15.4.3 Specifications for EIA Study

SECTION 2
SPECIFICATIONS

2.1 OBJECTIVES

The Environmental Impact Assessment (hereinafter referred to as the "EIA") Study aims at:

(1) Assessment of magnitude and degree of anticipated environmental impact/s which may be caused by the implementation of the proposed Project,

(2) Preparation of recommendations and proposed countermeasures to mitigate the assessed environmental impact/s for smooth implementation and successful achievement of the objectives of the proposed Project.

2.2 TARGET AREA

The overall target area of the EIA Study is the planned sewerage service area of Metropolitan Tirana in the target year of 2010 and its surrounding area as shown in Figure 2.1.

The major attention of the EIA Study shall be paid to the proposed Site of the Tirana Sewage Treatment Plant and its vicinity as shown in Figure 2.2.

2.3 SCOPE OF PROJECT

(1) Overall Scope of the Proposed Project

The magnitude and description of the proposed projects are summarized in Tables 2.1 and 2.2, respectively.

Table 2.1 Overall Scope of the Proposed Project

Item	Phase 1 (2001)	Phase 2 (2010)
Areas to be Served	842.2 ha	1,809.6 ha
Population to be Served	253,970	525,290
Planned Sewage Flow (daily average)	50,790 cu.m/day	105,060 cu.m/day

Table 2.2 Project Description

Item		Description
Project Name		Rehabilitation and Expansion of Sewerage System in Metropolitan Tirana in the Republic of Albania
Project Background		Tirana City, the national capital, has been suffered from inundation and degradation of sanitary conditions due to deterioration of superannuated sewer system
Objective of the Project		Urgent improvement of urban sanitation and rehabilitation of existing sewer system
Project Location		Metropolitan Tirana
Executing Agency		Ministry of Public Works, Tourism and Territory Adjustment (MOPWT)
Number of Beneficiaries		525,200 persons to be served by sewerage system in 2010
Scope of Project	Type of Project	Rehabilitation & Expansion
	Project Area	Area: 1,817.9 ha, Planned Population: 525,200 persons, Planned Sewage Flow: 105,058 cu.m/day (Daily Average)
	Sewage Collection Method	Separate Sewer System
	Sewage Treatment Plant	Treatment Method: Aerated Lagoon, Treatment Capacity: 105,058 cu.m/day
	Sludge Treatment/Disposal	Sun Drying at Sedimentation Basin, Landfill
	Sewer Pipeline	Underground Pipeline, No Pumping Station
	Effluent Disposal	Discharge Point: Tirana River, Effluent Quality: BOD 25 mg/L

(2) Phased Implementation of the Project

The proposed Project will be implemented by two phases: Phase 1 by target year of 2001 for the urgent rehabilitation/improvement of the existing sewerage system, and Phase 2 by target year of 2010 for the overall improvement and expansion of the sewerage system.

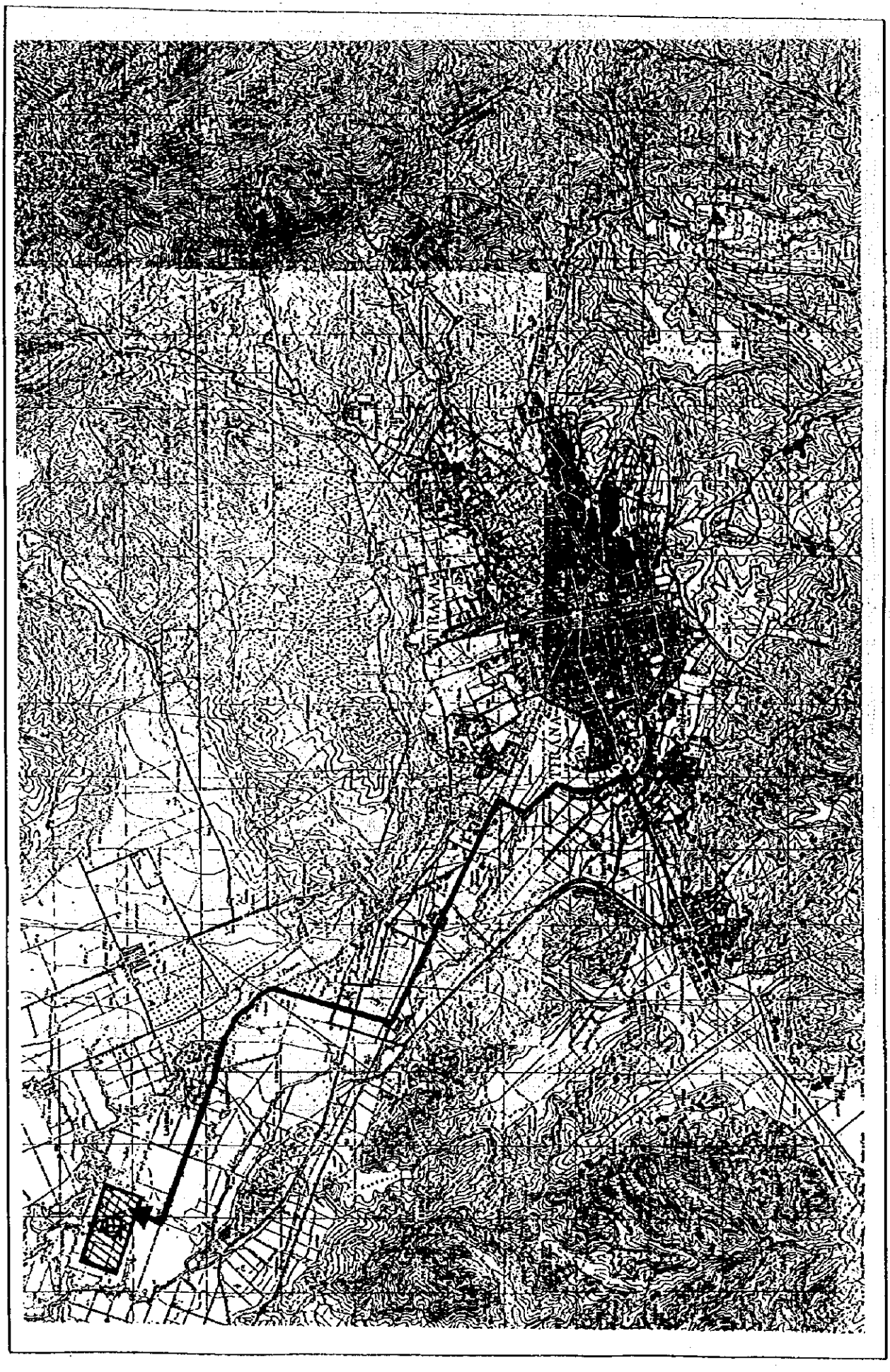


Figure 2.1 Target Area of EIA Study

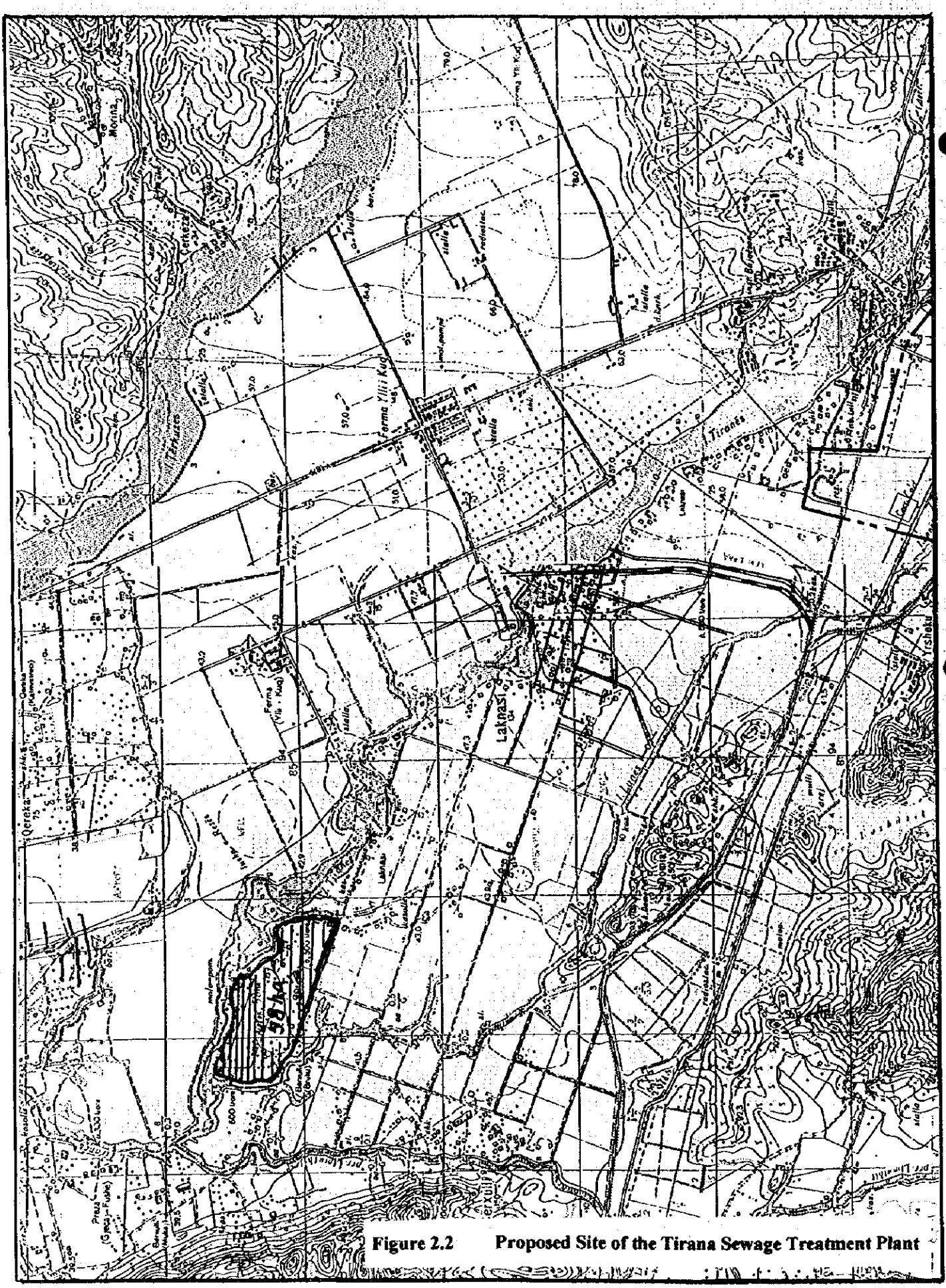


Figure 2.2 Proposed Site of the Tirana Sewage Treatment Plant

(3) Sewage Collection Method

Separate sewer system will be introduced in the proposed Project:

Sanitary sewer to collect domestic, commercial and industrial wastewater and to convey to the sewage treatment plant

Storm Sewer to collect rain water run-off and dispose to the river.

(4) Sewage Treatment Plant

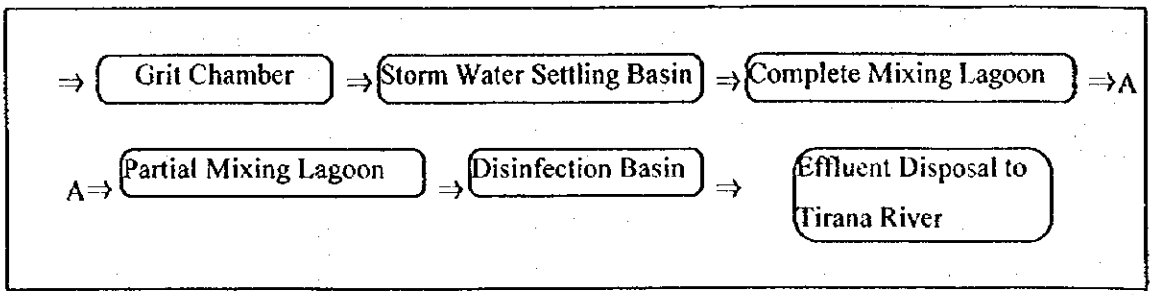
The collected sewage will be treated by aerated lagoon and final sedimentation basin at the proposed Tirana Sewage Treatment Plant. The general layout of the treatment facility is shown in Figure 2.3.

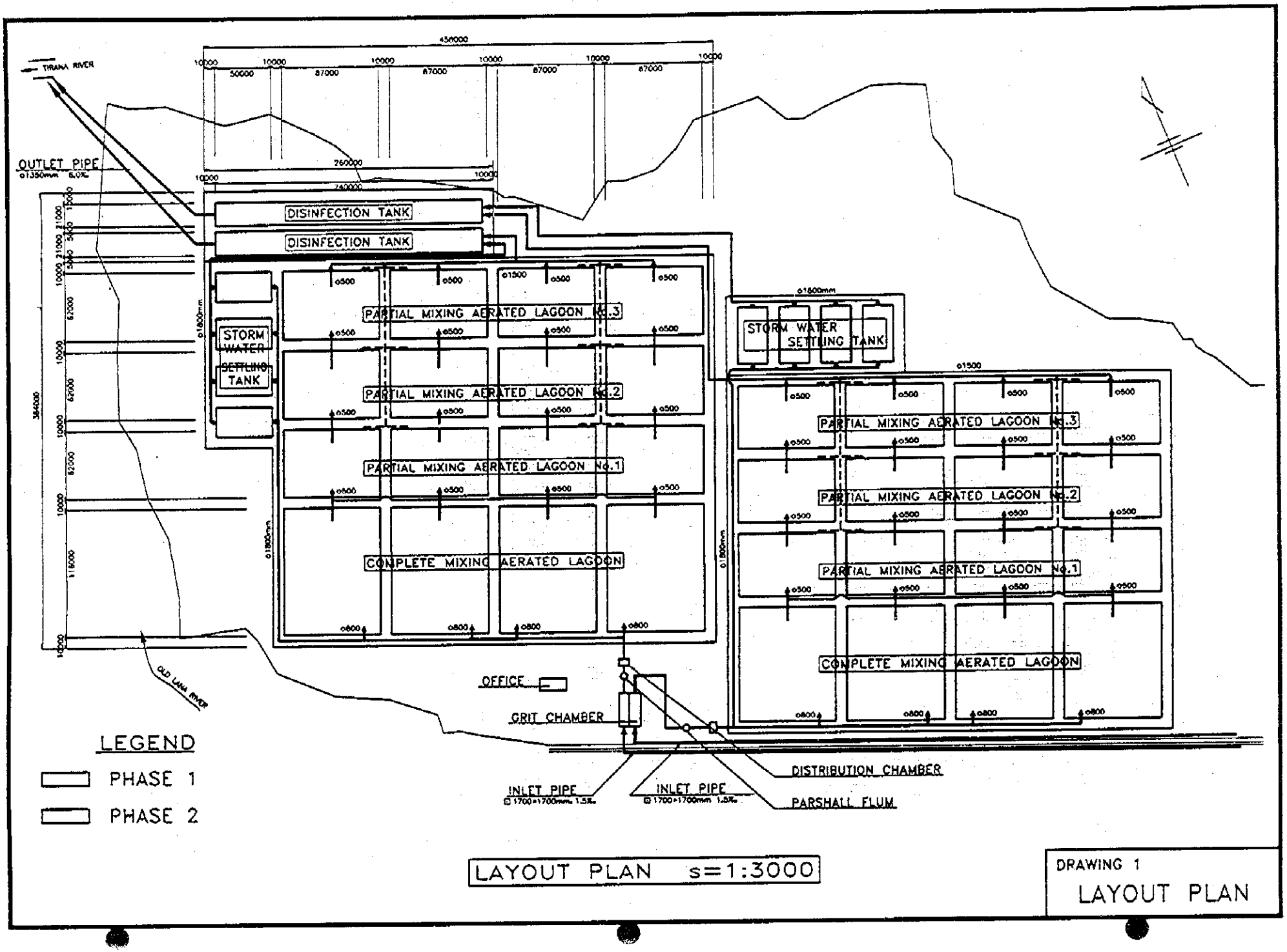
The sewage treatment plant is planned to have the following treatment efficiency:

	BOD	SS
Influent	200 mg/L	200 mg/L
Effluent	25 mg/L	35 mg/L

Treated effluent will be discharged into Tirana River. The proposed sewage treatment process is shown in Figure 2.4

Figure 2.4 Proposed Sewage Treatment Process





LAYOUT PLAN s=1:3000

DRAWING 1
LAYOUT PLAN

2.4 ENVIRONMENTAL CONDITIONS OF THE PROJECT

The Environmental conditions of the proposed Project is summarized in Table 2.3.

