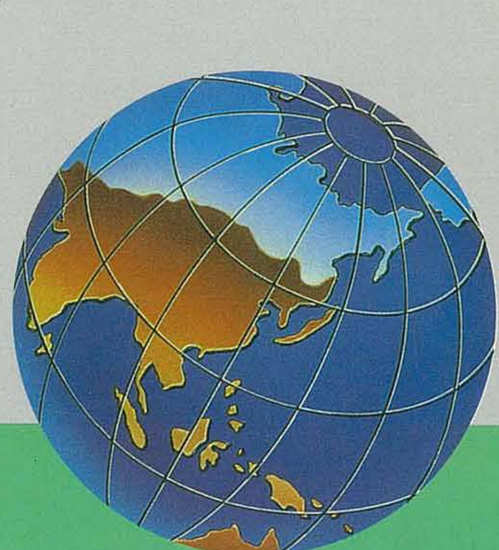
Shiu Wing Steel Mill
Tuen Mun Area 38

Environmental Impact Assessment (EIA)

Final Report
Volume 1
Text



AXIS
Environmental

SHIU WING STEEL LIMITED

SW STEEL

SHIU WING STEEL MILL
TUEN MUN AREA 38

ENVIRONMENTAL IMPACT ASSESSMENT (EIA)

FINAL REPORT
VOLUME 1
TEXT

MARCH 1994

(Addendum is not required)

AXIS Environmental

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CHAPTER 1
INTRODUCTION

1. INTRODUCTION

1.1 BACKGROUND

Shiu Wing Steel Ltd presently operate Hong Kong's only steel mill in Tseung Kwan O. Continued operation of the mill at this location is incompatible with the future planned use of the area. Following discussions with Government *Shiu Wing Steel Ltd* have agreed to decommission this mill and build a new steel mill of approximate capacity 650,000 t/a of steel products in Tuen Mun Area 38. The nominated EAF capacity is 500,000 t/a, with the balance of 150,000 t/a being provided by imported billets.

AXIS Environmental Consultants Ltd (AXIS) were commissioned by *Shiu Wing Steel Ltd* in November 1992 to undertake the Environmental Impact Assessment (EIA) for the proposed steel mill. The EIA identifies the potential environmental impacts associated with the construction, operation and decommissioning of the proposed steel mill, and proposes mitigation measures for these. It includes detailed environmental information concerning the construction and operation of the proposed plant to be used at the new steel mill.

It should be noted that a final decision has not been made upon the exact size and type of electric arc furnace (EAF) that would be utilised at the proposed steel mill. Consequently, this assessment examines the environmental impact of the overall development assuming typical EAFs of the required capacity.

Once a final decision has been made on the exact type of EAF, a supplementary report (or reports) will be issued to more precisely assess the overall environmental impact and, if necessary, amend any previously recommended mitigation measures.

Site formation for the proposed steel mill commenced in September 1993 with the approval of EPD, having agreed the necessary mitigation measures to help ensure that there is no significant environmental impact.

1.2 SCOPE AND OBJECTIVES OF THE EIA

This EIA describes the proposed development, identifies and assesses the potential environmental impacts upon the surrounding environment and recommends mitigation measures to reduce any impacts to acceptable levels in accordance with existing Government requirements. Environmental monitoring and audit requirements are also included in the EIA; these would be used to assess the effectiveness of the mitigation measures recommended.

The Terms of Reference for the EIA study were provided by the Environmental Protection Department (EPD). They detail the objectives, scope and requirements of the EIA, and are included in Volume 2, Appendix 1.

1.3 PROJECT JUSTIFICATION BENEFITS

The relocation of the steel mill from Tseung Kwan O to Area 38 in Tuen Mun has arisen from a Government decision that heavy industry should be relocated to the area. A Special Industrial Area (SIA) has been created to give this effect. The relocation offers a number of benefits:

- it offers the opportunity for review of all site practices. From an environmental point of view, it would permit measures to be incorporated into the design and operation of the new plant to help prevent any significant environmental impact;
- it would permit the latest operational and environmental technology to be utilised;
- it would be located on the west side of Hong Kong, in accordance with EPD's policy for potentially air polluting industry;
- it would be located in a centralised new industrial area, with supporting infrastructure;
- it would permit the decommissioning of the existing steel mill in Tseung Kwan O, where continued operation of the plant is incompatible with the future planned use of the area.

In addition the expansion in capacity of the plant would result in the following advantages for Hong Kong:

- more employment
- greater self-sufficiency in reinforced steel bar
- more recycling of waste scrap metal.

1.4 STUDY PROGRAMME

Previous work, undertaken by another environmental consultancy prior to the appointment of AXIS, has resulted in the submission of an Inception Report in October 1990 and a Working Paper in January 1991 (ERL (Asia) Ltd, 1990, 1991).

AXIS submitted the draft EIA in June 1993 and a Steering Management Group (SMG) meeting was held on 27 July 1993. Outstanding issues were resolved over the following 10 weeks and additional air quality modelling was undertaken. The environmental issues associated with site formation were agreed with EPD and site formation commenced in September 1993.

As noted in Section 1.1, a supplementary report (or reports) may require issuing when a final decision has been made on the type and size of EAF. It is expected that the only issue that may require some change in assessment is operational air emissions. It is expected that these report(s) would be available in late 1993 or early 1994.

1.5 PROJECT PROGRAMME

Site formation commenced in September 1993 and would be expected to be completed by June 1994, marine pier construction by December 1994 and plant building construction by July 1995. Plant installation would commence by May 1995 and the rolling mill commencing operation in early 1996. This programme may alter subject to obtaining the necessary approvals from Government.

CHAPTER 2
PROJECT DESCRIPTION

2. PROJECT DESCRIPTION

2.1 INTRODUCTION

The proposed steel mill would be located in the Special Industries Area (SIA) of Tuen Mun Area 38. It would operate 24 hours/day and some 300 days per year. The area of the proposed site is approximately 9 hectares, more than half of which will require reclamation. The site would have direct marine access, and also road access from Lung Mun Road. A location plan is shown in Figure 2.1.

This chapter describes the proposed development as follows:

- proposed steel mill, including plant layout, process description and details of the main unit operations involved (Section 2.2);
- materials usage and production, including transport and handling (Section 2.3);
- water and energy consumption (Section 2.4);
- waste discharges, including gaseous and dust emissions, liquid effluents, solid waste, and noise (Section 2.5);
- construction activities, including site formation, reclamation, pier construction and process plant installation (Section 2.6);
- site facilities and works, including construction facilities, building structures, amenities, paving and road works, marine pier, road access, car parking, water supply, drainage systems and landscaping (Section 2.7);
- staffing, including the construction phase workforce and operational phase staffing (Section 2.8);
- occupational health and safety (Section 2.9).

2.2 PROPOSED STEEL WORKS

2.2.1 Plant Layout

The proposed steel mill site in Tuen Mun Area 38 is approximately 9 ha in area. This is a larger site than the existing steel mill at Tseung Kwan O. The design and planning of the new works would be set out to provide an integrated and efficient material flow and production line. The latest technology would be utilised to ensure maximum productivity, and minimum detrimental impacts on the environment. A preliminary layout of the site is illustrated in Figure 2.2.

A main workshop would house the majority of the steel production plant and operations. These would include the furnace bay with EAFs, continuous casting bay, billet storage bay, reheating furnace, rolling mill bay, and the storage and distribution bays for finished product.

Auxiliary facilities at the site would include the water treatment plant, slag handling area, oxygen plant, electrical substation, and raw material storage area. Administration and supporting facilities such as car parking areas, offices, and canteen would also be provided.

2.2.2 Process Description

The proposed steel mill would produce high tensile steel reinforcing bars for use in the construction industry. The manufacturing process would be similar to that of the existing steel mill in Tseung Kwan O, and is illustrated in general terms in a Production Flow Chart (Figure 2.3).

The primary raw material used in the steel making process would be scrap metal. This would be delivered to the site via both sea and road. Sea vessels would berth at the pier, and mobile cranes used to transfer the scrap metal to the scrap storage area.

The scrap would be cut, crushed and screened in a scrap processing area. After processing, the scrap would be loaded into a scrap bucket, transferred to the furnace bay, and discharged into an EAF for meltdown at a temperature above 1550°C. Carbon and lime would be added to the furnace, and oxygen introduced via a lance. Slag is formed on the surface and is removed prior to tapping.

When the required temperature and chemical composition of steel is reached, the molten steel would be tapped into a ladle and transferred to a Ladle Furnace (LF) for final adjustment of steel chemistry. In the ladle furnace ferro-alloys, lime and carbon are added. The molten steel is then passed to the Continuous Casting Machine (CCM) for casting into billets. These steel billets would either be transferred directly to a reheating furnace or to a billet storage area.

The billets would be reheated in a Reheat Furnace (RF) to a rolling temperature of about 1150°C. The heated billets would then be rolled in the Rolling Mill (RM) to the required bar size, and cooled by water sprays and air. The steel bars produced are then sheared to the required length.

The steel bar product would be used as reinforcing bars and hence do not require high surface quality. As such, typical surface finishing operations such as acid pickling/etching, painting, enamelling, solvent cleaning, and galvanising would not be required and therefore no effluents from such operations would be produced.

2.2.3 Main Unit Operations

The main unit operations of the proposed steel manufacturing process are the EAF, CCM, RF and RM. Fabric filters (FF) would be the principal pollution control plant. These are detailed below.

Electric Arc Furnace (EAF)

At present it is proposed that two conventional 50 t EAFs would be used in the proposed steel mill. These use electric power as the source of heat, and graphite electrodes positioned above the cold charge of scrap to produce a melting arc. Refining is carried out by combining the heat developed from electrical resistance of the molten metal and heat radiated from the arc. In addition, carbon and lime are added to the furnace, and oxygen is injected via a lance. When the steel has the required chemistry and temperature, it is tapped into a ladle for transfer to the continuous casting bay.

Atmospheric discharges from the EAF would exit a 35m stack.

Ladle Furnace (LF)

The ladle receiving molten steel from the arc furnace would be on a ladle transfer car which moves on a fixed rail to a position under a ladle furnace cover. Further refining will be carried out in the ladle by addition of ferro-alloys, lime and carbon. The temperature of the molten steel is increased and maintained in the ladle by the electric arcs mounted in the ladle furnace cover. The LF would have a small hood connected into the EAF dust collection system.

Continuous Casting Machine (CCM)

The ladle of molten steel after treatment in the ladle furnace is lifted above the CCM and poured through a sliding gate valve. The steel flow is controlled to the water cooled moulds, which progressively solidify the molten steel into billet strands. The emerging billet strands are further cooled by direct water spray in a secondary cooling zone. These strands are bent through a 90° arc until horizontal and then cut mechanically to form billets. The billets are finally air cooled and then transferred either directly to the RF or stored for later use or sale.

Reheat Furnace (RF)

The billets are reheated to a rolling temperature of about 1150°C in a fuel oil fired RF. The flue gases from the furnace pass through a waste heat recuperator and then discharge from a 35 m gas stack. In the recuperator, heat is recovered from the discharge gases by use of a heat exchanger to preheat the furnace combustion air supply.

Rolling Mill (RM)

The hot billets would be discharged from the RF to be processed through a series of mill stands which together form a RM about 200m long. At each mill stand, the cross section of the billets would be reduced and reshaped until the desired bar sizes emerged from the final stand. The steel reinforcing bars produced would be quenched by water sprays and air on the cooling bed before shearing to appropriate lengths. Any off-cut material would be recycled to the EAF.

Dust Collectors (DC)

Primary and secondary fumes extracted from the EAF would be conveyed via water cooled ducts and extended surface area air coolers to the dust collectors for cleaning. These filters would clean the gas stream by passing it through filters bags made of a felt cloth. The fabric filters would be of either pulse-jet or reverse air design. Dust collected from the process would be stored in hoppers and pelletised on discharge for ease of handling and to minimise fugitive atmospheric emissions.

2.3 MATERIALS USAGE, PRODUCTION, TRANSPORT AND HANDLING

2.3.1 Production

The proposed steel works is expected to have a production capacity of 650,000 t/a. This is based on two 50 t furnaces operating at an average 83% availability for 300 days/a.

This would be an increase in production relative to the existing steel mill at Tseung Kwan O. The majority (about 77%) of the steel products would be produced from billets cast on-site, whilst the remainder would require purchase of billets from other sources. The high tensile steel reinforcing bars produced would be distributed and sold for use in the construction industry.

Both liquid oxygen and gaseous oxygen produced by a Pressure Swing Adsorption (PSA) plant will be used on site. Information on oxygen and safety issues is provided in Section 2.9.2.

2.3.2 Raw Materials

Raw materials used on-site would include scrap metal, magnesite, dolomite, oxygen, oil, alloys, and refining agents. The raw materials used to produce steel products are detailed in Table 2.1.

2.3.3 Transport and Handling

The site has both marine and road access, which would facilitate the transportation of raw materials as well as finished products. Table 2.2 lists the anticipated mode(s) of transport that would be used at the proposed works for movement of these items.

Sea vessels would generally not be larger than 25,000 dwt. It is however possible that an occasional larger vessel (37,900 dwt) may be accepted. Local scrap steel would often be delivered by lighters.

The impact of road and marine movements associated with the proposal are described in Section 9. Although materials may be received or dispatched on a 24 hour basis, it is envisaged that most movements would occur during normal working hours (7:00am to 5:00pm).

Table 2.1 Raw Material Usage

Raw Material	Proposed usage (tpa)
Scrap metal *	550,000
Billets *	150,000
Alloys & Refining Agents:	
- Graphite	2,000
- Ferro-silicon	}
- Ferro-manganese	} 14,000
- Lime	} 10,000
- Limestone	}
Reheater Industrial Diesel Oil	15,000
Magnesite (MgO) Refractory Lining	} 5,000
Dolomite Refractory Lining	}
Pressurised Oxygen	31,200
Liquid Oxygen **	100
Carbon Electrode ***	2,000

* Scrap metal/billet proportion may vary

** Used for cutting large scrap

*** For every tonne of steel produced, about 4 kg of the carbon electrode would be consumed.

Table 2.2 Mode of Transporting Materials

Goods	Transport mode
Raw Material:	
Scrap metal *	} Sea vessels (70%)
Billets *	} Road trucks (30%)
Alloys and Refining Agents:	
- Graphite	}
- ferro-silicon	}
- ferro-manganese	} Sea vessel/truck
- Lime	}
- Limestone	}
Reheater Industrial Diesel Oil	Coastal tanker/road tanker
Magnesite (MgO) Refractory Lining	Road truck
Dolomite	Sea vessel/truck
Liquid Oxygen	Road tanker
Carbon Electrode	Sea vessel/truck
Product	
Reinforced Steel Bar **	Sea vessels (40%) Road trucks (60%)

* Scrap metal/billet proportion may vary, and transport mode may vary

** Transport mode may vary

All materials to be used at the new mill are presently used at Tseung Kwan O, where a high safety record in terms of handling has been maintained. The preferred methods for handling materials are outlined in Table 2.3.

Table 2.3 Methods of Handling Materials and Products

Goods	Method of Handling
Raw Material	
Scrap metal	Unloaded from sea vessels with electric overhead cranes; charged into EAF by shop floor car carrying scrap bucket. Local scrap delivered by road trucks & unloaded by electric overhead travelling cranes.
Billets	Unloaded from sea vessels and moved within plant by cranes.
Alloys and Refining Agents:	
- graphite - ferro-silicon - ferro-manganese - Lime - Limestone	} } Crane/front } end loader } }
Reheater Furnace Oil	Gravity/pump systems
Magnesite (MgO) Refractory lining	Crane/front end loader
Dolomite	Crane/front end loader
Liquid Oxygen*	High pressure pump
Carbon Electrode	Crane/fork lift
Product	
Steel Products	Crane/truck

2.4 WATER AND ENERGY CONSUMPTION

2.4.1 Water

Steel mill operations require water for cooling purposes. Freshwater would be the primary process cooling medium, and would be recirculated rather than discharged from the site. Some 100,000 m^3/day of seawater would be used at the proposed steel mill for cooling the freshwater in titanium plate-type heat exchangers.

Fresh cooling water would be sprayed directly onto the CCM and RM and may become contaminated by lubrication oils and scale. This water would be passed through a settlement tank and oil interceptor to remove oil and solids before pumping through heat exchangers and re-spraying onto the CCM and RM.

Fresh water used to cool the hot fume ducting and furnaces would be recirculated through another heat exchanger, without any need for prior treatment to remove oil and solids.

The flow diagram for the water cooling arrangement is illustrated in Figure 2.4.

Any freshwater lost through evaporation would be replenished by make up water. There would be no blowdown from the freshwater recirculating system.

2.4.2 Energy consumption

The two EAFs, (each rated at 32MW) would consume the vast majority of the site energy requirement. It is anticipated that they would be powered only 83% of the time. Sea water pumps, fans, cranes and other electrical equipment would also be required increasing the overall electricity demand for the whole of the proposed mill to approximately 70MW. As with all electrically powered items, no local air pollution will result.

In addition, the RF would consume approximately 2,700 l/h (maximum 3,500 l/hour) of fuel oil of (maximum) sulphur content 0.5% by weight. The RF would be equipped with a recuperator to utilise some of the waste heat (Section 2.2.3).

There would be no fuel-fired boiler at the proposed steel mill, however hot water may be generated from energy recovery from the EAF gases.

2.5 WASTE DISCHARGES

The discharges from the proposed steel works would be in the form of dust fumes, liquid effluents, solid waste and noise.

2.5.1 Atmospheric Emissions

The primary sources of atmospheric emissions would be:

- the EAFs
- CCM
- RF
- fugitive dust emissions
- activities during the construction and decommissioning phases.

There would be both primary and secondary atmospheric discharges from the EAFs. The primary fumes would be drawn off directly during operation through a port in the furnace roof. These fumes would include atmospheric emissions during oxygen lancing, which generates large quantities of fine red iron oxide fume. The pollutant gases from the furnace would be largely carbon monoxide (CO), sulphur dioxide (SO_2) and nitrogen oxides (NO_x) at high temperature (1100-1200°C).

The secondary fumes include significant emissions that would occur during scrap charging, slagging and steel tapping and not collected by the furnace roof port. Emissions would be extracted to extended surface air coolers prior to cleaning by fabric filters.

Atmospheric discharges would include any particulates that pass through the filter, in addition to CO, SO_2 and NO_x. Discharge would be from a 35m stack, typically at about 67°C. The total air extraction rate passing to the fabric filters is expected to be 640,000 Nm^3/h.

RF flue gas emissions would include SO_2, NO_x, CO and particulates. The SO_2 emitted would be limited by the legislated maximum 0.5% sulphur content in the fuel oil. Flue gases would cool in the recuperator prior to discharge from a 35 metre stack at an anticipated temperature of 120°C.

Molten steel would discharge from the CCM into a water cooled mould sleeve. However, owing to the short-distance, small flow and minimum contact surface, the potential for fume emissions would be slight. Steam is generated as a result of cooling the molten steel with water spray.

Fugitive dust emissions would occur from the handling and transportation of raw materials, the effects of wind on materials storage areas, and small quantities of fume escaping from the rolling mill. The EAF building would have no roof vents, and any fugitive emissions would settle within the building. Lime, one of the refining agents that would be used, can emit significant dust should mishandling occur.

Construction activities would cause atmospheric emissions as a result of the reclamation, loading/unloading of fill materials, and vehicle movements. Decommissioning would also result in atmospheric emissions, mainly from demolition.

Atmospheric emissions are discussed in more detail in Chapter 4.

2.5.2 Solid Wastes

There would be five principal categories of solid waste arising from the proposed development; slag, dust, scale, construction waste and demolition waste.

- dust would be collected from the plant's air emission control system. Hoppers below the fabric filters would collect the particulates extracted from the EAF furnaces. The dust would be pelletised on discharge from the hoppers, to facilitate handling and to prevent fugitive atmospheric emissions. EAF dust is primarily ferric oxide and can contain elevated levels of the oxides of copper, zinc, lead, magnesium and nickel;

- slag would be formed in the EAF, rising to the surface as impurities, and would comprise some 50% calcium oxide and elevated levels of the oxides of copper, zinc, lead, magnesium and nickel;

- some iron scale would be formed as a result of cooling and contracting of formed hot metal. It comprises more than 90% iron oxides and would be produced at both the CCM and the RM;

- during construction, the main solid waste that would be generated would be the volume of dredged material and waste resulting from site formation;

- solid waste would result from the decommissioning of site, including building material waste and possibly contaminated land.

Solid waste management is discussed in more detail in Chapter 7.

2.5.3 Liquid Effluents

The main liquid effluents would be:

- cooling water
- sewage
- contaminated surface water run-off
- polluted water resulting from construction activities such as dredging, reclamation and mud dumping.

Cooling water discharges have the potential to thermally impact upon receiving waters.

Sewage would arise during the construction, operating and decommissioning phases. All sewage arisings would be treated before discharge.

Surface water run-off may pick up contaminants such as suspended solids, process waste or oil. Any contaminated surface water would be treated before discharge.

Water quality impacts may arise from of site formation and construction activities, notably dredging and reclamation leading to potential problems of increased turbidity, deoxygenation and release of toxins.

The water flow arrangements for the proposed plant is discussed in Section 2.4.1, and details of effluent parameters and loadings are provided in Chapter 5, which also addresses the likely environmental impacts and mitigation measures.

2.5.4 Noise

Noise would be generated primarily by the following:

- EAF
- RM
- construction and decommissioning activities.

The EAF would represent the main noise source due to vibration of scrap metal charge and the striking of the arcs during meltdown, particularly at the beginning of the melt.

The RM would generate noise from the movement of the steel on the rolls, guides and guillotine.

During construction, noise would be generated by dredgers, barges, earthmoving equipment, excavators, pile drivers, cranes and trucks. The main noise emission when decommissioning would be from demolition.

There would be many other noise emissions resulting from activities such as scrap metal handling, traffic noise, RF burner noise, fans, pumps, compressors, transformer hum, etc.

Noise from the proposed plant is discussed in more detail in Chapter 6.

2.6 CONSTRUCTION ACTIVITIES

Site formation commenced in September 1993 (with the approval of EPD) and will take place over a period of approximately 2½ years and involve:

- site formation including reclamation
- marine pier construction
- building construction and plant installation.

Site formation involves dredging, seawall formation, reclamation and piled quay formation. It is estimated that 340,000m^3 of mud requires dredging, 20,000m^3 of this being classified as class C, which is considered to be seriously contaminated. Any dredged mud generated requires disposal. Part of the site for the proposed works already exists and the remainder of the site would be formed by a southern boundary, and a temporary eastern seawall would be constructed (this seawall would be extended later with further reclamation as part of Area 38 development).

Marine pier construction would involve driving piles and installing ground anchors. Reinforced concrete beams would be cast at the pile heads and precast concrete decks fitted to supporting beams. The deck would then be cast.

When site formation is completed, buildings would be constructed and the process plant installed. These process units would most likely be delivered by barge and assembled on-site.

During the construction period, the types of construction plant would include:

- grab dredgers, hydraulic dredgers, hopper barges, lighters, tugs, barge with piling plant;
- excavators, bulldozers, rollers, crane, trucks, vans, cars.

2.7 SITE FACILITIES AND WORKS

2.7.1 Construction Facilities

Temporary construction facilities would include hardstand areas for storage of construction materials, and single storey demountable huts for contractor use. Sewage arisings would be either treated on-site or pumped/transferred to the Pillar Point Sewage Treatment Works (STW). The handling method chosen by the construction contractor would be required to satisfy EPD's discharge standards requirements. Waste from a canteen to serve the construction workforce would gravitate, via a grease trap, to the sewage pit.

2.7.2 Buildings and Structures

The proposed site would encompass facilities orientated to maximise site efficiency and minimise environmental impact.

The two main buildings on site would be one for the EAFs and ancillaries, including the CCM, and the RM. The EAF building would be approximately 25m x 120m and 30m high, and the RM building would be approximately 300m x 50m and 18m high. The finalised building heights could be higher depending on the final EAF design and configuration (Section 1.1).

Other prominent structures on the site include the fume dedusting plant (including hoppers), the slag handling area, the electrical switchboard cabin and the water treatment plant.

There would be two chimneys on site, one serving the EAF fabric filter (35m) and the other serving the RF (35m). If the finalised building heights are higher, the stack heights would also be accordingly higher.

The offices would be situated at the furthest corner of the compound from the production processes, adjacent to Lung Mun Road.

2.7.3 Storage Areas

Scrap would be received and stored openly adjacent to the marine pier and in front of the main workshop housing the EAFs. The scrap storage area would be serviced by overhead cranes.

The ferroalloys, which are heavy and do not dust, would be stored in an open bay. Other raw materials, such as fluxes, refining agents and refractory lining, would be stored either in external silos or indoor bins.

Oil for the RF would be stored in a bunded storage tank of capacity approximately $350m^3$. Liquid oxygen would be stored in an insulated cryogenic storage vessel of approximately $50m^3$ capacity.

Billets and the final product reinforcing bars would be stored openly on-site at the product storage and distribution yard.

2.7.4 Marine Pier

The pier would be a concrete deck structure set on piles. It would be located at the south-west of the site to receive raw materials delivered by sea (such as liquid oxygen and scrap), and for distribution of steel products.

The pier would be capable of mooring vessels of up to 37,000 t DWT in addition to accommodating lighters.

2.7.5 Car Parking

To accommodate staff and visitor parking requirements, car parking for 60 vehicles is proposed. Parking facilities for up to 12 lorries would be provided. In addition, an extensive lorry queuing area within the site would be set aside to substantially eliminate any queuing into the entrance of the steel mill.

2.7.6 Paving and Road Works

All major roadways and the scrap handling areas would be concreted after allowing time for land consolidation and settlement. Some areas cannot be concreted, for example billet storage yards, because they would utilize heavy tracked vehicles.

There would be two vehicle entrances, one off the existing Lung Mun Road service road and one of a new access road. It is likely that two weighbridges would be installed on site.

2.8 STAFFING

2.8.1 Construction Phase Workforce

Construction would be in three over-lapping phases over approximately 2½ years, as detailed in Section 2.6, to include site formation, pier construction and plant installation. The daytime on-site workforce over this period is anticipated to peak at approximately 150.

2.8.2 Operational Phase Staffing

The main production operations would operate 24 hours per day and 7 days per week. There would be approximately 400 staff working over 3 shifts, comprising 160 staff on the day shift and 120 staff on each of the other two shifts.

2.9 OCCUPATIONAL HEALTH AND SAFETY

2.9.1 General Issues

Shiu Wing Steel Ltd have managed their existing site operations in Tseung Kwan O for more than 30 years, and have considerable experience with the nature of the risks associated with such operations.

Details are included in Appendix 2 concerning site occupational health and safety, including :

- possible hazards and dangers
- effects on health
- protective measures.

2.9.2 Oxygen use options and safety issues

Currently, liquid oxygen is delivered by Hong Kong Oxygen & Acetylene Co. Ltd. (HK Oxygen) to the Tseung Kwan O steel mill in insulated "iso-tanks" by barge on a near daily basis. The liquid oxygen (at a temperature of -200°C) is then transferred to two on-site storage tanks (50 and 25m^3 capacity).

In the new steel mill there will be significant changes to these arrangements:

- liquid oxygen will be delivered in bulk road tankers for use in on-site oxy-cutting.

- on-site oxygen production facilities will be used for production of approximately 95% purity oxygen for EAF lancing.

Liquid Oxygen

It is expected that one of the two existing cryogenic storage tanks would be relocated to the site from the Tseung Kwan O steel mill. At this time it is proposed that the $50m^3$ tank would be relocated. The liquid oxygen tank would be located as shown in Figure 2.2.

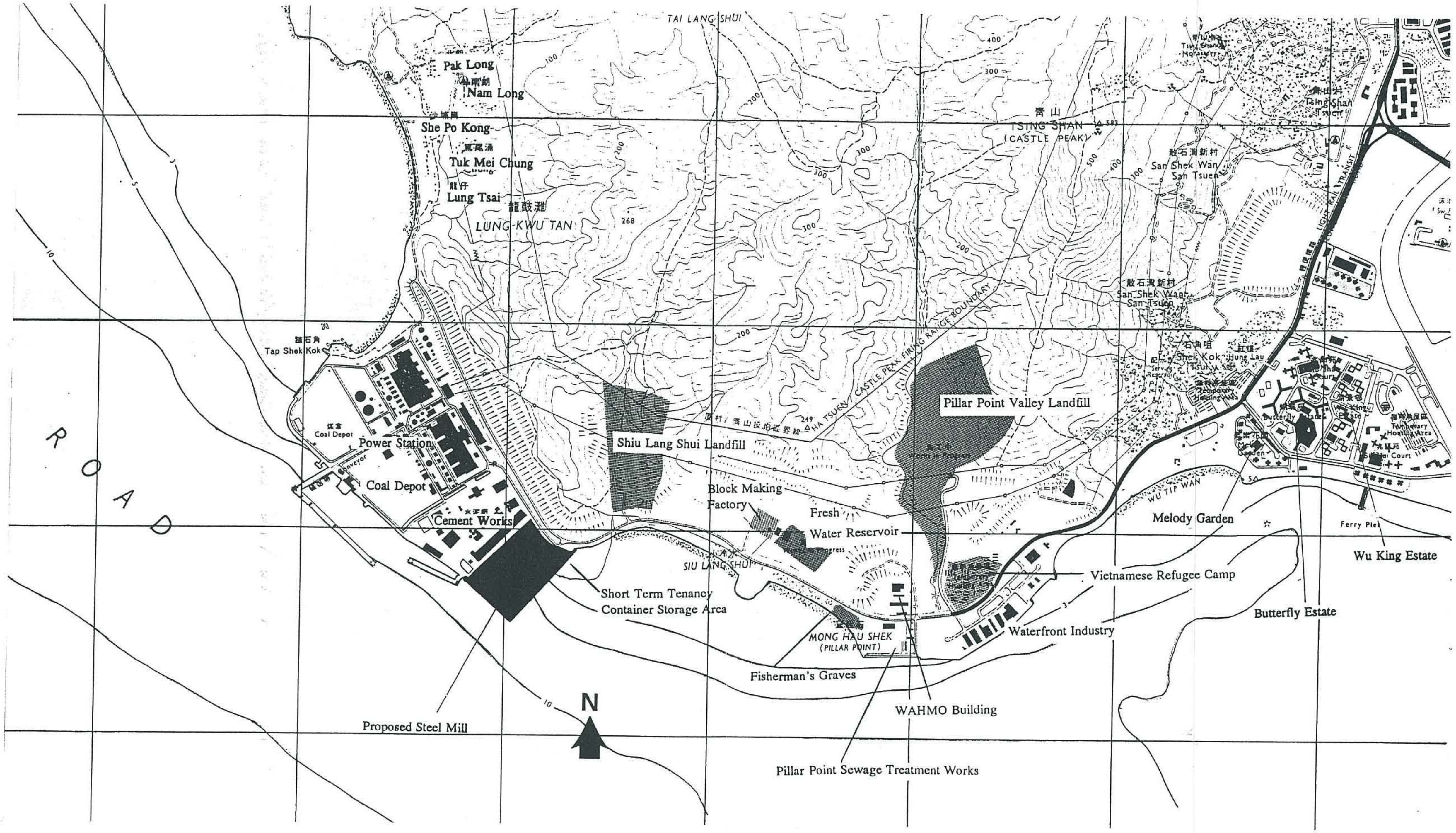
FSD requirements would be met in regard to the provision of a bund wall around the tank to limit the spread of a liquid spill, and other safety requirements, such as being located at least 6 metres away from combustible material. A Dangerous Goods Licence (DGL) application will be made prior to installation.

PSA Oxygen

The PSA (Pressure Swing Adsorption) oxygen plant would produce about $3{,}000Nm^3/hr$ of oxygen of approximately 95% purity, for use in EAF lancing.

A PSA oxygen generator is based on the principle that some solids (e.g. molecular sieves) adsorb different gases at different rates. In an oxygen PSA, compressed air is passed through a bed of molecular sieve material. This preferentially adsorbs nitrogen leaving the oxygen free to pass through. This process works until the material is saturated with nitrogen. To produce a continuous supply of oxygen a PSA has two or more beds. As one bed becomes saturated another starts to produce oxygen while the first bed is regenerated. Thus an oxygen PSA is in principle very simple comprising an air compressor, two or more beds of molecular sieve and the related pipework and valves. In addition a PSA will often include a buffer store for the oxygen to smooth out variations in production flow and pressure.

The PSA oxygen plant would produce a continuous supply of low pressure oxygen. The plant would be located as shown in Figure 2.2.



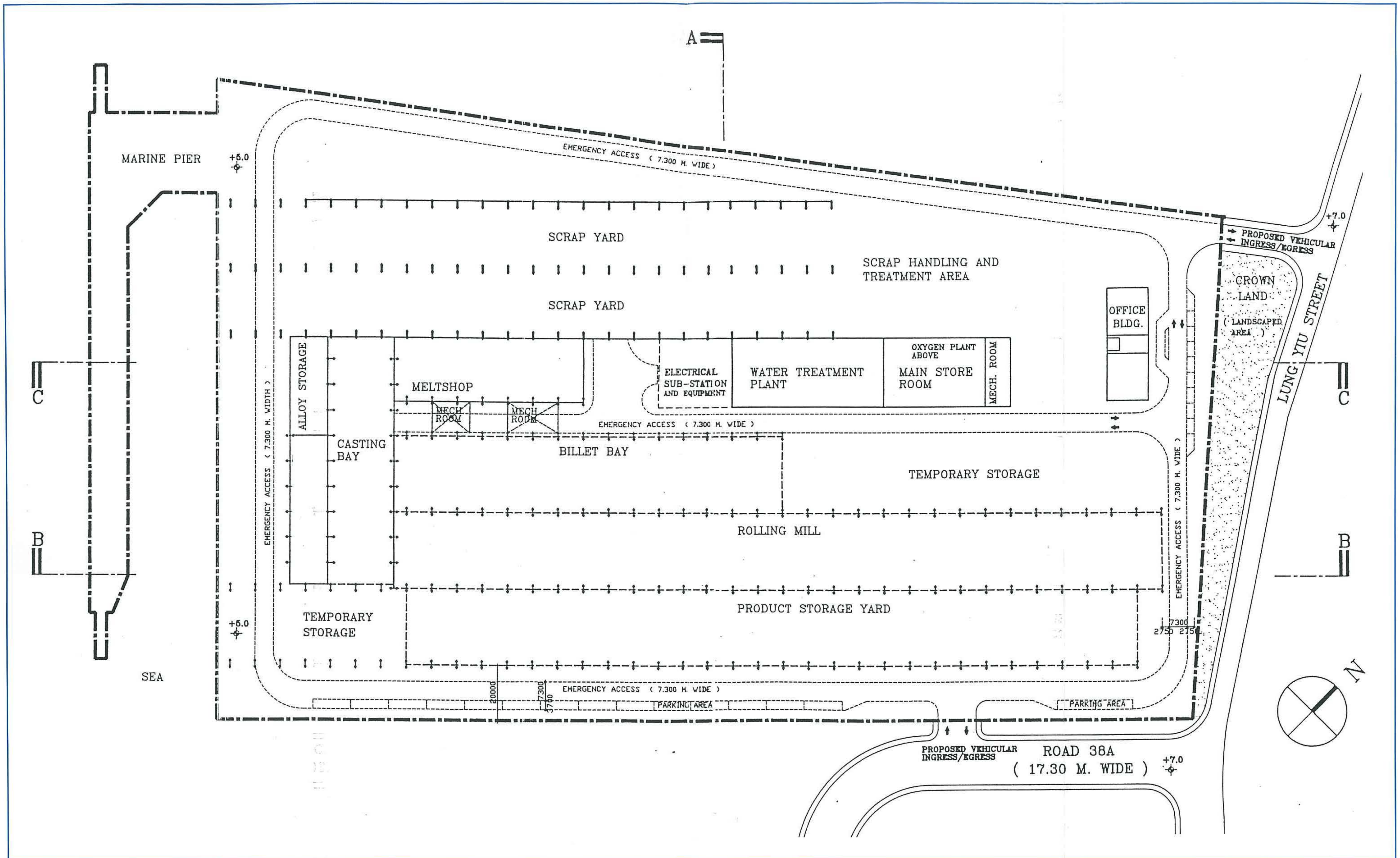
AXIS Environmental

0 250 500 750 1000m

Shiu Wing Steel Mill

Figure 2.1: Location of Proposed Steel Mill

053000/October 1993



AXIS Environmental

THE SITE

BUILDING ROOF AREA

LANDSCAPED AREA

ROBERT WEE ARCHITECTS
2102 TUNG SUN COMM. BLDG.
194 - 200 LOCKHART ROAD,
WANCHAI, HONG KONG
TEL. 511 8383, FAX 507 4915

0 50m

SEPT.,1993 TM372-MP2b

Shiu Wing Steel Mill

Figure 2.2: Proposed Steel Mill Layout

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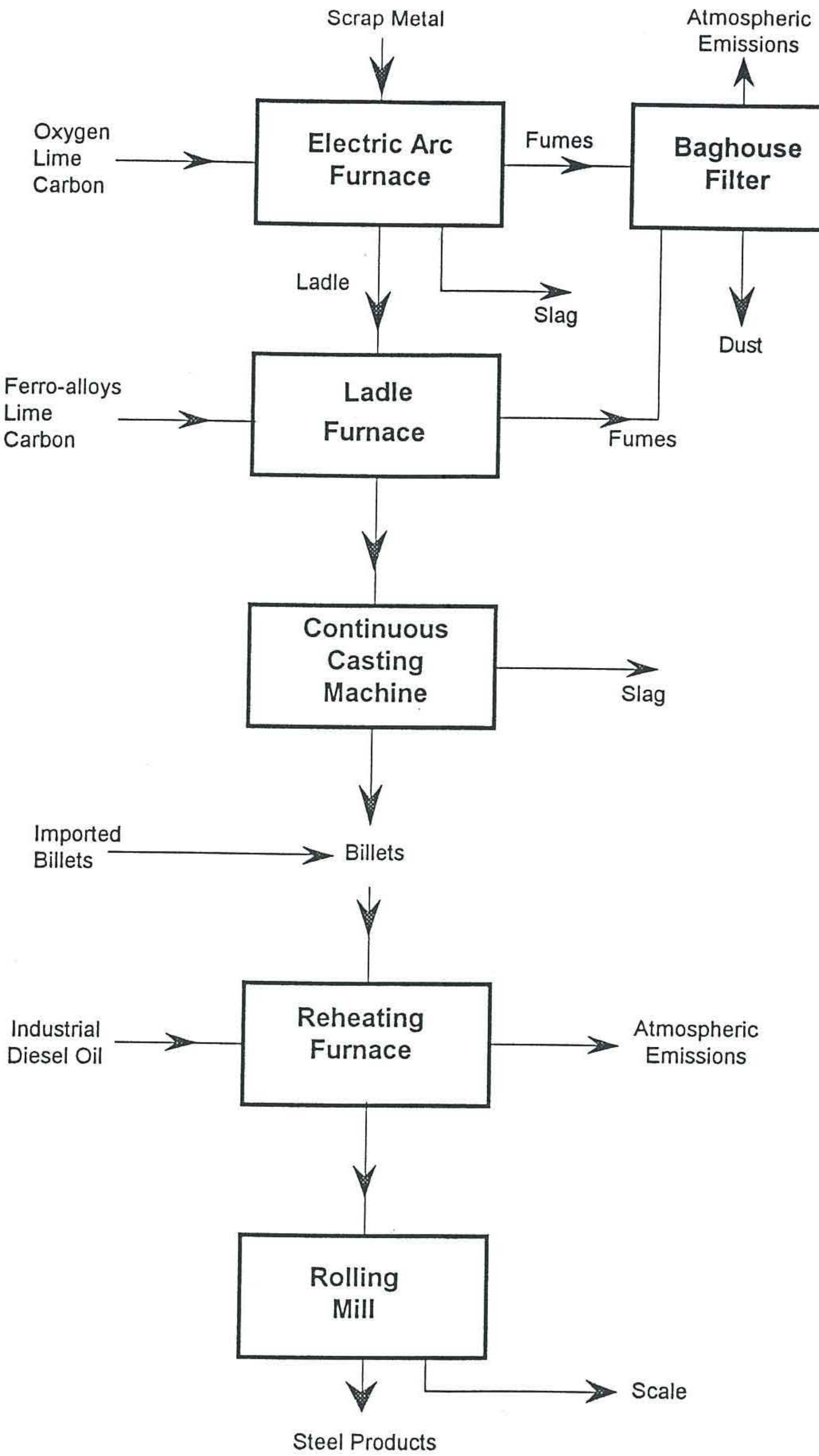

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Shiu Wing Steel Mill

Figure 2.3 Production Flow Chart

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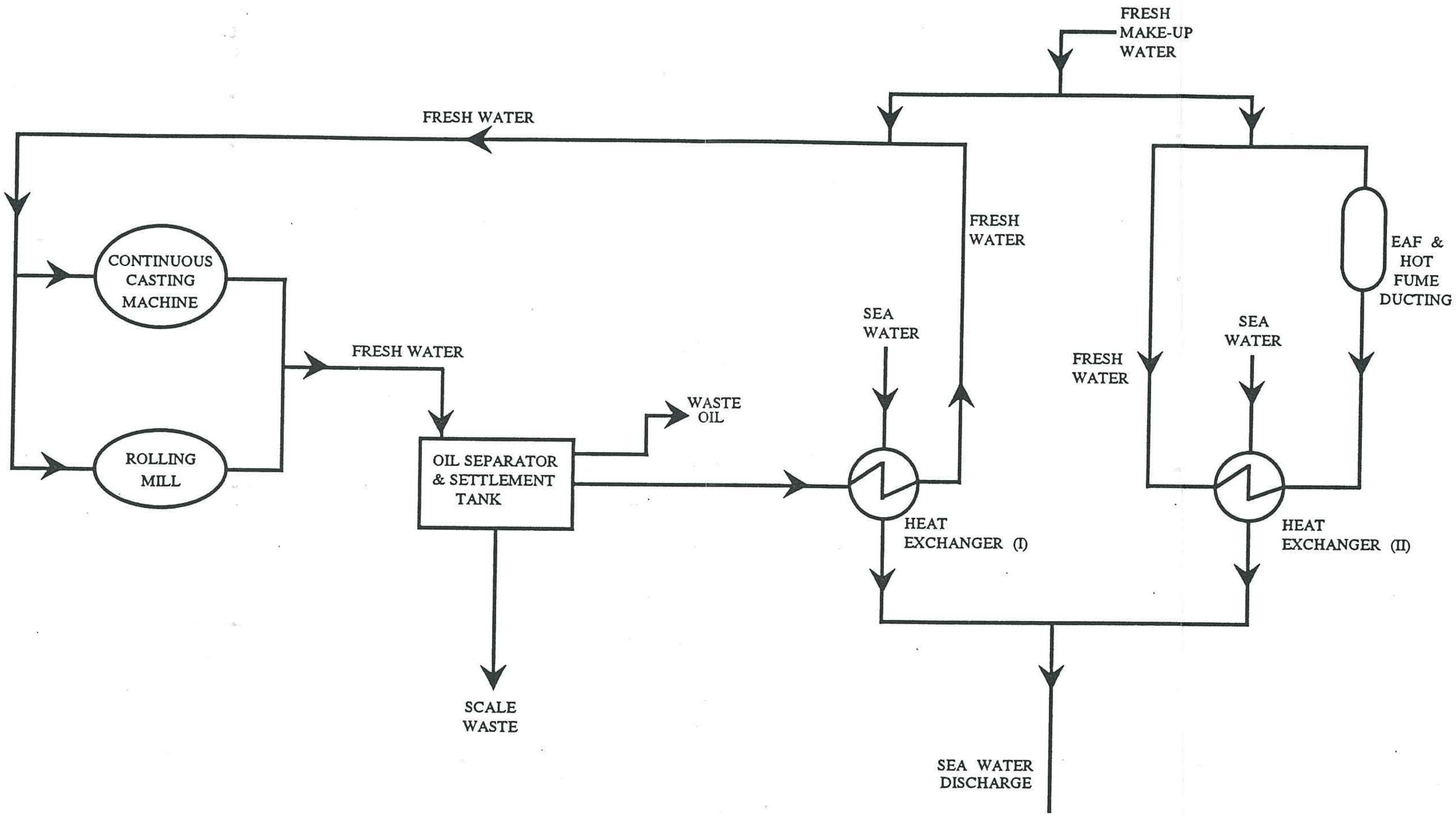

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Shiu Wing Steel Mill

Figure 2.4 Cooling Water Flow Diagram Mill Location

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CHAPTER 3
SURROUNDING LAND USE

3. SURROUNDING LAND USE

3.1 INTRODUCTION

The proposed steel mill would be located in Tuen Mun Area 38 (Figure 3.1), an area planned for substantial development in the near future. Although Area 38 falls within the boundary of Tuen Mun New Town, the Study Area may be described as urban fringe, being relatively undeveloped. This is emphasised by the presence of Castle Peak which separates Area 38 from the New Town residential areas.

