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SI/SOL/90/801 J12103

October 1990

Original: English

Ranadi Industrial Estate Rehabilitation and Henderson Industrial Estate Development Study

Engineering Aspects

Honiara
Guadalcanal Province
Solomon Islands

Technical Report

Prepared for the Government of Solomon Islands by the United Nations Industrial Development Organisation acting as executing agency for the United Nations Development Programme.

Based on the work of Murray North (SI) Ltd. Engineering Consultant.

United Nations Industrial Development Organisation Vienna.

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EXPLANATORY NOTES

Currency Equivalents

In this report the symbol $ refers to Solomon Islands Dollars. The UN operational rate of exchange for the period August - October 1990 was:

SI $	=	US $ 0.3997
US $	=	SI $ 2.50

ABBREVIATIONS

a.s.l	above sea level
Ha	Hectares
KPa	Kilopascals
KVA	Kilovolt amperes
m	metres
m3	Cubic metres
MAL	Ministry of Agriculture and Lands
MTWU	Ministry of Transport Works and Utilities
mm	millimetres
PVC	Polyvinyl chloride
SI	Solomon Islands
SIEA	Solomon Islands Electricity Authority
SIG	Solomon Islands Government
SOPAC	South Pacific Applied Geoscience Commission

Abstract

Ranadi Industrial Estate Rehabilitation and Henderson Industrial Estate Development Study SI/SOI/90/801 J12103.

The purpose of this Report is to enable the Solomon Islands Government to prepare requisite plans and other documentation to justify the rehabilitation of the Ranadi Industrial Estate and planning/development of the Henderson Industrial Estate for getting a loan agreement with the Asian Development Bank.

The duration of the study was from 20 August to 26 October 1990.

Main Conclusions and Recommendations

The existing infrastructure services at Ranadi Industrial Estate are sub-standard and there has been a need for some considerable time to upgrade them. The upgrading proposals are contained in Section II.B. of this report and it is recommended that these be carried out accordingly.

The removal of sand from the foreshore at Ranadi Industrial Estate is probably a significant factor in the continuing erosion and it is recommended that sand removal be stopped forthwith.

There will be a need for industrial land near Henderson Airport as the use of the airport increases. The proposed Henderson Industrial Estate is a suitable location to accomodate both airport related uses and general industrial uses. It is recommended that the infrastructure development proposals contained in Section III B be carried out.

The methods of sewage treatment and disposal for both Ranadi and Henderson Industrial Estates should be seen as medium term solutions. There is a need for studies to be carried out to determine sewage treatment and disposal system for Honiara so that land for the former can be secured now.

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I

INTRODUCTION

This Study is conerned with the rehabilitation of the engineering infrastructure of the established 70 ha Industrial Estate at Ranadi including roading, stormwater drainage, sewerage, power and telephone improvements and the development of a new 25 ha Industrial Estate near Henderson Airport.

The report has been prepared by Murray North (SI) Ltd, Consulting Engineers and was prepared in conjunction with work carried out by Mr H C Perkins Planning Consultant.

The report has been prepared to enable the Solomon Islands Government to prepare requisite plans and other documentation to justify the rehabilitation of the Ranadi Industrial Estate and the planning/development of the Henderson Industrial Estate for getting a loan agreement with the Asian Development Bank.

The study commenced on 20 August and was completed on 26 October 1990.

Scope of the Consultancy.

(A) Engineering Services and Topographical Survey for Henderson Area:

(1) Carry out the field work involving:

(i) review of available information/documents and discuss the overall status of the proposed estate;

(ii) survey the planned site for the Henderson Industrial Estate and carry out subsoil test on the spot;

(iii) prepare sewerage and drainage design for the site and cost estimates.

(2) Prepare a subdivision plan of the Henderson Industrial Estate incorporating the land needed for the proposed new intended terminal and the main road realignment options.

(3) Prepare a final report for the submission to the Government through UNIDO.

(B) Enineering services and cost estimation for Ranadi Industrial Estate Rehabilitation.

(1) Provide preliminary design and cost estimates for the upgrading of the supportive infrastructural services, such as

(i) upgrade and realignment of existing roads;

(ii) sewerage disposal;

(iii) drainage requirements (provision of storm water drainage)

(iv) water supply

(v) provision of required electricity and telephone lines;

(vi) flood protection measures;

(vii) factory housing and other building costs.

The main activities carried out during the course of the study included;

<u>Ranadi Industrial Estate</u>

- Site visits to determine the extent of the existing services and the need to extend those services.
- Inspection and utilisation of MAL topographical survey data for the estate.
- Inspection of the SIG plan records of services where available.
- Consultation with MTWU and other Government officers, particularly the Water Unit Director, and the power and telephone service authority officers.
- Review of previous studies.
- Definition of the extent of services extensions needed.
- Development of standards preliminary design of the infrastructure and preparation of estimates for the rehabilitation of the Estate.
- Review factory building costs.
- Preparation of the report and plans.

Henderson Industrial Estate

- Carry out of a topographical survey and the preparation of a contour plan.

- Preparation of a subdivisional concept plan, after reviewing proposals available for a new Airport terminal and determining that these did not impinge on the Estate area.

- Brief consultation on site with an Australian Army representative concerning World War 2 ordinance disposal.

- Consultation with SIG officers.

- Inspection of SIG plan records of existing services outside the site.

- Review of previous studies.

- Carrying out of a series of dynamic cone penetrometer tests on site.

- Development of standards preliminary design of the infrastructure and preparation of estimates for the construction of the estate.

- Preparation of report and plans.

In addition to the above Murray North Staff attended three meetings called by the Physical Planning Division of MAL to discuss progress on the study.

II

RANADI INDUSTRIAL ESTATE

A Site description

1. Introduction

The Ranadi Industrial Estate is located on Kukum Highway approximately 6 km to the east of Point Cruz in central Honiara. It was developed approximately 12 years ago and is partially serviced, those services being provided on an ad hoc basis as demand required. The area of surveyed sites within the estate is approximately 47 Ha with other land within the 70 Ha boundary also being suitable for subdivision. There is an existing refuse disposal tip on the north eastern corner of the estate.

2. Topography

The site is formed from a sand and gravel beach ridge system fronted by a low or non-existent dune. It has a low elevation generally sloping towards the sea with the higher parts of the site in the southwest and southeast corners being around 4m a.s.l. While the estate is reasonably flat there are local variations of up to 1.5m in elevation in the centre of the site. The site is bounded in the south by the Kukum Highway and the Golf Course, in the east by Kombito Creek, and in the west by the Marine School of the Solomon Island College of Higher Education.

3. Roading

The estate has 4384m of existing road all unsealed (with one minor exception) and either surfaced with river run gravel or coronus. There is no comprehensive road stormwater drainage system and as a consequence there is significant potholing and in one instance a complete collapse of the carriageway. There is no regular maintenance grading. Ranadi Cresc has been sealed previously but due to inadequate maintenance has mostly reverted to a gravel surface except for a 230m length on its southern leg. Ranadi Road needs realigning for a 950m length to shift it away from the beach, and site it adjacent to the parcels it serves. Plan No.1 shows the existing roading and Annex No.1 summarises the reserves widths, individual road lengths, and present surfacing. Road No.4 is partially formed and Road No.6 unformed.

4. Services

4.1 Water

The estate is partially reticulated with water. The supply comes from a 225mm dia PVC main laid on the sourthern side of Kukum Highway. There is a 75mm dia PVC main serving the western end, (Ranadi Cresc), Ranadi Road and the northern end of Road No.2 while the eastern end and part of Road No.1 are served by a 100mm dia PVC main. There is no connection between the 75 and 100mm dia mains. Likewise Ranadi Cresc has no connecting ring main. There are few isolating valves and no fire hydrants within the estate. There are no water mains laid in Roads No.3,4 most of No.5 or 6. Plan No.2 shows the existing water mains. The only treatment the water supply receives is chloriration.

The source of the water supply is the Panatina Tanks fed from bores. These are located 700m from the Estate to the Soutwest. There are plans afoot tc augment bore source.

4.2 Power

The estate is mostly served by 1100 volt overhead power lines with the exception of a short 270m section of Ranadi Road, Roads Nos 3,4 and 6. There are two existing platform pole mounted transformers one in each of Road Nos 1 and 2 and a ground level transformer in Ranadi Road at its southern intersection with Ranadi Cresc. Plan No.3 shows these services.

4.3 Sewerage

Two areas of the estate are served by reticulated sewerage. All the properties in Ranadi Cresc are reticulated with a 150mm dia pipe located immediately adjacent to the parcel frontage. This sewer discharges untreated sewage onto the foreshore just below high water adjacent to parcels 233/237. There is clear evidence of sewage washing back onto the beach. The other area served is at the eastern end of the estate where use is made (by the soap factory) of a 150m dia sewer serving King George VI School which is located outside the estate on the southern side of Kukum Highway. This sewer also discharges untreated sewage onto the foreshore, at high water level adjacent to Parcel 185. All other properties are served by septic tanks with effluent discharge through soakholes. Plan No.4 shows the existing sewers. Both discharge pipelines appear to have suffered break back as a result of foreshore erosion. A pre 1976 survey shows the end of the western discharge point some 35m seaward of its present position.

4.4 Stormwater

There is no effective stormwater system serving the estate. Water from the eastern end of Road No.1 has in the past discharged into a low area adjacent but as the land has been developed this depression has been filled in to the extent that there is no drainage for a large area of the road. It is fortunate that the nature of the soils of the estate are freely draining hence the industrial users can just live with the problem at present.

5. Geotechnical

There is no geotechnical data available but Honiara experience indicates that normal design bearing capacities can be allowed for building foundation design with each site being considered on its merits.

6. Sand and Gravel Extraction

Sand and gravel extraction has been taking place from the foreshore for in excess of 14 years and is currently being carried out under licence on parcel 2 along a 100m sea frontage. It is also being carried out along another 230m of coast line immediately to the west of parcel 2. While not suggesting that the author has the expertise to quantify the effects of this extraction, never-the-less it is considered that this not only exposes the estate to inundation from the sea particularly during cyclones but is also a major factor in the significant erosion that has occurred over the period of extraction. Clearly the sand and gravel extraction should be stopped now.

7. Flooding and Coastal Erosion

7.1 Flooding

There is no definitive information available concerning flooding in the estate. The most recent serious flooding event on Guadalcanal was as a result of 'Cyclone Namu' in May 1986. The rainfall which accompained this cyclone has been estimated at a frequency of 'probably 50 years', (5). In report (6) an assignment is made of the flood hazard (based on cyclone Namu) in the Lungga River delta area and apart from a small area at the eastern end the estate is considered to be 'safe'. In discussion with some of the occupiers of the land at Ranadi concerning flooding during Namu the main concern was the effect of wind driven waves. This is not to say that some of the lower lying properties weren't effected by flooding.

7.2 Coastal Erosion

A very comprehensive topographical survey of Ranadi was carried out by Lands and Survey pre-1976. Unfortunately Lands is unable to give the date of this Survey, which was done before Road Nos 1-5 were constructed. A plot of the High Water mark from this Survey on to the Lands 1:2500 topographical maps indicates extensive coastal erosion at the eastern end of the estate of 30m plus varying to only a metre or two at the western end. A 'SOPAC' expert Mr Rick Gillie was in Honiara at the time this study commenced and his considered opinion is that erosion has been taking place at about 1m per year. His formal report is to be presented later in 1990. In view of this erosion it is considered unwise that any further development take place between the coast and Road No.1.

B Proposed Rehabilitation and Upgrading

1. Roading

It is proposed that the following road upgrading work be carried out;

- All roads be reconstructed with a pavement of 200mm of compacted coronus, and that use be made of the existing carriageway where it is suitable.

- All roads be sealed with 1 or 2 coats of bitumen and chips as per the details in Annex 1.

- All roads have 1.5m wide shoulders and be drained by open water tables.

- A 950m length of Ranadi Road be resited adjacent to the parcels on its south side.

- Road No.6 be constructed using approximately 1m of coronus fill.

- Road No.4.A 70m length of road previously sold to the Honiara Gold Club be legalised to provde frontage to parcels 157-159.

- Existing seal in Ranadi Cresc to be retained.

The estimated cost of the road upgrading works including contingencies (10%) and survey design and observation fees (7.5%) is $ 477,500.

The estimates have been based on known roading contract rates in Honiara.

The unit rates for maintenance costs are shown in Annex 4.

2. Services

2.1 Water

The watermain upgrading proposals are shown on plan No.2 and are generally:

- Ranadi Cresc. Complete the ring using 165m of 75mm dia main and install hydrants on the existing and new main every 100m. Install one new isolating valve.

- Ranadi Road. Lay 1072m of 100mm dia main and abandon the 75mm and 50mm dia main laid on the north side of the road. Install 13 hydrants (10 on the new main and 3 on the existing). Install 4 isolating valves on the new main.

- Road No 2. Lay 385m of 100mm dia main, install 7 hydrants (4 on the new main and 3 on the existing). Install 2 isolating valves.

- Road No 1. Lay 223m of 100mm dia main, install 7 hydrants (2 and 5). Install one isolating valve.

- Road No 3. Lay 190m of 50mm dia main with one isolating valve.

- Road No 4. Lay 125m of 75mm dia main with one isolating valve.

- Road No 5. Lay 290m of 100mm dia main, 2 hydrants and 2 isolating valves.

- Road No 6. Lay 120m of 75mm dia main, 1 hydrant and 1 isolating valve.

The estimated cost of the water supply upgrading works including contingencies (10%) and design and observation fees (7%) is $259,000.

In preparation of the estimates, use has been made of a Ministry of Transport Works and Utilities (UN Cooperating Agency DTCD) report prepared in 1989, and the Noro Township contract rates.

2.2 Power

The power upgrading proposals have been prepared by the Distribution Engineer of the Solomon Islands Electricity Authority. They cover the installation of overhead aerial bundle conductor in Roads No 2,3 and 6 and the compeltion of the service in Ranadi Road. Provision is made for general upgrading and the installation of 3 additional 300 KVA, 11000/415 V transformers.

The estimated cost of the electrical upgrading including contingencies (10%) is $160,000.

The estimates were prepared by the SI Electricity Authority after consultation with the author.

2.3 Telephone

The telephone cabling proposals have been prepared by Solomon Islands Telekom. They cover the installation of underground ducts and cabling, joint chambers and distribution poles. The proposed reticulation is an extension of the existing reticulation system.

The estimated cost of the telephone supply proposals, including contingencies (10%) is $90,300.

The estimates were prepared by the Solomon Islands Telekom after consultation with the author.

2.4 Sewerage

The sewerage proposals are shown on Plan No 4. The existing sewers are left in place and the balance of the estate is served by gravity sewerage with the exception of 5 parcels fronting Kukum Highway at the eastern end. Two pump stations are needed although both would be relatively shallow. In report (3) Clause 5.3 (d) it was proposed that fine screening be carried out (for Honiara) as an interim measure. This proposal has been followed being the only form of treatment suggested. The effluent would then be discharged through a marine outfall discharging 100m offshore. Only detail design will show as to whether this has to be a pumped or gravity outfall. The latter has been included in the estimates. The existing eastern sewer is to be connected to a pump station while the soap factory can be connected to the new reticulation. The existing eastern shoreline outfall can be abandoned. The existing western outfall should be retained and extended to 100m offshore.

