2 PROJECT DESCRIPTION

2.1 INTRODUCTION

The Sha Tin Sewage Treatment Works Stage III Extension (the Project) is designed to increase the treatment capacity of the existing Sha Tin Sewage Treatment Works (Sha Tin STW) to cater for increasing wastewater flows and loads as a result of residential developments in the Sha Tin catchment area. The Project is also required to comply with the new effluent discharge standards to be proposed by the Environmental Protection Department (EPD).

At present, the treated effluents from both the Sha Tin STW and the Tai Po STW are conveyed, via pumps and a sewer tunnel, to the Kai Tak Nullah for disposal into the Victoria Harbour. This scheme is known as the Tolo Harbour Effluent Export Scheme (THEES) and will remain in place upon completion of the Project. The performance of the THEES is subject to an independent monitoring and verification programme being managed by the EPD under Agreement No. CE 1/98.

The Project comprises the development of the following process elements:

- primary sedimentation tanks;
- activated sludge aeration tanks;
- final sedimentation tanks;
- anaerobic sludge digestion tanks;
- sludge dewatering facilities; and
- ultra-violet disinfection facilities.

The works also involve the installation of electrical and mechanical (E&M) equipment for these new facilities and the replacement of some E&M equipment in the existing Stage I/II facilities.

2.2 PROJECT LOCATION AND HISTORY

2.2.1 *Project Location*

The Stage III Extension is located within the boundary of the existing Sha Tin STW but will extend the developed area further towards the waterfront of Tolo Harbour, as presented in *Figure 2.2a*. The site is located at the mouth of the Shing Mun River where it meets the Tolo Harbour and faces the Tolo Harbour in the northeast, the Tolo highway in the northwest, the Shing Mun River to the southeast and the Sha Tin Race Course to the southwest. The existing T6 bridge passes over the site and the Shing Mun River.

2.2.2 *Site History*

The existing Sha Tin STW and the proposed site for the construction of the Project fall within the Sha Tin Outline Zoning Plan (OZP). The site is on reclaimed land which was formed in the 1970s as part of the Sha Tin New Town Development. Prior to this development, the reclamation area was part of the Sha Tin Hoi. The

Sha Tin STW was commissioned in 1982 and the combined Stage I and II works were completed in 1986.

2.2.3 *EIA Study Area*

The EIA Study Area is defined by the Study Brief as follows:

> *"... a distance of 500 m from the boundary of the Project."*

The assessment area for the visual impact assessment is different and is described as follows:

> *"... all sensitive receivers regarding the visual impact assessment shall be assessed within the visual envelope from which there is a view of any part of the works of the Project."*

In addition, and owing to the fact that the treated effluent from the Sha Tin STW will be exported to the Victoria Harbour for disposal, the Study Area for the water quality impact assessment will also include:

> *"...the off-site impact at the Kai Tak Nullah and Victoria Harbour."*

The existing and planned land uses and developments within the EIA Study Area are summarised in *Table 2.2a*. Further details are provided in *Section 7*. The numbered descriptions correspond with the numbered sites shown in *Figure 2.2a*.

2.2.4 *Project History*

The design and planning of the Sha Tin STW began in 1970's and is based on a three stage approach, aiming to provide an ultimate treatment capacity for an average flow of 275,000 m^3 day^{-1}. Stage I was commissioned in 1982 and had a design capacity of 102,960 m^3 day^{-1}. The combined Stages I and II were completed in 1986 with an average design flow of 205,000 m^3 day^{-1}. The original design layout had allowed for the provision of an additional 33% capacity to supplement Stages I and II for unforseen or unplanned developments requiring further treatment capacity.

In response to the pressing needs to reduce nutrient inputs to the Tolo Harbour, shortly after the commissioning of Stages I and II, the capacity of the Sha Tin STW was subsequently reduced to 150,000 m^3 day^{-1} in order to achieve a higher nitrogen removal efficiency by the works.

In light of the increasing sewage treatment requirements, a Project Review[3] on the Sha Tin STW Stages I and II was commissioned by the Territory Development Department (TDD) and was completed in April 1996. This Project Review described and recommended the scope of works required for extending the treatment capacity of the STW and resulted in the development of the Stage III Extension proposal. DSD was given subsequently the responsibility for the design and construction of the Project. In June 1997, DSD completed a review of the requirements on the *Project Review Report* and the results were summarised in the *Adoptive Review Report*[4]. The design of the Project is currently in progress

[3] Territory Development Department (1996). *Sha Tin Sewage Treatment Works Stage 3: Project Review - Final Report.* New Territory East Development Office, Sha Tin New Town Stage II. April.

