

Figure 4.2.7(1) Grain size distribution inside Tema Port

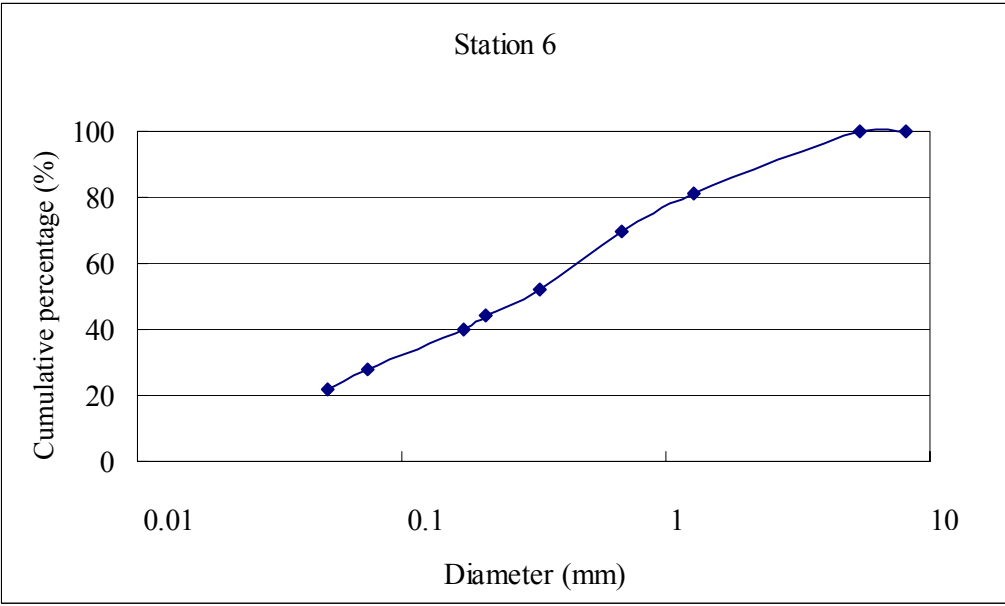


Figure 4.2.7(2) Grain size distribution inside Tema Port

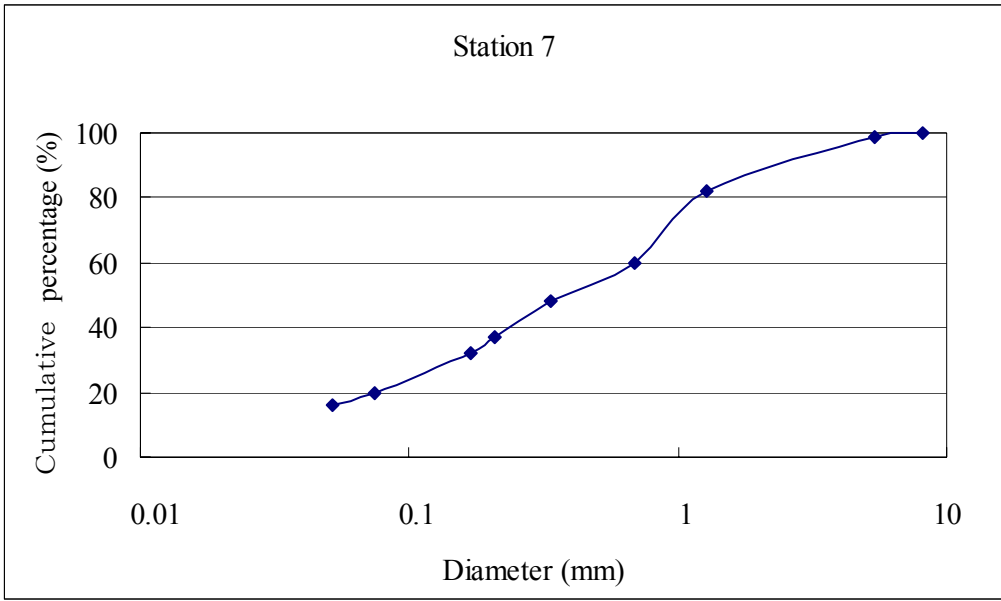


Figure 4.2.7(3) Grain size distribution inside Tema Port

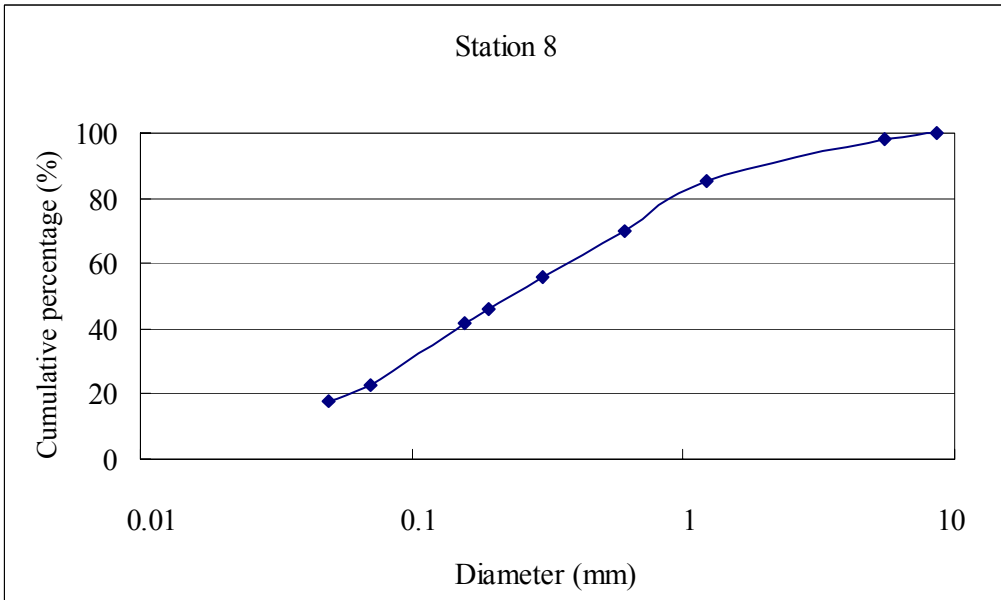


Figure 4.2.7(4) Grain size distribution inside Tema Port

TP9=..fs/wit/tp9.ss.1p

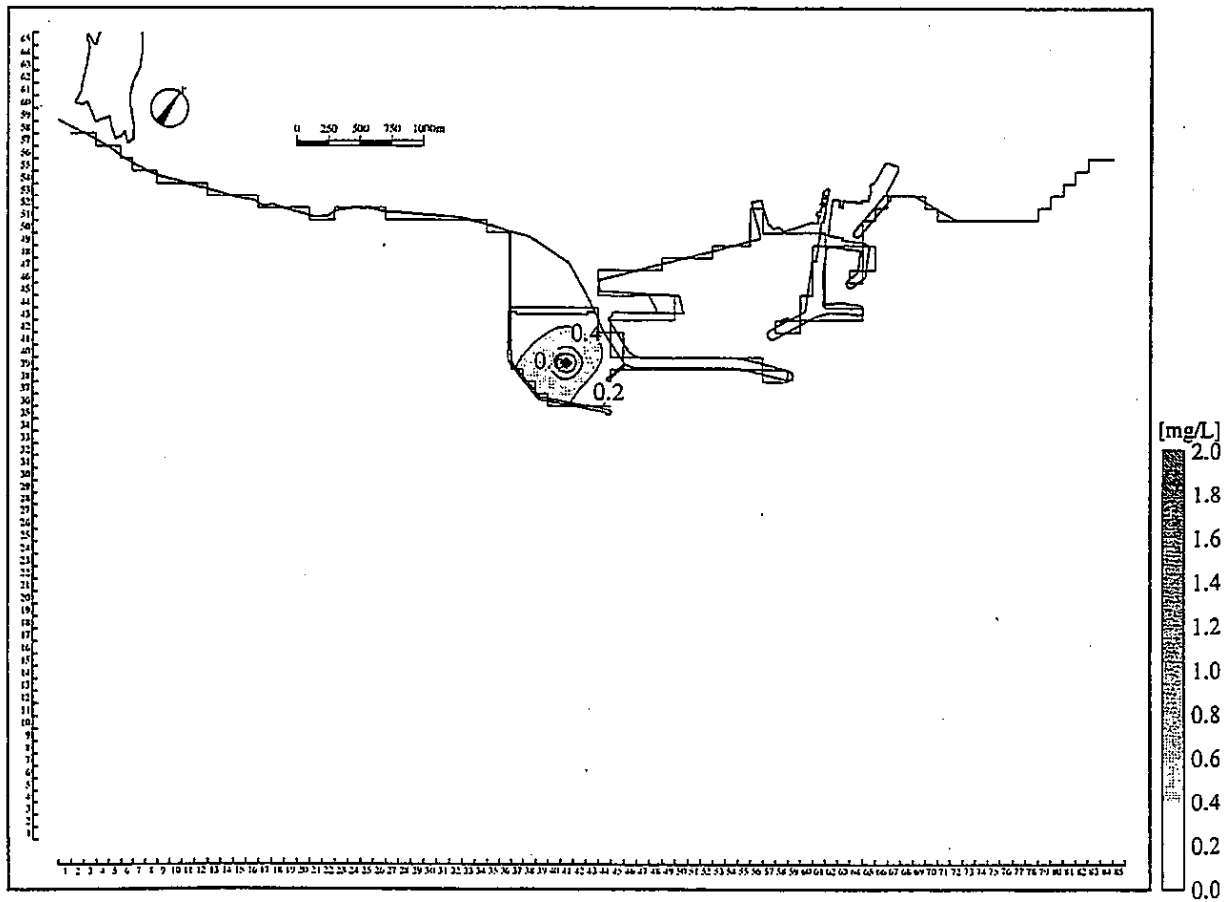


Figure 4.2.8 Predicted SS Distributions in Tema Port

TP9=../cod/out/tp9.cod.g

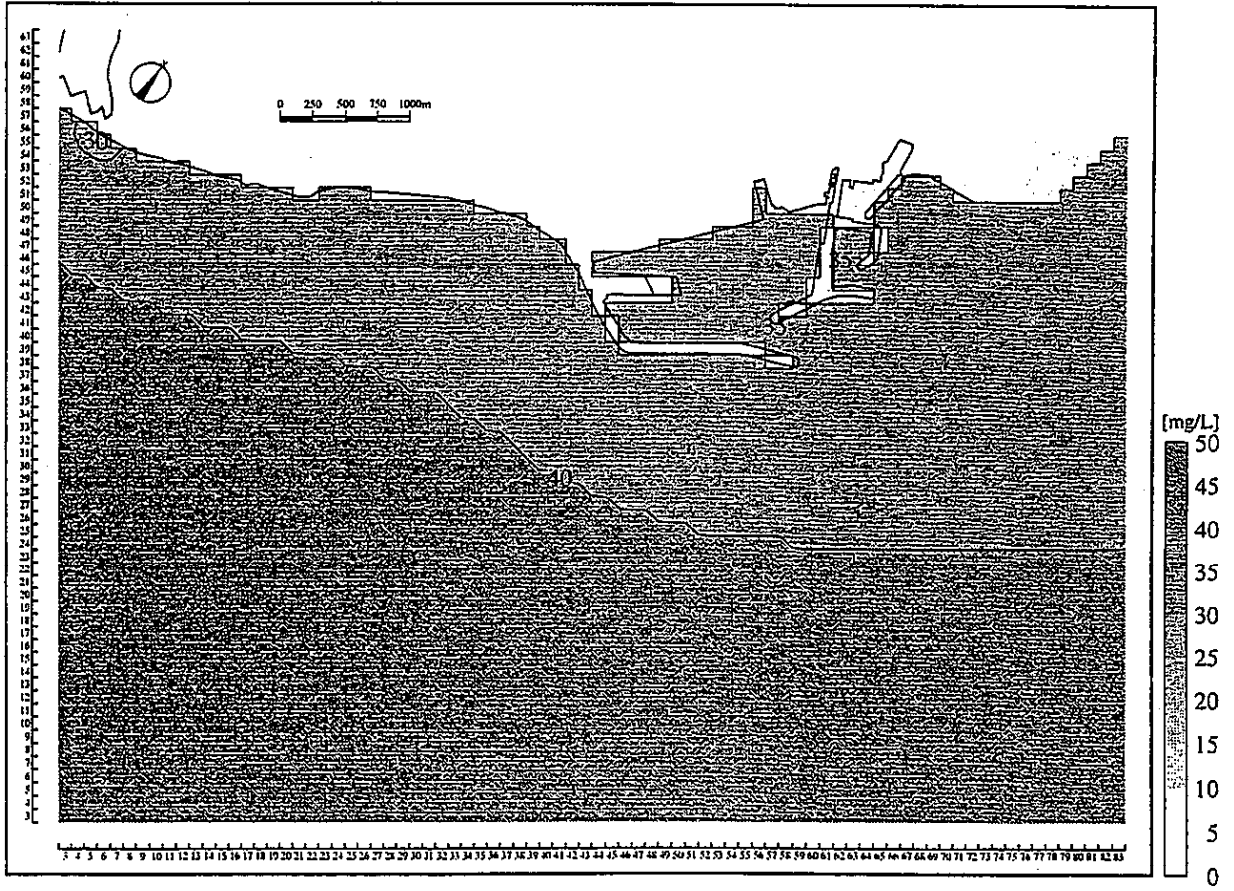


Figure 4.2.9 Simulated COD Distributions (Present)

TP9-./cod/nut/tp9.cod.2010dr

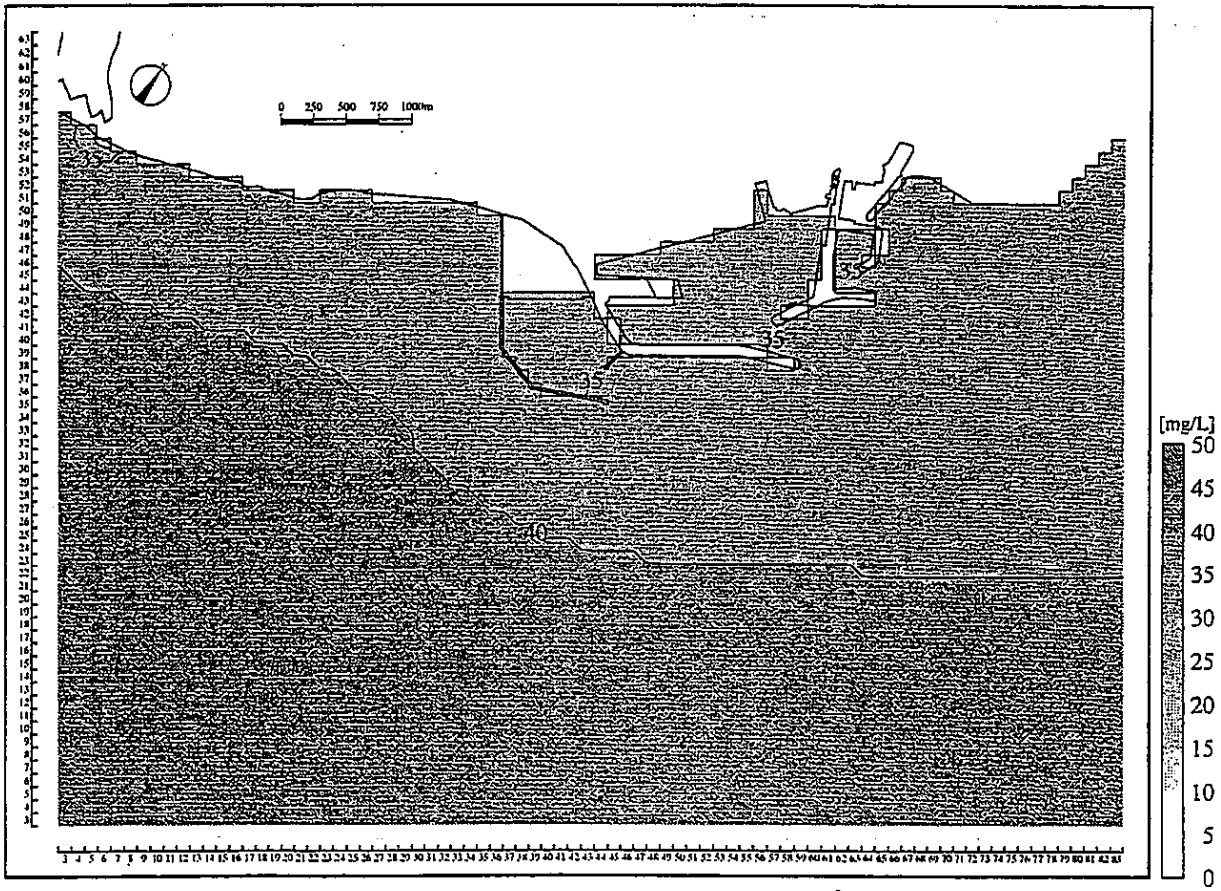


Figure 4.2.10 Predicted COD Distributions (Y2010)

