PART I

THE SURVEY RESULTS AND RECOMMENDATION

CHAPTER 1

OUTLINE OF TLP SYSTEM PROJECT

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1.1 OUTLINE OF TLP SYSTEM

The TLP System is designed to collect the tailings slurry at the starting point near Camp 4 from the feeder lines of six (6) mines in the Baguio mining area, Island of Luzon, Republic of the Philippines, and send it through a common line to Lingayen Gulf for its disposal.

The estimated quantity of slurry from the six (6) mines including future production is shown below:

	Quantity of slurry (m^3/d)	Pulp density % (Solid weight)	Dry tonnage DMT/year
Average	67,100	39	12,775,000
Maximum	90,500	35	-
Minimum	43,000	43	-

Figs. 1 and 2 show the route and profile of the common line respectively. Of the total length of 26.0 km, the tunnel measures 16.4 km. including the underground falls (0.6 km of access tunnel is not included). The common line consists of a launder line (19.7 km) and a pipe line (6.3 km). Two emergency ponds, one water tank and one water pump equipment are provided as the attachments.

The feeder lines will be constructed and maintained by the mines. With due regards to them, any independent plan by each mine will be respected. However, the technical recommendations will be given to them as the feeder lines are closely related with the common line.

The final disposal of tailings at the Lingayen Gulf will be in the form of reclamation. The reclaimed land will accommodate a volume of tailings produced in 20 years. Four (4) plans are proposed for the construction of the bulkhead for the reclaimed land.

Below are the features and basic concepts of the TLP System Project.

(1) Features of the Common Line

a. Taking Care of Excess Head at the Mountain Area

The mountain area has an average gradient of 2.9% and produces an excess head of about 200 m against the line's proposed gradient of 1.25%. A new idea of underground fall has been adopted in the Project to take care of this excess head. This will reduce the operation costs and also facilitate the preliminary tunnel work.

b. Main Use of Launder Line and Its Gradient

Since construction and operating costs of launder line are cheaper than the pipe line, it is decided to mainly use the launder line.

In other similar examples of slurry transportation in the Philippines, the slurry with a pulp density of about 50% flows down the launder with a gradiant of 1.0%. In this Project, a gradient of -1.25% is adopted because the pulp density of the slurry will be relatively low, i.e. 39% average of the fluctuation of the density of slurry. The gradient of the pipe line should range from 0 to 0.5% and no invertion should be done as this is unfavorable for slurry transport. Considering the frequency of repairs, a single launder line and a double pipe line is proposed.

c. Transport of Slurry to the Sea Area by Natural Head

The slurry is transported thru a maximum length of 6.9 kms. pipeline from the sea coast for its disposal by reclamation. The head required for this transportation is obtained from the natural head at the 5.3 km line laid on the height at the sea coast shore. This system is cheaper than the launder line laid between the same division with a pump facilities, in both construction and operation costs, and easer than the latter in maintenance and control.

(2) Tunnel Excavation Plan

a. The 15-km. tunnel, if driven from both sides will take about 8 years to finish. To reduce it, the tunnel is proposed to be divided into 7 working sections, that is, A-B, C-B, D-E', G-F, H-I, J-I and K-L, the longest section less than 2.5 kilometers.

b. The tunneling work constitutes a critical path in the entire work schedule for the common line. To reduce the term of this tunneling work, it is planned to secure an excavation speed of more than 100 m/month.

c. The tunnel section is planned to be 2.8 m x 2.5 m which is necessary for the facilities and operation of the line.

(3) Four (4) Plans for Reclamation at the Sea Area

Four (4) plans of constructing bulkhead for reclamation are proposed. These are classified into two (2) groups with two (2) plans each. One group includes the use of rubble foundation and a combination of rubble foundation and corrugated cells to construct an enclosed bulkhead. The enclosed bulkhead should be constructed in advance. The other group is by building an enclosed causeway by using raw tailings or coarse grained tailings classified with cyclones.

The reclamation system most suitable for the condition of the sea area should be adopted in consideration with the features of the above mentioned plans and economic considerations.

The first group is usually employed in port dredging work. The second group with the use of tailings is similar to the one adopted by Marcopper. However, differs from it is that the coarse grained tailings is classified before it is used for constructing the causeway and that the bank surface of sea side is covered by rubbles to protect it from damage by waves for a long period of time.

In these plans using tailings for embankment, pollution of the sea area will be inevitable to some extent until the construction of the bulkhead (2.5 - 3.5 years) is completed. After the completion, further, the tailings in the bulkhead will be at such a state that contamination with sea water would be negligible as it is covered with rubbles. However these plans are advantageous in that the construction cost is far cheaper than those of the other plans.

1.2 CONSTRUCTION COST

Calculation criteria for construction costs are tabulated in Table 1-1 and the total constuction costs are shown in Table 1-2.

Table 1-1 Caluculation Criteria for Construction Cost

(1) Prices are based on the market prices as of February 1978.

(2) Quantity of works to be executed is based on the Schedule attached to this Feasibility Study.

(3) The unit prices of the Philippine labor costs, material costs and rental fees of construction equipment are used to calculate the direct construction cost.

(4) The indirect construction cost is 30% of each direct construction cost for land part and 16% of it for sea part. This indirect construction cost includes overhead expenses at the worksite and administrative expenses.

(5) Special calculation criteria for each work item are specified.

(6) The following factors are not included:

a. Import taxes for materials procured overseas.
b. Interests during the construction period.
c. Escalation of prices.
d. Costs of supervision in the construction works.

(7) Reserve fund is 9.1% of the construction cost.

(8) The rate of exchange is 1 peso (Philippine) for 33 Japanese yen.

Table 1-2 Summary of Construction Cost Unit: Million Peso & Million Yen

	Cost item \ Estimate	Estimated amount			Materials cost procured From overseas			Remarks
		Philippines Peso	Equivalent Yen (Ex. at ¥33/₱)	% v.s. land cost	Philippines Peso	Equivalent Yen (Ex. at ¥33/₱)	% v.s. each cost	
Land section (L)	Tunnel	87.2	2,876	40.9	25.4	837	29.1	
	Launder line	45.1	1,487	21.1	0	0	0	
	Pipeline	42.0	1,387	19.7	12.8	422	30.5	
	Common facilities	7.7	253	3.6	0.2	6	2.3	
	Sub-total (A)	(182.0)	(6,003)	(85.3)	(38.4)	(1,266)	(23.3)	
	Right of way	1.8	60	0.9				
	Re-survey of route for confirmation	0.8	27	0.4				
	Surveys in detail prior to definite design	1.6	52	0.7				
	Definite design	7.6	254	3.6				
	Sub-total (B)	(11.8)	(393)	(5.6)				
	Total (A) + (B)	193.8	6,396	90.9				
	Reserve fund	19.4	640	9.1	3.8	127	19.8	
	Total	213.2	7,036	100	42.2	1,393	19.8	
Sea section (S)	A. Rubble system	231.6	7,644	-	0	0	0	* the figure is involved in each A,B,C,D cost.
	B. Corrugated cell system	195.2	6,442	-	76.7	2,530	39.3	
	C. Raw tailings system	102.7	3,388	-	0	0	0	
	D. Classified tailings syst.	105.9	3,495	-	0	0	0	
	Surveys in detail prior to definite design	0.3*	9*	-				
	Definite design	1.5*	50*	-				
	Reserve for: 9.1% on each, (A,B,C,D syst.) contingency: cost is commonly added.							
Total (L + S)	In case of adopting A system	444.8	14,680	-	42.2	1,393	9.5	
	- " - B system	408.4	13,478	-	118.9	3,923	29.7	
	- " - C system	315.9	10,424	-	42.2	1,393	13.4	
	- " - D system	319.1	10,531	-	42.2	1,393	13.2	

The construction cost for land part totals 213 million pesos including the reserve fund (9.1% of the total) and the definite design cost. For the sea area, the construction cost will vary with construction methods ranging from 103 to 232 million pesos.

The aggregate construction cost both for land and sea areas will amount to 316 to 445 million pesos, varying with construction methods at the sea area.

1.3 RUNNING COST

Table 1-3 shows the annual running costs calculated on the basis of present prices but do not include future escalation of prices and taxes. Cost for reclamation pipeline is fully included in running cost.