Aerial photographs of the site are provided in Appendix 3.

This chapter discusses the land uses and related issues including sensitive receivers (SRs), relevant to the proposed development as follows:

- existing land uses local to the proposed steel mill, including industrial, Government/Institution-Community (G/IC) and residential developments in addition to cultural centres, ecology and amenities (Section 3.2);
- planned land uses local to the proposed steel mill, including planned areas of reclamation and development, in adherence to the Expanded Development Study of Tuen Mun Area 38 (Section 3.3);
- discussion of salient issues (Section 3.4).

3.2 EXISTING LAND USE

The existing landuses in the vicinity of the proposed steel mill (which would be sited on the coast) in Tuen Mun Area 38 are illustrated in Figures 2.1 and 3.1, and are summarised below.

3.2.1 Existing Residential

The following residential areas presently exist in the area local to the proposed steel mill site:-

- Lung Tsai, Tuk Mei Chung, She Po Kong and Nam Long village settlements (the nearest village is 1.8 km north-northwest of the proposed site);
- a temporary Vietnamese Refugee Camp, which is expected to close by December 1994 (Area 46, 2 km east of the proposed site);
- Melody Garden, Butterfly and Wu King residential estates (Area 28, 3 km east-northeast of the proposed site);
- Tuen Mun New Town (4 km east of the proposed site).

3.2.2 Existing Industrial

The following industrial facilities currently operate in the area surrounding the proposed steel mill site:

- Container Storage Area under short term tenancy (STT) agreement (operating on a portion of the proposed site). There are other STT Container Storage Areas also operating in Areas 45C, 46A and 47;
- China Cement Works (adjacent to and northwest of the proposed site);
- Castle Peak Coal Fired Power Station (400 metres northwest of the proposed site);
- Block Making factory (Area 38, 1 km east of the proposed site);
- Cement Batching Plant (Area 38, 1km east of the proposed site);
- Waterfront activities e.g. boatyards, sawmills (Area 40, 2 km east of proposed site).

3.2.3 Existing G/IC

The following are located in the proximity of the proposed Steel Works site:

- Siu Lang Shui fresh and salt water service reservoirs (Area 49, on top of the embankment directly north of the proposed site);
- Pillar Point sewage treatment plant (Area 47, 1.8 km east of proposed site);
- the restored Siu Lang Shui Landfill (Area 38B, 300 m to the northeast of the proposed site);
- the operating Pillar Point Landfill (located between ridges in Area 46B, 1.8 km to the northeast of the proposed site);
- fisherman's graves (Area 38B, 1.6 km east of proposed site). It is understood that these will be relocated either in Areas 24 or 50. Thus there would be no fung shui impact with regard to the proposed steel mill.

3.2.4 Existing Cultural Centres, Ecology and Amenities

There are various other sites and activities in the environment surrounding the proposed steel works site that may be viewed as sensitive receivers, and these are summarised here:

- Butterfly Beach, which is gazetted and in the North West Water Control Zone. The water quality at the beach is classified as barely acceptable (Area 45, 2.7km to the east of the proposed site);

- Lung Kwu Tan archaeological site (4 km north of the proposed site);

- three islands of Special Scientific Interest (SSIs) because of their importance as resting grounds for migratory birds:

  - Lung Kwu Chau (4 km west of proposed site)
  - Sha Chau (5 km south west of proposed site)
  - Pak Chau/Tree Island (5 km west-southwest of proposed site);

- the Department of Agriculture and Fisheries advise that some 60 fishing vessels are known to fish regularly in the sea area between Pillar Point and Tap Shep Kok (directly off the coast of the proposed site). The annual fishery production is estimated at 36t, and valued at approximately HK$1 million;

- the Siu Lang Shui area is not an agricultural area, Lung Kwu Tan being the nearest farmed land at a distance of over 2 km. There are no local areas keeping livestock or fishfarms;

- quarrying and landfills have resulted in much of the local area having little ecological importance. The area north and adjacent to the proposed steel mill site comprises barren slopes of no ecological significance. Small scrubland is evident on the slopes just behind Siu Lang Shui beach with *Pinus elliottii*, *Losuarine agrictifolic*, *Tiochidion dasyphyllum*, *Rhus chinensis*, *Lantana camera*, *Phychotria rubra* and *Gleichenia lineas*. Dense tropical shrubs can be found in the grassland further north in the Castle Peak firing range.

  The proposed steel mill site is partly existing and the remaining area would require reclamation. The existing area is of no significant ecological importance.

3.3 PLANNED LAND USE

There are many new developments planned for the area local to the proposed steel mill (see Figure 3.1). Local planning is detailed in the Adopted Layout Plans L/TM 40/IN and L/TM 38/1A. Strategic planning in the area is detailed in the Port and Airport Development Study (PADS), the Sub-Regional Land Use Plan and the Expanded Development Study of Tuen Mun Area 38. Future developments are summarised below.

3.3.1 Planned Residential

- A low density housing development is planned for 1000 people (Area 45C west, 2.6km east of the proposed steel mill). Development would include two schools, a hotel and a leisure centre.

3.3.2 Planned Industrial

- Area 38B is planned for reclamation and extensive industrial development which will include a 55 hectare Special Industrial Area (SIA). The proposed steel mill would be located at the western end of the SIA with factories of high employment density towards the eastern end. The proposed industries for the SIA are:

  - Centralised Incinerator
  - Chemical Waste Bulking/Treatment
  - Textile, Bleaching, Dyeing and Finishing
  - Bulk Cement Storage & Distribution
  - Styrene Monomer Storage/Delivery Site
  - Acetyl Plant
  - Polyester Plant
  - Polystyrene Resin Plant
  - Paper Processing Plant;

- planned development in Area 38B includes a 56 hectare River Trade Terminal (RTT) as part of PADS, 1 km east of the proposed steel mill site and adjacent to the SIA. Further deep waterfront industry and a cargo working area are planned beyond Area 38 and west of Castle Peak power station. More deep waterfront industry has also been suggested on reclaimed land at Deep Water Bay, to form a ribbon of major port development around the coast;

- a 40 hectare Multi-Purpose Terminal (MPT) may be located off Tuen Mun Area 40 adjacent and east of the RTT, at a distance of 2 km from the proposed site;

- Water Treatment Plant (Area 22, 7 km north-east of the proposed site).

3.3.3 Planned G/IC

- Tuen Mun West fresh water service reservoir (Area 38A, 1km east of the proposed site);

- crematorium, columbarium and funeral Services Centre (Area 46A, 2 km east of the proposed Steel Works);

- Livestock Waste Consolidation Plant (Area 49, some distance east of the proposed site);

- a golf course is proposed (Areas 45A and 45C, 3km east of the proposed steel works).

3.3.4 Other Planned Facilities

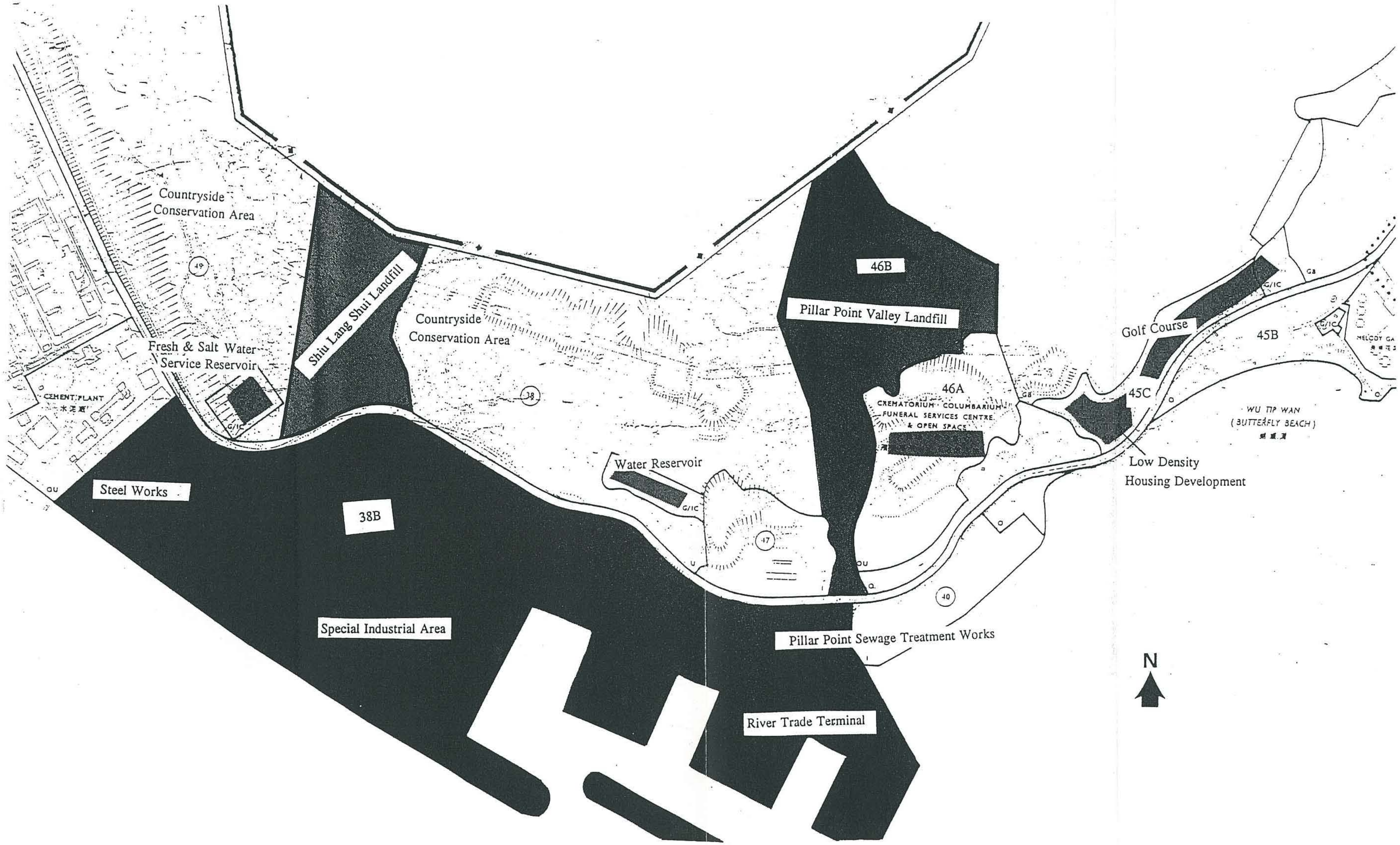
- The North Western New Territories Sub-Regional Land Use Plan (a non-statutory document) designates the western part of Area 38A and Area 49 as a Countryside Conservation Area (north of, and adjacent to, the proposed site);

- agricultural reserves are planned (Areas 55 and 56, more than 7km east of the proposed site).

3.4 DISCUSSION

- The proposed steel mill would be located in the relatively undeveloped SIA of Tuen Mun Area 38. This area and the surrounding environment are to undergo substantial development in the near future and the nature of the area will change significantly;

- the environmental impact that the proposed steel mill would have upon the sensitive receivers identified in this Chapter are assessed in Chapters 4 to 9 with regard to pollution resulting from liquid, air, solid, noise pollution, visual and traffic impact.



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Shiu Wing Steel Mill

Figure 3.1: Proposed Developments in the Surrounding Area

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Chapter 4
Air Quality

4. AIR QUALITY

4.1 INTRODUCTION

This chapter analyses the dispersion of emissions from the steel mill and assesses the likely impact of these on neighbouring land. The assessment has been undertaken using the AUSPLUME dispersion model, which has been used with local meteorological data, emissions data, and information about the local terrain to predict the concentrations of emissions at ground-level and at 30 m above ground-level.

The remainder of the chapter provides details of the analysis under the following headings:

- emissions and proposed controls
- dispersion characteristics of the area
- Hong Kong air quality objectives (AQO)
- procedures adopted in the modelling study
- predicted air quality impacts (operational)
- construction impacts.

4.2 EMISSIONS AND PROPOSED CONTROLS

4.2.1 Operational Phase

The operation of the mill is described in Chapter 2, and air emissions are discussed generally in Section 2.5.1. This section is confined to a discussion of those aspects of the operation that are relevant to air pollution.

The EPD have issued a set of Best Practicable Means (BPM) guidelines on control of air pollution control for Iron and Steel Works/EAFs (Appendix 4A), which would be used as a basis for licence conditions. The steel mill would be designed to meet these guidelines.

The principal emissions will be particulate matter, sulphur dioxide and nitrogen dioxide. Sulphur dioxide emissions will occur from the re-heat furnace, which will burn fuel oil containing up to 0.5% sulphur. Small quantities of nitrogen oxides will be emitted from the EAF and the re-heat furnace. Some carbon monoxide will also be emitted from the EAF stack.

Particulate matter emissions will occur as :

- fugitive emissions from activities such as the handling of scrap, slag and other raw materials, for example lime, and any residual emissions from building roof vents;

- controlled emissions from the EAF stack, and as part of the products of combustion from the reheat furnace.

The mill is planned to have a rolling capacity of 650,000 t/a and steel making capacity of 500,000 t/a. It will receive scrap product by barge and road and after sorting to remove any extraneous material and cutting to size the scrap will be loaded to bins for charging to the EAF. As described in Section 2.5.1, particulate emissions would be captured by a high volume dust collection system of capacity 640,000 Nm^3/h, and the air is de-dusted by filtering with a fabric filter system.

The de-dusted air from the EAF will meet EPD's license limit as set out in the BPM guidelines for this emission of 30 mg/m^3. For the purpose of estimating total suspended particulate (TSP) emissions, and for modelling the dispersion of TSP, the TSP loading in the discharged air has been assumed to be 10mg/m^3. This is an arbitrary figure chosen as a convenient basis for modelling and for the assessment. By comparison the measured emissions from the EAF at the Tseung Kwan O steel mill range from about 3 to 17 mg/m^3.

Based on the data collected from the current operation of the EAFs, and information supplied by prospective furnace suppliers, measured emissions from the proposed EAF furnace may be expected to vary from 2-3 mg/m^3 up to the BPM guideline limit of 30 mg/m^3. However the median figure is expected to be in the range 10 to 15 mg/m^3.

As noted in Sections 2.2.3 and 2.5.1, the fabric filters would be of pulse jet or reverse air design, and utilise a felt cloth. The filtration velocity would be approximately 1.1 m/min, which conforms to good practice for the intended use. It is proposed that tribo-electricity technology or alternative dust monitors would be fitted to the fabric filter outlet ducts to give early warning of any filter bag failure.

The residual dust emitted from the EAF stack would contain a proportion of heavy metals. Based on an analysis of existing filter dust, the total heavy metals would be approximately 15.5% (Section 7.2.2), primarily zinc (12.2%), manganese (1.7%) and lead (1.4%). Based on the emission limit of 30mg/m^3 set out in the EPD BPM guidelines, the predicted heavy metals emission rate would thus comprise 3.7mg/m^3 zinc, 0.5mg/m^3 manganese, 0.4mg/m^3 lead, and 0.4mg/m^3 other, including mercury, chromium, cadmium, vanadium and nickel.

There are no promulgated Hong Kong emission standards for heavy metals, although such standards may be set under best practicable means (BPM) requirements or licensing. The Hong Kong BPM notes for EAFs (Appendix 4A) include limits for lead (2mg/m^3) and cadmium (1mg/m^3). The emissions from the steel mill would meet these levels.

At the completion of each cycle, slag and molten iron will be removed from the furnace. Approximately 30,000 tonnes of slag will be produced per year. This will be removed from the site by trucks which will be loaded by front-end loader. In accordance with BPM, the slag handling area would be enclosed as much as practicable, and water sprays used as necessary to further minimise emissions.

The slag handling operation is estimated to produce approximately 3,900 kg of TSP per year. For the purpose of this assessment, it is assumed that 30% of this TSP would escape to the outside environment (that is 70% control would be achieved by partial enclosure of the slag handling area). Thus the net emission would be 1,170 kg/a, which based on a 300 day operating time gives 0.045 g/s as the maximum emission rate averaged over 24 hours. Details of the calculation of the estimate are provided in Appendix 4C.

An estimate is also provided in Table 4.1 of any residual emissions from building roof vents. This estimate accepts the practical reality that 100% collection of fume and dust from a steel mill is not feasible, and that even with the best hood and collection system design some fugitive losses will inevitably occur. The principal source for fugitive dust will be the roof vent of the rolling mill. There will be no roof vents in the EAF building.

Table 4.1 summarises all significant air emissions estimated to occur from the plant. The stack and emission point locations are shown in Figure 4.1, and by co-ordinate in Table 4.1. The emission rates in Table 4.1 are expressed in g/s, averaged over one hour. Over 24 hours the mill would be expected to operate for approximately 83 per cent of the time and in any year the plant would be expected to operate for 300 out of the 365 days. These factors have been incorporated in the modelling results in producing the ambient concentration isopleth diagrams for annual average concentrations presented later in this chapter. For the 24-hour concentrations it has conservatively been assumed that the emissions continue at the hourly level for 24 hours.

Table 4.1 shows building and chimney heights used in the dispersion modelling study. The largest building on site is the rolling mill, which is expected to be 18m high. The EAF building is expected to be about 30m high, except for the EAF fume hood, which will project to about 43m.

The fume hood extension is expected to be a comparatively small section of the building, of cross section about 20 x 25m, and would be located some 70m and 75m from the EAF furnace and reheat furnace chimneys respectively. It will thus not have a major effect on overall air flow over the building, or on the EAF and reheat chimneys. For modelling purposes, rolling mill and EAF building heights of 18m and 30m respectively have been assumed.

The estimated emissions summarised in Table 4.1 can be derived from information concerning the operation of the mill presented in earlier sections. However some additional assumptions not discussed earlier have been made. These are discussed below. Details of calculation of the more complicated emission rates are shown in Appendix 4C.

Emissions of NO_x from the EAF have been estimated using measurements (provided by EPD) of Shiu Wing's existing furnace. The maximum hourly measurement has been used in the calculations; thus the calculated longer term averages will be conservative.

Table 4.1 Summary of air emission parameters

Parameter	Source					
	Arc furnace stack	Re-heat furnace stack	Rolling mill	Vehicle movements - scrap/product	Scrap handling - sea/scrap	Slag handling
Location of emission point	800932 mE 2476872 mN	801976 mE 2476788 mN	801061 mE 2476835 mN	Seven sites used in modelling (East side)	Eight sites (seven for sea and one for road)	801000 mE 2467865 mN
Height of emission (m)	35	35	18	2	5	5
Volume of gas	640,000 Nm^3/h 797,070 Am^3/h	72,147 Nm^3/h 185,252 Am^3/h	1,296,000 Nm^3/h	-	-	-
Temperature (°C)	67°C	120°C	ambient	ambient	ambient	ambient
Building height (m)	35	35	18	-	-	-
Building width (m)	25	25	50	-	-	-
Emission point diameter/width (m)	3.75	2.09	volume source w=20, h=18	volume source w=50, h=4	volume source w=25, h=10	volume source w=20, h=10
Exit velocity (m/s)	20	15	-	-	-	-
Particulate emission (g/s)	1.78	0.23	0.18	0.036/0.151	0.035/0.015	0.045
SO_2 g/s	-	8.07	-	-	-	-
NO_x g/s	5.59	4.89	-	-	-	-
CO g/s	186	-	-	-	-	-

For the reheat furnace NO_x emissions have been estimated using data from the Rooty Hill steel mill EIA except that emissions have been increased by a factor of 3.15 (2.6 to account for the larger size of the current mill and 1.21 to account for the use of fuel oil compared with natural gas which is used at Rooty Hill). The factor of 1.21 for fuel oil compared with natural gas is taken from data presented in a US EPA (1973) engineering manual.

Emissions of TSP from the rolling mill roof vents have been based on the Rooty Hill data but the volume of ventilation air has been taken to be the same as at Rooty Hill. This is because the proposed steel mill will quench the steel using water, and the volume of natural ventilation air will thus be less than at Rooty Hill for a given throughput. In addition because of the water usage the dust loading in the air has been taken to be 0.5 mg/m^3.

Despite these assumptions, observation at the existing Tseung Kwan O steel mill suggests that these ventilation emission rates are very conservative, and in practice will be much lower than used in the modelling.

Dust emissions from vehicle movements have been based on a emission factor of 0.477 kg/km of vehicle movement (kg/VKT) (Appendix 4C), and the estimate that 30% of scrap will be delivered by road (the 70% by sea will not require vehicle movements), and that 75% of product will be exported by road and 25% by sea. It should be noted that the proportion of scrap arriving by sea and road could change in the future, however the overall effect of this charge on emissions estimates is not expected to be significant.

For material exported by sea there will be some on-site vehicle movements to transfer the product to the barges. Total dust emission from on-site transport of product is estimated to be 3,918 kg/a or 0.151 g/s (hourly average based on 300 days per year operation). Dust from on-site transport of incoming scrap is estimated to be 930 kg/a or 0.036 g/s (Appendix 4C) (average hourly rate based on 300 operating days per year).

Dust emissions from the handling of slag assumes a generation rate of 0.13 kg/t of slag handled (Appendix 4C) and also assumes 70% control of TSP generated to give a net emission rate of 1,170 kg/a or 0.045 g/s (average hourly rate based on 300 operating days per year).

4.2.2 Construction Phase

During the construction of the steel mill the following activities have potential to result in local dust nuisance:

- Fill material - 100,000 m^3 of rockfill and 1,000,000 m^3 of softfill are anticipated to be required to effect the site reclamation. Most of the rockfill and the bulk of the softfill is expected to be transported to site by sea. Only softfill that is obtained from land borrow areas has significant potential air quality impacts. Dust can be generated by handling, storage and spreading of dry soft fill.

- Vehicles - dust can be generated by vehicle movements on unsealed areas or dry, dusty roads. The dust quantities released depend on the silt content of the road material, vehicle speed, vehicle number, and weather conditions. Mud and dirt from construction areas may also be carried on to nearby roadways, dry out, and be entrained by passing vehicles. Vehicles will also emit exhaust fumes.

- Concrete batching - on-site concrete batching can be a source of dust emissions. There would not be any concrete batching plant on site during site formation. The large concrete blocks for the seawall will be pre-cast off-site. At this time it is not known whether the contractor for the marine pier or above ground works would use an on-site batching plant.

- Construction materials - windy conditions can generate significant volumes of dust from the disturbance of stockpiled materials.

4.3 DISPERSION CHARACTERISTICS OF THE AREA

4.3.1 Wind speed and direction

The wind speed and wind direction data used in the study were supplied by the Hong Kong Royal Observatory from data collected during 1989 and 1990 at a meteorological station at Chek Lap Kok. The data comprises ten minute averages of wind speed on the hour for each hour in the year. Wind direction data were provided on the hour as a wind direction values in degrees within ten degree intervals.

The dispersion model used to assess the dispersion of dust requires valid data in 24-hour blocks. Thus the Royal Observatory data set was edited to discard days where three or more hours of invalid or missing data occurred consecutively. Where two or less hours were missing the invalid or missing data were replaced with interpolated values.

Wind direction data were randomised by adding a random number between -5 and +5 to the Royal Observatory data so that the adjusted data consisted of values to one degree instead of the original values, which were logged in ten degree intervals. In addition, for modelling purposes it has been assumed that the minimum wind speed is 1.0 m/s. (Note: For this reason no calm periods are reported in the wind rose diagrams).

After processing the wind data as described above, a total of 8688 valid hours were available for 1989 and 8606 valid hours for 1990 (this corresponds to 99.2 per cent data recovery for 1989 and 99.2 per cent for 1990). The data are summarised by the seasonal and annual wind rose diagrams in Figures 4.2(A) and 4.2(B). Joint wind speed-wind direction and stability class tables are presented in Appendix 4B.

The most common winds on an annual basis are from the E and ESE. Data from Tuen Mun were also considered but the alignment of winds shown at Tuen Mun is influenced strongly by the local topography in the Tuen Mun area. Although the site is close to Tuen Mun, the Tuen Mun data would not be as representative of the steel mill site (which is located on a more exposed headland) as the Chek Lap Kok data.

The seasonal wind roses in Figures 4.2(A) and 4.2(B) show the variation in the pattern of winds over the year. The predominant summer winds are from the E, ESE and S, autumn winds are from the E, ESE and NNE, winter winds are from the E and ESE and spring winds are from the E and ESE.

Tables presented in Appendix 4B show the frequency of occurrence of various wind speed classes and stability conditions as a function of wind direction. The data shows the frequency of occurrence of different stability class. The annual average wind speed for Chek Lap Kok was 5.14 m/s in 1989 and 5.10 m/s in 1990.

4.3.2 Rainfall

Table 4.2 summarises the monthly and annual average rainfall and evaporation amounts for Hong Kong. Mean annual rainfall is 2214 mm which exceeds the mean annual evaporation of 1762 mm by 452 mm. However the winter months are comparatively dry and evaporation exceeds rainfall by a significant margin on at least six months of the year.

Table 4.2: Hong Kong Meteorological Data Summary

Table 4.2 Summary of monthly meteorological data for Hong Kong (1884-1939 and 1947-1992)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year (total)
Rain (mm)	23.4	48.0	66.9	161.5	316.7	376.0	323.6	391.4	299.7	144.8	35.1	27.3	2214
Number of rain days (>0.1mm) (dimensionless)	5.63	8.93	10.07	11.13	14.93	19.23	17.47	17.30	14.37	8.60	5.87	3.87	137.4
Evaporation (mm)	120.2	93.2	114.8	124.5	169.7	159.4	182.2	170.1	171.6	179.6	150.0	126.9	1762
Temperature (°C)													
Mean max	18.6	18.6	21.3	24.9	28.7	30.3	31.5	31.3	30.3	27.9	24.2	20.5	25.7
Mean	15.8	15.9	18.6	22.2	25.9	27.8	28.8	28.4	27.6	25.2	21.4	17.6	23.0
Mean min	13.6	13.9	16.5	20.2	23.9	26.9	26.6	26.3	25.5	23.1	19.2	15.4	20.9
Relative Humidity (%)	75	79	83	85	85	84	83	84	79	72	69	70	79

Source: Hong Kong Royal Observatory

4.3.3 Temperature and humidity

Temperature and humidity data are also presented in Table 4.2. Mean maximum temperatures are highest in July when the mean maximum is 31.5°C and lowest in January when the mean minimum is 13.6°C. The highest recorded maximum was been 36.1°C (18 and 19 August 1990) and the lowest minimum was recorded on 18 January 1893.

Relative humidity is highest in April/May and lowest in November, which is also the driest part of the year.

4.3.4 Atmospheric stability

Atmospheric stability is a parameter that describes the state of turbulence of the atmosphere and is a measure of the capacity of the atmosphere to disperse pollution. In the assessment procedure used in this study, atmospheric stability was assigned by the Royal Observatory and provided with the meteorological data file. Pasquill-Gifford stability classes were used. In the Pasquill-Gifford classification six stability categories, A through to F, are used.

Stability class A corresponds to light winds occurring with strong insolation. Mixing of plumes is rapid in these circumstances. Class B stability occurs under either cloudy or windy conditions or both cloudy and windy conditions. Again dispersion is generally rapid. Class F occurs under light wind conditions at night with clear skies. It is associated with inversions and poor dispersion. The other classes represent intermediate conditions.

Analysis of the Chek Lap Kok data shows the following distribution of stability classes for 1989 and 1990:

	1989	1990
Stability A	0.8%	0.7%
Stability B	7.7%	9.2%
Stability C	9.3%	9.6%
Stability D	61.4%	60.3%
Stability E	8.4%	8.8%
Stability F	12.4%.	11.4%

4.3.5 Mixing-height

Mixing-height is the height through which the emissions from a low level source would ultimately be mixed. The mixed-layer is usually capped by an inversion which limits the height through which the emission is mixed. Mixing height data for 1989 and 1990 have been analysed by the Royal Observatory and were made available to the study. The data comprised two estimates of mixing height per day, one related to night time conditions and the other to the maximum mixing height reached in the day.

In the AUSPLUME model, data are required for each hour of the day. To provide the required data it was assumed that the minimum mixing height recorded applied for all night time hours (one hour before sunset to one hour after sunrise). In the day, hourly data were determined from the maximum value provided by the Royal Observatory by fitting a quasi-sinusoidal curve to the mixed layer height as described by Powell (1976).

4.4 HONG KONG AIR QUALITY OBJECTIVES

Government policy sets Air Quality Objectives (AQOs) for seven main urban air pollutants. Objectives relevant for the present study are those relating to particulate matter, sulphur dioxide, nitrogen dioxide and carbon monoxide. The objectives are listed in Table 4.3.

The AQOs apply to pollution from all sources, and not to any single activity. In this respect, because suspended particulate is the pollutant of key concern, EPD have set an acceptable increment in 24-hour TSP concentrations from the site of 40 $\mu g/m^3$, which takes account of TSP contributed from other sources nearby.

Table 4.3 : Hong Kong Air Quality Objectives

Pollutant	**1-hour**	**24-hours (8-hours for carbon monoxide)**	**1-year (3 months for lead)**
Total Suspended Particles	-	260 $\mu g/m^3$ (not to be exceeded more than once per year)	80 $\mu g/m^3$
Respirable Particles	-	180 $\mu g/m^3$	55 $\mu g/m^3$
Sulphur dioxide	800 $\mu g/m^3$ (not to be exceeded more than three times per year)	350 $\mu g/m^3$ (not to be exceeded more than once per year)	80 $\mu g/m^3$
Nitrogen dioxide	300 $\mu g/m^3$ (not to be exceeded more than three times per year)	150 $\mu g/m^3$ (not to be exceeded more than once per year)	80 $\mu g/m^3$
Carbon monoxide	30,000 $\mu g/m^3$ (not to be exceeded more than three times per year)	10,000 $\mu g/m^3$ (not to be exceeded more than once per year)	-
Lead	-	-	1.5$\mu g/m^3$

4.5 AIR QUALITY MODELLING PROCEDURES

The AUSPLUME model was used in a standard manner in the present study with the exception of one set of model runs in which all terrain elevations of the receptors were raised by 30 m above their actual heights to assess the concentrations that would be expected in an open structure 30 m high. This evaluation was requested by EPD.

Terrain information was read from 1:20000 topographical maps of the area. Two terrain files were prepared. One had a grid spacing of 250 by 250 metres and occupied an area 9 km (east-west) by 7 km (north-south) as shown by the widely spaced dots in Figure 4.3. The second had a spacing of 50 m by 50 m and occupied an area 1 km by 1 km as shown by the closely spaced dots in Figure 4.3.

Terrain elevations were associated with each grid point, but for the fine grid these were set at a nominal height of 5 m above sea-level, which was assumed to be the final height of the reclaimed land. This assumed elevation is not critical in the modelling study because the bases of all stacks were taken to also be at 5 m above sea-level.

4.6 PREDICTED AIR QUALITY IMPACTS (OPERATIONAL)

4.6.1 Location of Sensitive Receivers

There are a number of existing and planned Sensitive Receivers (SRs) around the proposed steel mill, as described in Section 3, Surrounding Landuse. The principal settlement is Tuen Mun New Town, which is approximately 4 km east of the proposed site, and the areas of Melody Garden, Butterfly and Wu King residential estates, which are approximately 3 km from the site.

However, the nearest SRs to the east are the Temporary Refugee Camp (TRC) at Pillar Point (Area 46, 2 km east of the proposed site) and a proposed low density housing development (for 1000 people) in area 45C, 2.6km east of the site. The Camp is a temporary development and is scheduled to be closed by December 1994.

To the north-northwest of the proposed site are the village settlements of Lung Tsai, Tuk Mei Chung, Sha Po Kong and Nam Long. These villages are occupied by a population of about 500 lying in cottage type residential premises. The closest village is 1.8 km from the site.

Although the closest SR to the site are the village settlements to the north-northwest, these villages are screened from the proposed development site by mountainous terrain. Further the living environment at these settlements is dominated by the Castle Peak Power Station and the cement works.

The principal SRs are therefore considered to be the Pillar Point TRC and the proposed low density housing development. As the TRC is scheduled to be closed by December 1994 this SR is only relevant during the initial stages of the construction of the steel mill. At the time of writing no dates are known for the development of the low density housing proposal.

4.6.2 Particulate matter

Assessment

Figures 4.4 to 4.9 show the following:

- the annual average TSP ground-level concentrations
- the annual average TSP concentrations 30 m above ground-level
- the maximum 24-hour TSP ground-level concentrations
- the maximum 24-hour TSP ground-level concentrations (on the fine grid)
- the maximum 24-hour average TSP concentrations 30 m above ground-level
- the maximum 24-hour average TSP concentrations 30 m above ground-level (on the fine grid).

Contours shown in these plots (and in other following plots) are in the following increments so unlabelled contours can be determined - 0.01, 0.05, 0.1, 0.5, 1, 2, 5, 10, 20, 30, 40, 50, 60, 70, 90, 120, 150, 200, 250 $\mu g/m^3$.

The annual average contour plots indicate levels dropping rapidly to about 0.5$\mu g/m^3$ at the boundary of the Area 38 SIA area. There would thus be negligible impact on the nearest SR, the Pillar Point TRC.

Using the emission figures in Table 4.1, the 40$\mu g/m^3$ 24-hour increment set by EPD for the project is met approximately within the boundaries of sites immediately adjacent to the steel mill. At the nearest SR the highest 24-hour average is predicted to be about 2$\mu g/m^3$. At 30 m above ground-level, higher concentrations are estimated to occur over the site, however the 40 $\mu g/m^3$ due to the mill emissions extends just beyond the eastern boundary of the adjoining property to the east.

At EPD request, the point sources (the EAF furnace and the reheat furnace) were modelled separately to ascertain their contribution to predicted overall TSP levels resulting from the project. These results are shown in Figures 4.7(A) and 4.9(A), and indicate a comparatively minor contribution to overall TSP levels. Based on the arbitrary EAF emission rate of 10mg/m^3 chosen as the basis for the modelling study, the concentration at the outer boundary of adjacent sites is about 0.5 $\mu g/m^3$ (Figure 4.7A). Thus for the worst case emission rate of 30mg/m^3, the concentration would be only 1.5$\mu g/m^3$ compared with the EPD increment criterion of 40 $\mu g/m^3$. Thus fugitive emissions are the principal contributors immediately adjacent to the site, and control of fugitive emissions will be important to maintain acceptable TSP levels.

In interpreting this information the following points need to be made:

- the modelling has shown that emissions from the EAF and reheat furnace stacks are very minor contributors to air quality adjacent to the site.
- the mill will replace a temporary container handling depot, which is very dusty activity and an obvious significant contributor to TSP levels in the area.
- the 40$\mu g/m^3$ increment objective set by EPD was based on monitoring results that indicated high TSP levels in the area. The removal of the container handling depot, and expected improvements in control of fugitive dust emissions from the adjacent cement plant, should assist in lowering TSP levels.

Mitigation

As noted above the control of fugitive emissions will be important to maintain acceptable TSP levels. The proposed mitigation measures for fugitive emissions are:

- the rolling mill will use water quench for cooling the hot steel, which reduces the volume of ventilation air and hence the potential for fugitive emissions. In addition, observation at the existing mill indicates that fugitive emissions from the rolling operations are negligible; thus it is considered that the suggested emissions rate used in this assessment is very conservative;
- the vehicle movement emissions would be minimised by imposing a vehicle speed limit on site, keeping the roadways clean, and using water application in dry and windy weather. In addition the product storage yard is adjacent to the rolling mill, which is some 300m long, and is thus partially sheltered from wind effects;
- the slag handling area would be partially enclosed, and water would be used as necessary for cooling and for dust suppression;
- the emissions from scrap handling are dependent on the degree of rusting and the cleanliness of scrap received. If dusty scrap is received, emissions can be reduced by use of water sprays.

4.6.3 Sulphur dioxide

Figures 4.10 to 4.15 show the following:

- the annual average SO_2 concentrations at ground level and at 30 m above ground level;
- the maximum 24-hour SO_2 concentration at ground level and at 30 m above ground-level;
- the maximum 1-hour SO_2 concentration at ground level and at 30 m above ground-level.

It can be seen that all predicted concentration are well below the relevant AQOs.

4.6.4 Nitrogen dioxide

Figures 4.16 to 4.21 show the following:

- the annual average NO_x concentrations at ground-level and at 30m above ground-level;
- the maximum 24-hour NO_x concentrations at ground-level and at 30m above ground-level;
- the maximum 1-hour NO_x concentrations at ground-level and at 30m above ground-level;

Nitrogen oxides (NO_x) will be emitted mainly from the re-heat furnace and the EAF. Nitrogen dioxide (NO_2) concentrations are not shown on an isopleth diagram but have been assessed as follows. NO_2 levels from a combustion chamber are typically less than 2% of NO_x, however conversion of NO to NO_2 subsequently occurs in the flue system and the atmosphere. Typically it is accepted that NO_2 comprises approximately 5 to 10% of the total NO_x at the point of emission. Smith (1980) has reported 10% oxidation of NO to NO_2 occurring within about 3km downwind, increasing to 20% at 6km, 30% at 10km and 40% at 20km. For the purpose of this assessment, it was assumed that at the points where maximum ground-level concentrations occur, that 10 to 20 per cent of the NO_x may have been converted to NO_2.

Taking account of this factor, it can be seen that NO_2 concentrations will be within the AQOs.

4.6.5 Carbon monoxide

Carbon monoxide will be emitted from the EAF at the rate of approximately 186 g/s. A model run was used to determine the highest, second-highest and third-highest 1-hour and 8-hour concentrations at a height of 30m above ground-level. These were found to be 7,360, 7,250 and 7,190 $\mu g/m^3$ and 2,130, 2,010 and 1,950 $\mu g/m^3$ respectively, which are well within the respective AQOs of 30,000 and 10,000 $\mu g/m^3$. The ground-level concentration will be lower than the concentrations at 30m above the ground, and consequently they too will comply with the AQOs.

4.6.6 Lead

Minor quantities of lead would be emitted from the EAF stack. As described in Section 4.2, the lead emission is expected to be 1.4% of the dust emitted from the EAF stack. Lead emissions from the fugitive sources would be expected to be much less than this amount, because lead would be expected to be nearly completely volatilised in the EAF furnaces. Slag, for example, has less than 0.09% lead, and fugitive emissions from truck movements and scrap handling would also be low in lead emissions.

Ambient lead levels were projected directly from the TSP estimates assuming an emission rate based on all fugitive dust having a lead content of 1.4%. As described above, any such projections would be conservative. Based on the conclusions in Section 4.6.2, the maximum 24-hour average concentration of lead at the nearest SR would be less than $0.14\mu g/m^3$, and the annual average less would be less than $0.0014\mu g/m^3$. At the outer boundary of adjacent sites, the annual average would be less than 0.03 $\mu g/m^3$. These figures indicate that ambient lead levels arising from the steel mill would be well within the AQO of $1.5\mu g/m^3$ (3 month average).

4.7 CONSTRUCTION IMPACTS

4.7.1 Potential Impacts

Construction dust is not considered to pose any major threat to human health, as the particles are generally too large to be respirable. However, construction dust does have the potential to severely affect local amenity, and to cause nuisance.

The principal source of the respirable fraction will be diesel engines on construction equipment which would be a minor contributor to existing levels.

Construction dust has the following potential impacts:

- dust settling onto vehicles, into homes, and on washing;
- aggravating bronchial conditions and irritating eyes of pedestrians;
- fouling air conditioning systems;
- creating an unpleasant environment.

4.7.2 Mitigation

It is possible to reduce the potential impacts of construction dust nuisance through good housekeeping and the adoption of simple practical measures. Mitigation measures may be applied as indicated below.

- Housekeeping

  Good housekeeping on construction sites is essential to minimize construction dust. Areas that are neglected, in particular stockpiles of construction waste, excavated soil or construction material, can act as sources of dust in dry and windy weather. In addition, in wet weather, rain can carry off accumulated dust from these areas onto nearby roadways. When this dust dries out it can be entrained by passing vehicles.