The proposals are aimed at improving sewer drainage for the estate with the knowledge that at some stage at Honiara Sewerage Master Plan must be implemented.

The estimated cost of the sewerage proposals is $1,573,000. In preparing the estimates use has been made of report (7), the Noro Township contract rates, and prices from a supplier of milliscreens. The costs include contingencies 10% and fees 8.5%.

2.5 Stormwater

It is proposed that stormwater drainage be mainly by open water table and drain, with road crossings and existing entrances (where necessary) being culverted. It will be necessary to construct up to 4 new outfalls to the sea and 1 to Kombito Creek. In the case of the former regular maintenance will be required to keep the outfalls clear as the sea will naturally rebuild the foredune across the opening. Detailed survey and design will be necessary to prove the proposals which are shown on Plan No.5.

The estimated cost of the stormwater drainage proposals is $154,400 which includes contingencies 10% and fees 7.5%. The estimates have been based on known contract costs in Honiara.

2.6 Maintenance

The unit rates for maintenance are shown in Annex 4.

3 Landfill

Report (5) mentions a low lying area of about 2 ha within the estate which requires filling but does not identify it. An inspection of the topographical survey mentioned under Section II A 7.2, Coastal Erosion indicates that this area is on the north side of Road No 1 between Road Nos 5 and 2, where levels are (or in some cases were) under elevation 1m. Development has started in this area with the occupiers providing their own filling. At this stage it is considered that the best policy is to allow occupiers to continue to do this.

4. Flood and Erosion Control Measures

4.1 Flooding

Since the Ranadi Estate is considered 'safe' from serious flooding the only measure considered necessary is to fix minimum floor levels for new buildings. A survey of existing floor levels should be carried out and as a result of this and data related to any flooding, a recommendation can be made to the Honiara Municipal Authority for minimum building floor levels. In dealing with flooding history it must be remembered that it may be as a result of the lack of a stormwater disposal system. The estimated cost of preparing a plan so that control can be exercised at building permit issue is $4000.

4.2 Erosion Control

Recommendations will depend upon the results in the report being prepared by SOPAC but in general terms there is little that can be done to stop coastal erosion except that in this case sand and gravel removal should be prohibited now. As an interim measure (and probably as a permanent measure) no further developemnt should be permitted on the north side of Ranadi.

5 Option for the Future Use of the Refuse Disposal Site

It has been recognised for some considerable time that the refuse tip in Ranadi Estate has a limited life: Recent reports (2) and (4) have attempted to indicate options for alternative sites. It is suffice to say that neither report identified an acceptable economical alternative site and much more work is required to do so. As to the future use of the area which has been used for tipping refuse it can be unequivocally said that it will never be suitable for building on because tipping has been uncontrolled and without compaction. The site can be made into an area suitable for passive recreation by levelling and then keeping control of the natural vegetation by mowing.

6 Factories for Rental

Towards the end of 1989 staff from the Ministry of Commerce and Primary Industries obtained quotations for the supply of prefabricated portal frame structures (20 x 12m) complete and ready for erection. The quotations came from the United Kingdom (2), Australia (1) and Solomon Islands (1). The lower prices for the buildings (with an allowance for 12 months inflation and exchange rate adjustment) averaged $67,200. To this must be added foundation and floor slab construction, provision of services and access to the site. A reasonable estimate for this sized building, without subdivision for separate occupancies, is $100,000.

7 Industrial Service Centre

A site for an "Industrial Service Centre" has been identified on the south side of Kukum Highways and to the west of the Ranadi Road intersection. Power, water, and telephone, services exist on Kukum Highway. Estimates have been prepared to cover the cost of a sealed parking area (1100m2) with kerb and channel, concrete footpath and access to the Highway. In addition since the intersection of Ranadi Road and Kukum Highway has no natural drainage the cost of providing stormwater drainage to this along with the service centre and the adjacent properties to the east has also been estimated. While the total stormwater drainage cost is included in the estimate the cost should be shared across those that benefit. It is proposed that 'on site' sewage treatment and disposal take place in view of the separation of the Service Centre from the Estate and the small amount of sewage that would be generated. The estimates are;

Parking Area	$ 75,620
Stormwater Drainage	$135,000

C Estimated Costs of Rehabilitation and Upgrading

Cost Estimates

Roading	$477,500	
Water	259,000	
Power	160,000	
Telephone	90,300	
Sewerage	1,573,000	
Stormwater Drainage	154,400	
Flood Control (Building Floor Levels)	4,000	
Landscaping, Coastal Frontage and Rubbish Tip Areas	10,000	$2,728,200
Factories for Rental (20 x 12m) $100,000 each		-
Industrial Service Centre		
Roading	75,620	
Stormwater Drainage	135,000	210,620
Total Excluding Rental Factories		$2,938,820

III HENDERSON INDUSTRIAL ESTATE

A Site Description

1 Introduction

The proposed Henderson Industrial Estate is situated on Henderson Road approximately 10km east of Honiara. The estate covers an area of 23 Ha and is located immediately to the north of and towards the western end of Henderson Airport. The northern boundary is adjacent to a proposed new road access to the Airport.

2. Topography

The site forms part of the greater Lungga River delta and is generally flat but has isolated sandstone outcrops forming low (up to 10m high) hills. The flat area has an elevation of approximately 8.0m above sea level. One of the hills located just to the north of the centre of the site is the dominant feature and covers about 25% of the area of the estate. This hill is the site of a WW2 tunnel with openings on the south and southwestern sides.

3. Roading

The estate is bounded by Henderson Road on it west and south boundaries. The road connects Honiara with the Guadalcanal Plains, has a sealed width of 8m and cuts across the south west corner of the estate.

4. Services

4.1 Water

The estate is not serviced by water at present, but a 100m dia water main is located on the southern side of Henderson Road along the southern boundary of the site. This main serves the airport.

The source of water is the Panatina tanks, fed from bores, which at present are not considered adequate to service the estate according to the Ministry of Transport Works and Supply Water Unit Director. There are plans to augment and upgrade the bore source.

4.2 Power

There is no power source on the estate at present. An 11KV overhead power line coming from Honiara, is located along the southern side of Henderson Road along the estate's southern boundary.

4.3 Telephone

There are existing underground telephone cables running along the western and southern sides of the estate, following Henderson Road. These cables cross over the south-west corner of the site.

4.4 Sewerage

There is no sewerage reticulation system in the vicinity of the site.

4.5 Stormwater

The site is currently drained by overland flow to the northeast. An open drain is located near the eastern boundary and discharges to the north. This drain serves Henderson Road and part of Henderson Airfield.

5. Geotechnical

In report (8), the site is described as having been formed from river sediments, overlying the calcareous sandstone of the Honiara Beds. The Lungga has cut chanels through this sandstone, leaving isolated surface outcrops as low hills, rising up to 10m above the reasonable flat sediment deposit plain. The sediments range in size from clays to gravels.

A series of dynamic cone penetrometer tests were carried out and in 50% of these no penetration was achieved further than 100mm below surface level. This is considered to be as a result of World War 2 activities on the estate where hard standings as a base for structures have been constructed. In the other 50% of the tests there was reasonable consistency in the results and the 'poorly consolidated' (8) sandstone outcrops and the flood plain deposits would provide an adequate bearing design capacity of 100KPa. From investigations at the nearby Lungga River Bridge site it was stated in report (9) that the liquification potential of the subsurface material is low. Each building site created should be considered on its merits.

6. Flooding

There is no definitive information available concerning flooding in the estate. The most recent serious flooding event on Guadalcanal was as a result of Cyclone Namu in May 1986. The rainfall which accompained this cyclone has been estimated at a frequency of "probably 50 years", (5). In report (6), an assessment is made of the flood hazard in the Lungga River delta area, based on Cyclone Namu and the majority of the estate is considered to be 'safe'. Since the land immediately to the north and east of the estate is classified as 'moderate probability of flooding', there is a need for a comprehensive investigation into the flooding potential before any extension of the 25 ha estate is contemplated.

The moderate probability classification means that these areas are likely to flood in a 50 year return period, and were flooded during cyclone Namu.

B Proposed Development

1. Earthworks

Reasonably extensive earthworks will be required to form sites suitable for industrial uses. The low hills will need to be cut down considerably, by up to 6m depth. This cut material should be spread over the site to depths of up to 1.0m, to improve the lots on the lower ground.

The estimated cost of the earthworks, including contingencies (10%) and survey, design and observation fees (7.5%) is $593,400.

The estimates have been based on known earthwork contract rates in the Solomon Islands.

2. Roading

Three new roads are proposed to be formed on the site. These are shown on Plan No.9. All will be constructed with pavements of 200mm thick coronus laid on a compacted subgrade, and will be sealed to 8.0m width with 2 coats of bitmen and chips.

The estimated cost of the new road construction, including contingencies (10%) and survey, design and observation fees (7.5%) is $152,300.

The estimates have been based on known roading contract rates in Honiara.

3. Services

3.1 Water

The watermain proposals are shown on plan No.10. These consist of 100mm dia mains laid along the 3 roads. The estate will be connected to the existing 100mm dia. watermain. Isolating valves and hydrants are to be installed as shown on the plan, the latter being at a maximum spacing of 100m.

The estimated cost of the water supply works, including contingencies (10%) and design and observation fee (7%) is $236,000.

Because of the current water supply problems, a contribution towards the cost of upgrading the existing water supply boreholes at Panatina will be necessary and an additional cost of $100,000 has been estimated for this.

In preparation of the estimates use has been made of a Ministry of Transport, Works and Utilities (UN Cooperating Agency DTCD) report prepared in 1989 and the Noro Township contract rates.

3.4 Power

The power supply proposals have been prepared by the Distribution Engineer of the Solomon Islands Electricity Authority. They cover the installation of overhead aerial bundle conductors and two 500 KVA transformers.

The estimated cost of the electrical supply proposals, including contingencies (10%) is $271,000.

The estimates were prepared by the SI Electricity Authority after consultation with the author.

3.3 Telephone

The telephone cabling proposals were prepared by Solomon Island Telekom. They cover the installation of underground ducts and cabling, joint chambers and distribution poles.

The estimated cost of the telephone supply proposals, including contingencies (10%) is $50,300.

The estimates were prepared by the Solomon Islands Telekom after consultation with the author.

3.4 Sewerage

The sewerage proposals are shown on Plan No.11.

Conventional on site treatment and disposal such as septic tanks, and effluent soakage are unlikely to be suitable because of the relatively high water table and probable existence of clays in the top 2 or 3m of the site (8). Consequently, a communal sewerage system has been proposed. Because of the relatively flat ground, three pump stations will be required to deliver the effluent to a treatment plant. One option for treatment is milliscreening and then pumping the effluent to the Lungga River. This is not an ideal solution and a detailed study of the polluting effects of effulent on the river would need to be undertaken before large volumes were discharged. Another option, and the preferred one, is to use oxidation ponds sited to the east of the estate which would treat sewage until an overall scheme was built for the development of the area north of Henderson Airfield.

The ponds proposed could then be abandoned. In siting the ponds cognisance would need to be taken of the fact that this form of treatment can give rise to offensive odours. Oxidation ponds have the advantage of low capital and operating costs, low maintenance requirements, and a high removal of faecal bacteria. The treated effluent can be discharged to the open drain on the eastern boundary of the estate.

3.5 Stormwater

The stormwater drainage proposals are shown on Plan No.9. It is proposed that stormwater drainage be mainly by open water table and drains, with road crossings and entrances to the lots being culverted. These drains will discharge into the existing open drain system which flows generally northwards into the Lungga Delta. These existing drains will require some cleaning out to remove debris and vegetation.

Tne estimated cost of the stormwater drainage proposals including contingencies (10%) and design and observation fees (7.5%) is $105,200. The estimates have been based on known contract costs in Honiara.

3.6 Maintenance

The unit rates for maintenance are shown in Annex 4.

4. Flooding Control Measures

The majority of the Henderson estate is considered 'safe' (6) from serious flooding. There is a need however to fix minimum floor levels as a precaution. Additional investigatory work is needed and the estimated cost of this and preparing a plan so that control can be exercised at building permit issue is $8,000.

C Estimated Costs of Development

At Annex 3 is a summary of the unit rates which were used to 'make up' the estimates set out below.

Cost Estimates		
Earthworks	$593,400	
Roading	152,300	
Water	336,000	
Power	271,000	
Telephone	50,300	
Sewerage	1,370,300	
Stormwater Drainage	105,200	
Flood Control (Building floor levels)	8,000	2,886,500

RANADI INDUSTRIAL ESTATE
SCHEDULE OF ROADS

Note Distances are from and to edge of proposed seal, and allows for realignment

Road name or Number	Reserve Width m	Parcels Serving	Length m	Comments on Existing Condition	Recommended surfacing Reconstruction	Proposed Carriageway	Estimated cost of Construction
Ranadi Road	25-72	Sol Air Freight - Coast	1488	Coronus, 950 to be realigned	2 coat seal	6m	$ 166,300
Road No 1	20	West-east centre of estate	918	Coronus, no drainage toward eastern end	2 coat seal	6m	$ 90,700
Road No 4	20	124 - 133	146	Consists of 2 wheel tracks	1 coat seal	4m	$ 9,300
Road 5	20	79 - 86, 54, 100 - 115	282	Narrow gravel	1 coat seal	4m	$ 20,900
Road No 3	22	157 - 162	202	Partly surfaced with coronus	1 coat seal	4m	$ 13,600
Ranadi Cresc	20	Western end of estate	602	230m sealed balance gravel	1 coat seal	4m	$ 35,200
Road No 2	30-32	Eastern end, Highway to Ranadi Road	746	Coronus	2 coat seal	6m	$ 88,300
Road No 6	15	177 - 183	115	Not formed, needs filling full length	1 coat seal	4m	$ 19,900
		Total	4499m		Upgrading cost	including contingencies	$ 444,200
					and fees Survey design observation	7.5%	$ 33,300
						Total Cost	$ 477,500

RANADI INDUSTRIAL ESTATE

COST ESTIMATES

SCHEDULE OF UNIT RATES $ SI

1. Roading

Clearing lineal metre		$ 4-10
Earthworks Cut to fill		$ 8/m3
Cut to Waste		$ 10/m3
Imported Fill		$ 15/m3
Bitumen Sealing one coat		$ 4-50/m2
two coats		$ 8-00/m2

2. Stormwater Drainage

Shallow Vee drains		$ 2-00 per metre
Open drains		$ 11-00/m
Outlet drains		$ 15-00/m
Culverts (local pipe)	600mm dia	$150/m
	914mm dia	$180/m
Imported corrugated steel culvert		1.2m dia $1670/m
		1.4m dia $1870/m
Culvert headwalls		$290 - 820 each
Property entrance culvert		$300 each

3. Watermains

50mm dia pipe	$ 35/metre
75mm dia pipel	$ 46/m
100mm dia pipe	$ 60/m
Isolating valves	$750 - 1500 each
Hydrants	$800 - 900 each

4. Sewerage

Gravity mains	150mm dia	$174/mm
	200mm dia	$301/mm
Pumping mains	100mm	$ 76/mm
Pump Stations		$52,000 - 61,000 each

Notes: 1. All rates include Preliminary and General.
2. Sewerage pipe rates include manholes.