The annual running cost for land part will be 4,260,000 pesos. That for the sea area part will change with construction method within a range from 2,278,000 to 2,421,000 pesos. About 75% of the total annual cost (6.6 million pesos) will be spent for renewal and repair of pipes.

1.4 WORK SCHEDULE

The entire work schedule is tabulated in Table 1-4. The total construction period for the land part is 3 years including the trial operation period.

The construction of bulkhead by rubble foundation or corrugated cell method will also be completed in three (3) years. The bulkhead work by the two tailings methods cannot start until the transport operation begins. It requires 2.5 years for raw tailings method and 3.5 years for the coarse grained tailings method to complete the bulkhead work for securing a reclamation area for tailings produced in 20 years.

Even after completion of the construction work, the common line cannot be used before completion of the feeder lines. Therefore, care should also be given to the work schedule for the feeder lines.

It is also desirable to commence the construction work during dry season.

1.5 REPAYMENT OF CONSTRUCTION AND OPERATION COSTS

Evaluation of an investment in a project is generally made from the standpoint of investment efficiency. However, for evaluation of the

Table 1-3 Summary of Annual Running Cost

(Unit: 1,000 Pesos, or 1,000 Yen
Exchange rate: 33 yen/peso)

	Item		Estimate	Equivalent Yen	Ratio %	Note
Land area	Labor cost		438	14,450	10	41 persons
	Line repairs	Launder repair	112	3,700	3	Concrete repair once/10 years
		Pipe repair	252	8,320	6	120° rotation of pipe once/year
		Pipe renewal	2,882	95,100	67	Pipe weight 1,300 t/year once/3 year
		Head work repair	136	4,480	3	Drop box & drop tank
		Instrument repair	16	530	0.4	
		(total)	(3,398)	(112,130)	(80)	
	Repairs of tunnel, roads and attached emergency facilities		424	14,000	10	
	Total		4,260	140,580	100	
Sea area	Embankment system	A. Rubble foundation	2,278	75,170	0.35	Pipe cost within reclaimed land: 1,892,000 pesos
		B. Corrugated cell	2,278	75,170	0.35	
		C. Raw tailings	2,385	78,700	0.36	1,982,000 pesos
		D. Classified tailings	2,421	79,890	0.36	
Grand total	System A for sea		6,538	215,750		
	System B for sea area		6,538	215,750		
	System C for sea area		6,645	219,280		
	System D for sea area		6,681	220,470		

Note) The ratio of the sea area cost is shown against the total land and sea area cost.

Table 1-4 Work Schedule

Work item \ Year	01 year	02 year	1st year	2nd year	3rd year	4th year	5th year	6th year	7th year
Definite study									
Common line construction work									
Tunnel									
Flow line									
Test									
Sea area construction work									
System A (rubble foundation)									
System B (corrugated cell)									
System C (raw tailings)									
System D (classified tailings)									
Start of tailing transportation						⇒			

investment in such a project as the TLP system, a social factor such as environmental improvement will be considered in addition to the investment efficiency, and evaluation of such social factor will be made on the side of the Philippine Government.

The toll charge/DMT is calculated on the supposition that construction and operation costs for the TLP system will fully be paid by the toll charges collected from the mines which will use this System for disposal of their tailings.

For calculation of toll charges, the modified discounted cash flow method was employed. Namely, the construction costs, running costs and interest rates of loaned money to be disbursed during the construction period and over the whole period of operation are grouped as cash outflow and the toll charges (unknown) collected from mine operators according to the volume of tailings carried out in the form of slurry from each mine as cash inflow. Such toll charges were determined, by using the same discount rate as the interest rate of loan (annual interest rate), that makes the current value of cash outflow equal to the total amount of cash inflow which is changed to the current value at the time the system starts actual operation.

Calculations were made on 35 cases by assuming five cases of construction and running costs and seven cases of interest rates. In calculation, electronic computer was used.

The calculation criteria are as follows:

a. Both capital cost and operation cost are assumed to occur at the beginning of each fiscal year.

b. The interest is assumed to be paid at the end of each fiscal year.

c. The toll charge is assumed to be paid at the end of each fiscal year.

d. The dry tonnage of tailings and the operation cost are assuemed to be constant over the entire operation period.

The input data given in the calculation are as follows:

a. Tonnage of tailings: 12,775,000 DMT/year

b. Period : 3 years for construction
20 years for operation

Following table shows the calculated toll charges.

Table 1-5 Calculation of Toll Charge

(Unit : peso/DMT)

Sea area embankment method	Interest / Case	2%	3%	4%	6%	8%	10%	15%
Rubble foundation method	A	2.68	2.92	3.18	3.73	4.35	5.02	6.94
Corrugated cell method	B	2.51	2.73	2.96	3.47	4.04	4.66	6.42
Raw tailings method	C	2.04	2.19	2.35	2.70	3.08	3.48	4.61
Classified tailings method	D	2.05	2.20	2.35	2.70	3.07	3.47	4.57
(For reference) Land part only	(E)	(1.39)	(1.49)	(1.61)	(1.88)	(2.17)	(2.50)	(3.42)

CHAPTER 2

OPINIONS AND PROPOSALS FOR TLP SYSTEM

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OPINIONS AND PROPOSALS FOR TLP SYSTEM

2.1 OVERALL VIEW

a. The Baguio mining area has peculiar topographical and weather conditions, but these will not pose any technical difficulty in the construction of TLP system. As the length of the tunnel is about 2/3 of the total length of the common line, construction cost will be comparatively higher than the cost of other facilities in the Philippines similar to the TLP system. The unit transportation cost will be rather low, i.e. about 0.073 pesos/t-km (or 2.4 yen/t-km.), among the projects for transporting the slurry over a long distance. In this Project, such a large amount of slurry-13 million DMT/year is conveyed through the line employing launder line which is cheaper than pipe line.

b. This TLP System has the advantage over the other slurry transport system in that annaul escalation of the operation cost will be small. If a permanent tailings dam could be constructed at a suitable location within a radius of less than half of this transportation distance from the mining area, the total cost will be higher than that of the TLP System over a long period of time. Further, this alternative plan becomes insignificant if any of the mines in the area cannot use the dam due to its capacity or location. As a matter of fact, it is impossible to obtain such a suitable large dam site at the mountain area.

c. When the tailings disposal by TLPS is realized, pollution of the Agno and the Bued Rivers and their tributaries and damages to the farming region by tailings will be eliminated. However, the effects of the so far accumulated siltation cannot be eliminated so soon.

d. The method of tailings disposal at the sea area is to form a reclaimed land of tailings and not to discharge it into the open sea. For construction of the bulkhead around the reclamation area, four methods are proposed which have different merits and demerits with respect to construction cost, environmental pollution during construction of bulkheads, etc. The different methods should be examined by the concerned organizations or agencies taking into consideration port dredging works and reclamation works. The method to be adopted should be determined by the Philippine Government with due consideration to the political, social and economic conditions of the country.

2.2 PROPOSALS

(1) General

a. This project is based on a Presidential Executive Order issued in 1971. The six (6) mining companies involved are being requested to participate and cooperate in this project.

For successful implementation of the Project, participation of all the mining companies concerned as well as cooperation of the land owners for acquisition and exclusive use of the land site are essential.

Although planning of this Project has originally been motivated by such political and social demands as environmental improvement of a local community, it is necessary to take proper actions for reducing the economical burden on the mines in the area. The Government should adopt financial policies which are favorable to the mines. At the same time, the Project should not be operated by a profit-making firm but by a public organization fully authorized to coordinate all the activities of the Project with the mines' operations for smooth operation as well as for a reduction of the cost.

b. The reclaimed land will be about 1,200 has. to accomodate tailings produced in 20 years. This feasibility report does not deal with the utilization of this reclaimed area as any land development program has yet been established. It is desirable, therefore, that such program be discussed as soon as possible.

c. By disposal of the tailings at the sea area, contamination of rivers due to overflow water from the tailings dam will be considerably improved. However, underground mine water will still be discharged into rivers, so that it is necessary to study its effects on the quality of river water.

d. The Philippine Government thru the N.P.C.C. has a Water Quality Criteria but has no waste water quality criteria at present. To this effect, data gathered were not used as a basis to determine whether the quality of the decant water which overflows from the reclaimed land to the sea meets the requirement of N.P.C.C. or not. Therefore, this problem also requires further discussion.

e. Effects of overflow water from the reclaimed land on the sea environment are related to various factors such as conditions of tidal and ocean

currents, weather conditions, sea bottom topography, ecosystem, etc. in addition to quantity, quality and the position of outlet of the overflow water, all of which need a longterm observations. These observations should be done by such sampling surveys as conducted by N.S.D.B. in 1972. In case there is any problem in the quality of overflow water as the result of observation, it is technically easy to execute any additional work to cope with the problem.

f. Although not directly related to the present feasibility report, the five (5) inch dia. compressed air pipe used in the excavation of the tunnel will become useless. It is possible to utilize it as a water pipe for irrigation and to employ the pump facilities at the Apangat River to provide irrigation water.