  If unwanted or unneeded materials are removed from the site as soon as possible, and the site kept generally clean, the potential for dust nuisance can be reduced significantly.

- Water

  In dry and windy weather, fugitive dust emissions can be reduced considerably by application of water to those areas from which dust may arise.

  When spreading dry fill material, water spraying should be utilised to reduce dust emissions. Marine fill will not create much dust due to its wet nature.

- Vehicles

  Dust control measures for construction vehicles are:

  - water spraying of construction areas and roadways in dry and windy weather;
  - restriction of vehicle speeds;
  - wheel and under-body washing of trucks prior to leaving the site;
  - provision of wheel washing troughs;
  - damping or covering potentially dusty loads.

  The diesel engines used in construction vehicles and equipment may become smoky if not properly maintained. Diesel engines may also smoke if they are underpowered and the fuel mixture has been made richer in an attempt to deliver more power. Smoke from diesel engines can be prevented by:

- regular and proper maintenance, in particular by ensuring that the engine, injector systems and air cleaners are in good condition;

- ensuring the engine is properly tuned, and that the engine is of adequate power for the required duty.

• Stockpiling

Control measures for stockpiling are:

- erect a hoarding around the site to minimise off-site impacts;

- keep on-site stocks to a minimum;

- keep stockpiles contained in three-sided bunkers;

- good housekeeping to keep the area surrounding the stockpiles clean, in order to prevent dispersal of dusty material from beyond the stockpile area.

• Concrete batching

Appropriate control measures include:

- storage of aggregate and sand in either enclosed bins or in appropriately enclosed bays;

- keep yard areas clean and dampen with water in dry and windy weather;

- store bulk cement in closed silos fitted with appropriate fabric filters, and also high level alarms to prevent over-filling;

- venting the weigh hopper through a simple hanging filter, or to the bulk cement silo;

- covering of conveyors on top and sides, with a metal board under;

- enclosure of transfer points;

- use of fine water sprays around the truck charge point during loading of pre-mix materials into the truck mixer.

Provided mitigation measures such as those above are implemented, dust levels should not be unacceptable. It should be noted that a concrete batching plant of silo capacity greater than 50t is a specified process under the Air Pollution Control Ordinance. In addition EPD have draft BPM guideline notes for the control of dust from concrete batching plants.

4.8 CONCLUSIONS

The principal air emission from the plant will be particulate matter. By far the major potential dust source are the EAFs. This would be controlled by a fume extraction system passing to a fabric filter.

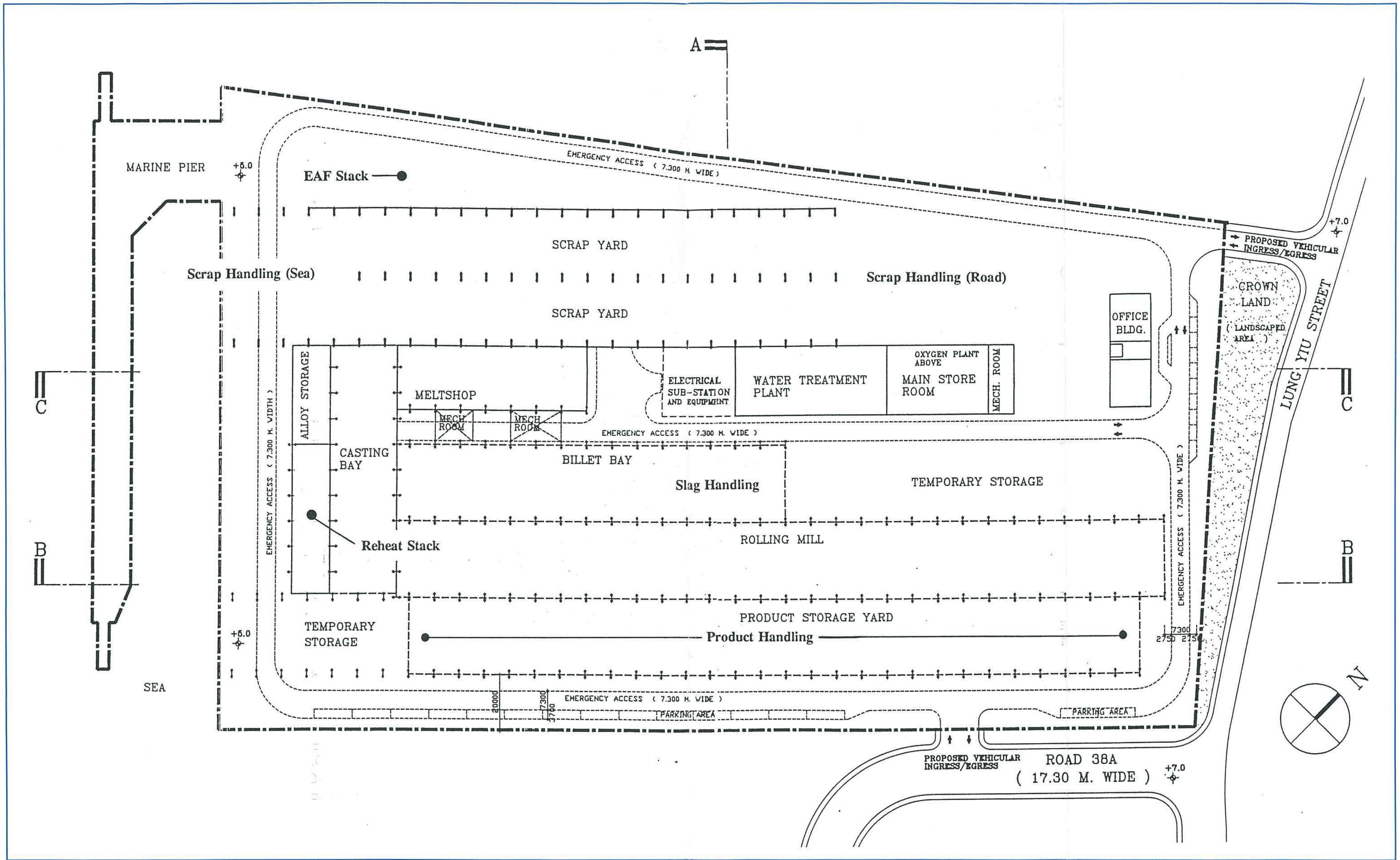
Fugitive dust emissions would also be generated from other parts of the process, including slag handling, and handling of refining agents including lime and alloying material. The best practicable means (BPM) of control would be used to minimise these emissions.

Other lesser emissions are sulphur dioxide and oxides of nitrogen from the re-heat furnace, and some carbon monoxide and oxides of nitrogen from the EAF stack. Fuel oil of maximum sulphur content 0.5% would be used to fire the re-heat furnace.

The EPD BPM guideline limit for the EAF is 30mg/m^3, 2 mg/m^3 for lead and 1mg/m^3 for cadmium. These limits would be met. EPD have also set an acceptable increment in the 24-hour TSP concentrations for the site of 40μg/m^3.

The emissions were modelled using the AUSPLUME model, and estimates obtained for ground-level and at a height of 30m. The modelling indicated that the EPD acceptable increment of 40μg/m^3 for 24-hour TSP is met approximately within the boundaries of sites immediately adjacent to the steel mill. All gaseous emissions, and also lead, are well within the AQO levels.

The modelling also showed that the EAF and reheat furnaces are low contributors to the particulate emissions from the site. For a worst case emission rate from the EAF furnace of 30 mg/m^3, the concentration at the outer boundary of adjacent sites is about 1.5μg/m^3, compared with the EPD increment criterion of 40 μg/m^3. Thus control of fugitive emissions will be important to maintain acceptable TSP levels.



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THE SITE

BUILDING ROOF AREA

LANDSCAPED AREA

ROBERT WEE ARCHITECTS
2102 TUNG SUN COMM. BLDG.
194 - 200 LOCKHART ROAD,
WANCHAI, HONG KONG
TEL. 511 8383, FAX 507 4915

0 50m

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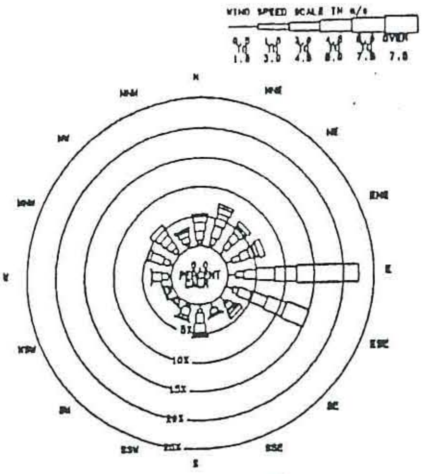
Shiu Wing Steel Mill

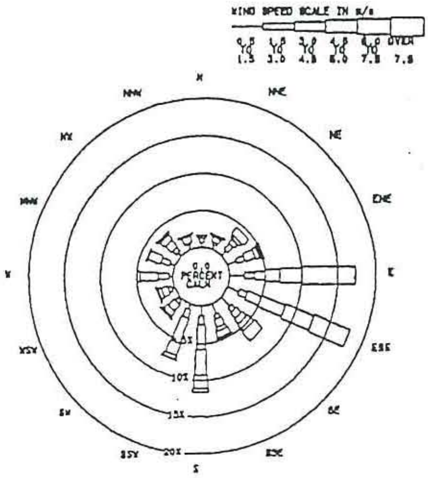
Figure 4.1: Air Emissions Sources

053000/October 1993

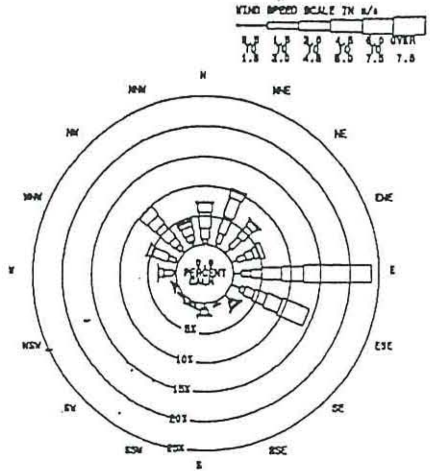
WIND ROSES FOR CHEK LAP KOK (1989)



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Chek Lap Kok 1989



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Chek Lap Kok Summer 1989



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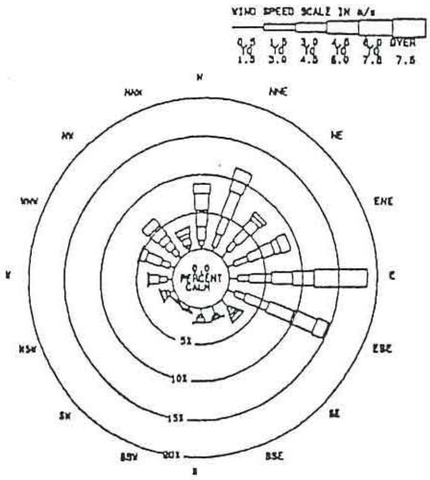
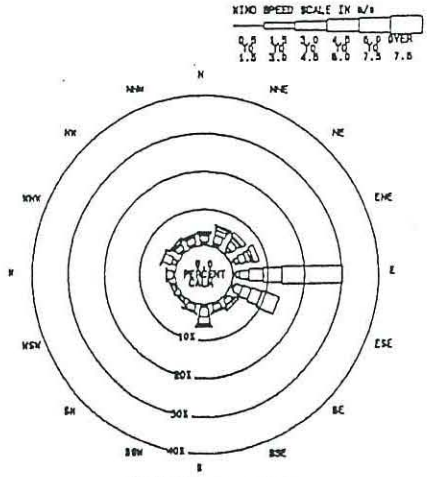
Chek Lap Kok Winter 1989



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Chek Lap Kok Autumn 1989



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Chek Lap Kok Spring 1989

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Figure 4.2(A): Wind Roses for Chek Lap Kok (1989)

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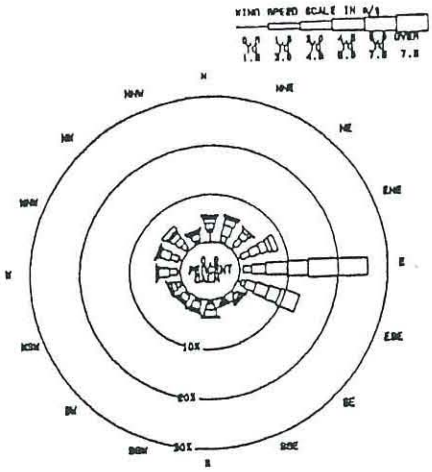
WIND ROSES FOR CHEK LAP KOK (1990)



DISTRIBUTION OF WINDS
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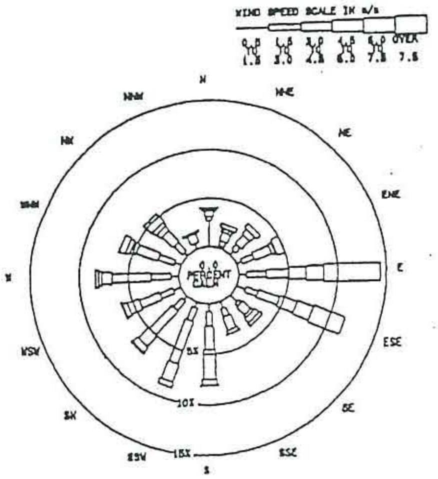
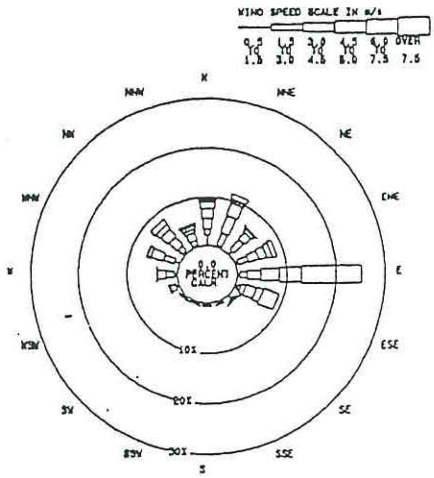
Chek Lap Kok 1990



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Chek Lap Kok Summer 1990



DISTRIBUTION OF WINDS
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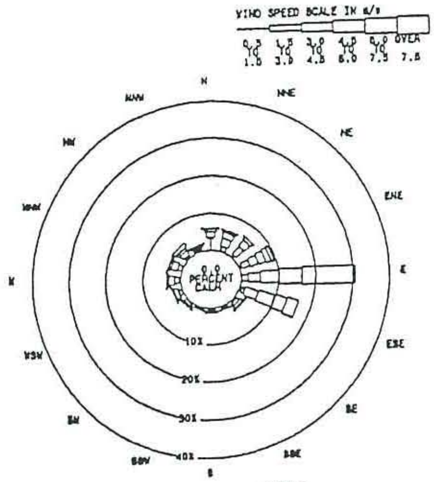
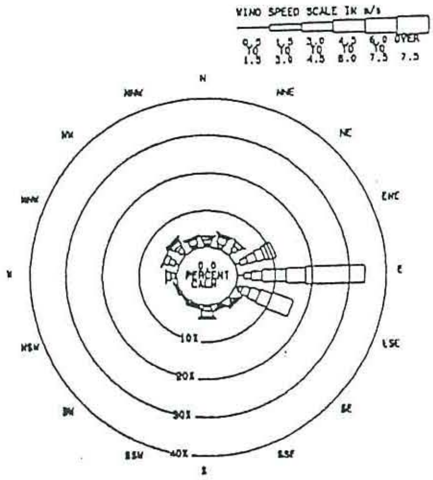
Chek Lap Kok Winter 1990



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Chek Lap Kok Autumn 1990



DISTRIBUTION OF WINDS
FREQUENCY OF OCCURRENCE IN PERCENT
Chek Lap Kok Spring 1990

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Figure 4.2(B): Wind Roses for Chek Lap Kok (1990)

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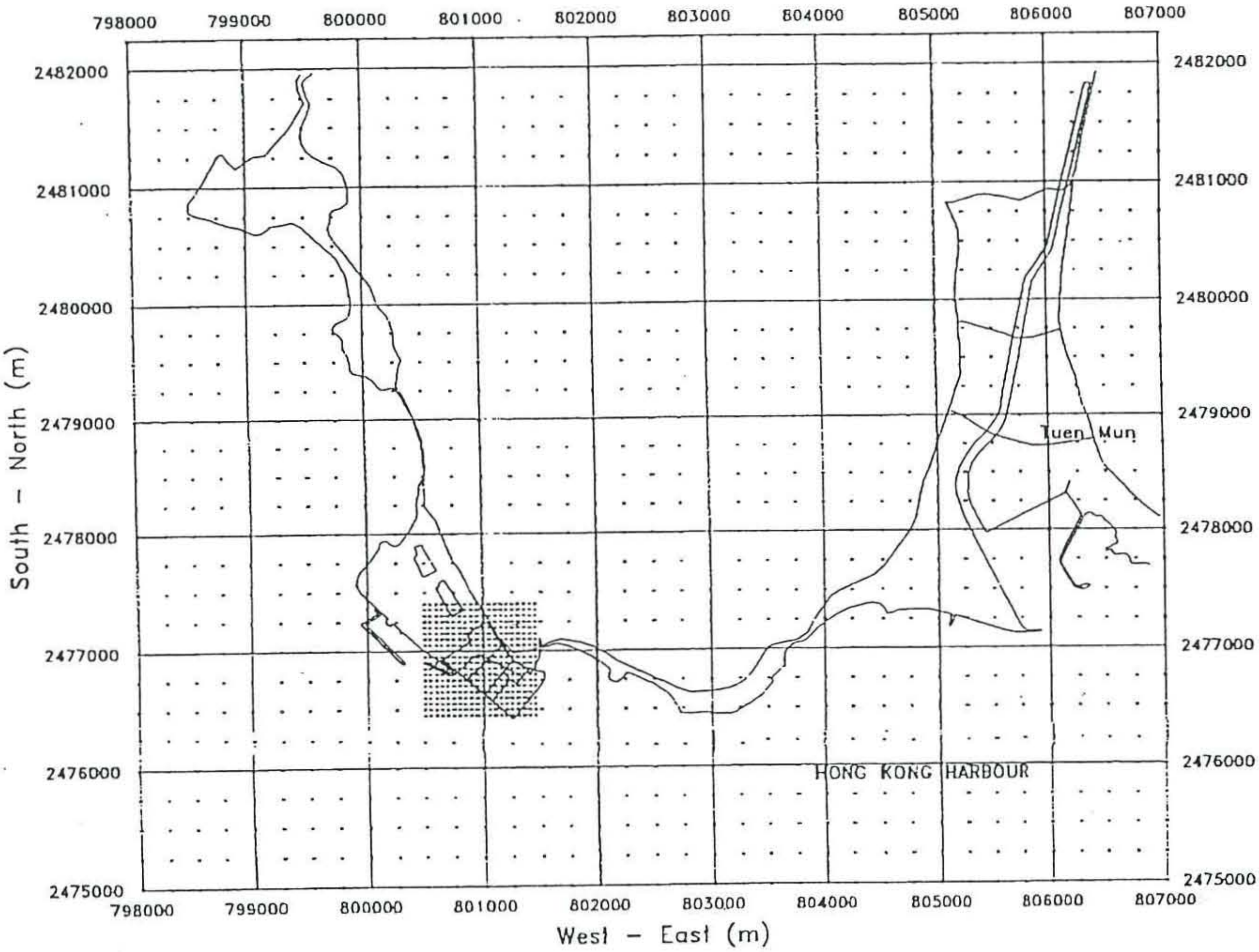

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Figure 4.3: Receptor Grid for Model Predictions

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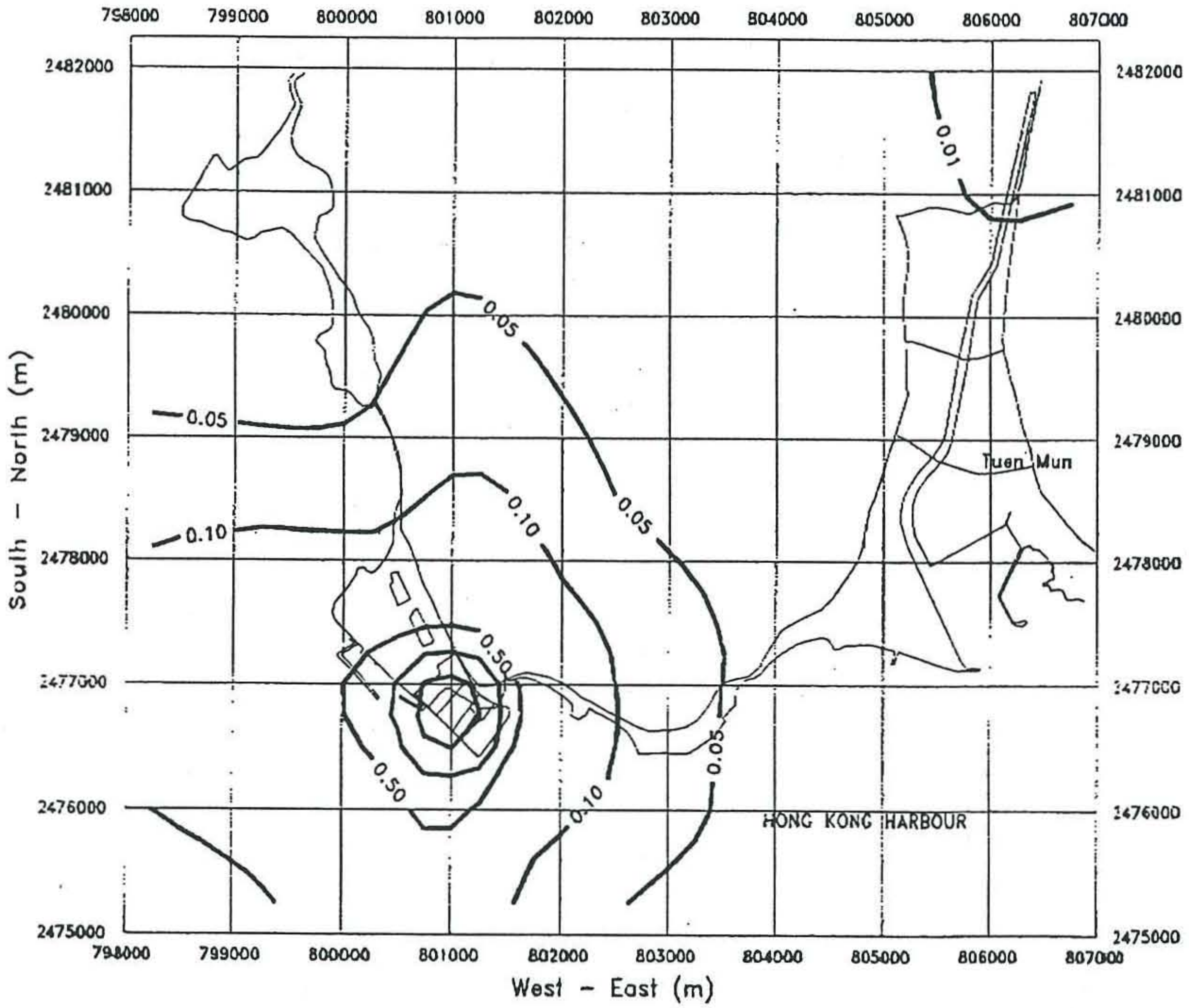

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Figure 4.4: Annual Average TSP Concentrations at Ground-Level ($\mu g/m^3$)

053000/October 1993

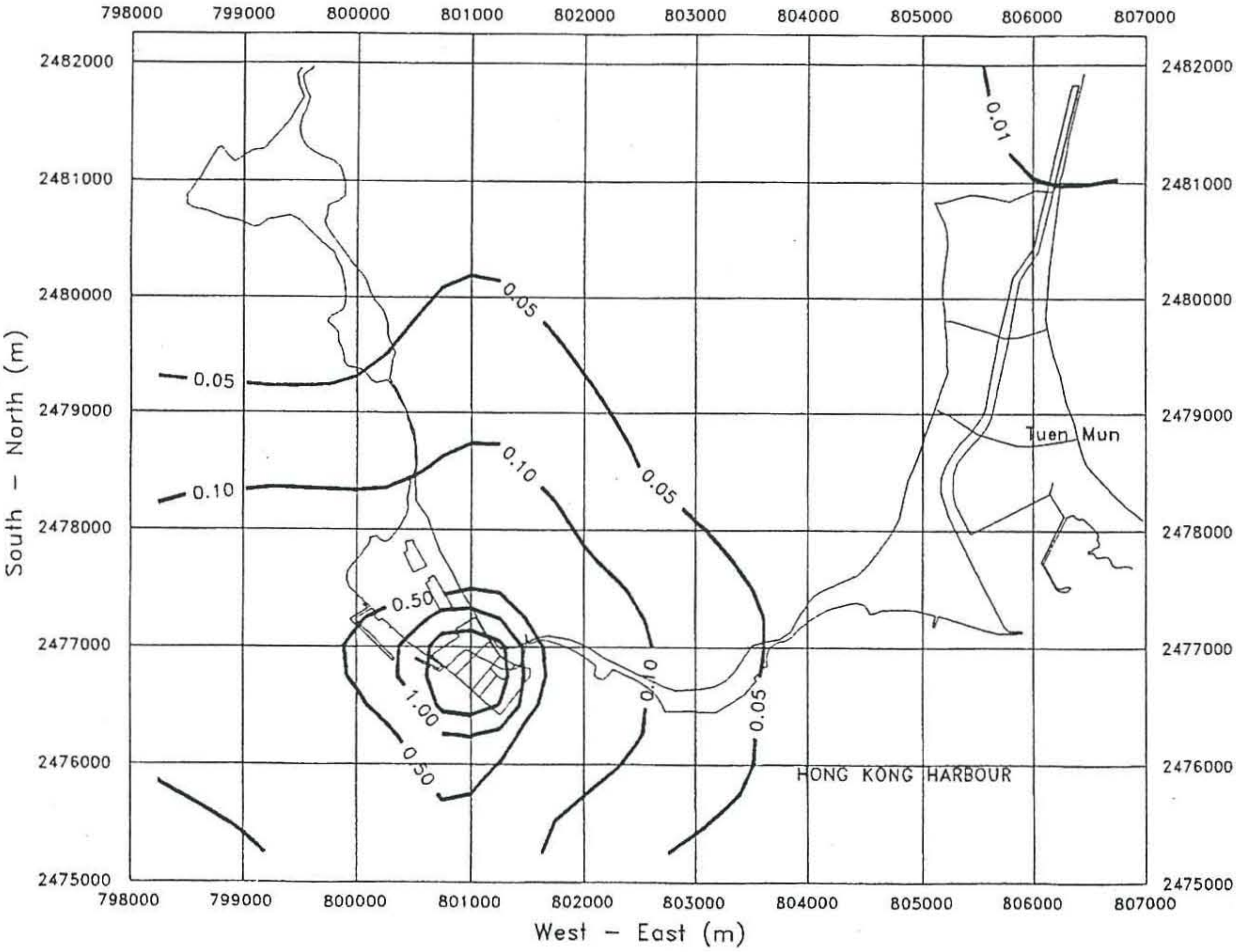

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Figure 4.5: Annual Average TSP Concentrations at 30m above Ground-Level ($\mu g/m^3$)

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053000/October 1993

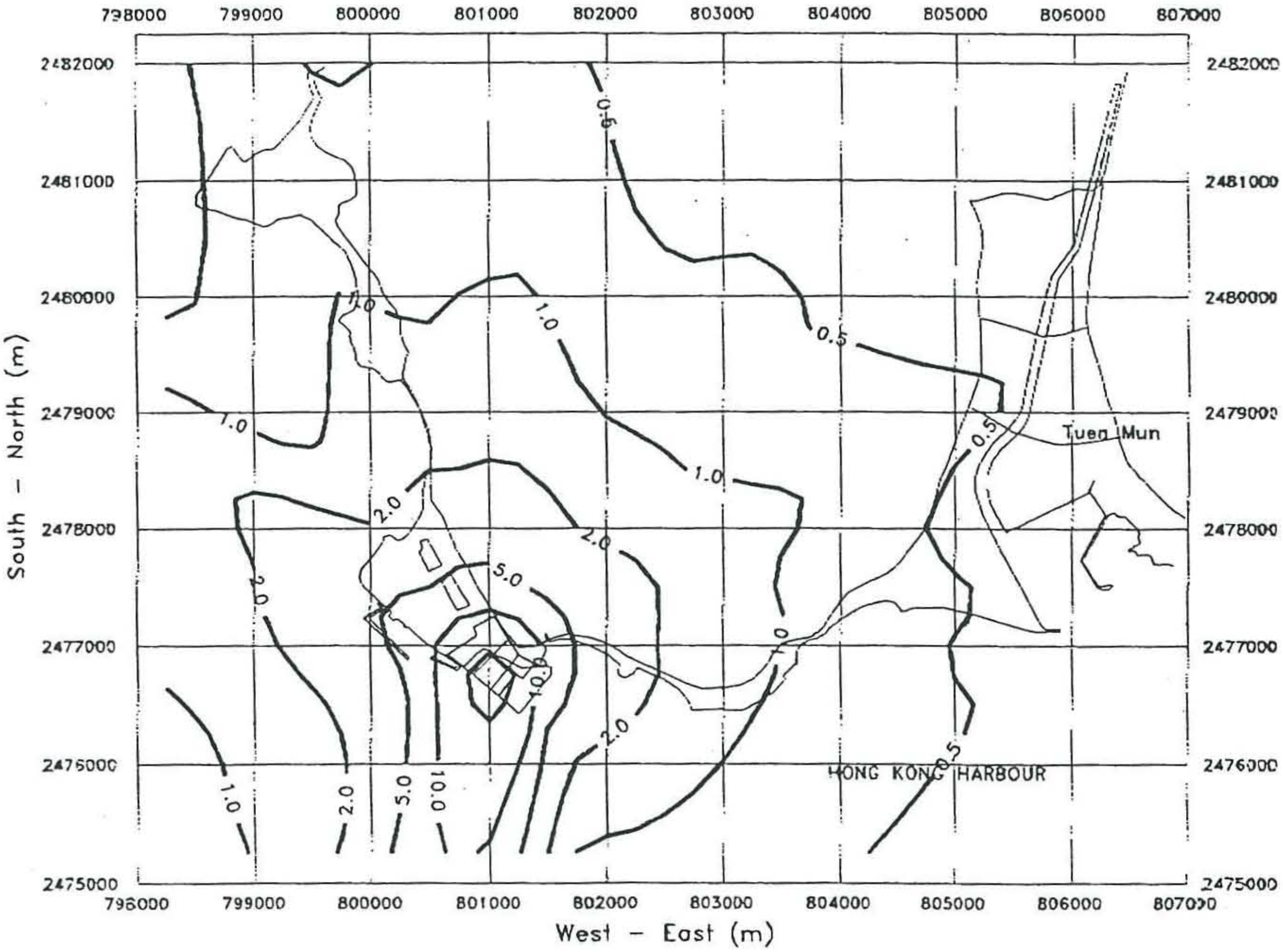

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Figure 4.6: Maximum 24-Hour TSP Concentrations at Ground-Level ($\mu g/m^3$)

053000/October 1993

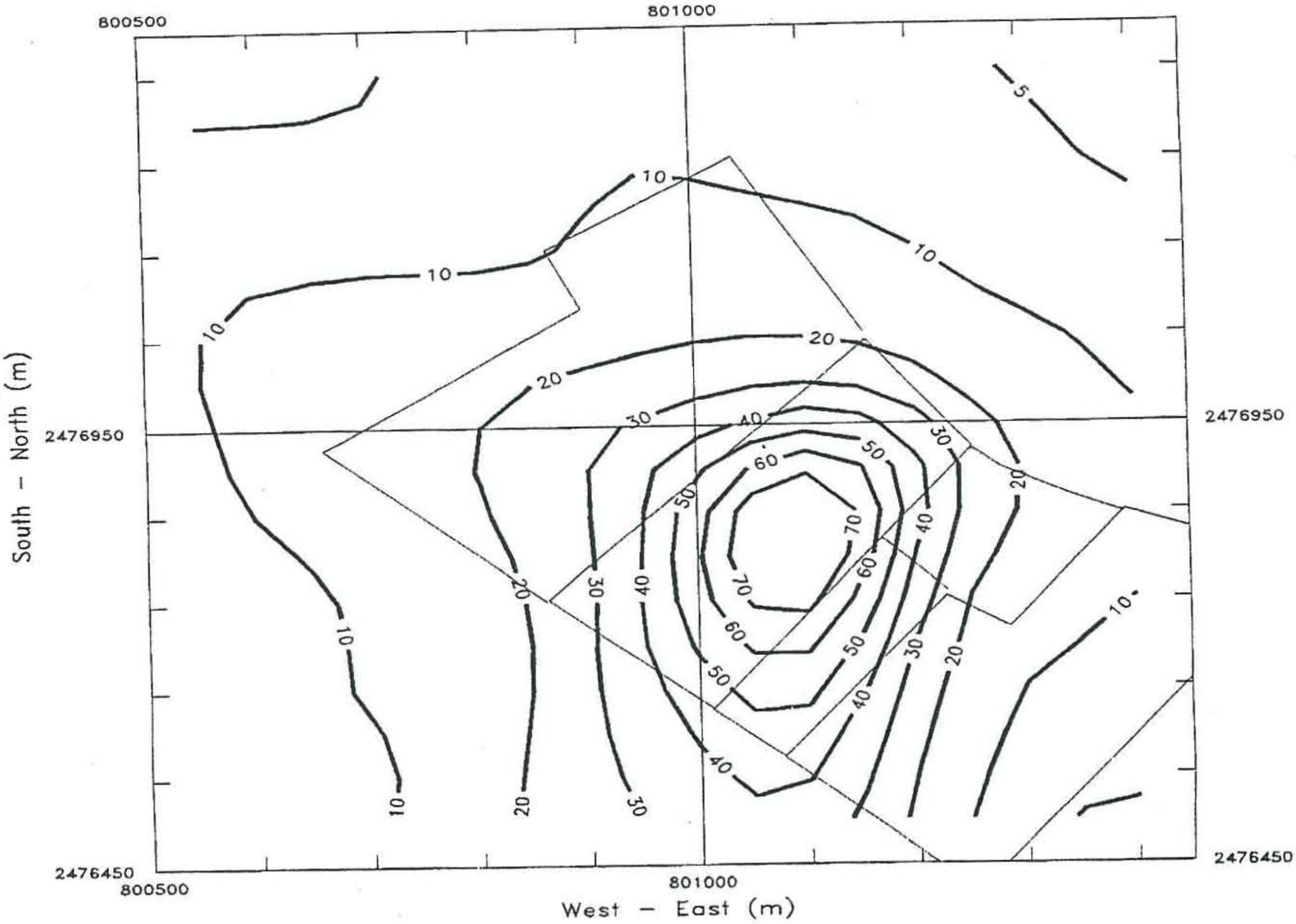

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Figure 4.7: Maximum Nearfield 24-Hour TSP Concentrations at Ground-Level ($\mu g/m^3$)

053030/October 1993

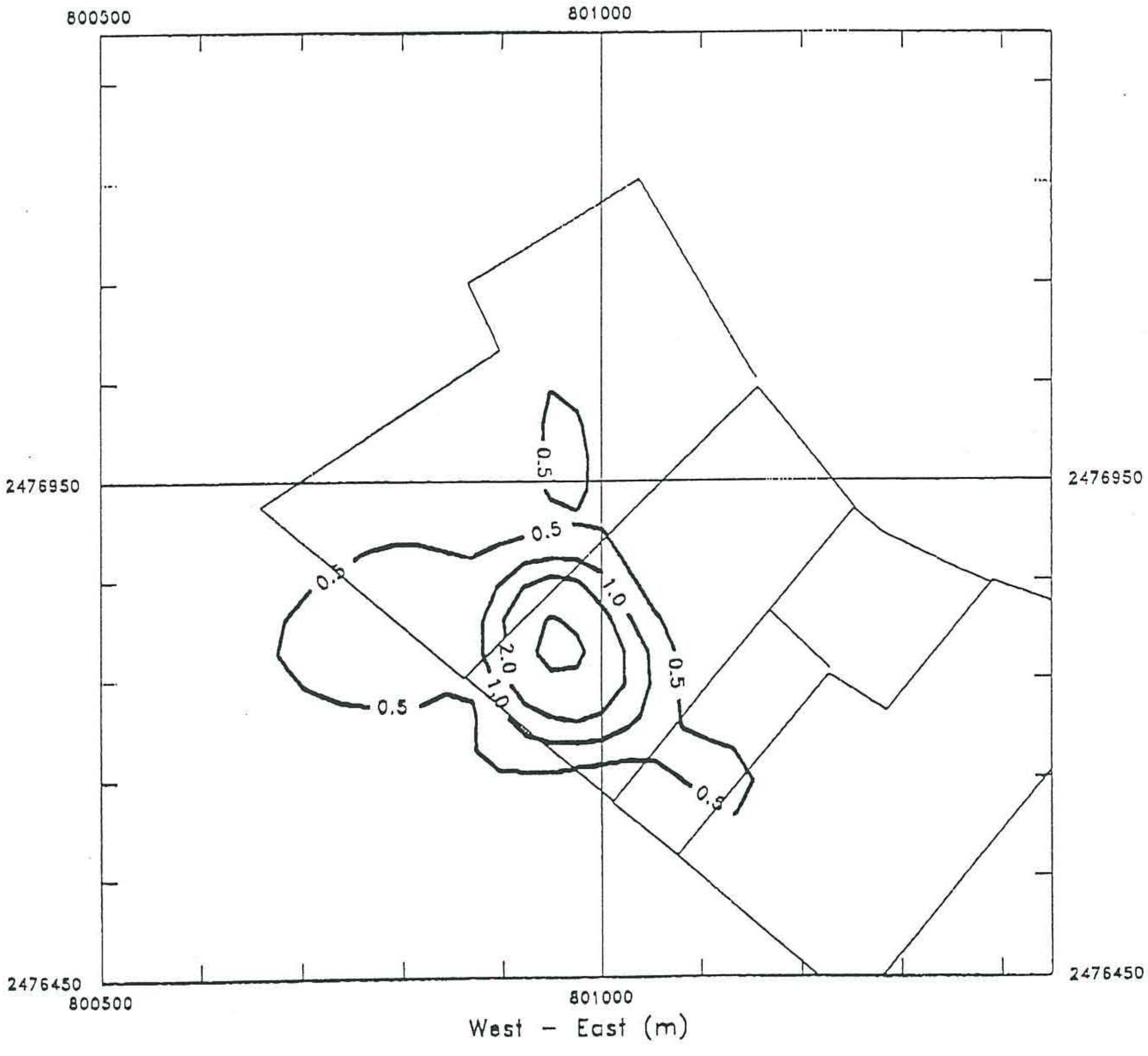

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Figure 4.7(A): Maximum Nearfield 24-Hour TSP Concentrations at Ground-Level Due to Point Sources ($\mu g/m^3$)

053000/October 1993

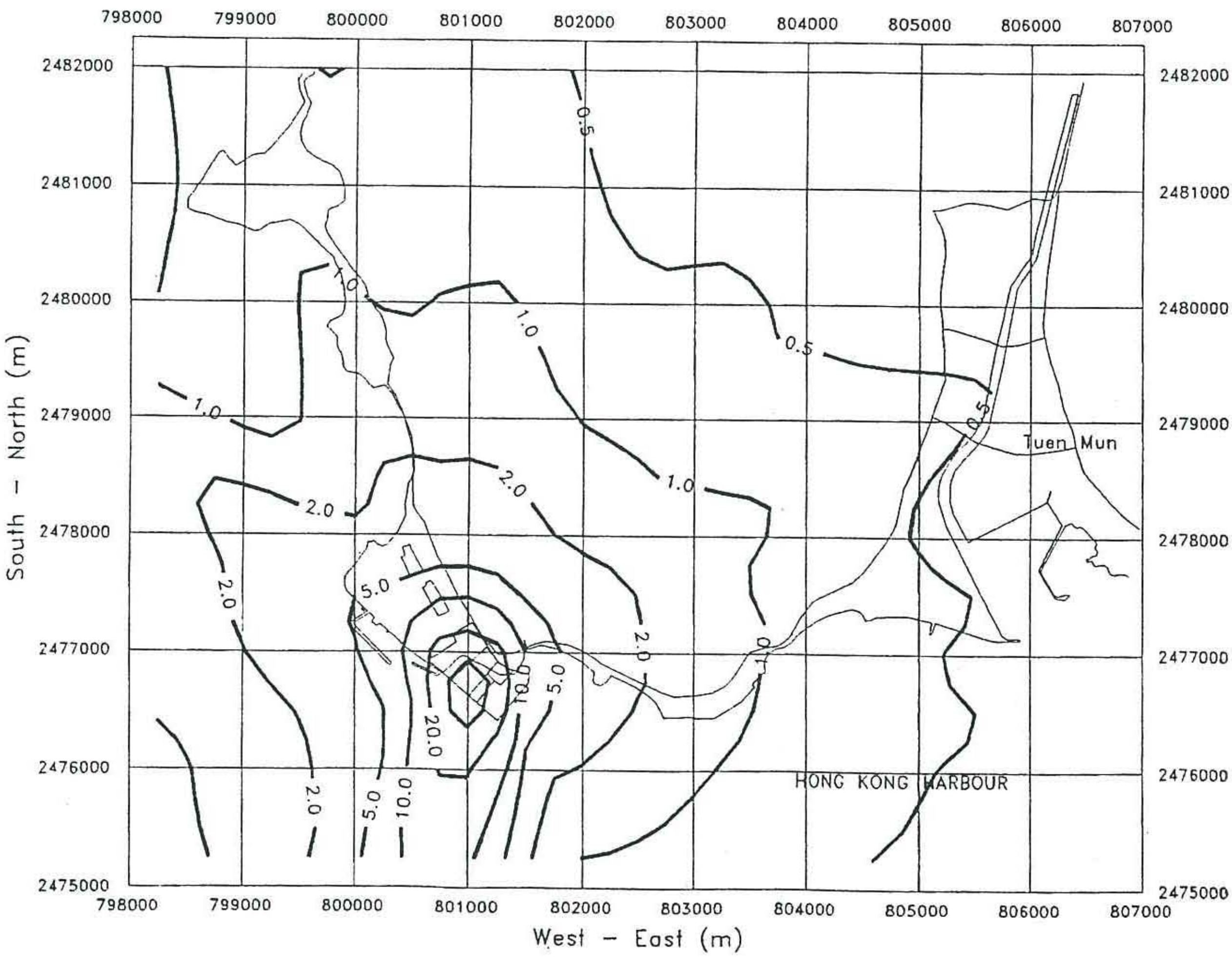

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Figure 4.8: Maximum 24-Hour Average TSP Concentrations at 30m Above Ground-Level ($\mu g/m^3$)