TP9NEW=../cod/out/tp9.cod.2010dr
TP9OLD=../cod/out/tp9.cod.g

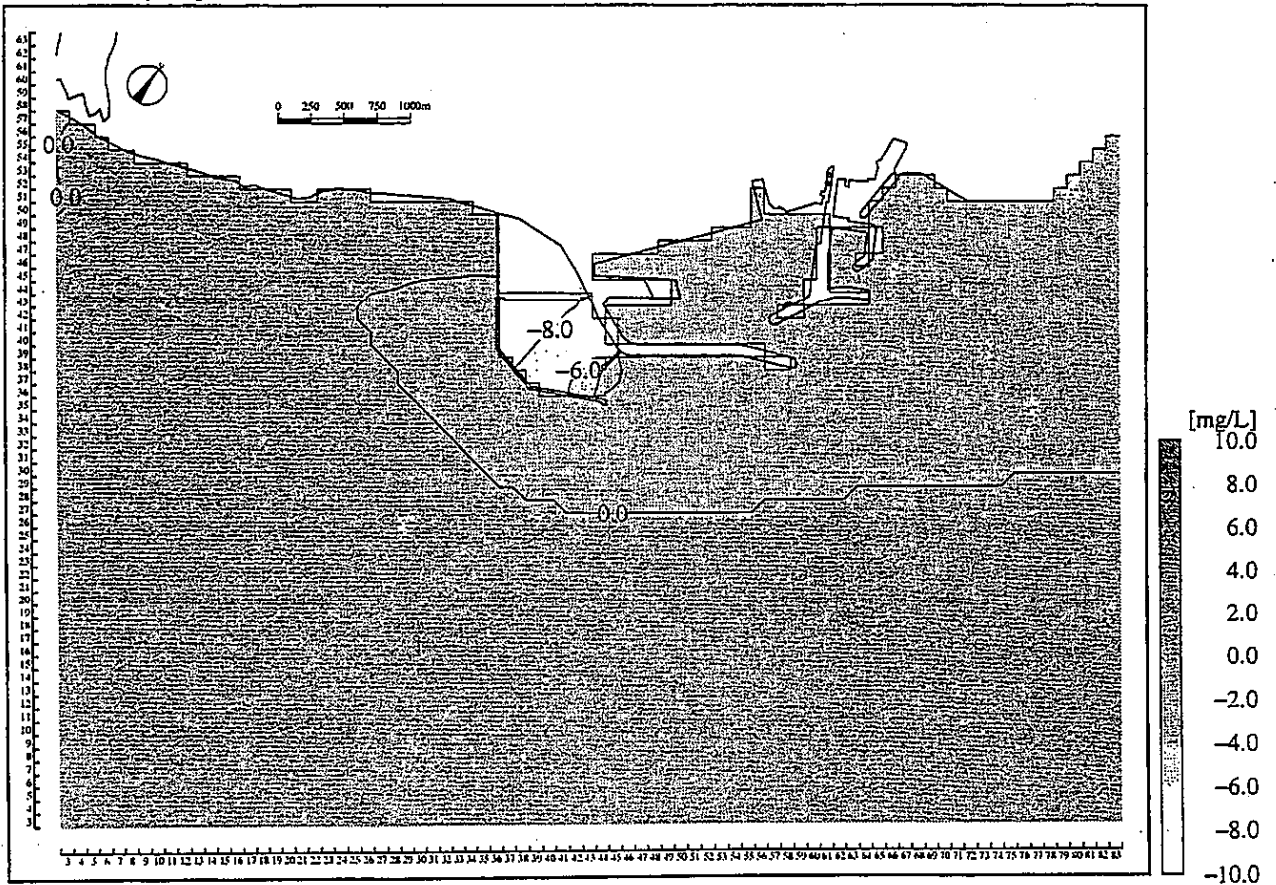


Figure 4.2.11 Difference of COD Distributions between Present and Y2010

4.3 Bottom Sediment Quality

4.3.1 Construction Phase

Removal of the sea bottom sediment will be implemented only outside the existing port basin. Therefore, the sediment (mud) contaminated with heavy metal in the existing port basin will not be disturbed.

4.3.2 Operation Phase

Altered port configuration may have an effect to deposit mud contaminated with organic matter and heavy metals in the port basin. Careful monitoring on the sediment quality in the port basin will be required.

4.4 Noise

4.4.1 Construction Phase

Noise in the construction phase was evaluated as very small for every activity of possible impact. Construction noise will mainly occur at the waterfront area that is far from the residential area. The distance will reduce the noise level reaching to the residential area. In the port area, the noise level caused by construction machines/vehicles and demolishing existing facilities will remain within the existing noise level that comes from the existing cargo-handling machines.

4.4.2 Operation Phase

Increased cargo-handling and transportation of cargo will bring about more noise nuisance than the present. The impact of road traffic and cargo-handling in the future was evaluated below.

(1) Methodology

Noise level of Tema Port will be modeled using the method shown in the following flow chart.

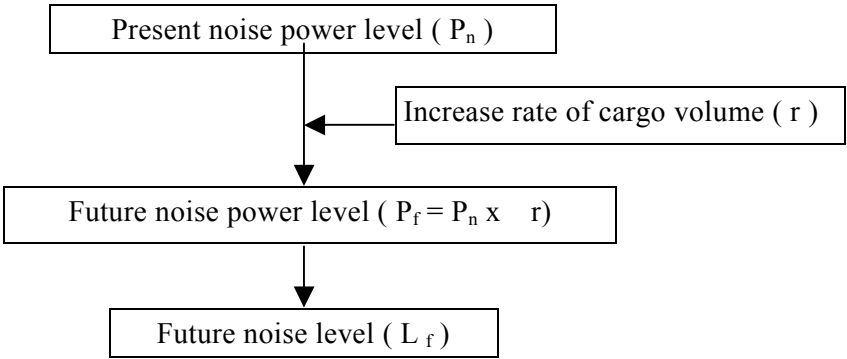


Figure 4.4.1 Flow chart of noise modeling

- (a) Cargo volume was considered as the noise source. Noise power level was measured along roads.
- (b) Future noise power level was calculated by multiplying the increase rate of cargo volume to present noise power ($P_f = P_n \times r$).
- (c) Future port activity impact on noise level was estimated by the following basic formula.

$$L = 10 \log (P / P_0)$$

Where, L : noise level

P_0 : standard noise power (2×10^{-5})

P : noise power

$$\begin{aligned} L_f &= 10 \log (P_f / P_0) = 10 \log \{(P_n \times r) / P_0\} \\ &= 10 \log (P_n / P_0) + 10 \log r \\ &= L_n + 10 \log r \end{aligned}$$

(2) Application of Noise Model to Tema Port

1) Equivalent Continuous Sound Level

Noise level survey and traffic survey were conducted at the points shown in Figure 3.3.2.

Present equivalent continuous sound level (L_{Aeq}) was calculated as Table 4.4.1 by the following formula.

$$L_{Aeq} = L_{50} + (L_{10} - L_{90})^2 / 57$$

Table 4.4.1 Present Equivalent Continuous Sound Level

Site No.	(dB(A))		
	9 Aug. 2001	10 Aug. 2001	11 Aug. 2001
1	65.4	64.8	61.5
2	75.3	60.3	67.0
3	67.4	70.1	67.4
4	65.4	71.4	71.8
5	76.5	70.8	68.1
6	62.0	62.5	64.0
7	67.4	65.9	66.8
8	79.0	76.0	65.4
9	64.1	60.6	75.1

2) Increase Rate of Cargo Volume (Future vehicle traffic and cargo-handling)

Vehicle increase was used for the increase rate, which was estimated based on the annual cargo-handling volume to be transported by vehicles:

$$10,217,000 \text{ tons} / 6,002,000 \text{ tons} = 1.70 \quad (2010/2000)$$

3) Future Equivalent Continuous Sound Level

Future equivalent continuous sound level was calculated by following formula and shown in Table 4.4.2.

$$L_f = L_n + 10 \log r$$

$$\begin{aligned} 10 \log r &= 10 \log 1.70 \\ &= 2.3 \end{aligned}$$

(3) Future Noise Level

The predicted future noise level is shown in Table 4.4.2. Environmental Quality Standards of Ghana stipulate that the permissible noise level in the light industrial areas during daytime should be 70 dB(A). The predicted noise level means the daily maximum value that the roadside residence would receive in the future. The future noise level will often exceed the EQS permissible level. This adverse effect should be minimized.

Table 4.4.2 Future Equivalent Continuous Sound Level (Daytime)

Site No.	Day-1	Day-2	Day-3	EQS
1	67.7	67.1	63.8	Light Industrial Area 70 dB (A) for daytime 60 dB (A) for night
2	77.6	62.6	69.3	
3	69.7	72.4	69.7	
4	67.7	73.7	74.1	
5	78.8	73.1	70.4	
6	64.3	64.8	66.3	
7	69.7	68.2	69.1	
8	81.3	78.3	67.7	
9	66.4	62.9	77.4	

4.5 Odor

The source of the existing odor is the wastewater discharging into the port basin from the hinterland. Interviews to port workers, however, did not get any complaints. In addition, GPHA has not received any complaints from residents in the vicinity.

It is not likely that the Port will give odor nuisance to port workers and local people in its operation phase, because the catchment area of the said wastewater will not change in the future.

4.6 Erosion

In the operation phase, the expanded port area will alter the regime of the littoral drift, slightly decreasing the easterly sand supply. A sand beach east to the Port, which is being used as a drying field for fish, will suffer from the erosion.

4.7 Fauna and Flora

4.7.1 Construction Phase

Turbid water dispersion from the dredging site will degrade the habitat value for aquatic species. The dispersion, however, will be limited to very small area. Therefore the impact of this activity on the marine species will be negligible.

Noise in the construction phase will not affect significantly the waterfowl habitat in Sakumo Ramsar Site because it is temporal.

4.7.2 Operation Phase

Occurrence of reclaimed land means the extinction of coastal shallow sea area. Shallow sea area is known to have the water purification function and nursery function for marine species. Both of these functions, however, cannot be expected for the project site because the reclamation area has bedrock without seaweeds, that has little water purification function and nursery function. Thus the impact of the extinction of sea area on the marine fauna and flora will also be negligible.

Noise and lights of vehicles from the road will be a problem for waterfowls in Sakumo Ramsar Site. This adverse impact should be minimized.

4.8 Economic Activities

In the medium term, the project is expected to impact positively on the level of economic activity both locally i.e. within the port city of Tema and nationally mainly through increased employment, increased industrial activities and improved incomes of the communities.

4.8.1 Construction Phase

Direct employment will be created for the labor that would be used during the various construction phase. The purchasing by construction workers will also occur. Construction-related companies will need local procurement to some extent then facilitate the local economy.

4.8.2 Operation Phase

Operation of the Port will require the direct employment for port workers, truck drivers, shipping agents and other port-related industries. Indirect employment will be created in the various industries and trade related ventures that would expand due to the growth generated by the port expansion. Government agencies such as Customs, Immigration etc. will require more staff to attend to increased ship calls and cargo volumes. Indirect employment creation by the private sector will arise from expanded industries, trade, finance etc. in line with the port expansion. The increased industrial activities would result in greater economic activities. Transportation of increased cargoes would also create more jobs and increase economic benefits.

Another major impact on economic activities is in the area of income generation. GPHA is expected to earn more than double its present earnings in Tema by 2010. These increases will be complemented by increases in the earnings of port service agencies such as ship agents, freight forwarders, haulage companies etc.

4.9 Resettlement

The construction activities at Tema Port will be confined to the existing port areas. Therefore there will not be the need to acquire additional lands beyond the Port. This implies that there would not be the need to resettle any persons as a direct result of the port development project.

4.10 Infrastructure

A very crucial component of the infrastructure development is the need to improve the port access roads to handle the increase in vehicular activity that would result from the increase in port activity. A new access road will be constructed connecting the planned container yard and Meridian Road. This would have a permanent positive impact to the local society.

Service infrastructure such as electricity, water and telecommunication will need to be expanded to support the port developments. Electricity demand will grow with the installation of new equipment. The use of electronic data interchange for cargo documentation will also require expanded telecommunication networks to the ports.

4.11 Fisheries

The adverse effect of the port development on fisheries is not pointed out. Fishing activities are prohibited within and around the port area. The port waters are therefore not considered to be of major fisheries significance except for illegal artisanal fishing. The increased vessel traffic both in the construction and operation phases would not obstruct the activity of fishing boats, because the degree of increase is not so large (1 – 2 vessels per day).

The main port structures consisting of breakwaters and wharves serve as habitats for reef-associated fish. These contribute to the fisheries as a stockyard of juveniles that later migrate to the main fishing grounds. Generally in Ghana, the fish tend to spawn in the Western coastal areas near Takoradi and then migrate eastwards towards Tema.

4.12 Land Use

Under the proposed port development, no change is planned in the nearby land use, so that the port development would cause no effect.

4.13 Waste

4.13.1 Construction Phase

Generally, construction and demolition activities result in considerable solid waste generation from sources such as:

- Packaging material used for various inputs such as cement bags, wooden crates etc.
- Broken concrete blocks and debris from demolition
- Offcuts and shavings of wood from carpentry works
- Metal pieces, empty paint containers, etc.
- Litter from life of workers

These should be adverse impacts. On the other hand, reclamation will work as a positive impact to cope with the solid wastes. The dredging will generate mostly solid/slurry waste in the form of dredged spoil. All these solid wastes will be used for reclamation of portions of the Port.

4.13.2 Operation Phase

Port operation also generates considerable wastes consisting mainly of packaging material, remnants of bulk cargoes and damaged cargoes etc. Ships also generate substantial wastes that require disposal when in port. Due to the proposed ports development, the levels of waste generation will increase in relation to the expected increase in port productivity. This may cause an adverse effect for environmentally sound port management.

4.14 Public Health and Safety

In the construction and particularly operation phases, increased traffic will give rise to more threat of the traffic accident to local people. This will require the adequate preventive measures.

During the operational phase, the risks to the health and safety of port workers will arise from the various components of the port operations. Cargo handling activities result in a variety of accidents, the common ones being:

- Container spreader knocking workers
- Persons trapped between containers
- Cargo wire slings parting while lifting or lowering loads
- Cargo falling overboard
- Forklifts slipping on ramps, falling into cargo holds
- Stacked cargo in sheds breaking and falling on workers
- Fire and explosion risks arising from handling of hazardous cargoes

Chapter 5 Mitigation of Impact

Since monitoring on the impacts of development activities on the environment is fundamental to manage the sound port development, the monitoring program is prepared apart from this section.

5.1 Air Quality

The increased air pollution should be mitigated by planting in the port area and along the road in the vicinity of the residential area.

5.2 Water Quality

In the construction phase, a silt protection curtain should be employed to surround the dredging site and the water way from the reclamation to reduce the SS dispersion. Coagulant may be introduced to the reclamation area to facilitate the sedimentation of the mud contaminated with heavy metals.

5.3 Bottom Sediment Quality

Severely contaminated mud to be dredged should be contained in the reclamation area, because of the reason of the hard structure there, and should be sealed securely.

5.4 Noise

A roadside fence or plantation to alleviate the noise should be installed in Sakumo Ramsar Site. It is also desirable on the Meridian Road. Setting a buffer zone along the road would be most effective, where possible.

5.5 Erosion

Careful monitoring on the shoreline change should be done. Beach nourishment will be implemented when necessary.

5.6 Fauna and Flora

A roadside fence or plantation should be installed in Sakumo Ramsar Site. This will also reduce the impact of light of vehicles during night.

5.7 Economic Activity

In order to enhance the positive impact to local community, it is expected that, apart from the foreign workers, most of the labor that would work on the port projects would be recruited from the residents of the local communities. This should help to control the influx of non-resident job seekers and reduce the slums.

5.8 Infrastructure

To maximize the benefit to the local community, it is desirable to facilitate the development of infrastructure in accordance with port expansion. The improvement of the road would be the first priority to meet the purpose of the promotion of the public safety.

5.9 Waste Management

Wastes from operational activities will be transported to the approved municipal landfill sites in Tema. The waste collection bins in the ports are of the covered type. In addition, all other trucks carrying wastes will be adequately covered to prevent spillage on the way to the landfill sites.

It is recommended that the development plans should allow for existing waste management facilities to be expanded to cater for the increased levels of activity in the port.

It is also recommended that reception facilities for oily/liquid waste should be provided within Tema Port as part of the Port State Control regime to be implemented under the auspices of the Shipping and Navigation Division of the Ministry of Roads and Transport.

5.10 Public Health and Safety

During the construction phase, inspection should be made to ensure that truck drivers would comply with the safety guidelines which should be established by GPHA.

During the operation phase, traffic signal lights will be located at the junctions of access roads to the Port and the existing trunk roads. Speed limit signs and directional signs will be located at vantage points along these roads to guide road users.

Chapter 6 Evaluation

The evaluation was made for the short-term development plan of Tema Port from the environmental point of view. Table 6.1.1 summarizes the results of impact assessment shown in Table 4.1.1. The principal environmental problems in future would involve:

- Waste generation
- Noise generation

The magnitude of impacts will be generally small (1 or 2 in the five-rank rating) and it is not likely that severely adverse effects would occur as a consequence of the port development.

It was also estimated that the plan would give positive impacts mainly on the socio-economic environment of Tema. The magnitude of positive impact was not large either (1 to 3 in the five-rank rating), because the public involvement in the planned project was not so extensive. These impacts should be amplified to contribute to the poverty reduction of the area.

After all, the short-term development plan of Tema Port was evaluated to be proceeded. Provided with the coordination with other infrastructure planning, such as waste management system, sewage treatment system and road network, the development of Tema Port will largely improve the situation of local community.

Since the alternative plans were prepared and evaluated in the phase of Master Plan study (see Interim Report (1)), the short-term plan did not have the alternatives. Therefore, comparative evaluation with alternatives was not done.

Table 6.1.1 Summary of Evaluation of Environmental Impact

Phase	Impact	Mitigation	Positive effect	Negative effect	Total
Preparation	No activity	-	-	-	-
Construction	Dredging & other marine works	Silt protection curtain	-	Waste Water quality Noise	-6
	Construction machines, vehicles, and vessels	Setting signals Announcement to local residents	Local economy	Waste Air quality Safety Noise	+1
	Reclamation	Carefully designed containment	Waste	Air quality Water quality	-1
	Demolition of existing facility	Enhanced waste handling capacity	-	Waste Air quality Noise	-7
	Employing construction workers	Local employment and vocational training	Local economy	Waste Water quality	+8
Operation	Altered port configuration	Announcement to fishermen	-	Sediment quality Erosion	-8
	Increased ship-call	Waste reception facility	Local economy	Waste	+4
	Increased cargo-handling	Dust protection fence or plantation Proper waste management program	Local economy	Waste Noise	+2
	Increased port workers	Proper waste management program	Local economy	Waste	+9
	Port-associated development	Improvement of road Coordination with city planning	Infrastructure	-	+10
	Rearrangement of facilities	-	-	-	0
	Increased land transportation	Setting signals Soundproof fence	Local economy	Fauna and Flora Air quality Noise Safety	-4
Demolition	Not applicable	-	-	-	-
Total					+8

Chapter 7 Environmental Management Plan

The aim of the Environmental Management Plan is to ensure development and conservation co-exist during various stages of the project implementation, thereby achieving sound port development. Environmental Management Plan identifies in advance, potential environmental impacts from the port development and suggests mitigation measures or other alternative measures to offset significant negative impacts.

