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Report

Conceptual Design and Management Plan for the Industrial Estate at Karanawnwatta, Dankotuwa

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This report was prepared by Dr Ajith De Alwis, Dr S Bhuvendralingam, Dr Sohan Wijesekere (all of the Univ of Moratuwa) and Mr Sanath Ranawana (NAREPP) The recommendations contained herein represent the best professional judgment of the team only

1 Introduction

This report addresses issues that must be taken into consideration in developing an industrial estate It is based on information collected during an Initial Environmental Examination Study of the site Additional information was obtained from discussions with officials of the Regional Industrial Service Committee for the North Western Province and specific industrialists interested in locating plants within the estate

The report addresses issues pertaining to infrastructure, facilities and services that are necessary in ensuring that the industrial estate functions effectively and efficiently The assimilative capacity as well as the available resources of the surrounding environment have been considered in designing the facilities for the industrial estate Here, the term environment does not imply just the natural environment, but the built environment as well

Specific information on the type, number, scale and mix of industries was taken into consideration in recommending various facilities for the estate Obviously, these factors have a bearing on the nature and capacity of the required facilities

2 Zoning, Buffers and Industry Mix

2 1 Zoning

Industries which are proposed to be established at the Dankotuwa industrial estate can generally be classified as follows

Type A -- Liquid waste generating industries

A 1) Food & Beverage industries (e g , meat processing, animal feed, wine bottling, etc)

A 2) Others (e g fish net, fibre dyeing, etc)

Type B -- Dust and gaseous emission generating industries

B 1) Coir based industries (e g , fibre & brushes, tyre retreading)

B 2) Polymer & Ceramic based industries (e g terra cotta, plastics polyurethene foaming)

The industrial estate should be zoned into 4 divisions (see Fig 2 1) in order to accommodate the four categories of industries A 1, A 2 B 1 and B 2

2 2 Buffers (i e , green belts)

It is further proposed that each zone of the industrial estate be surrounded by a green belt of at least 3 m width The zones where industries classified under B 1 and B 2 are to be located, should be surrounded by a 7 m wide green belt (see Fig 2 2) The objective of the green belt is to minimize the adverse impact generated by industries within a zone (such as dust emissions, generation of obnoxious smell etc) to the outside environment, as well as to have an aesthetically pleasing visual environment

As an additional precaution, it is recommended that the factory units of the following two industries be surrounded by individual green belts (7 m wide) in order to minimize inconvenience to other industrial units within the estate These are

1) RL enterprises having an animal feed processing unit, can potentially produce obnoxious smell which would severely impact other food & beverage units catering for human consumption

2) Singular enterprises producing polyurethene foam have the potential to generate hazardous air pollutants including cyanide compounds

Based on author's discussion with a botanist[1], the following variety of tree species are recommended to be grown within the green belt

a) *Tabooviya Rosea*
b) *Pelta Phorum* (Kaha Mara)
c) Mahogany (species Kaya)
d) Pihimbia
e) Kohomba[2]

It was suggested that shrubs such as 'Iksura' and 'Croatains' be interspaced with the above mentioned trees in order to have an effective green belt

Plant nurseries situated in Ratmalana (Forest Dept) and near the Public Library at Cinnamon Gardens are possible sources for obtaining above mentioned trees and shrubs

2 3 Road Reservations

A road reservation of 12m for the main internal road and a reservation of 6m for other secondary roads within the estate has been kept (see Fig 2 3) The road reservation is to cater to future expansion works and for laying utility infrastructure for the estate The