[4] Drainage Services Department (1997). *PWP Item 4276DS Sha Tin Sewage Treatment Works: Adoptive Review (Revised Final).*

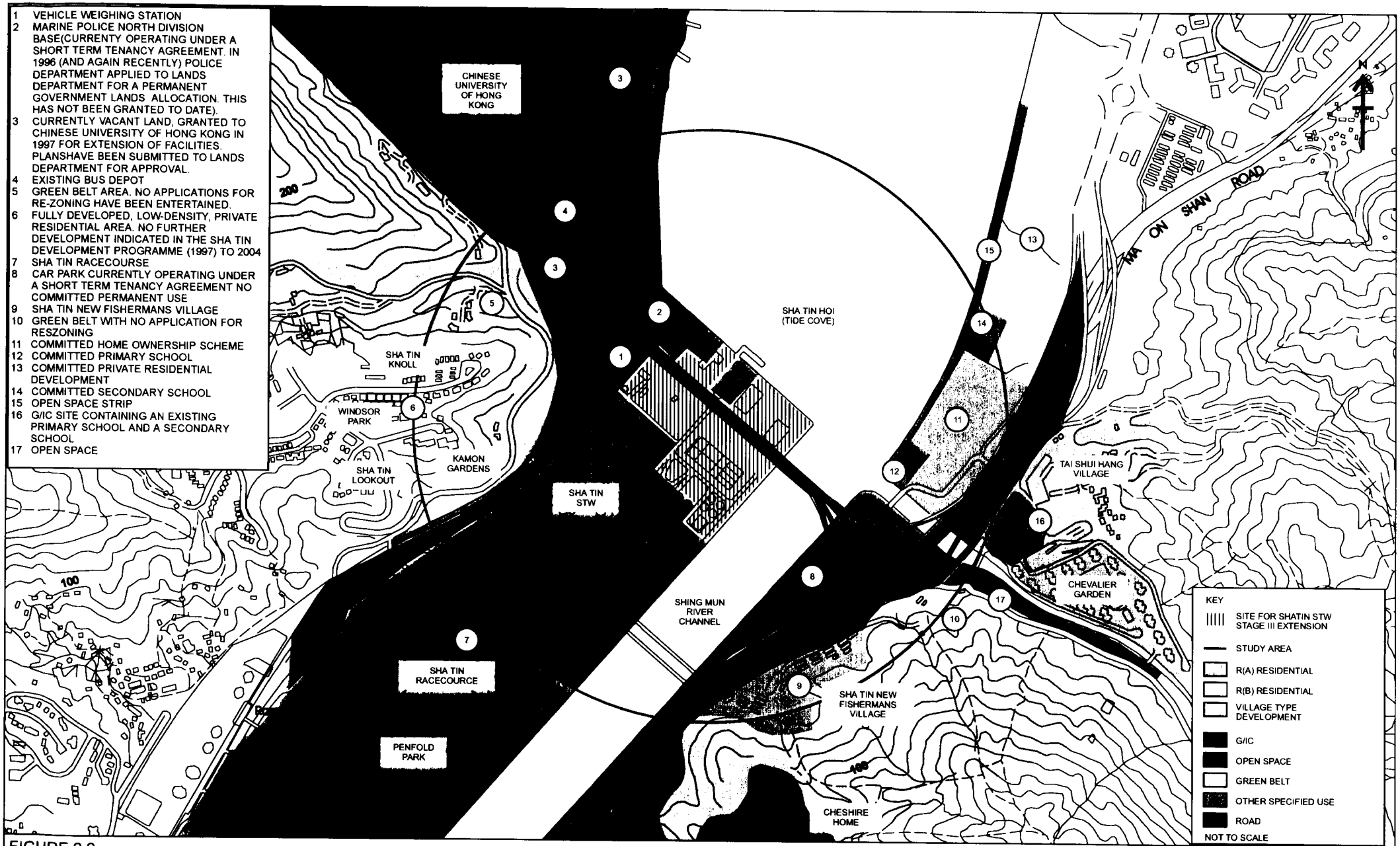

FIGURE 2.2a

LOCATION OF THE PROJECT AND EIA STUDY AREA

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Table 2.2a ***Existing and Planned Landuse in the EIA Study Area***