ANNEX 3

HENDERSON INDUSTRIAL ESTATE

COST ESTIMATES

SCHEDULE OF UNIT RATES $ SI

1.	**Earthworks**		
	Clearing		$ 3000/hectare
	Strip Overburden and reinstate		$ 5/m3
	Cut to fill		$ 4.50/m3
2.	**Roading**		
	Shape and Trip subgrade		$ 0.5/m2
	Basecourse 9200mm)		$ 3/m2
	Bitumen Sealing (two coats)		$ 8/m2
3.	**Stormwater Drainage**		
	Shallow Vee Drains		$ 2/m
	Open Drains		$ 11/m
	Outlet drains		$ 15/m
	Culverts (local pipe)	600mm dia	$150/m
		914mm dia	$180/m
	Culvert headwalls	600mm dia	$290 each
		914mm dia	$600 each
	Property entrance culverts		$300 - $600 each
4.	**Watermains**		
	100mm dia pipe		$ 60/m
	Isclating valves		$1500 each
	Hudrants		$ 800 each
5.	**Sewerage**		
	Gravity mains (150mm dia)		$ 174/m
	Pumping mains (100mm dia)		$ 76/m
	Pump Stations		$52,000 - $61,000 each

Notes: 1. All rates include Preliminary and General.
2. Sewerage pipe rates include manholes.

ANNEX 4

MAINTENANCE OF ENGINEERING INFRASTRUCTURE

There are no costs locally available which are applicable to the maintenance of the engineering infrastructure of the Ranadi and Henderson Industrial Estates. The figures set out below have been derived from local data and from previous overseas experience.

The followig annual costs can be used as a guide;

Roading $2500 per kilometre (excludes resealing)

Resealing of carriageways (every 10 years) $4.50/m2

Stormwater Drainage 2% of capital cost

Water	1.5% of capital cost
Sewerage	3.0% of capital cost (this allows for the high cost of electricity for pumping)
Power	by SIEA out of its' charges
Telephone	by Solomon Telekom out of its charges

ANNEX 5

GOVERNMENT OFFICERS AND OTHERS

CONSULTED DURING THE STUDY

Ministry of Agriculture and Lands

1. Mr S. Likaveke, Chief Physical Planner, Physical Planning Division
2. Mr G. Scott, Principal Surveyor, Lands and Survey
3. Mr J Vaikota, Senior Supervisor, Land and Survey

Ministry of Commerce and Primary Industry

4. Mr A. Arafoa, Under Secretary (Technical)
5. Mr J. Allen, Chief Technical Advisor (UNDP)
6. Mr T. Makabo, Principal Industrial Officer Industrial Development Unit

Ministry of Transport Works and Utilities

7. Mr S. Maezama — Under Secretary (Works)
8. Mr D. Makini — Director Water Unit
9. Mr L. Kakai — Senior Works Officer Water Unit

Ministry of Natural Resources

10. Mr D. Tolia, Deputy Director Geology
11. Mr D. Depledge, Senior Water Resources Advisor, Water Resources Section
12. Mr R. Gillie, Coastal Geologist, South Pacific Applied Geoscience Commission, Suva

Ministry of Health and Medical Services

13. Mr R. Abrams, Public Health Engineer, World Health Organistion

Solomon Islands Electricity Authority

14. Mr M. Nation, Distribution Engineer

Solomon Telekom Co Ltd

15. Mr J. Gabriel, General Manager
16. Mr B. McCarthy, Manager Engineering

Industrialists - Ranadi

17. Mr P. Bradford — Island Enterprises
18. Mr J. Lee — Builder

Consultant Planner

19. Mr H. Perkins, temporarily attached to Physical Planning Division

ANNEX 6

PREVIOUS REPORTS REVIEWED

1. Tecn Econ Ltd: Solomon Islands Industrial Sites Development Study, Final Report: UNIDO September 1986, 133 pages.

2. Cameron McNamara Ltd: Honiara Town Refuse Disposal Study, Report on Sanitary Landfill Options: Honiara Town Council, February 1988, 32 pages plus appendices.

3. Wallis, Dr Ian G. Marine Outfall Studies, Assignment Report,Honiara and Gizo, World Health Organisation, 1989, 19 pages.

4. Ogawa, Dr. H, Advisory Services on Improvement of Solid Waste Management in Honiara, Assignment Report, World Health Organisation, 1990, 13 pages.

5. Carter, Ralf, Hurricane and Flooding Frequency in the Lungga Delta Area, CCOP/SOPAC, June 1986, 17 pages plus tables.

6. Trustrum, N.A, Whitehouse, I.E. and Blaschke P.M, Flood and Landslide Hazard Northern Guadalcanal Solomon Islands Department of Scientific and Industrial Research,N.Z., July 1989, 46 pages plus 5 maps.

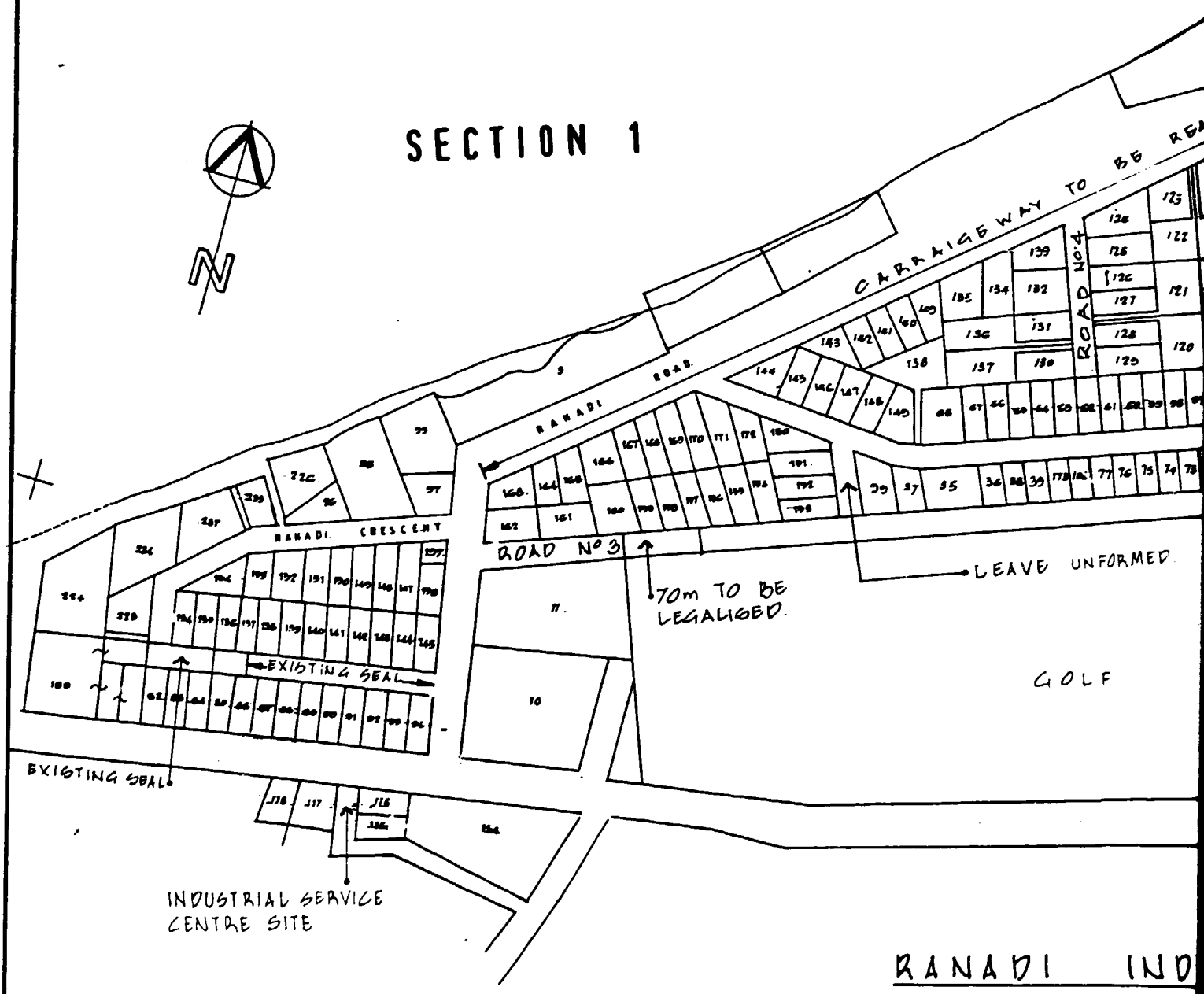
7. Balfours, Technical Assistance for Water Supply and Sanitation Project (Asian Development Bank) April 1986, 160 pages plus 5 drawings.

8. Ikioa, P and Depledge, D. Hydrogeological Study in Henderson Area, Ministry of Natural Resources, Solomon Islands, May 1990 8 pages plus 7 maps and tables.

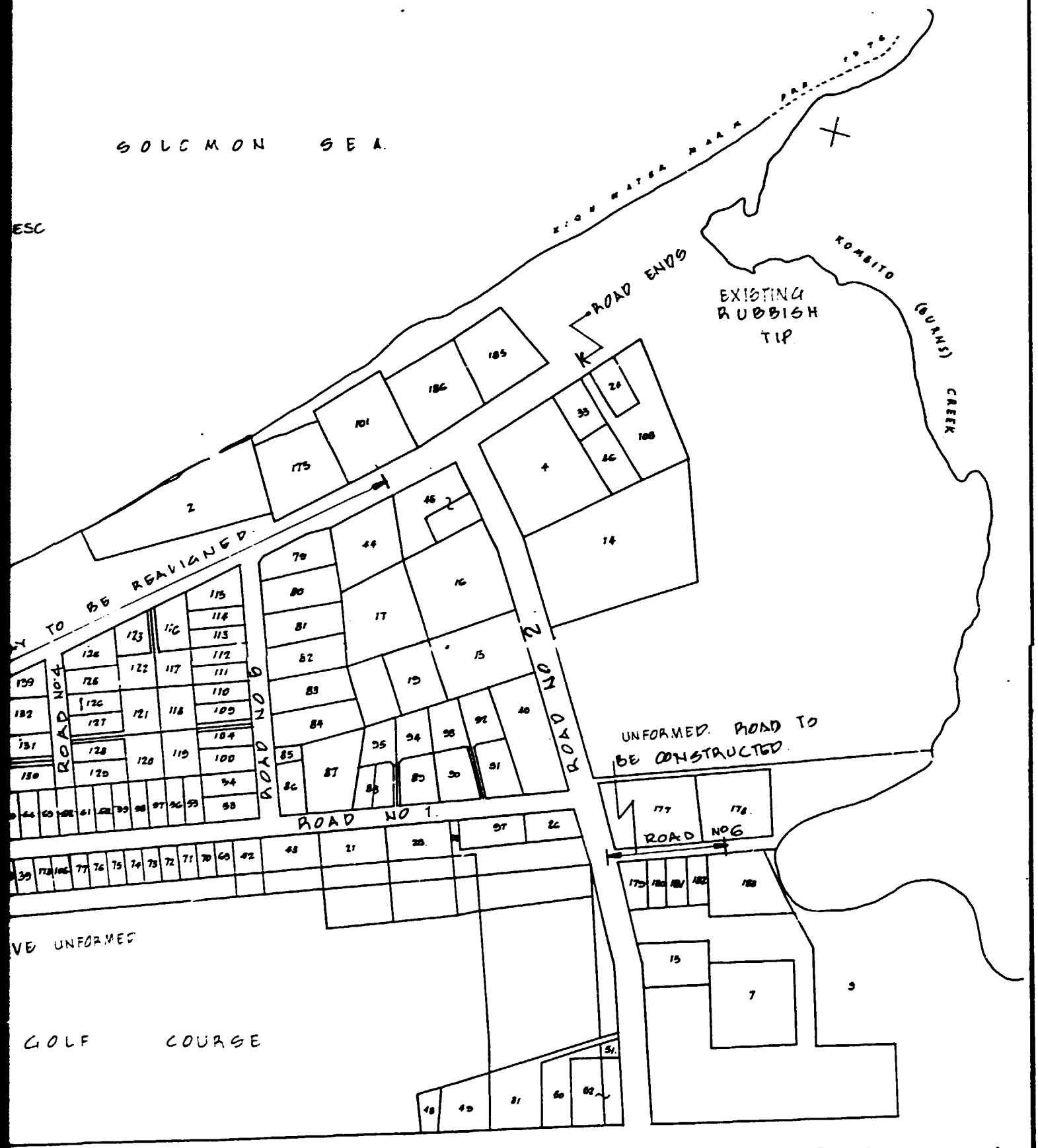
9. Japan International Co-operation Agency Basic Design Study on the Project for Reconstructing the Lungga Bridge in Solomon Islands, September 1989, 117 pages.

NOTES:

1. ALL ROADS HAVE AN EXISTING SURFACE OF GRAVEL OR CORDUUS EXCEPT FOR A 230m SECTION OF SEAL IN RANADI CRESC
2. ANNEX 1 SHOWS UPGRADING DETAILS
3. ALL ROADS TO BE SEALED.
4. PARCEL NUMBERS ARE SHOWN.



RANADI IND



PLAN NO 1.

SECTION 2

01 INDUSTRIAL ESTATE.

SCALE 1:5,000

drawing title: ROADING.

scale: 1 : 5000

drawing number: 6019781/1

rev.

SOLOMO

——— NEW WATER MAIN.