053000/October 1993

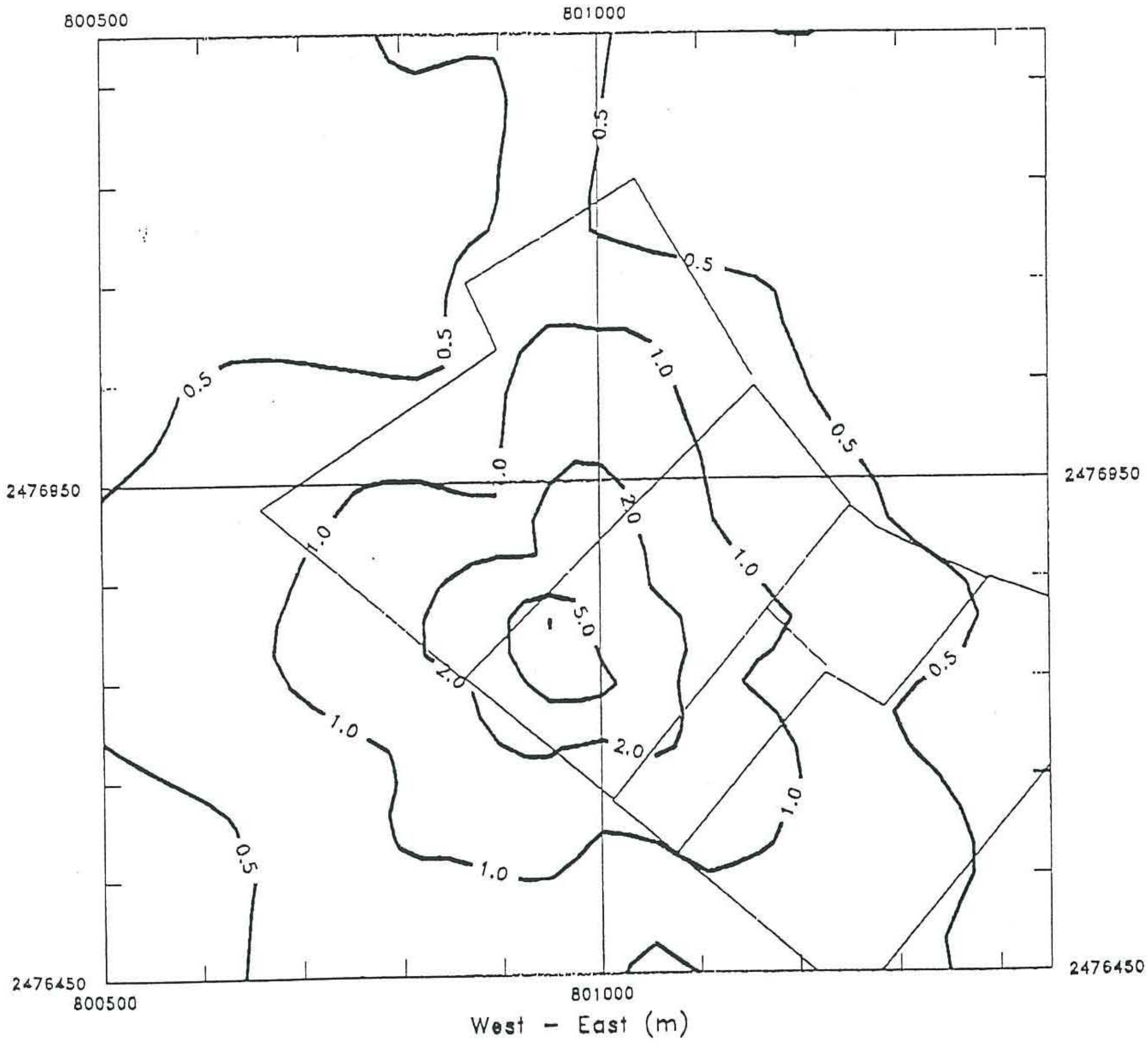

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Figure 4.9(A): Maximum Nearfield 24-Hour TSP Concentrations at 30m Above Ground-Level Due to Point Sources ($\mu g/m^3$)

053000/October 1993

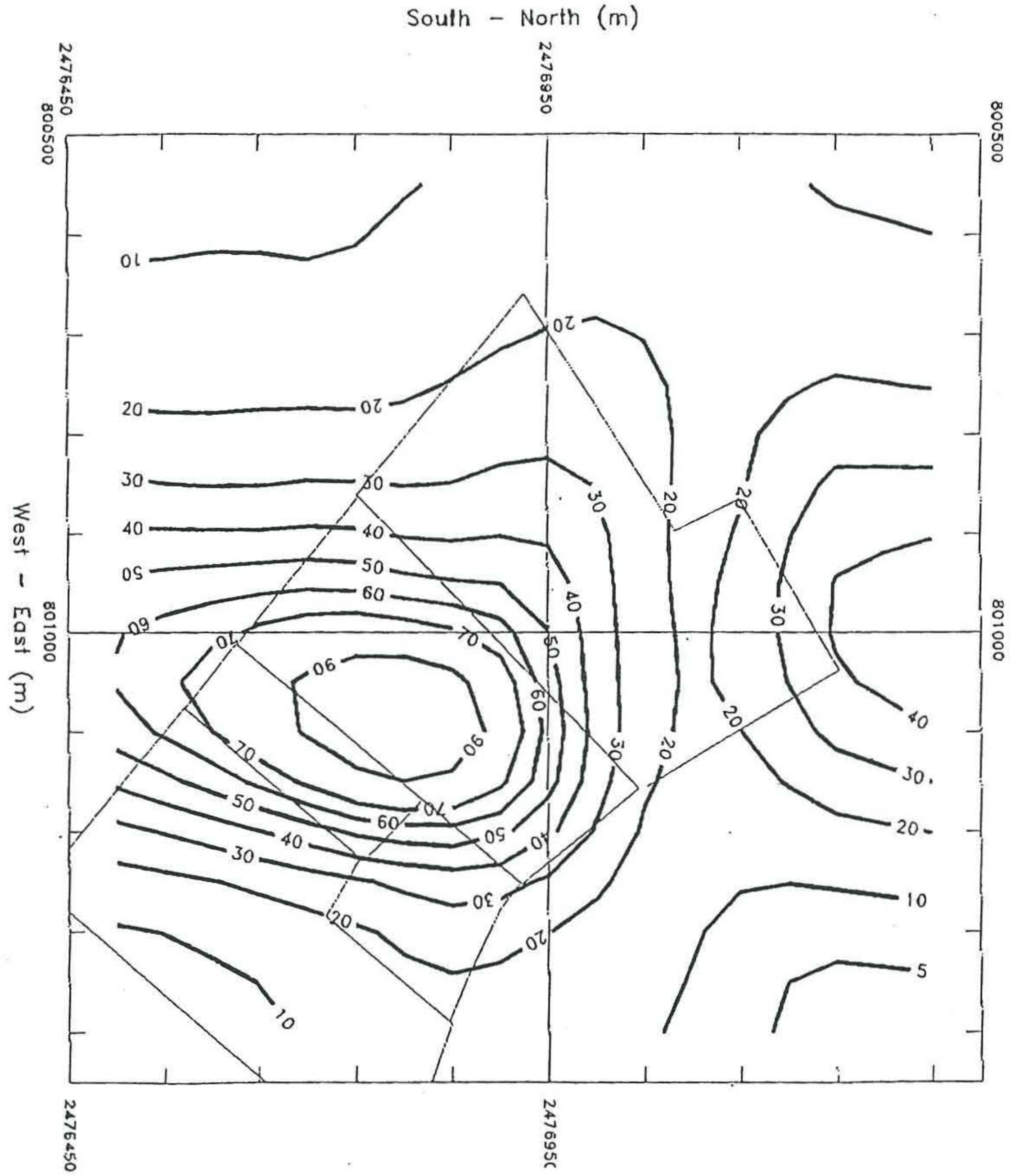

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Figure 4.9: Maximum Nearfield 24-Hour TSP Concentrations at 30m Above Ground-Level ($\mu g/m^3$)

053000/October 1993

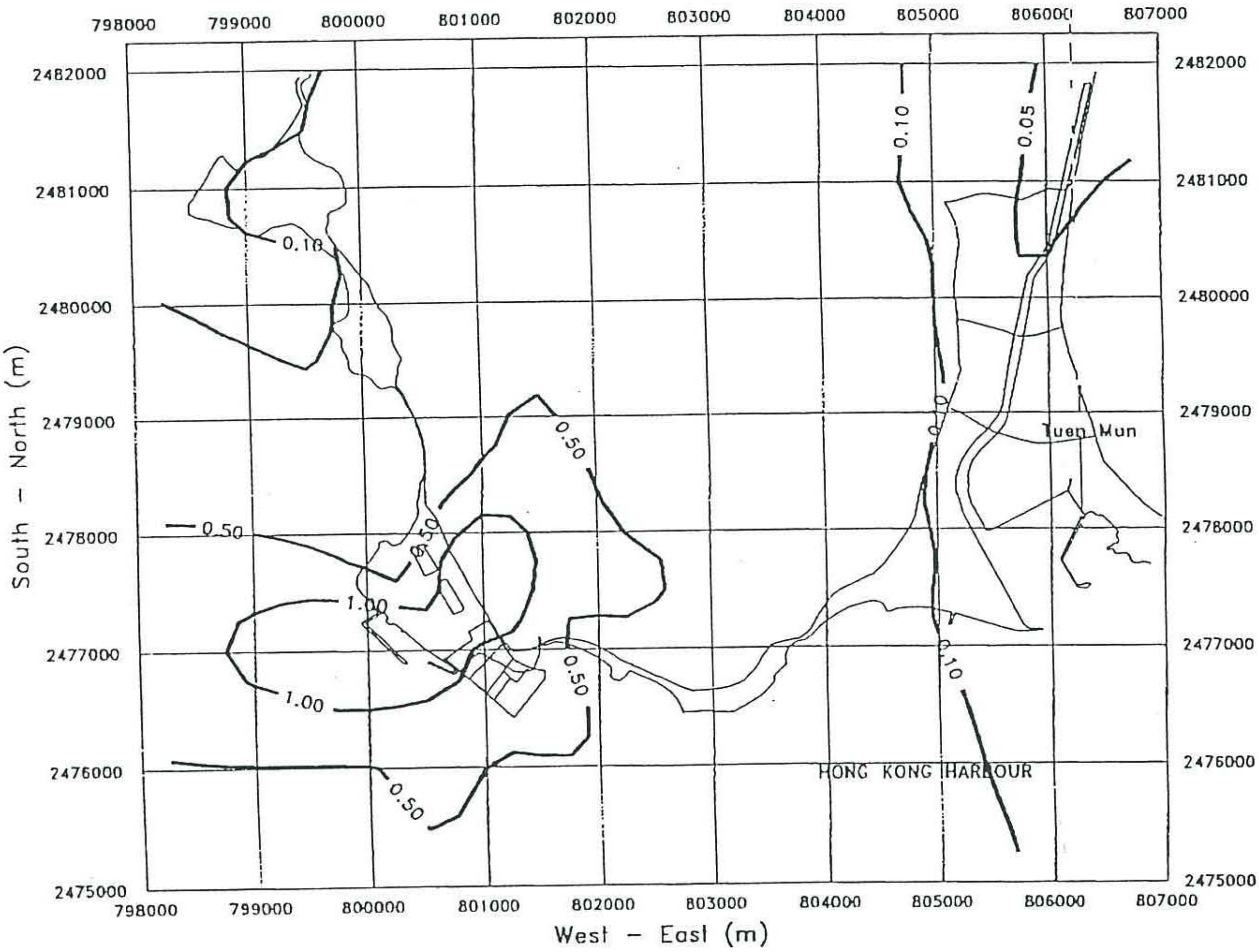

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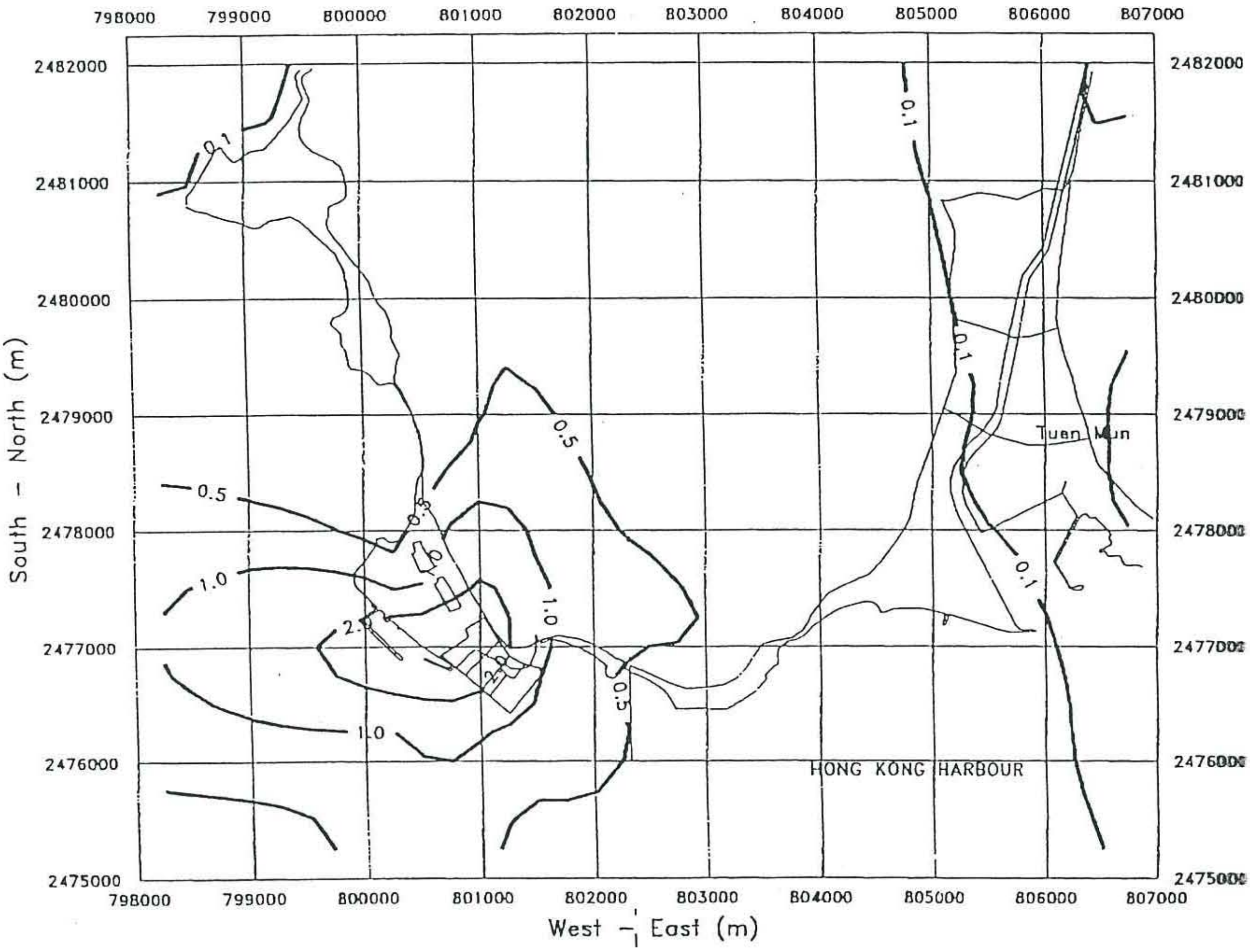
Figure 4.10: Annual Average SO_2 Concentrations at Ground-Level ($\mu g/m^3$)

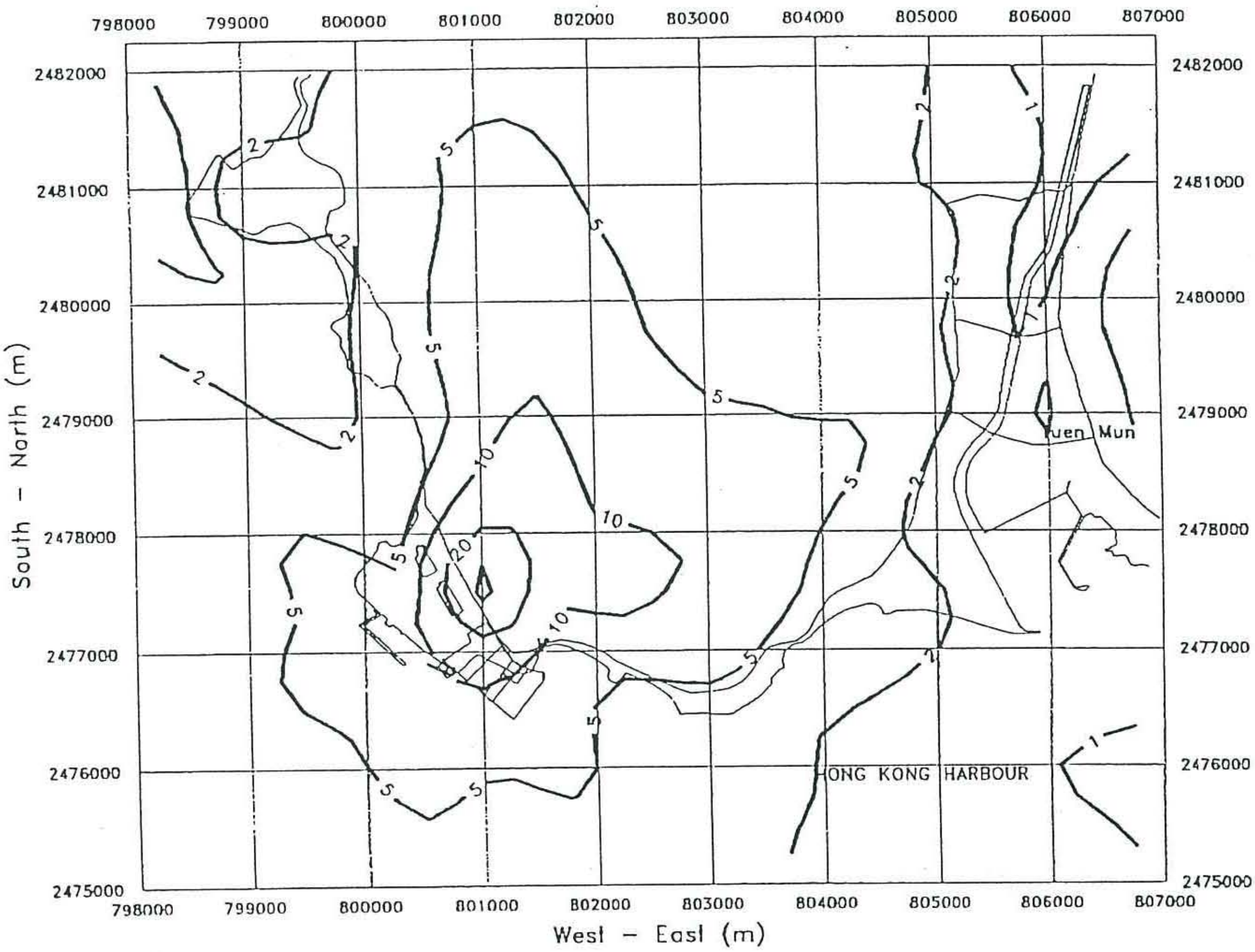
053000/October 1993



Shiu Wing Steel Mill

Figure 4.11: Annual Average SO_2 Concentrations at 30m Above Ground-Level ($\mu g/m^3$)

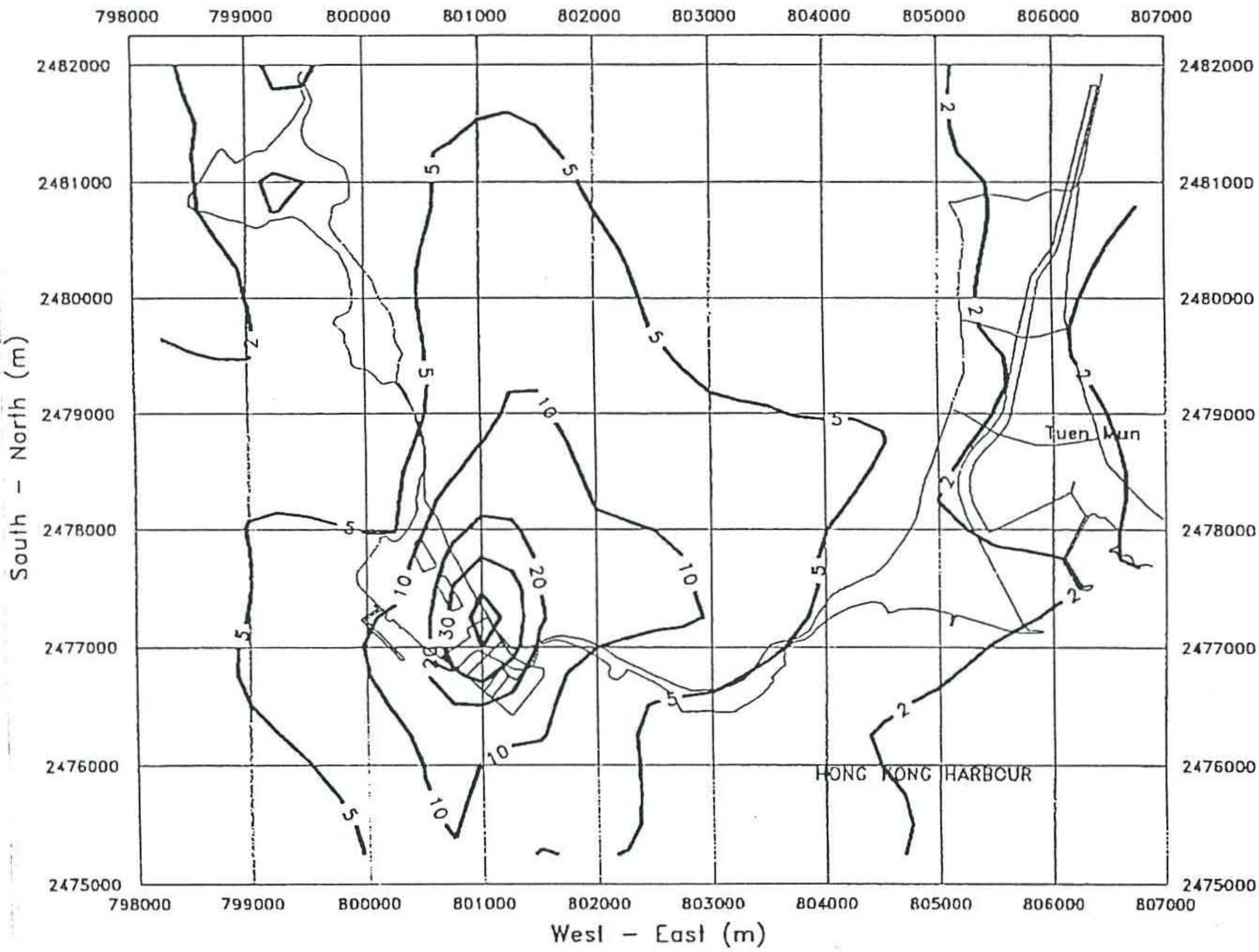
053000/October 1993



Shiu Wing Steel Mill

Figure 4.12: Maximum 24-Hour SO_2 Concentrations at Ground-Level ($\mu g/m^3$)

053000/October 1993



Shiu Wing Steel Mill

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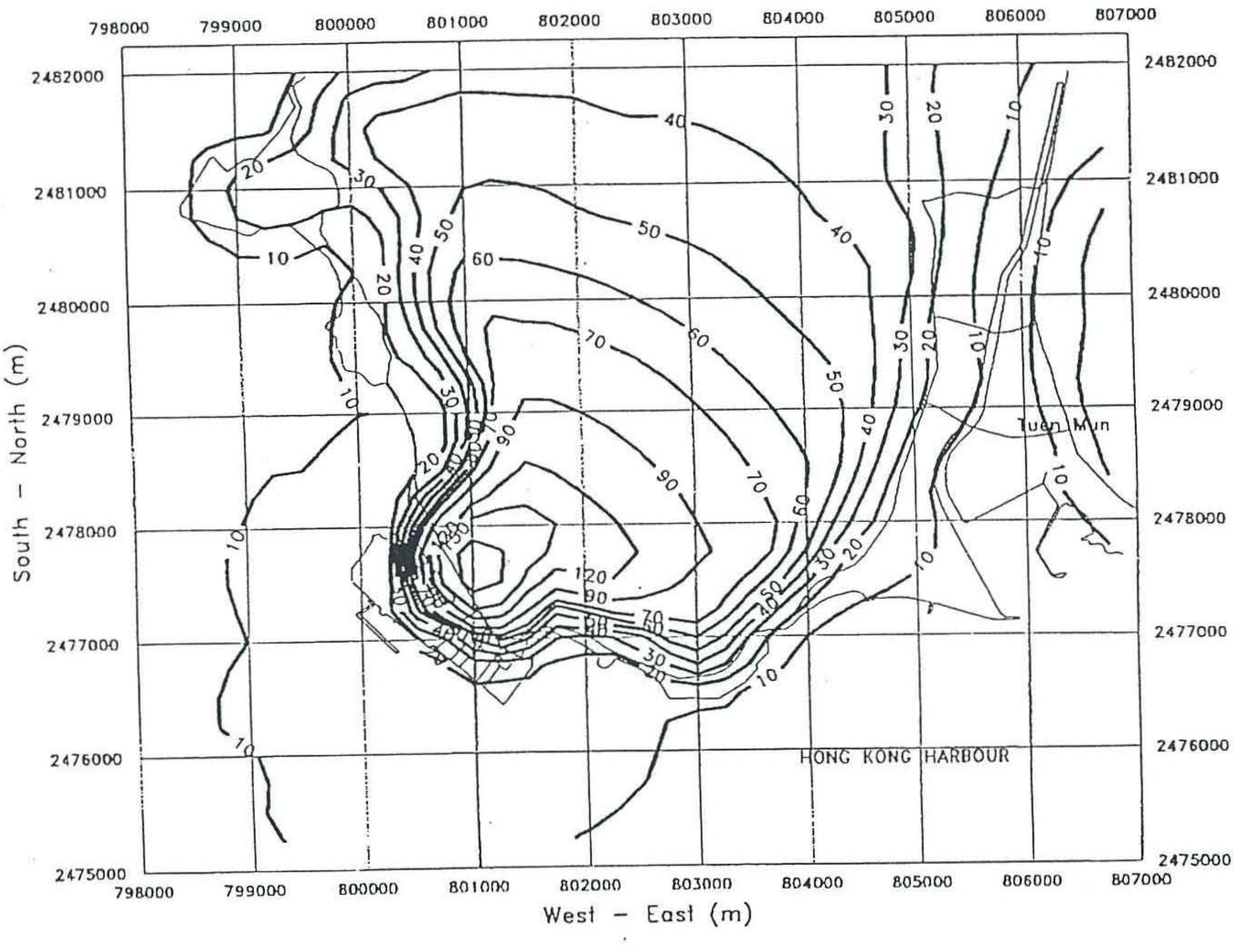
Figure 4.13: Maximum 24-Hour SO_2 Concentrations at 30m Above Ground-Level ($\mu g/m^3$)

053000/October 1993

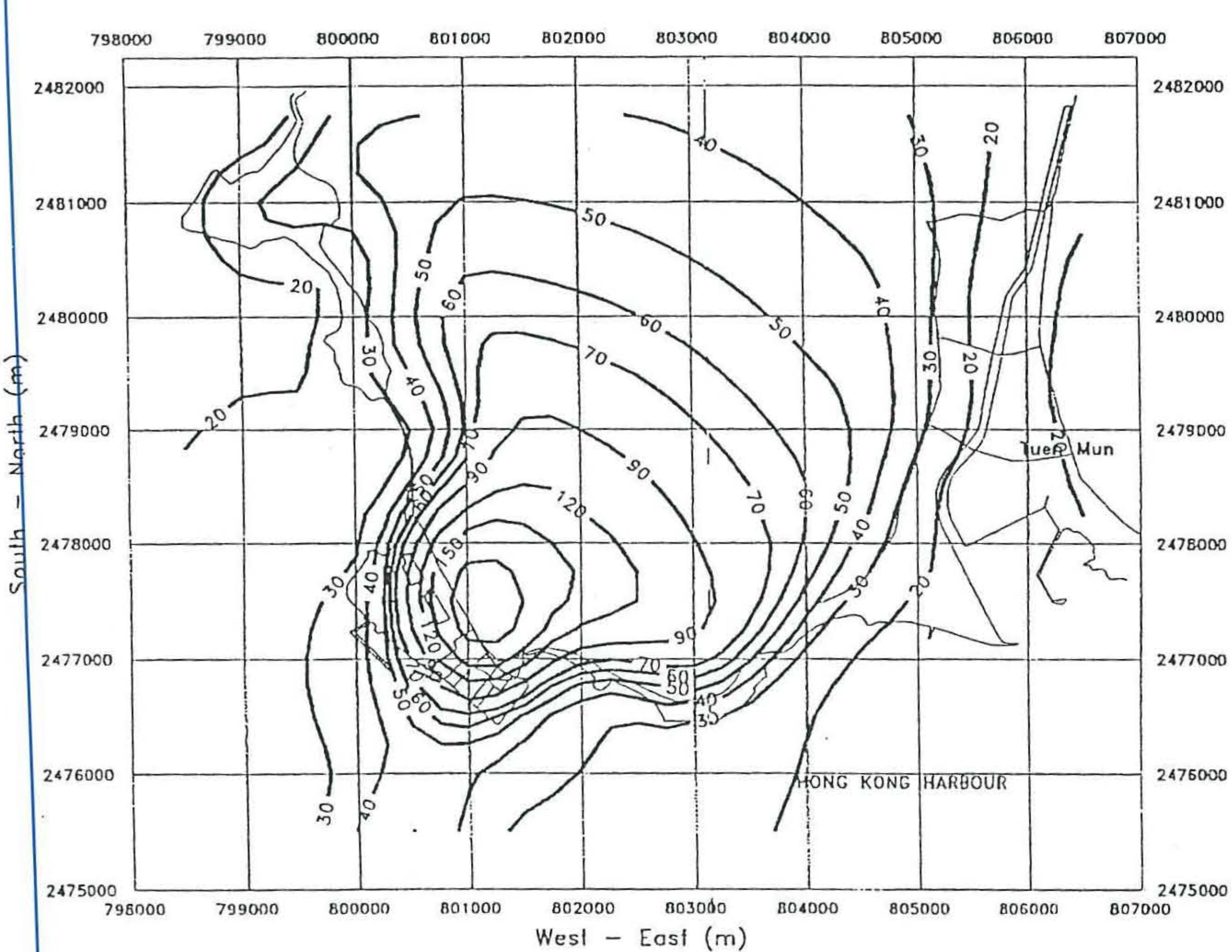


Shiu Wing Steel Mill

Figure 4.14: Maximum 1-Hour SO_2 Concentrations at Ground-Level ($\mu g/m^3$)

053000/October 1993

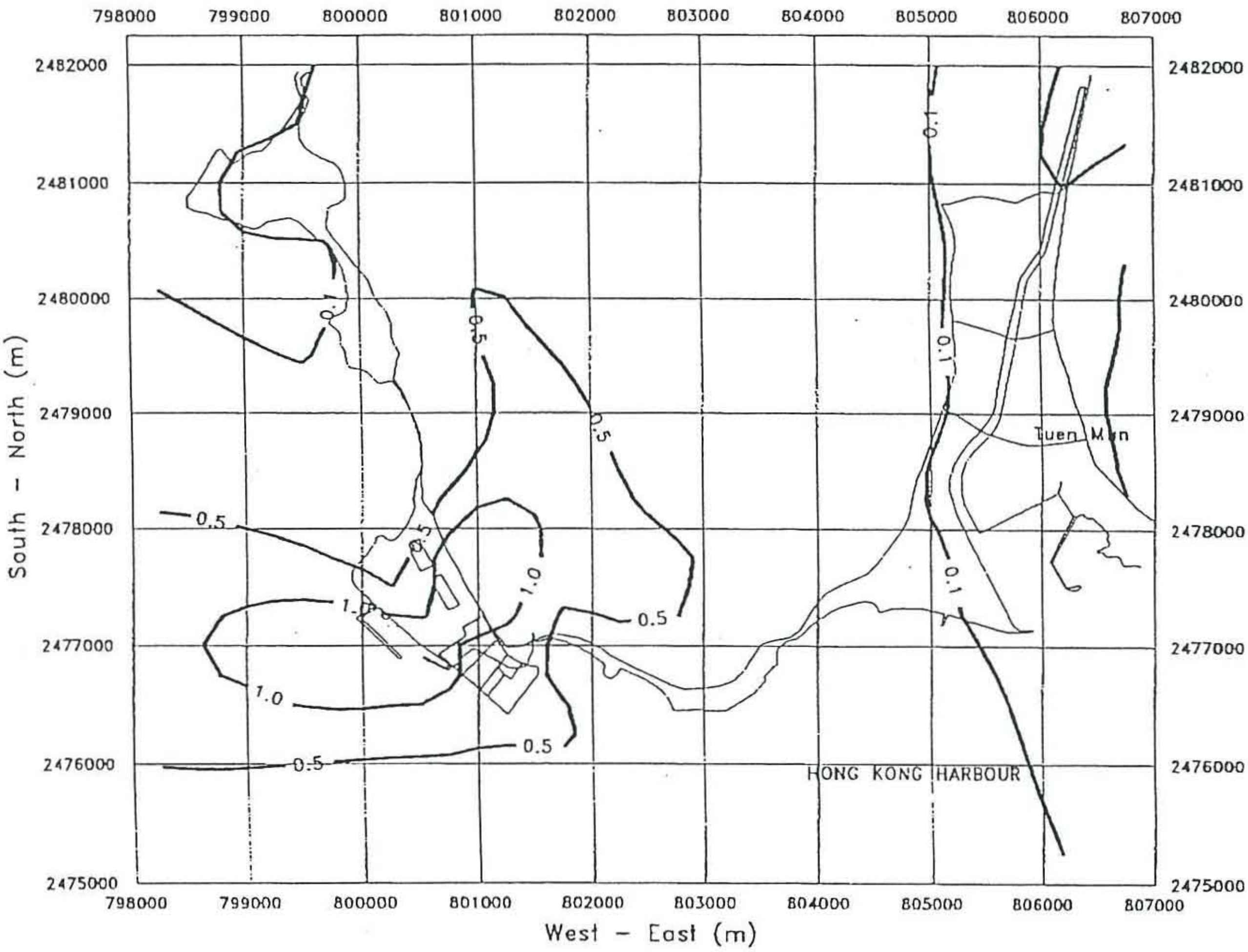
AXIS Environmental



Shiu Wing Steel Mill

Figure 4.15: Maximum 1-Hour SO_2 Concentrations at 30m Above Ground-Level ($\mu g/m^3$)

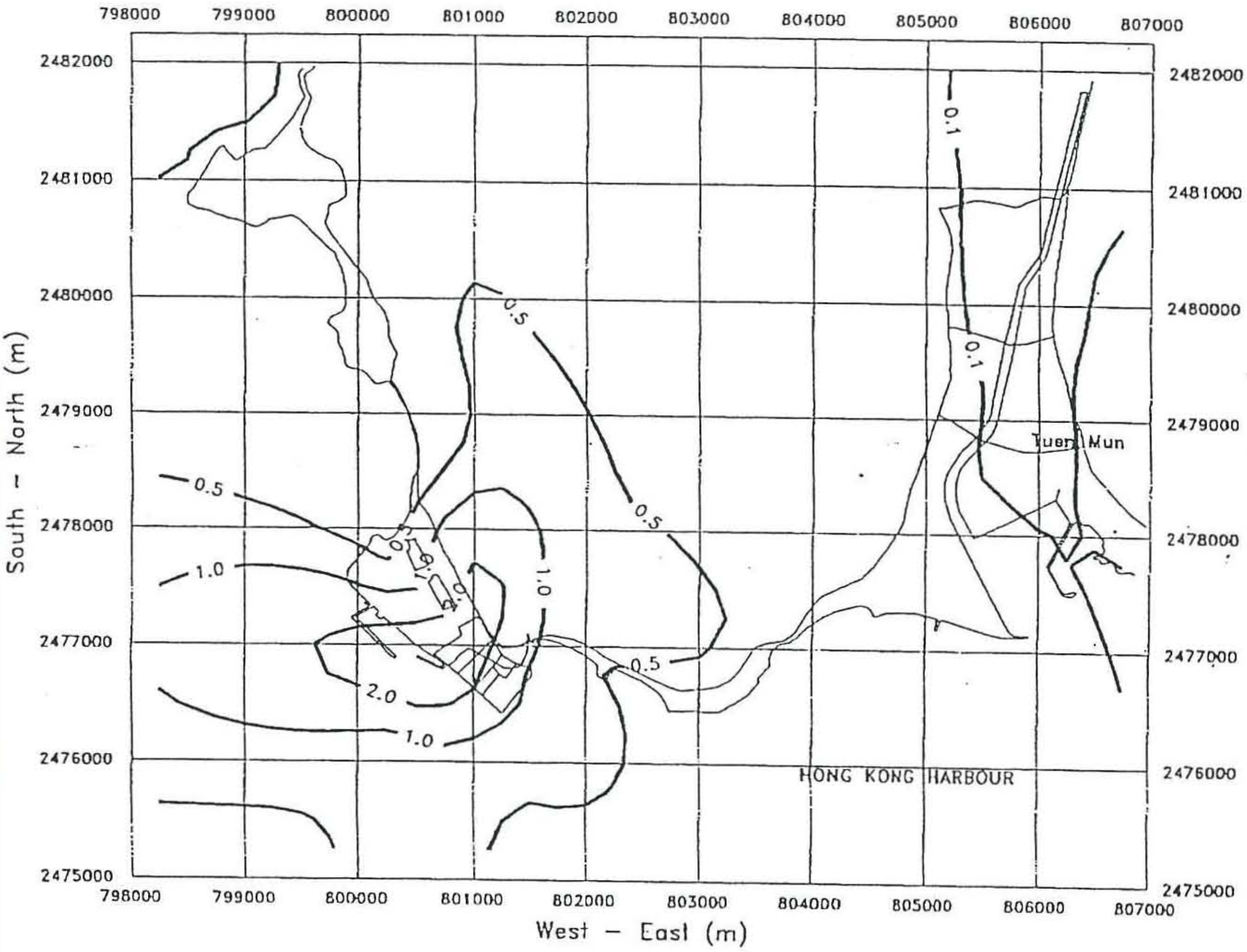
053000/October 1993



Shiu Wing Steel Mill

Figure 4.16: Annual Average NO_x Concentrations at Ground-Level ($\mu g/m^3$)

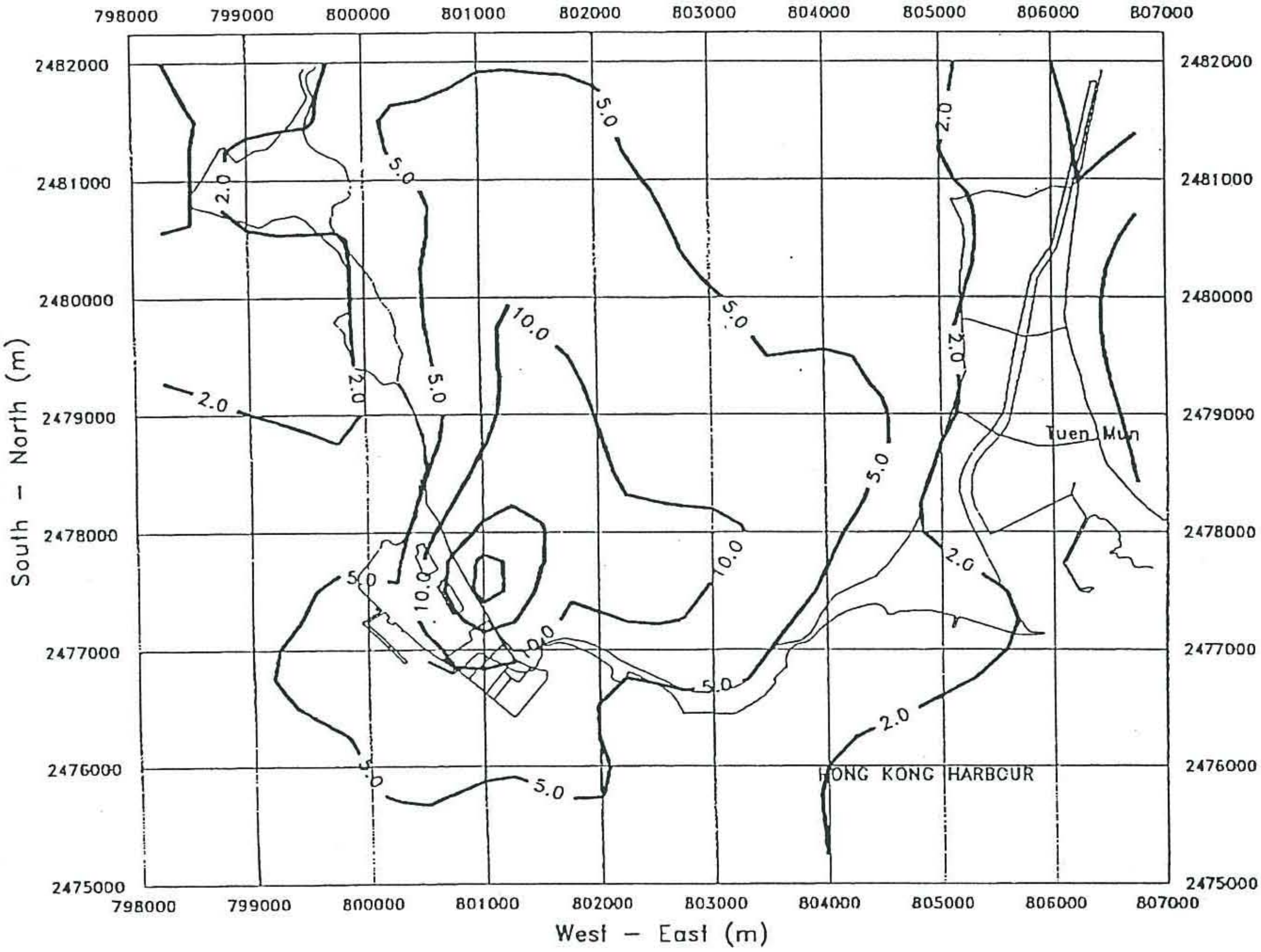
053000/October 1993



Shiu Wing Steel Mill

Figure 4.17: Annual Average NO_x Concentrations at 30m Above Ground-Level ($\mu g/m^3$)