[1] Hiran Amarasekera, Phd, personal communication

[2] slow growing

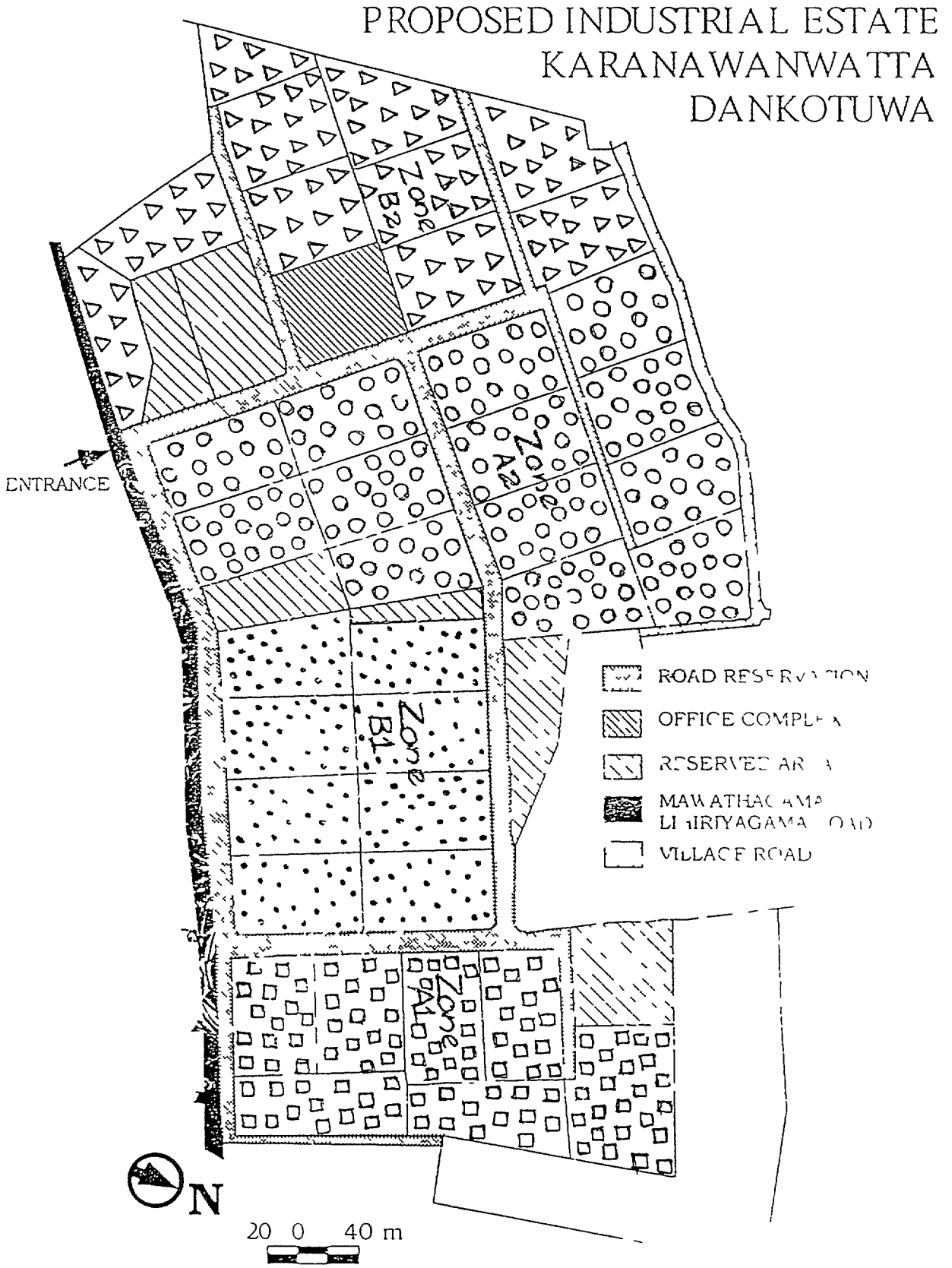


FIG 21' ZONING OF INDUSTRIAL ESTATE

fig 2

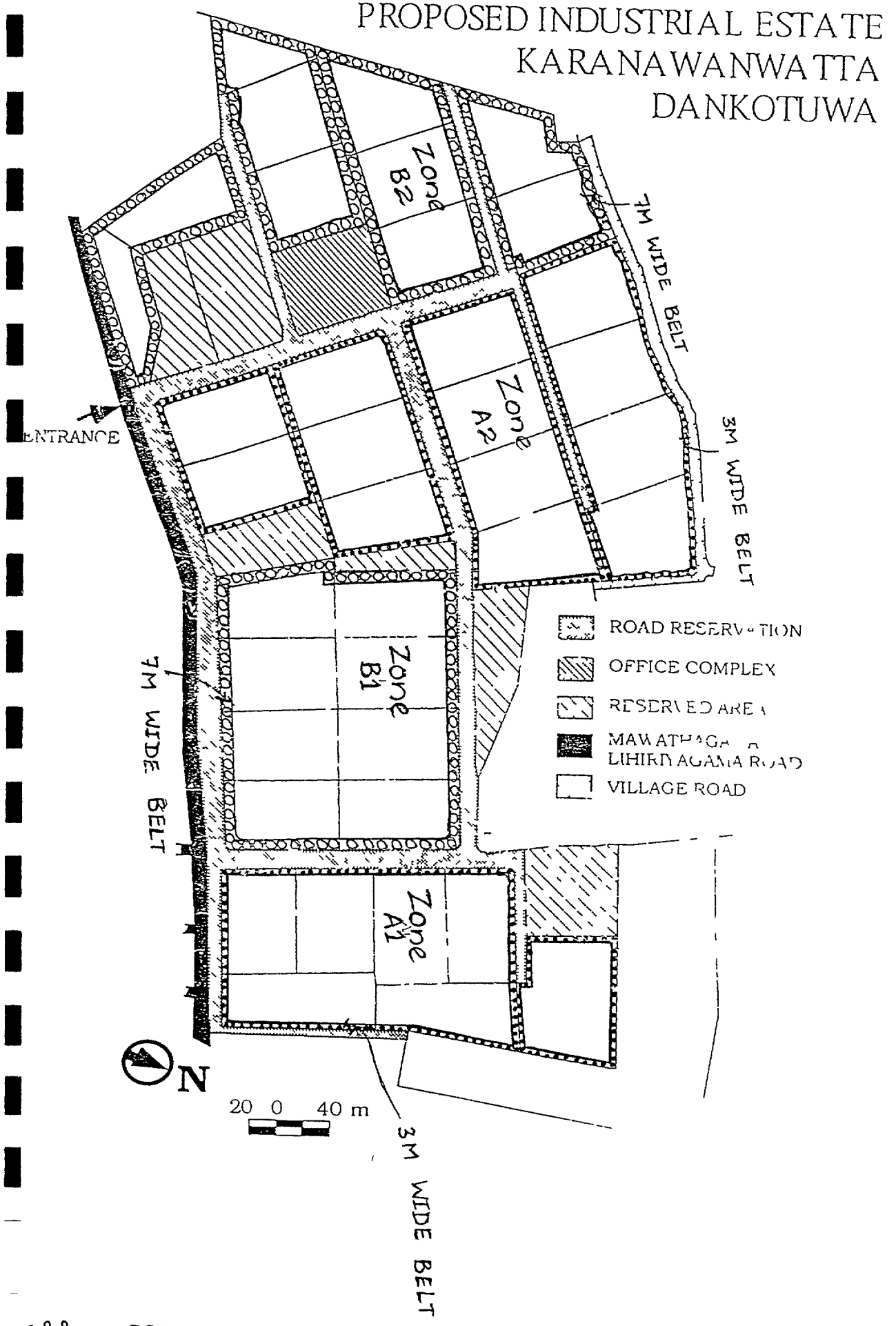


FIG 22 GREEN BELT FOR THE INDUSTRIAL ESTATE

PROPOSED INDUSTRIAL ESTATE
KARANAWANWATTA
DANKOTUWA

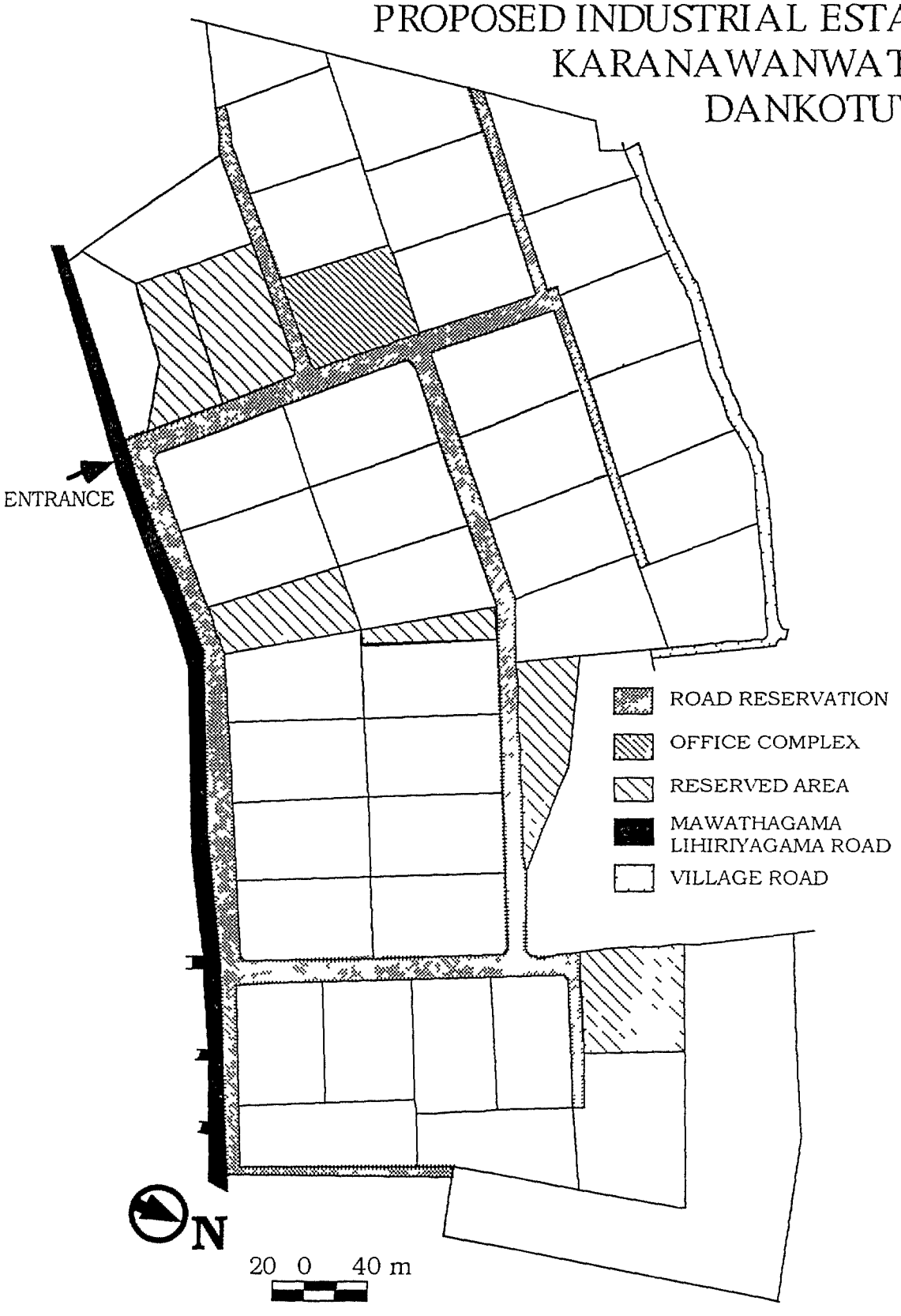
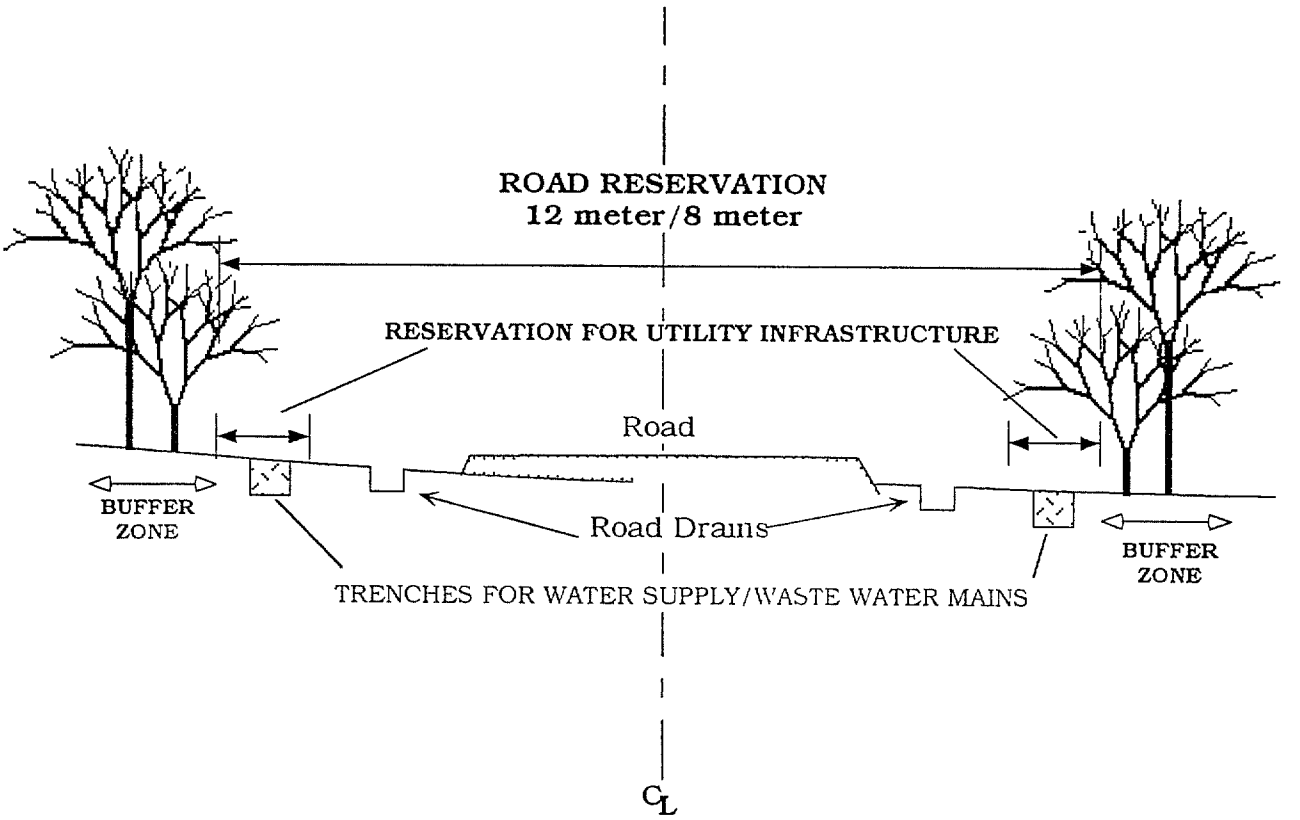


FIG 2 4: PROPOSED INDUSTRIAL ESTATE
KARANAWANWATTA
DANKOTUWA

TYPICAL ROAD RESERVATION LAYOUT



utility infrastructure include water supply, waste water, telecommunications, electricity and fire fighting (hydraulics)

The reservation for these purposes are to be within the allocated reservation but beyond the road drain as sketched in Figure 2 4 A reservation of 12 m would be adequate to incorporate the service mains However a minimum reservation of 8m within the estate is recommended

3 Internal Transportation

The internal road network has been laid out as per Figure 3 1 Roads leading in dead ends must have adequate turning space The strength of the road base should be capable of withstanding the expected heavy vehicle traffic Junctions should be wide enough to allow long vehicles to manuver safe turns Proper road signs indicating speed limits and location of bends etc , need to be erected

4 Surface Water Runoff and Storm-water Drainage

4 1 Surface Water Runoff

The drainage pattern of the site for the proposed industrial estate at Karanawanwatta - Dankotuwa is shown in Figure 4 2 based on the contour map in Figure 4 1 and supplemented by site inspections The roads in the blocking out plan were also super imposed on the contour map to arrive at the drainage pattern after the road network development

Soil within the estate can be categorized into two major types namely the gravelly and silty/sandy According to infiltrometer tests done previously, the sandy soil possessed a high saturated conductivity The sandy zone covers a major area, approximately 75% of the proposed industrial estate Approximate areas with these two soil types are mapped in Figure 4 3

Sandy soil type clearly shows the potential to loose a significant percentage of volume of soil by erosion if the land cover is removed and this was evident during the site visit Gravelly regions are found at the top most elevations of the estate with average slopes of about 3%

Therefore, the proposed industrial estate which is located on a small hillock contains the threat of generating significant erosion during rains if the land cover is not maintained to a satisfactory degree

Once the industrial estate is fully developed, the impermeable land cover is certain to increase and the runoff would increase by 50-65% when compared with the coconut estate situation