Table 2.3 Environmental Conditions of the Project

Item		Description
Project Name		Rehabilitation and Expansion of Sewerage System in Metropolitan Tirana in the Republic of Albania
Social Environment	Local Residents (Inhabitants/aborigines/awareness of project)	Majority of local residents are private and government employees with their dependents and increasing tourists
	Land Use (City/agriculture/historic ruins/ sightseeing spots/hospitals, etc.)	National capital city under expansion of urban area with rapid increase of population
	Economy/Transportation (Commerce/agro-fisheries/ industrial estate/bus terminal)	Center of national economy and tourism with hotels
Natural Environment	Topography/Geology (Steep slope/loose foundation/ swamp/faults)	Terrace of Tirana River, gently declining to western direction, consisting of Palaeogene carbonate formations and Paleogene flysch formations
	Conditions of Coastal Area (Erosion, sand deposits, tidal current, etc.)	Not Applicable
	Important Fauna & Flora (Natural park, endangered species, etc.)	Not identified
Public Nuisance	Status of Public Complaints (Noteworthy public nuisance)	Inundation, deterioration of sanitary conditions, water pollution
	Status of Adopted Countermeasures	Laws and regulations on environmental protection are under preparation.

2.5 SCOPE OF EIA STUDY

(1) Initial Environmental Evaluation

The initial environmental evaluation of the proposed project was carried out by the JICA Study Team through screening and scoping of the anticipated environmental impacts as shown in Table 2.4. The EIA Study shall be carried out for those which identified as scores "A" and "B" in his evaluation.

Table 2.4 Results of Initial Environmental Evaluation

Item			Score	Description
Social Environment	1	Relocation of Local Residents	B	Location of sewage treatment site for land acquisition
	2	Economic Activity	D	No negative impact foreseen
	3	Transportation & Social Facilities	B	Traffic jam during implementation
	4	Separation of Local Society	D	No separation foreseen
	5	Ruins & Cultural Assets	D	No presence confirmed
	6	Water Right & Right of Common	D	No right confirmed yet
	7	Public Hygiene	B	Depending on Disposal Manner of Excess Sludge
	8	Wastes from Project	B	Same as above
	9	Natural Disaster	D	No large scale landscaping planned
Natural Environment	10	Topography & Geology	D	No significant change planned
	11	Soil Erosion	D	No large scale landscaping planned
	12	Groundwater	D	No discharge to aquifer planned
	13	River, Lake & Pond	B	Treated sewage be discharged to Tirana R.
	14	Coast & Sea	D	No coastal line exists
	15	Flora & Fauna	D	No endangered species confirmed yet
	16	Climate	D	No significant change imposed
	17	Scenery	D	No significant change of scenery imposed
Public Nuisance	18	Air Pollution	D	No pollutant to be emitted
	19	Water Pollution	B	Treated sewage to be discharged into Tirana R.
	20	Soil Pollution	B	Manner of disposal of excess sludge
	21	Noise and vibration	B	During pipe installation work by open cut method
	22	Land subsidence	D	No groundwater utilization planned
	23	Odor	B	Some smell anticipated from the sewage treatment plant

Note: Score; A-Significant impact anticipated.
B-Slight impact anticipated
C-Unknown (subject to further verification)
D-Almost no impact anticipated and not subject for IEE (Initial Environmental Evaluation) and EIA (Environmental Impact Assessment)

(2) Scope of Work

The following scope of work shall be undertaken by the Contractor in the course of EIA Study:

1) Laws and regulations on EIA, environmental protection and sewerage project

The existing laws and regulations pertaining to the EIA, environmental protection and sewerage project shall be reviewed and legislative requirements shall be clarified. This particular study shall cover not only the existing laws and regulations, but also such requirements under consideration or proposed for the government approval.

2) Itemized assessment of environmental impact/s

Based on the results of the initial environmental evaluation, itemized assessment of environmental impact/s with their magnitudes shall be carried out for those identified impact items.

3) Preparation of recommendations and proposed countermeasures

For those identified impact item/s, recommendations and proposed countermeasures to mitigate environmental impact/s shall be prepared.

(3) Preparation of EIA Report

The EIA Report shall be prepared covering the above mentioned scope of work. Supporting data and information, reference materials shall be attached to the EIA Report.

2.6 SCHEDULE OF EIA STUDY

The EIA Study shall be completed within three (3) weeks upon signing and approval of the Contract.

15.4.4 EIA Study Report

Environmental Impact Assessment of the Project

"*Rehabilitation and enlargement of sewage system of Tirana, the capital of the Republic of Albania and their treatment*"

This Environmental Impact Assessment aims at the identification of the possible environmental effects, which will be created especially as a result of a construction of the treatment plant. It will also give recommendations on possible measures which may reduce the negative effects with minimal investments.

This Environmental Impact Assessment is not a final one, as it will be completed during the development and implementation of the project, making possible it's improvement in the appropriate time, and also the efficient use of available natural and financial resources.

The project presented by JICA is in compliance with the new environmental policy, which is solving one of the most important problems of Tirana "Management and disposal of sewage." It has two main directions:

1 - The improvement of public sanitation and the environmental situation of Tirana aiming at the improvement of public health.

2 - Improvement of the quality of Tirana river and Lana through the improvement of the discharges of polluted waters, according to existing standards.

The first part of the project deals with the improvement and the rehabilitation of the entire system of sewerage aiming at the improvement of the very hard environmental situation of Tirana.

During the last five years the population of Tirana is doubled without regarding changes of infrastructure, which has been deteriorated and this has had a direct influence on the quality and standard of living.

It is worth to mention that the situation in Tirana has been aggravated also as a result of :

1 - The extreme overuse of the existed system of sewage pipelines which have been constructed since the 60s with a 20 years perspective life.

2 - The absence of the system of sewage pipelines for the 1/4 of the city which discharge their sewage into Tirana and Lana river.

3 - The construction of new building area without any sewage pipelines.

4 - Most of the natural hydrographic network including partially Lana and other collectors, are overflowed during the periods of rains.

In this situation, there is a drastic negative effect on the public sanitation, which influences directly the spread of infections epidemics. These epidemics have not been that rare for Tirana, especially during hot weather. As result of overused pipelines there are about 20,000 interceptions of sewage waters with those of drinking waters. This is a very dangerous situation to the human health. This grave situation is reinforced, because of the insufficiency of drinking water supplies.

Unreasonable discharges of sewage into Tirana and Lana river have damaged not only the environment where they are discharged, but also have influenced the quality of underground waters, which are also a source of drinking water for Tirana during the hot weather.

To improve this situation the project aims at this general strategy: "To stop the aggravation of the situation, and improve it" by giving priority the improvement of human health.

This project solves in a proper way the very grave problem of the system of pipelines in Tirana, which are very old and overused or which do not exist at all in many parts of the city.

It is important to put the emphasis on the fact that this project must take into consideration the unexpected growing of different human activities, such as food plants, furnaces of some colored metals, Cu, Pb, treatment leather factories, printing offices, etc., which are discharged into the system of sewage pipeline or into the Tirana river.

It must also be taken into consideration the fact that many bars, restaurants and kiosks along Lana discharge their waste water into Lana and may have a very undesirable effects on the quality of it's waters.

The second part of the project presents the treatment plant of waste waters, the technology which will be used, the quantity and quality of internal and enter waters and the treatment of its sludge.

This treatment plant is foreseen to be built in the northwest direction of Tirana in a distance of 10 km from it, near the Berxull village.

The foreseen site of 58 ha is located in that point where are joined Tirana river and Lana.

These are its eastern, northern and western limits. In the south there is an agricultural land. There is not any high hill around.

The land of the place where the plant is to be constructed is an agricultural one of a good quality with about 20 houses and some orchards. There are some other houses about 150 - 200 m away from this place and all around exist a good quality land.

In this place there is an annual average rainfall of about 1,300 mm, which varies with the seasons. There are about 120 rainy days in a year and the temperatures are laid from 8.8 to 38.4 ℃ in summer days. These are optimal differences for the foreseen technology.

During some years it has been studied that the wind direction is from northwest to southeast, with an average speed of 1.5 m per second.

The selected area has a subclay and clay layer of around 14 m depth and this is an acceptable stratum for the selected technology. After that there is a stratum of gravel, of about 15 m and after that a clay stratum again. Because of the geological construction this area is a part of the greatest aquifer of the country, Tirana - Ishem - Fushe - Kuqe and most powerful supplier of water of the central part of the Albania. In this point of view, the settlement of the plant in such area is a very delicate issue.

Regarding the transportation during the construction of the plant, there is not any difficulty as there exist two different directions to the object. The first is from Tirana - Durres road to bridge of Limuth and the second is on side of Kamza passing through Laknas Comune.

The selection of technology

The sewage treatment plant is planned to treat about 105,060 m^3 of waters per day starting from 2010, serving in this way to a population of about 525,290 inhabitants, of a area of 1,809.6 ha.

The quality of waters is foreseen of 200 mg l BOD, 200 mg/l SS. We can see from these parameters that these are waters of low strength (soft waters).

The post treated waters will have a BOD of 25 mg/l, a SS of 35 mg/l. These are standards of European Union, so entirely acceptable from us.

The selection of technology flowsheet of this sewage treatment plant is based on some comparative techno-economic calculations, which take into consideration some factors:

1 - The existence of proper places for the treatment plant.

2 - The possibility to ensure the zones of health protection.

3 - The ensurance of the requested quality of waters according to the approved standards.

4 - The relief.

5 - The distance from the discharging points of treated waters.

6 - The quantity of sludge, which will be discharged from the treatment plant.

7 - The possibility of disposal or treatment of sludge.

8 - The ensurance of qualified workers.

This way of selecting technological flowsheet on the bases of comparison with some other flowsheets, taking into consideration some factors as surface area of the plant, electricity, the efficiency of the sewage treatment, the equipment, maintenance, etc., is a good one, but I think it is to be completed with the migration of habitants of this zone.

I agree with the selected flowsheet of aerated lagoon for these reasons :

The aerated lagoon as an interception of activated sludge and stabilization pond have some features:

1 - They require a larger surface than activated sludge, but smaller than stabilization pond.

2 - Their demand for electricity is smaller than that of activated sludge.

3 - These treatment plants have minimal demand regarding work and supervision and there is no need for a continuos operation from operators.

4 - The capital investments are lower, especially when are used approximate means.

5 - The draft reduction of BOD and SS from these lagoons is about 90 % and it is good enough.

6 - There is a very little influence from different fluxes of raw materials.

7 - The quality of discharged waters is a good one and there is no problem for sludge as the continuos and content mixing ensure a normal photosynthesis.

8 - The quantity of accumulated social substances is low.

Taking into consideration everything mentioned above, the actual conditions and the economic potential of our country, as well as the existence of industrial plants without treatment of their waste waters, I agree with the selected technology from JICA.

The treatment of sewage includes large volumes of sludge in a semiliquid condition and there is an important problem to take them away. This is an environmental problem, too.

It must be absolutely required that these sludge must not reach even in small quantities the place of discharge of treated waters, as this will have a very dangerous effect on hydraulic resources.

At the same time, the treated sludge must not be discharged into hydraulic resources as they cause undesirable problems, especially for the pollution of its bed and problems regarding the pass of the light.

The treatment of sludge varies according to quantity and local conditions and their treatment must be done when its use is not in accordance with sanitary rules. So this problem is to be discussed during the final phase of the project.

In this case it is suggested a sun dry method with sedimentation basin, which make possible to reduce the humidity to 50 %.

In conclusion, I suggest the presentation of some data regarding the composition of this sludge as I consider it an important problem with a direct effect on the environment.

The quantity of sludge generated from the first stage of the treatment must be sent to the disposal site of urban solid waste, or must be put underground in a place where it must be controlled by the competent authorities.

Conclusions

I have these objections regarding the selected technology and the selected site where the treatment plant will be constructed:

1 - The recommended site for the construction of the treatment plant, being near two superficial resources presents a potential risk for their pollution in the case of any breakdown or in the case of any non-compliance with technologic parameters during the treatment of waters as well as during treatment of sludge.

The existence of only one point of discharge with great quantities of polluted substances is a risk as it makes difficult the process of self cleaning of the river waters being in the same time a polluting source for surface and underground waters as well as for the public health.

The settlement of the water treatment plant on a very important aquifer presents a risk, because of the unexpected infiltration.

2 - The distance from the polluted water treatment plant to the gathering basin of sludge, being---- km will create problems regarding the maintenance and a greater probability of different breakdowns.

It would also be difficult to find proper specialists for this treatment plant.

3 - I think that the selection of the technology based on the actual situation of our country, the quantity of waters to be treated, the efficiency of treatment of about 90 % including the treatment of sludge is very acceptable taking into consideration the initial lower cost, as well.

But apart from that I have some objections regarding the selected technology:

3.1 - The considerable surface area of about 58 ha, being in a residential area with a good agricultural land will need a compensation to the houses, land and orchards, which means a large amount of money.

3.2 - The great surface occupied will create pollution problems, because of bad smells and insects, all the inhabitants should be taken away less than 400 m from the treatment plant.

The selection of this technology for the treatment of sludge presents some negative aspects regarding the pollution of the environment. These may be:

1 - The sludge out from the treatment plant contain great quantities of inorganic and organic substances as well as pathogens. So being exposed to a great surface they present a risk on the environment.

2 - This technology needs a long time for their dehydration increasing also the possibilities for breakdowns in these basins.

3 - It needs new basins after the filling of the existed ones.

4 - Their final disposal is a difficult problem, especially in the conditions of privatization of the land and the possibilities of the farmers to use it.

Some considerations to be taken into account during the final compilation of the project for reducing the impact on the environment.

During the final compilation of the project the methodology for determination of the quality of polluted waters, which will be treated would be presented. It must also be taken into consideration the waste waters of small industries inside the treated zone, especially in the upper flowing of Tirana river and Lana.

Measures are to be defined regarding the treatment of dischargings in Lana. There are about 400 bars, restaurants and kiosks along Lana that discharge their waste waters directly into it. The owners of these must be obliged to pay the municipality for the inclusion of their dischargings into the main system of sewage pipeline.

Taking into consideration the time when the treatment plant may be built, I think that the calculations must be done over a period of 20 years regarding the increasing of the population.

We should try to get another better place for constructing of the treatment plant taking into account those factors :

1 - It must be a less populated zone and a land with a lower quality to avoid the social - economic problems that may be created, reducing in the same time the construction cost of plant.

2 - It must be further away regarding the discharging place as well as the under-ground aquifer as it is today.

3 - There are some mitigation measures to be taken as well as some calculations to be done for the displacement of the houses, which are nearer than 400 m from the treatment plant.

4 - Depending on the category of the object, according to the urban standards it must be fixed a sanitary protection belt, which I think to be 400 m taking into account also the wind rose. This is made according to the standards of city planning foreseen in the corresponding Law of Nr. 7693 date 6.4.1993.

5 - The basins must be saved from different breakdowns and infiltration into underground waters. For that reason must be carry out some other sinking by hydrogeology sector.

6 - There are to be taken some safety measures as the settlement of a purification system in case of any potential breakdown.

7 - There are to be taken measures for making of a green protection belt with appropriate trees to reduce the negative effect of bad smells, which come out from the treatment plant.

8 - It is to foresee the qualification of the personnel that will work in this plant as it is the first of that kind in our country.

Some special conditions and standards.

All the wastes, such as sludge, sand, waste waters coming from the cleaning of equipment and pipelines must not be disposed out of the zone of the plant with the permission of corresponding authorities, responsible for this problem.

A detailed planification is to be done about the unexpected events, regarding the dischargings, which must be attended seriously during all the time in order to prevent the accidents and to reduce its effects on the environment. This must be controlled continuously for 24 hours the quality of treated waters.

Also the addition of nutrient substances and other harmful substances of the treatment plant must be controlled in order to reduce their potential passing into untreated waters.

The improvement of monitoring

In order to help the good operation of the first treatment plant of sewage in our country as well as to improve local and state monitoring, we are giving some suggestions:

1 - To enlarge gradually the system of information regarding the environment, especially polluted waters, in accordance to the priorities and actual possibilities.

2 - To widespread the monitoring network and to increase the liability of the data. To substitute the expensive methods of registration and measuring with others less expensive.

3 - To oblige private and state enterprises to make monitoring in points appointed by local authorities.

4 - To strengthen the national monitoring system, in order to determine the actual pollution inside Albania. To reach this it is to coordinate the work of scientific institution, in appliance with the Government decision on monitoring.

5 - A central laboratory near the CEP, should be built to analyze all the samples sent by regional environmental agencies as well as their interpretation regarding the environmental impact assessment. This must be the most qualified center regarding the environmental issues.

The legal framework

Despite of the existed legal framework regarding the environmental problems such as the Law Nr. 7664 date 21.1.1993 "On Environmental Protection," it needs some additions, which will present the gained experience during these next years.

At first should be applied the law on available standards of dischargings on environment.

Some regulations regarding the dischargings and their continuously control they need to be compiled. This must be organized for different objects.

The municipality must take a decision with which it obliges with taxes or fees all the owners of objects to solve their problems of dischargings. This is the case of bars, restaurants and kiosks along Lana or another small industrial object. A regulation for the protection of Lana from different pollution should be compiled.

We think that it is the time for the new industrial objects to apply the principles "Polluter pays."

Also for the large objects, which may have a strong impact on the environment it should be drawn the attention of the public.

The Institute of Urban Planning should compile regulations and normative acts for construction of houses and other social buildings in the areas without pipelines and especially without sewers.