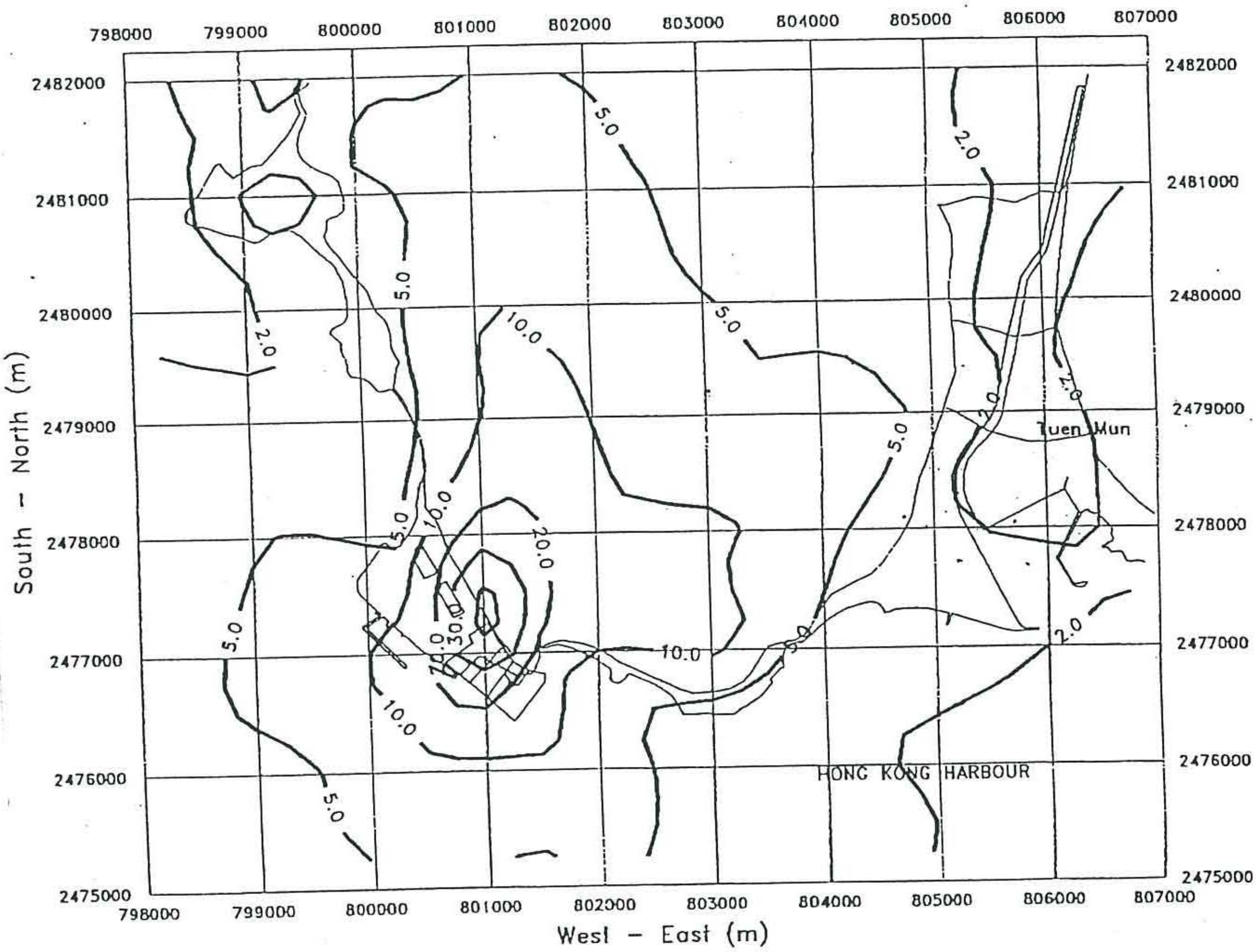
053000/October 1993



Shiu Wing Steel Mill

Figure 4.18: Maximum 24-Hour NO_x Concentrations at Ground-Level ($\mu g/m^3$)

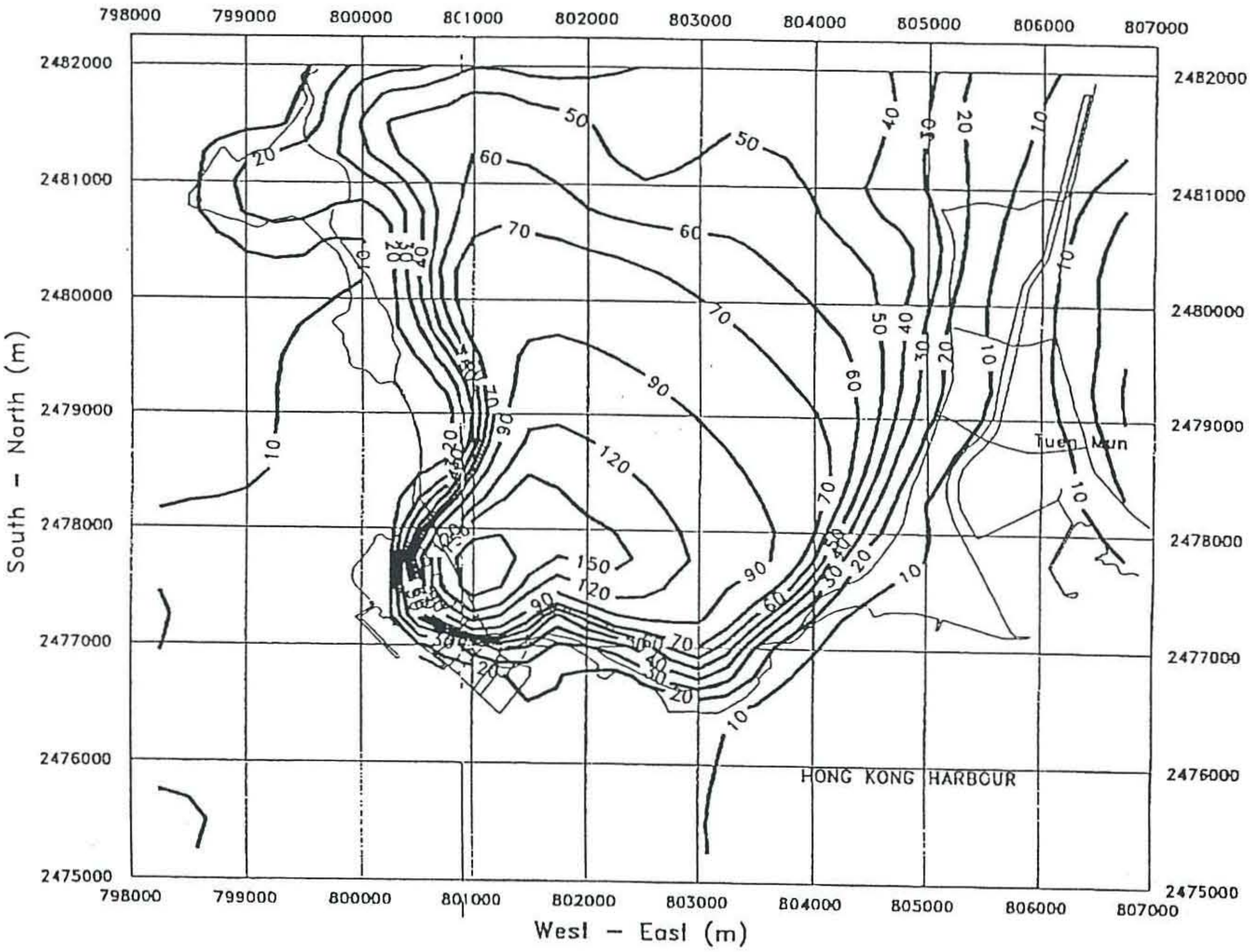
053000/October 1993



Shiu Wing Steel Mill

Figure 4.19: Maximum 24-Hour NO_x Concentrations at 30m Above Ground-Level ($\mu g/m^3$)

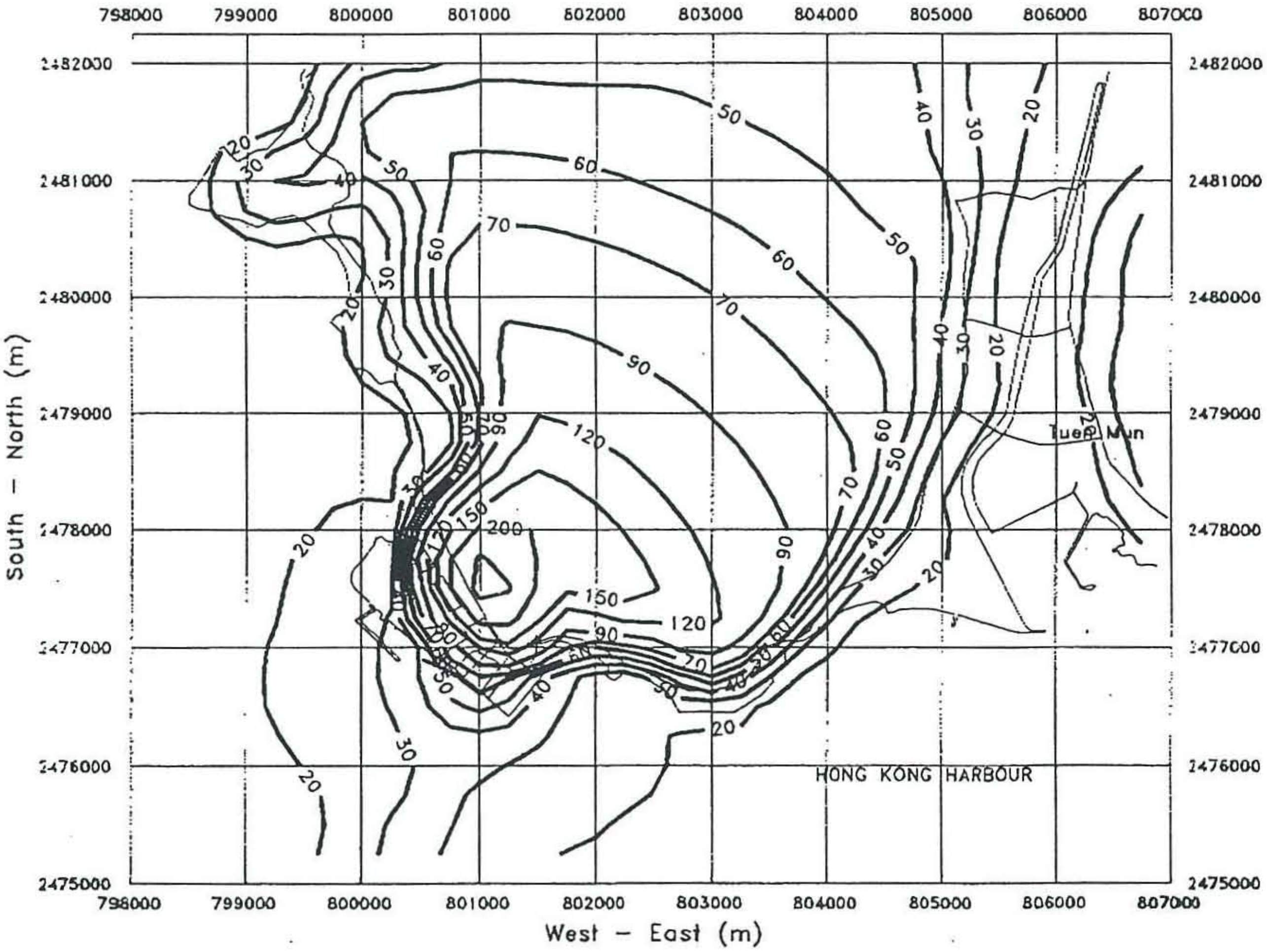
053000/October 1993



Shiu Wing Steel Mill

Figure 4.20: Maximum 1-Hour NO_x Concentrations at Ground-Level ($\mu g/m^3$)

053000/October 1993



AXIS Environmental

Shiu Wing Steel Mill

Figure 4.21: Maximum 1-Hour No_x Concentrations at 30m Above Ground-Level ($\mu g/m^3$)

053000/October 1993

Chapter 5
Marine Water Quality

5. MARINE WATER QUALITY

5.1 INTRODUCTION

The operation of the proposed steel mill would result in some aqueous discharges to the surrounding environment. This chapter identifies and considers these emissions in detail in order to assess and minimise their potential environmental impact. Mitigation measures are proposed to permit the construction and operation of the steel mill without significant environmental impact to the marine environment.

This chapter examines:-

- legislation relating to aqueous discharges & marine water quality (section 5.2);
- the existing and future local marine environmental (section 5.3);
- the potential marine impacts associated with development during both the construction and operating phases:

-	Construction Phase: (Section 5.4)	Dredging, reclamation & dumping Sewage Surface Water
-	Operating Phase: (Section 5.5)	Cooling Water Sewage Surface Water Waste Oil;

- mitigation measures are recommended to ensure there is no significant environmental impact during the construction phase (5.6) and operating phase (5.7);

- conclusions (section 5.8).

5.2 LEGISLATION

There are 10 Water Control Zones (WCZ) in Hong Kong (Figure 5.1). The proposed steel mill will be located within the North Western Water Control Zone (NWWCZ) which was declared in April 1992.

Discharges are governed by a Technical Memorandum (TM) issued under Section 21 of the Water Pollution Control Ordinance, which sets the permissible standards for effluents discharged to sewers, drains, inland waters and to the sea. Any aqueous discharges must be licensed. In deciding whether to grant a license, the Authority's purpose is to meet Water Quality Objectives (WQO) set out in the Ordinance.

The WQO for the NWWCZ are shown in Table 5.1. The standards for effluents discharged into foul sewers leading into Government sewage treatment plants such as Pillar Point are shown in Table 5.2, and for effluents discharged into the inshore waters (NWWCZ), Table 5.3.

Table 5.1: Water Quality Objectives

A.	**Aesthetic Appearance**	
(a)	Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole Zone
(b)	Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	
(c)	Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	
(d)	There should be no recognisable sewage-derived debris.	
(e)	Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	
(f)	Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	
B.	**Bacteria**	
(a)	The level of *Eschericahia coli* should not exceed 610 per 100 mL, calculated as the geometric mean of all samples collected in a calendar year.	Secondary Contact Recreation Subzones
(b)	The level of *Eschericahia coli* should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive. Samples should be taken at least 3 times in one calender month at intervals of between 3 and 14 days.	Bathing Beach Subzones
C.	**Dissolved Oxygen**	
	Waste discharges shall not cause the level of dissolved oxygen to fall below 4 mg per litre for 90% of the occasions during the whole year; values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2 mg per litre within 2 m of the seabed for 90% of the sampling occasions during the whole year.	Marine waters
D.	**pH**	
(a)	The pH of the water should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 unit.	Marine waters excepting Bathing Beach Subzones
(b)	the pH of the water should be within the range of 6.0-9.0 unit for 95% of samples collected during the whole year. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 unit.	Bathing Beach Subzones
E.	**Temperature**	
	Waste discharges shall not cause the nature daily temperature range to change by more than 2.0°C.	Whole zone
F.	**Salinity**	
	Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole zone

(... cont'd)

Table 5.1 (cont'd): Water Quality Objective

G.	**Suspended Solids**	
Waste discharges shall neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.		Marine waters
H.	**Ammonia**	
The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).		Whole zone
I.	**Nutrients**	
(a)	Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
(b)	Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.3 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Castle Peak Bay Subzone
(c)	Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1 m below surface, mid-depth and 1 m above seabed).	Marine waters excepting Castle Peak Bay Subzone
J.	**Toxins**	
(a)	Waste discharges shall not cause the toxins in water to attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole zone
(b)	Waste discharges shall not cause a risk to any beneficial use of the aquatic environment.	Bathing Beach Subzones
K.	**Phenol**	
Phenols shall not be present in such quantities as to produce a specific odour, or in concentration greater than 0.05mg/l as C_6H_5OH		Bathing Beach Subzones
L.	**Turbidity**	
Waste discharges shall not reduce light transmission substantially from the normal level.		Bathing Beach Subzones

Table 5.2 Standards for Effluents Discharged into the Foul Sewers Leading into Government Sewage Treatment Plants
(All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated)

Flow rate (m³/day) / Determinant	≤10	>10 and ≤100	>100 and ≤200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤1500	>1500 and ≤2000	>2000 and ≤3000	>3000 and ≤4000	>4000 and ≤5000	>5000 and ≤6000
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (°C)	43	43	43	43	43	43	43	43	43	43	43	43	43
Suspended solids	1200	1000	900	800	800	800	800	800	800	800	800	800	800
Settleable solids	100	100	100	100	100	100	100	100	100	100	100	100	100
BOD	1200	1000	900	800	800	800	800	800	800	800	800	800	800
COD	3000	2500	2200	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Oil & Grease	100	100	50	50	50	40	30	20	20	20	20	20	20
Iron	30	25	25	25	15	12.5	10	7.5	5	3.5	2.5	2	1.5
Boron	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Barium	8	7	6	5	4	3	2.4	1.6	1.2	0.8	0.6	0.5	0.4
Mercury	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.2	0.15	0.1	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Copper	4	4	4	3	1.5	1.5	1	1	1	1	1	1	1
Nickel	4	3	3	2	1.5	1	1	0.8	0.7	0.7	0.6	0.6	0.6
Chromium	2	2	2	2	1	0.7	0.6	0.4	0.3	0.2	0.1	0.1	0.1
Zinc	5	5	4	3	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Silver	4	3	3	2	1.5	1.5	1	0.8	0.7	0.7	0.6	0.6	0.6
Other toxic metals individually	2.5	2.2	2	1.5	1	0.7	0.6	0.4	0.3	0.2	0.15	0.12	0.1
Total toxic metals	10	10	8	7	3	2	2	1.6	1.4	1.2	1.2	1.2	1
Cyanide	2	2	2	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.08	0.06
Phenols	1	1	1	1	0.7	0.5	0.4	0.27	0.2	0.13	0.1	0.1	0.1
Sulphide	10	10	10	10	5	5	4	2	2	2	1	1	1
Sulphate	1000	1000	1000	1000	1000	1000	1000	900	800	600	600	600	600
Total nitrogen	200	200	200	200	200	200	200	100	100	100	100	100	100
Total phosphorus	50	50	50	50	50	50	50	25	25	25	25	25	25
Surfactants (total)	200	150	50	40	30	25	25	25	25	25	25	25	25

Table 5.3 **Standards for Effluents Discharged into the Inshore Waters of Southern, Mirs Bay, Junk Bay, North Western, Eastern Buffer and Western Buffer Water Control Zones**
(All units in mg/L unless otherwise stated; all figures are upper limits unless otherwise indicated)

Flow rate (m^3/day) Determinant	≤10	>10 and ≤200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤1500	>1500 and ≤2000	>2000 and ≤3000	>3000 and ≤4000	>4000 and ≤5000	>5000 and ≤6000
pH (pH units)	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9
Temperature (°C)	40	40	40	40	40	40	40	40	40	40	40	40
Colour (lovibond units) (25mm cell length)	1	1	1	1	1	1	1	1	1	1	1	1
Suspended solids	50	30	30	30	30	30	30	30	30	30	30	30
BOD	50	20	20	20	20	20	20	20	20	20	20	20
COD	100	80	80	80	80	80	80	80	80	80	80	80
Oil & Grease	30	20	20	20	20	20	20	20	20	20	20	10
Iron	15	10	10	7	5	4	3	2	1	1	0.8	0.6
Boron	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Barium	5	4	3	2	2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
Mercury	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.7	0.5	0.4	0.3	0.2	0.15	0.1	0.1	0.1
Total toxic metals	2	2	1.6	1.4	1	0.8	0.6	0.4	0.3	0.2	0.1	0.1
Cyanide	0.2	0.1	0.1	0.1	0.1	0.1	0.005	0.05	0.003	0.02	0.02	0.01
Phenols	0.5	0.5	0.5	0.3	0.25	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Sulphide	5	5	5	5	5	5	2.5	2.5	1.5	1	1	0.5
Total residual chlorine	1	1	1	1	1	1	1	1	1	1	1	1
Total nitrogen	100	100	80	80	80	80	50	50	50	50	50	30
Total phosphorus	10	10	8	8	8	8	5	5	5	5	5	5
Surfactants (total)	20	15	15	15	15	15	10	10	10	10	10	10
E. coli (count/100 ml)	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000	1000

Table 5.4: Summary Statistics of 1990 Water Quality of North Western Waters

Determinand		Urmston Road
Temperature (°C)	Surface	24.033 (17.830 - 29.136)
	Bottom	23.380 (18.000 - 28.378)
Salinity (ppt)	Surface	24.669 (19.505 - 30.310)
	Bottom	28.664 (25.030 - 31.418)
D.O. (% satn.)	Surface	97.674 (78.910 - 119.880)
	Bottom	89.053 (63.396 - 116.000)
pH		8.367 (8.023 - 8.737)
Secchi Disc (m)		1.950 (1.000 - 3.800)
Turbidity (NTU)		6.545 (2.467 - 14.667)
S.S. (mg/L)		7.306 (1.833 - 20.000)
Inorganic N (mg/L)		0.359 (0.108 - 0.568)
Total N (mg/L)		0.831 (0.463 - 1.075)
PO_4 - P (mg/L)		0.023 (0.003 - 0.035)
TP (mg/L)		0.066 (0.053 - 0.080)
Chlorophyll - a (μg/L)		2.372 (0.333 - 5.400)
E. coli (no./100mL)		178 (70 - 649)

Note:
1. Except as specified, data presented are depth average data.
2. Data presented are annual means except for *E. coli* data which are annual geometric means.
3. Data enclosed in brackets indicate the ranges.

5.3 EXISTING MARINE ENVIRONMENT

5.3.1 Water Quality

The are five Water Quality Monitoring Stations in the NWWCZ (Figure 5.2). The water quality data for 1990 for Urmston Road, the nearest monitoring station to the proposed steel mill, is shown in Table 5.4. The water quality results are generally acceptable, with only pH sometimes slightly exceeding the WQO in marine waters.

There are a number of non-gazetted beaches west of the proposed steel mill site, however these will no longer exist after planned reclamation of the bay.

There are also several gazetted beaches to the east of the proposed works, with Butterfly Beach (2.7km to the east) being the closest. The beach was ranked as poor under the Hong Kong Bathing Beaches Ranking Standard, which is based on the geometric mean of *Escherichia coli.* counts. This indicates that there is a distinct possibility that anyone swimming at this beach may contract a minor illness.

There has previously been a bacterial water quality problem in the area, caused mainly by livestock waste water and domestic sewage discharges into the bay. Tuen Mun New Town and Area 38 are both to undergo extensive development and the volumes of waste will rise accordingly. However, with the recent introduction of the NWWCZ (and the corresponding control over existing & future industrial discharges) and the future extension of Pillar Point Sewage Treatment Works submarine outfall, the water quality is expected to improve in the future.

5.3.2 Hydraulic Aspects

The coastal water of Hong Kong is affected by fresh water from the Pearl River and oceanic currents from the South China Sea. As a result, the seawater varies between estuarine conditions in the west to oceanic in the east, the effect of the Pearl River being most pronounced during the wet season.

At a more local level, the nature of the sea water is also influenced by local run-off and coastal topography. The water depth at the south of the proposed site would be approximately 16 m.

Flow conditions have been examined, (Scott Wilson, Kirkpatrick & Partners, 1990) from which Figures 5.3 and 5.4 are taken. It can be seen that currents are generally aligned parallel to the shore. Flow is in a south - easterly direction during ebb flow at a maximum of 1.5 knots,increasing during the wet season under the influence of the Pearl River. Flow is in the opposite direction during flood conditions. Currents are slower closer to shore.

The development of the proposed Shui Wing steel mill site will have little, if any, effect upon water currents. However, the steel mill is only a small part of the Area 38 development and the overall development will tend to push flood flows southwards, creating a flow concentration at the south east corner of the planned breakwater. Water currents off the coast of the proposed development will be likely to reduce slightly during flood conditions as a result of Area 38 development, whilst ebb tide flow conditions are unlikely to change.

5.4 POTENTIAL IMPACTS DURING CONSTRUCTION

The construction phase activities which have the potential to cause water pollution can be grouped into three main categories. These are:

- dredging, reclamation and dumping
- sewage discharges
- surface water discharges.

5.4.1 Dredging, Reclamation and Dumping

Water pollution can result from the following activities involved in reclaiming land necessary for the proposed steel mill site:

- dredging of marine mud and disposal of marine mud
- reclamation.

Dredging and Mud Disposal

The southern portion of the proposed steel mill site is currently a marine area and will have to be reclaimed to make up the complete site area site. Site formation commenced in September 1993 with the agreement of EPD. Marine mud is being dredged in the reclamation area.

Marine site investigations were undertaken in September 1991 (13 piston samples) and in October 1992 (3 vibrocore and 9 grab samples) in order to identify the extent of contamination of the marine mud. The result of the investigations are included in Appendix 5A.

The site investigation was agreed with EPD and samples analysed as detailed in Appendix 1 of the Works Branch Technical Circular No 22/92 *Marine Disposal of Dredged Mud*.

Marine deposits were classified based on their level of heavy metal contamination in accordance with the EPD Technical Circular No. 1-1-92. The extent of contamination has been discussed with EPD and it was agreed that mud to a depth of 0.5m on the south western half of the site was Class C which means that it is considered to be seriously contaminated, primarily by copper. The volume of contaminated mud to be dredged for seawall and reclamation is estimated to be 20,000m^3 while that of uncontaminated mud is 320,000m^3.

Dredging and mud disposal have the potential to have the following environmental impacts:

- Dredging typically results in an increase in suspended solids and water turbidity and this can have impacts upon aquatic life by blocking gills and smothering local benthic oganisms.

- The consequent reduction in light penetration reduces the oxygen generated by photosynthetic plant life, reducing dissolved oxygen levels in the water, leading to impacts on aquatic life.

- Heavy metals may be released from contaminated muds during dredging. These toxins can enter the food chain leading to bioaccumulation.

- It should be noted that the Castle Peak Power Station cooling water intake is some 700m from the proposed site. In addition the power station intake is equipped with a filter. It is thus not expected that the power station would be affected by construction works, either during reclamation or dredging. The monitoring programme during site formation would indicate if levels of suspended solids were rising to unacceptable levels.

- China Cement also has a cooling water intake in closer proximity to Shiu Wing site. It has been agreed in discussion with China Cement that dredging in areas close to the intake would only take place under ebb conditions, during which any increased suspended solids would tend to flow away from the intake. The intake is equipped with a filter and monitoring is being conducted.

Site Reclamation

Sea walls would be constructed first on the southern and eastern boundaries of the proposed site (the west and north are presently bounded by existing reclamation). Only a local increase in turbidity would be expected to result from placement of rocks in constructing the sea walls. One million cubic metres of fill is estimated to be required to bring the reclamation to the formation level. Increases in turbidity during infilling would be generally confined to the reclamation boundary by the sea walls.

Construction of the pier would not result in any significant environmental impact upon the marine environment, as the pier would be set on piles.

5.4.2 Sewage

There is presently no sewerage infrastructure serving the area, although trunk sewers will serve the area in an estimated six years. Once the sewerage infrastructure is available, EPD have indicated that sewage discharges from the site would be required to discharge to sewer (the sewage would go to Pillar Point Sewage Treatment Works (STW) and discharge via the planned extended submarine outfall). In the meantime, sewage could be treated and discharged locally, a temporary pipeline installed, or a collection sump and tanker to Pillar Point STW be used.

Any sewage discharged to sewer or sea would be required to satisfy the TM for effluent discharge standards (Tables 5.2 and 5.3). As such, treatment using septic tanks during the construction phase may not be satisfactory.

5.4.3 Surface Water

When the site formation is near completion, surface water drainage channels would be constructed. Surface water with potential to pollute would be connected to an oil interceptor (with by-pass) which would remove oils and solids prior to discharge via a 1500mm discharge pipe at the sea wall. The discharge would be required to satisfy the effluent standards to inshore waters shown in Table 5.3.

The sedimentation pit would be desludged at intervals. Oil would be removed from the surface of the interceptor, possibly by oil mops, and taken off-site by licensed contractor.

Thus, no significant environmental impacts are anticipated to result from surface water run-off during construction.

5.5 POTENTIAL IMPACTS DURING OPERATION

There are four main potential sources of pollution to the marine environment during the operation of the proposed steel mill:

- heated cooling water
- waste oil
- sewage
- surface water runoff.

Metal finishing activities, such as acid pickling, are not required at the proposed steel mill and as such the associated effluents would not arise.

5.5.1 Cooling Water

Sea water would be used as the medium to cool down the closed loop recirculated fresh cooling water (Section 2.4 and Figure 2.4) in the titanium heat exchangers. There would only be cooling sea water and no cooling fresh water discharges to the marine environment. The sea water would be used on a once through basis at a flowrate of about 100,000m^3/day (1.157 m^3/s).

The cooling sea water would discharge at approximately 9°C above the intake temperature. Based on the Urmston Road water quality data shown in Table 5.4, the ambient sea water temperature ranges between 17.8°C and 29.1°C, averaging 23.5°C. Consequently the temperature of the cooling water discharge would be expected to range between 26.8°C and 38.1°C, averaging 32.5°C.

The discharge of heated cooling water into the sea has potential to impact upon the marine environment primarily because the dissolved oxygen present in water reduces with increased temperature.

At this stage it is proposed that there would be no additives in the sea water to prevent fouling or corrosion and thus no associated environmental impact. The titanium heat exchangers in use at the existing Tseung Kwan O plant do not have any fouling problems. Should fouling arise as a problem, discussions would be held with EPD to determine a suitable anti-fouling agent.

5.5.2 Waste Oil

Recirculating closed loop fresh water would be employed for direct cooling of the CCM and RM.

The water would become contaminated with spent lubrication oils over a period of time and have the potential to contaminate the marine environment if discharged without treatment.

5.5.3 Sewage

It is envisaged that 400 employees will be required to operate the steel mill on a 3 shift basis, 24 hours a day. Calculations detailed in Appendix 5B estimate that 68 m^3/day of sewage would arise with 22.4 kg/day BOD load and 22.4 kg/day solids loading. This would result in a BOD of 330 mg/l and a suspended solids (SS) of 330 mg/l.

5.5.4 Surface Water

Surface water run off from the site has the potential, if not satisfactorily controlled, to impact upon the marine environment particularly with respect to oil contamination and suspended solids discharge.

5.6 MITIGATION MEASURES DURING CONSTRUCTION

5.6.1 Dredging and Mud Disposal

Uncontaminated mud would only be disposed of at the gazetted spoil grounds. No special dredging transport or disposal methods are required beyond those normally applied for ensuring compliance with WQO's or for protection of SRs near the dredging and disposal areas.

Class C contaminated mud would require dredging and transporting with care and using special procedures. It could not be dumped in gazetted spoil disposal grounds, but would require licenced disposal at a Contaminated Mud Disposal Area. There is estimated to be 20,000m^3 of contaminated mud, which has been allocated to Contaminated Mud Pit 2 at East Sha Chau by the Fill Management Committee (FMC) and endorsed by EPD. EPD has allocated South Cheung Chau for disposal of uncontaminated mud. A license for marine dumping is required, and the need for such a licence is included in the Contract Tender document. EPD's Additional Conditions for contaminated mud disposal are detailed in Appendix 5C.

To minimise potential impacts, the following mitigation measures would be followed during the dredging, transporting and disposal of dredged marine mud:

- tightly sealing mechanical grabs would be designed, maintained and used to avoid spillage, and whilst lifting closed grabs would be used;
- cutterheads of suction dredgers would be suitable for the material being excavated and would minimise overbreak and sedimentation around the cutter;
- where trailing suction hopper dredgers are used for dredging of marine mud, overflowing from the dredger by the operation of automatic lean mixture overboard systems (ALMOB), would not be permitted;
- all construction plant transported to the site would be sized such that adequate clearance is maintained between vessels and the sea bed, to

minimise turbidity generated by turbulence from vessel movement or propeller wash;

- all pipe leakages would be repaired promptly and construction plant would not be operated with leaking pipes;

- dredging would cause no visible foam, oil, grease, scum, litter or other objectionable matter to be present on the water;

- all barges and hopper dredgers would be fitted with tight fitting seals to their bottom openings to prevent leakage of material;

- loading of barges and hoppers would be controlled to prevent splashing of dredged material to the surrounding water. Barges or hoppers would not be filled to a level which would allow overflowing of material or polluted water during loading or transportation;

- adequate freeboard would be maintained on barges to ensure that decks are not washed by wave action;

- care would be taken to ensure that the barges are loaded in such a manner that dredged material does not spill onto decks and exposed fittings.

- when the dredged material has been unloaded at the disposal area, any material which has accumulated on the deck or other exposed parts of the vessel would be removed and placed in the hold or hopper. Decks would be washed clean in a way that prevents material from being released overboard. Hoppers and holds would not be flushed with water to remove any remaining material and would remain tightly closed at all times.

Dredging commenced in September 1993 with the agreement of EPD and water quality monitoring is being undertaken in accordance with an agreed site formation Monitoring Schedule, to ensure WQOs are not exceeded.

5.6.2 Sewage

Sewage arisings during construction would require some form of treatment prior to disposal. This could either be carried out on site or at a sewage treatment plant, and could be achieved by:

- on-site treatment by a more satisfactory process than septic tanks such as a Rotating Biological Contactor (RBC) or Aeration Sewage Treatment (AST) Plant;

- tankering sewage effluent to Pillar Point;

- pumping to Pillar Point STW (1.8km distant).

Because any on-site treatment plant would become redundant once sewer infrastructure is available in the area, the likely preferred disposal method is for the sewage be transported to the Pillar Point STW. Given that the anticipated peak construction workforce is only 150, the likely most economical method of disposal would be to construct a temporary storage tank/vessel and use road tankers to transport the sewage effluent to Pillar Point STW.

It is expected that some 25m³ of sewage/gray water would be produced per day. This volume of effluent would mean that 2 tanker trips to Pillar Point STW per day would be required. This option would need to be provided as a priority before construction activities start on site.

If there is a canteen on-site during construction, then a grease trap would treat its discharge. Discharges to Pillar Point STW would be required to satisfy the standards shown in Table 5.2. Licensing of sewage discharges would be required.

The construction contractor would be required to obtain approval from EPD for sewage disposal; the contractor would undertake any monitoring required.

5.7 MITIGATION MEASURES DURING OPERATION

5.7.1 Cooling Water

The WQO for the NWWCZ (see Table 5.1) stipulate that the 'waste discharge shall not cause the natural daily temperature range to change by more than 2°C'. It has been agreed with EPD that this WQO should be satisfied outside a 100 metre mixing zone. The TM for Effluent Discharge Standards to inshore waters (Table 5.3) only covers discharges of up to 6,000m³/day, for which the discharge temperature must remain below 40°C.

Thus the proposed sea water discharge (100,000 m³/day) would have a significantly greater volumetric discharge than that covered by the TM, but at a lower temperature, with its maximum temperature not exceeding 40°C at the point of discharge (Section 5.5.1).

It should be noted that the size of this thermal discharge is equivalent to less than 1% of the volume discharged by the adjacent Castle Peak power station. Owing to the relatively small size of this additional heat load, no cumulative effects are expected.

Also, the cooling water would be discharged from the steel mill from the most south-eastern position of the site. This location is as far away from the power station cooling water discharge as possible, thus ensuring that the possibility of cumulative impacts are minimised.

The cooling water will discharge from a 900mm diameter pipe at 2.4m below principal datum where 0 mPD represents mean low water springs (MLWS) and is 0.6 metres below mean low low water (MLLW), 1.2 metres below mean sea level (MSL) and 2.96 metres below mean high water springs (MHWS).

Calculations have been carried out to quantify the dilution of the cooling water discharge in the sea, and these are presented in Appendix 5D. Using the Cederwall equation for the buoyancy dominated near field (BDNF), the calculations illustrate that at MLLW the buoyant warm cooling water discharge would be diluted 3.13 times by the time it rises to the sea level during the wet season. This represents a 10/3.08 = 3.2°C rise in ambient sea water temperature, which is already close to satisfying WQO. The Brooks Method (reference Grace Marine Outfall Systems, Chapter 7) is used to estimate that at a current of 1 metre/sec, the increase in sea water temperature 25 metres from the discharge point is only 0.28°C, which easily satisfies WQOs well inside the agreed mixing zone of 100 metres.

During the dry season the corresponding dilution is greater (3.82) by the time the discharge reaches sea level, and within 25 metres the increase in sea water temperature is only 0.15°C, which again easily satisfies WQOs inside the agreed mixing zone of 100 metres.

Also, dilution of the cooling water would increase significantly at mean sea level and at mean high water springs.

Within the 100 metre mixing zone, there may be some impact resulting from the cooling water discharge, although the results indicate that it may only be within the first few metres that WQOs are exceeded. The benthic layer would not be expected to be affected because the cooling water discharge would be located above the seabed, and as warm water is more bouyant than cool the plume will rise.

5.7.2 Waste Oil

Waste oil produced during the operation of the steel mill would be licensed as a Chemical Waste and removed and taken off-site by a licensed contractor.

5.7.3 Sewage

The sewage arisings during the operation of the plant would gravitate to a pumping sump. From there sewage would pass to Pillar Point STW when the local sewage infrastructure has been completed. This should occur in some six years time.

In the interim, the developer should provide suitable interim treatment/ disposal facilities to the satisfaction of EPD, until the completion of the local sewage infrastructure.

Based on the TM for Effluent Standards discharged into foul sewers leading to Government sewage treatment plants (Table 5.2), for a volume of $68m^3$/day the anticipated BOD and SS loadings detailed in Section 5.5.3 are within the standards of 1000mg/l.

Kitchen effluent would pass through a grease trap prior to entering the sewage pump sump. This would ensure that the limit for oil and grease of 100mg/l is satisfied. The grease trap would be cleaned out regularly and be taken off-site by a contractor as a Trade Waste.

5.7.4 Surface Water

It is intended that all major roadways and the scrap storage area would be concreted, after allowing for consolidation and land settlement. Surface water from roofs and clean areas of site would be discharged directly to sea after passing through sediment traps.

Surface water from open areas where there is potential for contamination (such as open storage areas like the scrap storage area) would be drained to an interceptor for removal of oil and solids, prior to discharge to sea. The interceptor would have a by-pass to prevent flushing during periods of heavy rainfall. The waste oil collected would be licensed as a Chemical Waste and disposed off-site by a licensed contractor. The interceptor would be cleaned out periodically and the sludge disposed off-site by a contractor.

All the oil tanks would be bunded and any contaminated surface water would be removed off-site by a licensed contractor when necessary, but at least twice a year.

All raw materials would be stored under cover except scrap, which would be stored openly on concreted surfacing.

5.8 CONCLUSION

Potential sensitive receivers to marine impacts in the area are:

- Butterfly Beach (2.7km east of site)
- Tung Chung Mariculture Zone (8km south of site)
- Aquatic life and the general marine environment.

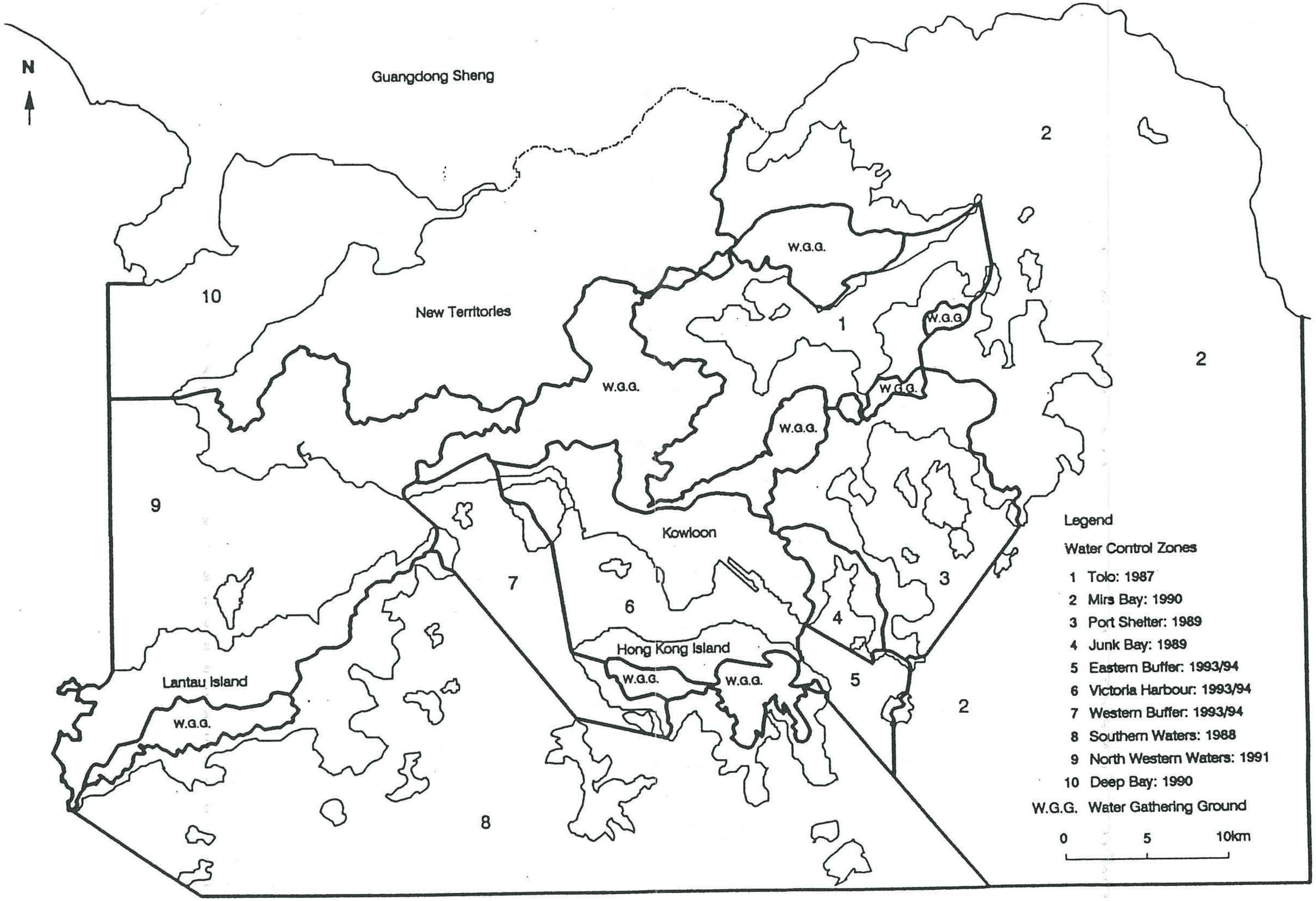
Dredging, reclamation and mud dumping would impact only locally upon aquatic life in the area in which activities occur, provided the recommended mitigation measures are employed.