Site No.	Description	Use
1	Directly north-west of the Sha Tin STW is a G/IC site accommodating a vehicle weighing station.	G/IC
2	To the north of the existing Sha Tin STW is a G/IC site containing a waterfront walkway along Sha Tin Hoi. Within the same G/IC zone, abutting the Stage III Extension, is the Marine Police North Division base. In 1996 and again recently, the Commissioner of Police applied to the Lands Department for a permanent Government Land Allocation; which will be granted upon approval of funding for the redevelopment proposal. The Stage III Extension overlaps the corner of this G/IC site. Drainage Services Department has also requested that this over-lapping area be designated for a temporary works area to be used from 2000 to 2004.	G/IC
3.	North-west of Tolo Highway is currently vacant land granted to the Chinese University of Hong Kong in 1997 for extension of facilities. Plans have been submitted to lands Department for approval.	G/IC
4a	North-west of Tolo Highway is in part a G/IC site containing a bus terminus.	G/IC
4b	North-west of Tolo Highway is in part an OU site reserved for a petrol filling station ("PFS") under the Sha Tin OZP.	OU
5	North-west of the site, across Tolo Highway, there is a steeply sloped green belt site, within which no applications for rezoning have been entertained.	No Specified Use
6	To the west of the green belt is a low-density residential site, zoned R(B) with low-rise housing distributed along a hillside, including Sha Tin Knoll, Kamon Gardens, Windsor Park, Sha Tin Lookout etc. The site is an established residential area, however some additional development is projected in the Sha Tin Development Programme, 1998/99 Edition for the 2 planning areas falling partly within the study area (i.e. 46 and 58B). The population is expected to increase from 892 to 963 between 1997 and 2007 within these two planning areas. The R(B) site is partly within the Study Area.	Residential R(B)
7	South-west of the existing Sha Tin STW is the Sha Tin Race Course within an OU zone. The stables abutting the Sewage Treatment Works site, fall within the Study Area.	Recreational
8	Along the southern bank of the Shing Mun River Channel, there is a G/IC site with no specified permanent use. It is currently used as a car park and operates under a Short Term Tenancy Agreement. The site has been identified as a potential site for a water-based recreation facility in the short to medium term under the Study on the Feasibility of a Proposed Aquatic Centre for Hong Kong (Phase I) recently undertaken by the Hong Kong Tourist Association (completed end of 1997). The facility, which would likely consist of facilities such as a club-house, service centre for boats, spectator stands, car park and associated service facilities, is subject to detailed investigation in Phase II of the feasibility study due to commence shortly.	G/IC
9	South of site 8 is the Sha Tin New Fisherman's Village, zoned V. 220 persons are estimated to reside in the village.	Residential
10	The village area (site 9) is surrounded by green belt, within which no applications for rezoning have been entertained.	Green Belt

Site No.	Description	Use
11	North-east of the site, between the southern waterfront of Sha Tin Hoi and Ma On Shan Road, a R(A) site committed for Home Ownership Scheme housing. The population upon completion, by 2000, is estimated to be 11,300.	Residential
12	In the south-west corner of the HOS site (11), a primary school is committed for development. A standard primary school accommodates 975 students.	Educational
13	To the north of the R(A) site (11), a Sandwich Class Housing development is committed within a R(B)2 zone. Upon completion of the development by 2000, the population of the site is estimated to be 3,180. A very small proportion of this site is included within the Study Area.	Residential
14	In the south-west corner of the SCH site (13), a secondary school is committed for development. A standard secondary school accommodates 1,350 students.	Residential
15	An open space strip separates the R(A), R(B) and school sites from Sha Tin Hoi.	Open Space
16	South-east of Ma On Shan Road, adjacent to site 11, there is a G/IC site containing an existing primary school and a secondary school (1,445 students). The zone also contains a local open space site on which the Regional Services Department has proposed a soccer pitch. The site falls partly within the Study Area.	G/IC Educational
17	An open space site south of the schools in site 16, falls partly within the Study Area.	Open Space

and a *Preliminary Design Report*[5] was issued DSD in May 1998.

2.3 BENEFITS OF THE PROJECT

As described in *Section 2.1*, the extended capacity for the Sha Tin STW is required to cope with the significant increases in sewage flows created by the population growth within the catchment of the Sha Tin STW. The STW is already treating approximately 33% more flow than its current design capacity[6] and recent population projections have predicted faster population growth than had previously been anticipated. By 2011, the Sha Tin STW is expected to serve a population of 694,000[7] which equates to an increase of approximately 20% on the population served in 1996. Upon the completion of the Stage III Extension and the necessary modifications to Stages I & II, it is estimated that the Sha Tin STW will be able to handle the flow produced from a total permanent residential population of 720,000 and from the commercial, institutional and industrial developments in the catchment.