Tirana, February 1997

Chairman of Working Group

Pandeli TOPALLI

SUPPLEMENTAL REMARKS

Request of Report Revision from Albania

REPUBLIC OF ALBANIA
MINISTRY OF PUBLIC WORKS AND TRANSPORT

TO : **NJS Consultants,**
KA: **Kenji HORI**
Fax: **00 81 3 3432 8907**

FROM : **General Directorate of Water Supply and Sewerage**
Fahri Maho,
Fax : 00 355 42 271 48

Ref : **Study on Sewerage System in Metropolitan Tirana**

Subject : **Coments/ Queries on the study design proposals**

Dear Mr. HORI,

We have reviewed and analised the Tirana Feasibility Study on Sewerage System, and considering the work done we comment as follow.

The primary purposes of the sewerage project are for the protection of the environment and the public health of citizens within and downstream of Tirana by the interception of untreated sewage, which presently flows into the Lana and Tirana rivers, and conveying it to a sewage treatment plant for treatment and safe disposal.

However, the following items require further explanation / clarification :-

1. No sewer interceptor on North side of Tirana river,

   The city of Tirana continues to expand on the North side of the river Tirana, but in the report there is no mention of any sewer interceptor on that side of the river. As a result untreated sewage will continue to flow into the river from the area from Babrruja through Bathore to Kamza.

2. Industrial effluents

   There is little mention of industries, their location or industrial effluents that may enter the sewerage system. Are there any industries that may produce hazardous liquid wastes which could affect the sewage treatment process. Do industries have effluent pre-treatment plants prior to discharge to the public sewer?

3. Pipe materials and specifications

   There has been no mention of the sewer pipe designs presently used which do not conform to common international standards. Consideration might be given to the development of local pipe manufactures to produce pipes with improved jointing details.

4. Chlorine disinfection of treated sewage effluent

   The use of chlorine to disinfect sewage effluent can lead to the formation of chlorophenols and other chlorine related chemicals which can be toxic and detrimental to river ecology. The time retention within the sewerage system and treatment works lagoon process should be sufficient to destroy most pathogens. If the water down stream is not used immediately for recreational uses, the use of chlorine for disinfection is debatable.

5. Sewage treatment plant sludge drying, removal and disposal

   There is little said regarding the production, drying, removal and disposal of the sludge that will accumulate in the lagoons. How often is it expected that each lagoon would be out of operation for de-sludging. Is there the option of selling the stabilised sludge as a soil conditioner to farmers and horticulturists.

6. The provision of LANA river for the future. Considering the rehabilitation of sewerage network, and the fact that effluents collected by main interceptor will charge directly on the Sewerage Treatment Plant, the flow on the river will be reduced and this will cause problems for self cleanning of river, so we will have big environmental problems in the future. It is better to have your opinion on this matter.

Hearing from you soon.

Regards

Fabri Maho

Tirana, on 25/ 02/ 1998.

Reply from the Study Team

NJS Consultants

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FAX COVER SHEET

TO:	MOPWT WS & SS	*FROM:*	Kenji HORI
Attention	Mr. Fahri MAHO	*Date*	4 March, 1998
Fax No.	355-42-27148	*Pages:*	1 of 4

Reference : Study on Sewerage System in Metropolitan Tirana by JICA

Subject : Information on Our Future Course of Modification for the Final Report

Dear Mr. Maho,

We received your FAX with thanks.

As a result of consulting with the Advisory Committee and JICA, we would like to inform you of our future course of modification for the Final Report as follows:

1. No sewer interceptor on north side of Tirana River
   It is our understanding that this area was determined, by mutual agreement between MOPWT and the Study Team, to be considered under another sewerage system in the future.
   (Refer to Page 2-34 to 2-44 of the Draft Final Main Report, M/M dated 9 August 1996 and the supplemental technical document dated 2 September 1996)

2. Industrial effluents
   We will provide supplemental information to be contained in the Appendix of Final Report.

3. Pipe materials and specifications
   We are ready to send some catalogs and/or documents to you via DHL.
   In addition, please note that the inquiries given to us pertaining to structural design, manufacturing methods and testing methods are not included in our Scope of Work.

4. Chlorine disinfection of treated sewage effluent

We have attached a reply to your comments/questions for your reference.
We hope that you will understand our position on these issues.

In Japan, chlorine related chemicals in drinking water have become a big issue. However, replacing the chlorine disinfection for both water supply and sewerage system cannot be considered, since the risk of water-related diseases is considerably high compared to the risk of developing cancer via chlorine disinfection.

In addition, the chlorine concentration in drinking water is ten times higher than that of sewage, and the possibility of drinking treated sewage directly is negligible.

Therefore, chlorine disinfection is still used for sewerage systems, not only in Japan, but in other developed countries.

The alternative methods of chlorination (for your information) are as follows:

a. Maturation pond
The method is economical and there is no necessity of daily operation and maintenance. The only disadvantage is that the method requires a large area (approx. 35ha).

b. De-chlorinization equipment
De-chlorinization can be achieved using sulfur dioxide (SO_2) or activated carbon. The system entails high costs (construction and O&M) and advanced-technology.

c. Other disinfection systems, such as the ultra violet ray method and the ozone method
These methods cannot be recommended for the sewerage system in Tirana, due to their significant disadvantages of high costs (construction and O&M) and the necessity of advanced technology.

In conclusion, it is recommended that the chlorine disinfection system is operated minimally with a monitoring system; however, the facility should be provided to deal with contigencies.

5. Sewage treatment plant sludge drying, removal and disposal

We will provide supplemental information to be contained in the Appendix of Final Report.

6. Flow reducing problem of the Lana river

We have attached a reply to your comments/questions for your reference.
We hope that you will understand our position on these issues.

Assuming that sewage flow is excluded from the river flow, the estimated BOD concentration at the central point of Tirana City is 20mg/L: This is not a satisfactory level, but this is exceedingly better than the unimproved condition (122mg/L).
Therefore, the development of the sewerage system cannot be denied as a first step to improve the present status of the Lana River

In Japan, we have experienced a tremendous improvement in the aquatic environment for almost a quarter-century. After completion of the sewerage system, the polluted river flow with foul odor became clear with abundant aquatic fauna and flora; also, the usability of the rivers increased over time.

Moreover, the highest priority should be given to improving public health, and thus aquatic environmental improvement should be considered in the second step.

In recognition that the daily maintenance of the river is a requisite regardless of the sewerage system, the establishment of a cooperative/communicative system between administrator of the river and the citizens for the dredging or cleaning of the river is recommendable.

In short, an aggressive action and/or stance on the past of the citizens to maintain the river is strongly desirable; however, the existing conditions are not preferable due to the disposal of wastes and soil.

In conclusion, the existing detrimental conditions should be resolved apart from any discussion on the influence of sewerage project.

For your information, the introduction of a treatment facility for river water (contact aeration process with open channel) is worth studying as a second step of the Lana

River improvement. We are ready to send some catalogs and/or photographs of this kind of facility to you via DHL.

If you have further questions/comments, please send us a reply by FAX.

Your kind attention on this FAX will be highly appreciated.

Regards

Kenji KORI

SUPPLEMENTAL REMARK No.1

INDUSTRIAL EFFLUENTS

1. The Impact of Industrial Effluents on the Sewerage System

In most of countries wherein public sewerage systems are being operated, there are particular legislative set-ups associated with the technical standards and appropriate technologies for handling wastewater with high pollution loads as well as toxic/hazardous substances.

These arrangements are enforced not only to protect sewerage systems from anticipated damage caused by such wastewater, but also to prevent secondary environmental pollution caused by effluent and excess sludge discharged from the sewage treatment plants.

Damage and/or hazards to sewerage systems may be classified into the following categories:

- Corrosion of concrete pipes and structures by highly acidic wastewater,
- Deterioration of biological treatment processes by the extreme biochemical characteristics of wastewater, including high organic pollution loads,
- Biological concentration of toxic/hazardous substances in microorganisms and sewerage sludge.

In this subsection, pretreatment facilities to remove such excessive pollutants at factories and establishments will be discussed, mainly looking into the major types of industries and commercial establishments.

Recommendations on pertinent the legislative arrangements will also be prepared to regulate prospective pollution sources.

2. Major Types of Pollution Sources

The following types of industries are anticipated for the major types of pollution sources:

- Textile dyeing,
- Chemical products manufacturing,
- Food processing, and

- Tanning.

Other major sources of high pollution load are:

- Slaughterhouses,
- Large scale restaurants, and
- Plating factories.

3. Legislative Arrangements

At present, there are no particular regulations or wastewater quality standards regarding industrial wastewater in terms of the operation of sewerage service in Albania.

In the absence of such regulations, the MOPWT does not posses any authority, either to prevent toxic/hazardous industrial wastewater from being discharged into sewerage systems, nor to regulate the acceptable strength of wastewater for sewerage systems.

The following table presents the Japanese regulations for industrial wastewater allowed to be discharged in the sewer network as prescribed in the Sewerage Act Enforcement Ordinance.

Table 1.1 Japanese Regulation on Industrial Wastewater Quality to Discharge into the Sewer Network

Items	Allowable Limit
1. Temperature	45℃
2. pH	5 - 9
3. BOD	600 mg/L
4. Suspended Solids	600 mg/L
5. Iodine Consumption	220 mg/L
6. Normal Hexane Extracts	Mineral Oil 5 mg/L Fatty Oil 30 mg/L
7. T-N	240 mg/L
8. T-P	32 mg/L
9. Phenols	5 mg/L
10. Copper and its Compounds	3 m/L
11. Zinc and its Compounds	5 mg/L
12. Iron and its Compounds (soluble)	10 m/L
13. Manganese and its Compounds (soluble)	10 mg/L
14. Chromium and its Compounds	2 mg/L
15. Fluorine and its Compounds	15 mg/L

Items	Allowable Limit
16. Cadmium and its Compounds	0.1 mg/L
17. Cyanic Compounds	1 mg/L
18. Organic Phosphoric Compounds	1 mg/L
19. Lead and its Compounds	0.1 mg/L
20. Hexavalent Chromium Compounds	0.5 mg/L
21. Arsenic and its Compounds	0.1 mg/L
22. Mercury, Alkyl Mercury and other Mercurial Compounds	0.005 mg/L
23. Alkyl Mercury	Not Detected
24. PCB	0.003 mg/L
25. Trichloroethilene	0.3 mg/L
26. Tetrachloroethilene	0.1 mg/L
27. Dichloromethane	0.2 mg/L
28. Chlorine Tetraoxide	0.02 mg/L
29. 1.2-Dichloroethane	0.04 mg/L
30. 1.1-Dochloroethylene	0.2 mg/L
31. Cis-1.2-Dichloroethylene	0.4 mg/L
32. 1.1.1-Trichloroethane	3 mg/L
33. 1.1.2-Trichloroethane	0.06 mg/L
34. 1.3-Dichloropropane	0.02 mg/L
35. Thiuram	0.06 mg/L
36. Simazine	0.03 mg/L
37. Benthiocarb	0.2 mg/L
38. Benzene	0.1 mg/L
39. Selenium and its Compounds	0.1 mg/L

4. Typical Example of Pretreatment Method for Industrial Wastewater

There are various kinds of pretreatment methods corresponding to the characteristics of industrial wastewater. The following table exhibits typical examples applicable to the relevant industries.

Table 1.2 Typical Pretreatment Methods of Industrial Wastewater

Type of Industry	Wastewater Quality						Major Substances Removed	Treatment Method
	pH (-)	BOD (mg/l)	SS (mg/l)	COD (mg/l)	T-N (mg/l)	T-P (mg/l)		
Textile Dying	3~11	10~350	20~250	300	25	10		SASM Chemical Clarification Oil Separation
Chemical Products	2~11	40~2000	70~600	—	80~100	10~20	Organic Solution	
Food Processing	6~8	300~600	100~300	200~400	50~80	10~15	Soluble Protein Oils	
Tanning	7~12	500~2000	400~3000	100~2000	250~350	10~20	Cu Sulfide	Recirculating Aeration Organic
Slaughter House	6.2~7.5	800~2000	1200~1600	—	—	—		
Large-scale Restaurant	—	10~900	20~800	—	—	—		Segregation
Matting Factory	1~2	—	30~150	10~200	—	—		Electrolysis

Note: — indicates no data available; others are standard values

SUPPLEMENTAL REMARK No.2

CHLORINE DISINFECTION OF TREATED SEWAGE

1. General

In some developed countries, chlorine related chemicals in drinking water have become a big issue. However, replacing the chlorine disinfection for both water supply and sewerage system cannot be considered, since the risk of water-related diseases is considerably high compared to the risk of developing cancer via chlorine disinfection.

In addition, the chlorine concentration in drinking water is ten times higher than that of sewage, and the possibility of drinking treated sewage directly is negligible.

Therefore, chlorine disinfection is still used for sewerage systems, not only in Japan, but in other developed countries.

2. Alternative Methods of Disinfection

The alternatives against chlorination are as follows:

a. Maturation pond
The method is economical and there is no necessity of daily operation and maintenance.
The only disadvantage is that the method requires a large area (approx. 35ha).

b. Dechlorination equipment
Dechlorination can be achieved using sulfur dioxide (SO_2) or activated carbon.
The system entails high costs (construction and O&M) and advanced-technology.

c. Other disinfection systems, such as the ultra violet ray method and the ozone method
These methods cannot be recommended for the sewerage system in Tirana, due to their significant disadvantages of high costs (construction and O&M) and the necessity of advanced technology.

3. Conclusion

It is recommended that the chlorine disinfection system is operated minimally with a monitoring system; however, the facility should be provided to deal with contingencies.

SUPPLEMENTAL REMARK No.3

DISPOSAL AND REUSE OF SLUDGE

1. Estimated Sludge Volume

1.1 Design condition

The basic information concerning sludge generation volumes is as follows:

Daily average sewage flow: $Q = 106{,}000\ m^3/day$

Influent water quality (SS): $SS_i = 200\ mg/L$

Effluent water quality (SS): $SS_e = 35\ mg/L$

Assuming that 70 percent of the total solids discharged to the partial mixing aerated lagoon are volatile. In this estimation, accumulated sludge in each cell will be removed every 4 years; thus, 6 cells of total 24 cells in the partial mixing aerated lagoon should be cleaned every year.

1.2 Calculation

To estimate the mass of sludge that must be accumulated in the basin each year without anaerobic decomposition, the below formula was used.

$$Mass = (SS_i - SS_e) \times Q/4series = (200 - 35) \times 106{,}000 \times 365/4 = 1{,}595{,}963\ kg/year/series$$

The Computation of the mass of volatile and fixed solids added per year, assuming that VSS=0.7 x SS, is below.

i. Volatile solids $(Mass)_{VSS} = 1{,}595{,}963 \times 0.7 = 1{,}117{,}174\ kg/year/series$

ii. Fixed solids $(Mass)_{FS} = 1{,}595{,}963 - 1{,}117{,}174 = 478{,}789\ kg/year/series$

To determine the amount of sludge that will accumulate at the end of 4 years, the procedure was as follows:

Assume that the maximum volatile solids reduction that will occur is equal to 75 percent and that it will occur within 1 year. To simplify the problem, assume that the deposited volatile suspended solids undergo a linear decomposition.

$$(VSS)_t = ((1+0.25)/2 + 0.25 \times (t-1)) \times (Mass)_{VSS}$$

$$= (0.625 + 0.25 \times (4-1)) \times 1{,}117{,}174 = 1{,}536{,}114\ kg/series$$

where $(VSS)_t$: mass of volatile suspended solids at the end of t year, kg

t : time, year

Total mass of solids accumulate at the end of 4 years.

SS_t = 1,536,114 + 478,789 x 4year = 3,451,270 kg/series = 3,451.3 ton/series/4years

Compute the sludge volume, assume the deposited solids will compact to an average value of 15 percent and that the density of the accumulated solids is equal to 1.06.

V_{total} = 3,451.3 / (1.06 x 0.15) = 21,706 m^3/series/4years

Accumulated sludge height at the end of 4 years.

Sludge volume in each cell is as follows:

V_{each} = 21,706 m^3 / 6cell = 3,618 m^3/cell

The cell configuration of the partial mixing aerated lagoon is as follows:

Bottom width: W1 = 31.0 m

Bottom length: L1 = 60.0 m

Gradient of slope: 1 : 3

Assuming the accumulated sludge height is 1.56 m, the capacity is computed as follows:

Surface width: W2 = 40.36 m

Surface length: L2 = 69.36 m

Capacity : (W1 x L1 + (W1+W2) x (L1+L2) + W2 x L2) x h/6

= (31.0x60.0+(31.0+40.36) x (60.0+69.36)+40.36x69.36) x 1.56/6

= 3,612 m^3/cell $\fallingdotseq$ V_{each}

The accumulated sludge will be dried following the completion of overflow or draining the supernatant liquor in each cell. The dried sludge configuration is estimated as follows:

Moisture content of the dried sludge: 60 %

Density of the dried sludge: 0.7

V_{dried} = 3,451.3 / (0.7 x 0.40) = 12,326 m^3/series/4year

1.3 Conclusion

- The accumulated sludge is estimated at 3,450 ton with a volume of 21,700 m^3 per year.
- The dried sludge is estimated at 3,450 ton with a volume of 12,300 m^3 per year.
- The water depth of the partial mixing aerated lagoon (4 m) is deep enough for the maximum accumulated sludge height (1.56 m).

