakes to take measures to prevent environmental incidents and mitiage pollution as presented in the report, at the same time strengthen training for the staff to improve environmental management capacity and operate the waste water treatment system in the safest and most effective manner without environmental pollution.

7.5.4. Management and control of environmental pollution

It is required to comply with reporting regime as stipulated in Article 14, Decre No.80/2009/ND - CP after the EIA report is approved.

The Employer undertakes to carry out environmental pollution management and control program of the project as presented and reported periodically to the environmental management agencies.

The Employer undertakes to compensate and remedy environmental pollution in case of environmental incidents upon deploying the project.

The Employer undertakes to recover the environment as stipulated in the Law on Environmental Protection after completing the project operation.

After completing the environmental works as mentioned in the EIA report and required in Decision on approval of the EIA report, the Employer will submit a report to the Department of Natural Resources & Environment of Nam Dinh province for checking and confirming the contents. The project only comes into operation upon confirmation of the Department of Natural Resources & Environment of Nam Dinh province is obtained.