FIG 3.1

PROPOSED INDUSTRIAL ESTATE KARANAWANWATTA DANKOTUWA

ROAD NETWORK

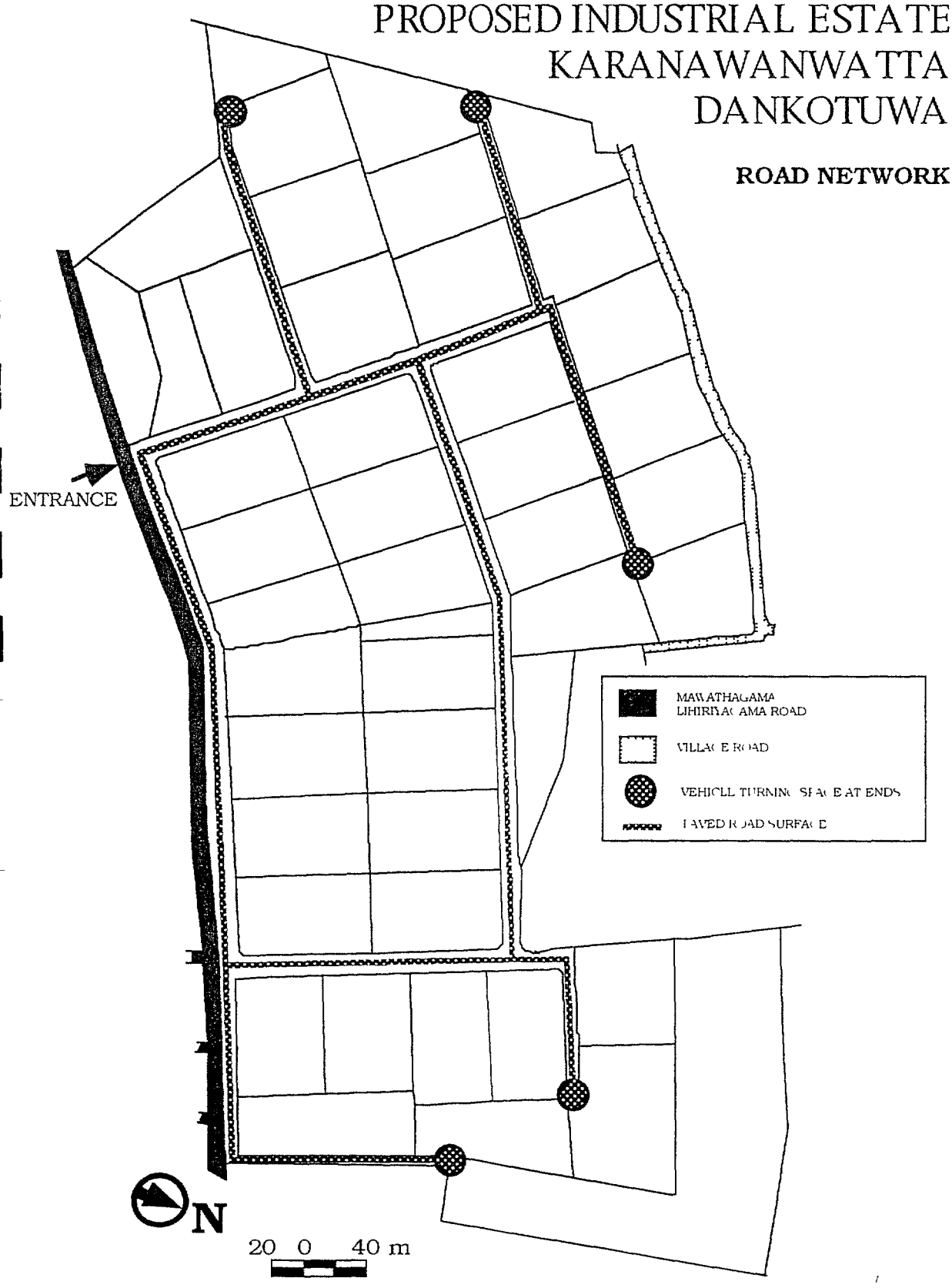


FIG 4 1

PROPOSED INDUSTRIAL ESTATE KARANAWANWATTA DANKOTUWA

GROUND CONTOURS

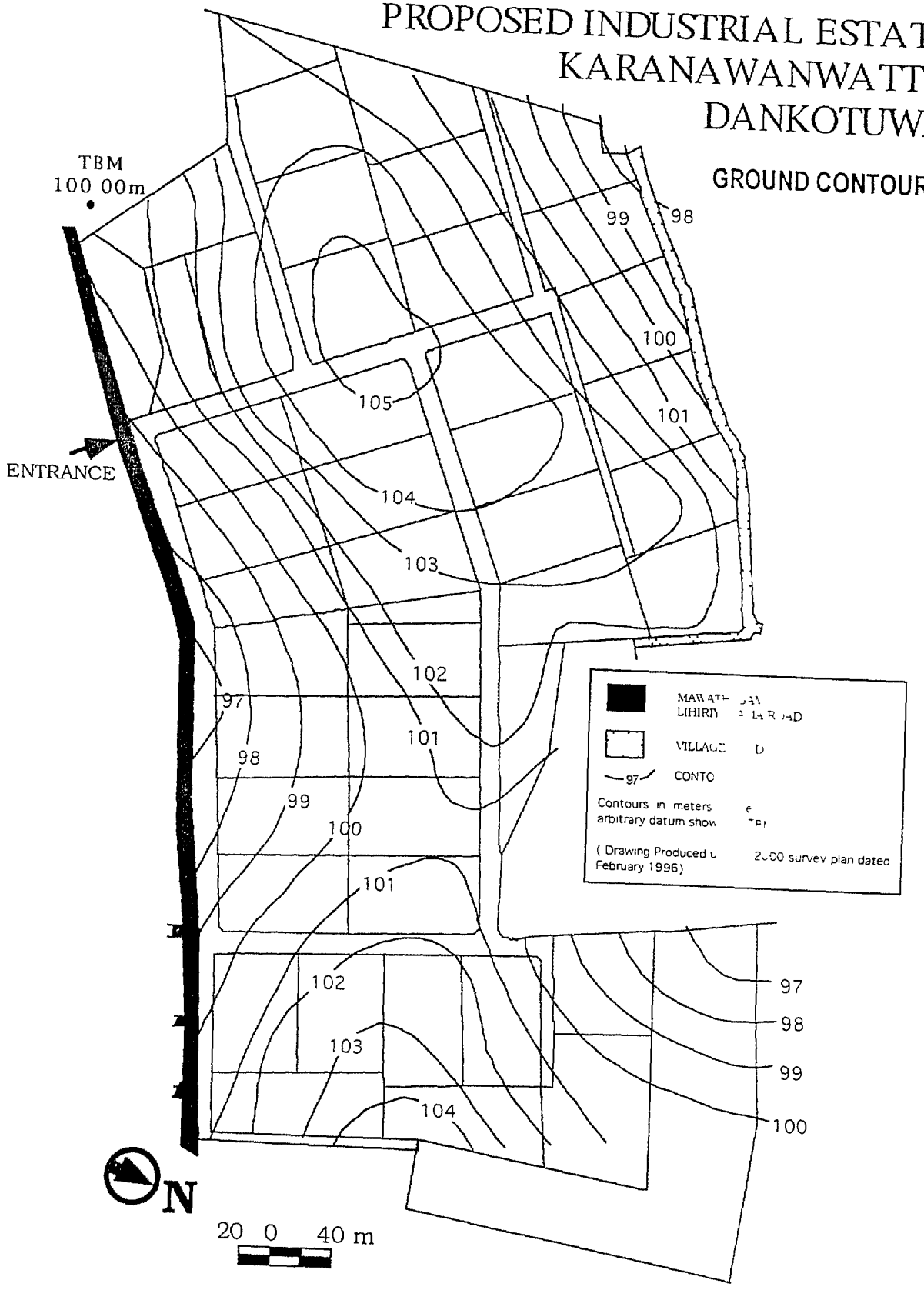


FIG 4 2

PROPOSED INDUSTRIAL ESTATE KARANAWANWATTA DANKOTUWA

DRAINAGE PATTERN

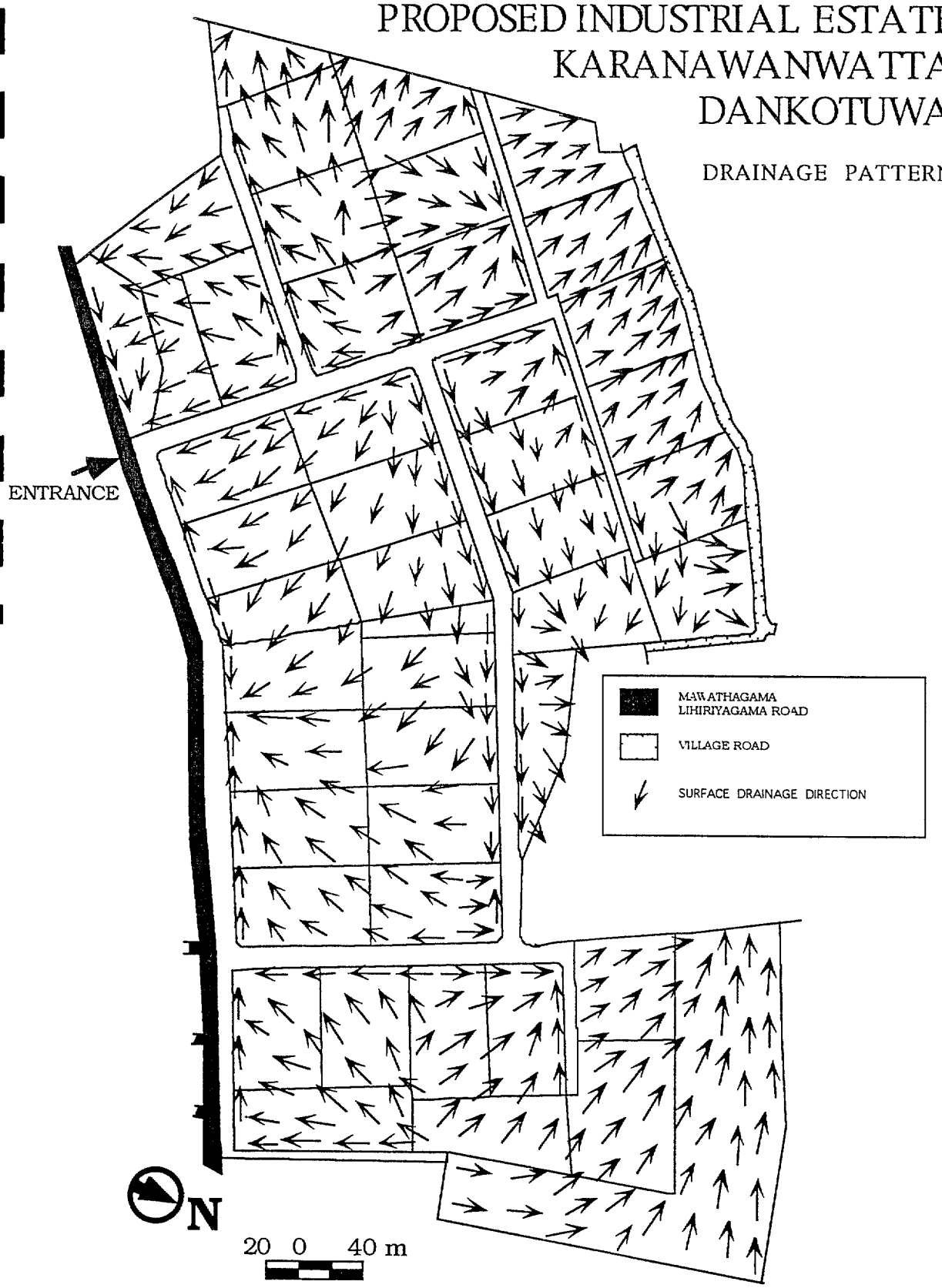


FIG 43.