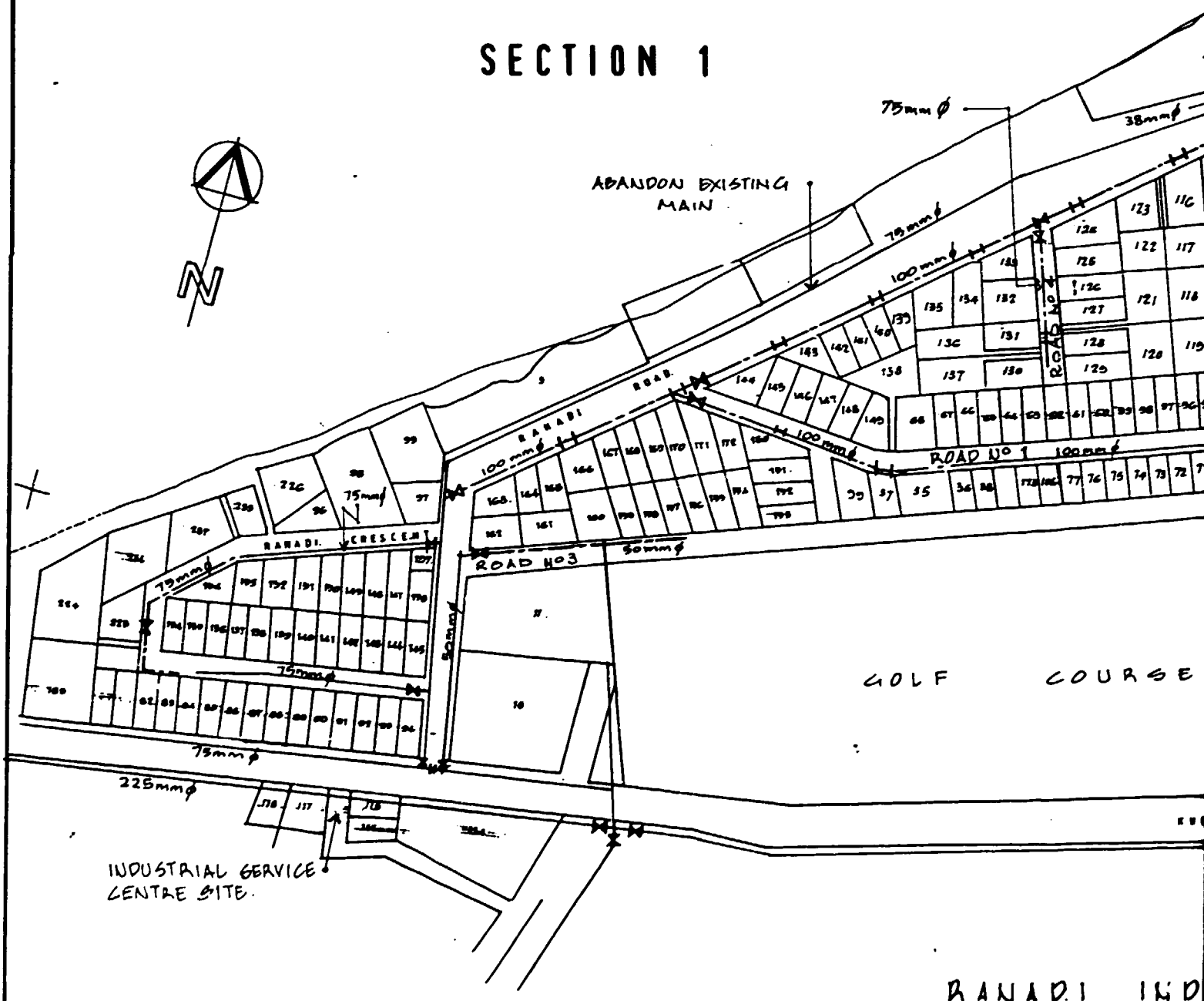
⊢ NEW HYDRANT

⋈ EXISTING ISOLATING VALVES.

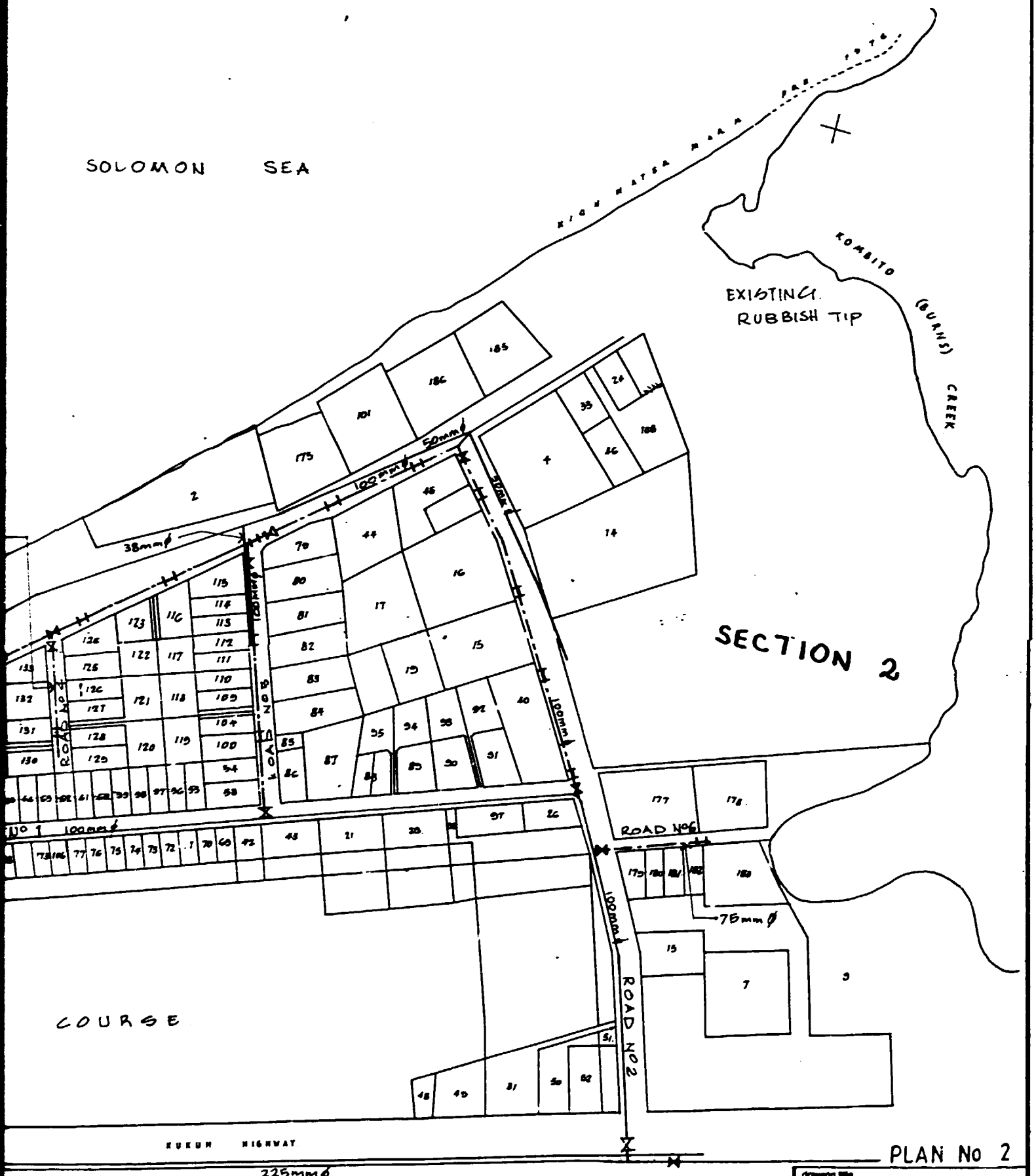
⋈ NEW ISOLATING VALVES.

NEW HYDRANTS ON EXISTING MAINS NOT SHOWN.

SECTION 1



RANADI IND



PLAN No 2

drawing title

WATER MAINS

scale 1 : 5000

drawing number 601978/2 rev.

NADI INDUSTRIAL ESTATE

SCALE 1:5,000

A1

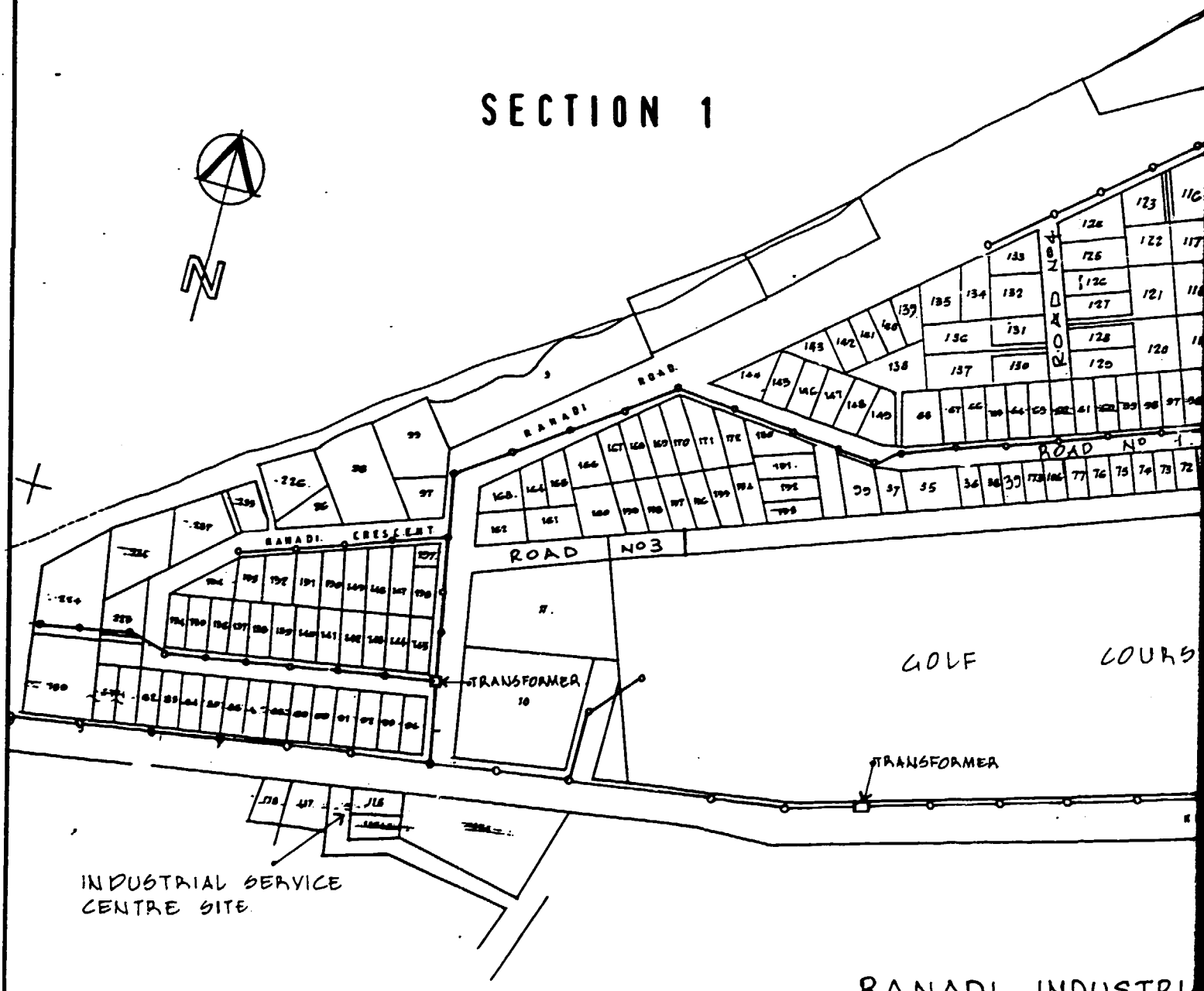
SO

O... ELECTRIC POLES

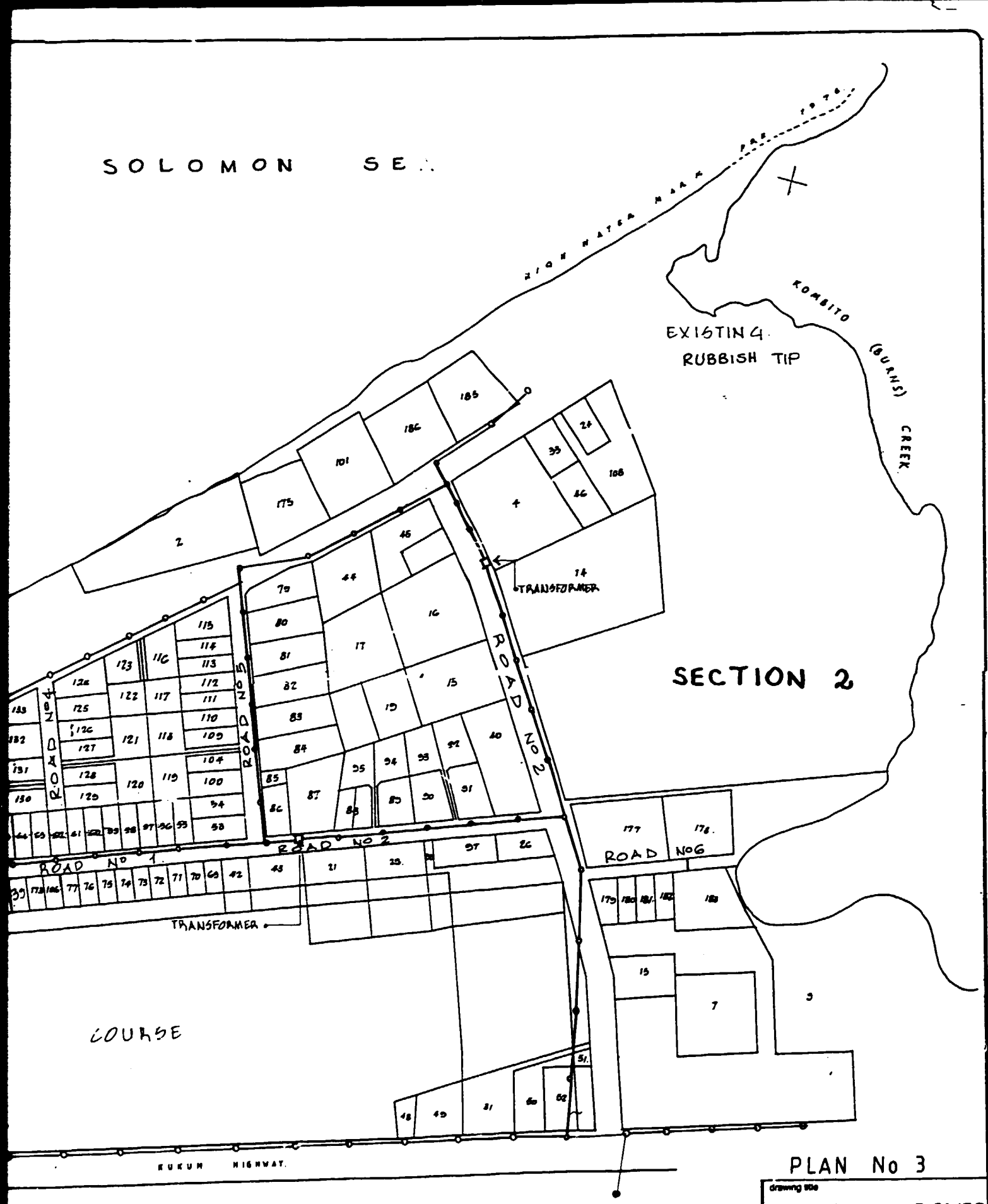
———. DISTRIBUTION LINES (OVER HEAD)