In addition, the EPD has undertaken a review of effluent discharge licenses for all Government operated sewage treatment facilities and has concluded that in order to minimize human health risks associated with the THEES and to protect aquatic life, more stringent standards are required. The proposed revisions to the standards include the introduction of limit values for bacteria (*E. coli*), ammonia (NH_3-N) and Total Residual Chlorine (TRC). Establishing an acceptable ammonia standard for the treated effluent is one of the key requirements of the assessment of water quality impacts. This aspect of the assessment is presented in *Section 4*. The existing provision of secondary treatment will be expanded to include ultra-violet disinfection facilities to further improve the quality of the treated effluent. The use of UV for disinfection rather than chloride renders the standard for TRC largely redundant.

2.4 PROJECT DESIGN

The details of the Project design have been presented in the *Preliminary Design Report*[8], prepared by the DSD. The major design features of the Sha Tin STW Stage III Extension are summarised in the following sections.

2.4.1 *Basis of Project Design*

The design of the Project is based on the population forecasts and estimated flows and loads in the Sha Tin New Town and Ma On Shan New Town catchment area. The new Pak Shek Kok development is also included in the forecast of wastewater flows and loads.

The Planning Department has forecasted that the population in the catchment area will increase from 648,000 to 694,000 in 2011, which is equivalent to an average dry weather flow (DWF) of 285,800 m^3 day^{-1} in summer and an average of 253,200 m^3 day^{-1} in winter. It is estimated that upon the completion of the Project, the STW will be able to cope with an average DWF of 295,000 $m^3 day^{-1}$ in

[5] Drainage Services Department (1998). *Op. Cit.*
[6] Drainage Services Department (1998) *Op. Cit.* Annex I
[7] Drainage Services Department (1998). *Ibid.*
[8] Drainage Services Department (1998). *Ibid.*

summer and an average DWF of 263,000 m^3 day^{-1} in winter. The average design loads for the influent are presented in *Table 2.4a*.

Table 2.4a ***Average Pollution Loads in 2011***

Pollutants	Load Factors (g^{-1} cap^{-1} d^{-1})	Load (tonnes^{-1})[a]	Concentration (mg l^{-1})[b]	
			Summer	Winter
BOD[c]	97	70	237	266
TSS	78	56.2	190	214
TKN	15.4	11.1	38	42
NH_3N	8.8	6.3	21	24

Notes:
(a) Figures based on a design population of 720,000.
(b) Figures based on an average DWF of 295,000 m^3 d^{-1} in summer time and an average winter flow of 263,000 m^3 d^{-1}.
(c) Figures provided by CE/SP, DSD. Reference : ( ) in SP/ 8/4276DS/S3/17

2.4.2 *Treated Effluent and Sludge Dry Solids Standards*

The existing effluent discharge standards for the Sha Tin STW and the preliminary design criteria for the Stage III Extension are presented in *Table 2.4b*. It is accepted that existing effluent standards will be maintained until the completion of both the Stage III Extension works and Stage I and II upgrading works. It should be noted that the existing effluent standard will be reviewed upon the completion of this EIA Study, in which it has been the subject of a set of sensitivity analyses (for further details please refer to *Section 4*).

The current minimum 30% dry solids requirement for landfill disposal of dewatered sludge cake will remain unchanged.

Table 2.4b ***Existing Effluent Discharge Standards (95%tile) and Preliminary Design Criteria for the Sha Tin STW***

Parameters	Existing Standard	Preliminary Design Criteria
TSS (mg l^{-1})	30	30
BOD (mg l^{-1})	20	20
TN (mg l^{-1})	20	25
NH_3N (mg l^{-1})	Not required	5
E.Coli (counts per 100ml)	Not required	5000
Total Residual Chlorine (mg l^{-1})	Not required	0.2

2.4.3 *Treatment Processes and General Layout of Stage III Extension*

The sewage and sludge treatment processes of the Stage III Extension are shown in *Figure 2.4a*. The general layout of the Project is shown in *Figure 2.4b*.