- Environmental monitoring plan
- Waste management plan
- Contingency plan

7.1 Environmental Monitoring Plan

7.1.1 Objectives

Environmental monitoring is the most basic and important component of the environmental management because it plays a role of a pilot for the port toward the sound port environment. A series of periodic surveys should be done in and around the Port. The objectives of the environmental monitoring is:

- To check whether the environmental quality is in compliance with the target value or not.
- To provide information for port planners/managers to revise the construction and operation plans to fit the environmental situation.
- To ascertain whether the predicted environmental values are correct or not.
- To know there are any the environmental nuisance that has not been predicted.
- To inform the public and port users of the environmental situation of the Port.

7.1.2 Environmental Element to be Monitored

The following environmental elements should be monitored and evaluated whether or not the obtained environmental quality meet the environmental target value or criteria set up in advance:

- Air quality
- Water quality
- Bottom sediment quality
- Noise
- Fauna in Sakumo Ramsar Site
- Waste management

7.1.3 Location

The above elements should be monitored in the site. The arrangement of monitoring site locations is suggested by the actual field survey conducted during the present Study for air, water, sediment and noise surveys. As for wastes, the collection activity should be inspected.

7.1.4 Time and Frequency

The monitoring should commence during the preparation phase to obtain the “blank data” before the actual development activity begins. During the construction phase, it is recommended that the monitoring field works would be carried out at least twice a year, once each in dry and rainy seasons. The same frequency is desirable for the operation phase.

7.1.5 Method

The methods employed in the actual field surveys conducted during the present Study for air water, sediment and noise surveys would be applicable. Waste management would be surveyed through field observation and interviews with relevant officers and workers. Waterfowls in the Ramsar Site should be monitored periodically by field observation.

7.1.6 Data Feedback System to Port Activity

It is recommended that an environmental management committee is organized in GPHA which is responsible for the environmental performance of the Ghana ports and receive the reports of environmental monitoring. The committee will give recommendations to the Director of GPHA to adjust the port activities to achieve the sound port environment that will be favored by public and port users.

7.1.7 Provision of Guidelines

The concrete target value should be established in prior to carry out the monitoring to guide the Port to environmentally sound situation. Environmental Quality Standards and “Assumed Environmental Criteria” introduced in the present Study will be a suggestion of the target values.

7.2 Waste Management Plan

Environmental Impact Assessment guidelines of Ghana emphasizes the importance of waste management. The waste management plan should be prepared to meet that requirement.

7.2.1 Inventory of Waste Source

Sources of waste generation should be identified including solid, liquid and slurry wastes. The inventory should also have information of the potential risk which may be accompanied with the waste.

7.2.2 Collection Method

Collection method should be established properly including the way of collection, frequency and treatment method considering the type and volume.

7.2.3 Treatment and Disposal Method

The treatment and disposal of wastes is most critical. The reclamation works should be addressed in the waste disposal plan. Though dumping sites in Tema city are available, they have come up to the end of the capacity. Incineration is most convenient way to reduce the volume of wastes.

Reception facilities for wastes should be provided for calling ships in the Port. The treatment and disposal of wastes from these facilities should be taken into the consideration.

7.3 Contingency Plan

7.3.1 Inventory of Possible Incident

It is necessary to prepare an inventory which lists up all the possible incidents in the Port including natural disasters, wreck, collision, explosion, etc.

7.3.2 Inventory and Provision of Materials against Incident

In order to clarify the capability to cope with the incidents, it is important to prepare a list of materials to reduce the damage from incidents. The Port should be provided with enough such stuff of necessary quality and quantity. The list should be reviewed to replace or supplement the required stuff.

7.3.3 Communication and Reporting System

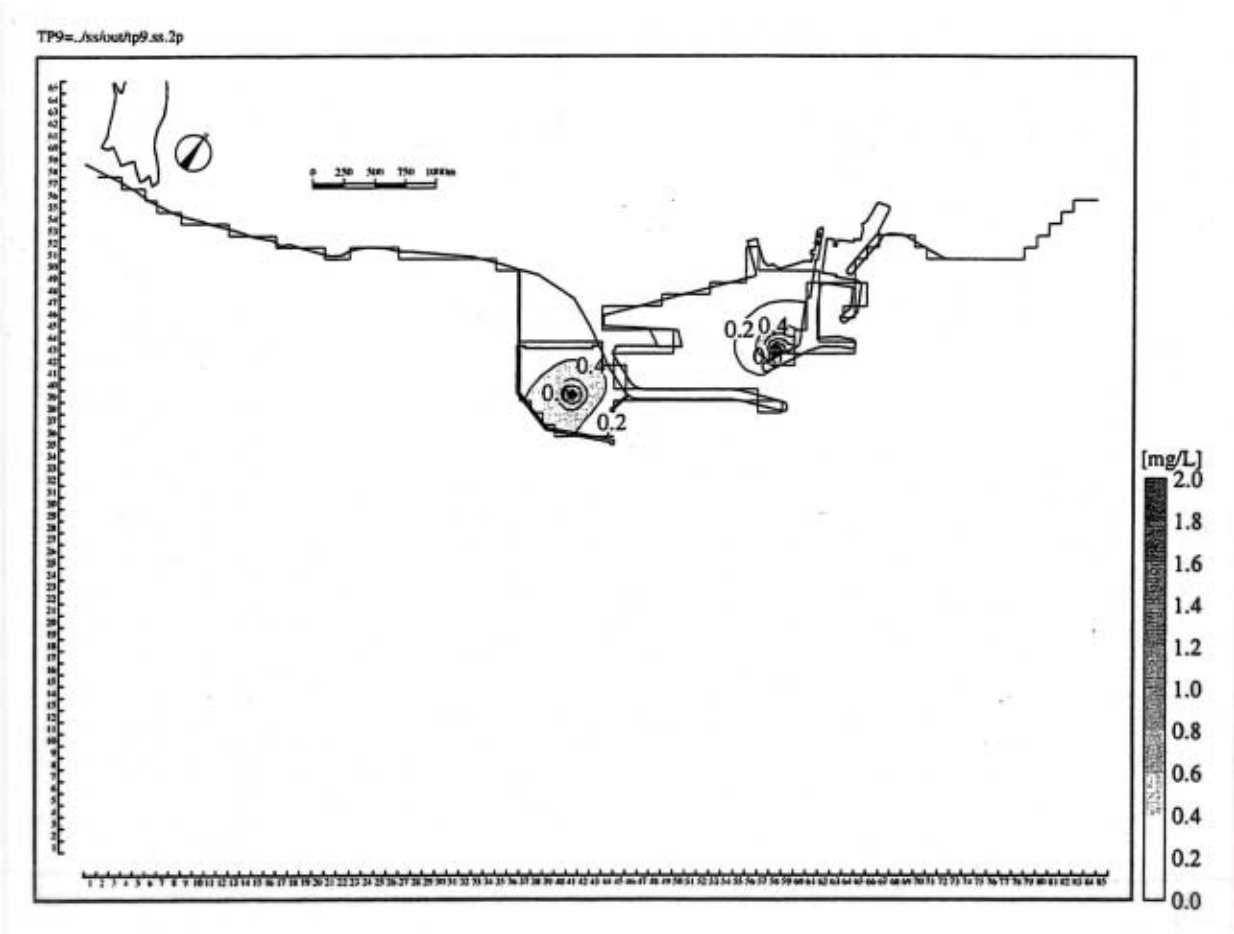
In the contingency, it is most important to keep communication and receive correct reports from the site to grasp the situation exactly. The necessary measures should be established.

7.3.4 Rescue system

The system for rescue activity should be ensured in coordination and cooperation with other organizations. The rescue system should be a network system composed of fire brigades, police and hospitals.

Supplemental Information

As supplemental information, a test run result of diffusion model for two dredging works at a time is shown bellow.



Supplemental Figure Predicted SS Distributions in Tema Port for Two Dredging Works

Appendices

- 1. Proposed Terms of Reference for EIA for Short Term Development (BB-1)
Plan for Tema Port**
- 2. Methodology of Surveys for Air Quality, Noise and Road Traffic (BB-7)**
- 3. Details of Noise Survey Data (BB-11)**
- 4. Field Data Sheet for Road Traffic Survey (BB-25)**

Proposed Terms of Reference for EIA for Short Term Development Plan for Tema Port

The proponent shall undertake an EIA that will consider negative as well as positive impacts of the project during the preparation, construction and the operation phase of the Tema Port. The study shall recommend measures for mitigation of negative environmental effects remaining after feasible adjustments have been incorporated in the project design.

The expected EIS shall involve the following information:

- Executive summary
- Introduction
- Project background and objectives
- Regulatory and administrative requirements
- Scope of the study – TOR
- Description of the proposed project
- Location
- Construction activities
- Operational activities
- Environmental baseline study
- Environmental elements with potential impacts

Table 1 List of Environmental Elements with Potential Impact

Environmental elements	
Pollution	Air quality
	Water quality
	Bottom sediment quality
	Noise/vibration
	Odor
Biophysical environment	Erosion
	Flora/fauna
Social environment	Economic activities
	Resettlement
	Infrastructure
	Fisheries
	Land use
	Waste
	Public health and safety

- Identification and evaluation of environmental impacts on the same environmental elements as the above with recommendations on necessary mitigation measures.

For air quality, water quality and noise, a quantitative analytical method should be introduced to compare the predicted values with environmental quality standards in Ghana. Concrete methods are shown below.

a. Work Plan of Hydrodynamic and Water Quality Model

(1) Objective

The objective of hydrodynamic and water quality modeling is to estimate projects' impacts on water quality in the initial environmental examination stage.

(2) Methodology

Tidal currents of Tema Port are modeled by numerical model of hydrodynamics. The model describes time-varying water levels and depth-averaged circulation of sea water. This type of model is appropriate for Tema Port area because vertical gradients of physical properties are relatively small. The basic equations of the model are:

<Equation of Continuity>

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial w}{\partial z} = 0 \dots\dots\dots(1)$$

<Equation of Motion>

$$\frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} + v \frac{\partial u}{\partial y} + w \frac{\partial u}{\partial z} - fv = -\frac{1}{\rho_0} \frac{\partial p}{\partial x} + \frac{\partial}{\partial z} \left(K_M \frac{\partial u}{\partial z} \right) + F_x \dots\dots\dots(2)$$

$$\frac{\partial v}{\partial t} + u \frac{\partial v}{\partial x} + v \frac{\partial v}{\partial y} + w \frac{\partial v}{\partial z} + fu = -\frac{1}{\rho_0} \frac{\partial p}{\partial y} + \frac{\partial}{\partial z} \left(K_M \frac{\partial v}{\partial z} \right) + F_y$$

Transport and diffusion of contaminants are modeled by numerical model of diffusion. The diffusion model describes the movement of contaminants based on the current field obtained by the hydrodynamic model. The basic equation of the model is:

<Equation of Diffusion>

$$\frac{\partial S}{\partial t} + u \frac{\partial S}{\partial x} + v \frac{\partial S}{\partial y} + w \frac{\partial S}{\partial z} = \frac{\partial}{\partial z} \left(K_H \frac{\partial S}{\partial z} \right) + F_s \dots\dots\dots(3)$$

where,

- x, y, z : right hand coordinate
- u, v, w : x, y, z component of currents [cm/s]
- p : pressure [g/cm/s²]
- f : Coriolis parameter[1/s]
- ρ_0 : representative density [g/cm³]
- K_M : eddy viscosity [cm²/s]
- K_H : eddy diffusivity [cm²/s]
- F_x, F_y : other forces [cm/s²]
- S : concentration [mg/L]
- F_s : loads [mg/s]

(3) Application to Tema

Tema Port area is expressed by computational grid system as below.

- Grid size: 100 m
- Area: about 8000 m by 6000 m (see Figure 4.2.1)

Other necessary data for the modeling such as depth, tidal amplitude, and pollution loads are based on the existing data.

(4) Output

Outputs of the model are:

- Current vector map for present condition and planned cases
- Distribution map of COD by contour line for present condition and planned cases

b. Work Plan of Air Quality Model

(1) Objective

The objective of air quality modeling is to estimate projects' impacts on air quality in the initial environmental examination stage.

(2) Methodology

Air quality of Tema Port will be modeled using the method shown in the following flow chart.

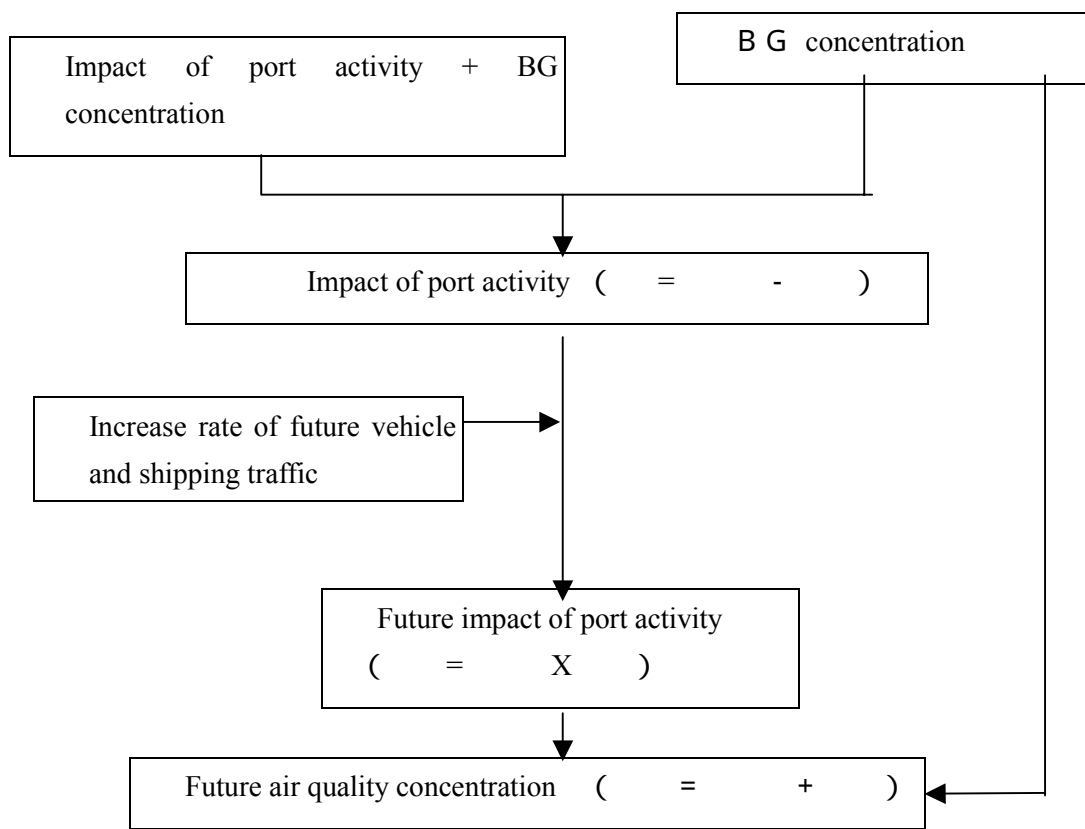


Figure 2 Flow Chart of Air Quality Modeling

- 1) Background concentration will be measured at a site with no impact of port activity.
- 2) Present port activity impact on air quality can be calculated by subtracting the background concentration from the measured air quality value.
- 3) Future port activity impact on air quality can then be estimated by multiplying the rate of emission increase to the air quality value obtained in 2).
- 4) Future air quality concentration can be obtained by adding the value in 3) to the background

concentration.

5) Vehicle and shipping traffic will be considered as the emission source.

(3) Parameter

- SPM
- SO₂
- NO₂

(4) Survey point

- 9 points (See figure 3.3.3)

(5) Output

- Predicted SPM concentration at 8 survey points.
- Predicted SO₂ and NO₂ concentration at 8 survey points.

c. Work Plan of Noise Model

(1) Objective

The objective of noise modeling is to estimate projects' impacts on noise level in the initial environmental examination stage.

(2) Methodology

Noise level of Tema Port will be modeled using the method shown in the following flow chart.

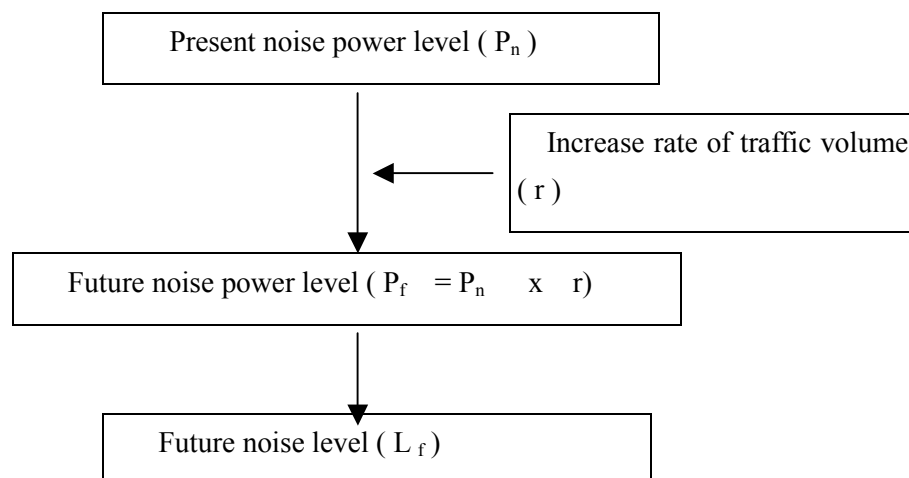


Figure 3 Flow Chart of Noise Modeling

- 1) Traffic volume will be considered as the noise source.
- 2) Future noise power level can be calculated by multiplying the increase rate of traffic volume to present noise power ($P_f = P_n \times r$).
- 3) Future port activity impact on noise level can then be estimated by following basic formula.

$$L = 10 \log \frac{P}{P_0}$$

L : noise level

P_0 : standard noise power (10^{-12})

P : noise power

$$L_f = 10 \log \frac{P_f}{P_0} = 10 \log \frac{P_n r}{P_0}$$

$$= 10 \log \frac{P_n}{P_0} + 10 \log r$$

$$I_f = P_n \times r$$

r : increase rate of traffic volume

(3) Parameter

- Noise power level
- Present traffic volume

(4) Survey point

- 9 points (See figure 3.3.3)

(5) Output

- Predicted noise level at 9 survey points.
- Proposed Monitoring Program
- Analysis of Alternatives
- Provisional Environmental Management Plan

Methodology of Surveys for Air Quality, Noise and Road Traffic

1. Description of the Tema Sampling Points

Site description for air quality, noise and road traffic surveys are given in Table 1. Local weather conditions are shown in Table 2.