Cooling sea water would discharge at -2.4 mPD and calculations predict the discharge to be significantly diluted by the time the warm buoyant discharge has reached sea level. WQOs would be satisfied easily within 25 metres, owing to further dilution because of its momentum, turbulence and current dispersion. The mixing zone agreed is 100 metres. There would be no impact expected upon the benthic layer, as the discharge would be bouyant, and would consequently tend to rise to the surface.

During construction and in the early part of operation sewage would either be treated on-site or tankered to Pillar Point STW. Any sewage discharge from site would satisfy the TM for Effluent Discharge Standards. Once the trunk sewer from Pillar Point STW is available (in some six years time) the plant would be connected into this system. It is also noted that the outfall at Pillar Point STW is to be extended 1.7km into the bay. Consequently, no marine impacts would result from the sewage from proposed steel mill.

Good site and waste management practice will minimise any contamination of surface water and the surface water would be collected and treated to satisfy discharge standards and allowed to discharge locally. No significant impacts upon the marine environment from surface water run-off from the proposed steel mill are expected.

Waste oil recovered from the recirculating fresh cooling water and surface water interceptor would be licensed as a Chemical Waste and taken off-site by licensed contractor. No significant impacts would result upon the marine environment.

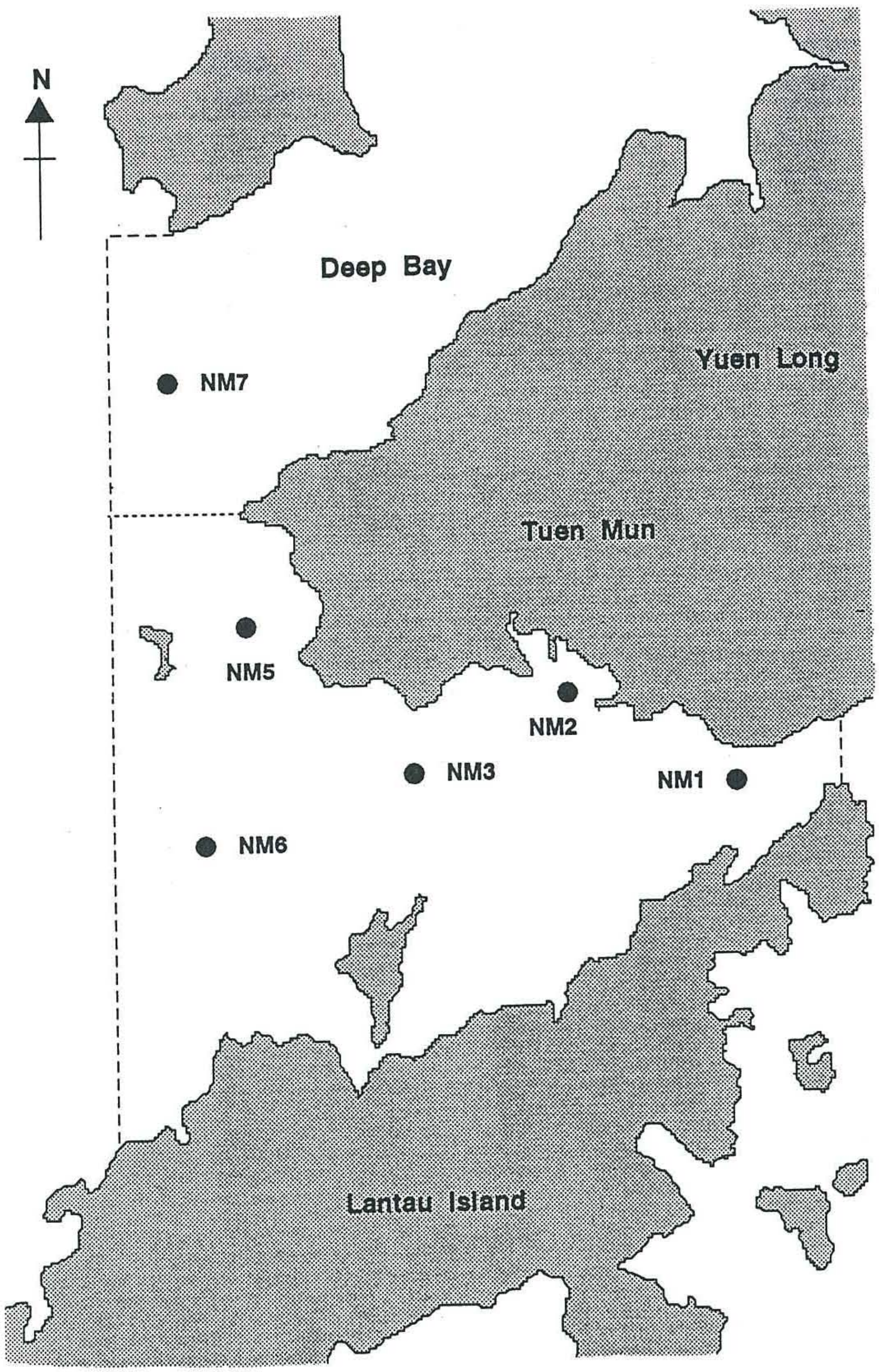


AXIS Environmental

Shiu Wing Steel Mill

Figure 5.1: Water Control Zones

053000/October 1993

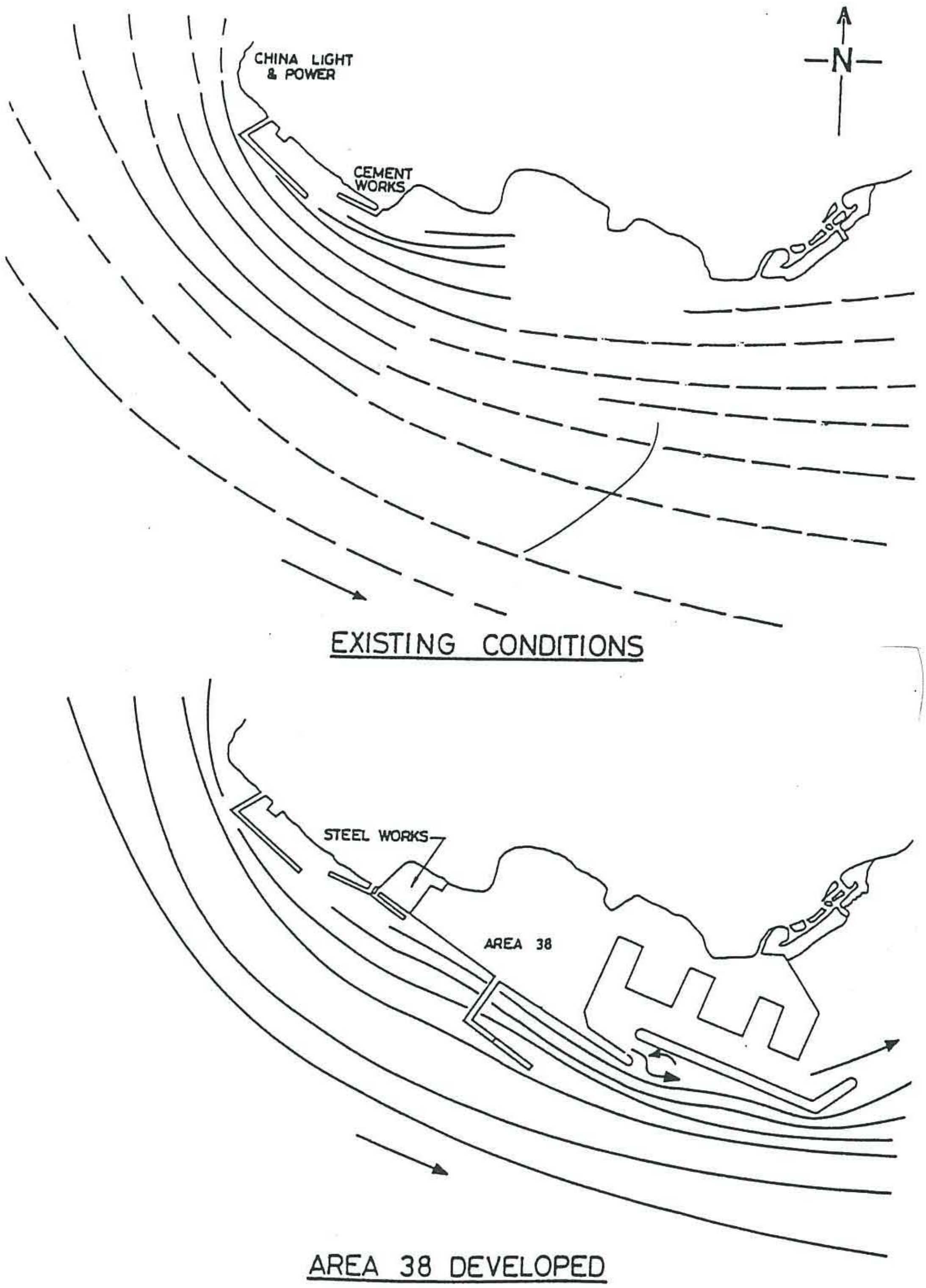


AXIS Environmental

Shiu Wing Steel Mill

Figure 5.2: Monitoring Stations in North Western Waters WCZ

053000/October 1993

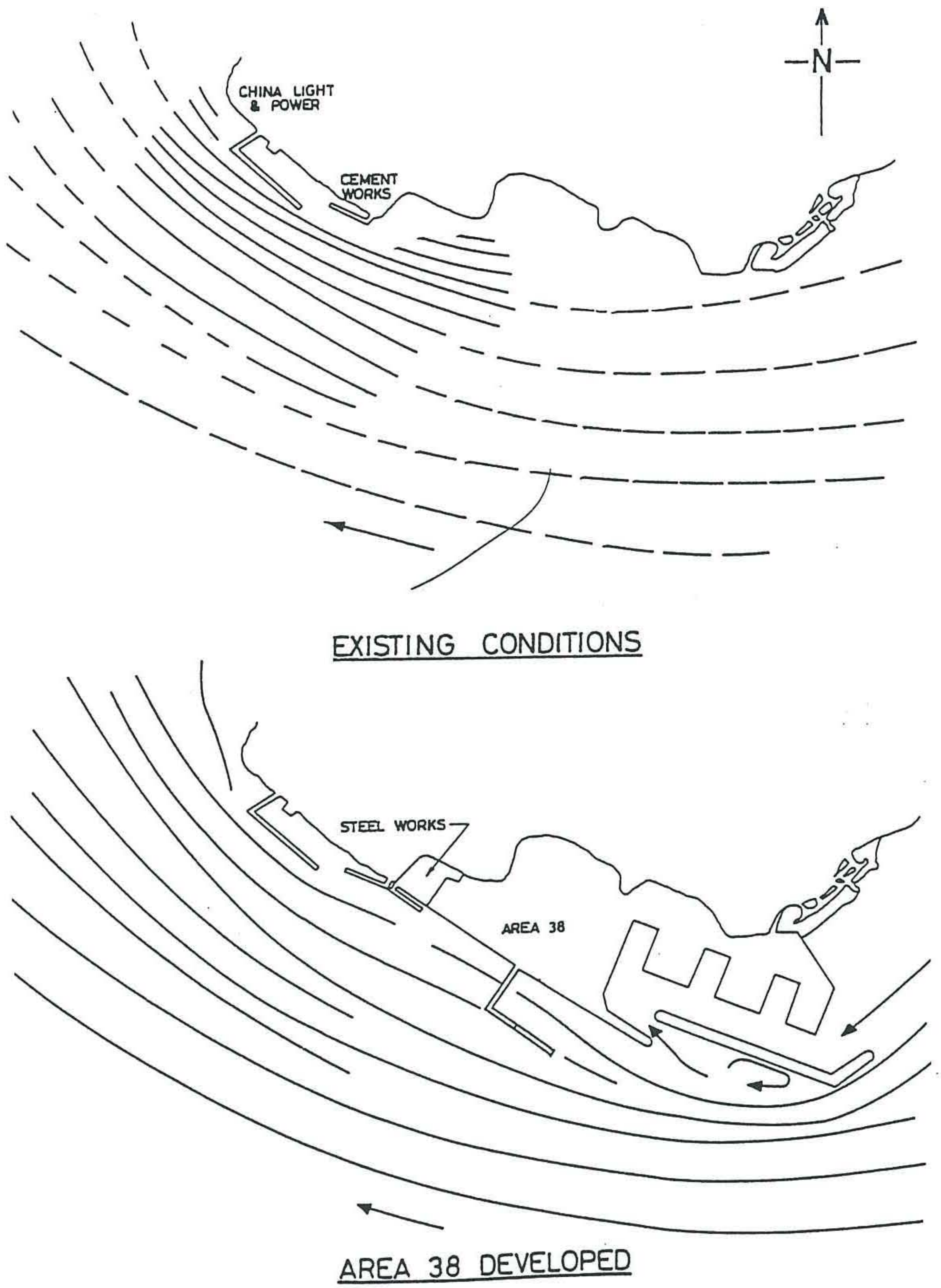


Reference 3

Shiu Wing Steel Mill

Figure 5.3: Near Field High Water - 3 hours (Flood Tide)

053000/October 1993



Reference 3

AXIS Environmental

Figure 5.4: Near Field High Water + 4 Hours (Ebb Tide)

053000/October 1993

Chapter 6
Noise

6. NOISE

6.1 INTRODUCTION

This chapter identifies existing and proposed Noise Sensitive Receivers (NSRs) and predicts the noise at those locations from the proposed development. This was done by assessing the noise from the existing Shui Wing steel mill and transposing those values to the proposed design for the new plant.

The effect of noise from the steel mill is discussed, and the predicted noise levels compared with the expected background levels and relevant environmental standards.

6.2 METHODOLOGY

The approach taken was as follows:

- potential NSRs were identified;
- background noise levels were determined for the nearest NSR;
- the types of equipment to be used were identified and the noise levels, and in some cases frequency spectrums, of the most prominent machines were determined from field measurements at the existing Shui Wing steel mill;
- the noise from the proposed steel mill was predicted at the NSR using the ENM computer prediction model;
- the predicted noise levels were compared to the background noise level, and to the Acceptable Noise Levels (ANL) contained in the TM *Assessment of Noise from Places Other than Domestic Premises, Public Places or Construction Sites* and TM *Noise from Construction Work other than Percussive Piling*. The noise levels were also compared to the recommended criteria contained in the Environmental Guidelines in Hong Kong (HKPSG) and expected character of Area 38 and its surrounding environment.

6.3 REGULATORY STANDARDS

6.3.1 Construction Noise

The Noise Control Ordinance refers to two TM relevant to construction noise. *Noise from Construction Work Other than Percussive Piling* specifies standards for all types of construction (other than percussive piling). These standards vary according to the nature of the area around the NSR and the time of day.

Percussive piling is controlled by the TM *Noise from Percussive Piling* which requires a permit to be is obtained prior to any percussive piling. It also restricts the hours that piling may occur. Permitted hours vary according to the noise level and the proximity of NSRs.

6.3.2 Operational Noise

Noise from the operations at the steel mill are controlled by TM *Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites*. This TM specifies Acceptable Noise Level standards according to the type of area around the site and the time of day. Corrections to take account of the character of the noise are also applied.

6.4 IDENTIFICATION OF NOISE SENSITIVE RECEIVERS

6.4.1 Location of Noise Sensitive Receivers

There are a number of existing and planned NSRs around the proposed steel mill, as described in Section 3, Surrounding Landuse. As noted in Section 4.6.1, the principal settlement is Tuen Mun New Town, which is approximately 4 km east of the proposed site, and the areas of Melody Garden, Butterfly and Wu King residential estates, which are approximately 3 km from the site.

However, the nearest NSRs to the east are the Temporary Refugee Camp (TRC) (Area 46, 2 km east of the proposed site) and a proposed low density housing development (for 1000 people) in area 45C, 2.6 km east of the site. The Refugee Camp is a temporary development and is scheduled to be closed by December 1994.

To the north-northwest of the proposed site are the village settlements of Lung Tsai, Tuk Mei Chung, Sha Po Kong and Nam Long. These villages are occupied by a population of about 500 living in cottage type residential premises. The closest village is 1.8 km from the site.

6.4.2 Discussion of Noise Sensitive Receivers

The closest NSR to the site are the village settlements to the north-northwest. However, these villages are screened from the proposed development site by mountainous terrain. Further the noise environment at these settlements is dominated by the noise from the Castle Peak Power Station. Therefore noise from the steel mill would not be a significant issue at the villages.

The principal NSR are therefore the Pillar Point TRC and the proposed low density housing development. As the TRC is scheduled to be closed by December 1994 this NSR is only relevant during the initial stages of the construction of the steel mill.

At the time of writing no dates are known for the development of the low density housing proposal. Should the proposed low density residential development not proceed the next closest NSR would be the development at Melody Gardens.

For the purposes of assessing the steel mill the existing Pillar Point Refugee Camp will be used as the NSR for construction activities. For operational noise both the proposed low density development and the residential development at Melody Gardens shall be used.

Figure 6.1 shows the location of the principal NSRs relative to the steel works.

6.4.3 Existing Background Noise at NSRs

The existing ambient noise levels near the three NSRs is dominated by road traffic noise. The Expanded Development Study of Tuen Mun Area 38 measured the background noise at several locations including around Melody Gardens, Butterfly Estate, Wu King Estate, Sui Hei Court and Sui Shan Court. The results of these measurements are given in Table 6.1 (Scott Wilson Kirkpatrick/Shankland Cox/ERL (Asia) Ltd, 1990).

Table 6.1 Background Noise Monitoring

Location	Description	L_{90} Noise Level dBA
11	5/F Car Park Sui Shan Court	56
12	5/F Car Park (North) Wu King Estate	58
13	5/F Car Park Sui Hei Court	56
14	5/F Car Park (South) Wu King Estate	57
15	12/F Fung Tip House (South) Butterfly Estate	62
16	5/F Community Centre Butterfly Estate	64
17	12/F Fung Tip House (North) Butterfly Estate	63
18	Footbridge over internal road Melody Garden	62
19	G/F Melody Garden	54
20	G/F THA opposite Melody Garden	58

Road traffic was also measured along Lung Mun Road (3m from the kerbside) near the Pak Kok Temporary Housing Area (opposite Melody Garden) and was found to be 79 dBA L_{10}. Assuming a 3 dB reduction for each doubling of distance from a roadway (line source) gives a noise level of approximately 60 dBA at 200m. Although ground absorption and other effects are likely to increase the attenuation over distance it is possible that a noise level of 55 dBA could occur at distances of up to 800m from the road. Road traffic noise levels are therefore likely to be dominant at the NSRs of potential concern.

In the case of high rise development such as at Butterfly Estate the front line of buildings would screen those behind but in the case of the Pillar Point TRC the buildings would not provide as much screening due to their smaller size and a layout that allows for a direct line of sight to the road from many of the buildings. Therefore at the Refugee Camp the noise from existing road traffic would cause a high ambient noise in excess of 60 dBA.

The design of the proposed low density development is not available for inclusion in this report. But given the scale of the development and the proximity to Lung Mun Road it would be expected that similar high noise levels would occur.

6.4.4 Effect of Future Development on Background Noise

The area around Tuen Mun is proposed for major development. In particular Area 38, of which the steel mill will be a small component, involves a significant reclamation occupying in excess of 100 hectares. The development is in three parts; the steel works which are located furthest from the NSR, a 55 hectare SIA and, closest to the NSR, a 56 hectare River Trade Terminal.

This development will significantly change the noise at the NSR due to an increase in traffic and an increase in industrial and commercial activity.

The Area 38 study predicts a significant increase in traffic noise due to the proposed development. Also, sections of the proposed development will be within 250 metres of the closest NSR. The River Trade Terminal can be assumed to operate on a 24 hour a day basis and therefore the activities from this development will significantly influence the level of noise making it unlikely that any activities from the steel works would be audible from the nearest NSRs.

There is no information available which estimates the likely noise from the proposed River Trade Terminal. However, in accordance with the TM under the Noise Control Ordinance, it is clear that the proximity of the SIA and the River Trade Terminal would make the Area Sensitivity Rating (ASR) "C". However, for the purposes of this report the conservative ASR of "B" shall be used.

6.5 IDENTIFICATION OF IMPACT SOURCES

6.5.1 Construction Noise

Construction would take place over 3½ years and would be in three parts:

- site formation including reclamation
- marine pier construction
- building construction and plant installation

To predict the noise from the different stages of the construction the values in the TM *Noise from Construction Work Other Than Percussive Piling* were used. The values in the TM are recommended only for distances up to 300 metres. Beyond that factors such as ground and air absorption would tend to reduce the noise levels more than that predicted. This would occur particularly in the higher frequencies.

The land form between the steel mill and the NSRs is not fully discernable from contour maps. However, it appears that there would be some screening due to the land form and the industrial development at Pillar Point. Accurate modelling is therefore not possible, and thus a prediction was conducted assuming no barriers and negligible air and ground absorption. This over-predicts the actual noise level, thereby providing a very conservative result. Table 6.2 lists the sound power levels (dBA) of machinery likely to generate significant noise.

Table 6.2 Noise Levels of Construction Machinery

Machine	Sound Power Level (dBA)
Grab Dredger	112
Tug	110
Cutter Suction Dredger	112 - 117**
Derrick Lighters	104
Grader	113
Excavator	112
Bulldozer	115
Dump Truck	117
Backhoe (Tractor)	118
Concrete Lorry Mixer	109
Concrete Pump	109
Air Compressor (Standard)	109
Crane, Barge Mounted (Diesel)	112
Lorry	112
Breaker, Hand Held (Pneumatic)	117
Breaker, Excavator Mounted (Pneumatic)	122

** No values are given in the TM for a cutter suction dredger. Therefore the noise level of a similar trailer suction dredge was used. This data came from a study done by the New Zealand Department of Health in November 1989. This dredge was powered by two 331 kW engines and had several other noise sources including 2 Caterpillar 3304, a Caterpillar 3408 and a Caterpillar 3412 engines. Sound power levels were not given but the study indicted that a noise level at 440 metres was between 51 and 56 dBA L_{eq}. Sound power was calculated using the formula $SWL = SPL + 10 \log 4\pi r^2 - 3$ dB

Site formation

Site formation would involve dredging, seawall formation, reclamation and piled quay formation.

It is estimated that 260,000 m^3 of mud would require dredging. During this stage it is anticipated that there will be one grab dredger and one cutter suction dredger. A tug and a hopper barge would also be operating in the area.

Seawall formation is anticipated to require a grab dredger, two derrick lighters, two hopper barges, and two tugs.

Reclamation is anticipated to require earth moving equipment. It is estimated that this would generally be 1 grader, 1 excavator, 2 bulldozers, 2 rollers, 1 backhoe and 4 dump trucks.

The noise from this equipment will vary depending on equipment design and the condition of mufflers, engine enclosures, etc. It is therefore necessary that during the construction phase of the development that noise from equipment is monitored and noisy equipment repaired or replaced.

Marine Pier Construction

The marine pier would involve driving piles and installing ground anchors. Reinforced concrete beams would be cast at the pile heads and precast concrete decks fitted to supporting beams. The deck would then be cast.

The principal noise source associated with the construction of the piers would be the pile drivers. However, piling is controlled by the procedures described in the TM *Noise from Percussive Piling*. This requires that a Construction Noise Permit (CNP) be obtained prior to any piling. A permit would limit percussive piling to the period from 0700 to 1900 or, if the noise exceeds the ANLS, even further.

Building construction and plant installation

During construction of the plant there would be a number of additional noise sources involved in reclamation work, such as earth moving equipment, trucks and other similar machinery. In addition, there would be concrete lorry mixers, concrete pumps, air compressors, cranes and, during the installation of major items of equipment, a barge crane.

Use of these items would vary depending on the stage of the construction. The noise level at NSRs would also vary depending on the location of the machines, particularly as building progresses and it acts as a barrier to the noise sources.

For the purposes of prediction a worst case scenario was chosen. This is a period when a barge mounted crane is unloading equipment and the site has several concrete lorry mixers, a concrete pump, electric tower crane, several air compressors and several earth moving machines. During most times the noise from the construction phase would be significantly quieter.

Decommissioning would involve similar machinery to the construction with the concrete lorry mixers being replaced by lorries retrieving material and the loading of lorries being done by mechanical loaders with similar characteristics to earth moving equipment. Decommissioning would also include air compressors as well as a number of breakers. However, given the type of construction breaking would primarily be done at ground level to remove foundations and floors. Breaking would therefore generally be screened from the NSRs.

6.5.2 Operational Noise

A previous study at the existing Tseng Kwan O steel mill (ERL (Asia) Ltd, 1990) determined the baseline noise levels of the principal noise sources. These showed that the principal noise sources are the EAF and the RM. Other sources identified were the RF, pump house, air compressor and the dust collection plant. There were also short term impulsive noises arising from the handling of the raw material and finished product.

The EAF emits tones of 100 Hz and harmonics plus variable level random noises. The maximum noise occurs at the beginning of the melt and reduces as the material becomes more homogeneous and the arc becomes more steady.

The RM causes a high level of noise over its length principally due to the product moving on rollers, vibratory feeders and the general machinery in the area. The reheating furnace also produces low frequency noise.

Short term noises included unloading scrap from the barge, feeding scrap into the basket, loading billets for reheat and cutting and bunching of products.

The results of the assessment of the particular machines and activities at the existing steel mill are summarised in Table 6.3.

Table 6.3 Sound Power Levels of main noise sources at existing Shui Wing steel mill.

Machine/Activity	Sound Power Level	Dominant Frequency
EAF	116.7 dBA L_{eq}	63Hz - 4 kHz
Rolling Mill	122.0 dBA L_{eq}	63Hz - 4 kHz
Reheating Furnace	116.5 dBA L_{eq}	250 Hz
Pump House	102.0 dBA L_{eq}	1 kHz
Air Compressor	108.5 dBA L_{eq}	1 kHz
Dust Collection Plant	113.0 dBA L_{eq}	63Hz - 4 kHz
Feeding Scrap to Basket	134.9 dBA L_{max}	2 kHz
Loading Billets for Reheat	144.7 dBA L_{max}	2 kHz

Note: Continuous noise sources are described in terms of L_{eq}. Short term (impulsive) noise sources are described in terms of L_{max}.
Source: ERL (Asia) Ltd, 1990

The operations at the proposed steel mill are expected to be similar to those at the existing steel works. However, in terms of noise there would be some significant differences. The most significant difference that may increase the level of noise is the increase in the capacity of the EAF. The actual type of EAF has not been determined and therefore the actual noise level of the final machine is not known.

However, as noted previously in this report the developers would use the latest technology to ensure maximum productivity, and minimum detrimental impacts on the environment. *Shiu Wing Steel Mill Ltd* would ensure that the new plant was not louder than the existing EAF when measured outside the plant in the direction of the NSR.

Other noise sources at the existing steel works would also be expected to be reduced at the new works. This would be achieved by the selection of new, more efficient equipment and by consideration of noise in the construction of new premises. In particular the better design and layout of the proposed works would enable screening of many of the noisiest activities. For example the location of the substantial product storage area would screen noise from the rolling mill. Changes in the handling of the raw product would also reduce the noise, especially the change from double handling of material and the use of scrap bays near the marine terminal.

6.6 PREDICTED NOISE LEVELS

6.6.1 Construction Noise

Construction noise would vary according to the stage of the development. However, to assess the worst case situations several different scenarios are considered:

- dredging
- seawall formation
- reclaiming the land
- construction of the steel mill
- piling.

To calculate the sound pressure levels at the NSR, Table 5 from the TM *Noise from Construction Work other than Percussive Piling* has been used. This table provides correction factors for distances up to 300m but as discussed previously does not include corrections for barriers, air absorption and ground absorption. It would therefore provide a conservative prediction of the attenuation and overpredict the actual noise level at the NSRs.

The distance to the nearest NSR, the Pillar Point TRC, is approximately 2.2 km from the centre of the proposed steel works. The two other NSRs, the proposed low density housing area and Melody Garden are located 2.8 km and 3.6 km respectively from the proposed works.

It should be noted that the predictions for the low density housing area and Melody Garden are for comparison only as the land form between the site and these two NSRs is such that a significant reduction in the level of noise would occur.

Dredging

For this scenario it is assumed that there will be one grab dredger, one cutter dredger, a tug and a hopper barge.

Total Sound Power Level (SWL) = $SWL_{grab\ dredger} + SWL_{cutter\ dredger} + SWL_{tug}$

$= 112\text{ dBA} + 117\text{ dBA} + 110\text{ dBA}$

$= 118.5\text{ dBA}$

Seawall formation

For this scenario it is assumed that there will be one grab dredger, two derrick lighters, two hopper barges, and two tugs.

Total Sound Power Level (SWL) = $SWL_{grab\ dredger} + 2 \times SWL_{derrick\ Lighters} + 2 \times SWL_{tug}$

$= 115\text{ dBA} + 107\text{ dBA} + 113\text{ dBA}$

$= 117.5\text{ dBA}$

Reclamation

For this scenario it is assumed that there will be one grader, one excavator, two bulldozers, two rollers, one backhoe and four dump trucks on the site at one time.

Total Sound Power Level (SWL) = $SWL_{grader} + SWL_{excavator} + 2 \times SWL_{bulldozers} + 2 \times SWL_{roller} + SWL_{backhoe} + 4 \times SWL_{dump}$

$= 113\text{ dBA} + 112\text{ dBA} + 118\text{ dBA} + 111\text{ dBA} + 123\text{ dBA}$

$= 124.5\text{ dBA}$

Construction of the Steel Mill

For this scenario it is assumed that there will be one barge mounted crane, 4 concrete lorry mixers, a concrete pump, an electric tower crane, four air compressors and four lorries.

Total Sound Power Level (SWL) = $SWL_{barge\ crane} + 4 \times SWL_{concrete\ mixers} + SWL_{pump} + SWL_{crane} + 4 \times SWL_{compressors} + 4 \times SWL_{lorry}$

$= 112\text{ dBA} + 115\text{ dBA} + 109\text{ dBA} + 95\text{ dBA} + 115\text{ dBA} + 118\text{ dBA}$

$= 122\text{ dBA}$

Piling

A Construction Noise Permit will be required for piling and therefore details of the noise level and the operating times will be given at the time of the application for the permit. It is therefore sufficient to state here that the distance from the proposed steel works is considerable and in accordance with the TM on *Noise from Percussive Piling* would allow even the most noisy form of pile driving during the hours of 0700 to 1900.

The predicted worst case construction noise levels are summarised in Table 6.4.

Table 6.4 Predicted worst case construction noise assuming no barriers, air or ground absorption

	Dredging	Sea Wall Formation	Reclamation	Steel Mill Construction
Pillar Point TRC	<43.5 dBA	<42.5 dBA	<49.5 dBA	<47 dBA
Proposed Low Density Housing	<40.5 dBA	<39.5 dBA	<46.5 dBA	<44 dBA
Melody Gardens (top floor)	<39.5 dBA	<38.5 dBA	<45.5 dBA	<43 dBA

6.6.2 Operational

It is proposed that the works will operate 24 hours a day, 7 days a week. Accurate modelling of the noise associated with the proposed works is therefore necessary to ensure that NSRs are protected from excessive noise.

The model used was the ENM model developed for the Australian and New Zealand Environment and Conservation Council. The model takes an input in octave sound pressure levels and calculates the noise at a receiver. The model takes into account the distance, ground and air absorption, temperature and wind, and the effect of barriers.

Each of the principal noise sources were modelled and the noise predicted at the proposed low density residential development and at the top floor Melody Gardens, 85m above ground level. The results are tabulated in Table 6.5.

Modelling for the Pillar Point Temporary Refugee Camp was not carried out as this camp is scheduled to be removed well before the steel works commences operation.

Table 6.5 Predicted Noise Levels at NSR, dBA

Machine/Activity	Proposed Low Density Housing	Top Floor of Melody Gardens
EAF	13.4	15.1
Rolling Mill	10.6	10.3
Reheating Furnace	15.7	18.1
Pump House	-16.9	-18.6
Air Compressor	-10.4	-12.1
Dust Collection Plant	7.7	8.9
Feeding Scrap to Basket	7.5	-1.7
Loading Billets for Reheat	17.3	8.1

Note: These values differ substantially from earlier predictions made in a preliminary report (ERL (Asia) Ltd 1991). It appears that this is due to the preliminary study not taking into account the height of the intervening land form between the steel mill and the NSR. Table 6.6 details the attenuation due to the land form determined by ENM.

Table 6.6 Barrier correction (dBA) due to intervening land form (ENM model)

Centre Frequency (Hz)	Proposed Low Density Housing	Top Floor of Melody Gardens
31.5	12.0	8.5
63	13.8	10.7
125	16.8	12.6
250	19.8	15.0
500	22.8	18.0
1000	25.0	21.0
2000	25.0	24.0
4000	25.0	25.0
8000	25.0	25.0
16000	25.0	25.0

To predict the total noise level at the NSRs a worst case scenario was assumed, with all machines operating. In this situation the total noise level would be calculated by logarithmically adding the individual sound pressure levels.

Total Sound Pressure Level (SPL) = $SPL_{EAF} + SPL_{rolling\ mill} + SPL_{reheating\ furnace} + SPL_{pump\ house} + SPL_{air\ compressor} + SPL_{dust\ collection}$

At the proposed low density residential development the total sound pressure level would equal 13.4 dBA + 10.6 dBA + 15.7 dBA + (-16.9) dBA + (-10.4) dBA + 7.7 dBA ~ 19 dBA

At the top floor of Melody Garden the total sound pressure level would equal 15.1 dBA + 10.3 dBA + 18.1 dBA + (-18.6) dBA + (-12.1) dBA + 8.9 dBA ~ 21 dBA

In accordance with procedure described in the TM *Assessment of Noise from Places other than Domestic Premises, Public Places or Construction Sites*, the predicted value must be adjusted to take into account the nature and character of the noise.

In accordance with the TM the Corrected Noise Level (CNL) equals the Predicted Noise Level (PNL) plus corrections for tonality, impulsiveness, intermittency and reflections.

$$CNL = PNL + C_{tonality} + C_{imp} + C_{int} + C_{reflection}$$

The noise from the Steel Works does exhibit some tonal character due to the EAF arc and the burners in the reheating furnace. These are likely to be controlled in the design of the new steel works, but assuming a worst case situation a correction of 6 dB may be added to the PNL.

The nature of the materials handling, particularly the feeding of scrap to the basket and loading billets, are impulsive. The attenuation of these noises is likely to make them insignificant, other than in the case of the loading of billets when assessed at the proposed low density residential development. However, some impulsive character would be present, and therefore a correction of 3 dB may be applied.

The nature of the EAF is one that varies in noise level. These variations would not be expected to significantly increase the noise level at the NSR but, assuming a worst case situation, an intermittency correction of 3 dB may be applied.

The PNL calculated with ENM does not consider the reflection from a building behind the receiver. However, the TM assesses the noise from industrial operations at a position immediately in front of a facade. Therefore a 3 dB correction must be added to take account of the required measurement position.

The total Corrected Noise Level from the operation of the Steel Works is therefore:

- at the proposed low density residential development:

  19 + 6 + 3 + 3 + 3 dBA

  = 34 dBA

- at the top floor of Melody Gardens:

  21 + 6 + 3 + 3 + 3 dBA

  = 36 dBA

6.7 ASSESSMENT OF IMPACTS

6.7.1 Comparison to Existing Background Noise

The purpose of environmental noise standards is to protect the quality of life of those people who are unwillingly required to listen to noise. Most international standards, including British Standard 4142, recommend that to minimise disturbance a noise should not significantly intrude above the background noise. BS 4142 advises that a difference of around 10 dB or higher between a noise (L_{eq}) and the background noise (L_{90}) indicates that complaints are likely, but differences of around 5 dB are of marginal significance.

In the current situation the background noise is determined by the level of road traffic. The current level of background noise is also expected to rise owing to the expected increase in traffic and the effect of the planned major SIA in Area 38.

The current background noise levels were discussed in Section 6.4.3. This indicated that the background noise at the ground floor of Melody Garden was 54 dBA and at the Temporary Housing Area opposite Melody Gardens was 58 dBA.

The proposed low density residential development is currently subject to noise from the Lung Mun Road and this would be expected to increase as the development in Area 38 occurs. It is therefore unlikely that at these places the levels of noise predicted from the steel mill would be audible other than at quiet times at night. Even then the level of noise would be such that it would not significantly intrude above the background noise.

6.7.2 Compliance with Acceptable Noise Levels (ANL)

Construction

In accordance with the TM 'Noise from Construction Work other than Percussive Piling', the Acceptable Noise Level (ANL) for a particular NSR shall be determined by

- identifying the NSR;
- determining the ASR of the area within which the NSR is situated;
- determining the Basic Noise Level (BNL) from the appropriate table in the TM;
- correct the BNL (if necessary) to determine the ANL.

This report has identified the principal NSR as the Pillar Point TRC. Given the proximity of this Camp to the existing industrial development at and around Pillar Point and to the proposed major development in Area 38 the appropriate Area Sensitivity Rating is "C".

In accordance with the TM the BNLs are 70 dBA during the evenings (1900 to 2300) and general holidays (including Sundays) during the day-time and evenings (0700 to 2300 hrs). During the night-time (2300 to 0700 hours) the BNL is 55 dBA.

For an ASR of "B" the maximum noise levels are 65 dBA and 50 dBA respectively.

No corrections would apply to the BNL and therefore the BNL equals the ANL.

The predictions of the noise from construction shows that the ANL for an ASR of B are not exceeded, although the PNL of some operations are close to the ANL. The predictions of construction noise have been based on a theoretical attenuation over distance of 6 dB in accordance with the principles of the TM.

However, the TM advises that this theoretical attenuation is not accurate for large distances. Factors such as air and ground absorption will reduce the level of noise from the machines. For middle frequencies of 500 Hz the expected reduction in noise level would be approximately 4 dB with higher attenuation for higher frequencies. Ground absorption would also tend to reduce the level of noise.

A further significant issue that prevented the noise from being accurately modelled was the difficulty in determining the topography between Pillar Point and the NSR. Contour plans for the area were not clear about the land form but a visual inspection showed that there was some land form separating the proposed steel mill from the NSR.

The predictions used were therefore theoretical, and would have over predicted the noise by at least 5 dB. The noise from the construction activities would therefore be expected to be considerably less than the ANL for 24 hour operations.

Operational

In accordance with the TM the ANL for a particular NSR shall be determined by:

- identifying the NSR
- determining the ASR of the area within which the NSR is situated
- determining the ANL from the appropriate table in the TM.

This report has identified the two principal NSRs that could be affected by the operations of the steel mill. They are the proposed low density housing between Pillar Point and Melody Gardens and the high density residences in Melody Gardens. In section 6.4.4 it is concluded that the NSRs, particularly the proposed low density housing, would be directly affected by the proximity of the future development in Area 38. However, it was determined that for the purposes of this assessment it would be assumed that the NSRs are indirectly affected and the ASR shall be assumed to be "B".

As the steel mill would operate 24 hours per day the relevant ANL from Table 2 of the TM is the night time noise level 55 dBA L_{eq}.

The predictions based on the current operations at the Shui Wing Steel Works, including the addition of corrections in accordance with the TM, show that the noise level at the two NSR would be:

- at the proposed low density residential development -34 dBA
- at the top floor of a building at Melody Gardens -36 dBA

The operational noise from the proposed steel mill would therefore readily comply with the Noise Control Ordinance.

6.7.3 Environmental Guidelines

Construction

The HKPSG does not specifically mention construction noise. Instead it concentrates on noise that is not temporary. Construction noise is temporary but in the current situation various construction activities would occur for 3½ years. It is therefore desirable that the proposed construction does not maintain a high level of noise for that period.

As discussed in Section 6.7.2 the predicted noise levels are significantly lower than the day time ANL. Further, the night time levels are complied with even though the effect of attenuation due to air and ground absorption and due to the barrier effect of the intervening land form were not considered. The noise from construction would therefore be significantly less than the ANL and would satisfy the intent of the HKPSG to achieve lower levels that the TM permit.

Operational

The HKPSG advises that the noise from new development should not exceed a standard that is 5 dB less than the relevant ANL. In the current case the ANL for industrial activities at night is 55 dBA L_{eq}. The Environmental Guideline level is therefore 50 dBA. The predicted noise levels, including corrections in accordance with the TM, are 34 and 36 dBA at the two NSRs, which are considerably less than the environmental guideline level.