2. Reuse of Sludge from Sewage Treatment Plant

2.1 Possible areas for sludge reuse

(1) Sludge use in forestry

The use of sludge in forested areas is subject considerations such as application rates, method of application, nitrogen requirements etc.

It is recommended that annual sludge application rates to forests be limited to 200 t DS/ha to prevent possible damage to tree root systems and to minimize the risk of water pollution by runoff since forest land often has steep slopes near water catchment areas.

The contamination of water supplies by nitrates can be prevented by limiting sludge application rates according to the nitrogen needs of the trees. A typical application rate of 40 t/ha in a single application every 5 years is quoted by the U.S. EPA.

Acidic soils, which may cause increase metal mobility is another area which should be investigated in regards to this reuse option.

(2) Sludge for turf production

Liquid, dewatered, dried or composted sludge may be used in turf production. If liquid sludge is to be used, it is recommended that it should be injected or ploughed into the soil prior to planting. If dewartered or dried sludge is applied on the surface to establish turf, public access should be limited for 3 months.

(3) Sludge use in parks and public recreational areas

Sludge may be used as a substitute for conventional inorganic fertilizer and as a soil conditioner in the maintenance of parkland vegetation - lawns, trees and shrubs, golf courses, sports fields etc., or in the reclamation of land for park establishment.

Surface application of liquid sludge is not recommended (except for land reclamation prior to park establishment) to reduce odors, to avoid sludge sticking to the surface of turf, particularly close cut, veil maintained turf such as golf courses, and to lessen public concerns relating to the use of sludge in public areas.

Dewatered or air dried sludge may be used but it is recommended that it should be evenly mixed with sand or soil and applied in thin layers and the sludge/soil mixture covered over by a minimum 50 mm thick layer of topsoil. Public access should be restricted until a vegetative cover is established.

Where sludge is to be used on sports fields where contact sports are played, it is recommended

that either the soil cover is increased to 125 mm or that heat dried sludge is used or that a minimum 3 month period is allowed before contact sports are played.

(4) Sludge use on highways, construction site landscaping

The construction of highways, shopping malls, large buildings etc. can create large areas of marginal, eroded or generally poor quality soil. Liquid, dewatered, dried or composted sludge may be used in landscaping these areas by mixing in with the soil prior to planting to provide a soil environment suitable for vegetative growth.

2.2 Sludge reuse in agriculture

Agricultural land is defined here as land used for planting food crops, for direct or indirect human consumption or for animal feed intended for for human consumption. It includes land used as pastures for animal grazing.

(1) Application methods

The spreading of sludge prior to crop planting is recommended because of the problem of adherence of sludge to plant surface if it is applied during growth. This is also a problem for pasture land, where sludge may adhere to grass and be ingested directly by grazing animals.

Sludge should not be applied during excessively wet weather conditions to prevent hydraulic overloading of the soil which may lead to excessive runoff from the site.

(2) Application rates

The application rate to crops is dependent on several factors including crop type, soil characteristics, site location, yield requirements, available nitrogen in the soil and contaminant levels in the soil and sludge. The relationship between the Annual Pollutant Loading Rate (APLR) and the Annual Whole Sludge Application Rate (AWSAR) is given by the equation:

$$APLR = C \times 0.001 \times AWSAR$$

Where APLR = Annual Pollutant Loading Rate (kg/ha/year)

C = Pollutant concentration in sewage sludge (mg/kg DS)

AWSAR = Annual Whole Sludge Application Rate (ton/ha/year)

The Table below outlines a method for approximating annual application rates based on the heavy metal content of any given sludge.

(Unit: mg/kg DRY WEIGHT)

AWSAR	5 t/ha	10 t/ha	20 t/ha	30 t/ha	40 t/ha	50 t/ha
Cadmium	50	25	12.5	8.3	6.3	5
Chromium	3000	1500	750	500	375	300
Copper	4000	2000	1000	667	500	400
Mercury	120	60	30	20	15	12
Manganese	2000	1000	500	333	250	200
Nickel	800	400	200	133	100	80
Lead	3000	1500	750	500	375	300
Selenium	1000	500	250	167	125	100
Zinc	10000	5000	2500	1667	1250	1000

Note: Limiting value of AWSAR suggested by US EPA.

(3) Crops

Food crops whose harvested parts are above ground and touch the sludge or soil-sludge mixture should not be grown for 6 months after application.

Food crops whose harvested parts are above ground and do not touch the sludge may be grown at any time but any dropped fruit should not be harvested for human consumption.

Food crops whose harvested parts are below the surface should not be grown for 4 years after land application, or 6 months if it can be demonstrated at that time that there are no viable helminth eggs in the soil.

Feed crops (for animal consumption) grown on land to which sludge has been applied should not be harvested for 1 month after application. This period of exposure to environmental conditions before harvesting allows wind action and rainfall to reduce the amount of sludge adhering to crops and to further attenuate pathogens.

Tobacco should not be grown on land receiving sludge because of excessive cadmium accumulation by this crop and the potential for increased exposure to cadmiun in cigarette smoke.

(4) Farm management

Pigs and poultry should be excluded from any pastures to which sludge has been added.

Where sludge is applied to pastures for grazing animals, it is recommended that the sludge be injected or ploughed in and a minimum 4 week no-grazing period should be observed.

Livestock should not be grazed on excessively short pastures nor during muddy conditions to prevent ingestion of large amounts of sludge amended soil.

(5) Soil

Soil pH should be 6.5 or greater at the time of sludge application. Depending on circumstances, acid soil will probably require working to lower soil metal limits because of increased

metal mobility and hence potential toxicity.

The concentration of heavy metals, plant available nitrogen and phosphorus, and pesticides in the soil should be measured before sludge is applied to agricultural land. If contamination with one of the metals contained in following table is found then the concentration of these must be considered in determining the permissible metal loading.

(6) Sludge sampling and analysis

Sludge should be sampled after processing, but before delivery to the user i.e. it should be representative of the sludge delivered to the user. Sludge analysis should be carried out at least every 12 months. Where changes occur in the characteristics of the wastewater being treated or if there is a change in the treatment process being used, then the frequency of analysis should be increased. Sludge should be analyzed for the pollutants listed in following table.

(7) Metal pollutants

Sludge for use in agriculture or in sludge (or sludge products) which is commercially marketed/retailed as potting mix or fertilizer etc. should meet the following criteria for metal concentrations and loading rates contained in below table.

Pollutant	Cmax (mg/kgDS)	Max. APLR (kg/ha)	Max. CLR (kg/ha)
Cadmium	8 – 20	0.25	2.5
Chromium	500	15	75
Copper	1200	20	100
Mercury	10	0.6	3
Manganese	500	10	50
Nickel	100	4	20
Lead	500	15	75
Selenium	25	5	25
Zinc	1800	50	250

Note: Cmax means maxim metal concentrations in sludge or sludge products.

APLR means maximum annual loading of metals in sludge or sludge products.

CLR means maximum cumulative loading of metals in sludge or sludge products.

2.3 Comments on Sludge Reuse System

Treatment/disposal of the sludge that is generated constant and permanent, as a consequence of sewage treatment, is a significant challenge for the sewerage system.

It is considered that reuse of the sludge is a radical problem-solving method in relation to the above mentioned challenge.
Through the reuse of treated sludge, the prevention of excessive loads going to waste-disposal dumping site, the recovery of worthy resources in the form of fertilizer and the sale of various sludge by products.
It is obvious that the recycling of sludge is an ideal system to mitigate environmental impacts as well as to contribute to building an economical sewerage and agricultural system.

Sludge reuse for agriculture land is regarded as an optimum solution among a multitude of sludge reuse methods due to its superiority in terms of stability, permanence and possible demand.

Future measures to be conducted related to the agricultural utilization of sludge are as follows:

1) To clarify the agricultural land and the demanded amount of the sludge in reference to the Annual Whole Sludge Application Rate (AWSAR), it is shown in "3.2 Sludge reuse in agriculture".
2) To establish a monitoring system for industrial wastewater and to develop a system for supervisory functions and accomplishment of adequate measures as the metal concentrations of the sludge is a crucial factor for agricultural reuse.
3) To study the countermeasures in case of the demands fall short of sludge products, such as the storage the dried sludge and landfill into existing solid waste dumping sites.

SUPPLEMENTAL REMARK No.4

STUDY ON THE FLOW REDUCTION PROBLEM OF THE LANA RIVER

1. Study basis

1.1 Basic features of the River

The Figure below illustrates the cross section of the Lana River at the Shetitorja Deshmort bridge.

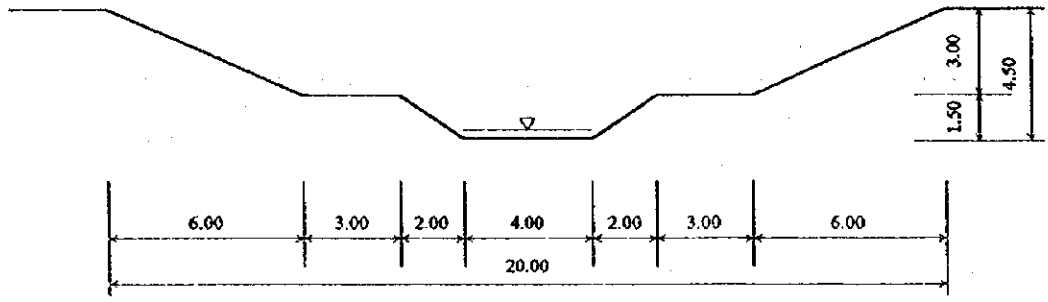


Fig. 4.1 Coross Section of the Lana River

At the bridge point, a gradient of the river bed is measured as 6/1,000.
(refer to Supporting report p.7.4.1-5, fig. 7.4.3 Long Section of Lana River, Point No. 31)

1.2 Water quality and water quantity

According to the results on the Project Evaluation (refer to Chapter 15 of the Main Report, clause 15.3.1 and Supporting Report p.15.4.1-16); future water quality of the Lana River is predicted in the below table.

Table 4.1 Estimated water quality of the Lana River

(Unit: BOD mg/L)

Year		Scenario 1	Scenario 2
Present	1996	122	
Future	2001	20	87
	2010	17	102

Likewise, the future water quantity of the Lana River is predicted shown in the table below. (refer to Supporting Report p.15.4.1-16)

Table 4.2 Estimated water quantity of the Lana River

(Unit: m^3/sec)

year		Scenario 1	Scenario 2
Present	1996	0.287	
Future	2001	0.187	0.480
	2010	0.181	0.517

Table 4.1 and 4.2 are estimated under the below conditions.

- Target point is the Shetitorja Deshmort bridge at the center of Tirana City.
- Scenario 1: after completion of the sewerage project
- Scenario 2: in case of no implementation of the sewerage project
- Both the quality and quantity of the river's flow are shown in the condition of mean low water level during the dry season (refer to Supporting report p.15.4.1-1)

In these tables, the former reveals the great deal of efficacy of the sewerage project.
Assuming that sewage flow is excluded from the river flow, the estimated BOD concentration at the central point of Tirana City is 20 mg/L. This is not a satisfactory level, but this is more better than the unimproved condition (122 mg/L).
Therefore, the development of the sewerage systems cannot be denied as a first step to improve the present status of the Lana River

While, the implementation of the project seems to have little effect on the river flow status.
The problems are discussed continuously in following section.

2. Hydraulic consideration

2.1 Water depth and flow velocity

The hydraulic specifications of the Lana River are analyzed in the below table intends to clarify the effects of the project. The calculation sheet is shown in Table 4.4.

Table 4.3 Estimated water depth and flow velocity

Unit: Water Depth (m) / Velocity (m/sec)

Year		Scenario 1	Scenario 2
Present	1996	0.115 / 0.59	
Future	2001	0.090 / 0.50	0.160 / 0.72
	2010	0.090 / 0.50	0.165 / 0.74

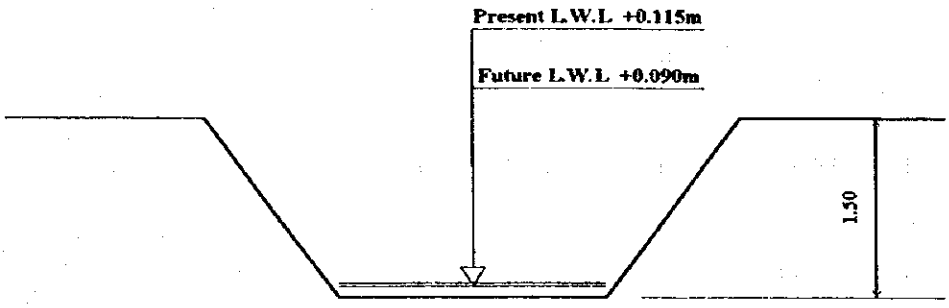


Fig. 4.2 Scenario 1 : with Implementation

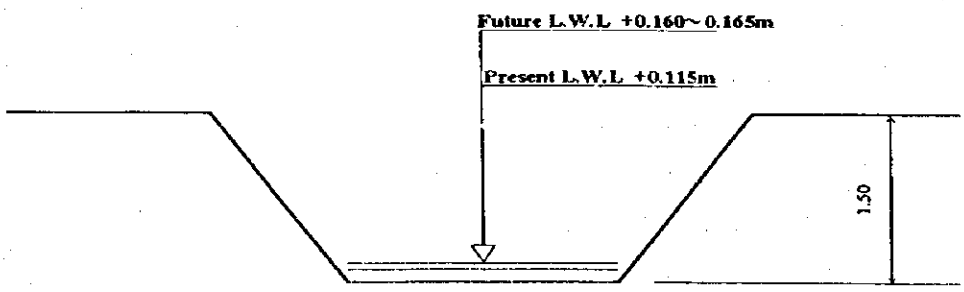


Fig. 4.3 Scenario 2 : without Implementation

As is evident in Table 4.3, there is no significant difference in scenario 1, however, the future flow is estimated at almost 1.5 times the condition in scenario 2.

Table 4.4 Water depth and flow velocity of the Lana River

n value of Manning's formula n = 0.030
Gradient of the river bed I = 0.006

Water Level (m)	Slope Length (m)	Water Surface Width (m)	Wetted Perimeter (m)	Water Area (m^2)	Radius (m)	Flow Velocity (m/sec)	Flow Quantity (m^3/sec)	Sinario 1 with Implementation	Sinario 2 without Implementation
0.050	0.0833	4.1333	4.1667	0.2033	0.0488	0.34	0.0701		
0.090	0.1500	4.2400	4.3000	0.3708	0.0862	0.50	0.1869	in 2001,2010	
0.100	0.1667	4.2667	4.3333	0.4133	0.0954	0.54	0.2228		
0.115	0.1917	4.3067	4.3833	0.4776	0.1090	0.59	0.2813	Present	Present
0.150	0.2500	4.4000	4.5000	0.6300	0.1400	0.70	0.4386		
0.160	0.2667	4.4267	4.5333	0.6741	0.1487	0.72	0.4886		in 2001
0.165	0.2750	4.4400	4.5500	0.6963	0.1530	0.74	0.5144		in 2010
0.200	0.3333	4.5333	4.6666	0.8533	0.1829	0.83	0.7098		
0.250	0.4167	4.6667	4.8333	1.0833	0.2241	0.95	1.0321		
0.300	0.5000	4.8000	5.0000	1.3200	0.2640	1.06	1.4026		
0.350	0.5833	4.9333	5.1666	1.5633	0.3026	1.16	1.8193		
0.400	0.6666	5.0666	5.3333	1.8133	0.3400	1.26	2.2808		
0.450	0.7500	5.2000	5.4999	2.0700	0.3764	1.35	2.7861		
0.500	0.8333	5.3333	5.6666	2.3333	0.4118	1.43	3.3345		
0.550	0.9166	5.4666	5.8333	2.6033	0.4463	1.51	3.9255		
0.600	1.0000	5.6000	5.9999	2.8800	0.4800	1.58	4.5587		
0.650	1.0833	5.7333	6.1666	3.1633	0.5130	1.65	5.2340		
0.700	1.1666	5.8666	6.3332	3.4533	0.5453	1.72	5.9511		
0.750	1.2500	6.0000	6.4999	3.7500	0.5769	1.79	6.7101		
0.800	1.3333	6.1333	6.6666	4.0533	0.6080	1.85	7.5111		
0.850	1.4166	6.2666	6.8332	4.3633	0.6385	1.91	8.3541		
0.900	1.4999	6.3999	6.9999	4.6800	0.6686	1.97	9.2392		
0.950	1.5833	6.5333	7.1665	5.0033	0.6981	2.03	10.1666		
1.000	1.6666	6.6666	7.3332	5.3333	0.7273	2.09	11.1366		
1.050	1.7499	6.7999	7.4999	5.6700	0.7560	2.14	12.1493		
1.100	1.8333	6.9333	7.6665	6.0133	0.7844	2.20	13.2051		
1.150	1.9166	7.0666	7.8332	6.3633	0.8124	2.25	14.3043		
1.200	1.9999	7.1999	7.9998	6.7200	0.8400	2.30	15.4470		
1.250	2.0833	7.3333	8.1665	7.0833	0.8674	2.35	16.6337		
1.300	2.1666	7.4666	8.3332	7.4533	0.8944	2.40	17.8646		
1.350	2.2499	7.5999	8.4998	7.8299	0.9212	2.44	19.1401		
1.400	2.3332	7.7332	8.6665	8.2133	0.9477	2.49	20.4606		
1.450	2.4166	7.8666	8.8331	8.6033	0.9740	2.54	21.8264		
1.500	2.4999	7.9999	8.9998	8.9999	1.0000	2.58	23.2379		