Table 1 Site Description for Air Quality, Noise and Road Traffic Surveys

ID	Site description	Parameters
St.1	Berth 2 between old buildings and Post Office	PM ₁₀ , SPM, SO ₂ , NO ₂ , noise & local wind speed, wind direction
St.2	Roundabout near the ports operations office	PM ₁₀ , SPM, SO ₂ , NO ₂ , noise & local wind speed, wind direction
St.3	Behind Shed 9	PM ₁₀ , SPM, noise & local wind speed, wind direction
St.4	Container stacking area close to the clinker discharge point	PM ₁₀ , SPM, SO ₂ , NO ₂ , noise & local wind speed, wind direction
St.5	Portland canteen near Ghacem	PM ₁₀ , SPM, SO ₂ , NO ₂ , noise, local wind speed, wind direction, Traffic
St.6	New Antrak container devanning area	PM ₁₀ , SPM, SO ₂ , NO ₂ , noise, local wind speed, wind direction, Traffic
St.7	Meridian roundabout	PM ₁₀ , SPM, SO ₂ , NO ₂ , noise, local wind speed, wind direction, Traffic
St.8	Community 2, on the Meridian roads near the ECG transformer station	PM ₁₀ , SPM, SO ₂ , NO ₂ , noise, local wind speed, wind direction, Traffic
St.9	Community 3-Nungua road at the Sakumo Ramsar site. Noise taken close Ramsar site sign post and the air quality taken on the sea side	PM ₁₀ , SPM, noise , local wind speed, wind direction, Traffic

2. Methodologies

2.1 Air Quality

The SPM and PM₁₀ were monitored by use of the Paschal 9000-dust monitor. This instrument uses the active principle of drawing air at a pre-calibrated flow rate of 10L/min (breathing rate) through a pre-weighed filter paper in SPM and PM₁₀ sampling heads respectively for one hour (and projected to eight hours, the normal working hours in Ghana). The filters were then re-weighed to determine the mass of SPM and Pm₁₀ collected over the time period. The analysis of TSP is thus by gravimetric method. The following formula was used to calculate the TSP values:

$$\text{TSP } (\mu\text{gM}^{-3}) = \frac{W_2 - W_1}{(\text{Fr} \times \text{Sampling Time in minutes})}$$

Where W_1 = initial weight of filter; W_2 = final weight of filter; Fr= flow rate. At each sampling point, the sampling time was one (1) hour. The air monitoring locations tally with the points at which the noise levels and meteorological data were monitored.

Preliminary work was done using the active principle of sucking 100cm³/stroke for a predetermined number of strokes using the Accuro 2000 sampler and dragger tubes to determine the types of dragger tubes to use for the air monitoring. The tubes are stacked with a reagent layer in an indicating tube, which are opened at both ends and hanged at the various monitoring points for eight (8) hours.

On the basis of diffusion, gases automatically flow through the tube, SO₂ thus reacting with the chemical reagent on the carrier layer giving a colour change from bluish violet to pale yellow (representing the mass of SO₂ that has reacted in the indicating tube). The indication is given in “ppm x hours”. The mean [SO₂] can be calculated from the length of the discolored zone and the exposure time.

$$[\text{SO}_2] \text{ in mLm}^{-3} \text{ (ppm)} = \text{detector tube indication/hours monitored.}$$

$$[\text{SO}_2] \text{ in } \mu\text{gm}^{-3} = \text{ppm/molar mass}$$

Just as in the case of SO₂, the atmospheric gases automatically diffuses through the tube impregnated with NaI + Na₂CO₃ appearing pinkish in the indication tube. Any NO₂ in the diffusing air reacts with the reagent to produce nitrite (a brown coloration) giving the concentration of NO₂ monitored over the period in ppm-h. [NO₂] in mLm⁻³ (ppm) = detector tube indication/hours monitored. [NO₂] in μgm^{-3} = ppm/molar mass

2.2 Noise Nuisance Baseline Data

The Castle 1800 Type 19a noise meter with A frequency-weighting always positioned 1.5 meters above the ground and approximately 20 meters from roads was used to monitor the ambient noise levels of the selected points in each of the ports/project corridors for the current noise nuisance baseline data and at each location 50 measurements (L_1 L_{10}) were taken at 30 seconds interval. The readings were ranked and plotted to enable the L_5 , L_{10} , L_{50} , L_{90} , L_{95} to determined for each of the location.

The sound pressure levels in dB emitted from two sources cannot be added arithmetically. E.g. a source emitting 80dB and another emitting 60dB do not, if put into the same location emit 140dB. Generally the higher noise would MASK the smaller one and the combined effect is only a little bigger than the higher noise. MASKING is the covering of a sound with another louder sound.

The Rule of Thumb rule demonstrates that, adding two equal sounds increases the SPL by 3dB and if one sound is more than 10dB louder than a second sound, the contribution of the later is negligible.

2.3 Traffic Survey

Traffic Survey was conducted at selected points on roads approaching both Tema and Tema Ports. The surveys were conducted for 72 continuous hours in each location together with noise monitoring. The vehicles were divided into Articulated trucks, Ordinary trucks, Large buses and Small Passenger cars/Vans.

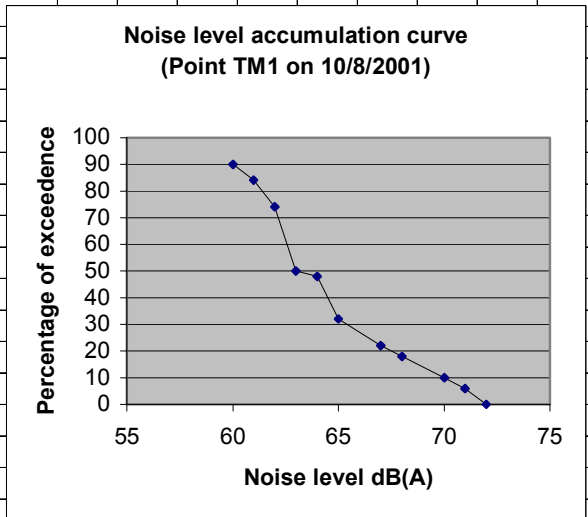
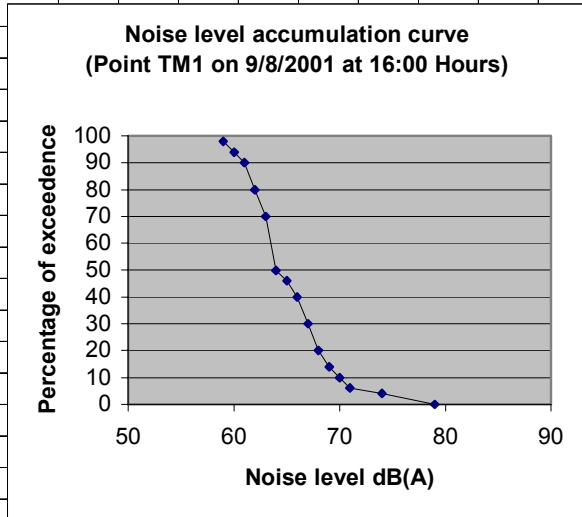
Table 2 Summary of Local Meteorological data at Tema

Site ID	Wind Speed (ms ⁻¹)				Wind Direction							
					Predominant Direction				Modal Bearing (°)			
	9/8	10/8	11/8	Mean	9/8	10/8	11/8	Range	9/8	10/8	11/8	Mode
*TM1	3.8	2.4	1.8	2.7	S	NNE	SW	NNE-SW	180	23	248	23-248
TM2	3.0	3.8	2.4	3.1	S	SSW	SSW	S-SSW	180	203	203	180-203
*TM3	3.8	2.4	1.8	2.7	S	NNE	SW	NNE-SW	180	23	248	23-248
*TM4	3.8	2.4	1.8	2.7	S	NNE	SW	NNE-SW	180	23	248	23-248
TM5	2.8	3.9	2.9	3.2	SSW	SSW	W	SSW-W	203	203	270	203-270
TM6	3.3	3.7	3.2	3.4	WSW	SW	SW	SW-WSW	248	225	225	225-248
TM7	3.1	3.6	3.9	3.5	SW	SW	SW	SW	225	225	225	225
TM8	3.5	4.4	0.52	2.8	SSE	S	S	SSE-S	158	180	180	158-180
TM9	3.2	4.0	3.8	3.8	SW	SSW	SW	SSW-SW	225	203	225	203-225

- one weather point was taken to represent the points marked * because of the closeness of the points.

Details of Noise Survey Data

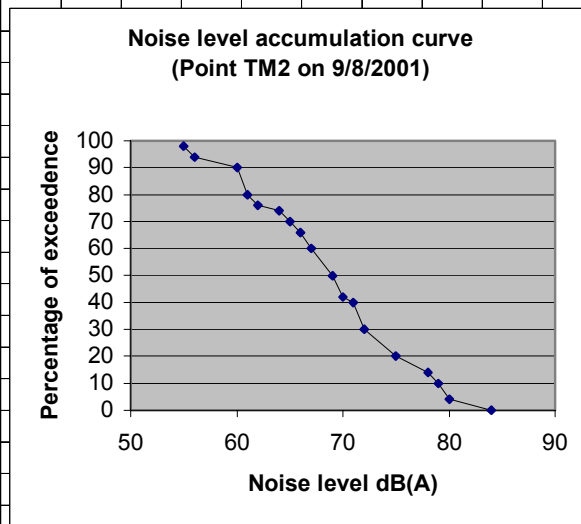
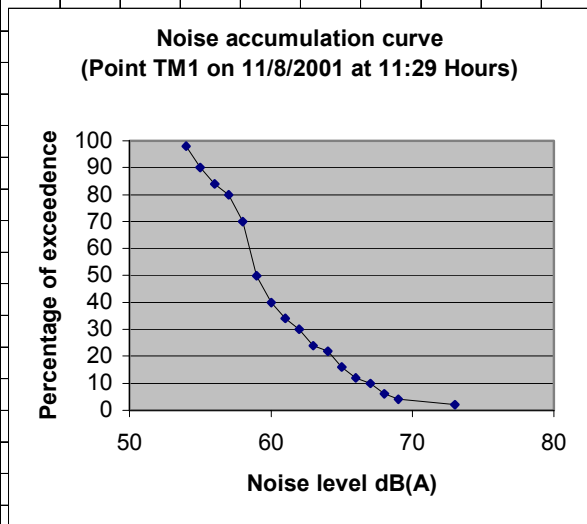
POINT TM1 ON 9/8/2001 AT 16:00 HOURS									POINT TM1 ON 10/8/2001								
No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%			
1	59	98	26	64	48	59	98		1	60	98	26	64	48			
2	59	96	27	65	46	60	94		2	60	96	27	64	46			
3	60	94	28	65	44	61	90		3	60	94	28	64	44			
4	60	92	29	65	42	62	80		4	60	92	29	64	42			
5	61	90	30	66	40	63	70		5	60	90	30	64	40			
6	61	88	31	66	38	64	50		6	60	88	31	64	38			
7	61	86	32	66	36	65	46		7	60	86	32	64	36			
8	62	84	33	66	34	66	40		8	61	84	33	64	34			
9	62	82	34	67	32	67	30		9	61	82	34	65	32			
10	62	80	35	67	30	68	20		10	61	80	35	65	30			
11	62	78	36	67	28	69	14		11	61	78	36	65	28			
12	62	76	37	67	26	70	10		12	61	76	37	65	26			
13	62	74	38	67	24	71	6		13	62	74	38	65	24			
14	63	72	39	67	22	74	4		14	62	72	39	67	22			
15	63	70	40	68	20	79	0		15	62	70	40	67	20			
16	63	68	41	68	18				16	62	68	41	68	18			
17	63	66	42	69	16				17	62	66	42	68	16			
18	63	64	43	69	14				18	62	64	43	68	14			
19	64	62	44	70	12				19	62	62	44	70	12			
20	64	60	45	70	10				20	63	60	45	70	10			
21	64	58	46	70	8				21	63	58	46	70	8			
22	64	56	47	71	6				22	63	56	47	71	6			
23	64	54	48	74	4				23	63	54	48	71	4			
24	64	52	49	79	2				24	63	52	49	72	2			
25	64	50	50	79	0				25	63	50	50	72	0			



L95 = 59.5 dB(A)
 L90 = 61 dB(A)
 L50 = 64 dB(A)
 L10 = 70 dB(A)
 L5 = 72.5 dB(A)

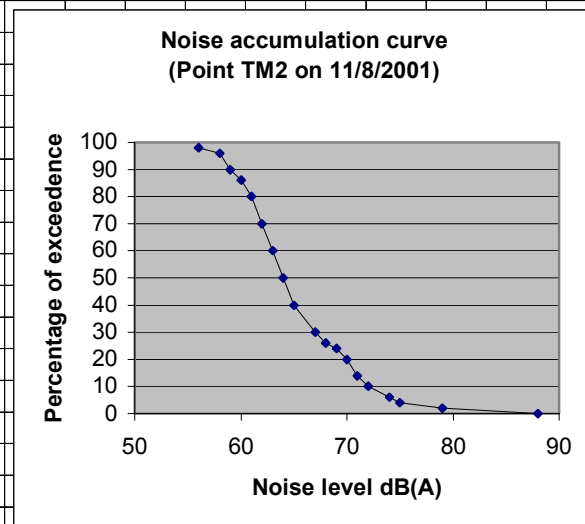
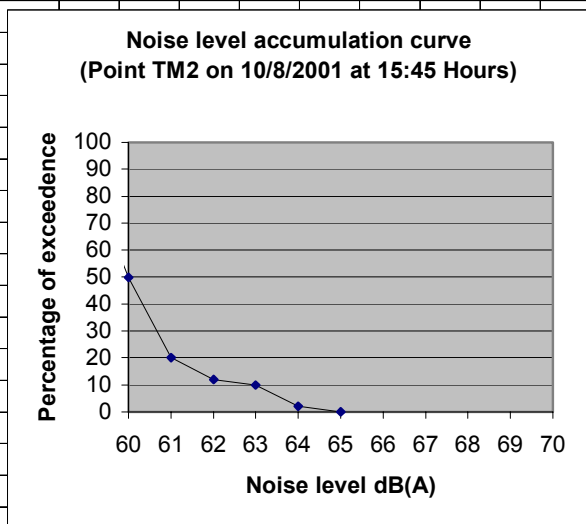
L95 = 60 dB(A)
 L90 = 60 dB(A)
 L50 = 63 dB(A)
 L10 = 70 dB(A)
 L5 = 71 dB(A)

POINT TM1 ON 11/8/2001									POINT TM2 ON 9/8/01								
No.	dB(A)	%	No.	dB(A)	%	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	dB(A)	%		
1	54	98	26	59	48	54	98	1	55	98	26	69	48	55	98		
2	54	96	27	59	46	55	90	2	55	96	27	69	46	56	94		
3	55	94	28	59	44	56	84	3	56	94	28	70	44	60	90		
4	55	92	29	60	42	57	80	4	60	92	29	70	42	61	80		
5	55	90	30	60	40	58	70	5	60	90	30	71	40	62	76		
6	56	88	31	61	38	59	50	6	60	88	31	71	38	64	74		
7	56	86	32	61	36	60	40	7	60	86	32	71	36	65	70		
8	56	84	33	61	34	61	34	8	60	84	33	72	34	66	66		
9	56	82	34	62	32	62	30	9	61	82	34	72	32	67	60		
10	57	80	35	62	30	63	24	10	61	80	35	72	30	69	50		
11	57	78	36	62	28	64	22	11	61	78	36	72	28	70	42		
12	57	76	37	63	26	65	16	12	62	76	37	72	26	71	40		
13	58	74	38	63	24	66	12	13	64	74	38	75	24	72	30		
14	58	72	39	64	22	67	10	14	65	72	39	75	22	75	20		
15	58	70	40	65	20	68	6	15	65	70	40	75	20	78	14		
16	58	68	41	65	18	69	4	16	65	68	41	75	18	79	10		
17	59	66	42	65	16	73	2	17	66	66	42	75	16	80	4		
18	59	64	43	65	14			18	66	64	43	78	14	84	0		
19	59	62	44	66	12			19	66	62	44	78	12				
20	59	60	45	67	10			20	67	60	45	79	10				
21	59	58	46	67	8			21	67	58	46	79	8				
22	59	56	47	68	6			22	67	56	47	79	6				
23	59	54	48	69	4			23	67	54	48	80	4				
24	59	52	49	73	2			24	69	52	49	80	2				
25	59	50	50	75	0			25	69	50	50	84	0				