PROPOSED INDUSTRIAL ESTATE KARANAWANWATTA DANKOTUWA

MAJOR SOIL TYPES AND GROUND WATER SOURCES

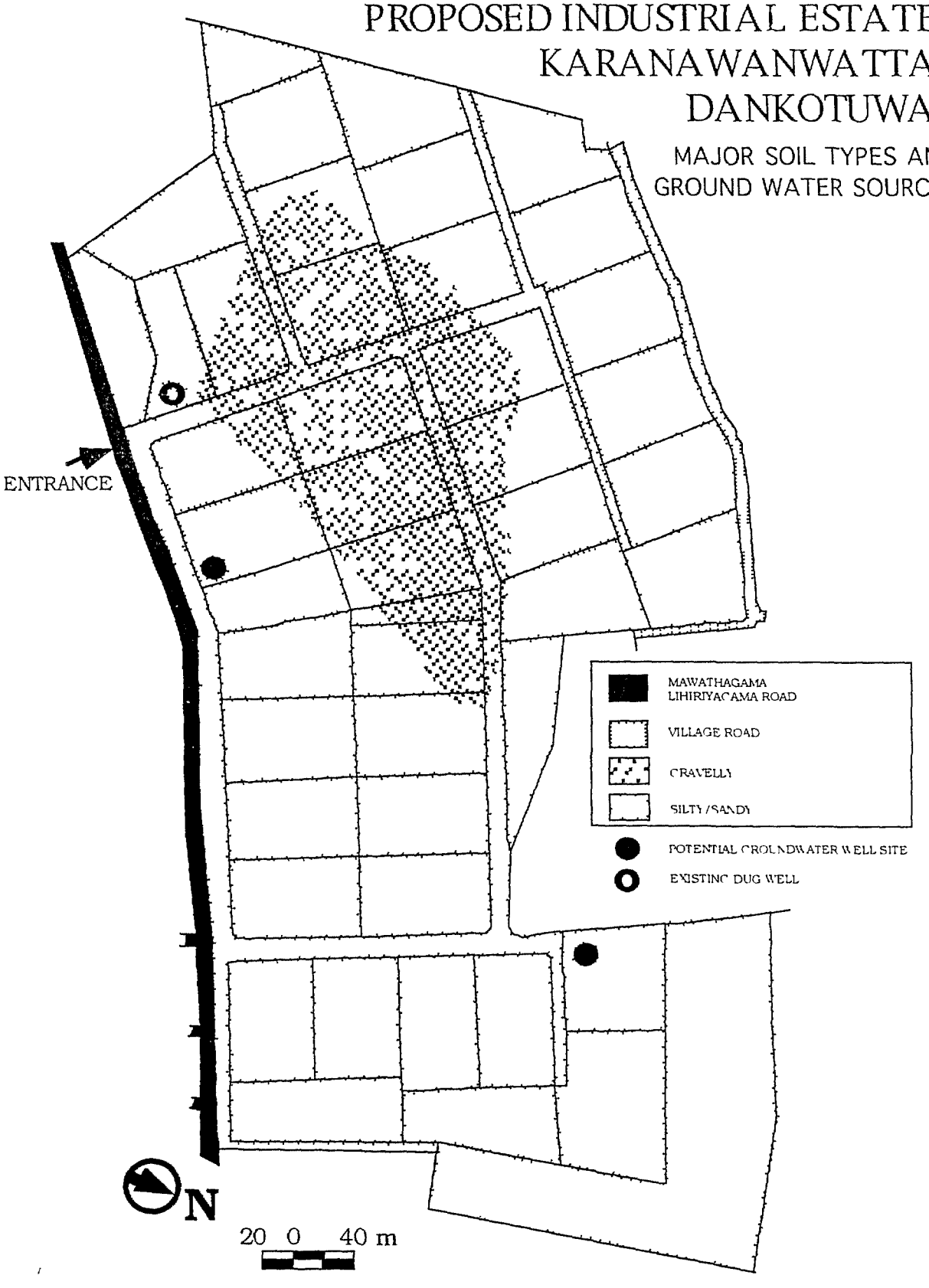
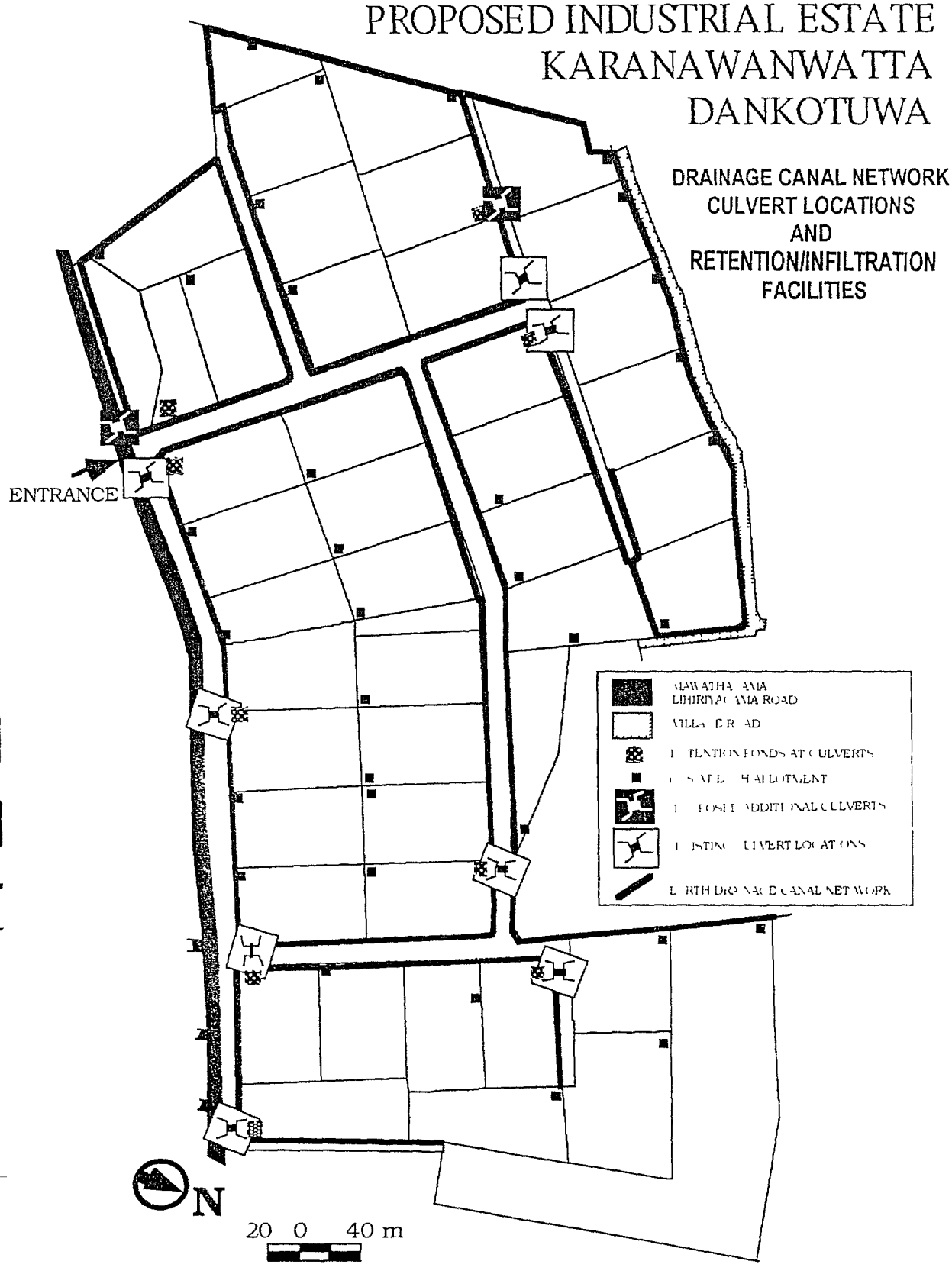


FIG 4.4:

PROPOSED INDUSTRIAL ESTATE KARANAWANWATTA DANKOTUWA



The existing soil types, present vegetative land cover, on site topography and the elevation with respect to the surrounding lands indicate that the rainfall received at the site is presently contributing significantly to recharge the groundwater As such the water quantities in dug wells at the near vicinity would certainly get adversely affected if the estate surface is stripped and converted to paved or bare, thereby reducing the capacity to replenish natural and ground water

Therefore adequate retarding action and retention facilities for surface runoff should be secured within the estate to ensure adequate penetration of rain water into the earth surface to enrich groundwater This retarding action would also arrest soil erosion

4 2 Detention/Infiltration Pits

In order to accommodate the change in land cover due to infrastructure development, each allotment should provide a pond with a volume equivalent of 0 7% of the surface area of the allotment The value of 0 7% was arrived at by considering expected degree of land use change from the pre-development stage to be reflected by a runoff coefficient of 0 8 and a two year return period as the appropriate design level for the expected rainfall

If the area of the allotment is 0 4047 ha (4047 sqm) then the required volume of retention storage amounts to 28 cubic meters As such a pond with a surface area of 28 square meters would be required if a depth of 1 meter could be provided for water accumulation It is recommended that an earth pit with a depth of 1 meter be provided at each allotment for retention & detention of rainwater having a downstream wall with a loosely packed rubble to permit the passage of surface runoff in a retarded manner (Figure 4 8) The surface coverage to be determined by the extent of each allotment under consideration

Based on the above, an unlined pit is recommended to be excavated at each allotment to a typical size as given in Table 1 Recommended location for each allotment is shown in Figure 4 4 Recommended depth is 1 0m and the side slopes need to be adjusted to prevent collapsing The dimensions given are for a pit with vertical slopes This retention pond should be located at the lowest most position of the allotment so that this position could capture most stormwater from the concerned property It is recommended to have a grass belt of at least 1 meter width to be grown at the upstream edge of this pit to trap silt entering the pit Periodical desilting of the pit and cleaning of rubble packing to prevent sealing of voids should be carried out

4 3 Road Drainage

Two earthen drains of at least 450mm x 450mm square in section on either side of each road should constructed to lead the rain water to safe draining locations Culverts have already been constructed, and it is suggested that the present locations be utilized to create retention areas facilitating enhanced infiltration of rain water and also to reduce flash turbid flows reaching downstream agricultural habitats outside the proposed industrial

estate Two additional culvert locations are recommended based on the drainage pattern of the estate

Proposed road drainage network and recommended retention ponds at culvert locations are shown in the Figure 4 4 This integrated retention pond/pit system would trap sediments in a stepwise fashion and retard the action of surface runoff while enhancing water entering the soil to recharge groundwater A typical sketch of recommended 1m deep retention ponds at the culvert locations are shown on the Figure 4 5

It is recommended to turf the slope surfaces at the near vicinity of the pit to obtain an aesthetically pleasant appearance, while ensuring the silt trapping, retention and infiltration functions

TABLE 4 1 Recommended Retention/Detention Pits at Each Allotment

Size of Allotment (ha)	Typical Values for Detention/Retention Pond	
	Length (m) & Width (m)	**Depth (m)**
0 10	2 65 X 2 65	1 0
0 15	3 20 X 3 20	1 0
0 20	3 75 X 3 75	1 0
0 25	4 20 X 4 20	1 0
0 30	4 60 X 4 60	1 0
0 35	4 95 X 4 95	1 0
0 40	5 30 X 5 30	1 0
0 45	5 60 X 5 60	1 0
0 50	5 90 X 5 90	1 0

4 4 Cross Drainage Allotments

Surface water drainage across allotments must be taken into consideration when blocking out land allotments It is important to ensure that the natural drainage paths to be maintained as far as possible during the construction of boundary walls

The entire industrial estate would be enclosed by a security fence around the perimeter, to isolate the estate from surrounding properties Boundary walls around each individual property should be discouraged Wire fences can be constructed with individual footings if necessary This will permit the flow of surface water without constraints

Avoiding boundary walls which create obstruction to surface flow is important to ensure natural cross drainage within the estate As the areas become developed, the cross surface flows become significant during heavy showers which cause inconveniencing downstream