(2) Process to Definite Design (Refer to Appendix B)

a. The following steps should be taken in the conduct of the definite design for the TLP System:

The first step:	To prepare a map on a scale of 1 : 5,000 along the common line route, and reconfirm the route of TLP System.
The Second step:	To confirm the data required for the difinite design.
The third Step:	To conduct the definite design.

b. This feasibility study is based on a topographic map on a scale of 1 : 50,000 (Air Photos taken in 1974-1953 and completed in 1956) with contour lines at intervals of 20 meters.
As a preparatory step before conducting the definite design, however, it is essential to prepare a map on a scale of 1 : 5,000, with contour lines at intervals of 5 meters for the mountain part and 2 meters for the plains and to ascertain the results of the feasibility study using the map mentioned above.

c. Conduct of the surveys in the second step is principally classified as follows:

- To survey geology of tunnel.
- To survey sea area.
- To conduct field tests on the launder's gradient.

Supposed time schedule for definite design is shown in Table 1-6.

Table 1-6 Supposed Time Schedule for Definite Design

Content of Survey	Monthly Time Schedule							
	1 2	3 4	5 6	7 8	9 10	11 12	13 14	15 16
1 PREPARATION OF MAP AND RECHECK OF ROUTE								
1-1 Air Photography								
1-2 Traverse Land Surveying								
1-3 Leveling								
1-4 Aero Triangulation								
1-5 Drafting								
1-6 Recheck of Route								
2 SURVEYS								
2-1 Survey on land part								
(1) Geologic survey of tunnel								
(2) Seismic prospecting								
(3) Boring								
(4) Tests								
2-2 Survey on Sea Part								
Depth of sea, tide, soil of sea bed and characteristics of tailings								
2-3 Field test of Launder's Gradient								
3 DETAIL DESIGN (include surveys of route)								