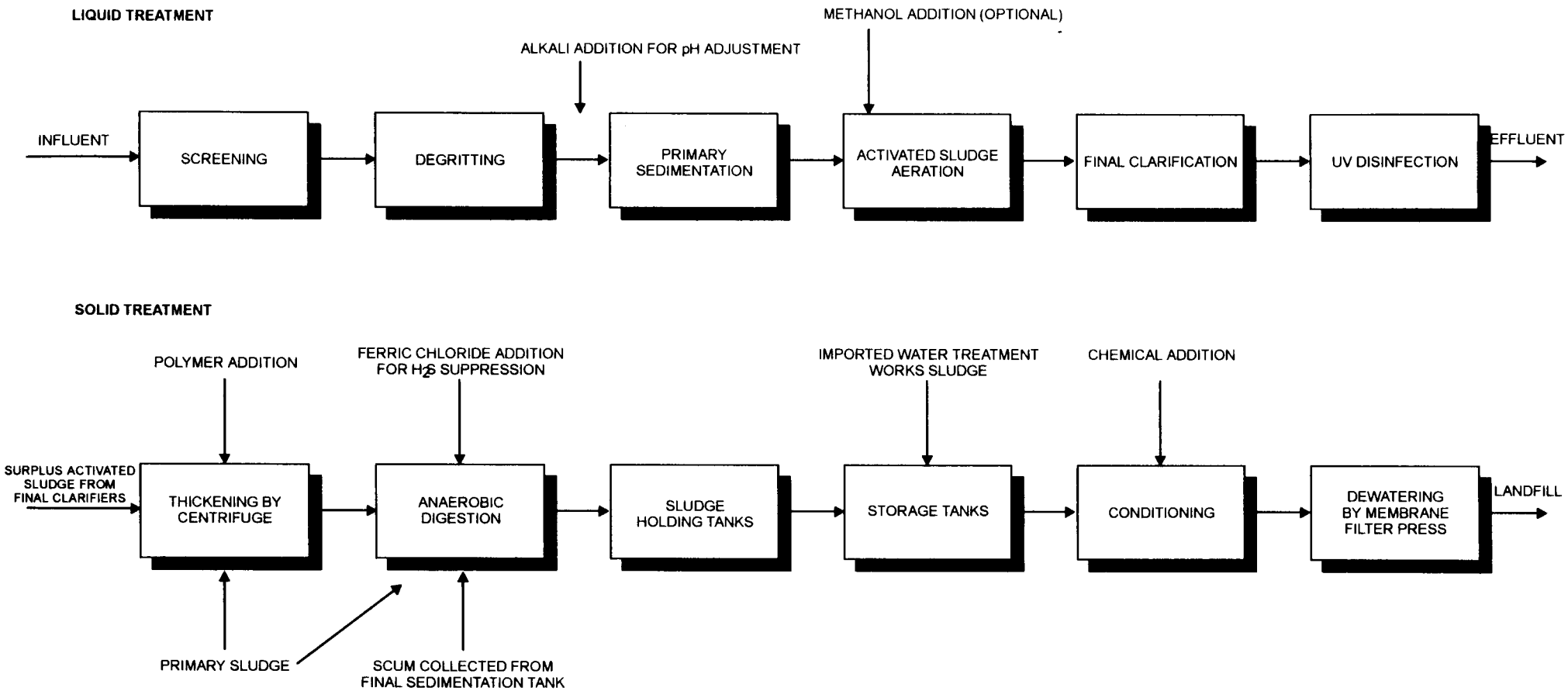

FIGURE 2.4a

PROPOSED SEWAGE AND SLUDGE TREATMENT AT SHA TIN STW

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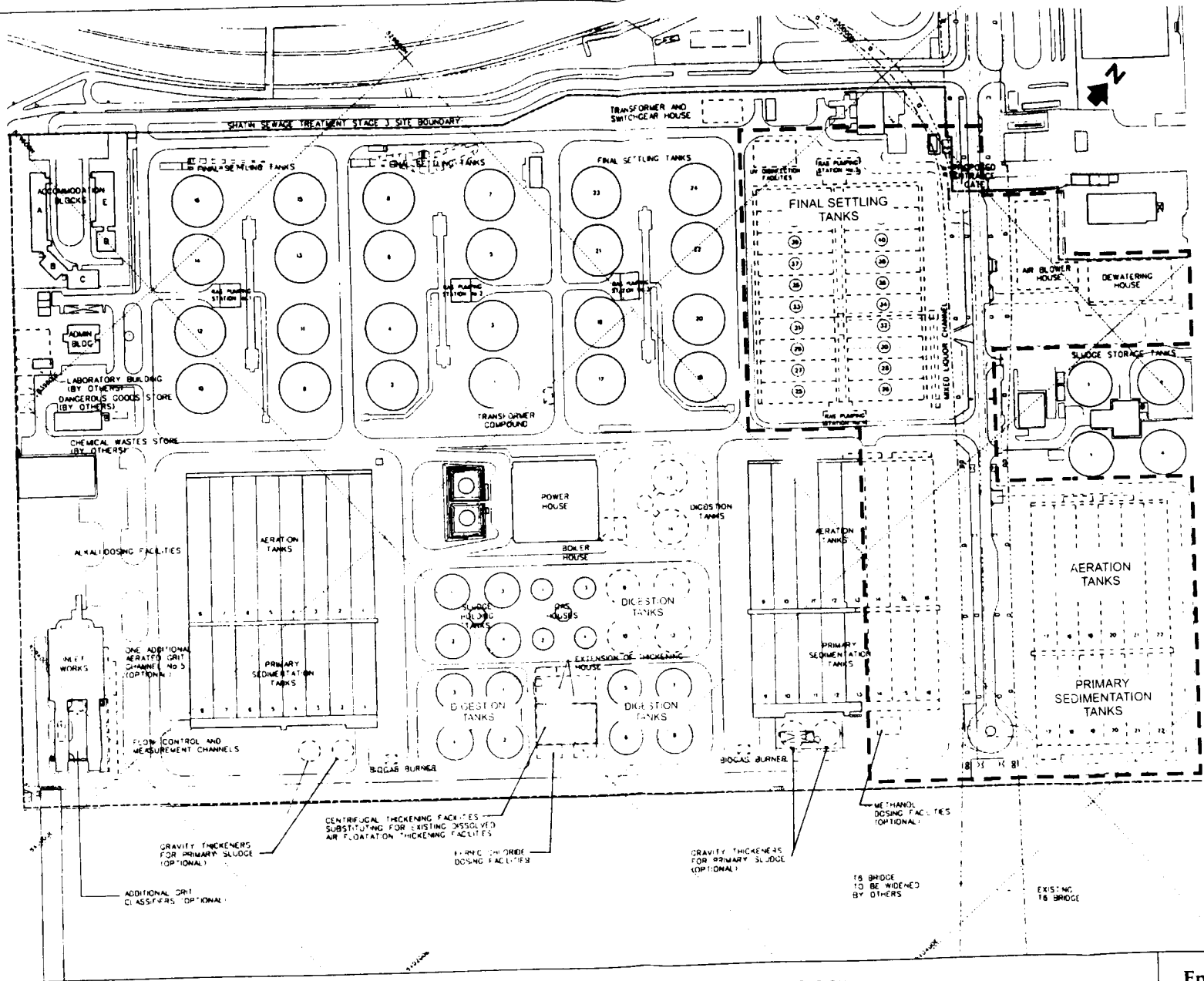

FIGURE 2.4b

GENERAL LAYOUT OF THE SHA TIN SEWAGE TREATMENT WORKS AND STAGE III EXTENSION

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The treatment process design is based on the assumption that the existing Stage I and II works are to be upgraded to meet the requirements of the Stage III works and that the flow will be evenly handled by the Stage I/II and Stage III facilities.

The influent will first pass through the grit chamber and screens at the inlet works for the removal of grit and other gross solids. This will be followed by primary sedimentation, activated sludge aeration and then final sedimentation. Both the primary and final sedimentation tanks are rectangular in shape and use the chain-and-flight system for sludge removal.

The biological treatment process is a single-stage nitrogen removal activated sludge process. The tank is divided between an anoxic zone and an aerobic zone, in a ratio of 1:3. Initial contact zones inside the anoxic zone are provided to minimize the growth of filamentous bacteria and hence to reduce the sludge bulking effect and bacterial foaming. Denitrification will take place in this anoxic zone, making use of the settled sewage as the carbon source. Supplementary methanol dosing facilities, if considered necessary, are provided for to offer more operational flexibility and to have better control of the nitrate nitrogen content in the effluent, which is particularly important in the winter.

Nitrification will take place in the aerobic zone where tapered aeration by means of air diffusers is provided. An internal recycle of 2 to 3 times the influent flow from the end of the aerobic zone to the anoxic zone is necessary to prevent excessive nitrate/nitrite levels in the effluent. The optimum pH for nitrification is maintained by dosing with alkaline materials, such as caustic soda, sodium bicarbonate, or soda ash.