FIG 4 5

PROPOSED INDUSTRIAL ESTATE KARANAWANWATTA DANKOTUWA

TYPICAL RETENTION/INFILTRATION FACILITY NEAR CULVERTS

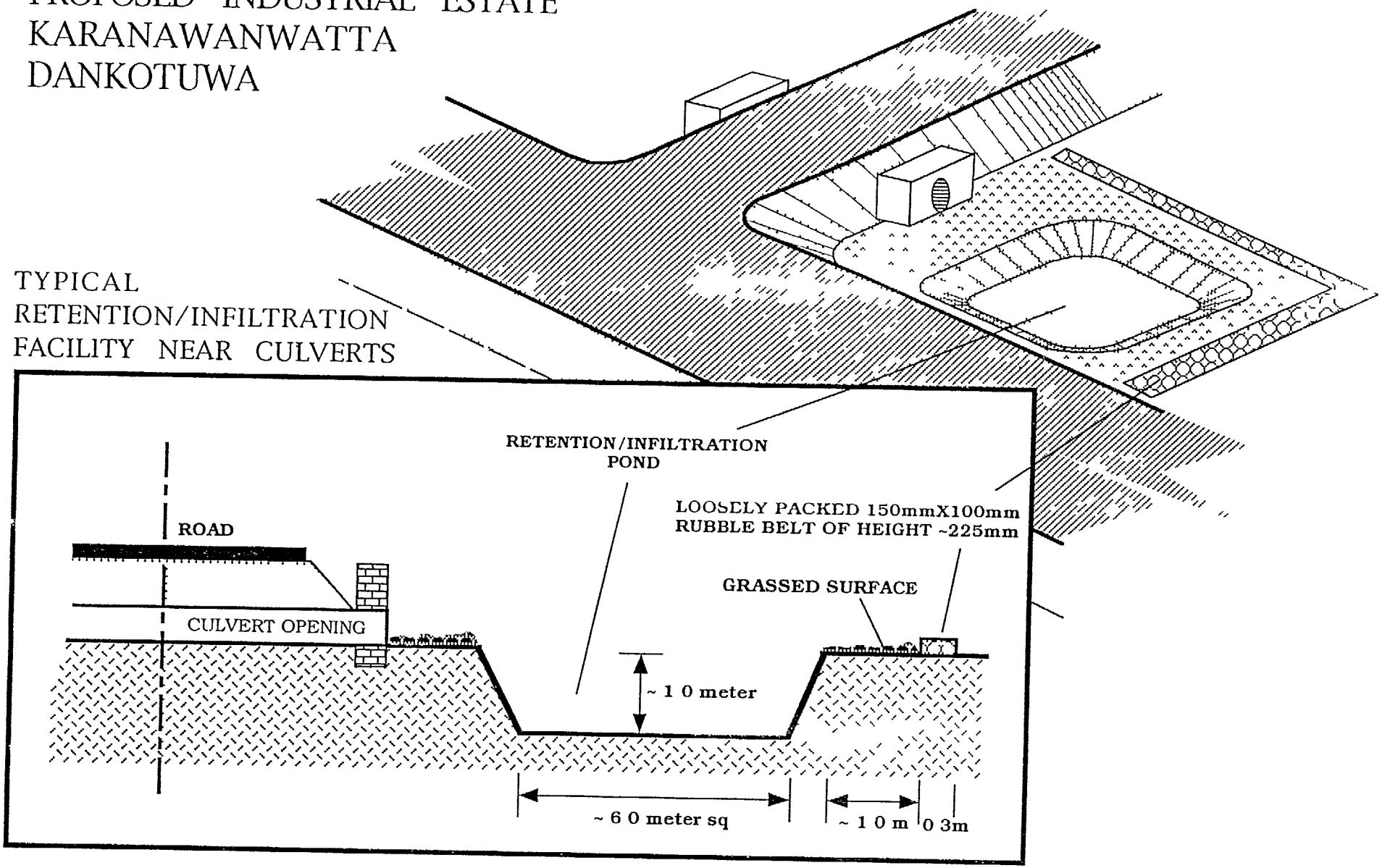
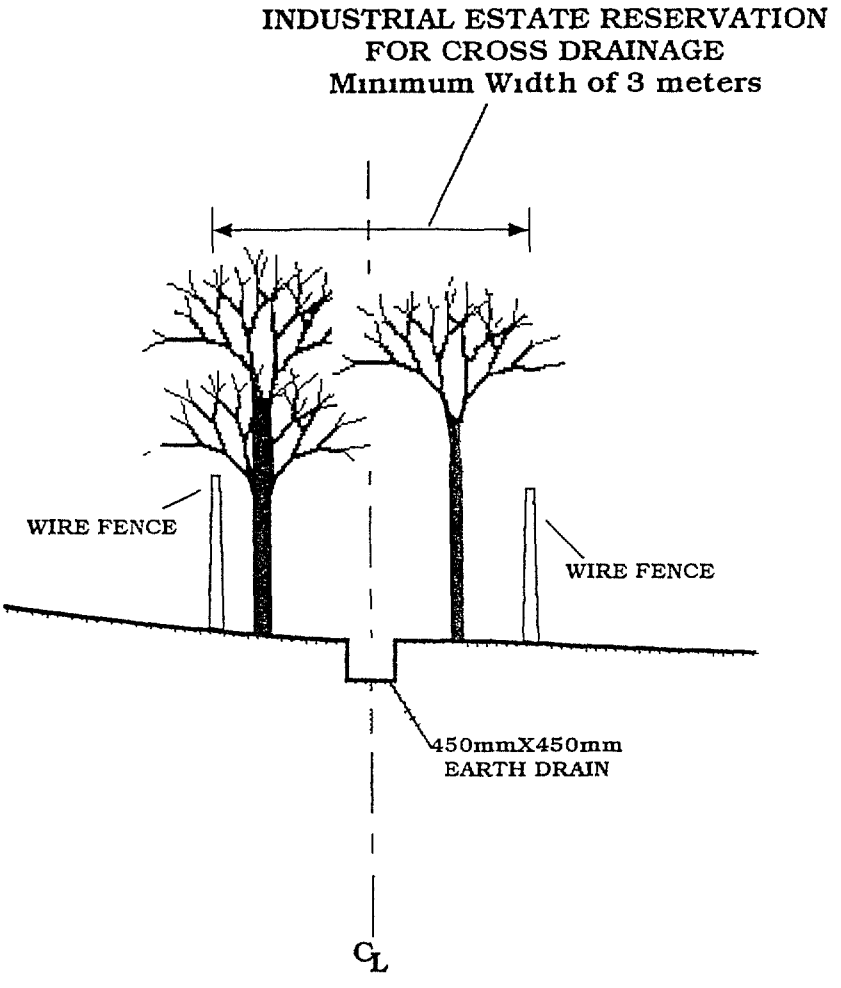


FIG 46

PROPOSED INDUSTRIAL ESTATE KARANAWANWATTA DANKOTUWA

TYPICAL CROSS DRAINAGE RESERVATION LAYOUT



occupants As such effective cross drainage measures are required within the industrial estate

Hence it is recommended to have a strip of 3 meters at each common boundary with a common earth drain of 450 mm x 450 mm at the center with two rows of trees on either side of the drains The common strip needs to be the property of the Industrial Estate Management and not of the individual property holders This strip would facilitate cross drainage, retarding of surface runoff reaching the downstream, the purpose of a wind barrier across the industrial estate and a green, shady environment

The trees to be planted in the common strip should serve the above purposes and the remaining surface of this strip should not be void of vegetation Ecological planting is recommended

A typical cross section of the common strip is shown in Figure 4 6 The common strips as per the present tentative land allocations are shown in Figure 4 7

However, when more than one allotment is owned by a single owner, the management must ensure that proportionate green strips are established within the premises with appropriate trees to serve the said purposes

5 Water supply

The recommended source of water supply for the industrial estates is by tapping groundwater through deep wells The total water requirement by all industries is estimated at 130 m^3/day Fire fighting requirements would be approximately 120 m^3/hr

Two probable locations have been identified for exploration (see Figure 4 3) One site is close to the entrance by the Mawatagama-Lihiriyagama road The other site is close to the recommended waste water disposal pond Hence it is recommended that the first exploration well be dug at the site close to the main entrance If this location is not adequate to meet the water demand the waste water disposal site will have to be suitably adjusted before the other source is tapped

A simple economic analyses illustrates the economic advantage of supplying water through a central water supply system

Fig 47

PROPOSED INDUSTRIAL ESTATE KARANAWANWATTA DANKOTUWA

CROSS DRAINAGE RESERVATION

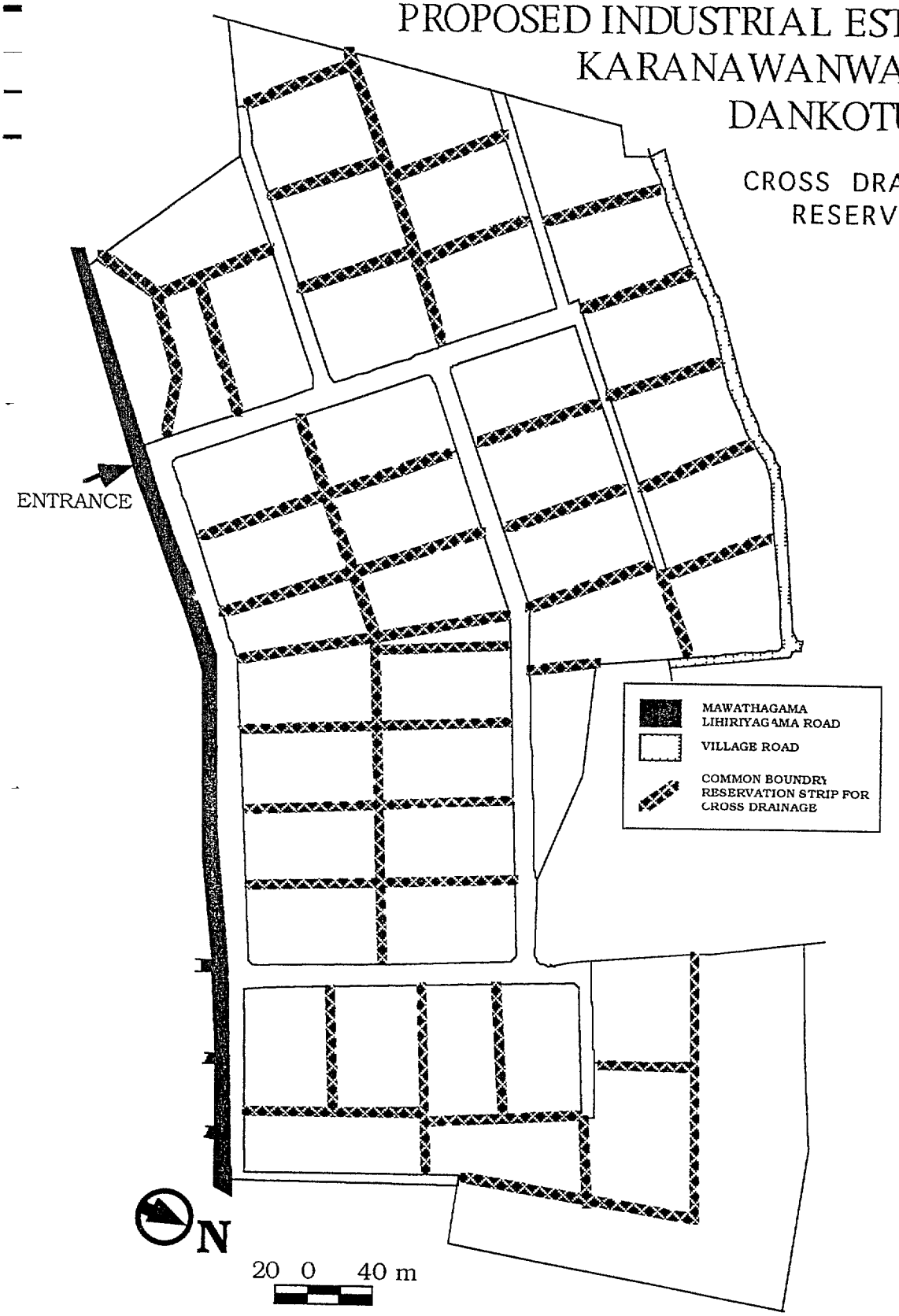
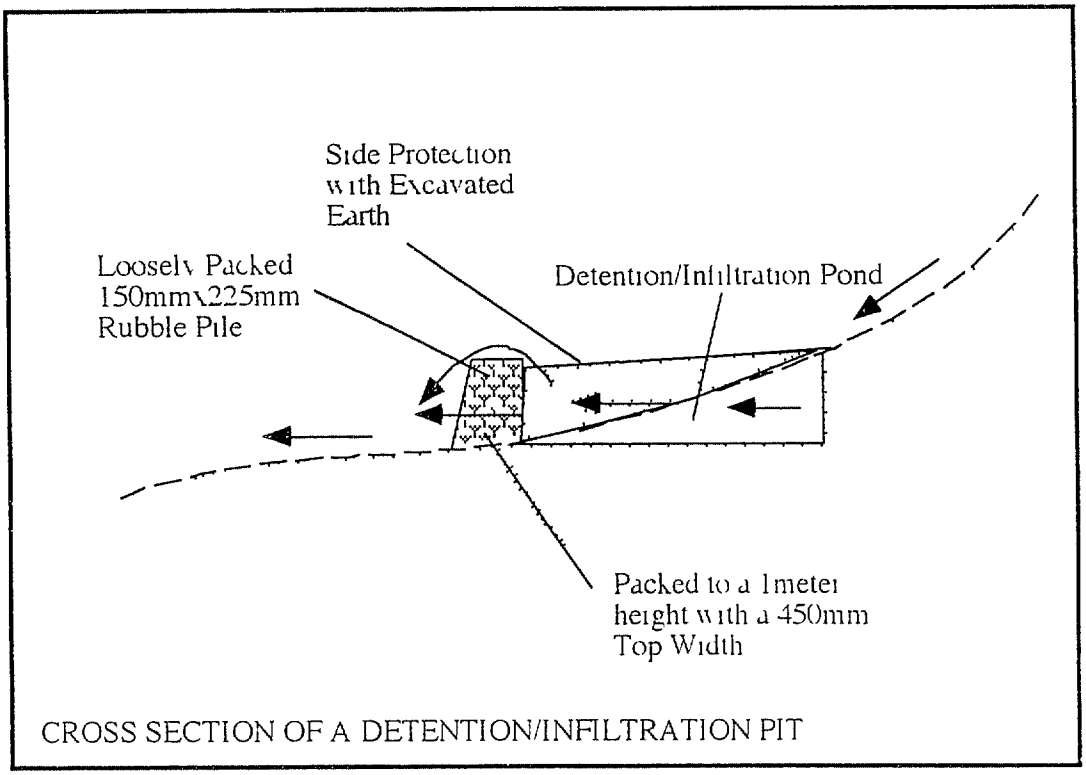