Remarks: ▭ Field work ——— Desk work and/or Time allowance

- - - - Preparation

DRAWING LIST

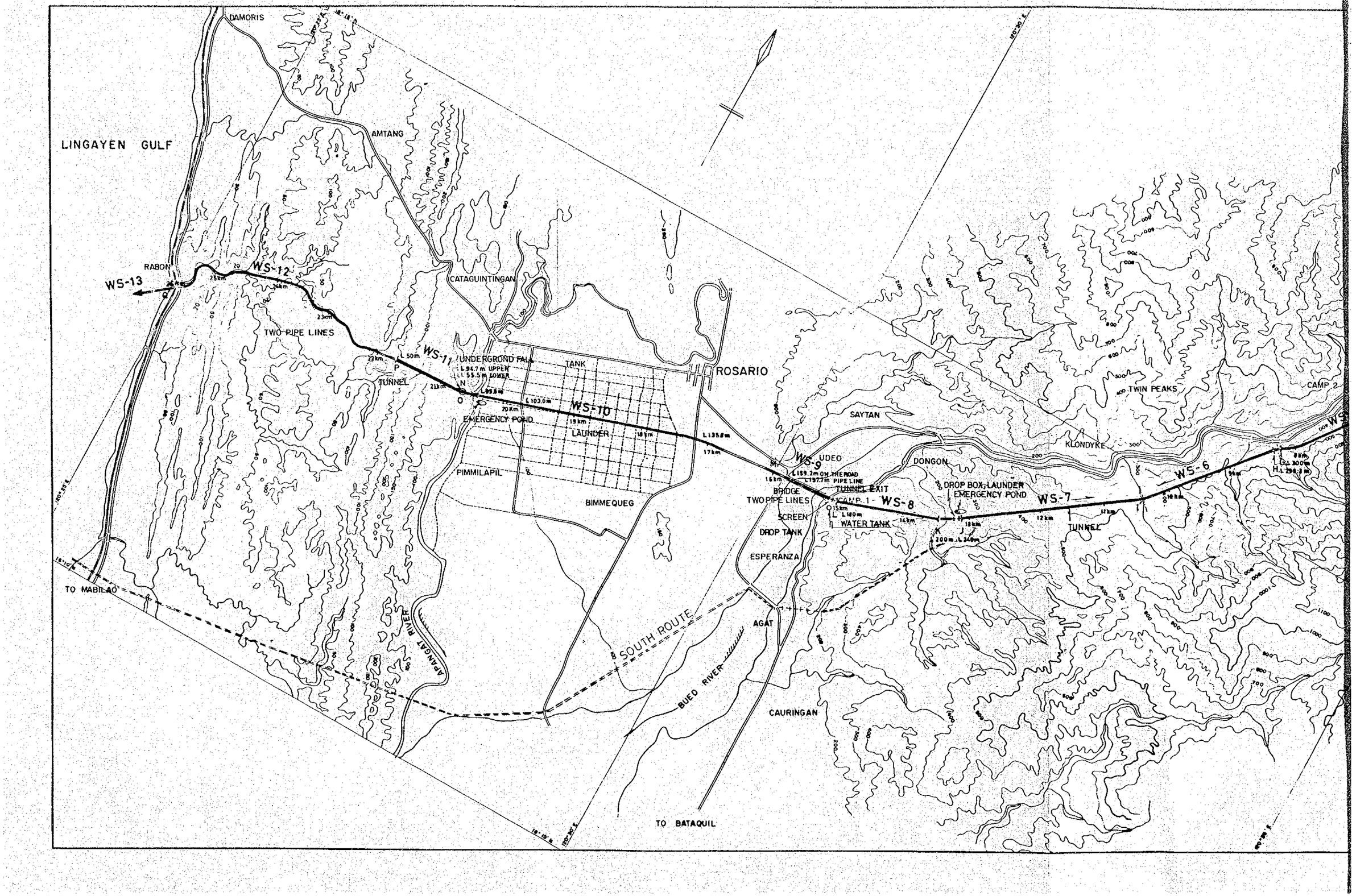
FIG. 1 Plan of Common Line

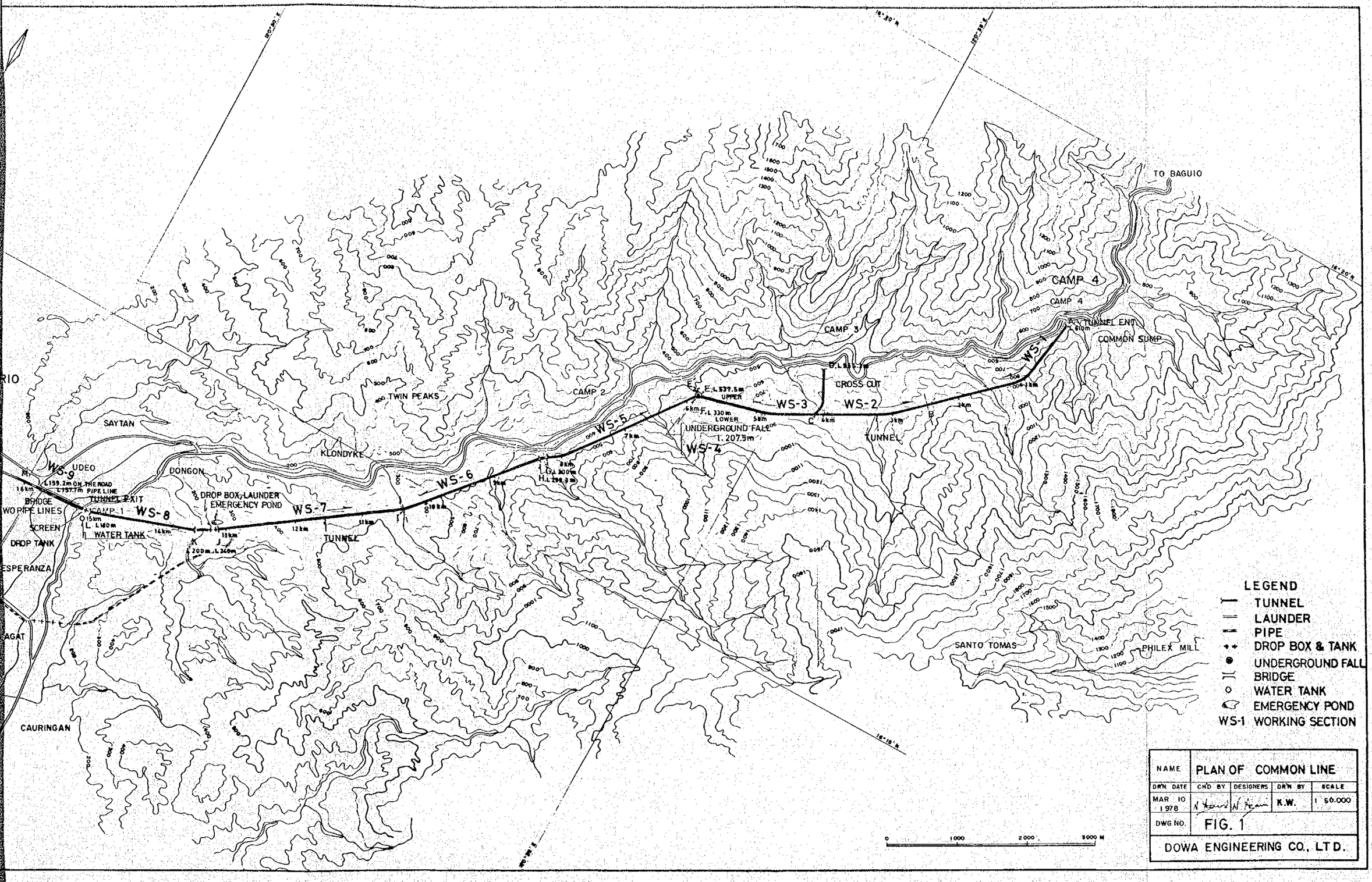
FIG. 2 Profile of Common Line

FIG. 3 Reclaiming Plan

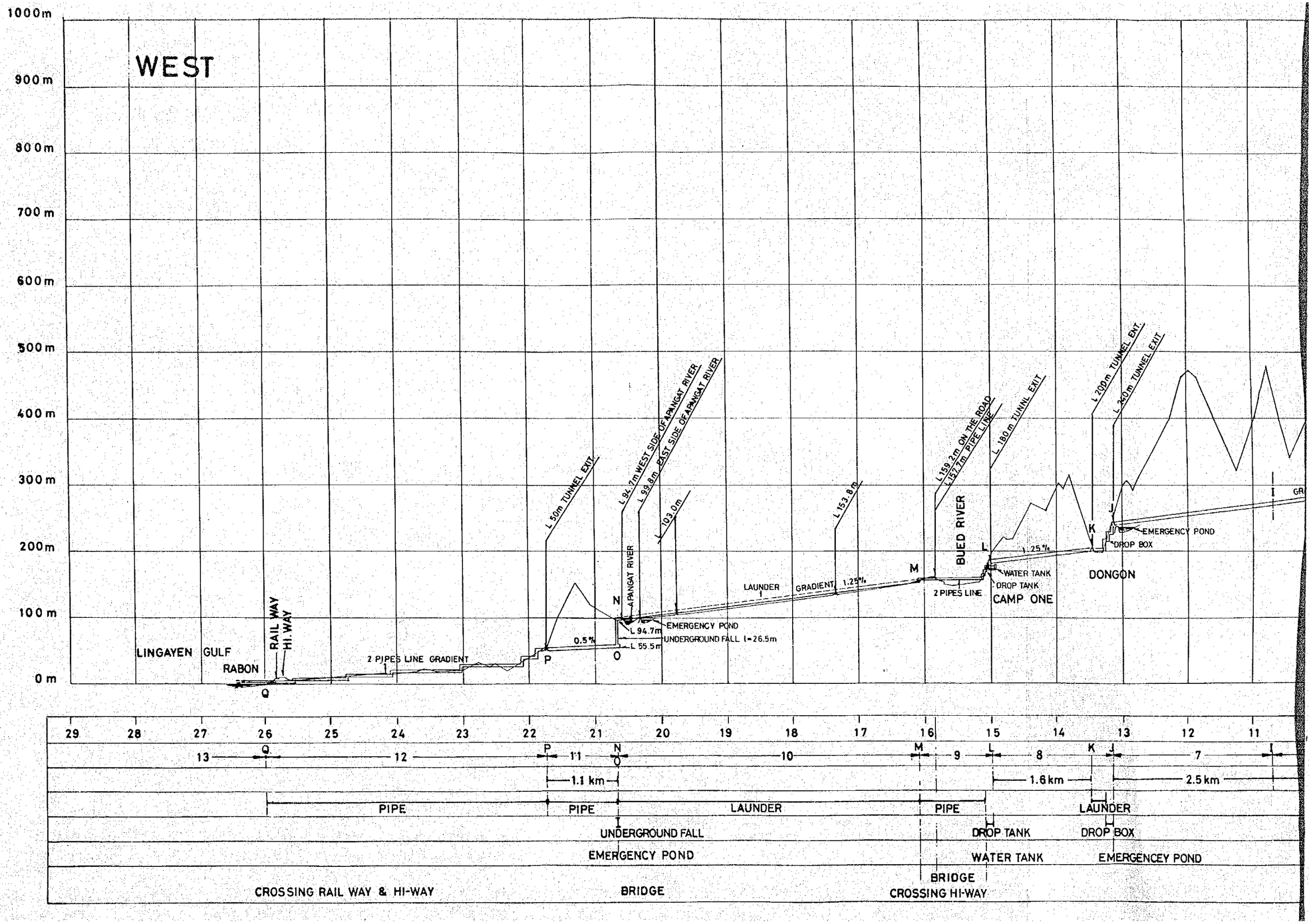
FIG. 4 Recommended Feeder Line

FIG. 5 Profile of Recommended Feeder Line


DAMORIS
LINGAYEN GULF
AMTANG
RABON
WS-13
WS-12
TWO PIPE LINES
CATAGUINTINGAN
WS-11
UNDERGROUND FALL
L 94.7 m UPPER
L 55.5 m LOWER
TANK
ROSARIO
TUNNEL
EMERGENCY POND
WS-10
LAUNDER
PIMMILAPIL
BIMMEQUEG
SAYTAN
TWIN PEAKS
CAMP 2
KLONDYKE
UDEO
WS-9
DONGON
WS-6
DROP BOX, LAUNDER
EMERGENCY POND
WS-7
BRIDGE
TWO PIPE LINES
TUNNEL EXIT
CAMP 1
WS-8
SCREEN
WATER TANK
TUNNEL
DROP TANK
ESPERANZA
TO MABILAO
SOUTH ROUTE
AGAT
APANGAT RIVER
BUED RIVER
CAURINGAN
TO BATAQUIL



NAME	PLAN OF COMMON LINE			
DRN DATE	CHD BY	DESIGNERS	DRN BY	SCALE
MAR 10 1978			K.W.	1 50.000
DWG NO.	FIG. 1			
DOWA ENGINEERING CO., LTD.				