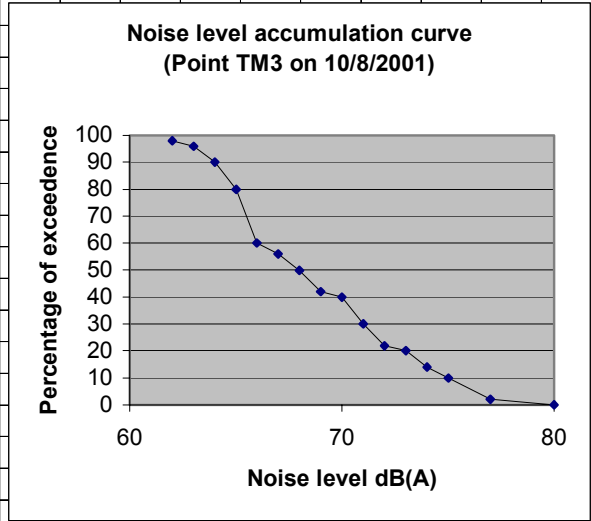
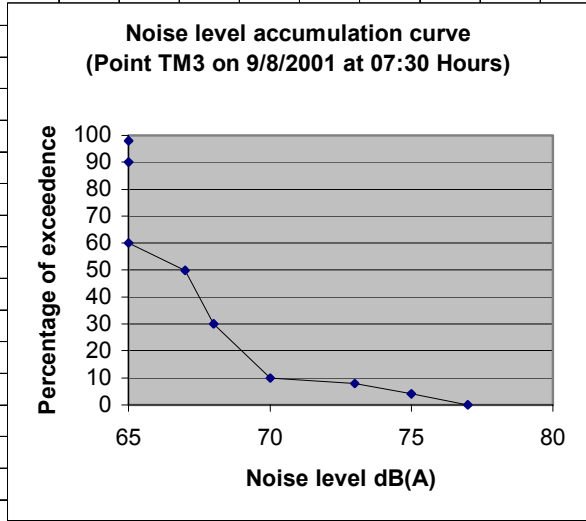
L95 = 54.5 dB(A)	L95 = 55.5 dB(A)
L90 = 55 dB(A)	L90 = 60 dB(A)
L50 = 59 dB(A)	L50 = 69 dB(A)
L10 = 67 dB(A)	L10 = 79 dB(A)
L5 = 68.5 dB(A)	L5 = 79.5 dB(A)

POINT TM2 ON 10/8/2001 AT 15:45 HOURS									POINT TM2 ON 11/8/2001								
No.	dB(A)	%	No.	dB(A)	%	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	dB(A)	%		
1	59	98	26	60	48	59	98	1	56	98	26	65	48	56	98		
2	59	96	27	60	46	59	90	2	58	96	27	65	46	58	96		
3	59	94	28	60	44	60	50	3	58	94	28	65	44	59	90		
4	59	92	29	60	42	61	20	4	59	92	29	65	42	60	86		
5	59	90	30	60	40	62	12	5	59	90	30	65	40	61	80		
6	59	88	31	60	38	63	10	6	59	88	31	66	38	62	70		
7	59	86	32	60	36	64	2	7	60	86	32	66	36	63	60		
8	59	84	33	60	34	65	0	8	60	84	33	66	34	64	50		
9	59	82	34	60	32			9	61	82	34	67	32	65	40		
10	59	80	35	60	30			10	61	80	35	67	30	67	30		
11	59	78	36	60	28			11	61	78	36	68	28	68	26		
12	59	76	37	60	26			12	62	76	37	68	26	69	24		
13	59	74	38	60	24			13	62	74	38	69	24	70	20		
14	59	72	39	61	22			14	62	72	39	70	22	71	14		
15	59	70	40	61	20			15	62	70	40	70	20	72	10		
16	59	68	41	61	18			16	62	68	41	70	18	74	6		
17	59	66	42	61	16			17	62	66	42	71	16	75	4		
18	59	64	43	63	14			18	62	64	43	71	14	79	2		
19	59	62	44	62	12			19	62	62	44	71	12	88	0		
20	59	60	45	63	10			20	63	60	45	72	10				
21	59	58	46	63	8			21	64	58	46	72	8				
22	59	56	47	63	6			22	64	56	47	74	6				
23	59	54	48	63	4			23	64	54	48	75	4				
24	60	52	49	64	2			24	64	52	49	79	2				
25	60	50	50	65	0			25	64	50	50	88	0				



L95 = 59 dB(A)	L95 = 58 dB(A)
L90 = 59 dB(A)	L90 = 59 dB(A)
L50 = 60 dB(A)	L50 = 64 dB(A)
L10 = 63 dB(A)	L10 = 72 dB(A)
L5 = 63 dB(A)	L5 = 74.5 dB(A)

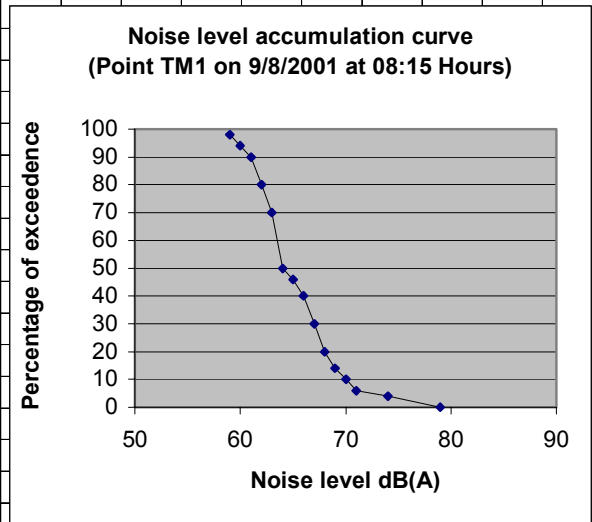
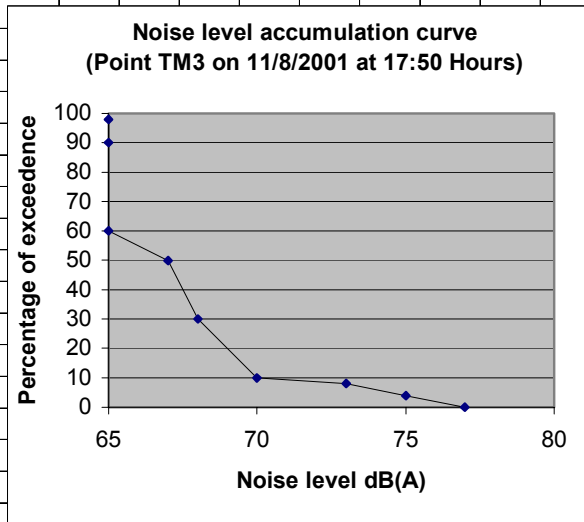
POINT TM3 ON 9/8/2001 AT 07:30 HOURS									POINT TM3 ON 10/8/2001								
No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%
1	65	98	26	67	48	65	98	1	62	98	26	68	48	62	98		
2	65	96	27	67	46	65	90	2	63	96	27	69	46	63	96		
3	65	94	28	67	44	65	60	3	64	94	28	69	44	64	90		
4	65	92	29	67	42	67	50	4	64	92	29	69	42	65	80		
5	65	90	30	67	40	68	30	5	64	90	30	70	40	66	60		
6	65	88	31	68	38	70	10	6	64	88	31	70	38	67	56		
7	65	86	32	68	36	73	8	7	64	86	32	70	36	68	50		
8	65	84	33	68	34	75	4	8	64	84	33	70	34	69	42		
9	65	82	34	68	32	77	0	9	65	82	34	70	32	70	40		
10	65	80	35	68	30			10	65	80	35	71	30	71	30		
11	65	78	36	68	28			11	65	78	36	71	28	72	22		
12	65	76	37	68	26			12	65	76	37	71	26	73	20		
13	65	74	38	68	24			13	65	74	38	71	24	74	14		
14	65	72	39	68	22			14	65	72	39	72	22	75	10		
15	65	70	40	68	20			15	65	70	40	73	20	77	2		
16	65	68	41	70	18			16	65	68	41	73	18	80	0		
17	65	66	42	70	16			17	65	66	42	73	16				
18	65	64	43	70	14			18	65	64	43	74	14				
19	65	62	44	70	12			19	66	62	44	75	12				
20	65	60	45	70	10			20	66	60	45	75	10				
21	65	58	46	73	8			21	67	58	46	75	8				
22	65	56	47	75	6			22	67	56	47	75	6				
23	65	54	48	75	4			23	68	54	48	75	4				
24	67	52	49	75	2			24	68	52	49	77	2				
25	67	50	50	77	0			25	68	50	50	80	0				



L95 = 65 dB(A)
L90 = 65 dB(A)
L50 = 67 dB(A)
L10 = 70 dB(A)
L5 = 75 dB(A)

L95 = 63.5 dB(A)
L90 = 64 dB(A)
L50 = 68 dB(A)
L10 = 75 dB(A)
L5 = 75 dB(A)

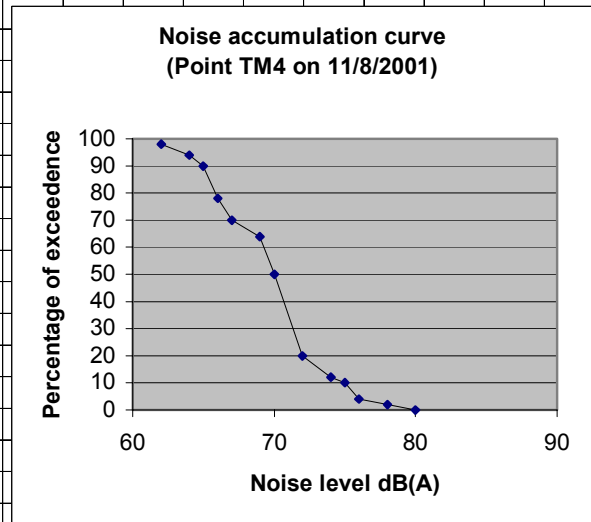
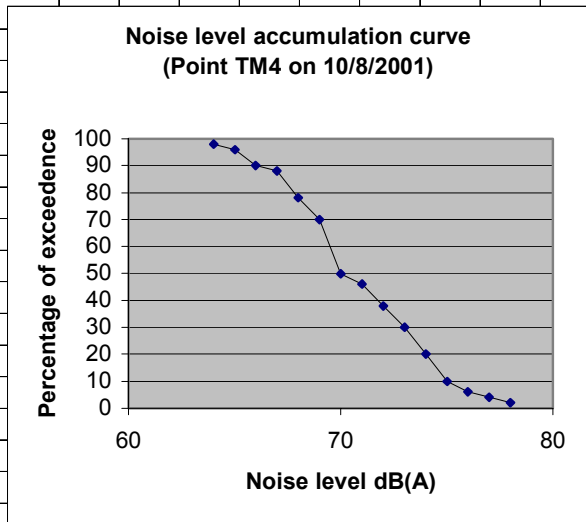
POINT TM3 ON 11/8/2001 AT 17:50 HOURS									POINT TM4 ON 9/8/2001 AT 08:15 HOURS								
No.	dB(A)	%	No.	dB(A)	%	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	dB(A)	%		
1	65	98	26	67	48	65	98	1	59	98	26	64	48	59	98		
2	65	96	27	67	46	65	90	2	59	96	27	65	46	60	94		
3	65	94	28	67	44	65	60	3	60	94	28	65	44	61	90		
4	65	92	29	67	42	67	50	4	60	92	29	65	42	62	80		
5	65	90	30	67	40	68	30	5	61	90	30	66	40	63	70		
6	65	88	31	68	38	70	10	6	61	88	31	66	38	64	50		
7	65	86	32	68	36	73	8	7	61	86	32	66	36	65	46		
8	65	84	33	68	34	75	4	8	62	84	33	66	34	66	40		
9	65	82	34	68	32	77	0	9	62	82	34	67	32	67	30		
10	65	80	35	68	30			10	62	80	35	67	30	68	20		
11	65	78	36	68	28			11	62	78	36	67	28	69	14		
12	65	76	37	68	26			12	62	76	37	67	26	70	10		
13	65	74	38	68	24			13	62	74	38	67	24	71	6		
14	65	72	39	68	22			14	63	72	39	67	22	74	4		
15	65	70	40	68	20			15	63	70	40	68	20	79	0		
16	65	68	41	70	18			16	63	68	41	68	18				
17	65	66	42	70	16			17	63	66	42	69	16				
18	65	64	43	70	14			18	63	64	43	69	14				
19	65	62	44	70	12			19	64	62	44	70	12				
20	65	60	45	70	10			20	64	60	45	70	10				
21	65	58	46	73	8			21	64	58	46	70	8				
22	65	56	47	75	6			22	64	56	47	71	6				
23	65	54	48	75	4			23	64	54	48	74	4				
24	67	52	49	75	2			24	64	52	49	79	2				
25	67	50	50	77	0			25	64	50	50	79	0				



L95 = 65 dB(A)
L90 = 65 dB(A)
L50 = 67 dB(A)
L10 = 70 dB(A)
L5 = 75 dB(A)

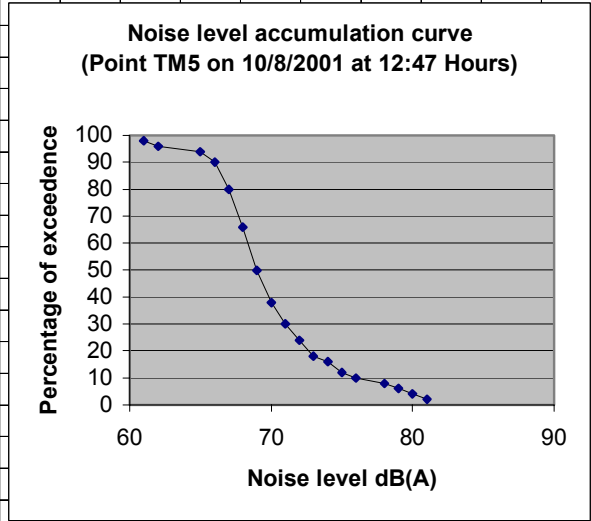
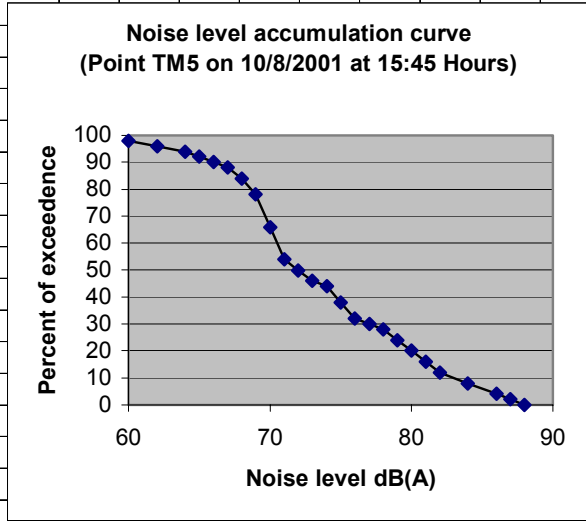
L95 = 59.5 dB(A)
L90 = 61 dB(A)
L50 = 64 dB(A)
L10 = 70 dB(A)
L5 = 72.5 dB(A)

POINT TM4 ON 10/8/2001									POINT TM4 ON 11/8/01								
No.	dB(A)	%	No.	dB(A)	%	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	dB(A)	%		
1	64	98	26	70	48	64	98	1	62	98	26	70	48	62	98		
2	65	96	27	71	46	65	96	2	64	96	27	70	46	64	94		
3	65	94	28	71	44	66	90	3	64	94	28	70	44	65	90		
4	65	92	29	71	42	67	88	4	65	92	29	70	42	66	78		
5	66	90	30	71	40	68	78	5	65	90	30	70	40	67	70		
6	67	88	31	72	38	69	70	6	65	88	31	70	38	69	64		
7	67	86	32	72	36	70	50	7	65	86	32	70	36	70	50		
8	67	84	33	72	34	71	46	8	65	84	33	70	34	72	20		
9	67	82	34	72	32	72	38	9	65	82	34	70	32	74	12		
10	67	80	35	73	30	73	30	10	65	80	35	70	30	75	10		
11	68	78	36	73	28	74	20	11	66	78	36	70	28	76	4		
12	68	76	37	73	26	75	10	12	66	76	37	70	26	78	2		
13	69	74	38	74	24	76	6	13	66	74	38	70	24	80	0		
14	69	72	39	74	22	77	4	14	66	72	39	70	22				
15	69	70	40	74	20	78	2	15	67	70	40	72	20				
16	69	68	41	74	18			16	69	68	41	72	18				
17	70	66	42	74	16			17	69	66	42	72	16				
18	70	64	43	75	14			18	69	64	43	72	14				
19	70	62	44	75	12			19	69	62	44	74	12				
20	70	60	45	75	10			20	70	60	45	75	10				
21	70	58	46	75	8			21	70	58	46	75	8				
22	70	56	47	76	6			22	70	56	47	75	6				
23	70	54	48	77	4			23	70	54	48	76	4				
24	70	52	49	78	2			24	70	52	49	78	2				
25	70	50	50	78	0			25	70	50	50	80	0				



L95 = 65 dB(A)	L95 = 64 dB(A)
L90 = 66 dB(A)	L90 = 65 dB(A)
L50 = 70 dB(A)	L50 = 70 dB(A)
L10 = 75 dB(A)	L10 = 75 dB(A)
L5 = 76.5 dB(A)	L5 = 75.5 dB(A)