FIG 4 8. TROPICAL DETENTION/INFILTRATION PIT AT EACH ALLOTMENT



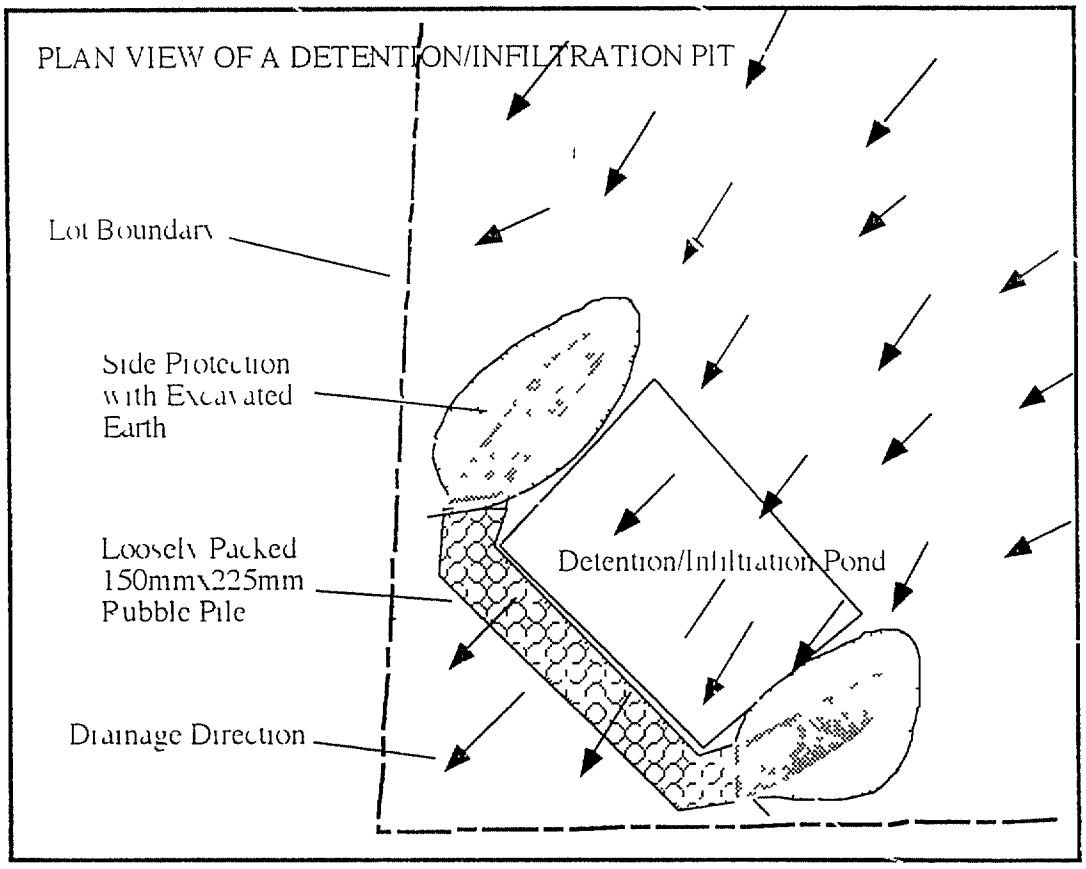


TABLE 5 1 Cost Comparison of Water Supply Alternatives

	Item	*Cost Rs ('000)*
Cost of water supply through a central system	Construction of deep well(s)	400
	Pumps	100
	Storage tank(s)	150
	Supply pipelines	250
	Total Cost	**900**
Cost of water supply via individual wells	Construction of 20 wells	1,500
	Pumps for 20 wells	300
	Total Cost	**1,800**

Note that the cost of individual storage tanks at each plant and the internal supply pipelines within individual sites have not been included since these costs are common to both alternatives It is assumed that firms will construct individual storage tanks even when water is supplied via a central system

Comparing the total cost in Tables 5 1 and 5 2 shows that a central water supply scheme would be significantly cheaper

In addition to the direct financial benefits, a central water supply system is advantageous from a 'social' point of view as well Although groundwater is available at the site, the sustainable yield and the extent of the water table have not been determined Excessive extraction could lead to a rapid depletion of the water table and cause related problems such as increased salinization and even land subsidence -- not to mention a shortage of fresh water If industrial firms within the estate are given the option of constructing individual wells, it will be difficult to regulate and control the use of groundwater Behaviour with regard to groundwater use would follow the pattern typical for use of a common property open access resource, where no single user has an incentive to use less groundwater, since it will only avail another to consume more Therefore each user will consume as much as possible

This problem can be resolved if water is supplied via a central scheme which can be regulated and monitored A water use fee can also be levied to provide the necessary incentives to reduce consumption Having to pay for water will also reduce the incidents of firms attempting to dilute their effluent in order to reduce the concentration Dilution is advantageous when firms have access to groundwater at no cost (except pumping costs) For all of the above reasons, it is strongly recommended that the industrial estate strictly enforce a system of central water supply

6 Liquid waste disposal

As per the data provided by Director of the north western province regional industrialization committee, the total water requirement (industrial and domestic) of the estate is expected to be 100 m^3/d Assuming a safety factor of 1 5 and waste generation factor of 0 85, total expected amount of liquid waste is calculated to be 130 m^3/d [3]

The following management options may be exercised for the purpose of adequately treating the generated liquid waste

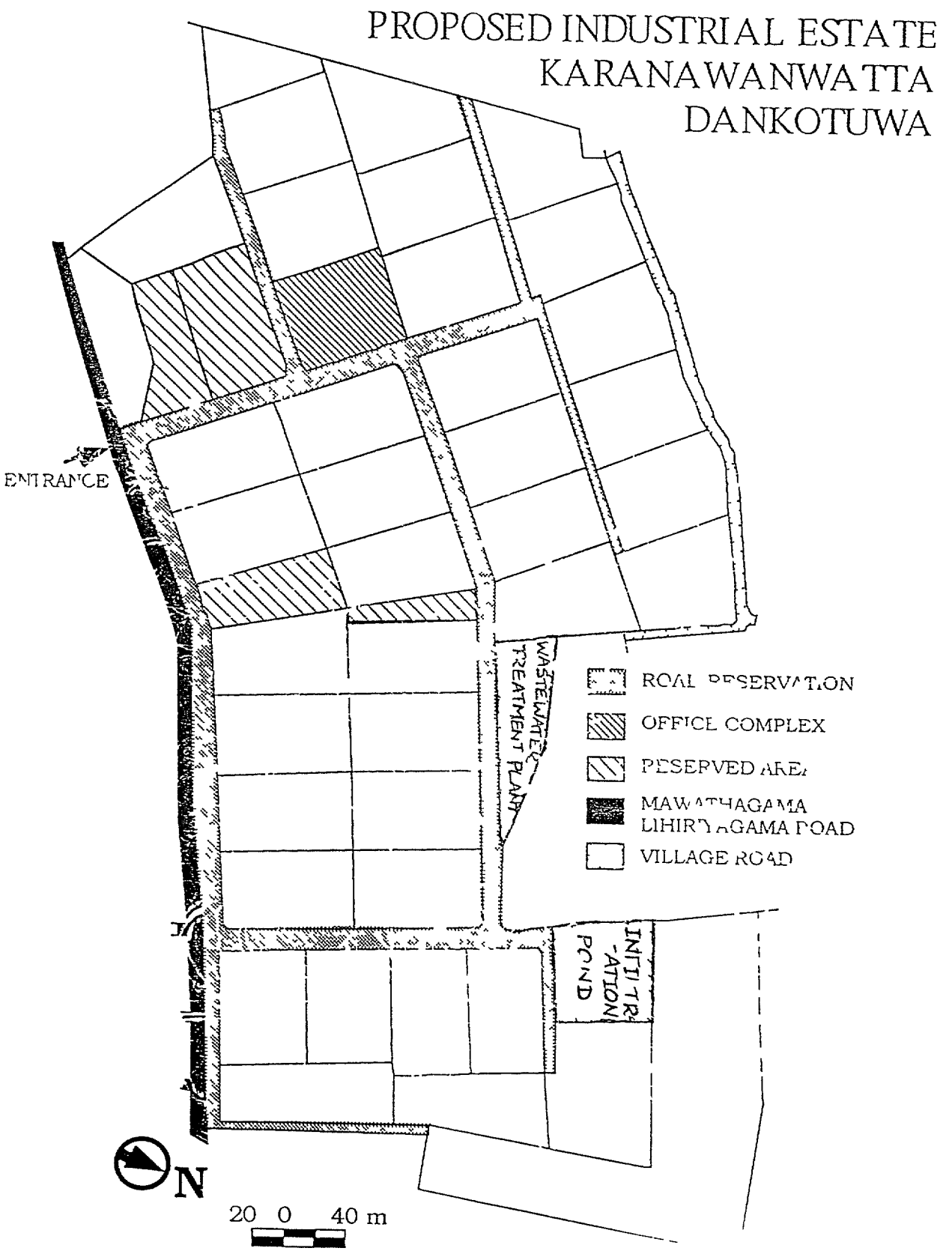
a) Treatment by individual units
b) Treatment via a central treatment facility
c) Treatment plant installed by the Honda meat processing unit can be utilized on a contractual basis, by the industrial units in the estate

On the basis of 'economies of scale', it is expected that options (b) and (c) will be superior to option (a) This is explained in section 6 3 below There is a precedence for scenario (c) in Sri Lanka (i e , a case in Wattala, where a treatment plant installed by Tan Lanka tannery, treats its own waste as well it's neighbouring Sultan tannery's waste) However this option may pose certain procedural problems vis-a-vis option (b) Potential complications include issues of accountability, responsibility for monitoring and control of the effluent stream, and mechanisms for collection of user fees These have to be foreseen and properly addressed through contractually binding agreements if this option is to be successful Economies of scale would dictate that option c) is preferred to option b), however the administrative and other procedural costs may outweigh these savings See Figure 6 1a and b for the proposed layout of the central treatment facility

The proposed treatment process is envisaged to provide a service upto a secondary treatment level The following processes are conceptually identified in order to provide a level of treatment, where the treated effluent would be of requisite quality to be disposed via land application (thru infiltration ponds) See Appendix A for required effluent quality for land disposal

[3] domestic waste to be collected in a sewerage system and transported to a central treatment unit