□--- TRANSFORMER

SECTION 1



RANADI INDUSTRI



PLAN No 3

drawing title
EXISTING POWER SERVICES

scale 1 : 5000

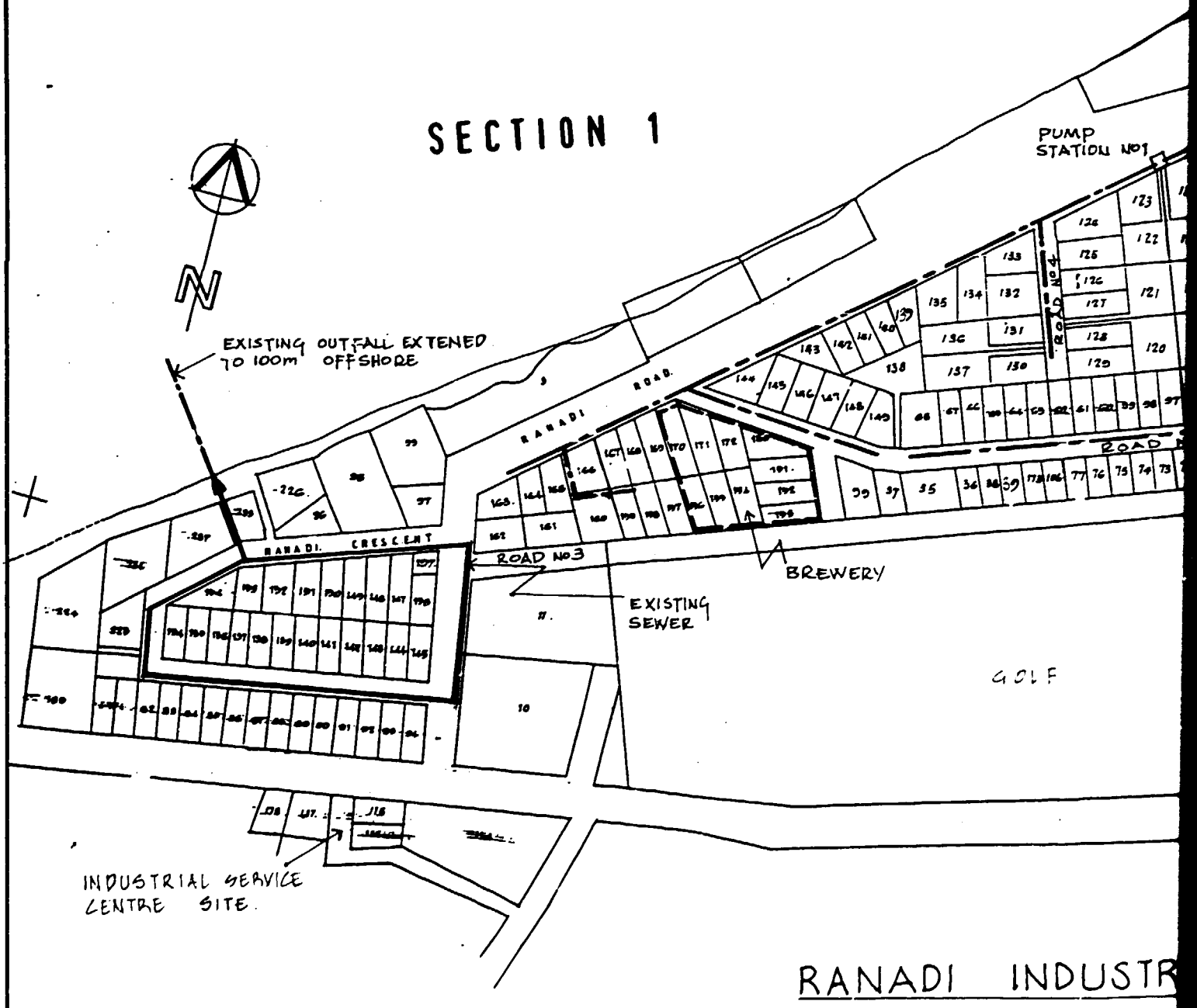
drawing number 601978/3 rev.

EXISTING SEWER

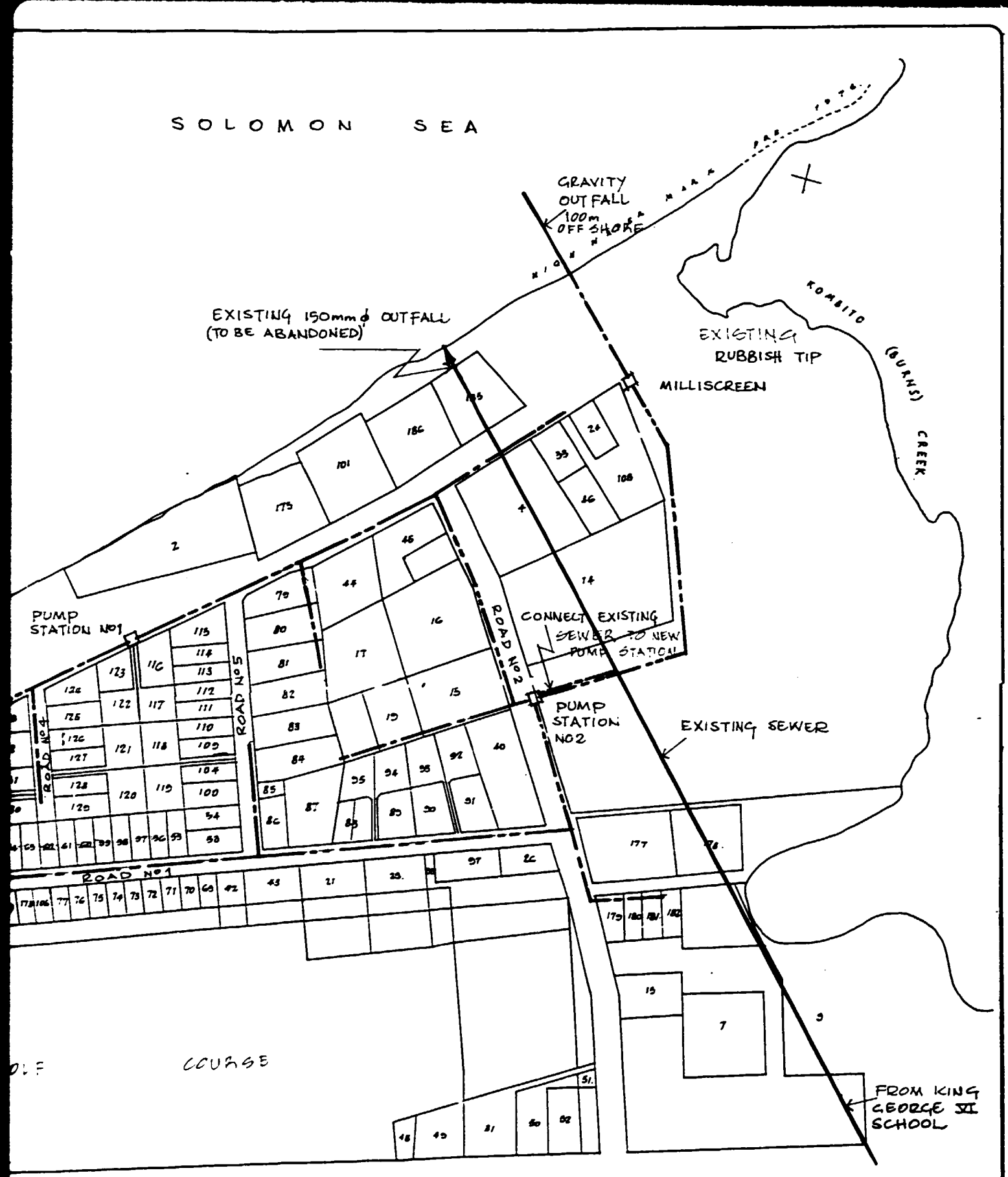
NEW 150mmØ

NEW 200mmØ

SECTION 1



RANADI INDUSTR



PLAN No 4

SECTION 2

INDUSTRIAL ESTATE

SCALE 1:5,000

drawing title
SEWERAGE PROPOSALS

scale 1 : 5000

drawing number 601978/4 rev.

SOL

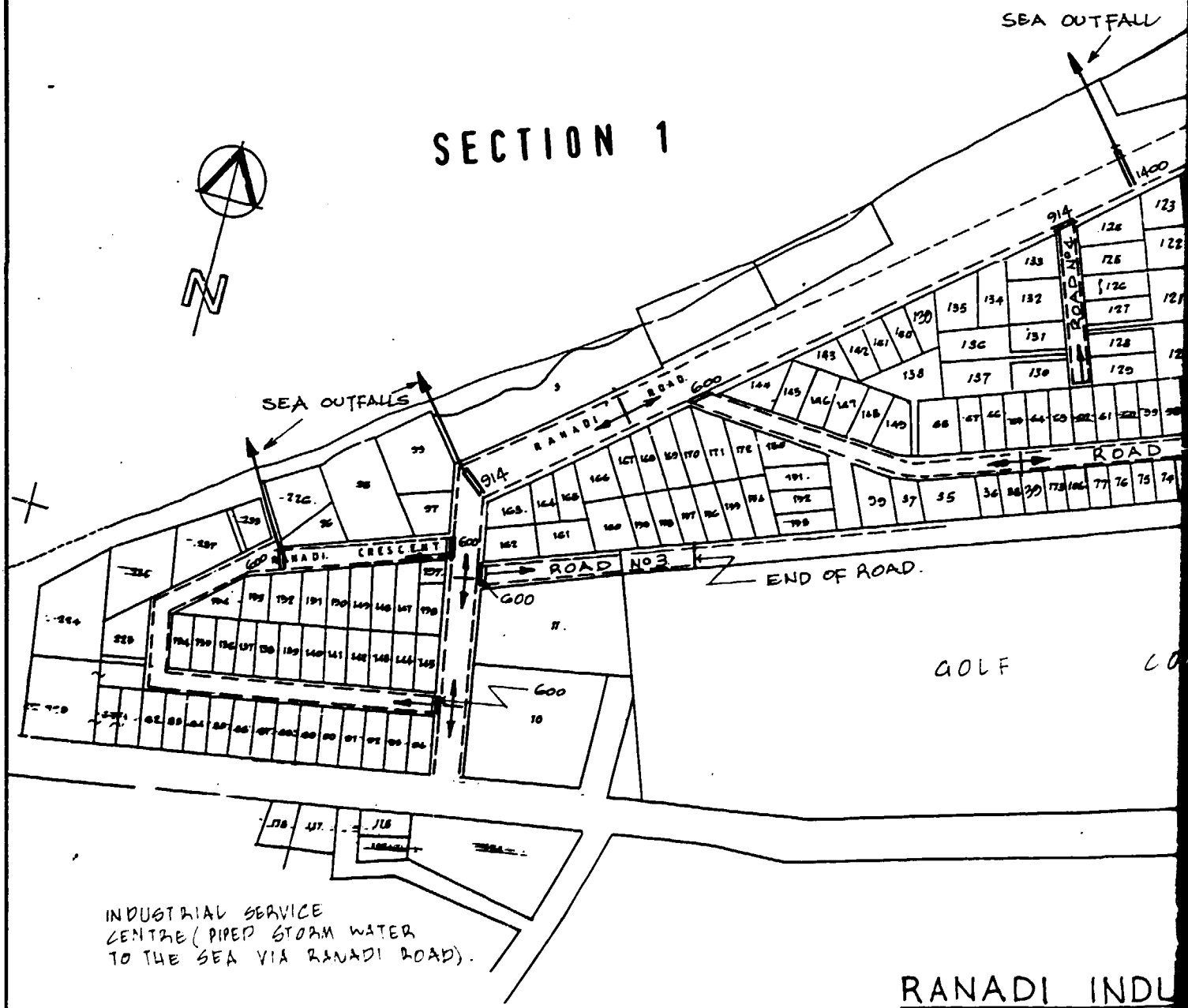
---...OPEN WATER TABLES

←+→ ----DIRECTION OF FALL

600mmφ PROPOSED CULVERTS

NOTE:

THESE PROPOSALS NEED TO BE PROVEN BY FIELD SURVEY.



RANADI INDU

PLAN No 5

SECTION 2

DI INDUSTRIAL ESTATE

SCALE 1:5,000

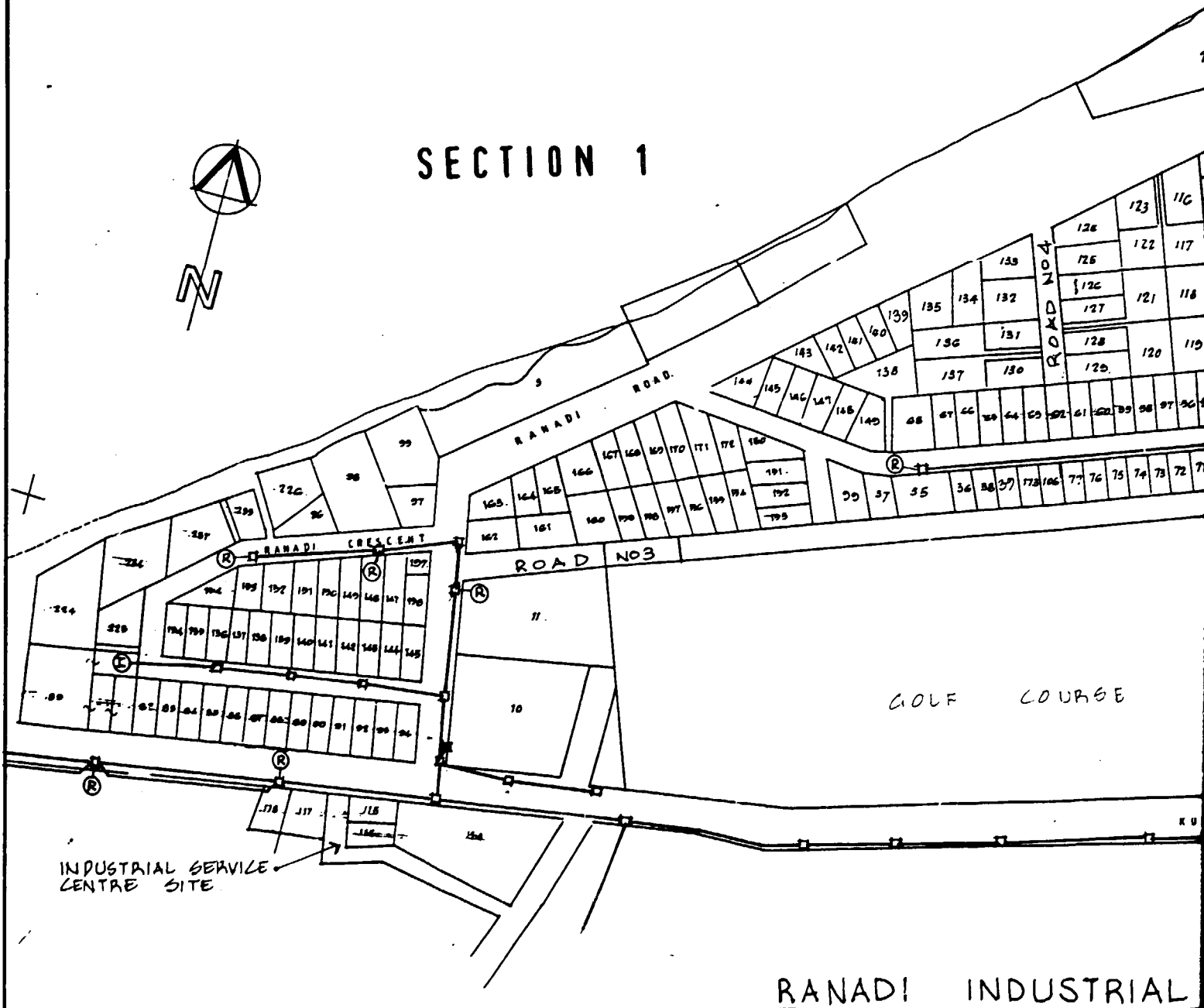
drawing title
PROPOSED STORMWATER DRAINAGE