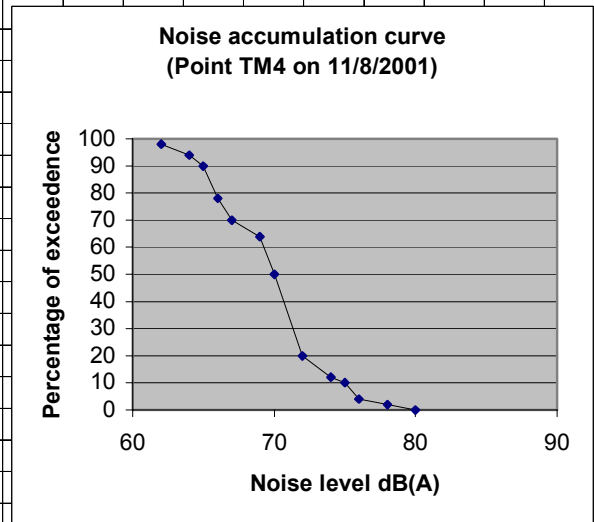
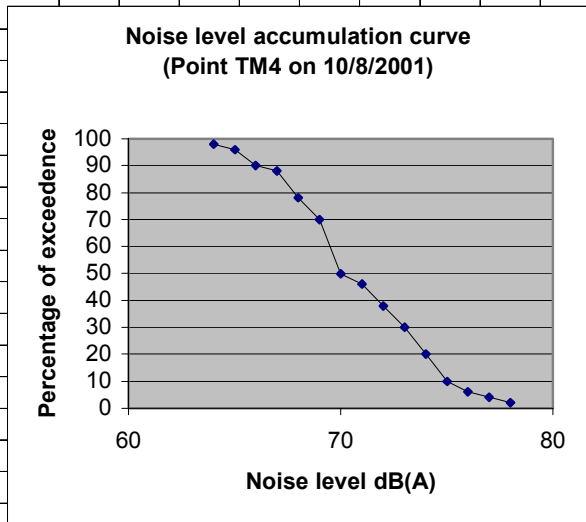
POINT TM5 9/8/2001 15:45 HOURS									POINT TM5 10/8/2001 12:47 HOURS.								
No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%
1	60	98	26	72	48	60	98	1	61	98	26	69	48	61	98		
2	62	96	27	73	46	62	96	2	62	96	27	69	46	62	96		
3	64	94	28	74	44	64	94	3	65	94	28	69	44	65	94		
4	65	92	29	75	42	65	92	4	65	92	29	69	42	66	90		
5	66	90	30	75	40	66	90	5	66	90	30	69	40	67	80		
6	67	88	31	75	38	67	88	6	66	88	31	70	38	68	66		
7	67	86	32	75	36	68	84	7	66	86	32	70	36	69	50		
8	68	84	33	75	34	69	78	8	66	84	33	70	34	70	38		
9	68	82	34	76	32	70	66	9	66	82	34	70	32	71	30		
10	69	80	35	77	30	71	54	10	67	80	35	71	30	72	24		
11	69	78	36	78	28	72	50	11	67	78	36	71	28	73	18		
12	69	76	37	79	26	73	46	12	67	76	37	71	26	74	16		
13	70	74	38	79	24	74	44	13	67	74	38	72	24	75	12		
14	70	72	39	80	22	75	38	14	67	72	39	72	22	76	10		
15	70	70	40	80	20	76	32	15	67	70	40	72	20	78	8		
16	70	68	41	80	18	77	30	16	67	68	41	73	18	79	6		
17	70	66	42	81	16	78	28	17	68	66	42	74	16	80	4		
18	70	64	43	82	14	79	24	18	68	64	43	74	14	81	2		
19	70	62	44	82	12	80	20	19	68	62	44	75	12	81	0		
20	70	60	45	82	10	81	16	20	68	60	45	76	10				
21	70	58	46	84	8	82	12	21	68	58	46	78	8				
22	71	56	47	84	6	84	8	22	68	56	47	79	6				
23	71	54	48	86	4	86	4	23	68	54	48	80	4				
24	72	52	49	87	2	87	2	24	68	52	49	81	2				
25	72	50	50	88	0	88	0	25	69	50	50	81	0				



L95 = 63 dB(A)
L90 = 66
L50 = 72 dB(A)
L10 = 82 dB(A)
L5 = 85 dB(A)

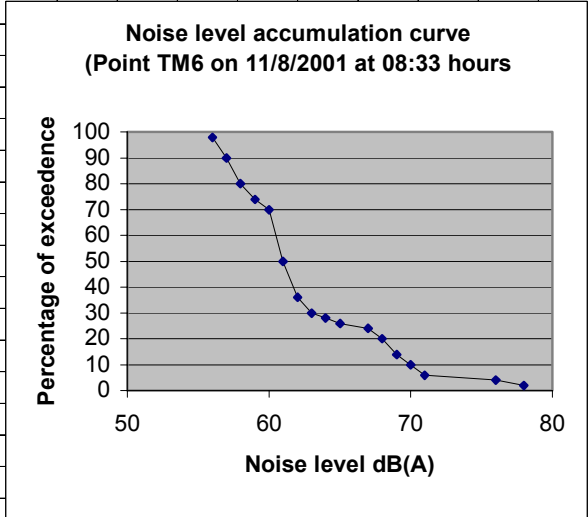
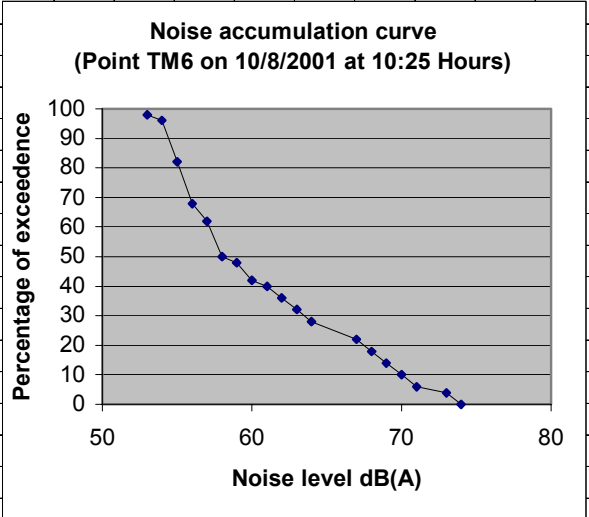
L95 = 63.5 dB(A)
L90 = 66 dB(A)
L50 = 69 dB(A)
L10 = 76 dB(A)
L5 = 79.5 dB(A)

POINT TM4 ON 10/8/2001									POINT TM4 ON 11/8/01								
No.	dB(A)	%	No.	dB(A)	%	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	dB(A)	%		
1	64	98	26	70	48	64	98	1	62	98	26	70	48	62	98		
2	65	96	27	71	46	65	96	2	64	96	27	70	46	64	94		
3	65	94	28	71	44	66	90	3	64	94	28	70	44	65	90		
4	65	92	29	71	42	67	88	4	65	92	29	70	42	66	78		
5	66	90	30	71	40	68	78	5	65	90	30	70	40	67	70		
6	67	88	31	72	38	69	70	6	65	88	31	70	38	69	64		
7	67	86	32	72	36	70	50	7	65	86	32	70	36	70	50		
8	67	84	33	72	34	71	46	8	65	84	33	70	34	72	20		
9	67	82	34	72	32	72	38	9	65	82	34	70	32	74	12		
10	67	80	35	73	30	73	30	10	65	80	35	70	30	75	10		
11	68	78	36	73	28	74	20	11	66	78	36	70	28	76	4		
12	68	76	37	73	26	75	10	12	66	76	37	70	26	78	2		
13	69	74	38	74	24	76	6	13	66	74	38	70	24	80	0		
14	69	72	39	74	22	77	4	14	66	72	39	70	22				
15	69	70	40	74	20	78	2	15	67	70	40	72	20				
16	69	68	41	74	18			16	69	68	41	72	18				
17	70	66	42	74	16			17	69	66	42	72	16				
18	70	64	43	75	14			18	69	64	43	72	14				
19	70	62	44	75	12			19	69	62	44	74	12				
20	70	60	45	75	10			20	70	60	45	75	10				
21	70	58	46	75	8			21	70	58	46	75	8				
22	70	56	47	76	6			22	70	56	47	75	6				
23	70	54	48	77	4			23	70	54	48	76	4				
24	70	52	49	78	2			24	70	52	49	78	2				
25	70	50	50	78	0			25	70	50	50	80	0				



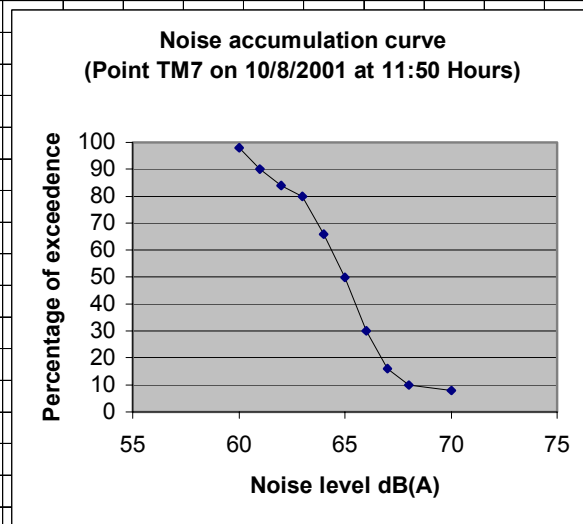
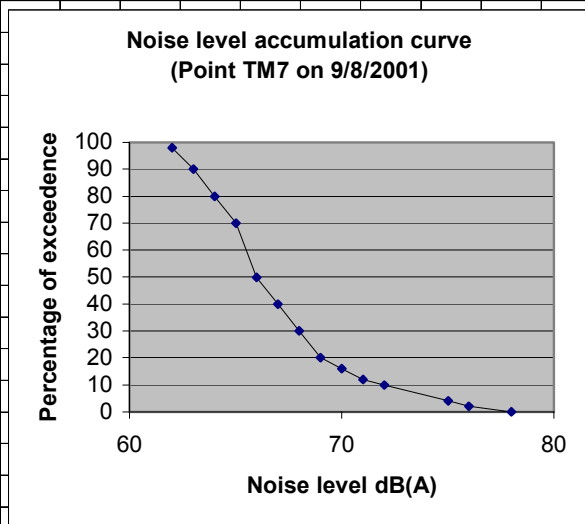
L95 = 65 dB(A)	L95 = 64 dB(A)
L90 = 66 dB(A)	L90 = 65 dB(A)
L50 = 70 dB(A)	L50 = 70 dB(A)
L10 = 75 dB(A)	L10 = 75 dB(A)
L5 = 76.5 dB(A)	L5 = 75.5 dB(A)

POINT TM6 10/8/2008 10:25 HOURS									POINT TM6 11/8/01 AT 08:33 HOURS								
No.	dB(A)	%	No.	dB(A)	%	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	dB(A)	%		
1	53	98	26	59	48	53	98	1	56	98	26	61	48	56	98		
2	54	96	27	59	46	54	96	2	57	96	27	61	46	57	90		
3	54	94	28	59	44	55	82	3	57	94	28	61	44	58	80		
4	54	92	29	60	42	56	68	4	57	92	29	61	42	59	74		
5	54	90	30	61	40	57	62	5	57	90	30	61	40	60	70		
6	54	88	31	61	38	58	50	6	57	88	31	62	38	61	50		
7	54	86	32	62	36	59	48	7	58	86	32	62	36	62	36		
8	54	84	33	62	34	60	42	8	58	84	33	62	34	63	30		
9	55	82	34	63	32	61	40	9	58	82	34	62	32	64	28		
10	55	80	35	63	30	62	36	10	58	80	35	63	30	65	26		
11	55	78	36	64	28	63	32	11	59	78	36	64	28	67	24		
12	55	76	37	64	26	64	28	12	59	76	37	65	26	68	20		
13	55	74	38	64	24	67	22	13	59	74	38	67	24	69	14		
14	55	72	39	67	22	68	18	14	59	72	39	67	22	70	10		
15	55	70	40	67	20	69	14	15	60	70	40	68	20	71	6		
16	56	68	41	68	18	70	10	16	60	68	41	68	18	76	4		
17	56	66	42	68	16	71	6	17	60	66	42	69	16	78	2		
18	56	64	43	69	14	73	4	18	60	64	43	69	14				
19	57	62	44	70	12	74	0	19	60	62	44	69	12				
20	57	60	45	70	10			20	60	60	45	70	10				
21	57	58	46	70	8			21	60	58	46	70	8				
22	57	56	47	71	6			22	60	56	47	71	6				
23	58	54	48	73	4			23	60	54	48	76	4				
24	58	52	49	73	2			24	60	52	49	78	2				
25	58	50	50	74	0			25	61	50	50	78	0				



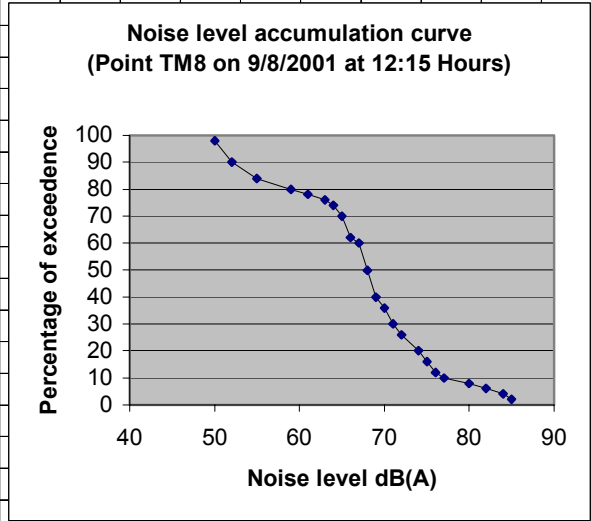
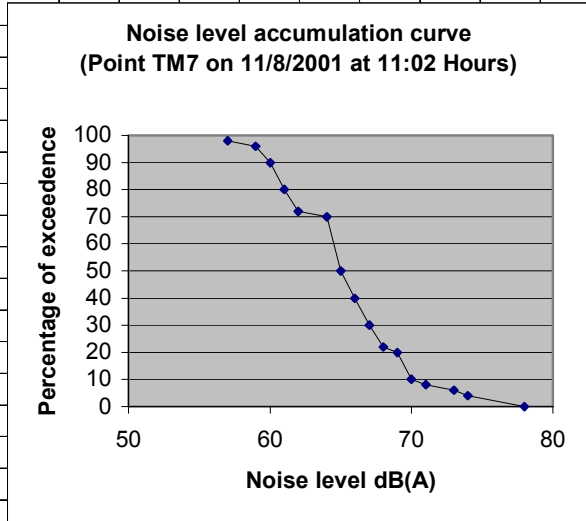
L95 = 54 dB(A)	L95 = 57 dB(A)
L90 = 54 dB(A)	L90 = 57 dB(A)
L50 = 58 dB(A)	L50 = 61 dB(A)
L10 = 70 dB(A)	L10 = 70 dB(A)
L5 = 72 dB(A)	L5 = 73.5 dB(A)

POINT TM7 on 9/8/2001									POINT TM7 ON 10/8/01 AT 11:50 HOURS								
No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%
1	62	98	26	66	48	62	98	1	60	98	26	65	48	60	98		
2	62	96	27	67	46	63	90	2	60	96	27	65	46	61	90		
3	62	94	28	67	44	64	80	3	61	94	28	65	44	62	84		
4	63	92	29	67	42	65	70	4	61	92	29	65	42	63	80		
5	63	90	30	67	40	66	50	5	61	90	30	65	40	64	66		
6	64	88	31	67	38	67	40	6	61	88	31	65	38	65	50		
7	64	86	32	67	36	68	30	7	62	86	32	65	36	66	30		
8	64	84	33	67	34	69	20	8	62	84	33	65	34	67	16		
9	64	82	34	67	32	70	16	9	62	82	34	65	32	68	10		
10	64	80	35	68	30	71	12	10	63	80	35	66	30	70	8		
11	64	78	36	69	28	72	10	11	63	78	36	66	28				
12	64	76	37	69	26	75	4	12	63	76	37	66	26				
13	65	74	38	69	24	76	2	13	63	74	38	66	24				
14	65	72	39	69	22	78	0	14	63	72	39	66	22				
15	65	70	40	69	20			15	63	70	40	66	20				
16	65	68	41	70	18			16	63	68	41	67	18				
17	65	66	42	70	16			17	64	66	42	67	16				
18	65	64	43	70	14			18	64	64	43	67	14				
19	65	62	44	71	12			19	64	62	44	68	12				
20	66	60	45	72	10			20	64	60	45	68	10				
21	66	58	46	72	8			21	64	58	46	70	8				
22	66	56	47	72	6			22	64	56	47	70	6				
23	66	54	48	75	4			23	64	54	48	70	4				
24	66	52	49	76	2			24	65	52	49	70	2				
25	66	50	50	78	0			25	65	50	50	70	0				



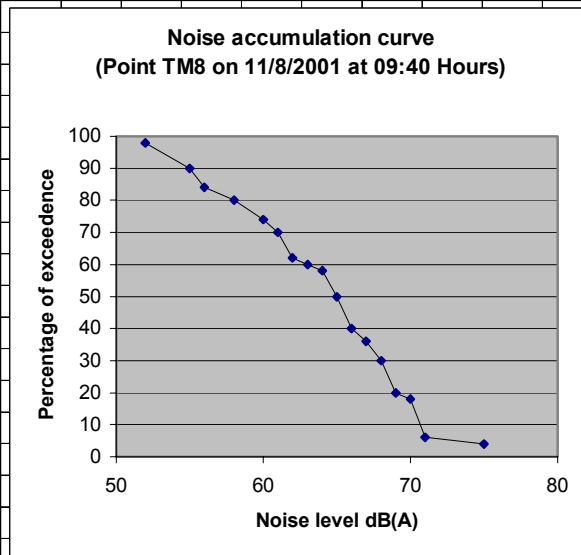
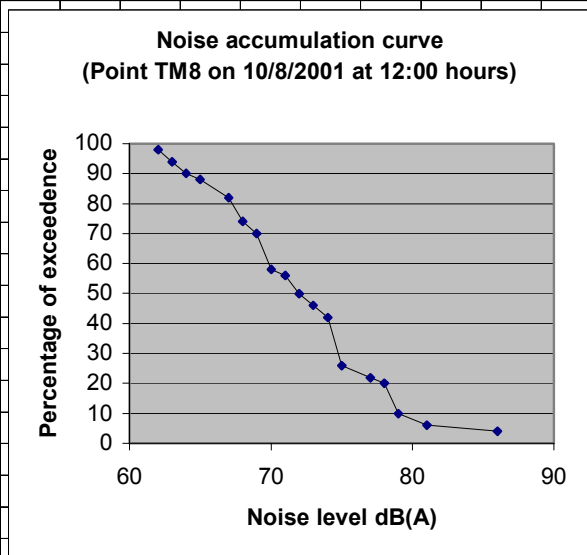
L95 = 62 dB(A)	L95 = 60.5 dB(A)
L90 = 63 dB(A)	L90 = 61 dB(A)
L50 = 66 dB(A)	L50 = 65 dB(A)
L10 = 72 dB(A)	L10 = 68 dB(A)
L5 = 73.5 dB(A)	L5 = 70 dB(A)