2.2 Tractive power of the river's flow (self-cleaning velocity)

The tractive power of the river's flow is given by the equation:

$$\tau \geqq \tau c \qquad \text{(A)}$$

$$\therefore \quad \omega \cdot R \cdot i \geqq \tau c \qquad \text{(B)}$$

where, τ : Tractive power of the river's flow

τc: Critical tractive power for sediment transportation

ω: $= \rho \cdot g$

ρ : Bulk density of water (= 1.0 t/m^3)

g: Gravitational acceleration (= 9.8 m/sec)

R: Hydraulic radius (m)

i : Hydraulic gradient (= 6/1000)

While, τc is shown using critical friction velocity (u^*c^2) as follows:

$$\tau c = \rho \cdot u^*c^2 \qquad \text{(C)}$$

where, u^*c^2: Critical friction velocity (m/sec) ; Table 4.5

Table 4.5 Critical friction velocity for soil particles

Grain diameter (cm)	0.2	0.3	0.4
u^*c^2 (m/sec)	3.73/100	4.97/100	5.69/100

Formula (B) can be converted to below formula.

$$\omega \cdot R \cdot i \geqq \rho \cdot u^*c^2 \qquad \text{(D)}$$

$$\therefore \quad g \cdot R \cdot i \geqq u^*c^2 \qquad \text{(E)}$$

$$\therefore \quad R \geqq u^*c^2 / g \cdot i \qquad \text{(F)}$$

Table 4.6 Adoption for the Lana River

Grain diameter (cm)	0.2	0.3	0.4
$R = u^*c^2 / g \cdot i$	0.6344	0.8452	0.9677
Required water depth (m)	0.85	1.20	1.45
Required flow velocity (m/sec)	1.91	2.30	2.54

In any cases, the estimated flow velocities during the dry periods (See Table 4.4) are far from the required flow velocities for sediment transportation. However, during the rainy periods, the flow velocity of the river will increase significantly and sediment will be transported.

3. Recreational function of the river

The usability of the river is determined by the parameters water depth, flow velocity and water quality.

The target levels of the above parameters are indicated in Table 4.7 to 4.9.

Table 4.7 Relationship between flow velocity and usage

Flow Velocity (m/sec)	Image of the flow	Suitable usage
< 0.1	A brooklet	
0.2	Slow moving river	Water's edge play for children
0.3		Catching small fish
0.4		
0.5	Swift stream	Walking, swimming
0.6		Limitation of boating
0.7		
0.8	Rapids	Hard to stand for adult
0.9		
> 1.0		Canoeing/Kayaking

Table 4.8 Relationship between water depth and human mental condition

Water depth	Flow velocity	Human mental condition
0.3 m		Threatened feeling
0.5 m	More than 0.6 m/sec	Oppressive feeling
0.7 m	More than 0.4 m/sec	Strong oppressive feeling

Table 4.9 Target level of water quality

Usage	Scenic Decoration	Limited Human Contact	Carp can live
Odor	Not unpleasant	- do -	- do -
Color	Less than 40 deg.	Less than 10 deg.	Less than 40 deg.
E. Coli form	1,000/100mL	50/100mL	1,000/100mL
PH	5.8 to 8.6	- do -	- do -
Turbidity	Less than 10 deg.	Less than 5 deg.	Less than 10 deg.
BOD	Less than 10mg/L	Less than 3mg/L	Less than 10mg/L

4. Basic policy to improve the degraded river condition

In Japan, there has been a tremendous improvement in the aquatic environment for almost a quarter-century. After the completion of sewerage systems, polluted rivers that had flowed with foul smelling waters became clear with abundant aquatic fauna and flora. Correspondingly, the usability of the rivers increased over time.

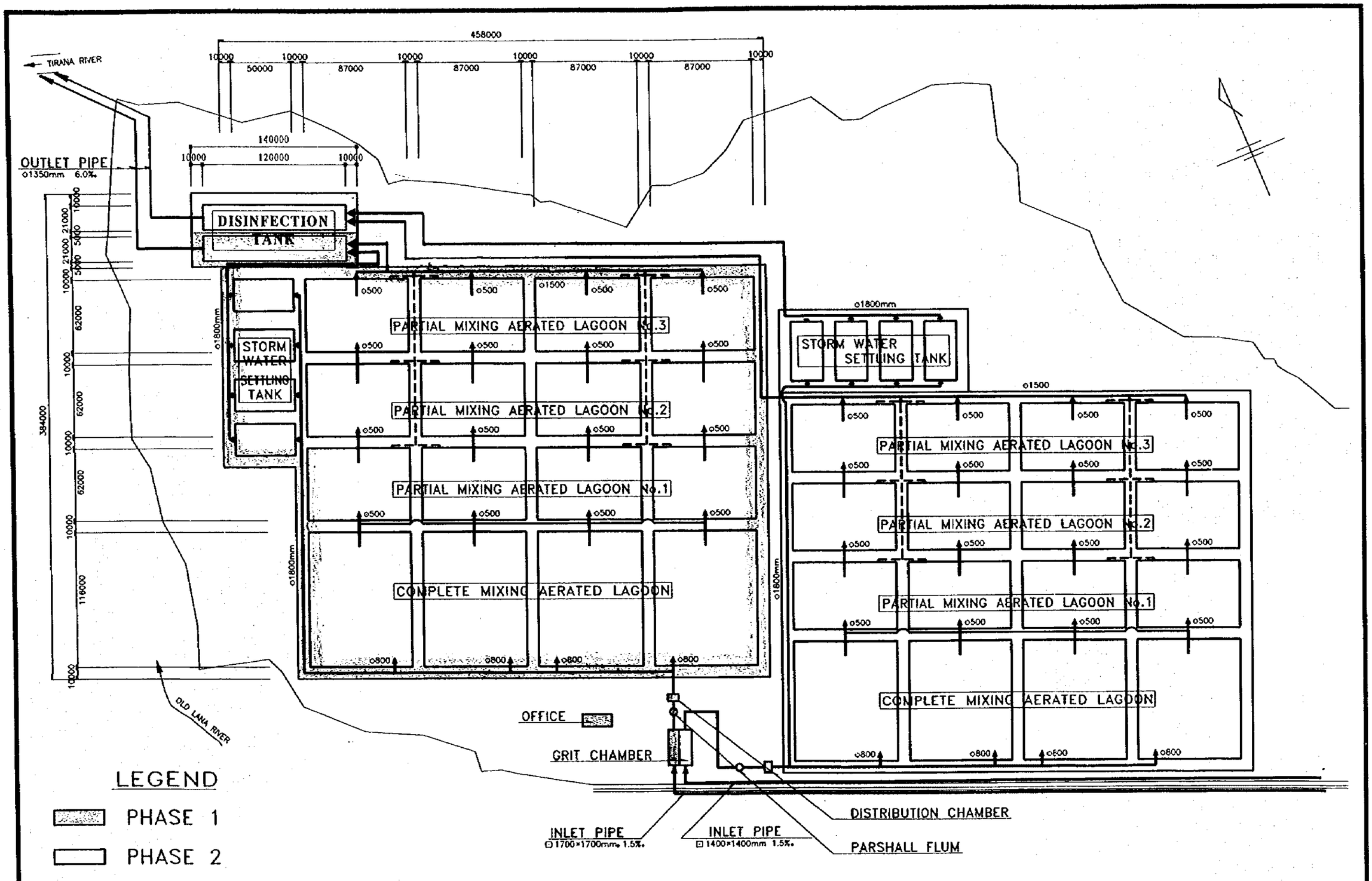
The highest priority should be given to improving public health, and thus aquatic environmental improvement should be considered as a second step.

In recognition that the daily maintenance of the river is a requisite regardless of the sewerage system, the establishment of a cooperative/communicative system between the administrator of the river and the citizens for the dredging or cleaning of the river is recommendable.

In short, an aggressive action and/or stance on the part of the citizens to maintain the river is strongly desirable; however, the existing conditions are not preferable due to the disposal of wastes and soil.

In conclusion, the existing detrimental conditions should be resolved apart from any discussion on the influence of sewerage project. The introduction of a treatment facility for river water (contact aeration process with open channel) is worth studying as a second step of the Lana River improvement.

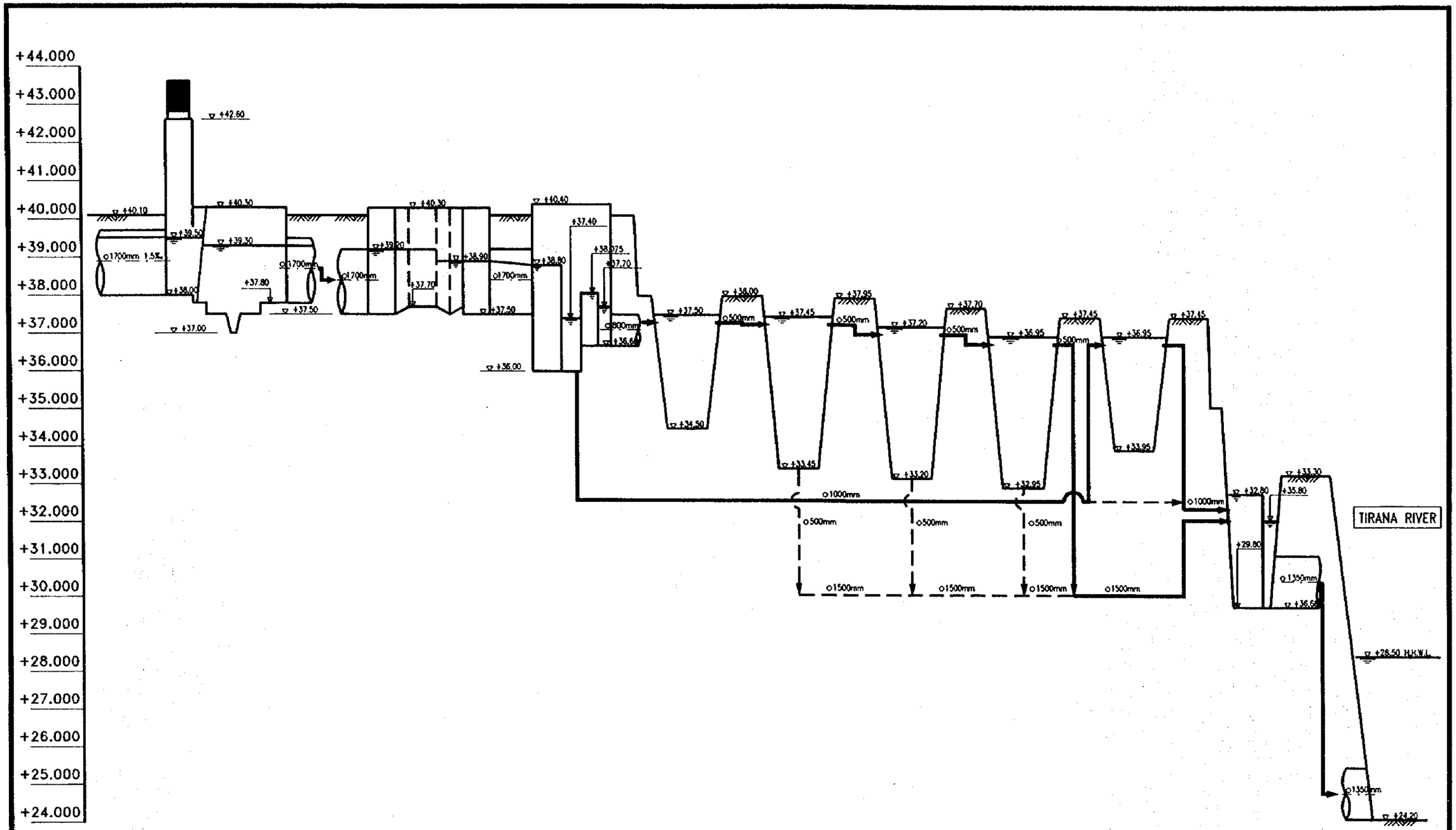
DRAWINGS



LAYOUT PLAN s=1:3000

DRAWING 1

LAYOUT PLAN



	INLET PIPE	GRIT CHAMBER	PARSHALL FLUM	DISTRIBUTION CHAMBER	COMPLETE MIXING AERATED LAGOON	PARTIAL MIXING AERATED LAGOON	STORM WATER SETTLING TANK	DISINFECTION TANK	OUTLET PIPE
PHASE 1	1	4	1	1	4	4 x 3 CELLS	4	1	1
PHASE 2	1	4	1	1	4	4 x 3 CELLS	4	1	1
TOTAL	2	8	2	2	8	8 x 3 CELLS	8	2	2

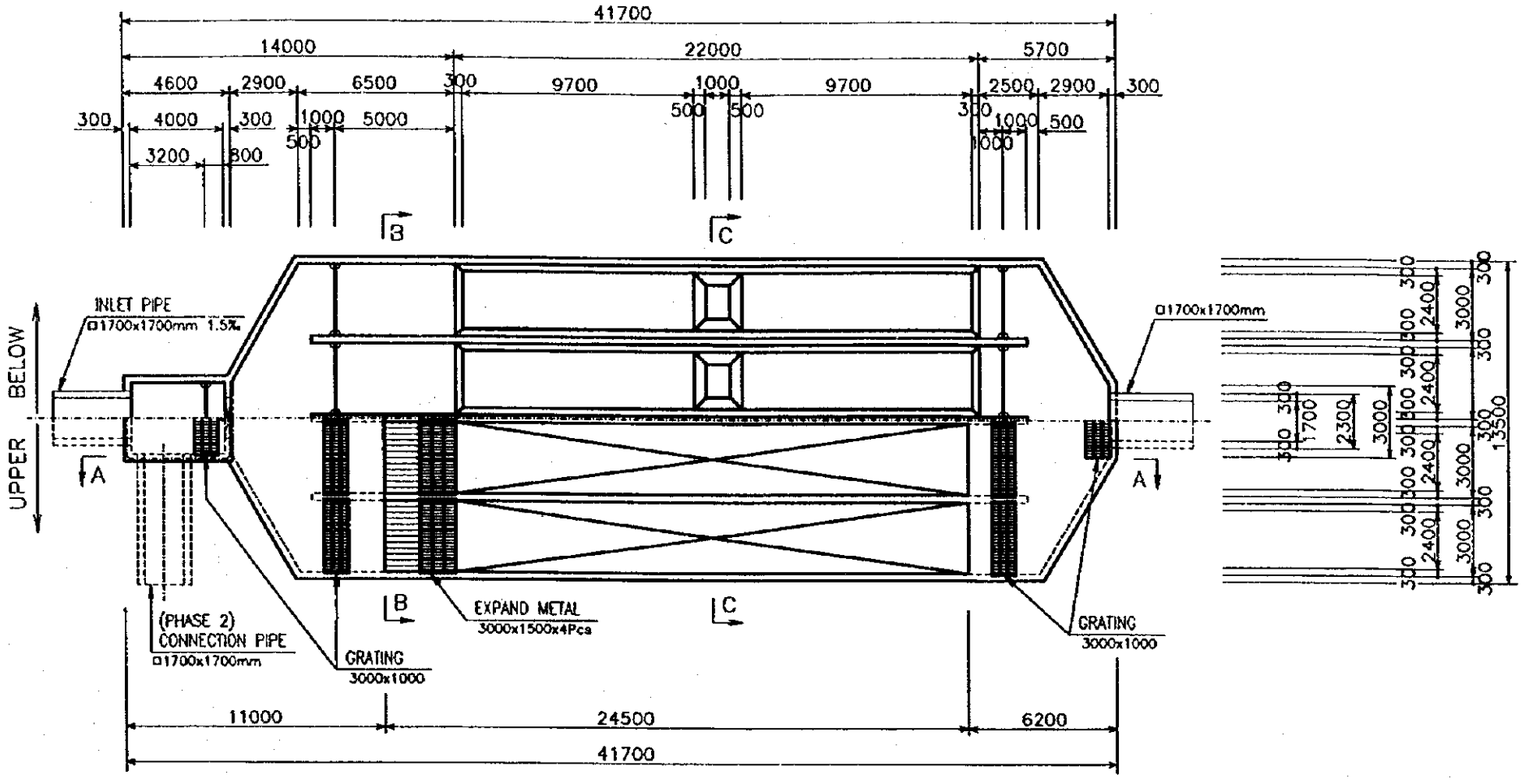
DRAWING 2

HYDRAULIC PROFILE

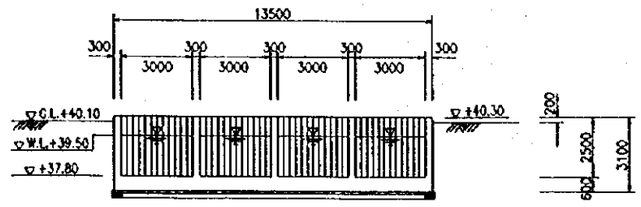
CMAL – COMPLETE MIXING AERATED LAGOON
PMAL – PARTIAL MIXING AERATED LAGOON
SWT – STORM WATER SETTLING TANK
○, o – AERATORS