scale 1 5000

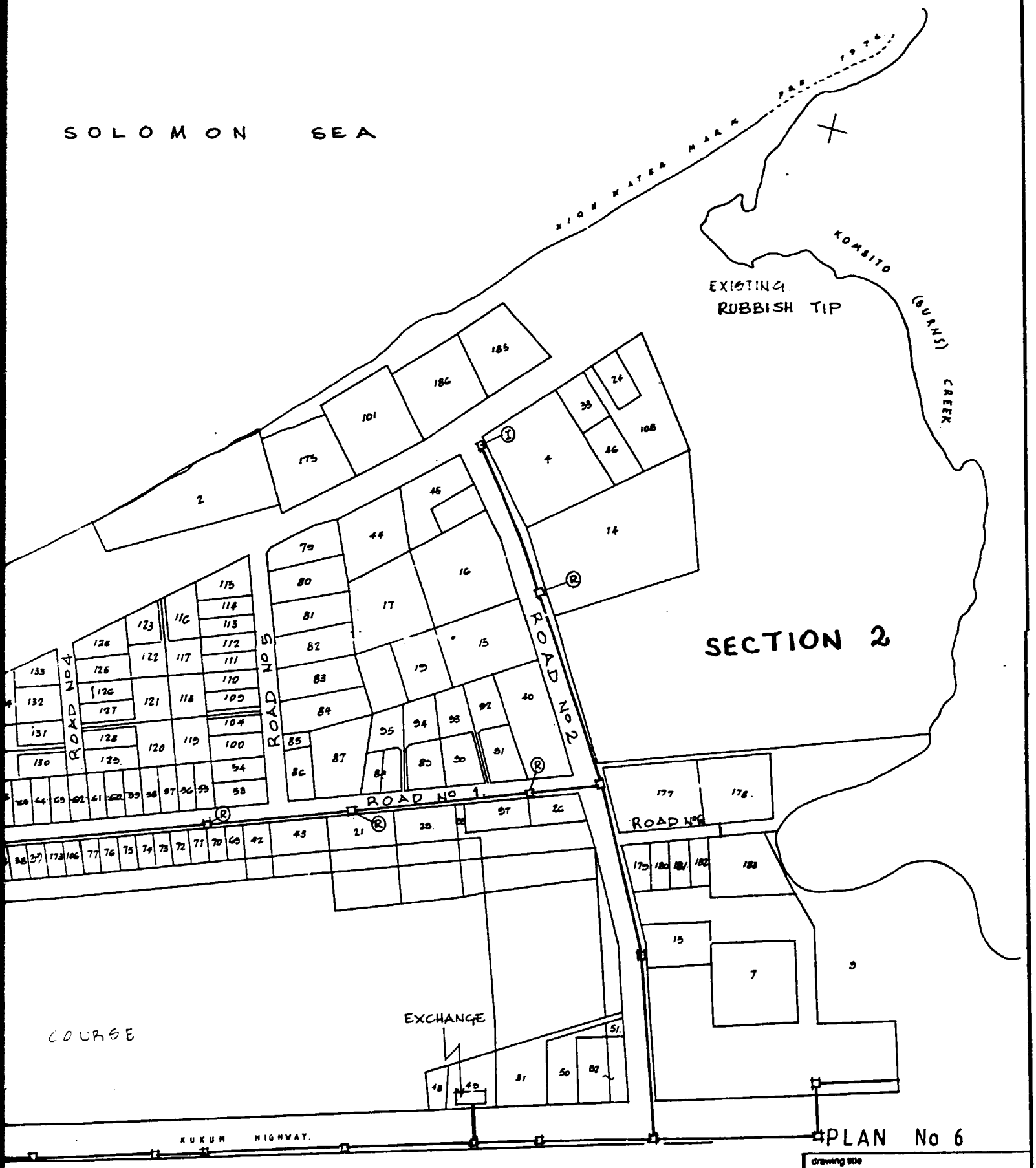
drawing number 601978/5 rev.

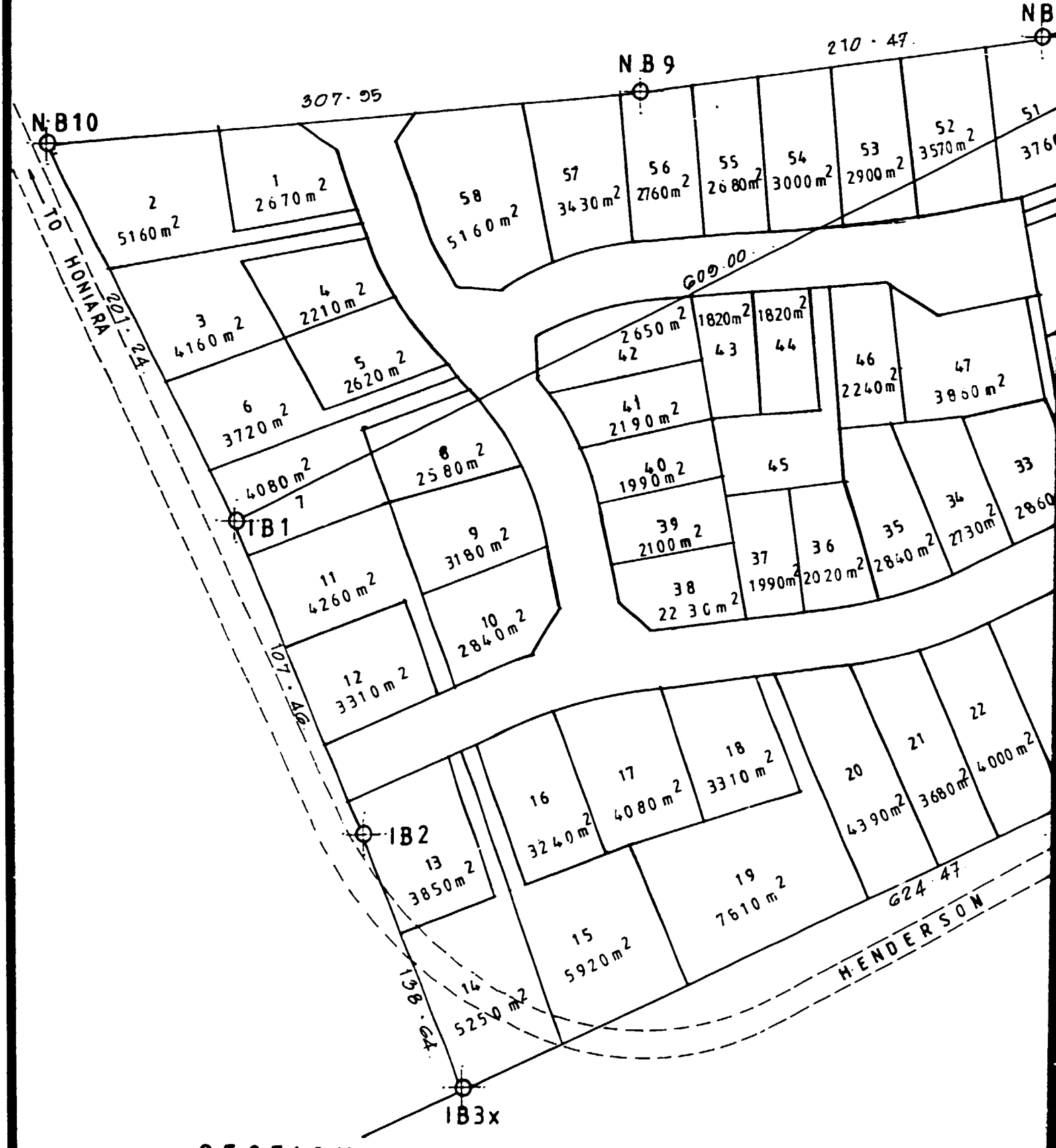
SOLOM

□ ..... JOINTING CHAMBER (VISIBLE)
Ⓡ ..... DISTRIBUTION POLE (RING TYPE)
Ⓘ ..... DISTRIBUTION BLOCK (INTERNAL)
⊠ ..... CABINET
——— UNDERGROUND DUCT ROUTE



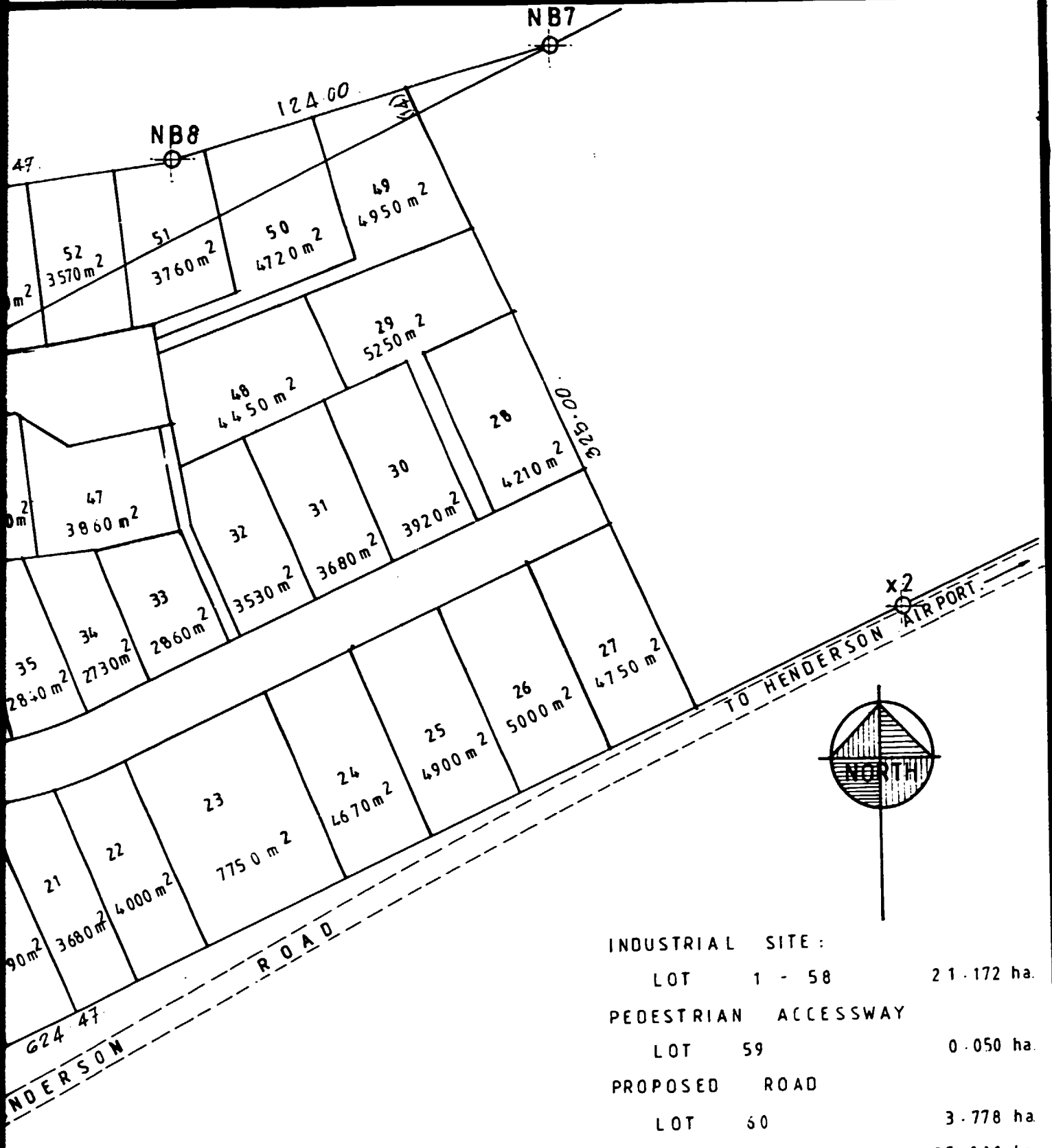
RANADI INDUSTRIAL


SOLOMON SEA
HIGH WATER MARK
KOMSITO (BURNS) CREEK
EXISTING RUBBISH TIP
SECTION 2
ROAD No 1
ROAD No 2
ROAD No 3
ROAD No 4
ROAD No 5
ROAD No 6
EXCHANGE
COURSE
KUKUM HIGHWAY
INDUSTRIAL ESTATE
PLAN No 6
drawing title
EXISTING TELEPHONE SERVICES
scale 1 : 5000
drawing number 601978/6
rev
SCALE 1:5,000



SECTION 1

HENDERSON INDUS



INDUSTRIAL SITE :

LOT 1 - 58	21.172 ha.
PEDESTRIAN ACCESSWAY	
LOT 59	0.050 ha.
PROPOSED ROAD	
LOT 60	3.778 ha.
TOTAL AREA	25,000 ha.