POINT TM7 ON 11/8/01 AT 11.02 HOURS									POINT TM8 ON 9/8/2001 AT 12.15 HOURS								
No.	dB(A)	%	No.	dB(A)	%	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	dB(A)	%		
1	57	98	26	65	48	57	98	1	50	98	26	68	48	50	98		
2	59	96	27	65	46	59	96	2	52	96	27	69	46	52	90		
3	59	94	28	65	44	60	90	3	52	94	28	69	44	55	84		
4	60	92	29	65	42	61	80	4	52	92	29	69	42	59	80		
5	60	90	30	66	40	62	72	5	52	90	30	69	40	61	78		
6	61	88	31	66	38	64	70	6	52	88	31	70	38	63	76		
7	61	86	32	66	36	65	50	7	53	86	32	70	36	64	74		
8	61	84	33	67	34	66	40	8	55	84	33	70	34	65	70		
9	61	82	34	67	32	67	30	9	59	82	34	71	32	66	62		
10	61	80	35	67	30	68	22	10	59	80	35	71	30	67	60		
11	61	78	36	67	28	69	20	11	61	78	36	71	28	68	50		
12	61	76	37	68	26	70	10	12	63	76	37	72	26	69	40		
13	61	74	38	68	24	71	8	13	64	74	38	74	24	70	36		
14	62	72	39	68	22	73	6	14	65	72	39	74	22	71	30		
15	64	70	40	69	20	74	4	15	65	70	40	74	20	72	26		
16	64	68	41	69	18	78	0	16	65	68	41	75	18	74	20		
17	64	66	42	69	16			17	66	66	42	75	16	75	16		
18	64	64	43	70	14			18	66	64	43	75	14	76	12		
19	64	62	44	70	12			19	66	62	44	76	12	77	10		
20	65	60	45	70	10			20	67	60	45	77	10	80	8		
21	65	58	46	71	8			21	67	58	46	80	8	82	6		
22	65	56	47	73	6			22	67	56	47	82	6	84	4		
23	65	54	48	74	4			23	68	54	48	84	4	85	2		
24	65	52	49	74	2			24	68	52	49	85	2				
25	65	50	50	78	0			25	68	50	50	85	0				



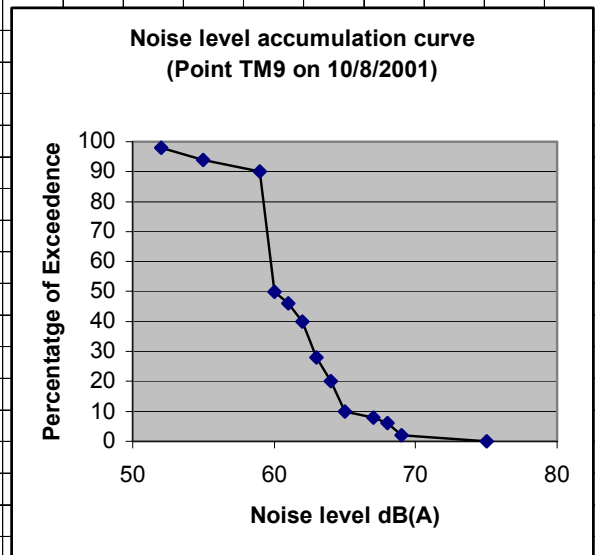
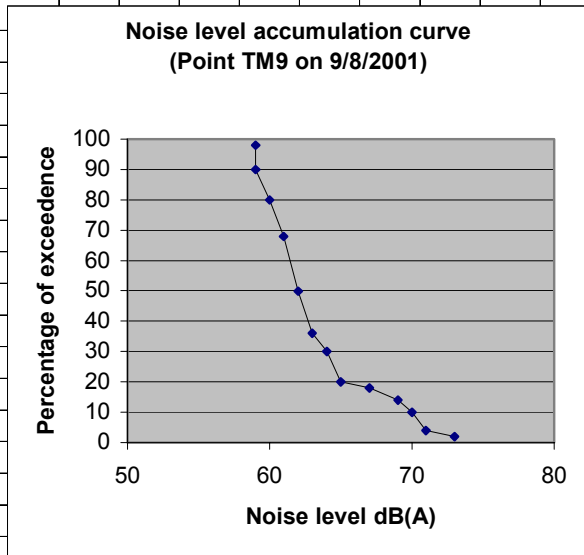
L95 = 59 dB(A)	L95 = 52 dB(A)
L90 = 60 dB(A)	L90 = 52 dB(A)
L50 = 65 dB(A)	L50 = 68 dB(A)
L10 = 70 dB(A)	L10 = 77 dB(A)
L5 = 73.5 dB(A)	L5 = 83 dB(A)

POINT TM8 10/8/2001 AT 12:00 HOURS									POINT TM8 ON 11/8/2001 AT 09:40 HOURS								
No.	dB(A)	%	No.	dB(A)	%	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	dB(A)	%		
1	62	98	26	72	48	62	98	1	52	98	26	65	48	52	98		
2	62	96	27	73	46	63	94	2	55	96	27	65	46	55	90		
3	63	94	28	73	44	64	90	3	55	94	28	65	44	56	84		
4	64	92	29	74	42	65	88	4	55	92	29	66	42	58	80		
5	64	90	30	74	40	67	82	5	55	90	30	66	40	60	74		
6	65	88	31	74	38	68	74	6	55	88	31	66	38	61	70		
7	65	86	32	74	36	69	70	7	55	86	32	67	36	62	62		
8	65	84	33	74	34	70	58	8	56	84	33	68	34	63	60		
9	67	82	34	74	32	71	56	9	58	82	34	68	32	64	58		
10	67	80	35	74	30	72	50	10	58	80	35	68	30	65	50		
11	67	78	36	74	28	73	46	11	58	78	36	68	28	66	40		
12	67	76	37	75	26	74	42	12	58	76	37	68	26	67	36		
13	68	74	38	75	24	75	26	13	60	74	38	68	24	68	30		
14	68	72	39	77	22	77	22	14	61	72	39	68	22	69	20		
15	69	70	40	78	20	78	20	15	61	70	40	69	20	70	18		
16	69	68	41	78	18	79	10	16	61	68	41	70	18	71	6		
17	69	66	42	78	16	81	6	17	61	66	42	70	16	75	4		
18	69	64	43	78	14	86	4	18	61	64	43	70	14				
19	69	62	44	79	12			19	62	62	44	70	12				
20	69	60	45	79	10			20	63	60	45	70	10				
21	70	58	46	79	8			21	64	58	46	71	8				
22	71	56	47	81	6			22	64	56	47	71	6				
23	71	54	48	86	4			23	65	54	48	75	4				
24	71	52	49	86	2			24	65	52	49	75	2				
25	72	50	50	86	0			25	65	50	50	75	0				



L95 = 62.5 dB(A)	L95 = 55 dB(A)
L90 = 64 dB(A)	L90 = 55 dB(A)
L50 = 72 dB(A)	L50 = 65 dB(A)
L10 = 79 dB(A)	L10 = 70 dB(A)
L5 = 83.5 dB(A)	L5 = 73 dB(A)

POINT TM9 ON 9/8/01									POINT TM9 10/8/2001								
No.	dB(A)	%	No.	dB(A)	%	dB(A)	%	No.	dB(A)	%	No.	dB(A)	%	dB(A)	%		
1	59	98	26	62	48	59	98	1	52	98	26	60	48	52	98		
2	59	96	27	62	46	59	90	2	55	96	27	61	46	55	94		
3	59	94	28	62	44	60	80	3	55	94	28	61	44	59	90		
4	59	92	29	62	42	61	68	4	55	92	29	61	42	60	50		
5	59	90	30	62	40	62	50	5	59	90	30	62	40	61	46		
6	60	88	31	62	38	63	36	6	59	88	31	62	38	62	40		
7	60	86	32	63	36	64	30	7	59	86	32	62	36	63	28		
8	60	84	33	63	34	65	20	8	59	84	33	62	34	64	20		
9	60	82	34	63	32	67	18	9	59	82	34	62	32	65	10		
10	60	80	35	64	30	69	14	10	59	80	35	62	30	67	8		
11	60	78	36	64	28	70	10	11	59	78	36	63	28	68	6		
12	60	76	37	65	26	71	4	12	60	76	37	63	26	69	2		
13	60	74	38	65	24	73	2	13	60	74	38	63	24	75	0		
14	60	72	39	65	22			14	60	72	39	63	22				
15	60	70	40	65	20			15	60	70	40	64	20				
16	61	68	41	67	18			16	60	68	41	64	18				
17	61	66	42	69	16			17	60	66	42	64	16				
18	61	64	43	69	14			18	60	64	43	65	14				
19	61	62	44	70	12			19	60	62	44	65	12				
20	61	60	45	70	10			20	60	60	45	65	10				
21	61	58	46	70	8			21	60	58	46	67	8				
22	61	56	47	70	6			22	60	56	47	68	6				
23	62	54	48	71	4			23	60	54	48	68	4				
24	62	52	49	73	2			24	60	52	49	69	2				
25	62	50	50	73	0			25	60	50	50	75	0				



L95 = 59 dB(A)
L90 = 59 dB(A)
L50 = 62 dB(A)
L10 = 70 dB(A)
L5 = 70.5 dB(A)

L95 = 55 dB(A)
L90 = 59 dB(A)
L50 = 60 dB(A)
L10 = 65 dB(A)
L5 = 68 dB(A)

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 5 Harbour Roundabout					Date: THUR 9-08-2001			
					Time: 06.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01								
01-02								
02-03								
03-04								
04-05								
05-06								
06-07	15	20	7	120	55	30	10	60
07-08	22	60	50	200	50	25	5	65
08-09	35	45	75	230	60	30	15	55
09-10	60	55	48	225	75	25	7	50
10-11	20	57	11	225	55	15	13	55
11-12	43	31	8	225	40	20	5	55
12-13	45	42	20	210	20	30	15	75
13-14	34	38	9	160	25	30	25	65
14-15	43	35	30	758	15	30	30	610
15-16	36	56	11	1510	10	10	55	855
16-17	29	49	10	1363	20	30	25	660
17-18	35	47	20	883	15	45	40	760
18-19	36	57	53	365	55	40	20	550
19-20	53	75	80	290	40	30	12	335
20-21	18	54	62	293	35	40	5	285
21-22	14	35	70	282	6	3	10	150
22-23	2	3	63	223	7	7	11	135
23-00	4	6	38	183	10	12	10	150
Average for 06-22	33.63	47.25	35.25	458.69	36.00	27.06	18.25	292.81
Average for 22-06	-	-	-	-	-	-	-	-
Average for total	33.63	47.25	35.25	458.69	36.00	27.06	18.25	292.81

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 5 Harbour Roundabout					Date: FRI 10-08-2001			
					Time: 00.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	1	0	0	35	22	30	12	120
01-02	1	0	3	30	10	12	5	90
02-03	2	0	3	42	5	8	3	20
03-04	1	4	12	42	5	7	3	10
04-05	3	43	47	63	5	3	8	15
05-06	34	51	70	90	15	11	15	170
06-07	22	15	25	665	48	41	43	120
07-08	22	31	21	607	23	51	75	120
08-09	33	45	33	393	43	72	35	120
09-10	53	45	45	520	106	78	40	381
10-11	51	35	18	733	71	103	63	360
11-12	22	45	16	635	100	113	53	274
12-13	30	42	12	440	33	57	46	347
13-14	34	36	12	478	40	47	36	307
14-15	56	60	50	602	46	75	41	285
15-16	45	41	17	605	82	80	60	385
16-17	38	57	15	583	87	85	63	295
17-18	45	55	30	1015	35	70	61	320
18-19	75	140	80	375	110	50	65	310
19-20	61	60	50	135	45	85	60	135
20-21	35	40	45	235	30	15	15	210
21-22	40	55	35	65	10	10	13	115
22-23	22	27	25	100	15	15	15	95
23-00	26	12	15	75	7	5	8	120
Average for 06-22	41.38	50.13	31.50	505.38	56.81	64.50	48.06	255.25
Average for 22-06	6.00	13.38	29.50	29.50	9.88	11.25	8.38	88.75
Average for total	23.69	31.76	30.50	267.44	33.35	37.88	28.22	172.00

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 5 Harbour Roundabout					Date: SAT 11-08-2001			
					Time: 00.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	6	6	8	21	3	0	5	20
01-02	4	7	5	17	3	0	0	15
02-03	6	6	4	13	1	0	0	10
03-04	7	7	4	18	2	0	2	22
04-05	3	3	5	65	2	0	5	56
05-06	10	0	10	95	20	3	5	130
06-07	7	20	10	210	45	50	30	185
07-08	25	25	9	190	10	8	8	155
08-09	50	30	1	237	20	17	5	140
09-10	27	30	3	310	24	45	6	490
10-11	20	28	4	335	41	18	5	545
11-12	17	33	3	392	23	34	4	465
12-13	16	28	5	390	32	37	5	405
13-14	14	17	6	280	17	37	6	330
14-15	8	18	8	220	30	38	6	305
15-16	10	7	6	225	45	15	5	330
16-17	20	10	2	300	57	45	5	350
17-18	25	11	4	245	88	97	10	360
18-19	12	12	6	120	7	10	0	98
19-20	4	6	2	295	5	8	8	120
20-21	5	7	2	220	6	12	5	125
21-22	1	5	6	180	4	4	8	65
22-23	0	0	6	170	2	5	7	105
23-00	0	3	10	140	0	2	3	100
Average for 06-22	16.31	17.94	4.81	259.31	28.38	29.69	7.25	279.25
Average for 22-06	10.50	8.50	9.50	50.50	6.63	2.88	5.00	58.50
Average for total	13.41	13.22	7.16	154.91	17.51	16.29	6.13	168.88

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 5 Harbour Roundabout					Date: SUN 12-08-2001			
					Time: 00.00-06.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	3	5	1	41	0	0	1	27
01-02	1	2	1	49	0	5	3	25
02-03	1	0	1	35	0	1	1	25
03-04	2	1	0	20	1	1	0	9
04-05	3	0	5	25	3	1	2	37
05-06	0	3	7	75	1	4	11	85
06-07								
07-08								
08-09								
09-10								
10-11								
11-12								
12-13								
13-14								
14-15								
15-16								
16-17								
17-18								
18-19								
19-20								
20-21								
21-22								
22-23								
23-00								
Average for 06-22	-	-	-	-	-	-	-	-
Average for 22-06	1.25	1.75	3.88	69.78	0.88	2.38	3.50	51.63
Average for total	1.25	1.75	3.88	69.78	0.88	2.38	3.50	51.63

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 6 Western Gate (Container depot)					Date: THUR 9-08-2001			
					Time: 06.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01								
01-02								
02-03								
03-04								
04-05								
05-06								
06-07	11	15	5	95	0	2	1	14
07-08	15	19	15	195	0	1	0	25
08-09	15	35	15	235	10	2	1	55
09-10	5	10	5	95	2	4	0	37
10-11	10	30	10	145	9	9	0	54
11-12	10	10	5	55	1	12	1	41
12-13	9	10	5	79	2	7	3	55
13-14	2	5	4	85	4	11	0	60
14-15	10	9	6	80	4	9	6	65
15-16	5	2	2	60	2	10	0	55
16-17	3	9	4	75	3	10	5	100
17-18	2	2	0	37	2	7	1	78
18-19	0	0	0	105	2	6	1	86
19-20	0	0	10	35	1	1	0	40
20-21	0	0	0	0	0	0	0	10
21-22	0	0	0	15	0	0	0	3
22-23	0	0	0	3	0	0	0	0
23-00	0	0	0	25	0	0	0	0
Average for 06-22	6.06	9.75	5.38	86.94	2.63	5.69	1.19	48.63
Average for 22-06	-	-	-	-	-	-	-	-
Average for total	6.06	9.75	5.38	86.94	2.63	5.69	1.19	48.63

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM6 Western Gate (Container depot)					Date: FRI 10-08-2001			
					Time: 00.00-00.00hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	0	0	0	20	0	35	0	15
01-02	0	0	0	0	0	0	0	3
02-03	0	0	0	0	0	0	0	0
03-04	0	0	0	0	0	0	0	2
04-05	0	0	15	0	0	0	8	0
05-06	0	50	15	125	0	32	2	55
06-07	5	13	4	95	5	5	5	30
07-08	7	29	8	192	3	12	2	78
08-09	2	26	12	185	1	5	0	45
09-10	3	20	5	124	1	4	0	35
10-11	11	10	6	112	9	5	0	44
11-12	5	14	7	100	7	9	0	39
12-13	8	15	3	81	5	3	0	66
13-14	6	14	5	105	4	9	0	50
14-15	3	9	1	55	3	9	0	61
15-16	9	4	0	54	7	14	0	75
16-17	7	11	3	60	11	11	1	87
17-18	1	0	1	30	10	20	1	50
18-19	40	50	0	65	10	17	0	105
19-20	0	50	0	20	10	25	0	5
20-21	30	0	0	30	0	0	0	0
21-22	9	0	10	20	0	1	2	4
22-23	10	0	0	15	00	0	0	0
23-00	110	0	0	25	0	0	0	1
Average for 06-22	9.13	16.56	4.06	83.00	5.38	9.31	0.69	48.38
Average for 22-06	0.00	6.25	3.75	21.63	0.00	8.38	1.25	9.38
Average for total	4.57	11.41	3.91	52.32	2.69	8.85	0.97	28.88