1000m
900m
800m
700m
600m
500m
400m
300m
200m
100m
0m
WEST
LINGAYEN GULF
RABON
RAIL WAY
HI WAY
Q
2 PIPES LINE GRADIENT
P
0.5%
O
N
L 94.7m
EMERGENCY POND
UNDERGROUND FALL I=26.5m
L 55.5m
APANGAT RIVER
L 50m TUNNEL EXIT
L 94.7m WEST SIDE OF APANGAT RIVER
L 99.8m EAST SIDE OF APANGAT RIVER
103.0m
LAUNDER
GRADIENT 1.25%
L 153.8m
M
2 PIPES LINE
BUED RIVER
L 159.2m ON THE ROAD
L 157.7m PIPE LINE
L 180m TUNNL EXIT
L
1.25%
WATER TANK
DROP TANK
CAMP ONE
L 20m TUNNEL ENT.
L 240m TUNNEL EXIT
K
J
EMERGENCY POND
DROP BOX
DONGON
I
GR
29 28 27 26 25 24 23 22 21 20 19 18 17 16 15 14 13 12 11
13 Q 12 P 11 N O 10 M 9 L 8 K J 7 I
1.1 km
1.6 km
2.5 km
PIPE
PIPE
LAUNDER
PIPE
LAUNDER
UNDERGROUND FALL
DROP TANK
DROP BOX
EMERGENCY POND
WATER TANK
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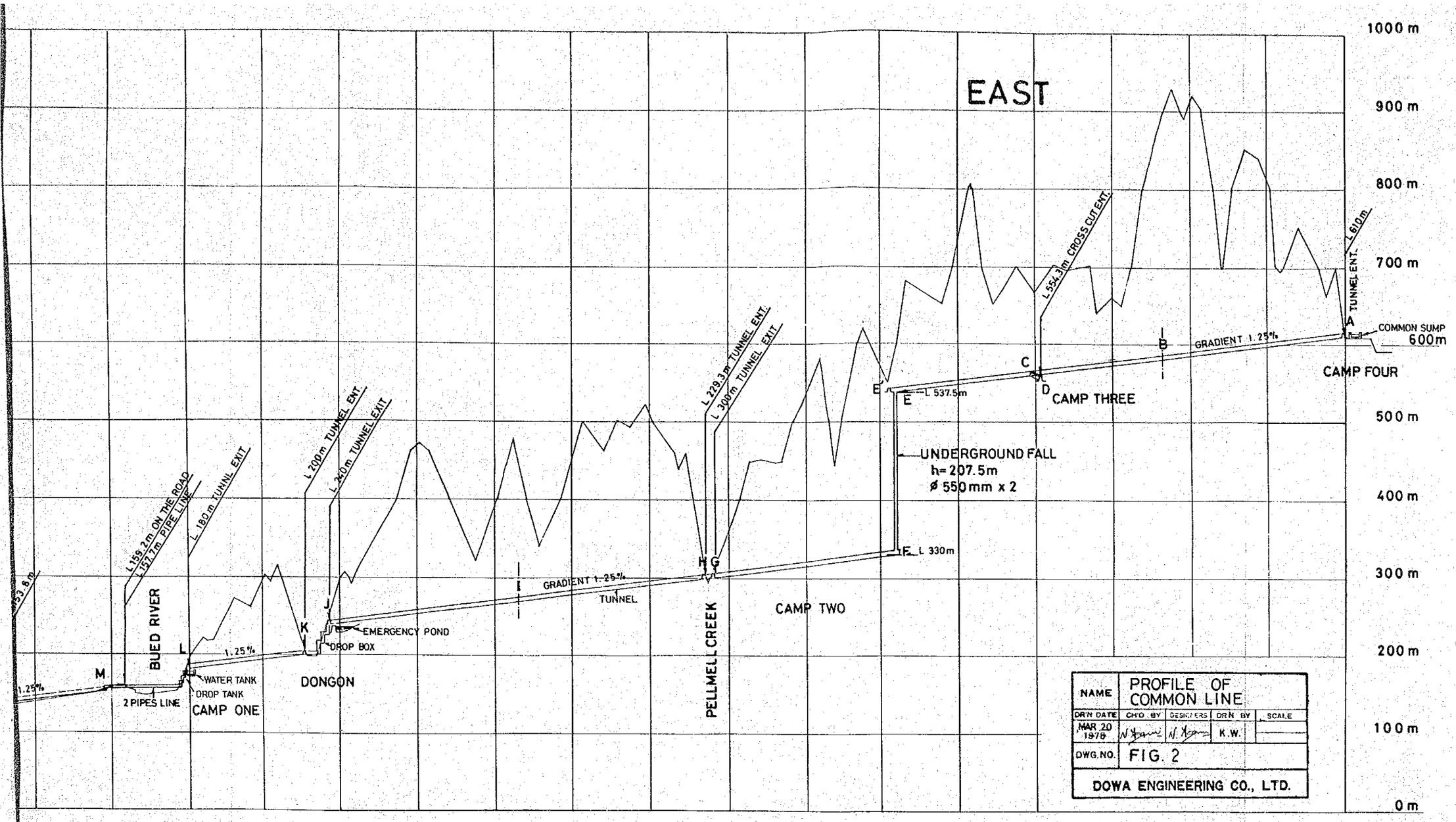
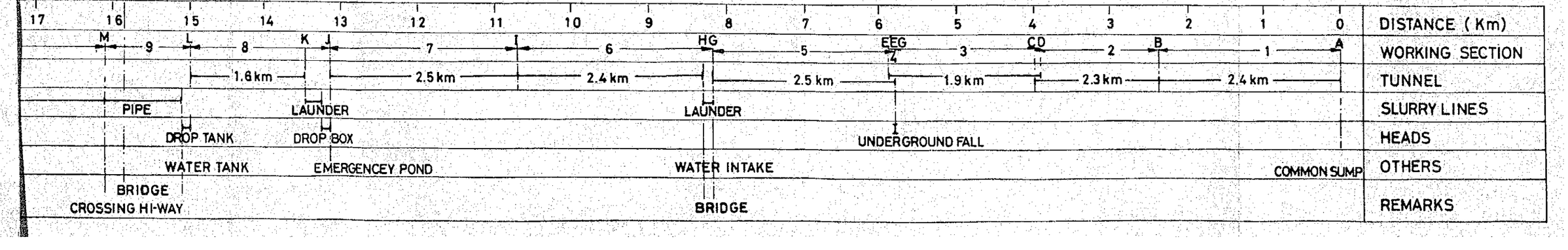
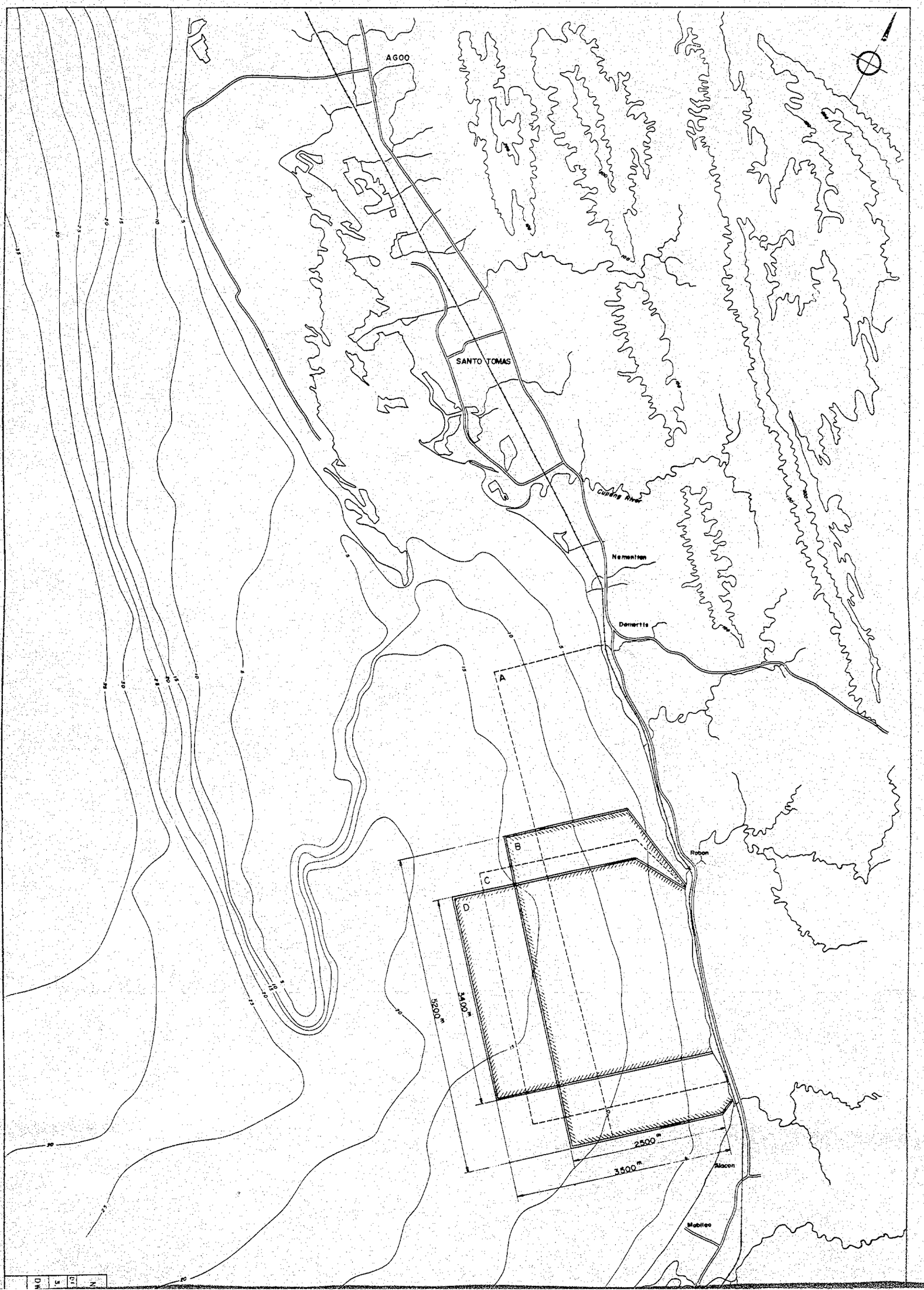
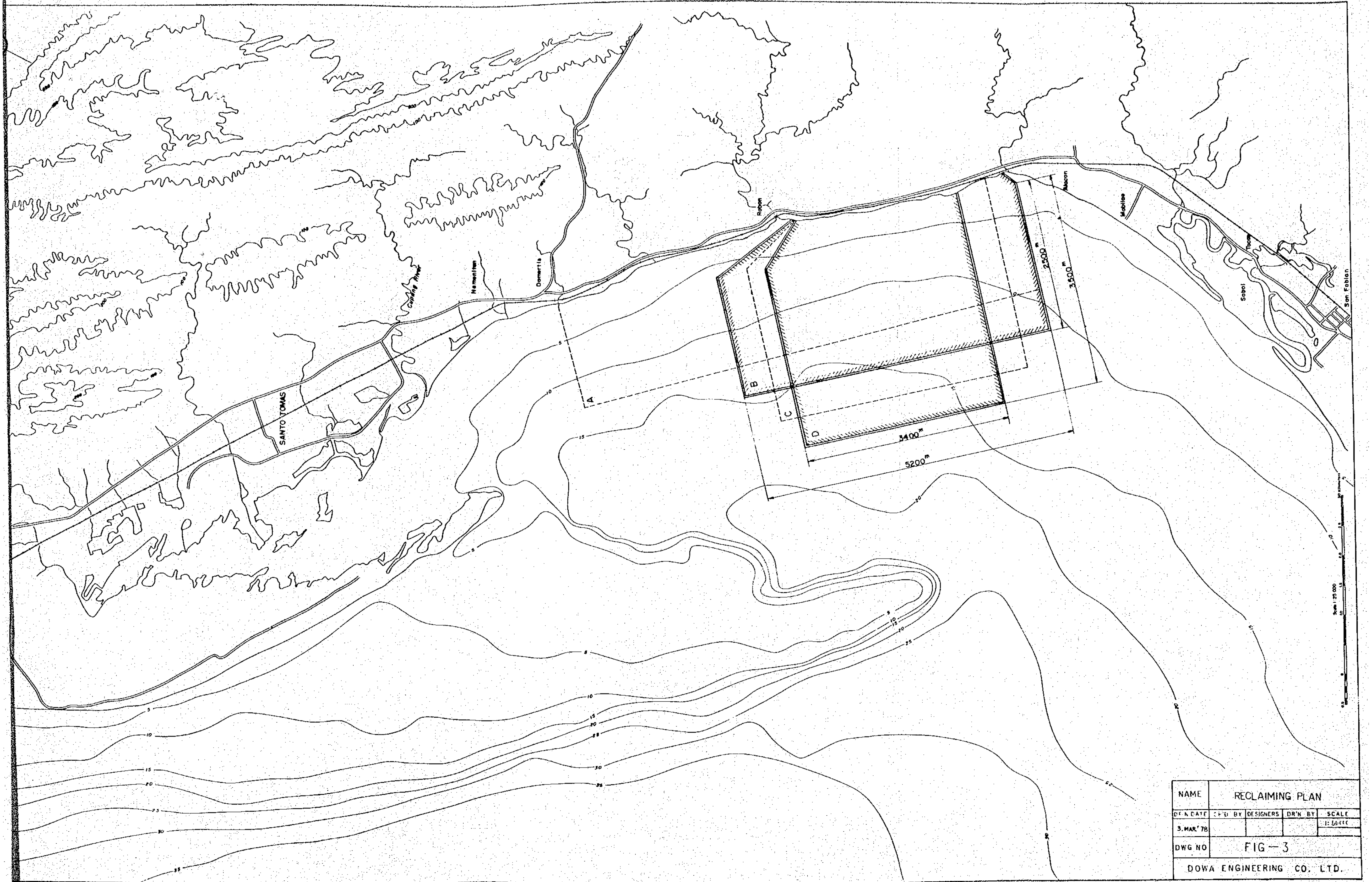
BRIDGE
CROSSING RAIL WAY & HI-WAY
BRIDGE
CROSSING HI-WAY