SCREEN GRIT CHAMBER
PARSHALL FLUME
PHASE 2
PHASE 1
DISTRIBUTION CHAMBER
PHASE 1
PHASE 2
DISTRIBUTION CHAMBER
CMAL
SWT
PMAL–1
PMAL–2
PMAL–3
DISINFECTION TANK
CHLORINE WATER
TIRANA RIVER
DISINFECTION TANK

DRAWING 3
FLOW DIAGRAM



BF & GF PLAN (1:250)



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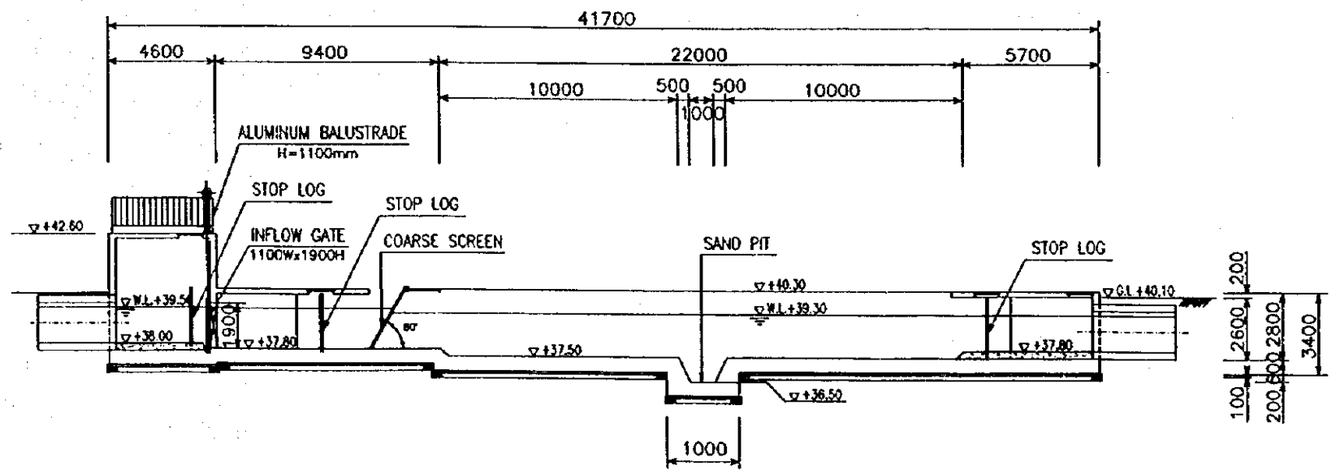

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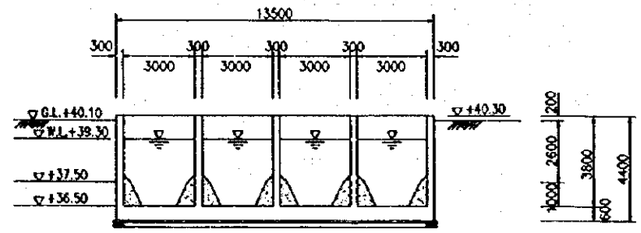
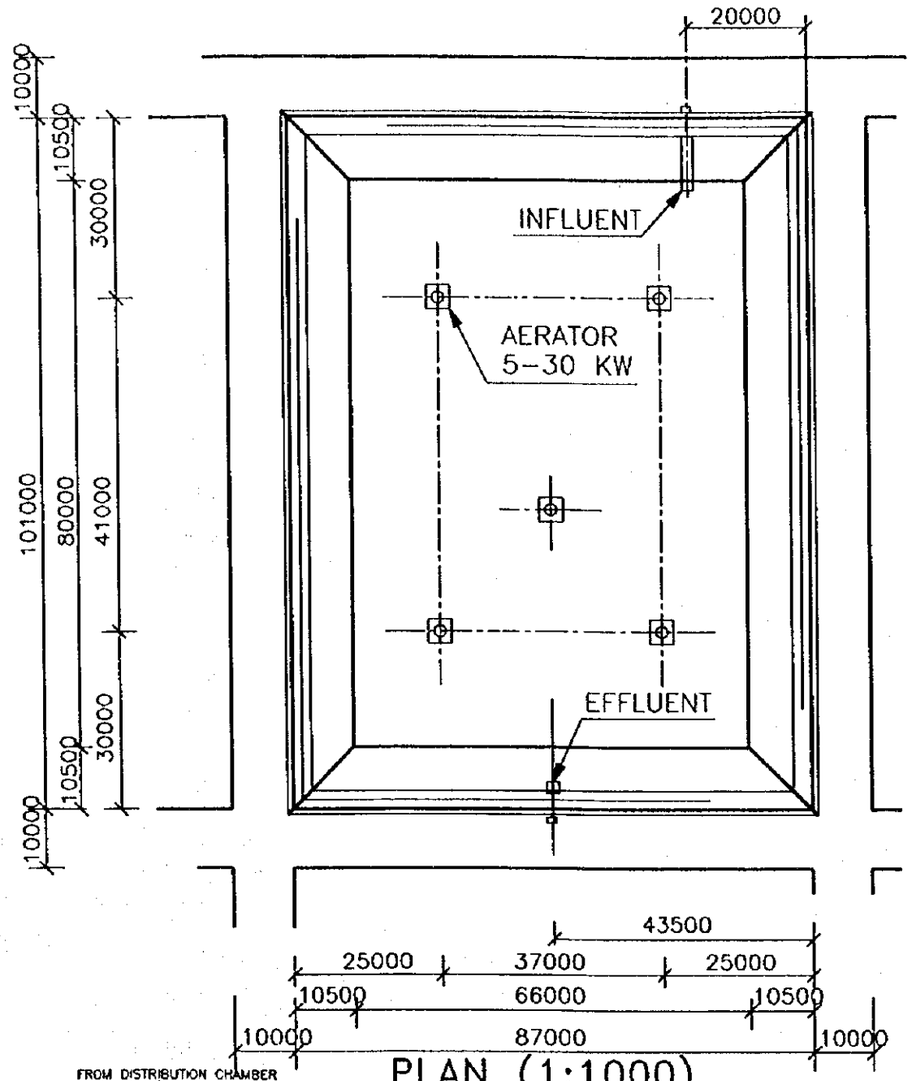


C-C SECTION (1:250)

DRAWING 4

GRIT CHAMBER



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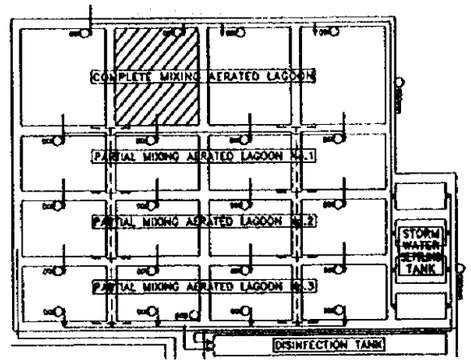

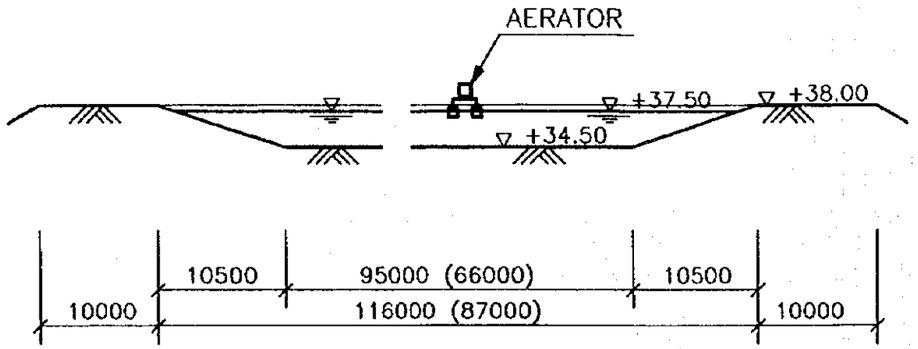

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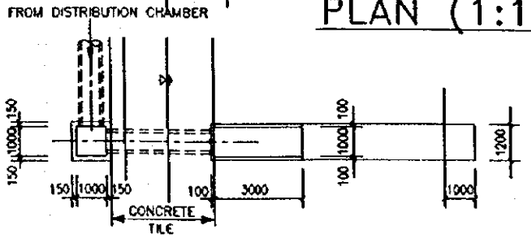

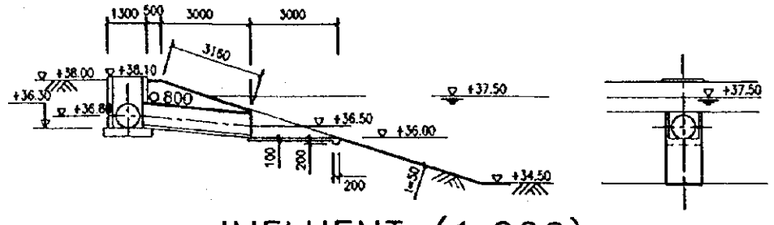

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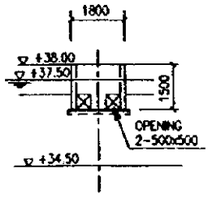
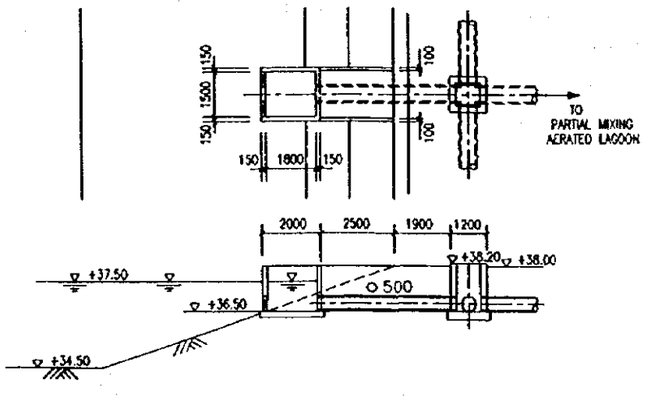
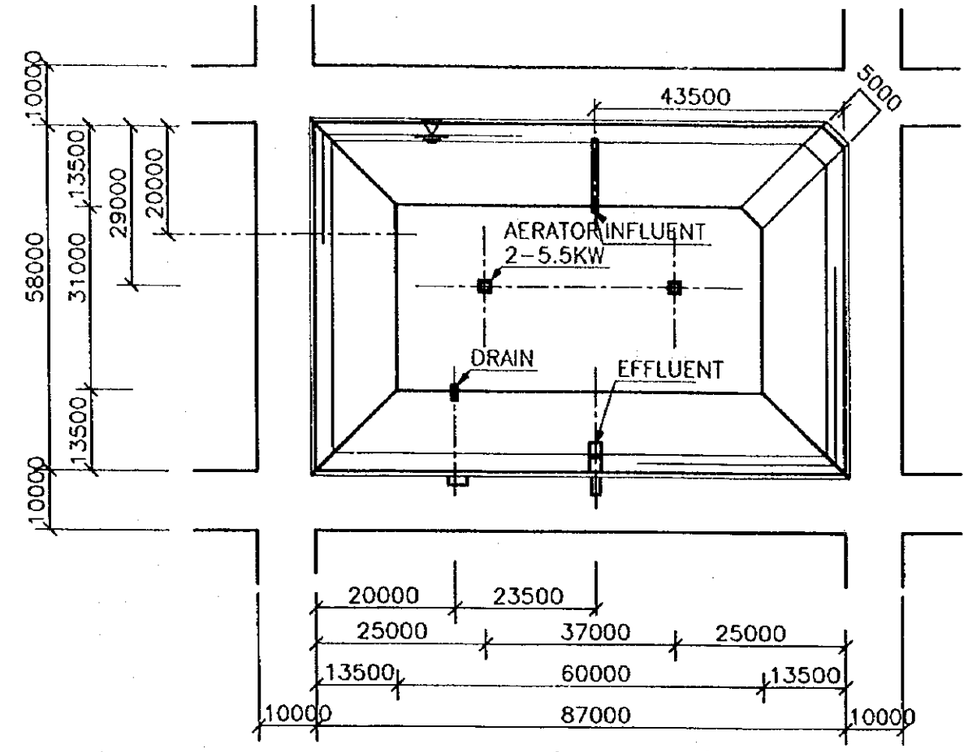




EFFLUENT (1:200)

DRAWING 5
COMPLETE MIXING
AERATED LAGOON



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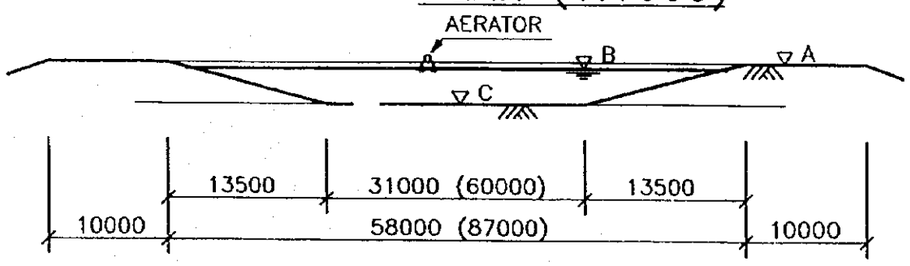

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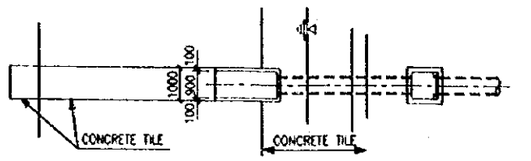

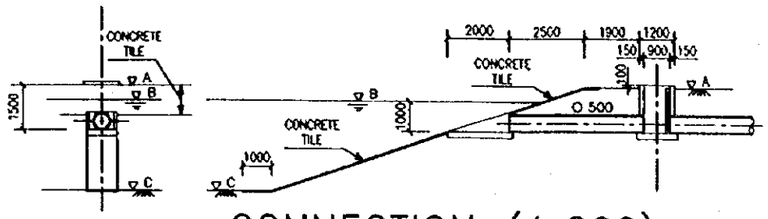

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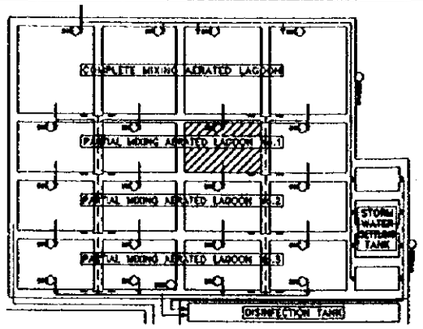
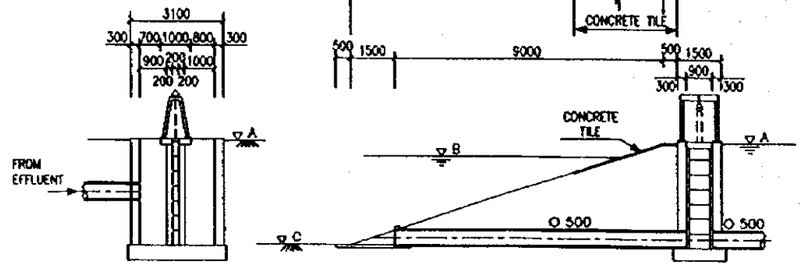


	A	B	C
I	37.95	37.45	33.45
II	37.70	37.20	33.20
III	37.45	36.95	32.95



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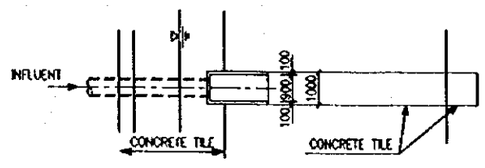