The ultraviolet disinfection chamber, consisting of four operational channels, is designed to handle a flow of three times the DWF. The new disinfection facilities will also serve the existing Stage I/II facilities. The high-intensity lamps will be grouped in the form of UV reactors and will achieve a significant reduction in bacteria levels in the effluent.

The primary sludge collected in the primary sedimentation tanks will be conveyed by pumps to the gravity thickeners, to achieve a minimum 5% dry solids content. In some circumstances, it may be pumped directly to the anaerobic digestors if sludge thickening is not considered necessary. The sludge collected in the final sedimentation tanks will partly be transferred to the centrifugal thickening house as Surplus Activated Sludge (SAS) and partly be recycled to the aeration tanks as Returned Activated Sludge (RAS). The thickened SAS will then be pumped to the anaerobic digestion tanks for treatment.

The anaerobic digestion process is a high rate degradation process conducted in the mesophilic temperature range. Six digesters are to be constructed in the Stage III Extension works. Together with the eight existing digestors, they provide a design hydraulic retention time of 20 days, which is greater than the current retention time and should ensure more effective treatment and reduced odour emission rates.

The digested sludge will be transferred to the existing four holding tanks where the supernatant will form and be removed while the sludge is being thickened. The thickened sludge will finally be dewatered either by the existing centrifuges

or the proposed membrane filter presses before collection and disposal to one of the strategic landfills.

General Layout

As indicated in *Figure 2.4b*, one aerated grit channel, associated flow control and measurement channels will be added to the existing inlet works.

Ten rectangular primary sedimentation will be added to the north-eastern end of the existing works. Tanks 13-16 will be located adjacent to the existing primary sedimentation tanks and tanks 17-22 will be located to the north-east of the T6 bridge, which runs over the site.

Ten rectangular aeration tanks will also be added adjacent to the primary sedimentation tanks. The alignment of tanks 13-16 will generally be parallel with the existing tanks. Tanks 17-22 will be located to the north-eastern side of the T6 bridge.

The Stage III Extension final settling tanks will be located between the existing final settling tanks and the T6 bridge. In order to achieve the necessary capacity and to make the best use of land, rectangular tanks will be used. Twenty tanks with an overall dimension of 120m by 80m will be provided.

According to the preliminary design, centrifugal thickening facilities for surplus activated sludge will be built within the existing digestion tank area. If considered necessary, separate gravity thickeners for primary sludge will be provided in the vicinity of primary tanks No. 1-4 and No. 9-12. Associated ferric chloride dosing facilities, a transformer room and switchgear room will also be located in this area.

The sludge dewatering house will be equipped with membrane filter presses and located to the north east, adjacent to the proposed main entrance. The filter presses and the associated feeding tanks, and the other dewatering facilities will all be housed in the building envelope.

Other associated facilities, including a transformer room, the ultra-violet disinfection facilities, a RAS pumping station, a switchgear house and air blower house will be built to the north-west of the site, near the proposed entrance gate.

2.4.4 *Alternative Design of the Project*

DSD is also currently considering an alternative design of the Project in order to cater for an increased sewage flow of 350,000 m^3 day^{-1} (A residential population of 830,000). The alternative design is basically the same as that already described in this section but will include two additional aerated grit channels, each of an equivalent size to the existing channel. Additional UV disinfection facilities, sludge treatment facilities and aeration facilities will be added accordingly to account for the increased flows and loads. Stamford baffles will be added to the existing circular settling tanks.

2.5 *Construction Activities*

The civil works for the Stage III Extension will mainly consist of piling, pipe laying, earthworks and concrete works. All works at the site will take place on reclaimed land and no marine works will be required. The piles to be used will

be of the non-displacement type with steel bar/H-section reinforcement. The piles will not exceed 1,200 mm in diameter. It is considered that no special construction methods and equipment are required. Details of the construction of the Stage III Extension are presented in *Table 2.5a*. The following text summarises the key elements of the civil works.

At the existing inlet works, pipeline modifications and provision of an additional trunk pipe to the six proposed primary tanks at the north-eastern corner (Tanks 17 to 22) will be carried out. A total of ten primary sedimentation tanks will be built. These will involve piled foundation and pipe laying works. The construction of aeration tanks will also involve associated piled foundation and pipe works. The air blower house will be built to the north of the site, near the proposed entrance.