6.8 CONCLUSIONS

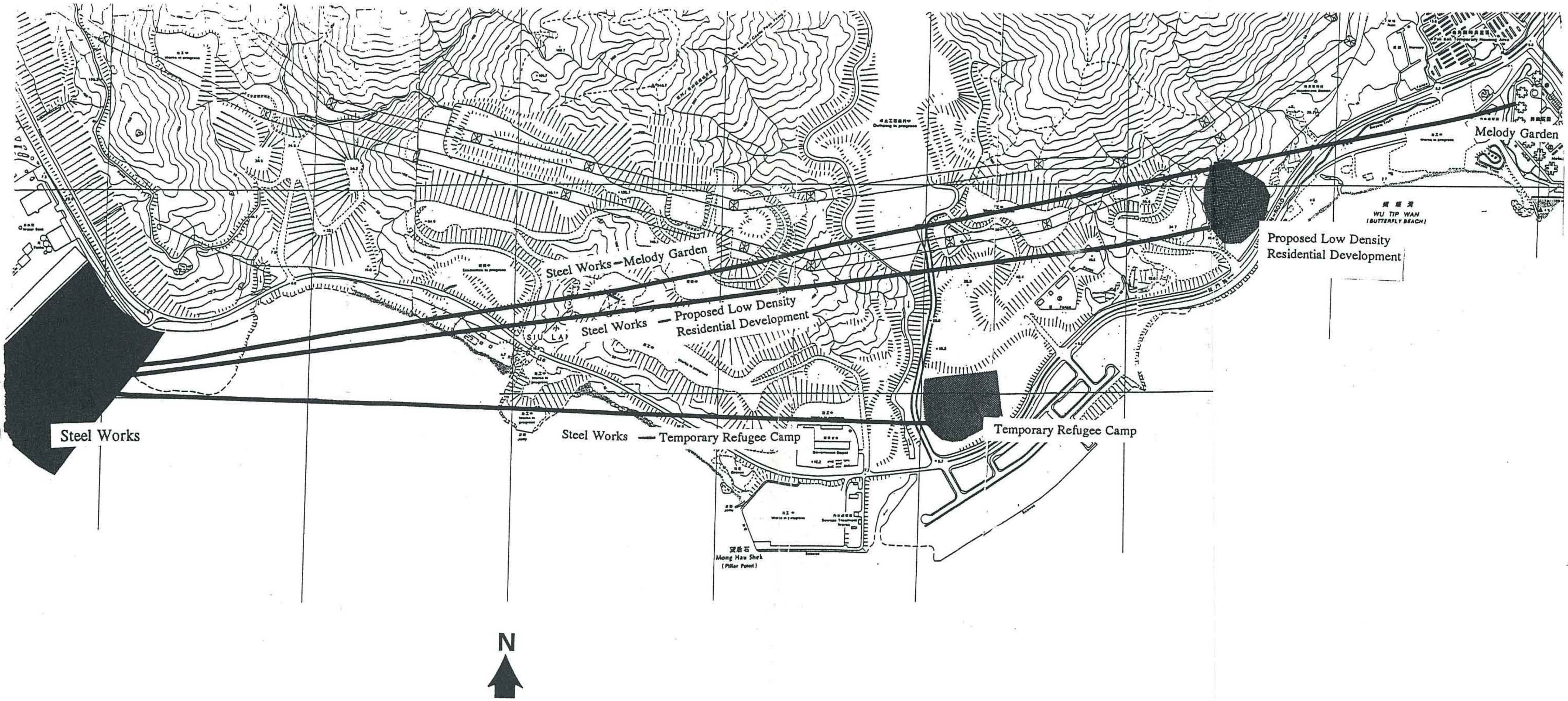
Throughout this study, where there has been any uncertainty the scenario which would result in the maximum noise level has always been used. The predictions made therefore are likely to over-predict the noise actual levels. Further, the predictions have been based to a large extent on the current operations of the Shui Wing steel mill at Tseung Kwan O.

However, new technology and the construction of a new plant should lead to considerable opportunities to achieve lower noise levels. Therefore the actual noise from the steel mill is likely to be lower than predicted and should not cause disturbance at the proposed low density residential development or at Melody Gardens.

Some construction noise may be audible at the Pillar Point TRC but this would readily comply with the requirements contained in the construction noise TM.

In relation to piling, a CNP must be obtained prior to any piling.

The development satisfies the relevant TMs and the HKPSG with respect to environmental noise.



AXIS Environmental

0 250 500 750 1000m

Shiu Wing Steel Mill

Figure 6.1: Locations of Principal Noise Sensitive Receivers

053000/October 1993

CHAPTER 7
SOLID WASTE MANAGEMENT

7. SOLID WASTE MANAGEMENT

7.1 INTRODUCTION

This Chapter gives details of the solid wastes associated with the operation and the eventual decommissioning of the proposed steel mill. Significant volumes of waste would be produced and this chapter examines the issues, as follows:

- The different types of solid wastes (Section 7.2);
- Waste leaching tests are described (Section 7.3);
- The possible treatment/disposal options are identified and discussed along with the potential environmental impacts. The leachate tests undertaken to determine the suitability of the materials for landfilling or reuse are assessed with regard to the options (Section 7.4);
- Mitigation measures and recommendations are proposed for the treatment/disposal of the solid wastes (Section 7.5).

7.2 WASTE ARISINGS

The major solid wastes that would result from the operation of the steel mill are referred to as slag, dust and scale.

Construction and reclamation activities would require dredging of marine mud and its subsequent disposal, and this is dealt with in Chapter 5 with regard to potential impact upon the marine environment.

In the longer term (an estimated minimum of 20-30 years) there would also be some solid waste resulting from decommissioning of the proposed works.

7.2.1 Slag

Slag would result from both the EAF and the ladle. During production it would rise to the surface as an impurity and be removed. Approximately 100 tonnes of slag per day (i.e. 30,000 tonnes/annum assuming 300 working days per year) would be generated by the proposed steel mill.

Slag is a hard grey granular material and comprises mainly of Calcium Oxide (approximately 50%), iron oxides and silica. These are all essentially benign substances from an environmental perspective. Slag can also contain elevated levels of oxides of heavy metals, all of which are potentially polluting. However, the metals are normally fused within the slag and therefore tend to be immobile.

7.2.2 Filter Dust

Dust would result from the collection of EAF exhaust gas dust particles by the baghouse filter. The filter dust would be stored in hoppers and be pelletised on discharge. An estimated 45 tonnes of dust per day (13,500 t.p.a.) would be generated by the proposed steel mill.

The filter dust comprises mainly iron oxide (approximately 50%), silica and lime. The composition will vary, however analysis has shown the typical heavy metal content to be 15.5%. This was primarily zinc (about 12%), manganese (1.7%) and lead (1.4%).

7.2.3 Scale

Scale is a waste product produced during casting and rolling operations. Scale comprises greater than 90% ferric oxides and needs to be removed to prevent it being rolled into the steel and marring the product quality. The scale would flake off the steel when cooling occurs during spraying by cooling water.

The scale would be picked up in the recirculating water system and carried to settling pits where the scale is separated from the water mobile crane and placed on a drainage pad to reduce the water content. Approximately 35 tonnes per day (10,000 t.p.a.) of scale would be produced.

7.2.4 Miscellaneous Solid Wastes

- Refractory materials used to line furnaces, ladles and tundishes would be removed from these vessels periodically when they have worn to minimum thickness for safe operation. The material is inert and mechanically strong.

- Spoil and demolition waste would result from the decommissioning and demolition of the proposed steel mill. It is difficult to realistically quantify these wastes at this design stage and could depend on a number of factors. There will be specific items such as the furnace and the refractory lining which will require disposal. No asbestos or asbestos containing materials will be used in the construction of the new steel mill and this will not therefore be an issue during decontamination.

- Waste paper will be generated from the offices etc., and would be amenable to recycling.

7.3 WASTE LEACHING TESTS

7.3.1 Tests were deemed necessary to quantify the pollution potential of the solid wastes. Leachate tests were conducted to help quantify this and to help determine what treatment and/or disposal options will be environmentally acceptable.

7.3.2 Waste Samples

Slag and filter dust samples were collected from different storage locations by AXIS during 3 site visits to Shiu Wing's existing steel mill on the 4th, 15th and 16th of March 1993.

The samples of filter dust were well mixed and tests performed on representative samples. Similarly, for the slag samples. In addition representative samples were collected from each and mixed together; tests were also conducted upon representative samples of this mixture. Thus leachate tests were conducted upon filter dust, slag and filter dust/slag mix, each with both water and acid as the leaching medium.

In addition, a simple leachate test was conducted on a scale sample collected from site on 15th March 1993.

7.3.3 Testing Procedure

The samples were extensively tested in accordance with the Harwell Waste Research Unit (WRU) Laboratory UK 'Testing of Hazardous Wastes to Assess their suitability for Landfill Disposal' (Appendix 7A). The tests are used to assess the feasibility of the disposal options, particularly to landfill.

The WRU leaching test is basically very simple. It is a repetitive batchwise shaking test, using either distilled water or dilute acid as the leaching fluid (the acid is used to provide a more aggressive leaching medium and to simulate leachate from co-disposal of hazardous waste with municipal waste). The duration of each extraction is determined from preliminary equilibrium tests.

The detailed leachate test procedures are described in Appendix 7A. The full results of the tests can be found in Appendix 7B and are interpreted in Appendix 7C with respect to landfilling.

7.4 TREATMENT/DISPOSAL OPTIONS AND POTENTIAL IMPACTS

7.4.1 Options

There are various disposal options for dealing with the solid wastes that would be generated by the steel mill, and they require discussion. The options are:

- dispose to landfill
- use as reclamation fill
- use as a road material base

The principal concerns associated with the slag and filter dust is the presence of significant concentrations of heavy metals. The suitability of the disposal options listed above can be determined by the extent by which heavy metals leach from the solid waste.

In addition, the following options exist for dealing with the solid wastes:

- waste stabilisation
- recovery/recycling

and the feasibility of these are discussed.

7.4.2 Landfill

Currently, the government provides landfilling free of charge. Industrial waste producers are responsible only for the cost of transporting waste to the landfills. Consequently there is currently little incentive for producers to minimise their waste production. However, this is anticipated to change with the forthcoming opening of the three strategic landfills WENT, NENT and SENT, when disposal costs will be levied. The charging levels and procedures have not yet been confirmed. Of these 3 landfills only SENT is proposed to accept Industrial Wastes for co-disposal.

Wherever possible the reuse of waste materials is preferred to direct disposal to landfill. However if it is not practicable to reuse some or all of the waste then disposal by landfilling would need to be considered. Whether or not these wastes could be disposed of to the new landfills will depend largely on 2 main factors. These are the environmental suitability of the waste and the quantity requiring disposal.

The results indicate that landfill disposal of scale and slag would have no significant environmental impact (Appendix 7C).

Results indicate that filter dust leaches significant quantities of zinc, lead and sulphates. Filter dust could be landfilled at SENT landfill, where dilution, attenuation, containment and treatment of the leachate is anticipated to result in no significant environmental impact (Appendix 7C). SENT landfill will accept industrial waste for co-disposal with municipal waste. The filter dust is not considered suitable for disposal to a non-containment landfill site.

7.4.3 Reclamation Fill

Industrial waste such as Pulverised Fuel Ash (PFA) from the power generation industry is used as reclamation fill in Hong Kong, and therefore this possible reuse merits discussion as a disposal option for solid waste arisings from the proposed steel mill. The Shiu Wing steel mill would only produce small quantities of waste in comparison with a power station. However, this potential reuse of waste products is worth investigating, not least because of the reclamations planned adjacent to the proposed site.

This option would be particularly attractive as the area adjacent to the proposed Steel Works is to be a Public Dump prior to commencement of reclamation. Thus, if acceptable, the waste arisings from the plant could be deposited immediately into the adjacent sea area, instead of having to store until reclamation commences.

However, the levels of metallic leachate contamination are significantly higher for slag and dust than for PFA (Reference Aspinwall & Company, 1992). There was also oil present in the leachate from the scale sample tested. These results would prevent this method of disposal/reuse from being an option without pretreatment of the materials.

7.4.4 Road Material Base

The high contaminant levels in the filter dust leachate prevent it from further consideration for re-use as road material base unless pretreatment is undertaken.

Slags are often used as road material base in the UK, Europe and New Zealand. The potential environmental impact of such a use is best assessed by considering the worst case and comparing the results of the leachate tests with the strict standards of effluents discharged into inland waters.

The levels of zinc, lead, barium and copper in the slag leachate exceed the standards; thus this option may result in environmental impact.

Oil contamination of scale prevents this option from being feasible.

7.4.5 Waste Stabilisation

This involves chemical stabilisation to physically bind heavy metals into an inert solid material, suitable for disposal to land without the need for leachate treatment. Cement or a cement/lime mixture is often used as the stabilisation medium.

Industrial wastes, such as the filter dust, arising from the proposed mill could be treated at the Chemical Waste Treatment Facility (CWTF), which would charge for this service. However, the CWTF is primarily intended for dealing with small quantities of waste, and not relatively large quantities of dust as would arise from the proposed steel mill. The amount of filter dust generated by the proposed steel mill would consume almost half of the capacity of the CWTF solid waste stabilisation plant at present, although it is possible this could be increased in the future.

A disadvantage of waste stabilisation is that because of the addition of cement type stabilising materials the volumes of waste increase and there is also a potentially significant cost implication. The likely cost of stabilisation in Hong Kong is difficult to ascertain. There is no commercial stabilisation plant available in Hong Kong and the charging arrangements for using the CWTF have not yet been finalised.

Waste stabilisation could be employed to chemically stabilise filter dust to prevent any heavy metals present from leaching into the surrounding environment.

After stabilisation, the resulting product may be disposed of using the options listed in 7.4.3 or 7.4.4 without significant environmental impact.

7.4.6 Recovery/Recycling

Filter Dust

There is potential for metals recovery from the filter dust, particularly with regard to zinc and lead. However, the concentrations of zinc and lead are insufficient for the purposes of recovery in lead/zinc smelters.

Recovery of zinc from the filter dust has always been technically difficult. However, recently a small number of commercial metal recovery plants capable of handling filter dust have started operating in the USA and Europe. This consists of a dc plasma furnace process to treat the dust to produce a non-toxic slag suitable for direct dumping, and to recover non-ferrous metallic products such as zinc and lead to defray operating costs. It is understood that the nearest such process to Hong Kong is in Japan. However this recycling of filter dust is a relatively new practise and has yet to be proven by time.

There is also the possibility of using the filter dust as feed to one of the following plants:

- sinter plant
- direct reduction kilns
- blast furnace
- zinc oxide plant

There are presently no such plants in Hong Kong but it may be possible to export filter dust to such plants in China.

Slag

It is not common for metals to be recovered from EAF slag, although some companies do recover the metals and re-use the slag as coated roadstone. However, no such metal recovery process exists in Hong Kong.

Scale

In the proposed Tuen Mun steel mill, the scale would be separated from the recirculating freshwater in a settlement pit. It may be possible to re-use this heavy scale as feed to a sinter plant in China.

Miscellaneous Solid Wastes

- Some of the waste refractory materials may be recoverable for reuse.

- Some of the materials resulting from the decommissioning and demolition of the proposed steel mill would be recoverable/resaleable.

- Waste paper produced by the proposed development could be recycled.

7.5 DISCUSSION AND RECOMMENDATIONS

7.5.1 Filter Dust

It is recommended that filter dust from the proposed steel mill is pelletised and disposed of at SENT landfill. Extensive leachate tests undertaken as part of this EIA suggest that this practise would have no significant environmental impact. Monitoring of the leachate will be undertaken at SENT landfill by the operator.

If levels of contamination are found to be excessive, the filter dust would require stabilisation prior to landfilling to ensure minimal environmental contamination.

It is also recommended that the technical, environmental and economic performance of the relatively new commercial dc plasma furnace process of heavy metal recovery be monitored to assess if it is a viable option.

In addition, the possibly of exporting the dust to China for re-use will be examined further.

7.5.2 Slag

It is recommended that slag is disposed of at either WENT or NENT, as it is a relatively inert waste.

7.5.3 Scale

It is recommended that scale is disposed of to either WENT or NENT, as it is a relatively inert waste. In addition, the possibility of exporting the dust to China for re-use should be examined further.

7.5.4 Miscellaneous Solid Wastes

- Refractory materials would be reused where possible, and depending an contamination levels, as construction material or reclamation fill.
- Spoil and demolition materials resulting from decommissioning and demolition of the proposed steel mill would be reused where possible. One of the most effective means of reducing problems during decommissioning of major industrial plant is to ensure the following:
    - No materials which are particularly toxic, environmentally persistent or difficult to dispose of, are used in the construction or incorporated during the operations. Examples of these are asbestos, asbestos containing materials such as thermal lagging, and PCBs. It has been agreed that these will not be used at the steel mill.
    - Ensure good site operational practise and good waste management practise is followed during the operational life of the plant. This will avoid contamination of the site from on-site disposal of material and indefinite storage of waste materials.
- Waste paper would be collected and taken off-site for recycling.

CHAPTER 8
LANDSCAPE & VISUAL IMPACTS

8. LANDSCAPE AND VISUAL IMPACT ASSESSMENT

8.1 INTRODUCTION

Both the construction and operation of the proposed steel mill would result in some landscape and visual impact. Thus chapter assesses their significance and examines:

- legislation and guidelines relating to visual impacts (Section 8.2);
- the methodology used in assessing landscaping and visual impacts (Section 8.3);
- the existing environment and landscape character (Section 8.4);
- the potential landscape and visual impacts during construction and the mitigation measures necessary (Section 8.5);
- the potential landscape and visual impacts during operation and the mitigation measures necessary (Section 8.6);
- Conclusions (Section 8.7).

8.2 EXISTING LEGISLATION AND GUIDELINES

There is currently no legislation which specifically relates to the visual impacts that arise from development. However, the need to address visual impact has been identified as part of the environmental review process and is recognised as an important issue in the Environmental Protection Department's Advice Note (2/90) on the *Application of the Environmental Impact Assessment Process to Major Private Sector Projects*.

In addition, the White Paper on *Pollution in Hong Kong - A Time to Act* states that the Government's overall policy objectives for environmental planning are:

- 'to avoid creating new environmental problems by ensuring the consequences for the environment are properly taken into account in site selection, planning and design of all new developments';
- 'to seize opportunities for environmental improvement as they arise in the course of urban redevelopment'.

While these policy objectives were originally designed for more specific environmental issues such as noise, water, air pollution and waste disposal, they can be applied to visual impact in the same manner. Landscape impact, however, is not specifically identified.

8.3 METHODOLOGY

8.3.1 Appraisal of baseline conditions

For the purposes of the assessment process it is important to distinguish between landscape and visual impacts:

- landscape impact relates to the effect upon the physical characteristics or components which together form the landscape, eg landform, vegetation etc;

- visual impact is a measure of the change to views of that landscape experienced by individual receptor groups, eg local residents.

Detailed baseline information is essential to predict and evaluate impacts. The baseline landscape and visual conditions will be assessed through the appraisal of the:

- the visual context; the views in and out of the area and their existing quality;

- landscape context; the physical features of the natural landscape, settlements and land use.

8.3.2 Appraisal of the impact sources

It is anticipated that development of the steel mill would result in visual impacts not only from site construction but also as materials, plant and equipment are brought onto site. The primary source of impact during the operational phase would be the steel mill; secondary, and more indirect impacts would arise from the delivery of raw materials and transportation of the finished reinforcing bar from site.

8.3.3 Assessment of landscape and visual impacts

The basis for the appraisal is a qualitative evaluation of the visual intrusion of the proposals and their impact upon key receptor groups and the baseline landscape. In order to determine the extent and level of impact on receptors, the immediate area as well as more distant viewpoints were examined. This allows a Zone of Visual Influence (ZVI) to be determined and the establishment of key viewpoints and receptors within this area (Fig 8.1). The sensitivity of receptors, identified within the ZVI, to change is categorised as high, moderate or low:

- highly sensitive receptors, include residential areas and institutions such as schools and hospitals;

- moderately sensitive receptors, include public open space and commercial development;

- low sensitivity receptors include transport corridors, industrial and manufacturing areas.

Impacts are defined within three categories, severe, moderate and slight, according to the significance of the impact upon the following criteria:

- visibility of the proposed development
- value of the existing views
- degree of change to existing views
- sensitivity of receptors
- proximity of receptors.

More variable factors, such as weather conditions, also need to be considered - for example, hazy conditions frequently prevail at specific times of the year, which can substantially reduce the significance of the visual impact of intrusive features and their contrast with the adjacent area.

Landscape impacts are determined principally in terms of their physical change to component elements of the landscape. This is assessed utilising the following criteria:

- character and quality of the existing landscape
- degree of change to key features of the existing landscape
- nature of predicted impacts
- ability of the landscape to accommodate change (ie sensitivity).

8.3.4 Development of mitigation measures

An integral part of the SIA development will be the implementation of proposals contained within the Landscape Masterplan of the Tuen Mun Area 38 Expanded Development Study. Ultimately, these could affect the impact of the steel works and will therefore be evaluated. Additional measures will be considered to mitigate impacts identified as a result of the assessment.

8.4 BASELINE CONDITIONS

8.4.1 Existing environment and landscape character

In the areas between Tap Shek Kok and Tuen Mun there is a sharp contrast between the natural and man-made landscape. Castle Peak dominates the area, rising from a north-south ridgeline to reach a maximum height of 583m. The ridgeline forms a natural divide between the proposed steel works and the urban area of Tuen Mun. To the west, two further ridgelines, at average heights of 250m-300m, form the natural backdrop to the SIA development and proposed site. The steep slopes are heavily dissected and characterised by patchy scrub vegetation and rocky outcrops, indicative of the dry south facing aspect.

Numerous footpaths cross the area, although their use is restricted by the Castle Peak (Ha Tseun) firing range which extends across much of the middle to lower slopes.

The valleys between the ridgelines have been used as landfill sites creating a fundamental inbalance between the natural ridge and valley landscape. The landfill at Siu Lang Shui has been restored and planted, while the site at Pillar Point is still operational.

On the lower slopes, man-made features intrude upon the natural landscape creating a degraded and despoiled environment. Localised quarrying has led to a series of unnatural landscape features, including platforms which have been the focus of activities such as block making factories and service reservoirs.

On the narrow coastal strip, more significant industrial activity dominates the landscape, and includes the container storage area, the China Cement Works and in particular the highly intrusive Castle Peak Power Station. To the east, cement batching plants at Siu Lang Shui and waterfront activities in Area 40 contribute to the degraded character of the area.

Residential areas are limited. With the exception of the Pillar Point Temporary Refugee Camp (Area 46), the closest settlements are the villages at Lung Tsai, Tuk Mei Chung, Sha Po Kong and Nam Long, approximately 2km to the north-west, and the high rise residential developments at Melody Gardens, Butterfly and Wu King Estates, some 3km to the north-east.

8.4.2 Assessment

The outcome of industrial and quarrying activity in this area is a series of eyesores that have created a degraded and unattractive environment along the coastal strip and lower slopes of Castle Peak. The landscape and visual impacts from development in this area are already regarded as severe.

To some degree, the scale, contrasting topography and backdrop of Castle Peak helps to mitigate and absorb these impacts, but only from more distant viewpoints. The ridgelines are recognised as important visual barriers, screening much of this area from the residential areas to the north-east and north-west.

It is against this existing landscape character that the landscape and visual impacts of the proposed steel mill are now evaluated.

8.5 CONSTRUCTION PHASE IMPACTS AND MITIGATION

8.5.1 Source of Impact

The construction of the proposed steel works would take approximately 3½ years. During this time, the principal sources of impact would be:

- site formation, including reclamation
- marine pier and building construction
- construction access.

It is anticipated that the majority of activity involved in the reclamation and construction will be relatively localised and contained within the site. Large scale construction equipment, including cranes and pile drivers, will be required for piling and building construction increasing the visual impact on the immediate area. Additional impacts on local receptors are anticipated as equipment and materials are brought onto site by both sea and road.

8.5.2 Landscape and Visual Impacts

The number of sensitive receptors in the immediate area is limited. The closest residential areas include the village settlements to the north-west and the high rise developments at Melody Gardens, Butterfly and Wu King Estates. From these locations, construction activity would be screened by the local landform, as illustrated in Figure 8.2. Equally, construction would not be visible from Butterfly Beach. The ridgelines would also act as visual barriers between the site and more distant receptors on Pearl Island (Lung Chue To) and adjacent areas.

The increase in construction traffic, by sea and road, would increase the visual impact on local receptors, particularly those located on the waterfront at Butterfly Estate, Butterfly Beach and Pearl Island. However, this activity would be intermittent and the impact would therefore be slight.

An increase in visual impact is anticipated on the highway corridor and industrial activity between Tap Shek Kok and Siu Lang Shiu. Although close to the source of impact, the impact on these receptors is not regarded as significant due to their low sensitivity.

From the more elevated viewpoints along the footpaths around Castle Peak, the reclamation and construction activity will be clearly visible, but in view of the existing degraded and industrial character of the adjacent area no more than a moderate visual impact, depending upon the distance of the viewpoint, is anticipated.

The site of the proposed development will span both the current container storage yard and the new reclamation, and as such, will have no landscape impact on the existing landform. It should be recognised, however, that the development would contribute, as part of the overall reclamation of the SIA, to the loss of the natural alignment of the coastline.

8.5.3 Mitigation

Although the proposed site works would have no direct impact on sensitive receptors, indirect, albeit intermittent, impacts on residential areas on Long Mun Road would result from construction access to and from the site. Wherever possible, construction traffic should be kept to a minimum.

Although receptors in the adjacent area are designated as low sensitivity, it is still important to minimise potential construction impacts by careful site organisation and layout. The following measures are recommended:

- restricting the construction area to a minimum;

- enclosing the site with hoardings to provide a definable boundary edge;

- minimising the erection time of visually obtrusive elements, such as tall equipment;

- restricting heights of storage materials, stockpiles and spoil heaps to low levels;

- minimising night time lighting.

Advance planting and ground modelling in the designated landscape areas should be adopted where damage from construction activity can be avoided. Ultimately, the planting would form the long term landscape treatment for the operational phase, thereby eliminating the need for temporary treatments, such as for dust suppression, whilst maximising growth opportunities for plant material by early implementation.

8.6 OPERATIONAL PHASE IMPACTS AND MITIGATION

8.6.1 Sources of Impact

As the development of the SIA and River Trade Terminal (RTT) proceeds, the impact of the steel works would affect not only present land uses but also those committed industrial developments on the reclamation. Other planned land uses in the immediate area include residential and recreational areas. In assessing the impacts during the operational phase, it will be necessary, therefore, to establish the impacts on both existing and proposed land uses.

The impact of the landscape areas which have been proposed along the northern boundaries of the site, as part of the SIA/RTT Landscape Masterplan, will also be assessed.

There are two principal sources of impact:

- the buildings and ancillary facilities
- the transportation of materials to and from the site.

The EAF operations would be housed in a building approximately 25m x 120m, and 30m high, although a height of up to about 35m may be required depending on the final design of EAF chosen. The rolling mill building would be approximately 50m x 300m, and 18m high. The scrap storage hoppers, between 8-10m height, would line the waterfront. These features would be most visible from the sea and from viewpoints immediately to the east and west.

The site layout is such that the majority of ancillary elements, administration and car park areas would be visually enclosed by the two main buildings.

Overall, the buildings are relatively few and simple in their external appearance. This, combined with decision to house the main storage area and distribution yard, would reduce the visual intrusion of the development.

In addition to the direct impacts of the works, further impacts must be assumed as a result of the delivery of scrap metal for processing, and the transportation of the finished product from site.

Figure 8.3 shows the existing landform. The photomontage in Figure 8.4 indicates the building form and site layout and its relationship to the surrounding area.

8.6.2 Landscape and visual impacts

The visual impacts from the operational phase of the development would be relatively similar to those identified during the construction period. The ZVI, identified in Figure 8.1, is contained by landform to the north, by industrial areas to the east and west, extending to the south across open water towards Lantau Island.

From Lantau, at distances of 8-9km, the site will be relatively insignificant, particularly when considered in relation to the Castle Peak Power Station. Ma Wa Chung in Tung Chung Bay, at present the most substantial development on the north side of the island, is almost 10km away and currently screened by Chek Lap Kok Island. Similar distances, and frequent hazy weather conditions, would minimise the impact on future development planned on the north side of the island.

The height of the buildings proposed are relatively modest compared to the height of the ridgelines that run to the north-east and north-west of the site. The landform would therefore screen the development from sensitive receptors in the villages to the north-west, the high rise development along the waterfront of Tuen Mun and the residential areas on Pearl Island (Fig. 8.2).

The impact on the industrial areas at Tap Shek Kok, Siu Lang Shui and Pillar Point, and motorists on Lung Mun Road, would be slight. More moderate impacts would be experienced by walkers on the hillsides above the site from where the works would be clearly visible.

The transportation of scrap metal would increase the amount of water traffic in the area and would marginally increase the visual impact on residential receptors along the Tuen Mun waterfront. The off-loading of scrap metal, however, would not be visible from these viewpoints. Transportation of materials by road would also marginally increase the local impact, principally on residential and recreational areas on Lung Mun Road. With the future development of the proposed dual 3-lane carriageway this impact might be reduced.

From the sea, the marine pier, storage hoppers and reprocessing building would be visible. The impact of the works would be less significant than the adjacent power station, but would still contribute to the overall industrial character along the waterfront. The increasing ferry traffic passing through this area would be subject to this kind of view.

The proposed land uses in the SIA and RTT are principally industrial and categorised as low visual sensitivity. While the steel works would be visible from some of these areas, as development on the reclamation proceeds the works would be largely screened from such viewpoints. The overall impact on this area would be slight.

Developments proposed in areas outside the SIA include a low density housing and school development for 1000 people in Area 45C, approximately 2.5-3 km east of the works. In area 46A, 2 km from the site, a crematorium and columbariam are proposed. Although the exact location and height of these various developments are still to be determined, it is anticipated that the existing landform will continue to screen these areas from the proposed steel works.

The North Western New Territories Sub-Regional Land Use Plan has designated the western part of Area 38A and Area 49, to the north and west of the site, a Countryside Conservation Area. The site will be visible from footpaths that cross this area.

Implementation of the Landscape Masterplan for Area 38 would create, as part of the overall framework, two landscape areas directly adjacent to the north and north-east boundaries of the site. The impact of planting and ground modelling in these areas would be localised, softening the boundary of the steel works and screening low level structures and activity from motorists and pedestrians on both Lung Mun Road and access roads through the SIA.

From higher elevations, particularly within the Countryside Conservation Area, planting will soften rather than screen the impact of the works. Planting, if developed in sufficient depth, would also act as a visual buffer to adjacent development. However, planting areas only extend around 25% of the boundary and consequently the majority of the site remains exposed.

No landscape impacts, in addition to those noted during the construction period, have been identified.

8.6.3 Mitigation

Industrial developments are typically difficult elements to integrate into the environment due to the scale and nature of their operations. Nevertheless, visual impacts can be reduced by careful attention to the site layout and design of the features contained within. An integral part of the design of the steel works will be to consider the visual relationship between the various components and their role in the development as a whole. Visually, the most important elements will be:

- the building design
- the way materials are stored within the site
- the boundary treatment
- the landscape treatment.

In visual terms, the scale, form and detail design of the buildings are important in providing a unifying element between the different structures. Minimising the number of external features would also help to simplify the form and reduce visual clutter.

Colour and materials are no less important, and play an essential role in minimising visual impact. Strong contrast in colour should be avoided, and muted colours that relate to, but not replicate, the natural environment should be considered. Colour should also be used to reduce the impact of the building mass by adopting one, or perhaps, two different tones. As a general principle, darker colours are generally used towards the base of buildings to create a sense of stability.

The photomontage in Figure 8.4 illustrates, to some degree, the guidelines indicated above. The final design should aim to:

- maintain a positive relationship, in terms of scale and form, between the different buildings on site;
- consider the relationship with buildings outside the site;
- create simple building forms with a minimum of external features;
- use materials and colour that both reduce the mass of the building and minimise the impact on the external environment.

The random storage of materials in industrial sites is frequently responsible for significant visual impacts. The use of hoppers to store scrap material at the steel mill is seen as a positive step towards minimising this potential impact. The design of the hoppers should also relate as far as possible to the buildings in their form, colour and material. The number of other external storage areas on site should be minimised, thereby reducing visual intrusion and clutter.

The treatment of the boundary area is also critical, particularly from public viewpoints. Providing a physical boundary feature, whether a wall or fence, would help to visually define and contain the site, and, if solid, provide a visual screen to low level activity and storage.

Landscape treatment within industrial areas is commonly an afterthought and frequently inadequate. Yet, a considered landscape framework can significantly reduce visual impacts, particularly from viewpoints at ground level. It is, therefore, important to ensure that planting along the northern and north-eastern boundaries of the site is substantial enough to provide a significant impact and help moderate the scale of the development. Ground modelling should also be considered, as this can elevate planting and thereby improve the screen and visual buffer, whilst providing spatial definition.

There are no landscape proposals, at this stage, along the remaining east and west boundaries. If a reserve of non buildable land of 4.6m is introduced, on safety grounds, along all common boundaries between plots, as suggested by Scott Wilson Kirkpatrick/Shankland Cox/ERL (Asia) Ltd (1990), the opportunity to introduce substantial landscape works into these areas should be considered. This would act as a visual buffer between the steel works and adjacent plots, as well as extending the landscape framework and reducing the visual mass of the industrial development as a whole.

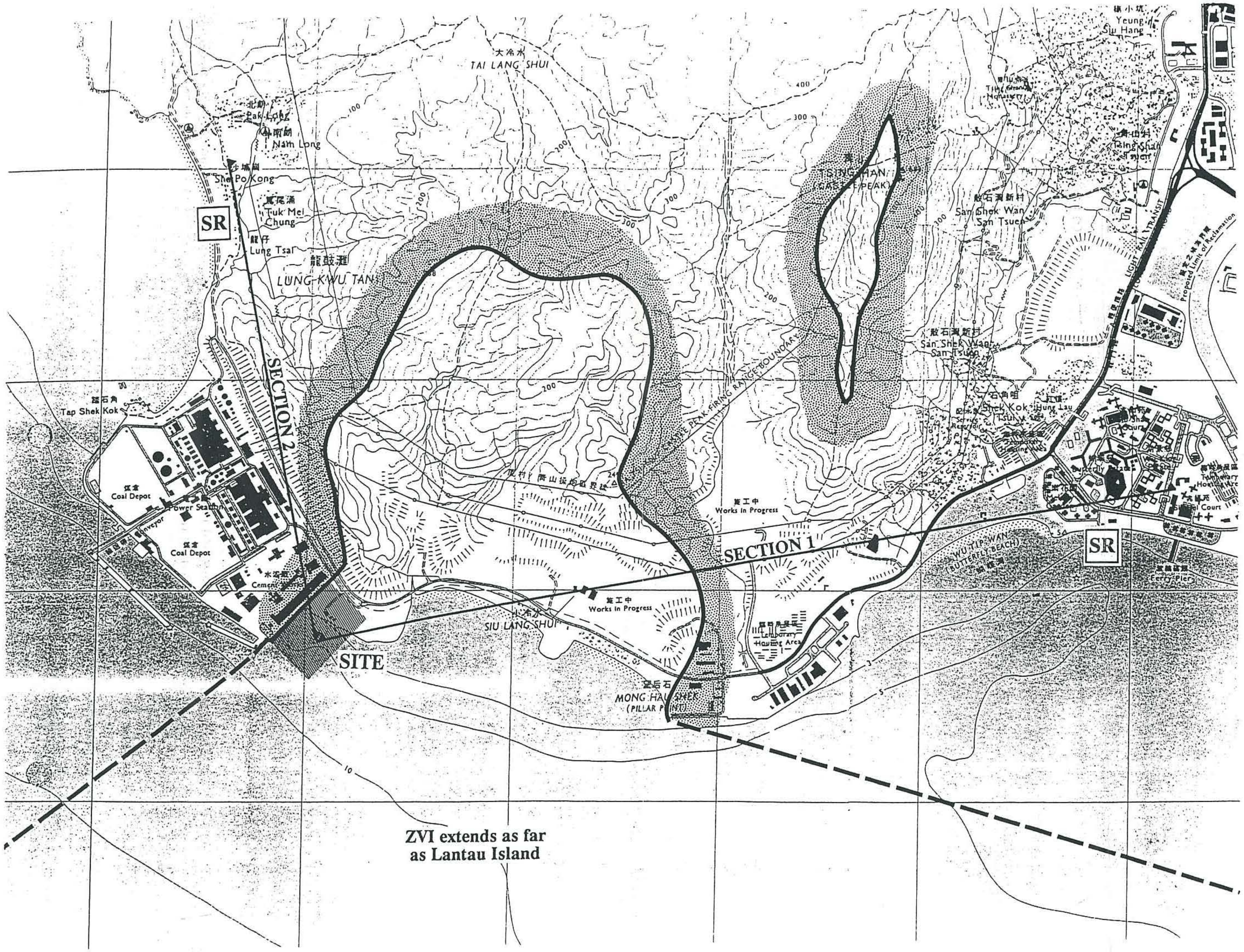
The relationship between the boundary treatment, planting and ground modelling should also be considered. Integrating these elements, for example, could provide an interesting and attractive feature enlivening the entrance to the site.

The potential for landscape treatment within the site would be limited. However, where space permitted, it could be used to provide shade and shelter around the administration, canteen and any recreation areas provided. It could also serve to visually separate these areas from the main works, and at the same time provide a degree of continuity with the boundary landscape.

8.7 CONCLUSIONS

The assessment has identified the following impacts:

- no direct visual impact on existing sensitive receptors during either the construction or operational phases;
- no direct visual impact on planned sensitive land uses in Areas 45C and 46A during the operational phase;
- slight visual impact on low sensitive receptors, adjacent to the site, during both the construction and operational phases;
- moderate visual impact on walkers in the Countryside Conservation Area;
- a marginal increase in visual impact on sensitive receptors outside the immediate area due to transportation of materials to and from the site;
- no landscape impact.