NAME	PROFILE OF COMMON LINE			
DR'N DATE	CH'D BY	DESIGNERS	DR'N BY	SCALE
MAR. 20 1978	N. Kam	N. Kam	K.W.	
DWG. NO.	FIG. 2			
DOWA ENGINEERING CO., LTD.				



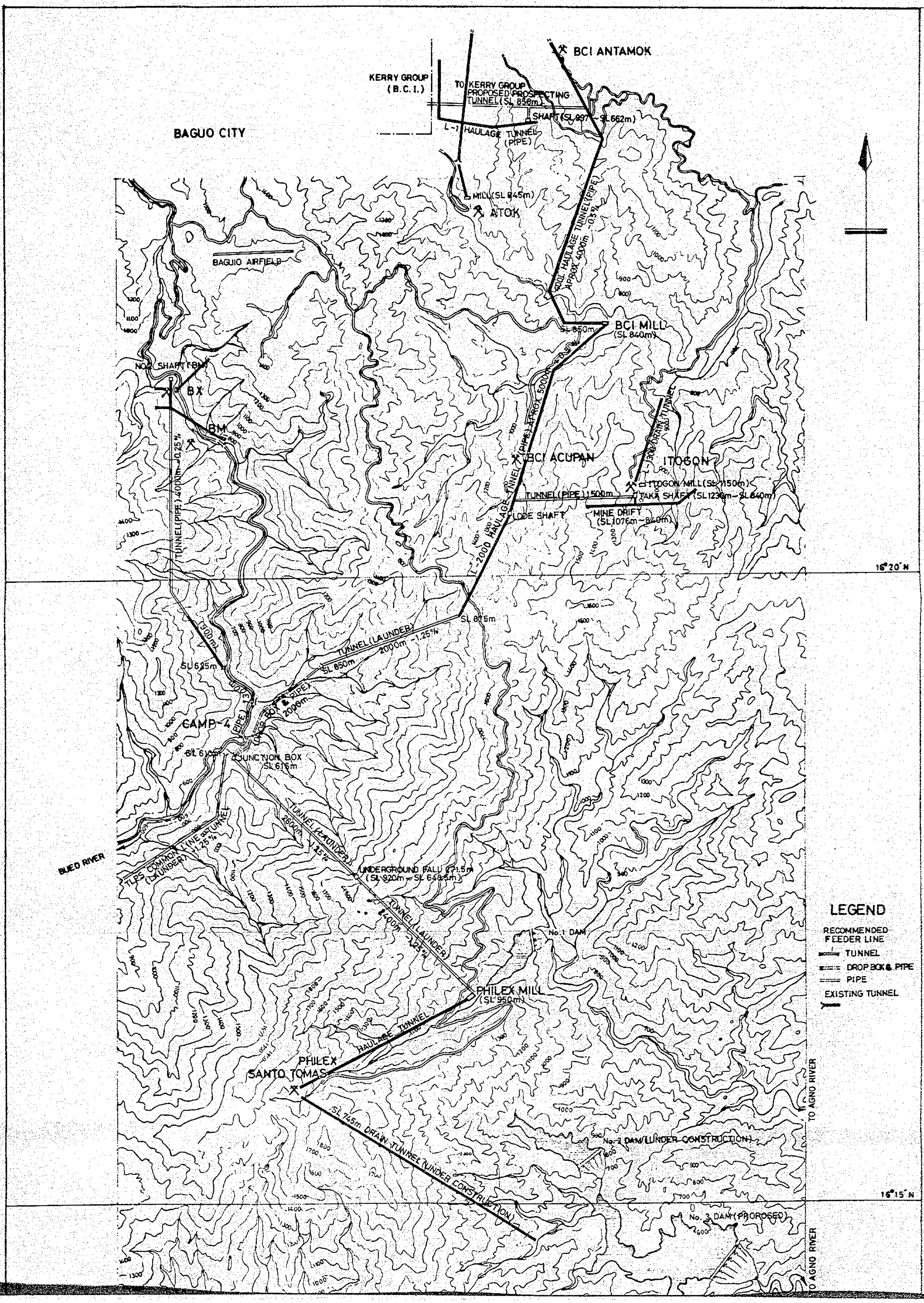

AGOO
SANTO TOMAS
Cupang River
Nemenian
Demeritis
A
B
C
D
Rotoon
5200m
3400m
2500m
3500m
Alacon
Mabitac

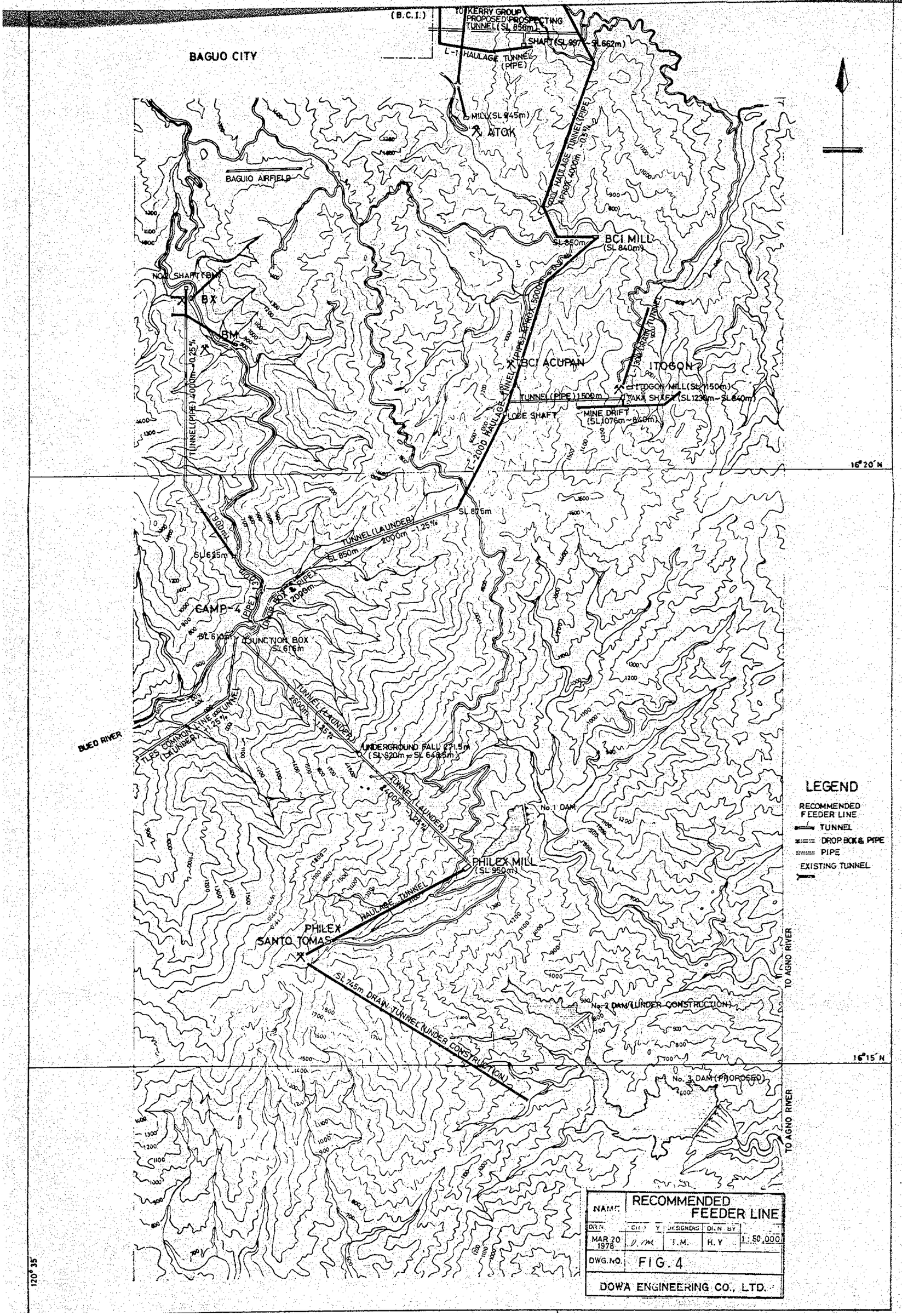


RECLAIMING PLAN

NAME	RECLAIMING PLAN			
DR'N DATE	CH'D BY	DESIGNERS	DR'N BY	SCALE
3. MAR.'78				1:50,000
DWG NO	FIG — 3			

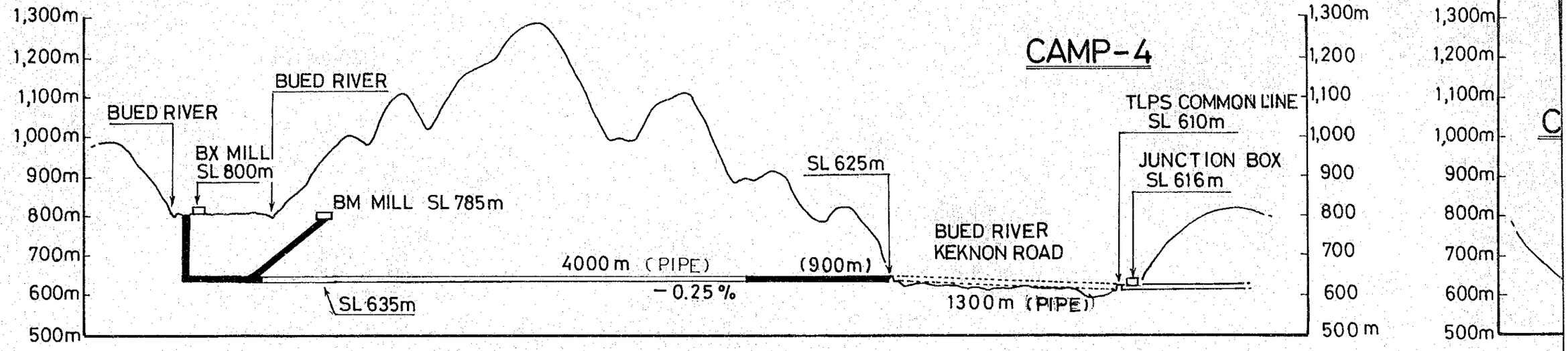
DOWA ENGINEERING CO. LTD.