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM6 Western Gate (Container depot)					Date: SAT 11-08-01			
					Time: 00.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	0	0	0	0	15	2	1	2
01-02	37	0	0	0	0	0	0	0
02-03	10	0	0	4	0	0	0	0
03-04	0	2	0	3	0	0	0	0
04-05	0	2	1	18	0	0	2	2
05-06	3	5	2	55	0	0	0	0
06-07	3	0	0	29	1	1	1	28
07-08	2	2	0	13	0	1	0	15
08-09	4	2	0	10	0	0	0	8
09-10	0	0	3	7	0	0	0	4
10-11	0	0	1	3	0	1	1	2
11-12	0	0	0	3	0	0	0	2
12-13	0	0	0	12	0	0	0	1
13-14	0	0	0	0	0	0	0	0
14-15	0	0	0	0	0	1	0	0
15-16	0	0	1	0	0	1	0	0
16-17	0	0	2	20	0	0	2	3
17-18	0	0	0	95	0	0	0	6
18-19	2	10	1	69	0	1	0	14
19-20	6	9	0	120	1	0	0	20
20-21	4	16	0	149	1	4	0	35
21-22	2	15	0	96	1	6	0	31
22-23	5	7	0	89	5	8	0	78
23-00	4	9	0	83	3	5	0	70
Average for 06-22	1.44	3.38	0.50	39.13	0.25	1.00	0.25	10.56
Average for 22-06	21.25	1.13	0.38	15.00	1.88	0.25	0.38	0.63
Average for total	11.35	2.26	0.44	27.07	1.07	0.63	0.32	5.60

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No:TM 6 Western Gate (Container depot)					Date: SUN 12-08-2001			
					Time:00.00-06.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	3	3	0	56	7	4	0	48
01-02	6	5	1	46	6	10	0	58
02-03	5	3	0	54	7	9	0	41
03-04	6	4	0	41	5	15	1	48
04-05	3	2	2	48	2	7	0	44
05-06	1	7	0	42	2	5	0	28
06-07								
07-08								
08-09								
09-10								
10-11								
11-12								
12-13								
13-14								
14-15								
15-16								
16-17								
17-18								
18-19								
19-20								
20-21								
21-22								
22-23								
23-00								
Average for 06-22	-	-	-	-	-	-	-	-
Average for 22-06	4.13	5.00	0.38	57.38	4.63	7.88	0.13	51.88
Average for total	4.13	5.00	0.38	57.38	4.63	7.88	0.13	51.88

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 7 Ghacem Junction					Date: THUR 9-01-2001			
					Time: 06.00-00.00hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01								
01-02								
02-03								
03-04								
04-05								
05-06								
06-07	105	85	65	155	110	110	60	140
07-08	60	100	35	340	150	105	35	145
08-09	175	70	15	380	85	100	55	155
09-10	100	70	10	460	165	125	50	175
10-11	85	50	3	465	155	75	35	210
11-12	25	23	5	520	175	60	30	240
12-13	150	125	5	910	150	125	0	0
13-14	170	145	145	962	200	175	0	0
14-15	160	162	138	860	140	0	0	0
15-16	95	82	37	830	105	0	0	0
16-17	140	58	49	981	110	0	0	0
17-18	92	43	40	970	0	0	0	0
18-19	6	14	11	93	85	75	105	75
19-20	0	6	5	80	75	105	75	75
20-21	0	5	0	62	105	115	105	90
21-22	1	5	17	60	140	105	140	155
22-23	0	1	0	50	60	80	120	120
23-00	1	2	5	35	40	55	60	155
Average for 06-22	85.25	65.19	36.25	508.00	121.88	79.69	43.13	91.25
Average for 22-06	-	-	-	-	-	-	-	-
Average for total	85.25	65.19	36.25	508.00	121.88	79.69	43.13	91.25

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM7 Ghacem Junction					Date: FRI 10-08-2001			
					Time:00.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	0	2	2	20	0	0	45	50
01-02	0	1	0	15	0	0	30	60
02-03	3	0	0	15	5	15	20	60
03-04	0	0	2	20	15	10	30	60
04-05	0	1	0	35	10	10	35	60
05-06	0	2	20	90	3	1	19	60
06-07	8	13	1	195	0	4	6	150
07-08	11	37	25	285	8	15	13	280
08-09	28	46	6	440	18	24	17	435
09-10	31	55	0	325	44	34	6	460
10-11	27	43	3	250	33	27	9	355
11-12	41	30	3	275	20	19	4	345
12-13	32	36	1	525	23	33	16	265
13-14	20	16	6	245	25	36	7	185
14-15	38	25	5	315	38	48	23	250
15-16	20	36	15	260	60	45	6	205
16-17	37	30	8	220	50	55	9	190
17-18	23	31	6	310	48	35	19	150
18-19	5	7	1	120	80	75	45	450
19-20	13	4	3	93	40	30	25	150
20-21	4	6	2	81	25	17	20	125
21-22	4	2	11	34	30	0	0	85
22-23	5	5	3	25	18	21	20	135
23-00	3	4	0	32	3	3	2	60
Average for 06-22	21.38	26.06	6.00	248.31	33.88	31.06	14.06	255.00
Average for 22-06	0.50	1.13	3.63	35.00	16.63	21.38	44.88	78.13
Average for total	10.94	13.60	4.82	141.66	25.26	26.22	29.47	166.57

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 7 Ghacem Junction					Date: SAT 11-08-2001			
					Time: 00.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	2	3	1	26	1	2	1	30
01-02	0	00	2	23	0	0	0	40
02-03	0	0	0	21	0	1	0	35
03-04	0	0	0	23	0	0	0	45
04-05	0	0	0	35	2	0	2	60
05-06	10	3	16	95	11	3	56	143
06-07	23	26	8	270	0	1	5	75
07-08	20	14	8	102	5	5	2	75
08-09	50	50	0	250	30	17	9	115
09-10	40	19	2	115	10	10	4	60
10-11	14	20	2	88	23	15	6	55
11-12	18	12	0	150	29	14	3	75
12-13	14	17	3	115	34	30	7	50
13-14	14	30	8	135	40	35	1	40
14-15	16	14	1	125	30	31	7	40
15-16	11	5	4	83	35	25	5	40
16-17	10	12	2	90	30	30	15	40
17-18	33	15	7	125	58	5	3	86
18-19	15	13	31	155	10	35	10	155
19-20	17	10	35	226	38	15	20	137
20-21	3	10	6	150	5	0	0	115
21-22	0	5	25	80	2	5	5	80
22-23	6	0	5	125	4	2	10	135
23-00	5	0	5	80	2	0	0	100
Average for 06-22	18.63	17.00	8.88	141.19	23.69	17.06	6.38	77.38
Average for 22-06	2.50	1.88	2.75	35.00	4.38	3.75	10.13	68.50
Average for total	10.57	9.44	5.82	88.10	14.04	10.41	8.26	72.94

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 7 Ghacem Junction					Date: SUN 12-08-2001			
					Time:00.00-06.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	5	2	3	60	1	1	1	115
01-02	0	0	0	60	0	0	0	15
02-03	0	0	0	0	0	0	0	150
03-04	0	0	0	10	0	0	0	15
04-05	0	0	10	60	5	5	20	35
05-06	0	0	11	60	0	0	15	70
06-07								
07-08								
08-09								
09-10								
10-11								
11-12								
12-13								
13-14								
14-15								
15-16								
16-17								
17-18								
18-19								
19-20								
20-21								
21-22								
22-23								
23-00								
Average for 06-22	-	-	-	-	-	-	-	-
Average for 22-06	2.00	0.25	4.25	56.88	1.50	1.00	5.75	79.38
Average for total	2.00	0.25	4.25	56.88	1.50	1.00	5.75	79.38

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 8 Community 2 Area					Date: THUR 9-08-2001			
					Time:06.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01								
01-02								
02-03								
03-04								
04-05								
05-06								
06-07	3	30	15	114	1	0	26	102
07-08	2	12	30	204	1	0	0	132
08-09	12	18	14	204	1	7	3	162
09-10	2	22	8	180	3	6	0	163
10-11	4	20	3	180	3	7	9	132
11-12	1	13	7	200	0	18	6	162
12-13	3	15	3	186	8	13	14	109
13-14	2	16	14	272	4	1	0	126
14-15	2	6	9	276	6	7	8	336
15-16	2	9	3	324	1	4	12	360
16-17	4	4	2	320	1	12	12	324
17-18	7	3	3	306	8	9	40	378
18-19	5	29	45	330	0	0	0	115
19-20	1	20	76	143	0	0	10	90
20-21	0	30	60	100	0	0	0	65
21-22	0	15	25	84	0	0	0	115
22-23	0	6	9	48	0	1	5	58
23-00	0	2	2	30	0	0	0	15
Average for 06-22	3.13	16.38	19.81	213.94	2.31	5.25	8.75	179.44
Average for 22-06	-	-	-	-	-	-	-	-
Average for total	3.13	16.38	19.81	213.94	2.31	5.25	8.75	179.44

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM8 Community 2 Area					Date: FRI 10-08-2001			
					Time: 00.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	0	0	1	15	0	0	20	35
01-02	0	0	0	10	0	0	0	21
02-03	0	0	0	0	0	0	0	5
03-04	0	0	1	10	1	0	0	10
04-05	0	4	10	20	3	1	1	20
05-06	0	2	3	25	2	1	5	56
06-07	2	4	8	54	0	0	0	0
07-08	0	2	12	285	0	5	2	118
08-09	1	9	6	583	2	5	0	198
09-10	3	18	3	390	0	10	1	137
10-11	6	11	6	312	1	6	1	108
11-12	10	19	4	252	10	33	18	126
12-13	0	7	2	349	2	10	4	166
13-14	1	8	13	237	3	10	1	102
14-15	12	8	7	259	6	8	10	162
15-16	1	6	10	246	7	3	12	143
16-17	3	6	6	240	0	4	10	164
17-18	7	5	12	168	5	2	3	120
18-19	1	5	2	75	1	5	5	120
19-20	3	3	0	71	2	6	6	120
20-21	0	0	3	25	0	2	2	90
21-22	1	2	3	40	0	0	5	72
22-23	0	2	4	28	0	7	10	60
23-00	0	0	6	22	0	2	3	36
Average for 06-22	3.19	7.06	6.06	224.13	2.44	6.81	5.00	121.63
Average for 22-06	0.00	1.75	3.25	19.75	0.75	0.38	3.88	27.50
Average for total	1.60	4.41	4.66	121.94	1.60	3.60	4.44	74.57

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM8 Community 2 Area					Date: SAT 11-08-2001			
					Time: 00.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	1	0	2	12	0	0	2	14
01-02	0	0	0	10	0	0	0	8
02-03	0	0	0	5	0	0	0	12
03-04	0	2	0	5	0	3	2	12
04-05	0	0	1	24	2	3	7	13
05-06	0	1	8	45	2	3	2	40
06-07	0	4	8	174	1	2	5	90
07-08	0	15	18	210	1	2	11	135
08-09	3	2	8	240	1	5	6	180
09-10	2	8	4	270	2	5	10	168
10-11	2	3	3	270	3	7	3	273
11-12	1	7	6	225	1	10	13	240
12-13	0	13	5	250	0	6	10	260
13-14	4	4	14	220	3	3	1	230
14-15	3	6	5	206	5	5	6	215
15-16	2	7	3	200	1	11	5	410
16-17	2	3	0	190	3	4	3	190
17-18	7	2	0	160	4	2	3	365
18-19	0	2	2	105	2	5	0	225
19-20	1	1	1	185	3	2	5	350
20-21	4	0	1	85	2	2	1	125
21-22	0	0	2	40	1	0	2	85
22-23	0	1	3	63	0	0	8	70
23-00	0	0	1	9	0	0	0	15
Average for 06-22	1.94	4.81	5.00	189.38	2.06	4.44	5.25	221.31
Average for 22-06	0.13	0.63	2.63	18.88	0.50	2.25	3.25	24.38
Average for total	1.04	2.72	3.82	104.13	1.28	3.35	4.25	122.85

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 8 Community 2 Area					Date: SUN 12-08-2001			
					Time:00.00-06.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	0	0	0	13	0	1	0	6
01-02	0	0	0	9	0	0	0	5
02-03	0	0	0	2	0	0	0	1
03-04	0	0	0	1	0	0	0	3
04-05	0	0	0	12	0	0	3	10
05-06	0	0	3	49	0	2	0	20
06-07								
07-08								
08-09								
09-10								
10-11								
11-12								
12-13								
13-14								
14-15								
15-16								
16-17								
17-18								
18-19								
19-20								
20-21								
21-22								
22-23								
23-00								
Average for 06-22	-	-	-	-	-	-	-	-
Average for 22-06	0.00	0.13	0.88	19.75	0.00	0.38	1.38	16.25
Average for total	0.00	0.13	0.88	19.75	0.00	0.38	1.38	16.25

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 9 Sakumono Ramsar Site					Date: THUR 9-08-2001			
					Time: 06.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01								
01-02								
02-03								
03-04								
04-05								
05-06								
06-07	11	16	38	350	5	10	20	255
07-08	4	44	35	885	0	5	11	270
08-09	2	65	7	950	3	15	2	210
09-10	5	28	3	605	15	11	1	535
10-11	12	52	3	625	10	15	2	585
11-12	13	48	10	605	5	27	3	557
12-13	10	36	7	500	14	30	7	590
13-14	7	44	17	500	12	31	1	520
14-15	13	17	16	500	15	22	18	530
15-16	10	22	22	570	5	24	6	540
16-17	12	21	14	470	4	32	15	685
17-18	11	7	11	415	11	22	24	625
18-19	5	3	0	335	20	22	95	740
19-20	3	2	1	362	2	7	25	540
20-21	5	0	1	275	5	10	18	338
21-22	15	35	30	185	1	2	3	303
22-23	0	5	45	155	0	2	10	87
23-00	0	15	15	130	0	0	3	82
Average for 06-22	8.63	27.50	13.44	508.25	7.94	17.81	15.69	488.94
Average for 22-06	-	-	-	-	-	-	-	-
Average for total	8.63	27.50	13.44	508.25	7.94	17.81	15.69	488.94

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 9 Sakumono					Date: FRI 10-08-2001			
					Time: 00.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	0	5	2	25	0	0	20	0
01-02	0	0	0	20	0	0	20	0
02-03	0	0	0	7	0	0	13	0
03-04	1	0	1	12	0	2	10	0
04-05	3	5	1	60	1	20	15	60
05-06	3	10	15	90	0	0	0	120
06-07	16	10	24	385	2	5	24	380
07-08	21	29	36	855	2	7	11	1125
08-09	19	38	17	970	1	16	5	1220
09-10	24	29	14	640	1	16	9	1195
10-11	27	25	21	595	4	23	14	1245
11-12	36	26	12	580	11	28	15	1160
12-13	24	24	15	595	5	23	16	1175
13-14	22	18	23	505	8	19	11	1170
14-15	21	15	21	360	5	28	23	1130
15-16	25	5	16	420	10	31	8	1205
16-17	18	15	24	440	15	28	30	1245
17-18	16	8	19	445	7	34	26	1275
18-19	60	90	113	288	4	96	30	345
19-20	40	100	110	315	7	45	28	150
20-21	5	70	75	215	3	15	3	75
21-22	2	45	53	290	0	22	8	65
22-23	2	45	60	215	0	23	25	90
23-00	0	15	77	210	0	3	3	255
Average for 06-22	23.50	34.19	37.06	493.63	5.31	27.25	16.31	885.00
Average for 22-06	0.88	5.00	9.88	62.38	0.13	3.00	11.38	43.63
Average for total	12.19	19.60	23.47	278.01	2.72	15.13	13.85	464.32

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM 9 Sakumono					Date: SAT 11-08-2001			
					Time: 00.00-00.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	1	2	20	85	0	4	1	28
01-02	0	5	2	35	0	1	0	19
02-03	0	8	7	100	0	0	2	22
03-04	0	5	16	50	0	2	0	15
04-05	0	0	0	65	0	2	6	57
05-06	35	48	50	310	0	0	3	94
06-07	19	11	36	340	0	6	45	332
07-08	30	17	62	460	0	8	65	377
08-09	21	16	35	620	0	10	46	444
09-10	14	15	34	510	0	9	47	627
10-11	11	14	14	555	0	23	59	510
11-12	13	14	10	635	2	23	54	581
12-13	15	16	16	540	7	9	46	555
13-14	18	10	25	425	1	18	46	625
14-15	9	6	16	410	0	38	50	690
15-16	16	8	13	480	0	33	50	667
16-17	6	9	18	425	0	17	65	639
17-18	15	5	13	430	7	19	51	643
18-19	7	22	50	480	4	10	5	550
19-20	5	20	113	630	3	1	7	475
20-21	0	15	90	450	0	10	10	345
21-22	0	25	43	370	0	2	12	225
22-23	0	0	55	175	0	1	4	210
23-00	0	6	30	195	0	0	5	65
Average for 06-22	12.44	13.94	36.75	485.00	1.50	14.75	41.13	517.81
Average for 22-06	4.75	16.00	29.00	133.75	0.00	4.38	5.00	72.50
Average for total	8.60	14.97	32.88	309.38	0.75	9.57	23.07	295.16

FIELD DATA SHEET FOR ROAD TRAFFIC SURVEY

Site: TEMA								
Survey Point No: TM9 Sakumono					Date: SUN 12-08-2001			
					Time: 00.00-06.00 hrs			
					Weather:			
Time Zone (hr)	Inbound				Outbound			
	Articulated trailer/truck	Ordinary truck	Large bus	Small passenger car /van	Articulated trailer/ truck	Ordinary truck	Large bus	Small passenger car /van
00-01	1	2	52	300	0	0	3	57
01-02	0	8	25	225	0	0	5	30
02-03	0	1	9	40	0	0	0	20
03-04	0	5	6	50	0	2	2	6
04-05	0	2	25	55	0	1	5	37
05-06	0	5	21	51	0	3	8	105
06-07								
07-08								
08-09								
09-10								
10-11								
11-12								
12-13								
13-14								
14-15								
15-16								
16-17								
17-18								
18-19								
19-20								
20-21								
21-22								
22-23								
23-00								
Average for 06-22	-	-	-	-	-	-	-	-
Average for 22-06	0.13	3.63	27.88	136.38	0.00	0.88	4.00	66.25
Average for total	0.13	3.63	27.88	136.38	0.00	0.88	4.00	66.25