PLAN NO.7

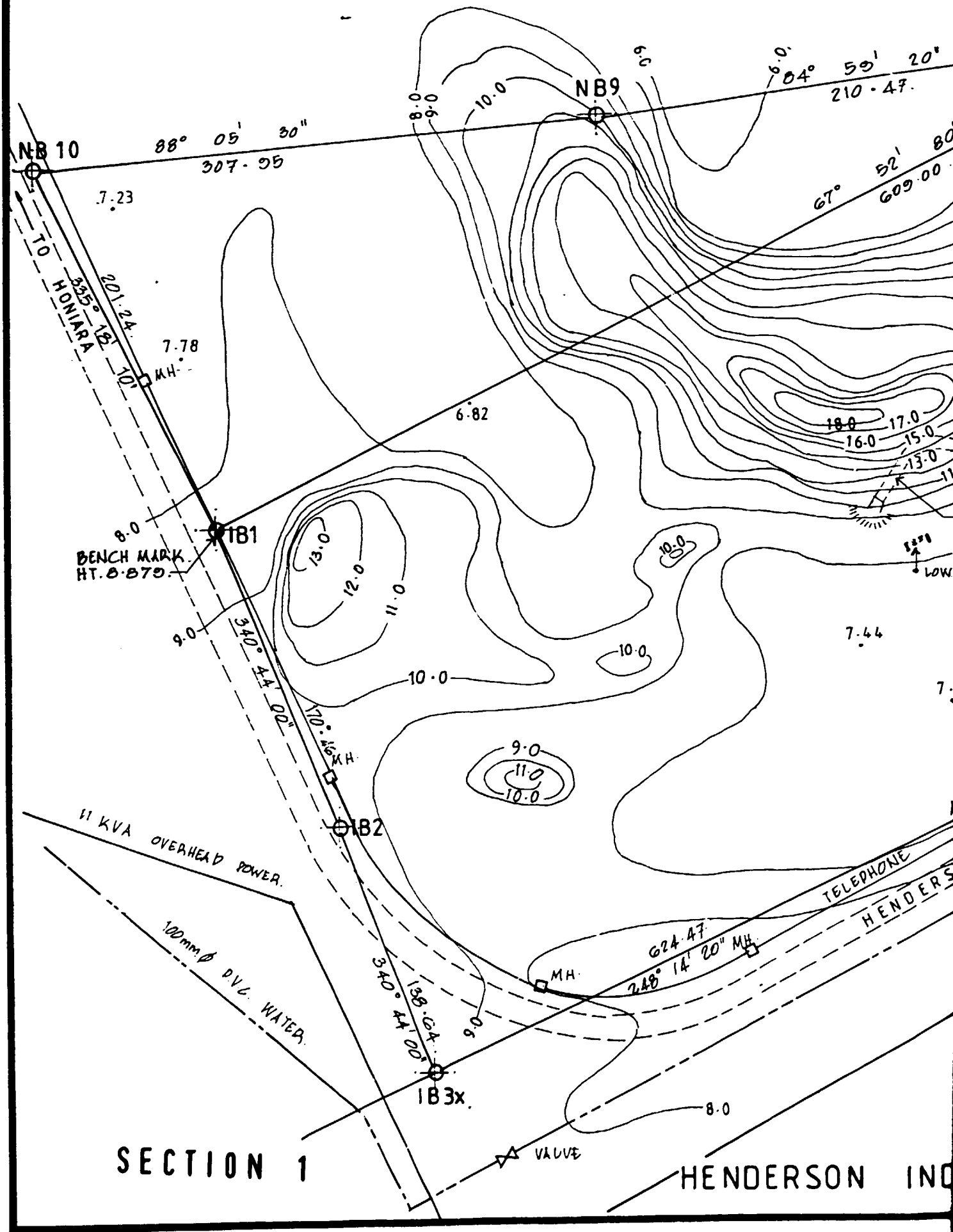
CONCEPT PLAN

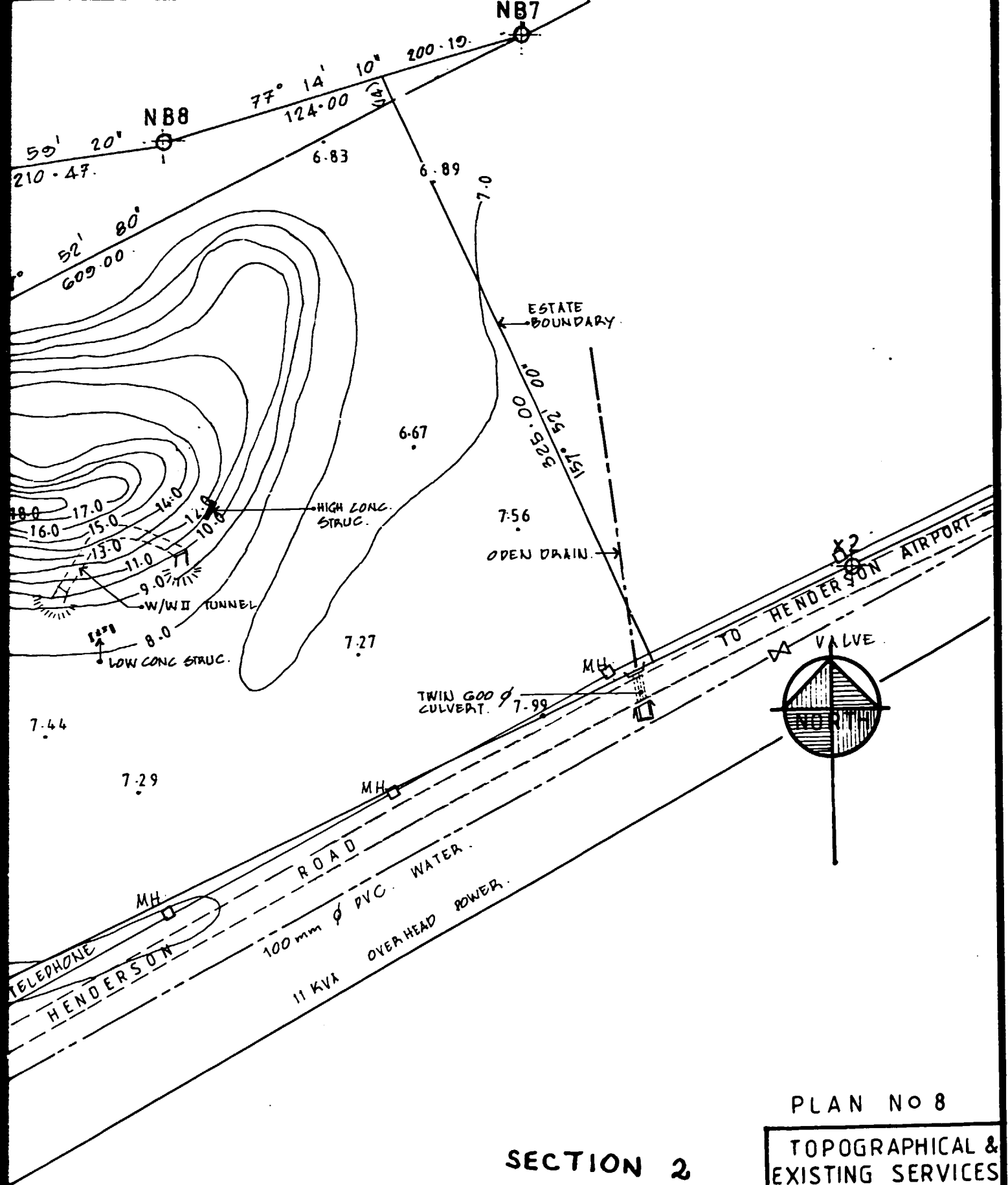
SCALE: 1:2,500

Org Nº 601978/7 rev

SECTION 2

ON INDUSTRIAL ESTATE


NB 10
88° 05' 30"
307·95
NB9
84° 59' 20"
210·47
67° 52'
609·00
TO HONIARA
335° 18' 10"
201·24
MH
7·23
7·78
6·82
IB1
BENCH MARK
HT. 8·879
8·0
9·0
10·0
11·0
12·0
13·0
16·0
17·0
18·0
340° 44' 00"
170·46
MH
IB2
7·44
9·0
11·0
10·0
11 KVA OVERHEAD POWER
100mmØ DVC WATER
340° 44' 00"
138·64
IB3x
MH
624·47
248° 14' 20"
MH
TELEPHONE
VALVE
8·0
SECTION 1
HENDERSON