AXIS Environmental

Site

Boundary of Zone of Visual Influence (ZVI)

SR Sensitive Receptors

Section Lines

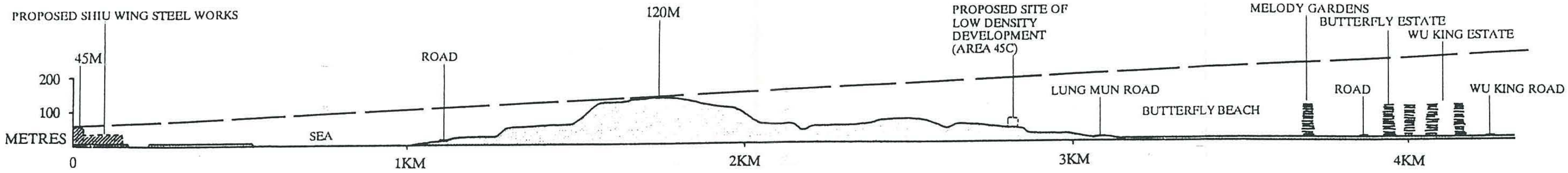
0 250 500 750 1000m

Shiu Wing Steel Mill

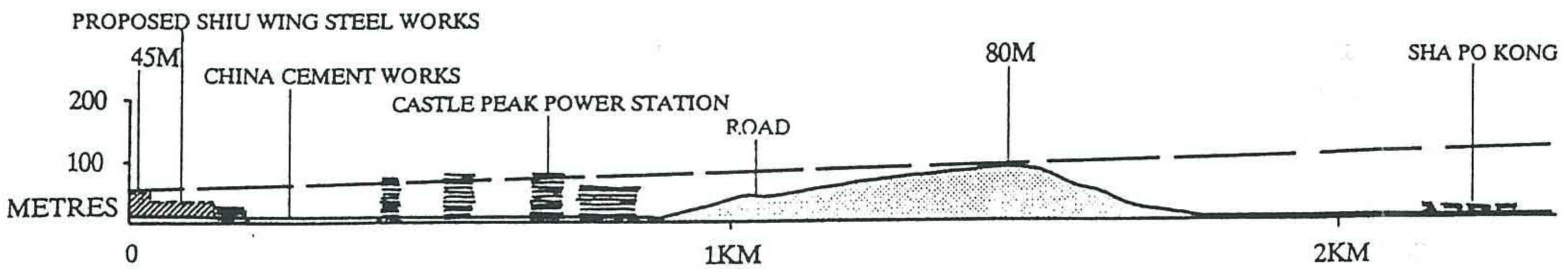
Figure 8.1: Zones of Visual Influence

053000/October 1993

SECTION 1



SECTION 2

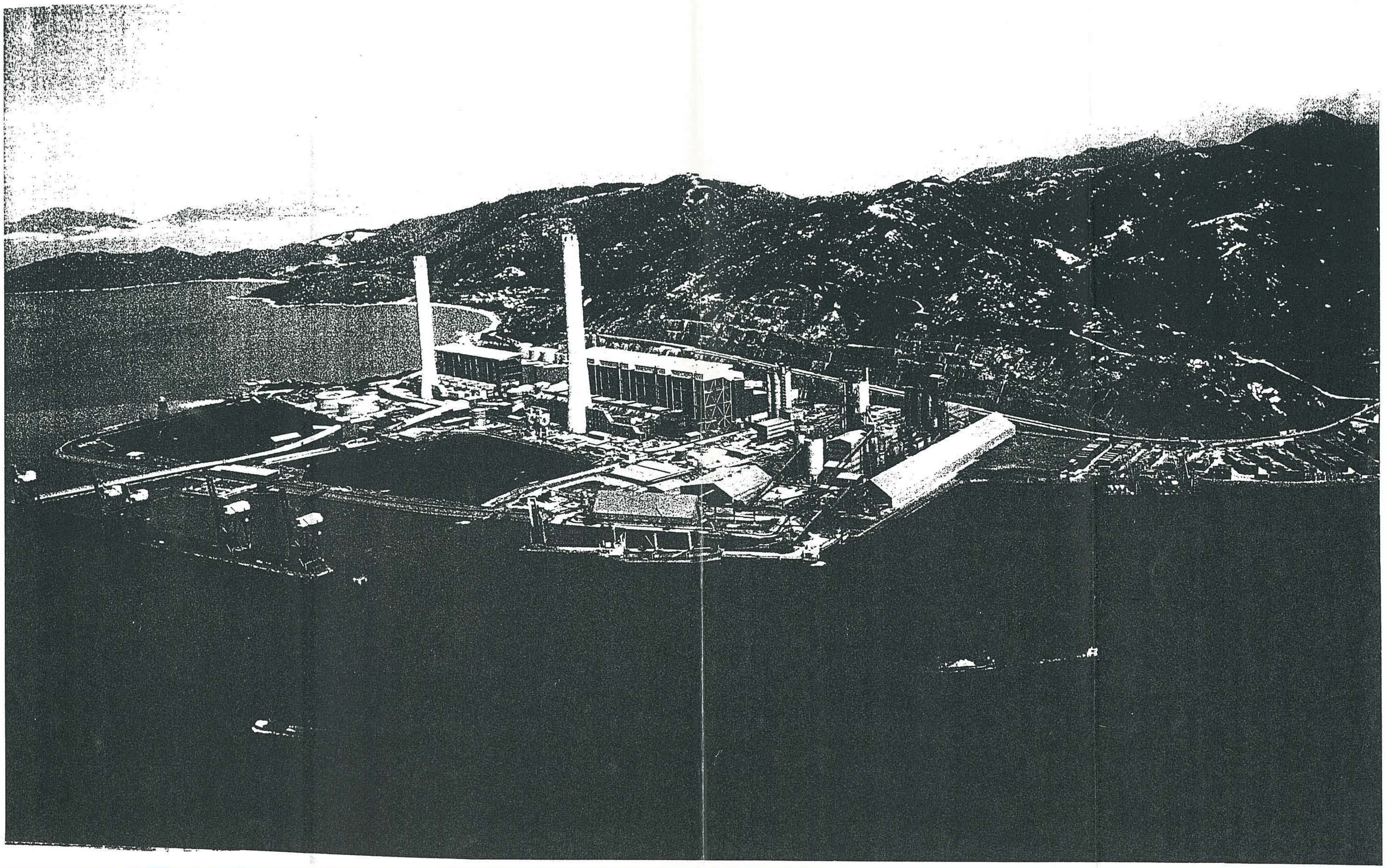


AXIS Environmental

Shiu Wing Steel Mill

Figure 8.2: Site Lines to Residential Areas

053000/October 1993



AXIS Environmental

Shiu Wing Steel Mill

Figure 8.3: Existing Nearby Land Uses

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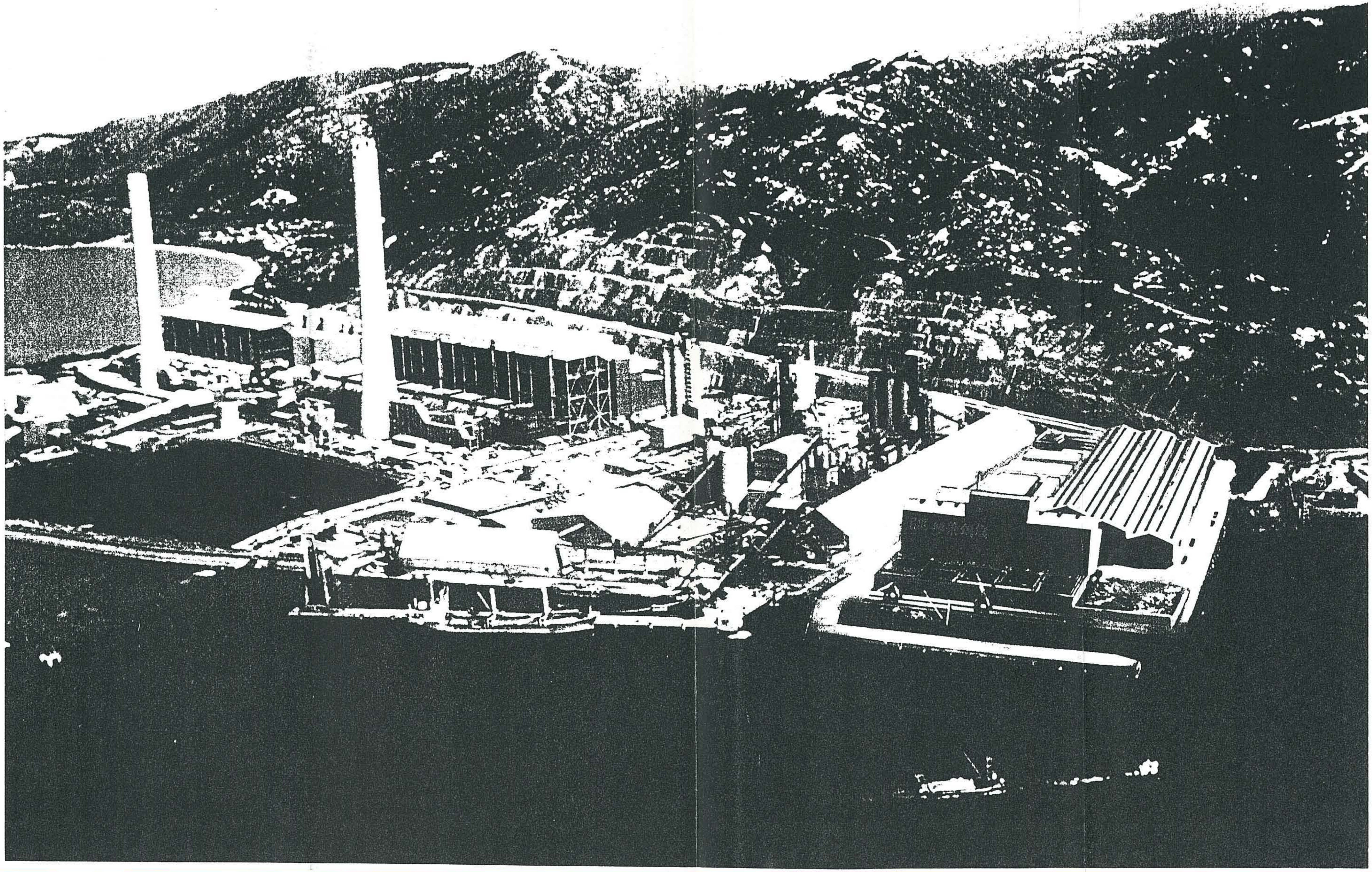

Shiu Wing Steel Mill

Figure 8.4: Photomontage of Proposed Steel Mill

053000/October 1993

CHAPTER 9
TRAFFIC ASSESSMENT

9. TRAFFIC ASSESSMENT

9.1 INTRODUCTION

This section assesses the effect of both the road and marine traffic resulting from development of the steel mill upon the existing land transportation and marine activities. It is viewed additionally in the context of the overall Area 38 development.

All road traffic data for this assessment have been taken from Scott Wilson Kirkpatrick/Shankland Cox/ERL (Asia) Ltd (1990). All marine traffic data have been taken from Scott Wilson Kirkpatrick and Partners/BMT Group (1990).

9.2 ROAD TRAFFIC

9.2.1 Existing Road Traffic

The existing road in Area 38 is Lung Mun Road, which runs from its intersection with Wong Chu Road on the western side of Tuen Mun New Town to the power station at Tap Shek Kok. The traffic on Lung Mun Road is mainly to the China Cement Plant and Castle Peak Power Station.

From the intersection with Wong Chu Road, Lung Mun Road is reduced to a single carriageway with some sharp bends and steep gradients. The road follows the existing shoreline and near Area 38 there are steep slopes on both sides of the road. To the south of the road the ground drops sharply away and on the northern side, there are steep slopes into the existing borrow land. There are no sealed roads into the existing hinterland except the road serving the Pillar Point controlled tip.

At the location of the proposed steel mill there is a container storage area on a Short Term Tenancy (STT), which would be removed before construction starts.

The traffic volumes for 1989 are detailed below:

To the east of cement plant:	600
To the west of cement plant:	400
STT Container Storage area :	500

Total	1500 vehicles per day each way

9.2.2 Forecast Road Traffic

It should be noted that the STT Container Storage area will close with the construction of the steel mill and this will result in 33 % reduction in the present number of vehicles using the road.

Lung Mun Road is to be upgraded to a dual 2-lane carriageway in a few years as there will be an increase in traffic flow due to the development of Area 38. Furthermore, there is a proposal for a dual 3-lane carriageway and a light rail transit LRT intersecting with Lung Mun Road. There is yet no implementation programme for the dual 3-lane carriageway and LRT service to Area 38.

The daily trips anticipated in Area 38 in 2001 are detailed in Table 9.1.

Table 9.1 Traffic flow generated by Area 38 in 2001

	2001
Goods trips, industry	5,000
Goods trips, River Trade Terminal	3,000
Goods trips, Container back-up area	750
Person trips	7,075
Total	15,825 (vehicles/day each way).

9.2.3 Traffic Generated During Steel Mill Construction

Most of the fill required for the development reclamation would come from marine sources, but there will be some materials transported by road. The construction traffic generated by the proposed steel mill is anticipated to be significantly less than the reduction in traffic resulting from the closure of the STT container storage area.

9.2.4 Traffic Generated During Steel Mill Operation

The removal of the STT Container Storage Area for the Steel Mill would result in a decrease in traffic to the site. 400 persons will be working at the mill and it is generously assumed that 10 % of them travel in their own vehicles. An average figure of 90 goods vehicles per hectare net site area per day was obtained for the type of development on Area 38. The proposed steel mill site is 8 hectares. Putting these data together gives the predicted traffic flow to the steel mill during operational stage.

Cars	40	
Local transport	18	(20 persons per bus)
Goods vehicles	810	(90*9)
Total	868	

During operational stage the contribution to the overall Area 38 traffic flow from the steel mill would be 5% in 2001.

However, the actual traffic generated by the proposed steel mill is anticipated to be significantly less than that predicted in Scott Wilson Kirkpatrick/Shankland Cox/ERL (1990) report, and is likely to be of the order of 150 vehicles per way each day.

9.2.5 Conclusions

The overall impact of road traffic due to the construction and operation of Shui Wing steel mill is considered to be small because:

- the road traffic related to the steel mill during construction and operational phases would only be a minor part of the total vehicle flow in Area 38 development;
- the increase in the traffic volume due to the steel mill is minor compared to the existing traffic from the container storage area (STT) which presently occupies the site;
- the widening and improvement of the Lung Mun Road will allow for more traffic;
- much of the transport to the steel mill will be by sea;
- Reserves for a dual 3-lane carriageway and LRT to serve the future development in Tuen Mun West will further improve the access to the area.

9.3 MARINE TRAFFIC

9.3.1 Marine Traffic

The marine traffic forecasts for the proposed steel mill is 50 Category C general cargo ships (up to 25,000 dwt) per year, in addition to 1,000 local barges per year. There may also be an occassional larger Category B vessel (38,000 dwt).

The total number of Category A-D ship movements (excluding local barges) anticipated in the developed Area 38 in 2006 is 16,600 per year.

9.3.2 Impact of Marine Traffic

Local Impact

The marine traffic local to the proposed steel mill site is presently mainly dominated by vessels to China Cement Works and Castle Peak Power Station; delays to these vessels, as a result of the proposed steel mill, will be short and infrequent, amounting to no more than an estimated average of six occasions per year.

Far Field Impact

The Category A-D marine traffic associated with the proposed steel mill is less than 1% of the total number of Category A-D marine vessels forecast for the developed Area 38 in 2006.

A radar survey shows that larger vessels pass well clear of Area 38, allowing adequate manoeuvring room for vessels arriving and departing. Smaller vessels which at present pass very close to the proposed site may need to amend their courses.

CHAPTER 10
ENVIRONMENTAL MONITORING & AUDIT

10. ENVIRONMENTAL MONITORING AND AUDIT SCHEDULES

10.1 INTRODUCTION

Environmental monitoring schedules and audit (EM&A) procedures are essential in order to:

- ensure that any environmental impacts resulting from the construction and operation of the steel mill are minimised or kept to acceptable levels;

- establish procedures for checking that mitigation measures have been applied and are effective, and that the appropriate corrective action is undertaken if and when required;

- provide a means of checking compliance with environmental objectives, recording anomalies and documenting corrective action.

This Chapter outlines monitoring and audit requirements in relation to air quality, noise, water quality and waste management, the details of which may be referred to in the appropriate Chapter.

Site formation work commenced in September 1993 after the agreement of site formation monitoring schedules with EPD.

Monitoring schedules for construction and operation of the steel mill have been provided for the necessary environmental parameters in Tables 10.1 to 10.6. Monitoring schedules and audit requirements would be incorporated into the construction contract(s) in the form of environmental clauses.

10.2 TECHNICAL/PERSONNEL REQUIREMENTS

10.2.1 Responsibilities

Ensuring that the EM&A requirements are met during plant operation is the overall responsibility of the Site Manager, who in this project is the Manager - Operations for *Shiu Wing Steel Ltd*. During construction, EM&A would be the responsibility of the contractor's Site Manager.

10.2.2 Staffing

The EM&A work will be carried out by suitably qualified and experienced personnel. The qualifications and experience of the monitoring and audit personnel should be sent to EPD for information/comment.

10.2.3 Monitoring and Audit Manual

The Site Manager should prepare an EM&A manual, the content of which would be agreed with EPD. The contents would include the following:

- the programme for construction of the steel mill and information on steel mill operation, and their required EM & A programmes;
- an overview of the potential environmental impact and the rationale for the EM&A programme.
- the location, frequency and type of environmental monitoring and audit requirements to assess the environmental impacts of the construction and operation;
- the form/content of event/action plans (including any emergency plans) for air, water, noise and solid waste impacts;
- review of pollution sources and working practices/procedures required in the event of environmental pollution levels being exceeded;
- the content/presentation of monitoring data, their audit and the actions taken with respect to non-compliance with environmental pollution levels;
- appropriate report formats/frequency of submission/special event reports, etc.;
- complaints/consultation procedures ;
- equipment type, service records and calibration requirements;
- the locations of sensitive receivers.

10.2.4 Reporting

A periodic monitoring and audit report would be prepared and submitted to the senior management representative and simultaneously sent to EPD. The frequency of reporting would be agreed with EPD.

The report should be a relatively brief and concise account of the environmental monitoring during the previous period and should include a summary of:

- *Project Data* - A synopsis of the project organisation, project programme, management liaison structure;
- *Monitoring/Audit Requirements* - Summary of monitoring parameters, Trigger/Action/Target Levels, Action Plans, environmental protection requirements in contract documents; and engineering conditions;

- *Monitoring Methodology* - Monitoring equipment used, locations, duration/frequency;
- *Monitoring Results* - Parameter, date, time, environmental conditions, location, etc.;
- *Audit Results* - Review of pollution sources, working procedures in the event of non-compliance with environmental monitoring levels, action taken in the event of non-compliance, follow-up procedures related to earlier non-compliance actions;
- *Complaints* - Liaison and consultation undertaken, subsequent action, database of telephone /written complaints, location of complaints, action plan and follow-up procedures etc.;
- *Appendices* - Appropriate drawings/tables of monitoring locations, sensitive receiver locations, environmental monitoring and audit requirements etc..

The monitoring and audit reports would be supported by submission of annual summary reports during the operational phase, and more frequent reports during the construction phase, typically quarterly.

10.3 ENVIRONMENTAL MONITORING SCHEDULES

10.3.1 General

Environmental monitoring falls broadly into two categories: firstly baseline monitoring which has been or is being undertaken to establish the existing conditions in the Study Area (this makes it possible to set limits for the construction and operational phases); secondly compliance monitoring, which should be carried out during both the construction and operational phases to achieve the following general objectives:

- to assess the performance of construction/operation activities in environmental terms;
- to obtain early warning of potential problem areas, permit timely remedial action and identify any environmental impacts;
- to comply with appropriate standards and environmental objectives; and
- to provide reassurance to local communities.

As part of the monitoring schedules three levels have been devised to monitor compliance with environmental objectives and to provide early warning of potential problem areas, thus stimulating the implementation of mitigation before the regulatory standards are reached (Figure 10.1). The three levels are described below:

- the **Trigger Level** is a reference value to be used as an 'early warning' of a deterioration in environmental quality. Achievement of this level may stimulate increasing the frequency of monitoring and undertaking preliminary investigation (for example to identify any obvious causes) and possibly remedial action if appropriate;

- the **Action level** indicates that deterioration is significant and that urgent corrective action is required;

- the **Target Level** is the maximum permissible level which will achieve compliance with the appropriate regulatory standards, or other standards such as construction noise criteria outside restricted hours, and is therefore the upper boundary/limit which is acceptable in terms of environmental quality. Consequently, achievement of this level is undesirable. Compliance monitoring schedules are therefore devised such that remedial action is taken to prevent this level being attained. The Target Level should not therefore be considered as the desired level.

As identified in the relevant sections of this Report, monitoring will be required to measure noise levels, particulate levels (for air quality), water quality parameters and waste management practices. In addition, monitoring will involve checking general working practices and compliance with the various control and mitigation measures identified in this Report. Monitoring results should be reported to the Site Manager and EPD, and reviewed on a regular basis.

The requirements for each of the environmental parameters are different, and therefore it is not possible to propose a single monitoring programme for all aspects. Requirements for individual parameters are summarized below, and where appropriate monitoring schedules are presented in Tables 10.1 to 10.6.

10.3.2 Environmental Monitoring Plan

A check list would be prepared relating to each of the environmental issues. Together with environmental clauses in the contract documents, this check list will form the basis of a proforma for the environmental monitoring programme.

Air Quality Monitoring

A programme of particulate monitoring would be developed to ensure both the effectiveness of dust control measures and to highlight any associated deterioration of air quality.

An air quality monitoring schedule is presented in Table 10.1. The Target Level for both the construction and operation stages comprises the accepted TSP limits at the monitoring location of 260$\mu g/m^3$ (24hr average) and 80$\mu g/m^3$ (annual average). In addition, during construction a 1 hour guideline figure for TSP of 500 $\mu g/m^3$ is recommended, to assess nuisance from short term site activities.

On breaching the warning levels, action should be taken as described in the Outline Action Plan (Tables 10.7). Monitoring is presently being conducted on site at Monitoring Station 6 (MS6) as shown on Figure 10.2. The MS is located on-site because the High Volume Air Sampler (HVAS) is not secure off-site. The baseline monitoring conducted over a period of 20 days indicated poor air quality, with some samples exceeding AQOs.

In addition, it will also be necessary to monitor and check the effectiveness of pollution abatement plant and measures. This will involve assessing the efficiency, maintenance and use of:

- Baghouse Filters
- Storage Silos
- Water sprays to suppress dust
- Wheel wash troughs.

In-situ continuous monitoring by triboelectric technology would be used to identify if leakage from the baghouse filters occurred (Table 10.2).

Regular checks would be made to ensure the:

- Enforcement of speed limits
- Regular servicing of plant and site vehicles
- Site cleanliness and the implementation of good site practice.
- Hoarding at site boundary is in good condition.

Guidelines for dust monitoring have been produced by EPD Air Control Group.

Noise Monitoring

Noise monitoring will be required to verify compliance with the Noise Control Ordinance ANL levels and with requirements of any construction noise permits (CNP) and criteria contained in the contract documents. An outline noise monitoring schedule is presented in Table 10.3.

As noted in Section 6, some of the activities are classed as industrial and some as construction. In summary the limits are 60dBA L_{eq} during the day and evening (0700 to 2300 hours) for industrial activities, 60dBA L_{eq} during the evening (1900 to 2300 hours) for construction activities, and at night (2300 to 0700 hours) 50dBA L_{eq} for industrial noise and 45dBA L_{eq} for construction noise.

The proposed steel mill development is to be located at the west end of Area 38 Special Industrial Area. Presently, the noise environment is dominated by the STT container terminal, cement plant and power station. The noise environment would change significantly with development of Area 38.

Should any construction be undertaken during restricted hours i.e. night-time (2300-0700hrs), public holidays and Sundays, noise levels will be controlled under the provisions of a CNP. The Target is therefore the relevant ANL in the Noise Control Ordinance. Where a CNP is in force, monitoring results would be submitted to EPD immediately they are available. On breaching the permit, action should be taken as described in an outline action plan (Table 10.8).

Day-time compliance monitoring would be also undertaken in response to complaints. Restricted hour monitoring would be undertaken at least twice during the restricted hours, (per 24hr period, once in the evening and once in the night-time), for a 5 minute time period, in accordance with the *Technical Memorandum on Noise From Construction Work, Other Than Percussive Piling*. Measurements would be taken (1m from the external facade) at the worst affected NSRs.

Checks will also be required to establish the implementation and effectiveness of mitigation measures. This will require checking and monitoring of:

- the use, maintenance and efficiency of construction equipment;
- the appropriate location of noisy plant/equipment;
- the hours of operation;
- the implementation of good site practice.

Marine Water Quality Monitoring

During Construction

Site formation commenced in September 1993 with the approval of EPD, with whom a Monitoring Schedule had been agreed (Table 10.4).

The objective of water quality monitoring is to minimise adverse impacts on water quality which may result from the construction and operational activities. Monitoring is required to check the impacts resulting from dredging and reclamation and will involve measurement of dissolved oxygen, suspended solids and turbidity.

Monitoring is undertaken at 5 Monitoring Stations (see Figure 10.2), MS1, MS2, MS3, MS4 and MS5. The intention of the monitoring programme is to utilise MS3, 4 and 5 as "running background", as these 3 Stations are approximately 500 metres from the dredging area, and there should not be any significant impacts at this distance. This running background data will be compared with the data from MS1 and MS2, which are only 100 metres from the dredging area. It is at MS1 and MS2 that Trigger, Action and Target Levels apply; WQOs were considered in setting these levels. On breaching these levels, action should be taken as described in the Action Plan (Table 10.9).

The recommended dredging methods and mitigation measures should be followed during site formation.

During Operation

In order to check the effectiveness of mitigation measures it will be necessary to ensure:

- the heat exchanger is effective;
- drainage channels, settlement tanks, sewage pumping pits and pipelines are being used and maintained;
- the effectiveness and maintenance of oil/grease interceptors;
- the use and adequacy of any waste reception/storage facilities.

Samples would be collected of liquid effluent discharges periodically to ensure compliance with TM Discharge Standards (Table 10.5).

Waste Management

Monitoring of waste arisings will occur during the construction and operational phases. Records should be maintained by the site operator with respect to quantities of arisings, handling, storage, movement and disposal of these wastes. An outline waste management monitoring schedule is given in Table 10.6.

Remedial action should be taken if records show that correct management of the waste is not being applied. Monitoring would be undertaken at SENT landfill by the operator to check that the filter dust leachate does not significantly impact upon the surrounding environment.

10.3.3 Action Plans

Action Plans would be devised to facilitate the appropriate and immediate response by relevant personnel, in the event that the Target, Action and Trigger Levels are either attained or exceeded. The appropriate action is determined by the frequency of complaints and/or exceedence of the compliance monitoring levels.

The requirement for Action Plans for the steel mill would be contained in the contract/lease conditions and suitable plans would subsequently be submitted by the site manager to EPD. Examples of appropriate Action Plans are outlined in Tables 10.7 to 10.9.

10.4 ENVIRONMENTAL AUDITING

10.4.1 General

The purpose of environmental auditing is to review the effectiveness of the overall environmental protection programme (both construction and operation) in terms of monitoring, mitigation and corrective action. The audit process should not be divorced from general management activities, and should promote a pro-active approach to environmental protection.

10.4.2 Construction Phase Auditing

Records of environmental monitoring would be maintained by the Site Manager and the environmental audit would seek to check:

- records of environmental monitoring procedures and results;
- that mitigation measures recommended in Sections 4.2, 4.7.2, 5.6, 5.7, 7.5, 8.5 and 8.6 of this report are being applied;
- records of exceedence of any regulatory requirements/target levels;
- details of control and mitigation action taken in response to unacceptable environmental impacts;
- records of any complaints from residents/SRs in the Study Area and the actions taken once the complaints have been received.

Assessment of monitoring records will ensure that any unanticipated impacts are being addressed and that any improvements required for future monitoring programmes are identified.

10.4.3 Operational Auditing

The audit would be designed to assess the environmental performance during the operation of the steel mill. Auditing should verify the findings of the EIA and provide a mechanism for:

- reviewing the effectiveness of, and requirement for on-going monitoring programmes;
- reviewing environmental management practices in terms of achieving environmental objectives;
- ensuring that mitigation measures recommended in Sections 4.2, 4.7.2, 5.6, 5.7, 7.5, 8.5 and 8.6 of this EIA report are being applied.
- reviewing the effectiveness of environmental mitigation;
- recommending improvements in environmental controls and operations in the event that environmental objectives are not achieved and environmental impacts are unacceptable.

An Audit Report and executive summary would be submitted to EPD within 4 weeks of completing the audit.

Table 10.1: Air Quality Monitoring Schedule

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
TSP	Baseline Monitoring	NA	NA	NA	At Monitoring Station MS6 as illustrated in Figure 10.2.	Daily 24 hr sampling for 2 week prior to commencing land works.
TSP	Compliance monitoring (AQO) during both construction and operation	30% above background	Mid-way between Trigger and Target level.	24hr TSP of 260$\mu g/m^3$ (AQO) * and annual TSP of 80$\mu g/m^3$	As above. Any relocation of the MS would be agreed with EPD.	** 24hr samples every 6 days.
TSP	Compliance monitoring (guideline) during construction	30% above background	Mid-way between Trigger and Target level.	1hr TSP of 500$\mu g/m^3$ (guideline) *	At downwind boundary, or as agreed with EPD.	Three 1hr samples on one day weekly during dry windy conditions.

Note :
* If baseline level exceeds AQO or guideline, EPD would be consulted on the appropriate target levels to be used.
** US EPA Ambient Air Quality Surveillance requirements as set out in Title 40 of the Code of the Federal Regulations, Chapter 1 (Part 50), Appendix B.
TSP Total Suspended Particulates

Table 10.2: Atmospheric Discharges Measuring Schedule

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
Particulates	To detect any leakage from Baghouse Filters	- - - - - - - - - - To be determined - - - - - - - - -			Downstream of Baghouse Filters	On-line

Note :

\- US EPA Ambient Air Quality Surveillance Regulations

Table 10.3: Noise Monitoring Schedule

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
L_{90}, L_{Aeq}	Baseline Assessment	N/A	N/A	N/A	NSRs	24hr monitoring period at main SR site. L_{90}, $L_{Aeq\ (5\ min)}$ monitoring at other nominal SR sites.
L_{90}, $L_{Aeq\ (5\ min)}$	Assessment for non-restricted daytime hours	$L_{eq} - L_{90} = 5dBA$; $L_{eq} \leq 60dBA$	$L_{eq} - L_{90} = 10dBA$; $L_{eq} \leq 60dBA$	$L_{eq} \leq 60dBA$	Complainant	In response to complaints
L_{90}, $L_{Aeq\ (5\ min)}$	Assessment for restricted hours	$L_{eq} - L_{90} = 5dBA$;	$L_{eq} - L_{90} = 10dBA$;		Complainant	In response to complaints
	Construction phase	$L_{eq} \leq 45dBA$	$L_{eq} \leq 45dBA$	$L_{eq} \leq 45dBA$		
	Operational phase	$L_{eq} \leq 50dBA$	$L_{eq} \leq 50dBA$	$L_{eq} \leq 50dBA$		
L_{90}, L_{Aeq}	Confirm Baseline Assessment for installation of new equipment, or mitigation measures, or change in operations	N/A	N/A	N/A	NSRs	L_{90}, $L_{Aeq\ (5\ min)}$ monitoring at nominal SR sites.

Note : NSRs - Noise Sensitive Receivers
N/A - Not Applicable

Table 10.4: Marine Water Quality Monitoring Schedule (Site Formation)

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
SS, DO, Turb*, Copper	Baseline Monitoring	N/A	N/A	WQO	5 Monitoring Stations** - 2 100m from dredging site boundary - 1 500m upstream - 1 500m downstream - 1 500m perpendicular to site	Prior to dredging 3 sampling trips @ each station in one week (mid ebb and mid flood each trip)
SS, DO, Turb*, Copper	Compliance Monitoring - dredging works	See Table 10.4.a	See Table 10.4.a	See Table 10.4.a ***	5 Monitoring Stations** - 2 100m from dredging site - 1 500m upstream - 1 500m downstream - 1 500m perpendicular to site	During dredging operations, 3 sampling trips per week (mid ebb + mid flood each trip)
Turb* SS, DO	Compliance Monitoring - filling operations	See Table 10.4.a	See Table 10.4.a	See Table 10.4.a ***	5 Monitoring Stations** - 2 100m from dredging site - 1 500m upstream - 1 500m downstream - 1 500m perpendicular to dredge site	During filling operations initially 3 sampling trips per week (mid ebb & mid flood). This will reduce by 1 trip per month if no exceedances occur, reduce to a minimum of 1 per week. If exceedance occur then revert to initial monitoring works. Three times per week during bathing season.

Note : N/A Not applicable
* Turbidity is measured to extinction depth to give an instantaneous indication of the water quality
** At each Monitoring Station, samples shall be taken at three depths: 1 m below surface, 1 m above sea bed, mid- depth
*** Trigger levels, Action levels and Target levels would apply at the 2 monitoring Stations 100 metres from the dredging site boundary.
SS = Suspended Solids

Table 10.4a : TRIGGER, ACTION AND TARGET LEVELS

The following reviewed Trigger, Action and Target Levels have been agreed following discussions with EPD.

Dissolved Oxygen

- Trigger Level 4.6mg/l, Action Level 4.3mg/l, Target Level 4.1mg/l. These values are water column averages (mean of surface, mid-depth and seabed samples).
- Trigger Level 3.0mg/l, Action Level 2.5mg/l, Target Level 2.1mg/l. These values would apply within 2 metres of the seabed.

Suspended Solids (SS)

<u>Trigger</u>	<u>Action</u>	<u>Target</u>
a) S > 24 AND exceed 30% of maximum of the control stations in the same day	*Persistently <u>2 times</u>: a) S > 24 AND exceed 30% of maximum of the control stations in the same day	*Persistently <u>3 or more</u> times: a) S > 24 AND exceed 30% of maximum of the control stations in the same day
or b) M > 47 AND exceed 30% of maximum of the control stations in the same day	or b) M > 47 AND exceed 30% of maximum of the control stations in the same day	or b) M > 47 AND exceed 30% of maximum of the control stations in the same day
or c) B > 50 AND exceed 30% of maximum of the control stations in the same day	or c) B > 50 AND exceed 30% of maximum of the control stations in the same day	or c) B > 50 AND exceed 30% of maximum of the control stations in the same day

Table 10.5: Liquid Effluent Discharges Measurement Schedule

PARAMETER	OBJECTIVE	TRIGGER LEVEL	ACTION LEVEL	TARGET LEVEL	LOCATION	FREQUENCY/TIMING
BOD, SS oil and grease	Compliance monitoring	80% Target Level	Average of Trigger and Targer Levels	TM	Sewage Pit	Upon commissioning during construction and operation and thereafter as required by DSD.
Temperature	Compliance monitoring - cooling water outlet	Ambient plus 9°C	Ambient plus 9.5°C	Ambient plus 9.8°C	Cooling water discharge	On-line
	- mixing zone boundary and control station	Ambient plus 1.7°C	Ambient plus 1.8°C	Ambient plus 1.9°C	Mixing zone boundary and control station	During commissioning

Note : TM = Technical Memorandum
SS = Suspended Solids

Table 10.6: Waste Management Monitoring Schedule

PARAMETER	OBJECTIVE	STANDARD	LOCATION	FREQUENCY/TIMING
Slag, Scale, filter dust and Miscellaneous Wastes	Record quantities arising and confirm that handling, storage, transfer and disposal are in accordance with GWMP.	TM Standards Sewer Discharge	SENT	Leachate monitoring undertaken by operator
	Trade Waste permits should be obtained. They should be taken off-site by a contractor for landfilling. Filter dust should be disposed of at SENT.		Landfill	
Waste Oil	Waste oil should be registered as a Chemical Waste and handled, stored, transferred and disposed as such.			

Note : GWMP Good Waste Management Practice.

Table 10.7: Air Quality Action Plan - Total Suspended Particulates

EVENT	FREQUENCY	ACTION	
		Monitoring Personnel	*Site Manager*
Breach of Trigger Value		Inform Site Manager	Check working methods/practices to identify any immediate causes; take appropriate remedial action if necessary
Breach of Action Level	One sample	Inform Site Manager	Check working methods/practices to identify any immediate causes; take appropriate remedial action if necessary
	Two consecutive samples	Inform EPD and Site Manager	Undertake detailed check of working methods and practices
		Propose remedial action	Carry out appropriate remedial action and inform EPD of remedial action
		Record events in monitoring report for submission to the Site Manager and EPD	Amend method statement, if appropriate
Breach of Target Level	One sample	Inform EPD and Site Manager	Undertake immediate check of activities and employ any appropriate mitigation.
		Propose remedial action	Ensure corrective action has been undertaken and is effective, and inform EPD of remedial action
		Record events in monitoring report for submission to EPD	Amend method statement, if appropriate Increase monitoring frequency

Table 10.8: Noise Action Plan

EVENT	ACTION *Monitoring Personnel*	*Site Manager*
Breach of: daytime (unrestricted hours) **Trigger value**	Inform site manager Investigate complaint	
Breach of: restricted hours **Trigger value;** daytime (unrestricted hours) **Action Value;** **1 complaint**	Inform site manager and EPD **Submit report to EPD within two weeks of receipt of complaint. Should the measured noise level exceed the Target, proposals to reduce noise should be recommended in the report	Check working methods, practices, to identify causes, take appropriate remedial action if necessary Inform EPD of remedial action taken
Breach of: restricted hours **Action value;** **More than 2 complaints**	Inform site manager and EPD; resample to confirm monitoring result Propose remedial action **Submit report to EPD within two weeks of receipt of complaint. Should the measured noise level exceed the target, proposals to reduce noise should be recommended in report. Confirm corrective action has been undertaken and is effective in monitoring and audit report	Undertake detailed check of working methods and practices. Ensure corrective action has been undertaken and is effective Amend method statement if appropriate Inform EPD of remedial action taken
Breach of: daytime (unrestricted hours)/ restricted hours **Target Value**	Inform site manager, EPD Confirm monitoring result and repeat measurement for a further 15 minutes (3x5 min) and 30 minutes respectively Undertake immediate check of activities Propose remedial action Submit report to EPD within two weeks Confirm corrective action has been undertaken and is effective in monitoring and audit report	Review noise sources and working procedures and methods For breach of restricted hours Target Value, cease restricted hours operation Ensure implementation of prompt remedial action Inform EPD of remedial action

note: ** Action associated with response to complaints

Table 10.9: Water Quality Action Plan

EVENT	FREQUENCY	ACTION *Monitoring Personnel*	ACTION *Site Manager*
Breach of Trigger Value		Inform Site Manager	Check working methods/practices to identify any immediate causes; take appropriate remedial action if necessary
Breach of Action Level	One sample	Inform Site Manager	Check working methods/practices to identify any immediate causes; take appropriate remedial action if necessary
	Two consecutive samples	Inform EPD and Site Manager; resample to confirm result Propose remedial action Record event in monitoring report for submission to operator and EPD	Undertake detailed check of working methods and practices Carry out appropriate remedial action and inform EPD of remedial action Ensure corrective action has been undertaken and is effective Amend method statement, if appropriate
Breach of Target Level	One sample	Inform EPD and Site Manager Confirm result & increase monitoring frequency Propose remedial action Continue monitoring after completion of remedial action to confirm action is effective Complete Monitoring Report and submit to operator and EPD	Undertake immediate check of activities and employ any appropriate mitigation. Ensure immediate implementation of remedial action and in extreme cases cease activities Ensure corrective action has been undertaken and is effective and inform EPD of remedial action Amend method statement, if appropriate

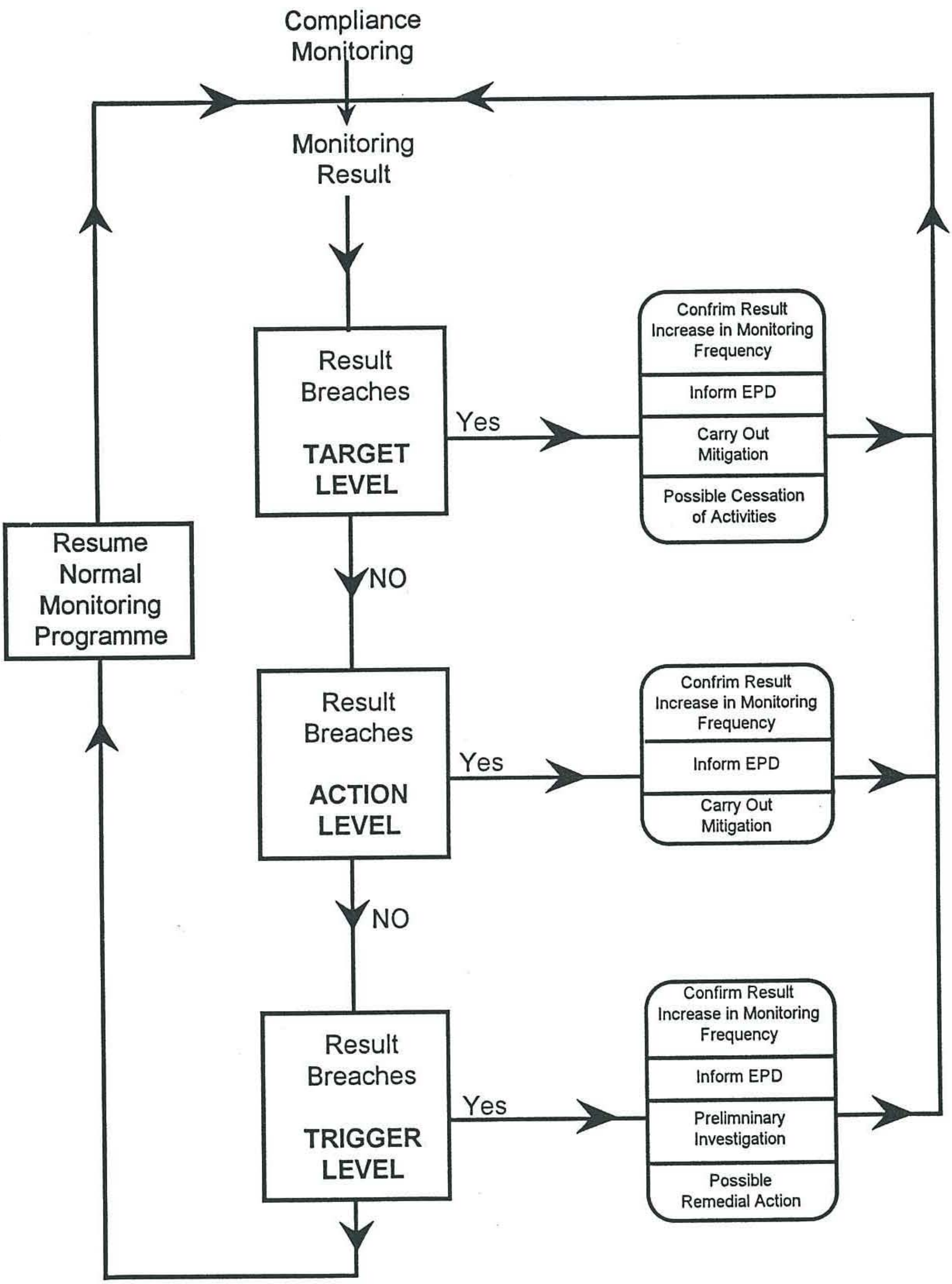

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Figure 10.1: Guide to Compliance Monitoring

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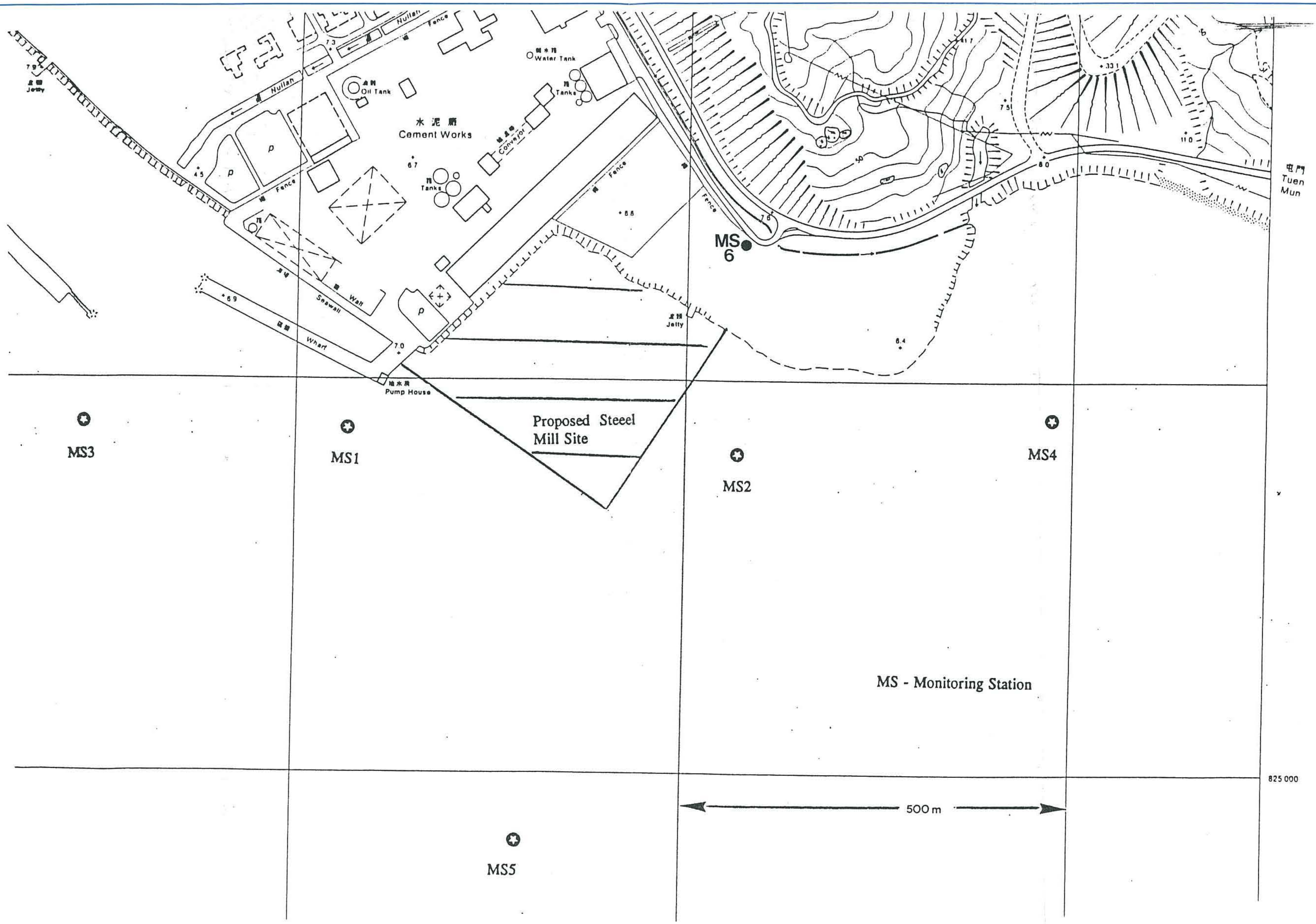

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Figure 10.2: Location of Monitoring Stations

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