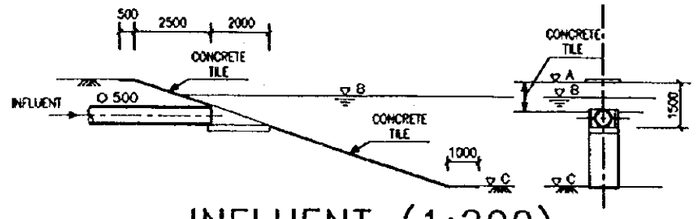

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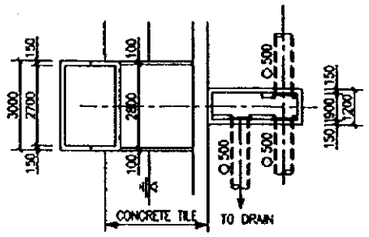
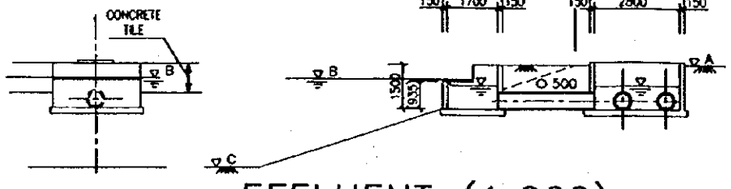
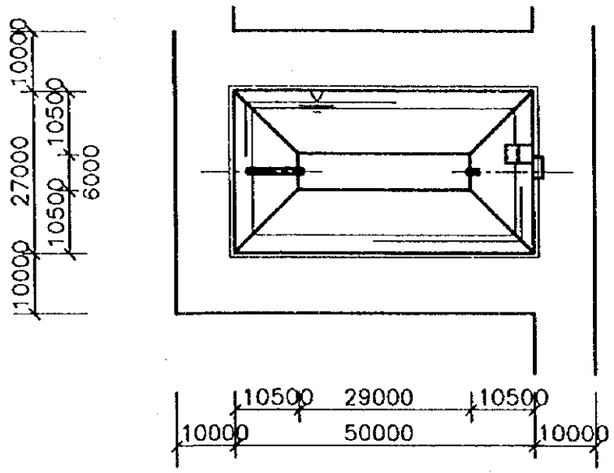




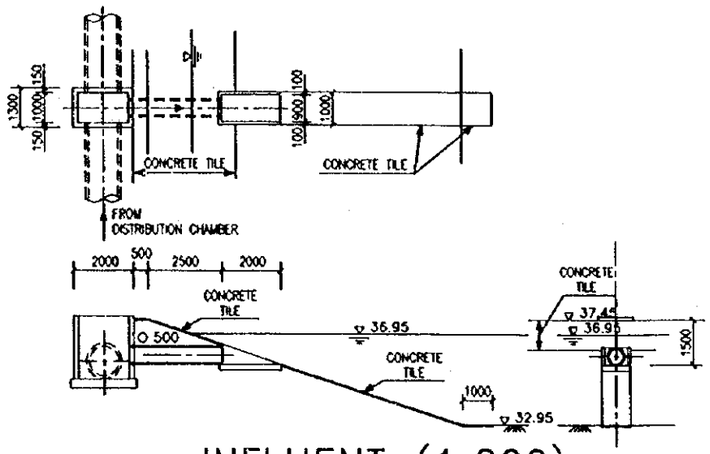
EFFLUENT (1:200)

DRAWING 6

PARTIAL MIXING AERATED LAGOON



STORM WATER SETTLING TANK PLAN (1:1000)



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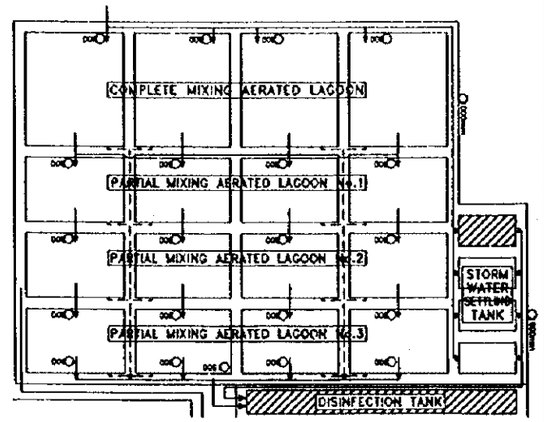

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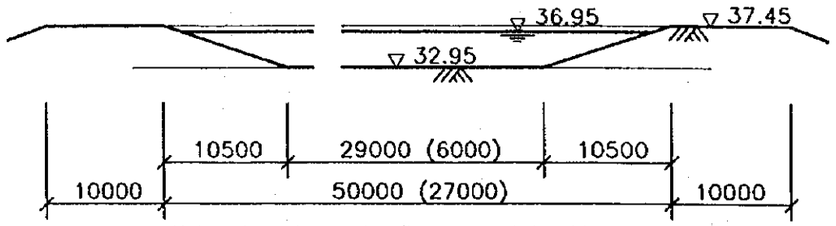
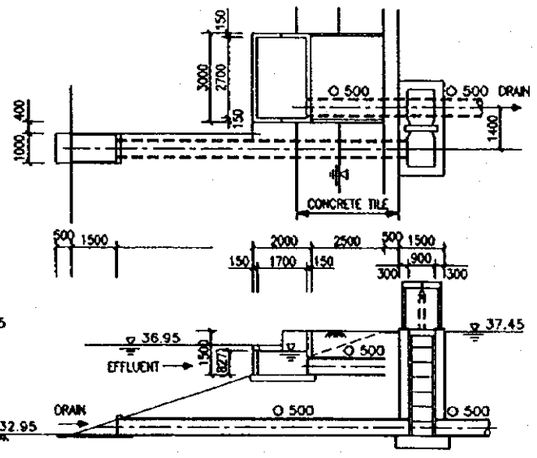


STORM WATER SETTLING TANK SECTION (1:500)



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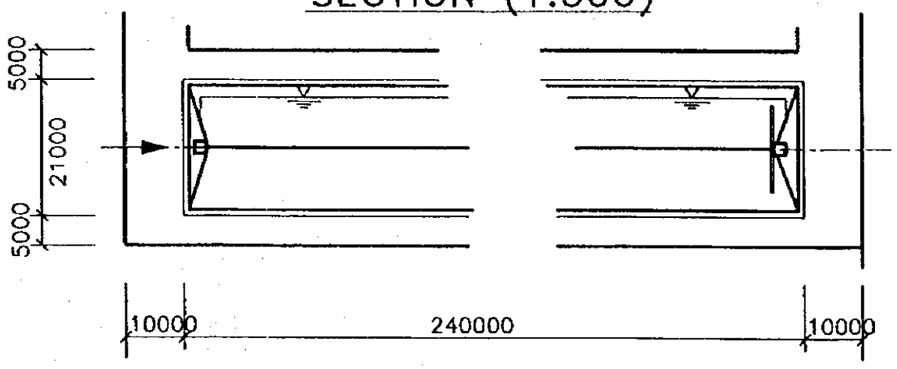
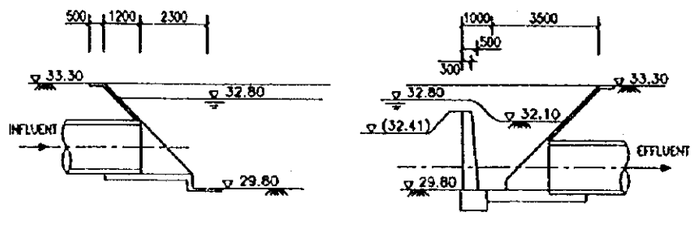


DISINFECTION TANK PLAN (1:1000)



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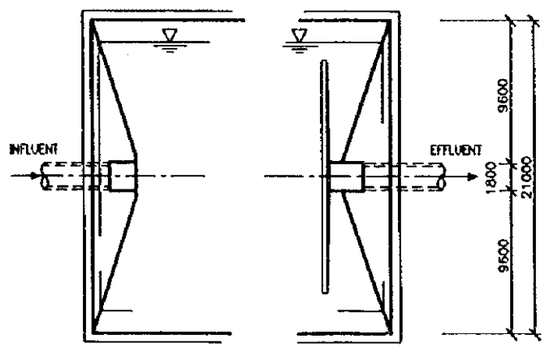
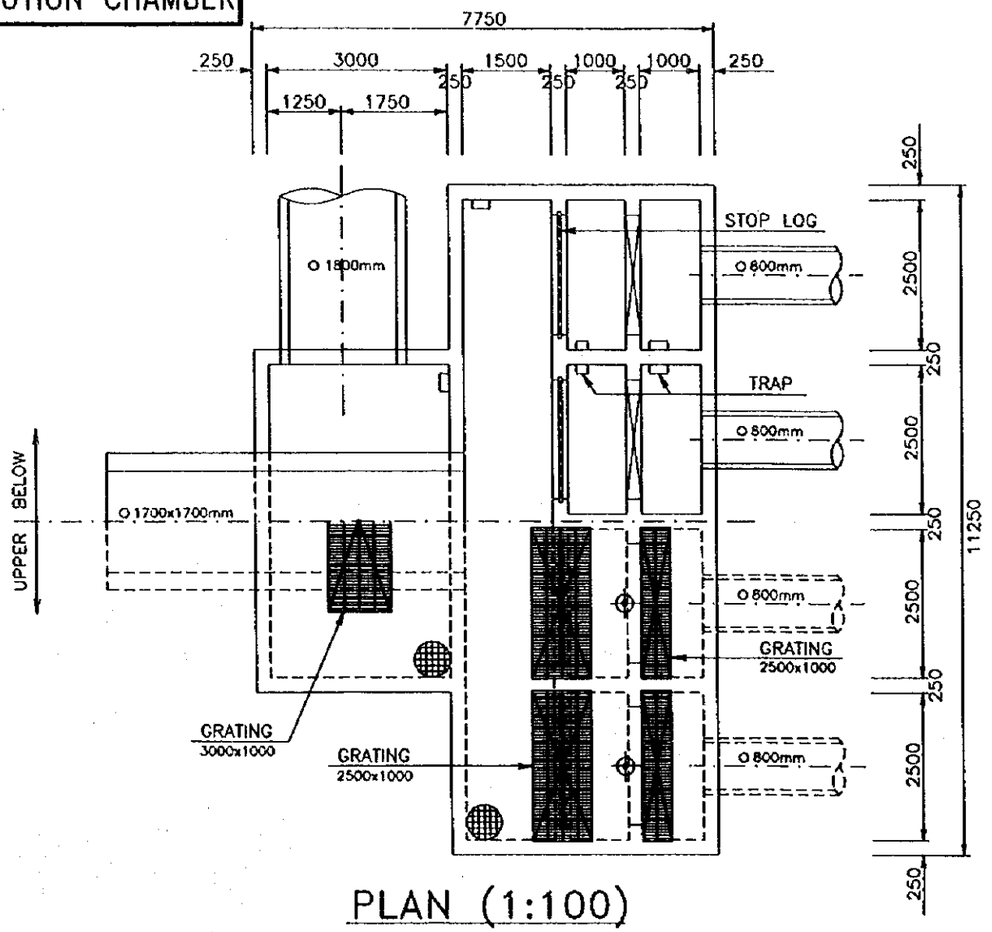


INFLUENT & EFFLUENT (1:400)

DRAWING 7
STORM WATER SETTLING TANK & DISINFECTION TANK

DISTRIBUTION CHAMBER



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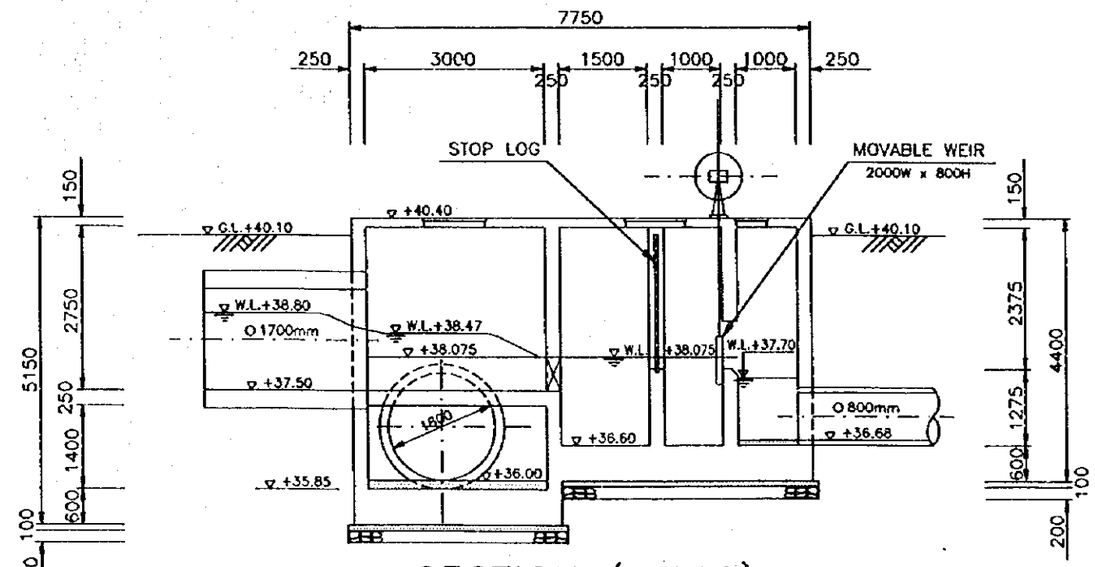
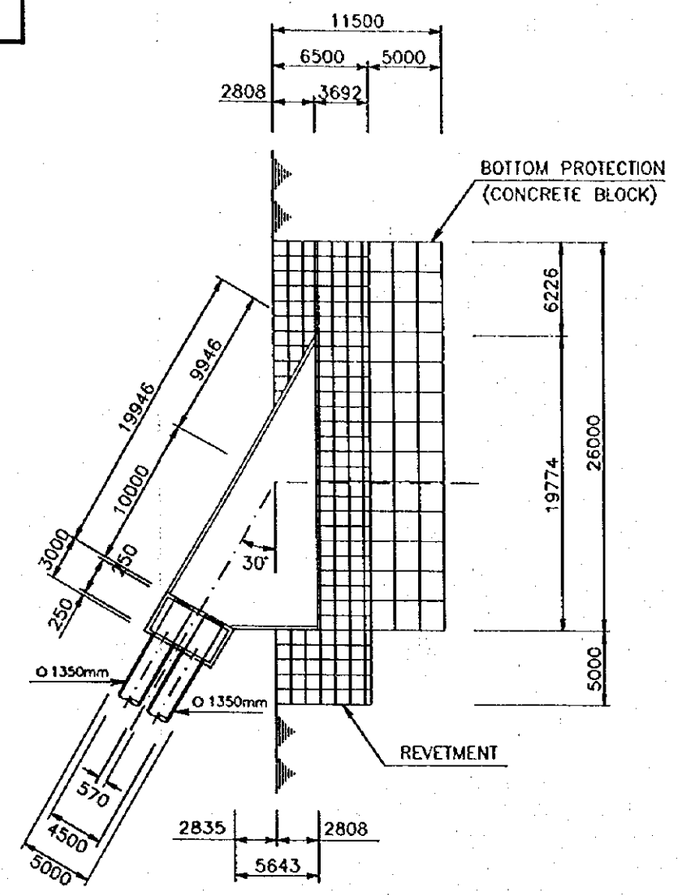


SECTION (1:100)

OUTFALL



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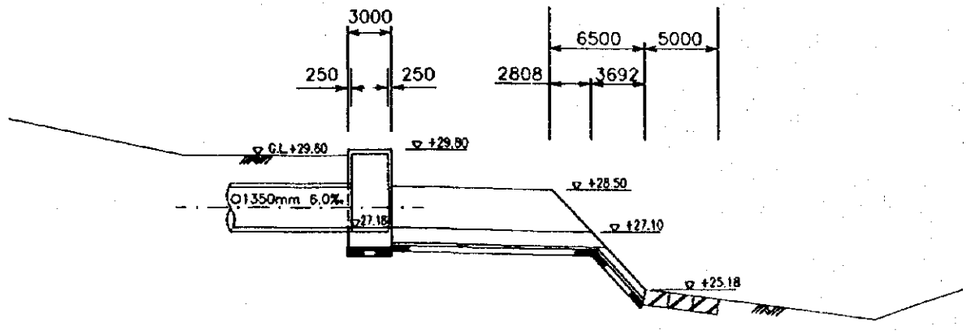
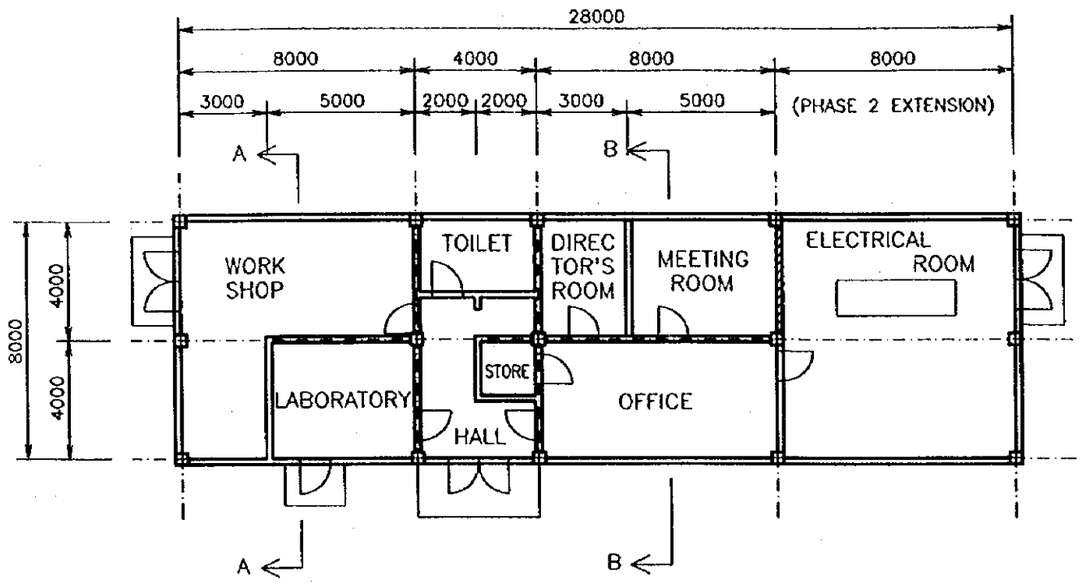