Twenty pairs of rectangular final settling tanks will be built with one twin mixed liquor channel and two RAS pumping stations. In addition, an ultraviolet disinfection chamber will be installed with an associated electrical panel house and high voltage switchgear room. All of these facilities will require piled foundation and associated pipeline laying works.

The existing SAS sludge thickening house will be extended to cater for the additional sludge volumes. The construction of the six additional digestion tanks and the associated dewatering facilities (a dewatering house and a sludge cake storage house) will also involve extensive piled foundation work and pipeworks.

Finally, a laboratory, an electrical supply and control system will have to be built to support the operation of the Stage III Extension . The associated E&M works during the installation of each of the major units of the Stage III Extension are summarised in *Table 2.5a*.

2.6 *WORKS PROGRAMME*

The construction works for the Stage III Extension are scheduled to commence in September 2000 and to be completed in December 2003. A detailed construction programme is not available at this stage; however, based on experience from other similar projects, the sequence of works likely to be undertaken is presented below:

- site preparation;
- excavation of soil;
- precast reinforced piling;
- substructure construction;
- backfilling and pile extraction;
- civil works, as described in *Section 2.5*;
- finishing work and pipe laying.

2.7 *OTHER RELATED PROJECTS*

It is anticipated that the construction of the Project will be interfaced with the T6 bridge widening project proposed by the Highway Department (HyD). The site boundary and work programme of the T6 bridge widening are yet to be determined. However, a preliminary review of the available information indicates that the T6 bridge site would not encroach upon the major Stage III

Extension treatment units. DSD has expressed their intention to complete the work within the T6 bridge site at an early stage of the programme in order to hand over the site to the HyD for the widening works.

Table 2.5a ***Summary of Major Civil and E&M Works***

Stage III Major Units	Civil Works	E&M Works
Inlet works	• One aerated grit channel (Optional) • Two flow control and measurement channels • Construction of two grit classifiers • Construction of trunk pipe to the proposed primary tanks at the north-eastern coast	• 1 bar screen (6mm) to be installed at existing screening chamber • Additional aerated grit channel, air supply system, grit pumps and grit classifiers
Primary sedimentation tanks	• 10 tanks • Associated piled foundation work and pipe works	Each tank to be installed with: • chain and flight type sludge collection system and scum collection system • primary sludge pumps
Aeration tanks	• 10 tanks • Air blower house (incorporated into the CLP switchgear and air blower house) • Associated piled foundation work and pipeworks	• Each tank to be installed with: (a) fine bubble membrane air diffusers; (b) mixers in contact zone and anoxic zone; and (c) MLSS return pumps and associated mains • Six centrifugal air compressors (5 duty + 1 standby) (installed at the air blower house) and associated pipework
Final settling tanks	• 20 pairs of rectangular tanks • 1 twin mixed liquor channel • 2 RAS pumping stations • Associated piled foundation work and pipeworks	• Each tank to be installed with chain and flight sludge collection system Each RAS pumping station to be installed with (a) four RAS pumping (three duty + one standby) (b) two SAS pumps (one duty + one standby) (c) scum pumps
Ultraviolet disinfection chamber	• 1 chamber (consisting of a minimum of 4 operational channels) • Associated electrical panel house and HV switchgear room • Associated piled foundation work and pipeline	• Each channel to be installed with high intensity UV lamps • Associated electrical installation and control • Transformers
Sludge thickening	• Modification and extension to existing SAS thickening house • Associated piled foundation work and pipework	Equipment to be installed includes: • five thickening centrifuges (four duty + one standby) • chemical conditioning system • sludge feed pumps, sludge transfer pumps, sludge service tanks etc. • transformers
Digestion tanks	• 6 tanks • Associated piled foundation work and pipework	Each tank to be installed with mechanical mixers, water heaters and other ancillary equipment.
Dewatering facilities	• 1 dewatering house • Associated piled foundation work and pipework	Dewatering house to be installed with membrane filter presses (three duty + one standby) and associated transfer pumps, chemical conditioning system and electrical accessories

Stage III Major Units	Civil Works	E&M Works
Laboratory	One new laboratory	Laboratory equipment (details to be determined)
Electrical supply	The CLP Switchgear and Air Blower House (w/piled foundation) includes • HV switchgear and LV switch board room • one air blower house	• The CLP Switchgear and Air Blower House to be installed with: (a) HV switchgear (vacuum circuit breaker) (b) LV switchgears and MCCs • transformers
Control system	-	The following control system to be installed: (a) sensors/analyser (b) SCADA/PLC system