FIG 6 1a



LAYOUT OF CENTRAL TREATMENT FACULTY

FIG. 6.1b.
LAYOUT OF CENTRAL TREATMENT FACILITY

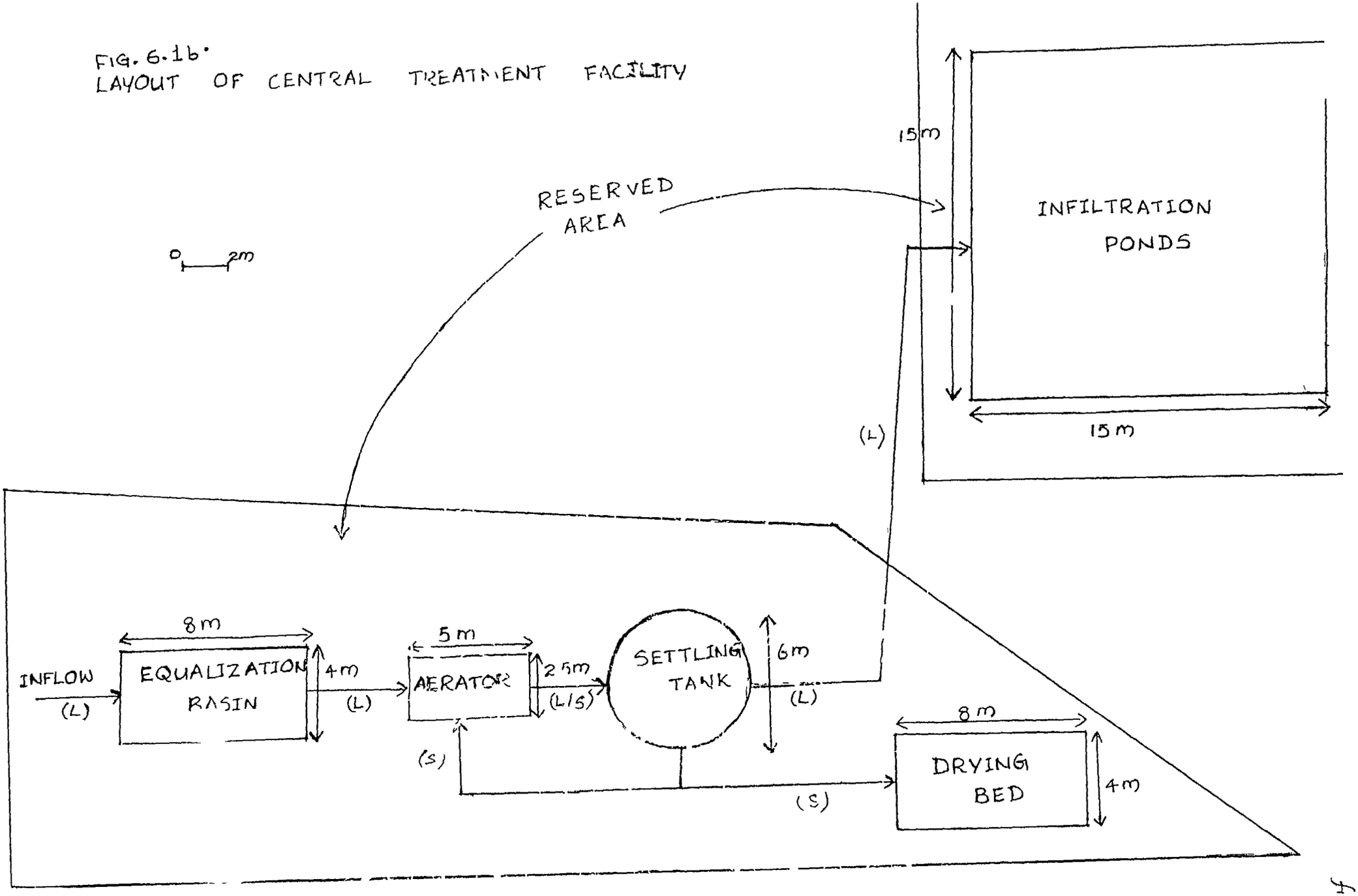


Fig 3b

TABLE 6 1 Proposed Treatment Processes

Treatment Process	Objectives
Equalization cum Primary Sedimentation Tank	Collection of industrial process and domestic type (kitchen/toilet) effluent Removal of settleable solids Producing a uniform quality of waste for the purpose of biological treatment
Biological Treatment Aeration Tank (Activated Sludge System)	Producing an aerobic environment for the growth of biological flocs in order to degrade organic contaminants
Biological Treatment Secondary Settling Tank	To separate biomass sludge from the liquid effluent
Final Collection Chamber	To apply disinfectant, such as bleaching powder etc A reservoir from which the effluent is sent to their final disposal destination - infiltration ponds
Sludge Drying Beds	To dry out wet sludge, thus reducing the volume of the sludge to be disposed Sludge can be used as a soil conditioner within the 'green belt'

6 1 Individual Unit Dimensions

The overall dimensions of the treatment units are based on certain values of design parameters assumed for the purpose of meeting the above mentioned objectives Specific assumptions made and detailed calculations are given in Appendix B

TABLE 6 2 Recommended Dimensions for Treatment Units

Treatment Unit	Recommended Dimensions
Equalization Basin	8 m x 4 m x 2 m (liquid depth)
Biological Treatment Unit (activated sludge system)	
Aeration Unit	5 m x 2 5 m x 2 m (liquid depth)
Settling Unit	6 m (dia) x 2 m (liquid depth)
Sludge Drying Bed	8 m x 4 m (dimension of individual cells 2 m x 1 m)
Final Collection Chamber	2 m x 1 5 m x 1 m (liquid depth)

6 2 Effluent Disposal

It is proposed that the treated effluent be disposed via land application (thro' infiltration ponds) Details pertaining to the required amount of surface area of the infiltration pond for treated effluent is given below

The site for land disposal of treated waste water needs to be determined and detail soil permeability parameter tests at the specific location should be performed to determine the dimensions of the soakage pit Table 2 indicates the approximate dimensions for various water load and soil saturated conductivity These values are based on a mass balance infiltration modeling using a one hour time step It should be noted that surface area of a given pit should not be changed providing additional depths unless supported by specific modeling to ensure satisfactory performance Also the suggested dimensions are for 365 working days a year and that no water loads are sent to the pit during night time

Table 6 3 Minimum Infiltration Pond Dimensions[4] for Waste Water Load and Soil Permeability

Q m3/day	Saturated Conductivity 1 7 cm/hr	Saturated Conductivity 2 0 cm/hr	Saturated Conductivity 3 0 cm/hr
100	L=17, W=15 D=0 20	L=15, W=14 D=0 24	L=14, W=10 D=0 35
200	L=25, W=20 D=0 20	L=21, W=20 D=0 24	L=19, W=15 D=0 35
300	L=30, W=25 D=0 20	L=25, W=25 D=0 24	L=21, W=20 D=0 35

6 3 Economic aspects of effluent disposal

As pointed out in the previous section with regard to water supply options, a significant economic advantage of an industrial estate is the ability to capitalize on 'economies of scale' Disposal of liquid waste is also an area where such economies of scale can be exploited

Three different options for treating liquid waste were presented in section 6 1 above Option a) involves substantially higher costs than option b) or c), as shown by the following comparison of costs For purpose of cost comparisons, option b) and c) are similar therefore only option a) and b) are compared here

Several industrial units that have been approved at the estate would generate process waste water that would have to be treated prior to discharge These include industrial

[4] Note all Dimensions are in meters

units producing fish nets and processed foods Production of terra cotta could also generate effluent that does not conform with established standards for discharge of industial waste water[5] In addition all industrial units will generate varying quantities of 'grey' water -- waste water generated by employees at the plant

Waste water treatment plants for individual industrial units (of the scale proposed at this estate) would cost between Rs 3 to 6 million On the other hand a central treatment plant with an estimated capacity of 150 m^3/day -- large enough to handle the total industrial and 'grey' waste water from all industrial units in the estate -- would cost approximately Rs 8 to 12 mn Some industrial units that discharge process waste water may have to install pre-treatment facilities to remove certain pollutants before the waste water is treated in the central treatment plant Such pre-treatment plants would cost between Rs 250,000 and Rs 1 mn Therefore, a central waste water treatment plant is more cost effective, if there are any more that two or three industrial units that generate process waste water

If a central treatment plant is constructed, many more 'polluting' industries could be accommodated at the estate Operating costs would also decrease (upto a certain level) with an increase in the number of industrial units using the central treatment plant Furthermore, most (if not all) industries can connect to the central treatment plant to discharge their 'grey' water The economic justification for a central waste water treatment plant is clearly evident even from this preliminary assessment

7 Solid Waste Disposal

Following recommendations are made with respect to the solid waste generated within the estate

i) Industries generating process solid waste are responsible for the disposal of the said solid waste

Industries such as coir-fibre, plastic, and tyre retreading etc have numerous recycling options (e g RDA is looking for buffing waste from tyre retreading process as a constituent for their bitumen carpet mix) These industries can possibly incorporate 'bag filters' for trapping these particulate emissions for the purpose of recycling (Tokyo Cement at Trincomalee have installed bag filters to collect cement dust emissions which is in fact is a component of their product - cement)

ii) Garden and kitchen waste can be either -

* removed by the town council

or

* used in the animal farm (run by the Honda meat people) as food for their animals

or

[5] Standards for discharge of industrial process waste water on land is given in Annex A The standards for discharge into inland surface water bodies is more stringent

28

* composted by the industrial estate management agency and used as soil conditioner for the green belt area

iii) Office waste (paper, plastics etc) to be disposed by the factory units themselves (e g by contracting a cleaning/janitorial agency)

7 Other issues

7 1 Cape Internationals (fish net dyeing) & Naleen Industries (fibre dyeing)

Effluent containing dye waste (colour causing substance) should be pre-treated for the purpose of removing bio-refractory chemicals It is recommended that a horizontal flow filter containing gravel and granular carbon layers (see Fig 7 1) in series be used as the pre-treatment facility before sending the effluent to the central treatment plant

flow = 20 m^3/d, T = 6 hrs

==> Volume = 20 m^3/d x d/24 hrs x 6 hrs = 5 m^3

Hence use a horizontal flow pre filter with the following dimensions
3 m x 1 5 m x 1 m (liquid depth)

7 2 Singular Agencies (polyurethene foaming)

Since polyurethene foaming using polyol and isocyanide produces hazardous air pollutants, following options may be considered by the project proponent

i) A relatively new foaming technology using liquid CO_2 can be pursued Initial investment in this case can be comparatively high Adapting this technology would be advantageous if the project proponents are hoping to target the export market in the future considering the oncoming environmental quality systems (ISO 14000) and 'non-tariff' barriers to the western market

ii) In the event of proceeding with the polyol/isocyanide technology, following precautionary measures should be adapted

a) Personnel working within the foam manufacturing chamber should observe basic occupational safety procedures, such as wearing gas masks, protective clothing etc

b) Adequate ventilation should be provided within the foam manufacturing chamber

c) Gas treatment for the removal/destruction of cyanide compounds should be implemented Catalytic oxidation process may be a feasible mechanism for cyanide destruction as shown on the following page