SECTION 2

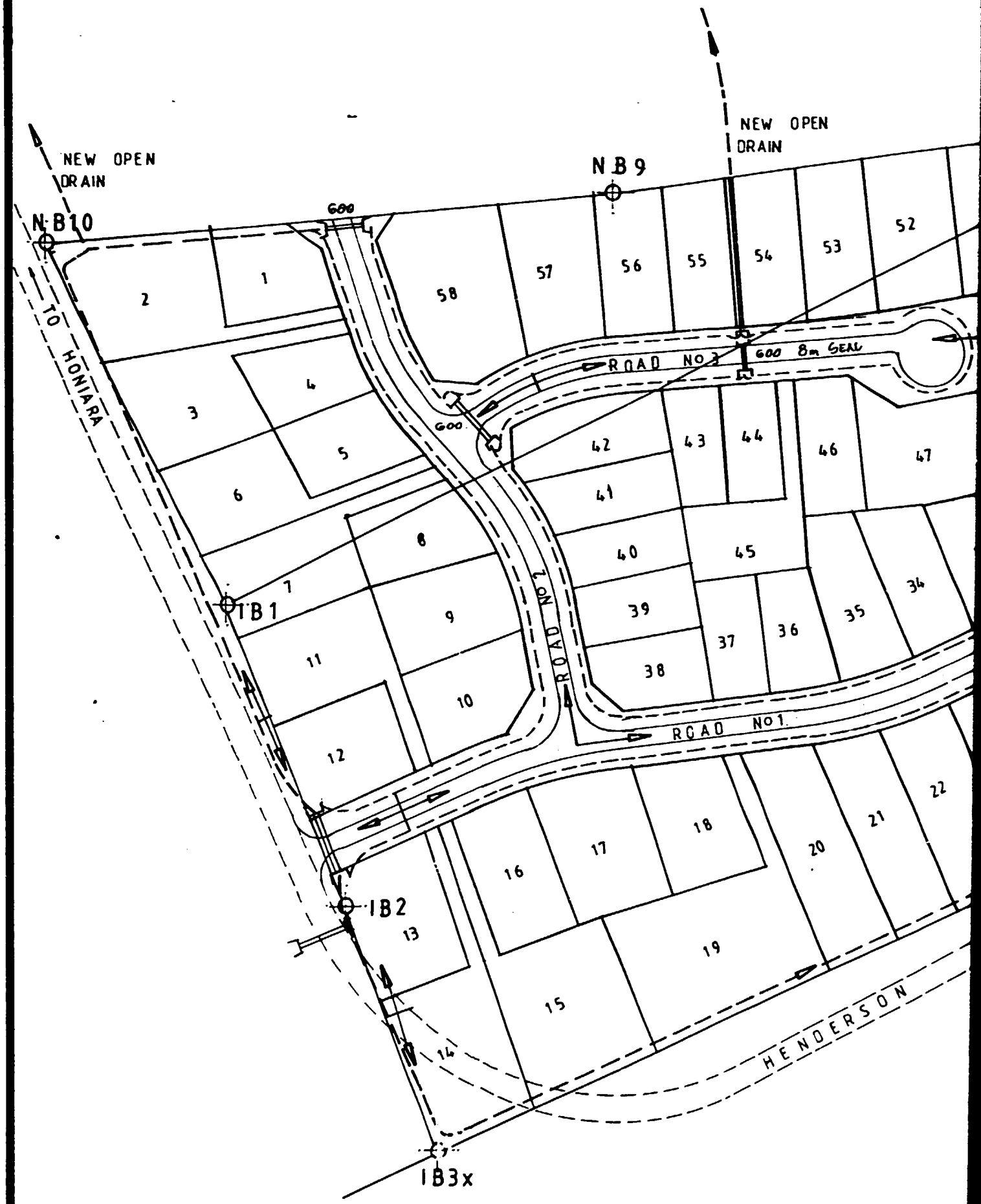
PLAN NO 8

TOPOGRAPHICAL & EXISTING SERVICES

SCALE : 1 2500

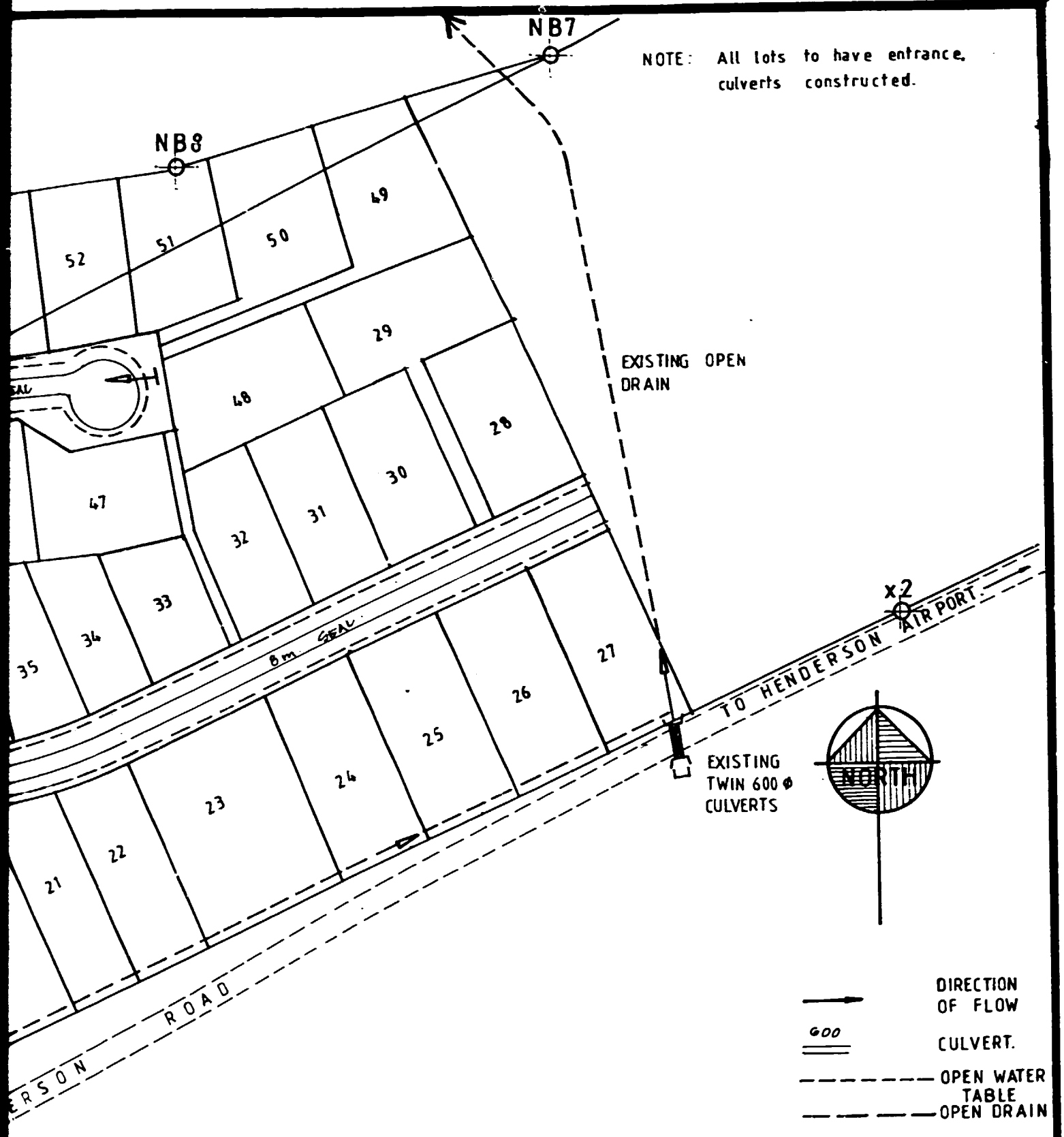
Drg. No. 601978/8 rev

ON INDUSTRIAL ESTATE



SECTION 1

HENDERSON IND



PLAN NO. 9

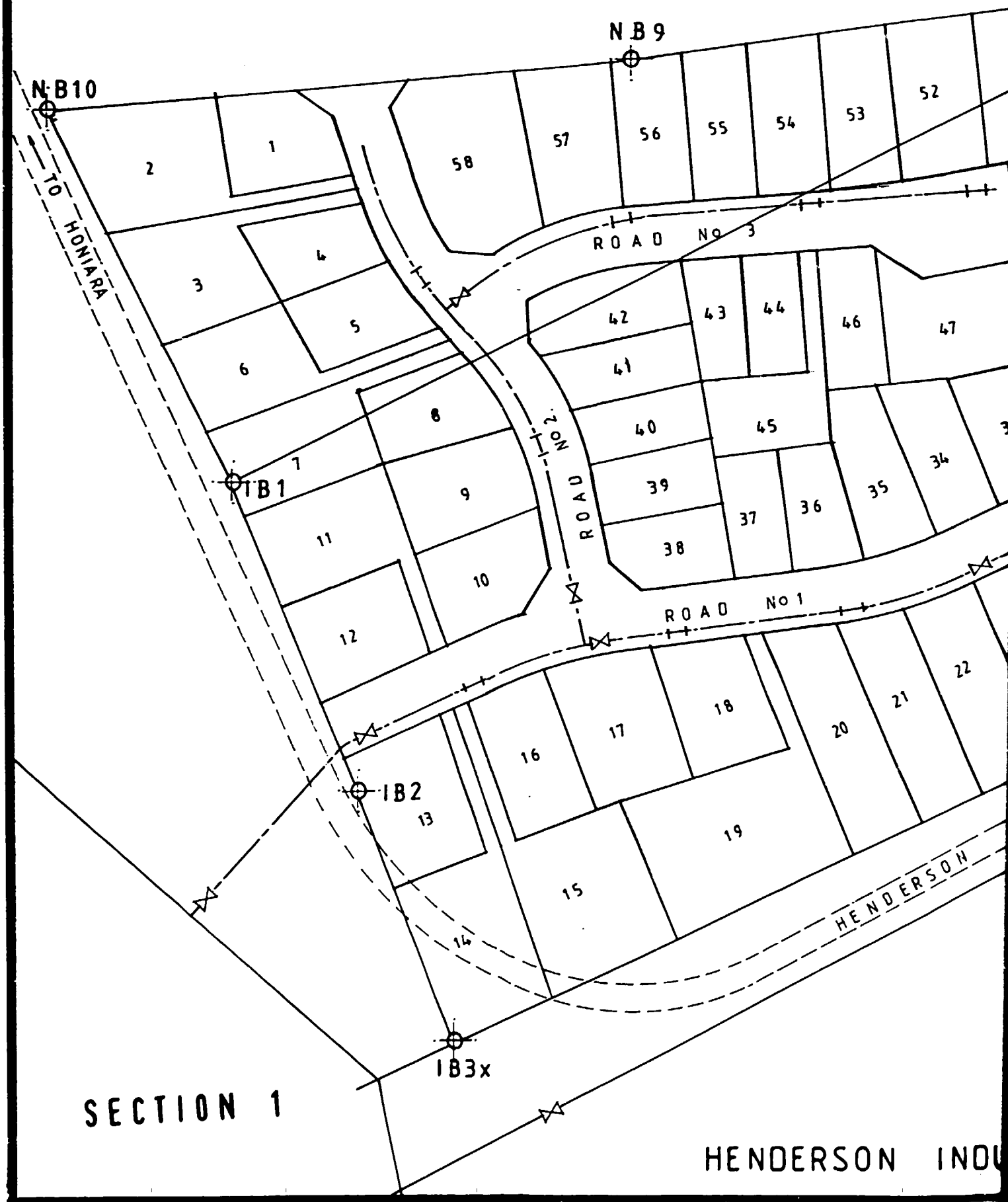
SECTION 2

ROADS AND STORMWATER DRAINAGE

SCALE: 1:2,500

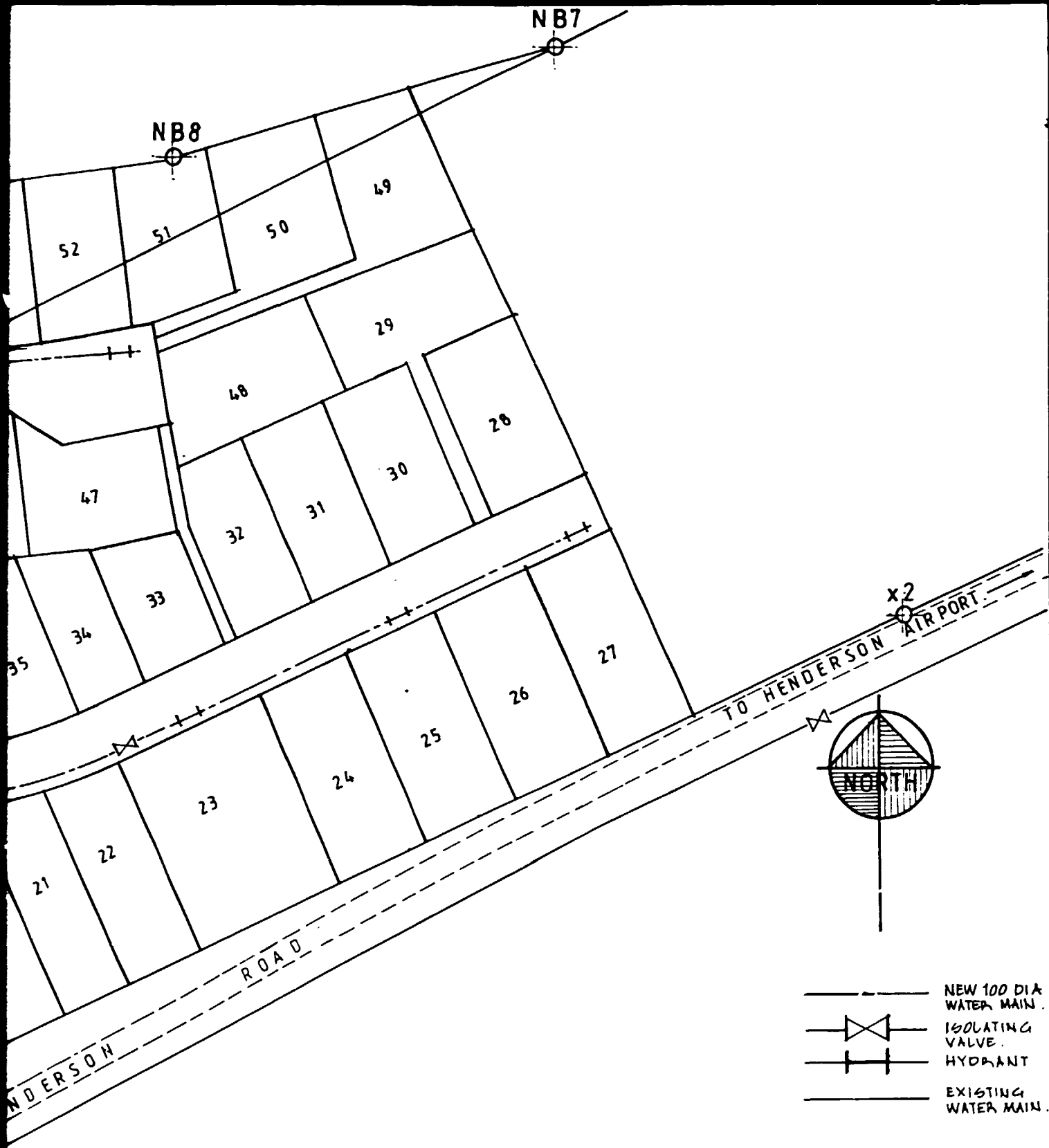
Drg Nº 601978/9 rev

ON INDUSTRIAL ESTATE



SECTION 1

HENDERSON INDU



SECTION 2

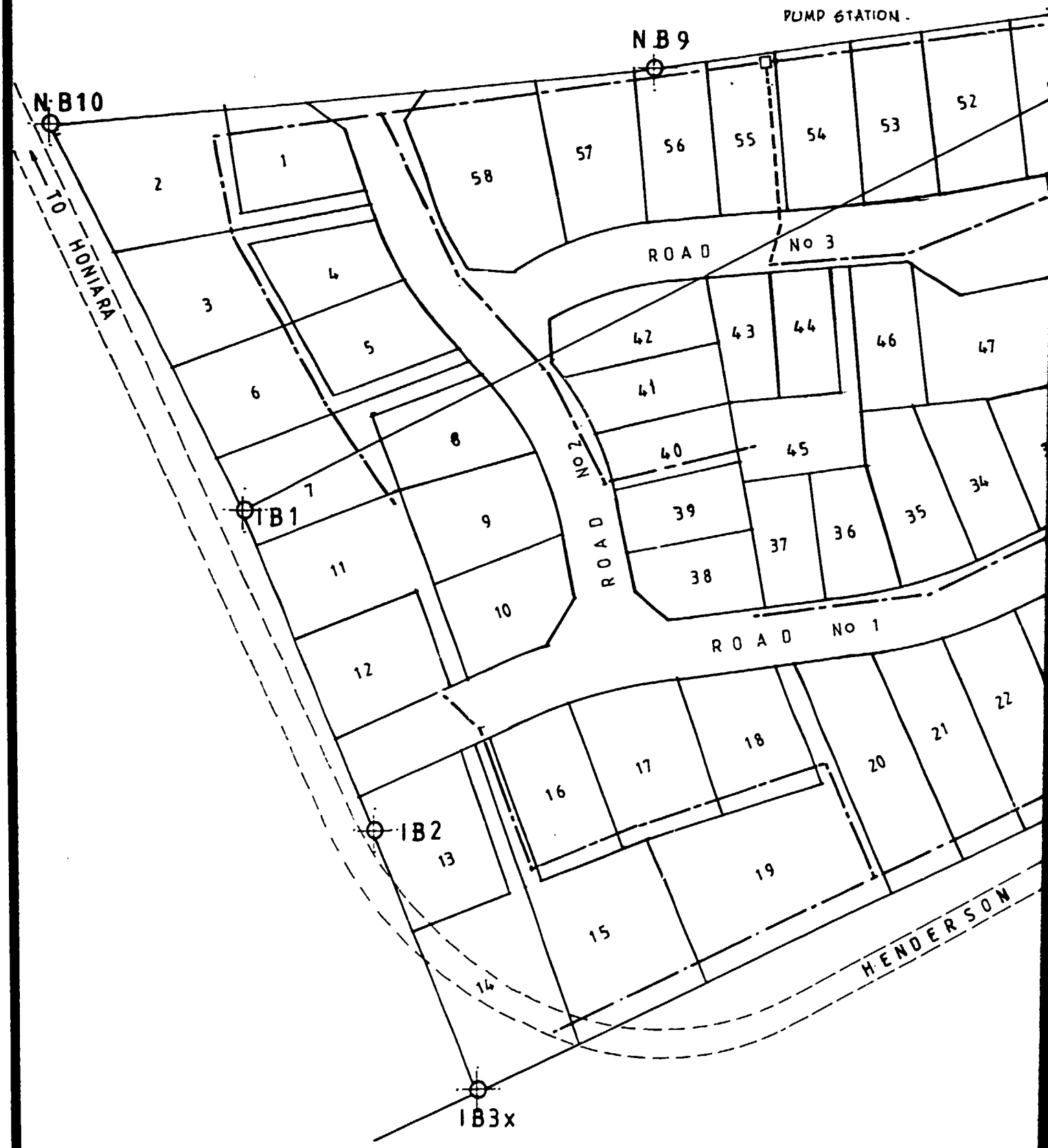
PLAN NO 10

WATER MAINS

SCALE: 1:2,300

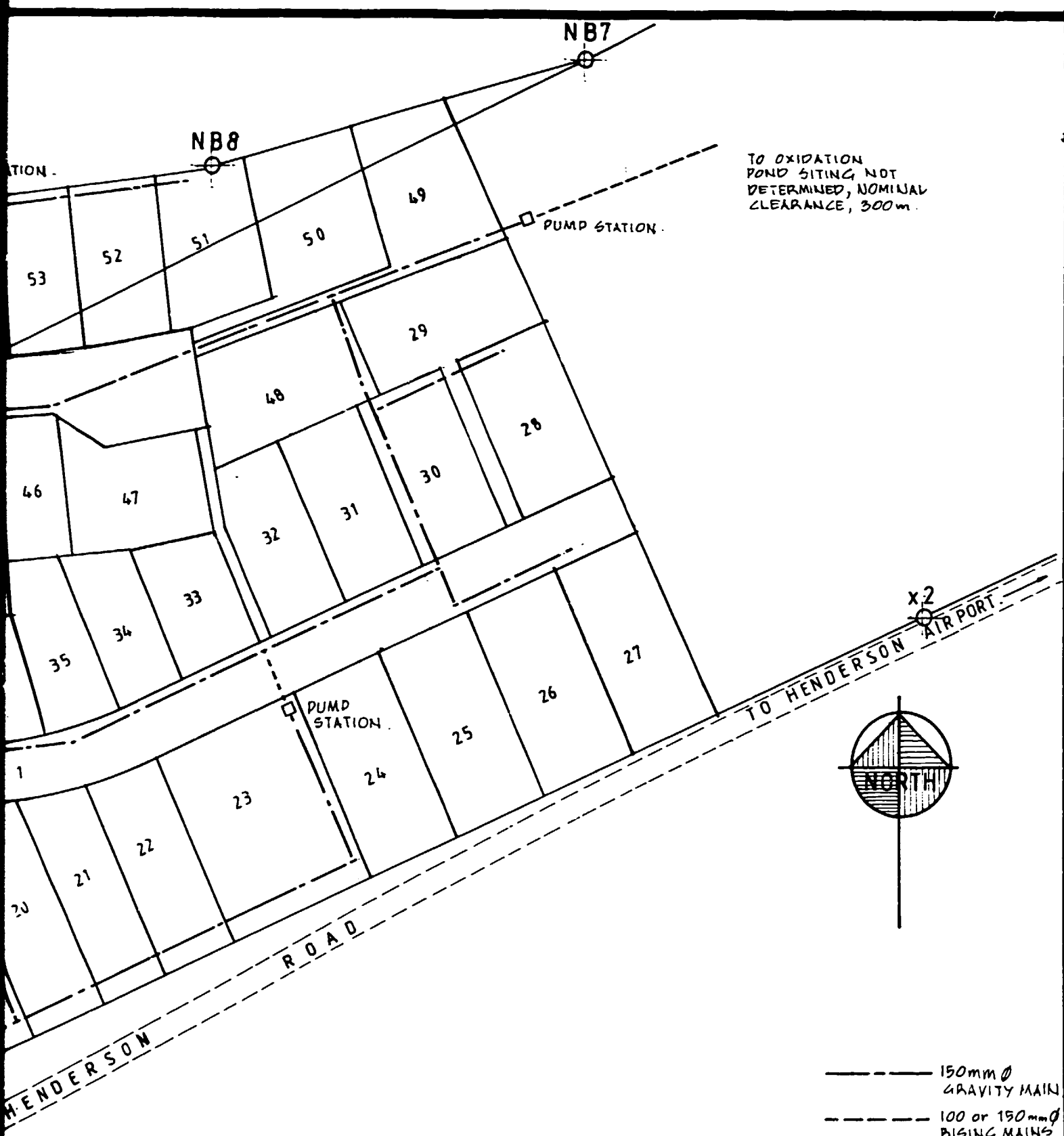
Org Nº 601978/10 rev

N INDUSTRIAL ESTATE



SECTION 1

HENDERSON IND



150mm ø GRAVITY MAIN

100 or 150mm ø RISING MAINS

SECTION 2

PLAN, NO. 11

SEWERAGE PROPOSALS

SCALE: 1:2,500

Org Nº 601978/11 rev

SON INDUSTRIAL ESTATE