SECTION (H 1:200 V 1:100)

DRAWING 8
DISTRIBUTION CHAMBER
& OUTFALL

ADMINISTRATION BUILDING



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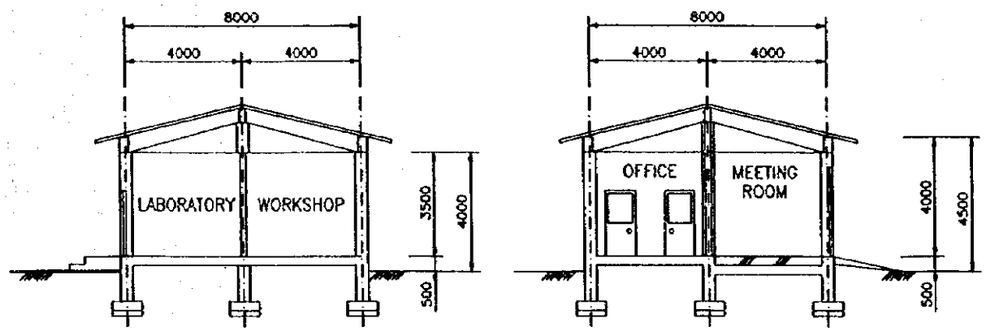
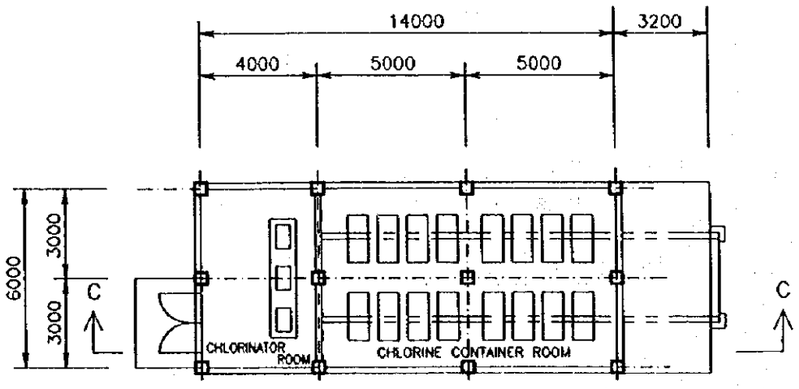


A–A SECTION (1:20) B–B SECTION (1:20)

CHLORINATION BUILDING



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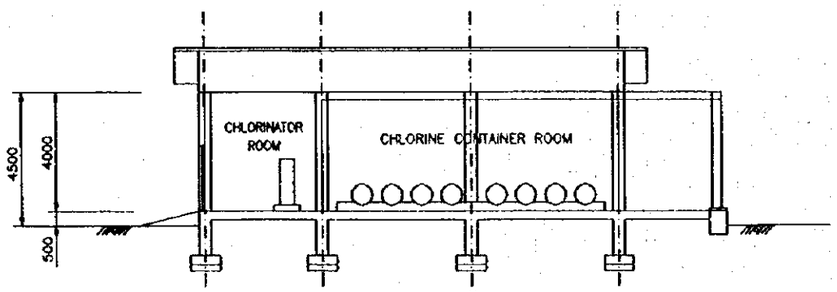
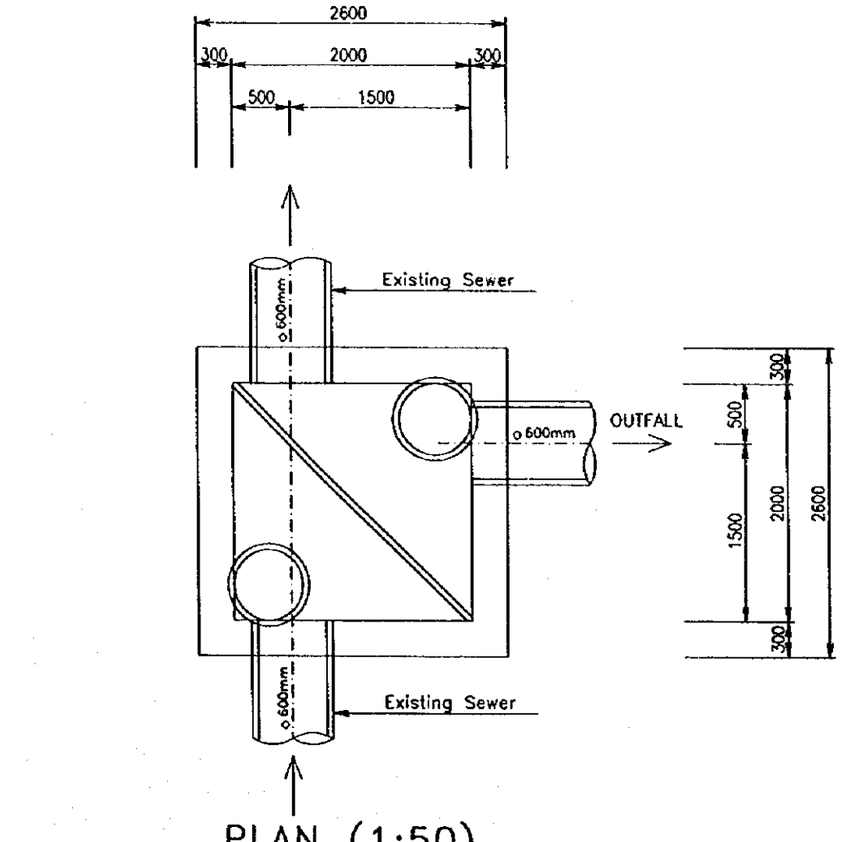


C–C SECTION (1:20)

DRAWING 9
ADMINISTRATION BUILDING & CHLORINATION BUILDING

STORM OVERFLOW CHAMBER



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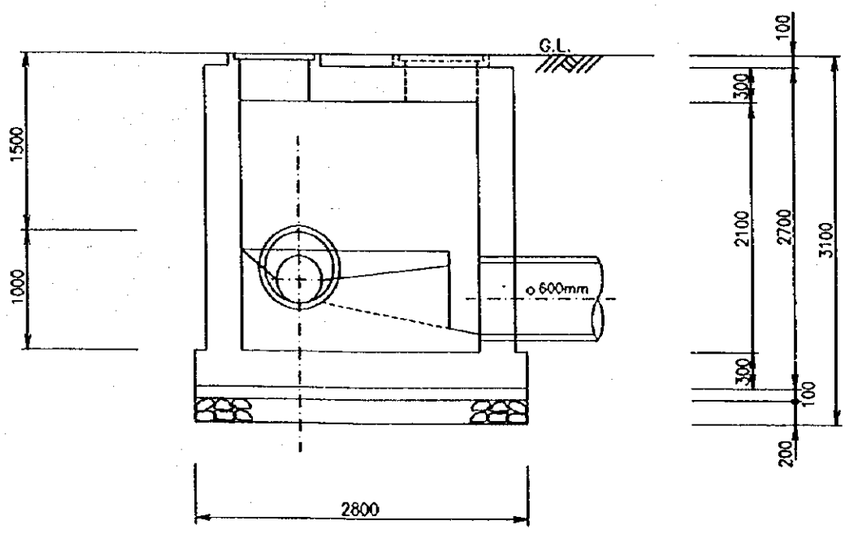

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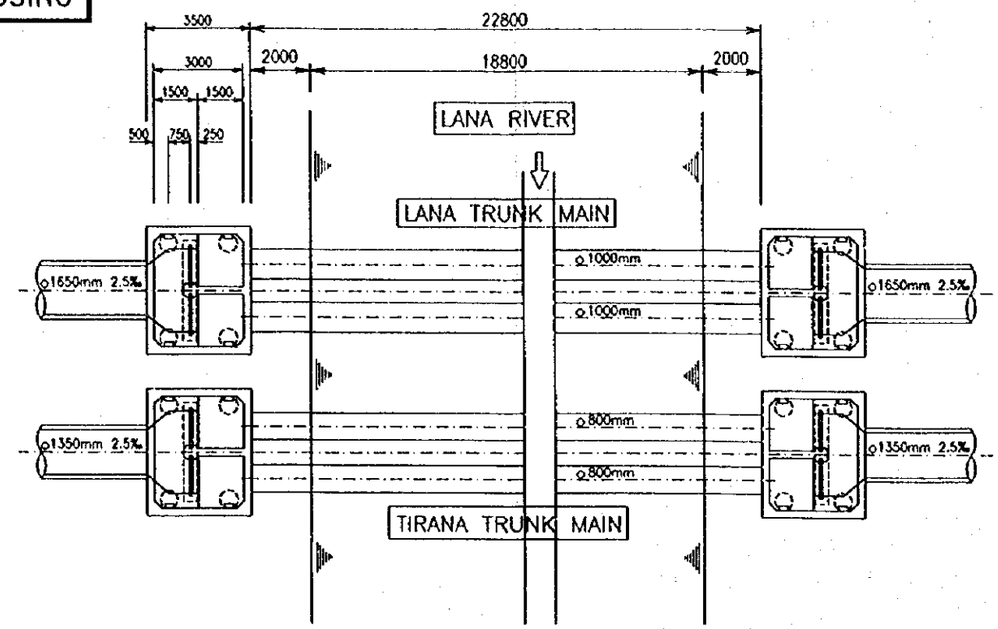
RIVER CROSSING



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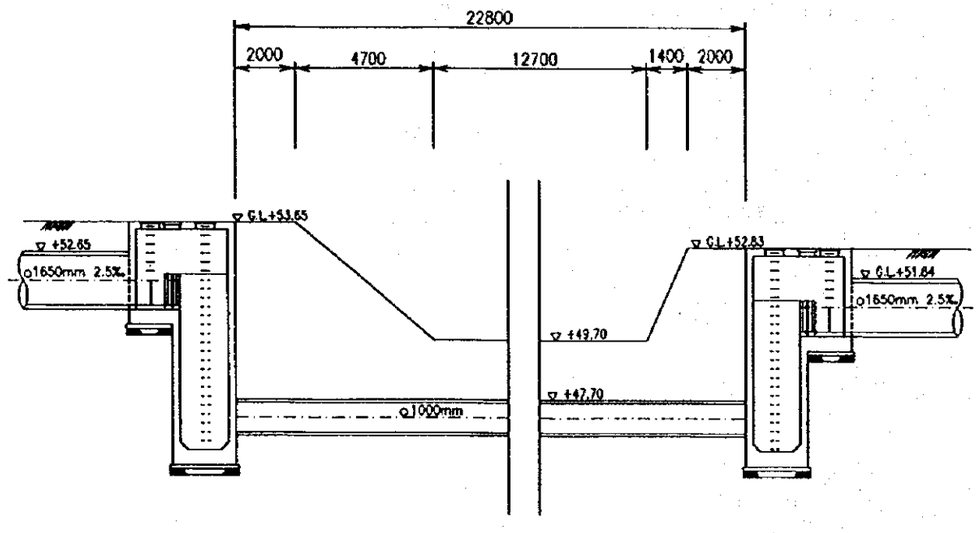
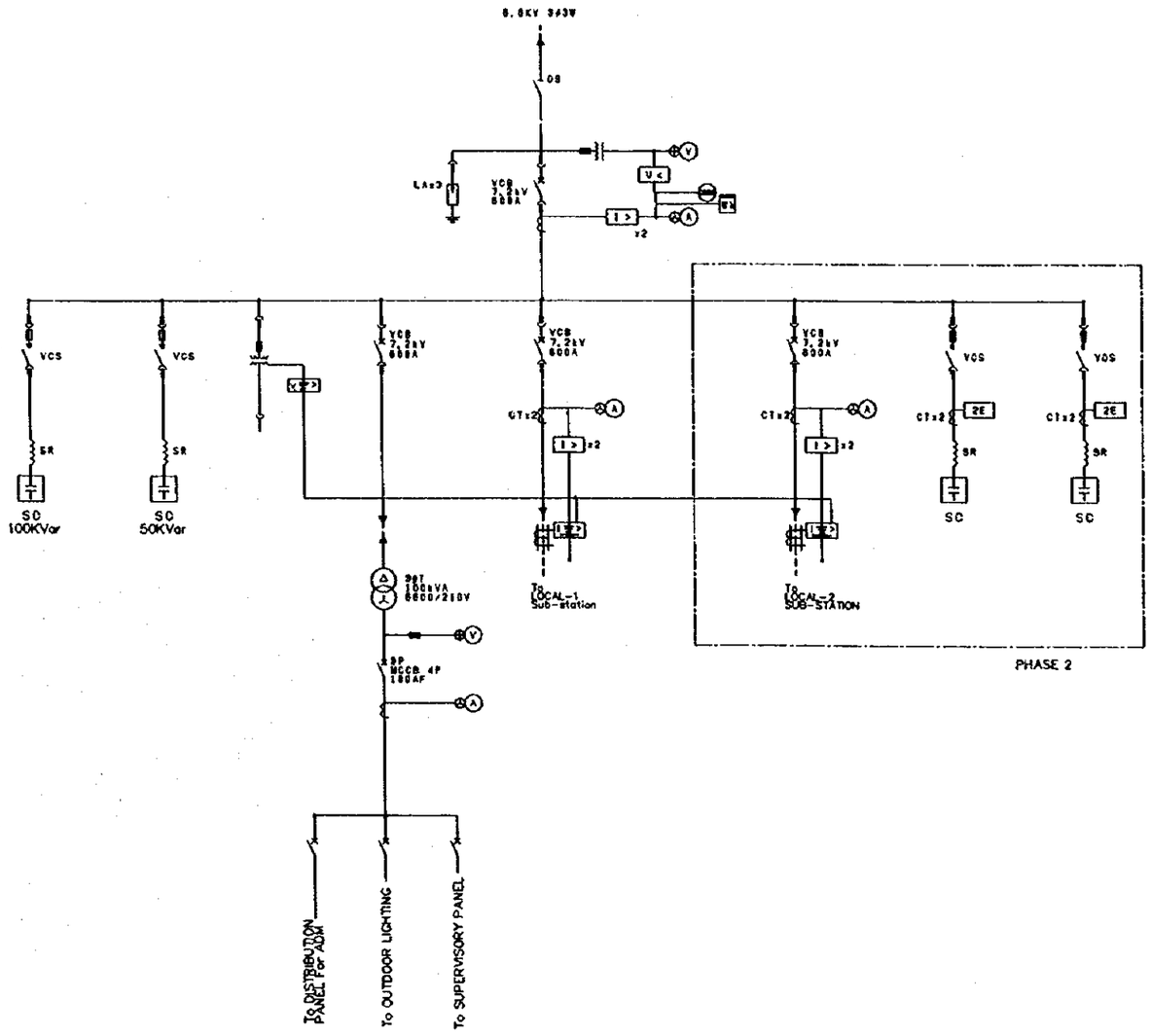


SECTION (1:200)

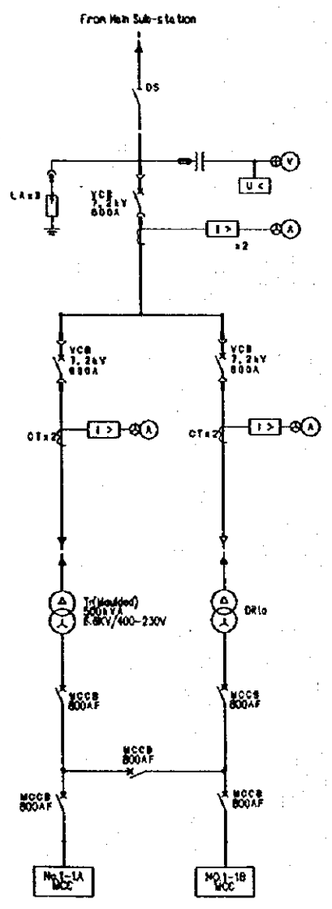
DRAWING 10

STORM OVERFLOW CHAMBER & RIVER CROSSING

MAIN SUB-STASTION



LOCAL SUB--STATION



DRAWING11

SINGLE LINE DIAGRAM