BCI ANTAMOK
KERRY GROUP
(B.C.I.)
TO KERRY GROUP
PROPOSED PROSPECTING
TUNNEL (SL 856m)
SHAFT (SL 997 ~ SL 662m)
L-1 HAULAGE TUNNEL
(PIPE)
BAGUO CITY
MILL (SL 845m)
ATOK
L-1000 HAULAGE TUNNEL (PIPE)
APROX. 4000m -0.3%
BAGUIO AIRFIELD
SL 850m
BCI MILL
(SL 840m)
NO. SHAFT (BM)
BX
BM
BCI ACUPAN
L-2000 HAULAGE TUNNEL (PIPE) APROX. 5000m
ITOGON
ITOGON MILL (SL 1150m)
TAKA SHAFT (SL 1236m ~ SL 840m)
TUNNEL (PIPE) 1500m
LODE SHAFT
MINE DRIFT
(SL 1076m ~ 840m)
1300 DRAIN TUNNEL
TUNNEL (PIPE) 4000m -0.25%
16°20' N
SL 875m
TUNNEL (LAUNDER)
2000m -1.25%
SL 850m
SL 625m
CAMP-4
DROP BOX & PIPE
2000m
(PIPE) 1300m
SL 610m
JUNCTION BOX
SL 616m
TUNNEL (LAUNDER)
2600m -1.25%
TLPS COMMON LINE TUNNEL
(LAUNDER) -1.25%
BUED RIVER
UNDERGROUND FALL 271.5m
(SL 920m ~ SL 648.5m)
TUNNEL (LAUNDER)
2400m -1.25%
No. 1 DAM
PHILEX MILL
(SL 950m)
HAULAGE TUNNEL
PHILEX
SANTO TOMAS
SL 745m DRAIN TUNNEL (UNDER CONSTRUCTION)
No. 2 DAM (UNDER CONSTRUCTION)
No. 3 DAM (PROPOSED)
TO AGNO RIVER
16°15' N
LEGEND
RECOMMENDED FEEDER LINE
TUNNEL
DROP BOX & PIPE
PIPE
EXISTING TUNNEL

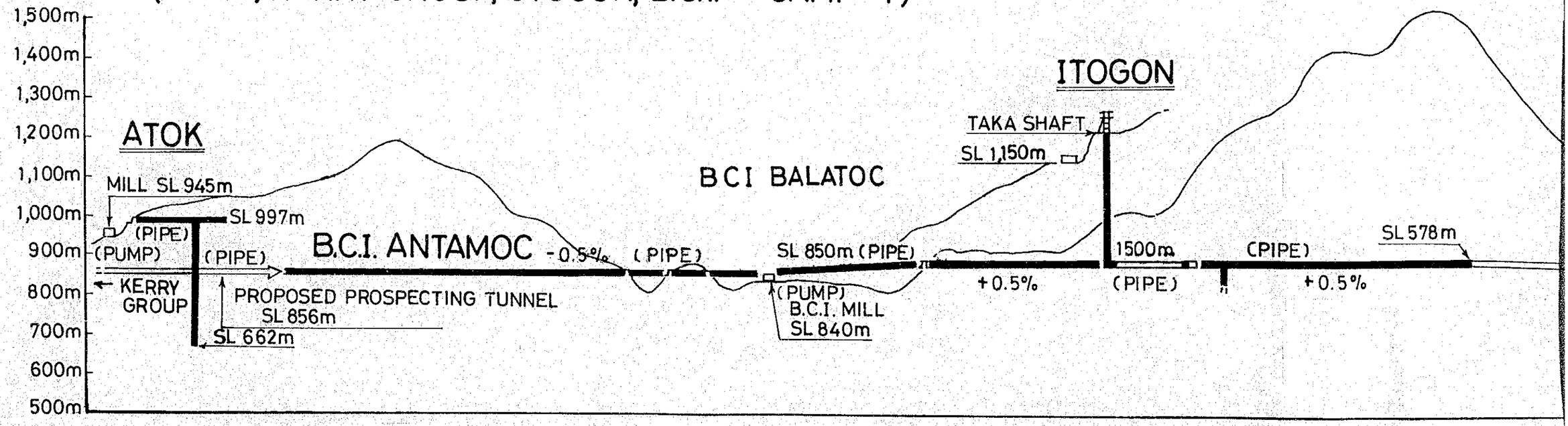


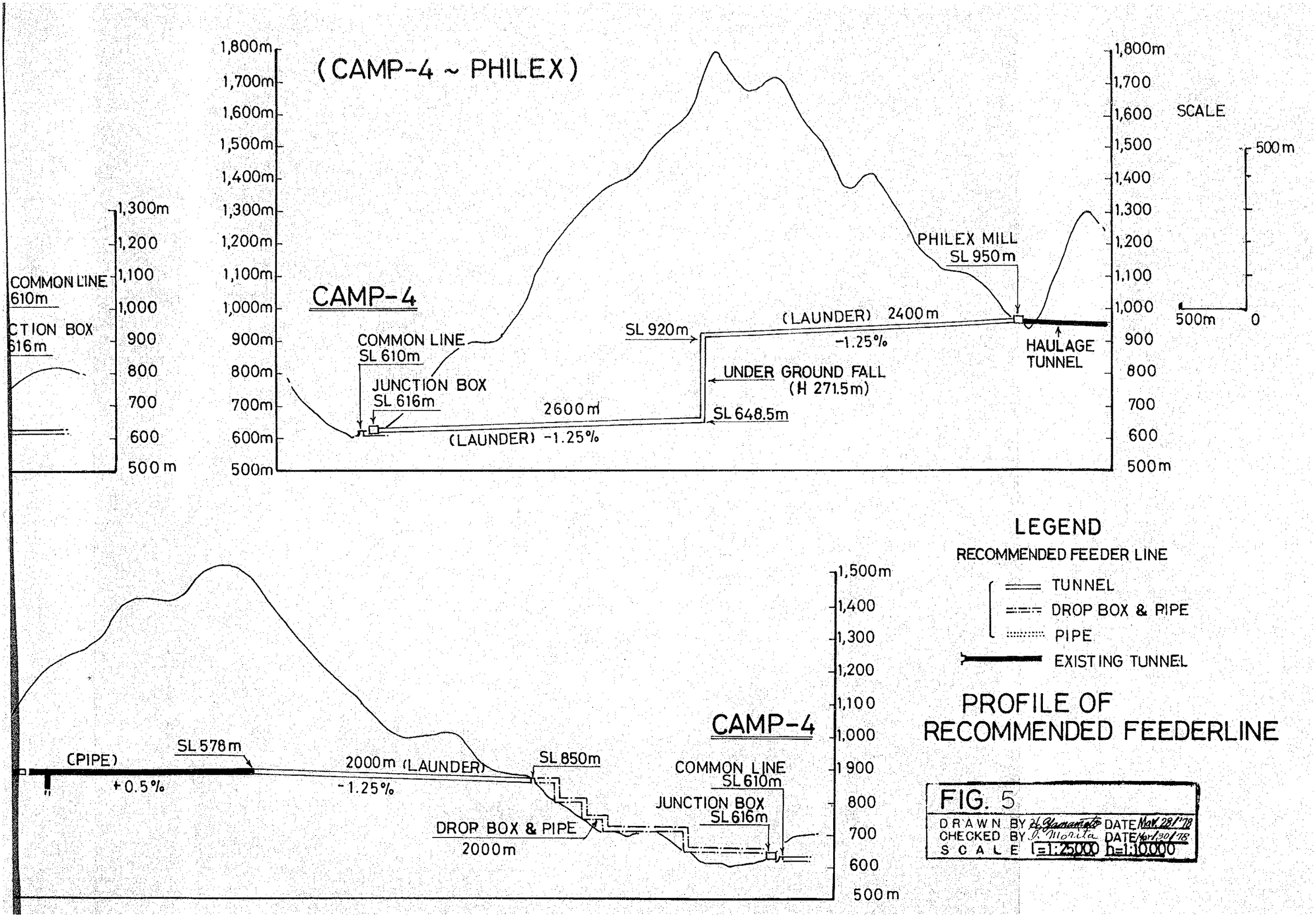
NAME	RECOMMENDED FEEDER LINE			
DRN	CHKD	DESIGNED	DRN BY	
MAR 20 1978		F.M.	H.Y	1:50,000
DWG.NO.	FIG. 4			
DOWA ENGINEERING CO., LTD.				

(BX & BM ~ CAMP-4)



(ATOK, KERRY GROUP, ITOGON, B.C.I. ~ CAMP-4)





PROFILE OF RECOMMENDED FEEDERLINE

FIG. 5

DRAWN BY H. Yamamoto DATE Mar. 28/'78
CHECKED BY I. Morita DATE Mar. 30/'78
SCALE l=1:25000 h=1:10000