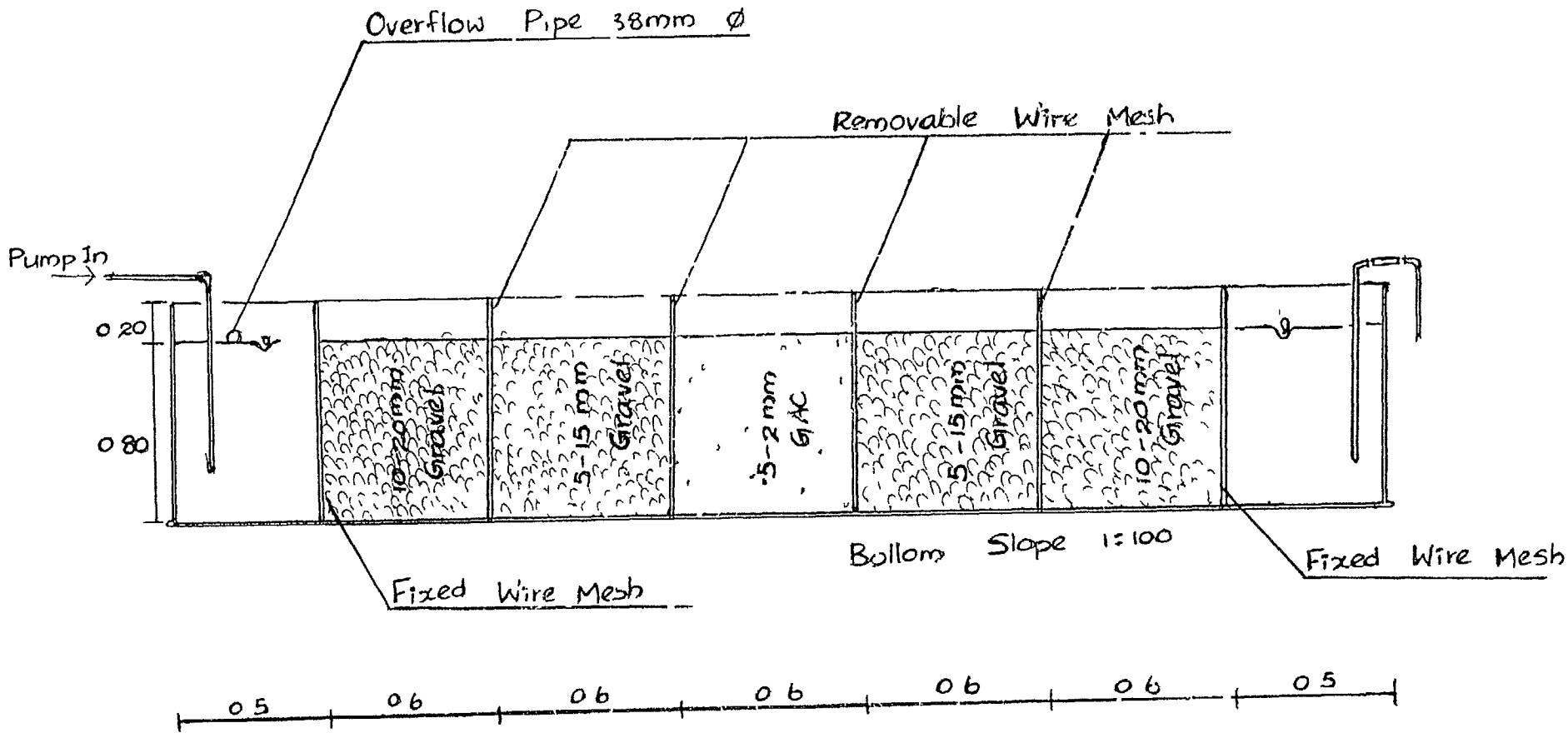


FIG 7.1 SCHEMATIC DIAGRAM OF HORIZONTAL FLOW FILTER

ALKALINE CHLORINATION PROCESS

$CN^- + Cl_2$ -----> $CNCl + Cl$

$CNCl + 2\ NaOH$ -----> $NaCNO + NaCl + H_2O$

$2\ NaCNO + 4NaOH + 3Cl_2$ -----> $2CO_2 + 6NaCl + N_2 + 2H_2O$
Chlorine demand = 6 82 g Cl_2 per g CN^- destroyed

See section 1 1 for green belt requirement

7 3 RL Enterprises (animal feed)

It is expected that RL enterprises would have an extremely synergistic relationship with the Honda meat factory Solid waste produced by meat producing activities would become the raw material for the animal food processing activity

Furthermore,liquid waste arising out of animal food processing being highly biodegradable, can be combined with the liquid waste arising out of meat processing for treatment purposes Additionally, the animal food processing unit would have a ready buyer of their products within the meat processing group

The only set back within this extremely synergistic relationship would be the obnoxious smell that can emanate from the animal food processing unit and may pose hygiene related problems to the food processing unit It is expected that the green belt requirements specified in section 1 1 would reduce or hopefully eliminate this problem

7 4 Salruk Ceramics (terra cotta ornaments)

High salt (Na^-) and turbidity (due to clay) content of the effluent would make it unsuitable for land disposal Hence it is recommended that a 'baffle' type flocculation unit be installed to remove turbidity causing particles as well as the in-organic ions The process flow scheme is given in Fig 7 2

flow rate = 10 m^3/d
retention = 25 mins

Recommended dimensions 1 m x 0 5 m x 0 5 m

Required chemicals Alum (0 5%) - flocculent, Lime (0 1 N) - pH adjustment

7 5 Wine Bottling Industry

Since the bottling process uses caustic (NaOH) to wash spent bottles, the effluent coming from this process has to be neutralized (by acid) before being sent to the central treatment plant

7 6 Dust Generating Industries

Air pollution control and recycling options may be pursued See section 6 for details

8 Recommended industrial estate management strategy

Sound and efficient management is critical to ensure effective functioning of the industrial estate All activities with regard to developing the industrial estate have been solely undertaken by the RISC of the NWP These include funding and facilitating infrastructure development, identifying and screening of industries, and obtaining all necessary permits and clearences The RISC has thereby accomplished a very significant project and done so with remarkable efficiency

Once the industrial estate begins to function, a very different set of management related responsibilities will need to be addressed These include

1 managing, operating and maintaining the common services and facilities,
2 facilitating administrative matters pertaining to the estate as a whole,
3 facilitating conflicts and other matters that arise between firms within the estate

It is recommended that a management unit be formed to undertake the above responsibilities This should be an independant unit consisting of a staff selected by the industrial firms within the estate The Unit will liase directly with the RISC as well as other regulatory and administrative agencies such as the NWPEA, DS office, and local authorities

The Management unit will be responsible managing, operating and maintaining the following infrastructure facilities and services

Infrastructure facilities

internal roads	drainage
water supply	telecommunication
electricity	sewer and wastewater
solid waste	fences and security lighting

Services

- security
- fire fighting
- administrative (issuace of EPLs, and other permits)
- maintaining and upkeep of buffer zones and other common areas

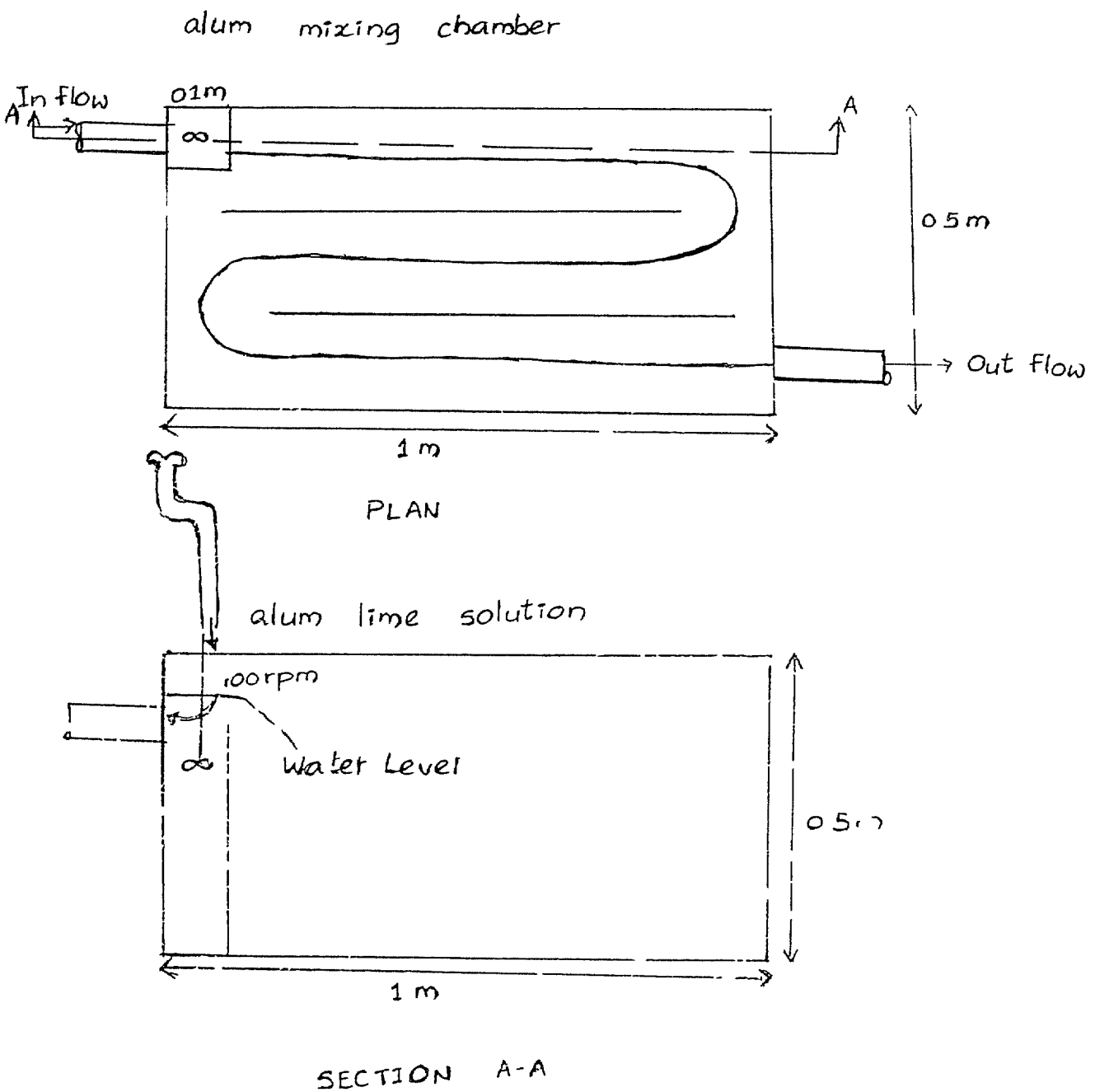


FIG 7.2 SCHEMATIC DIAGRAM OF FLOCCULATION CHAMBER

postal, banking, canteen and other services
waste management
waste monitoring

The management unit may find it difficult to undertake all of the above responsibilities Most of the above services could be subcontracted, with the management unit serving as the administrative unit This method of management is currently practices at the LINDEL industrial estate, and seems to work effectively

The precise organization of the management unit must be discussed more thoroughly, especially since the M/ID proposes to establish several other industrial estates as well It is recommended that this topic is be addressed through a series of discussions and a workshop where the views of many relevant individuals can be obtained

APPENDIX - A

TOLERANCE LIMITS FOR INDUSTRIAL EFFLUENTS DISCHARGED ON LAND
(The Gazette Extraordinary Of the Democratic Socialist Republic of Sri Lanka, February 02, 1990)

DETERMINANT	TOLERANCE LIMIT
Total dissolved solids, mg/l, max	2100
pH at ambient temperature	5 5 - 9 0
Biochemical oxygen demand in 5 days at 20 deg C, mg/l, max	250
Oil & Grease, mg/l, max	10
Chlorides, mg/l, max	600
Sulfates, mg/l, max	1000
Boron, mg/l, max	2
Arsenic, mg/l, max	0 2
Cadmium, mg/l, max	2
Chromium, mg/l max	1
Lead, mg/l, max	1
Mercury, mg/l max	0 01
Sodium absorption ratio	10 - 15
Residual sodium carbonate, mol/l, max	2 5
Radio active material (a) Alpha emitters uC/ml (b) Beta emitters uC/ml	 10^{9} 10^{9}

35

APPENDIX B
DIMENSIONS OF WASTE TREATMENT FACILITIES

EQUALIZATION BASIN

flow rate = 130 m^3/d

assumed retention time = 12 hrs

==> Volume = 130 m^3/d x 1/2 d = 65 m^3

assuming a liquid depth of 2 m,

recommended dimension 8 m x 4 m x 2 m (liquid depth)

BIOLOGICAL TREATMENT UNIT

Aeration Unit

assumed retention time = 4 hrs

==> Volume = 130 m^3/d x 1/6 d = 22 m^3

recommended dimension 5 m x 2 5 m x 2 m (liquid depth)

SETTLING UNIT

assuming a surface loading of 5 $m^3/m^2/d$

==> Required plan area = 130/5 = 26 m^2

==> Diameter of 2nd settling tank = $[4 \times 26/PI]^{1/2}$ = 6 m

recommended dimension 6 m (dia) x 2 m (liquid depth)

SLUDGE DRYING BED

estimated sludge production rate

= 130 m^3/d x 10^3 l/m^3 x 1000 mg COD/l x 10^{-6} kg COD/mg COD x 0 3 kg VSS/kg COD

= 39 kg VSS/d

==> Sludge produced per month = 39 kg VSS/d x 28 days = 1100 kg VSS

assuming a sludge density of 1 1 g/cc (1 1 x 10^3 kg/m^3)

==> Volume of sludge produced = 1100/(1 1 x 10^3) = 1 m^3

assuming a sludge layer of depth 5 cm,

==> Required area for drying bed = 1 m^3/0 05 m = 20 m^2 (say 30 m^2)

recommended dimension 8 m x 4 m

(dimension of individual cells 2 m x 1 m)

FINAL COLLECTION CHAMBER

assumed retention = 1/2 hr

==> Volume = 130 m^3/d x 1/48 d = 3 m^3

recommended dimension 2 m x 1 5 m x 1 m (liquid depth)