ROBE RIVER IRON ASSOCIATES

PROPOSED IRON ORE MINING AT MESA J, DEEPDALE

CONSULTATIVE ENVIRONMENTAL REVIEW

ADDENDUM "A"

RAIL ALIGNMENT OPTIONS

BISHAW GORHAM

1.0 RAIL ROUTE OPTIONS

A number of preliminary engineering studies have been undertaken by Robe to determine the alignment for extension of the existing railhead at Eastern Deepdale to Mesa J and the location of the rail crossing of the Robe River.

During the course of these studies four rail route options were examined in conjunction with consultants engaged primarily to advise on the recommended bridge structures for the rail crossing of the Robe River and to develop preliminary flood flow estimates in both the Robe River and Jimmawurrada Creek.

A copy of the preliminary Robe River Flood Study by AG Consulting Group advising on the estimated flood flows for various rainfall return frequencies of 1 in 5 to 1 in 100 years is attached as Appendix A of this report.

The rail route options examined were:-

Option 1	Extension of rail to western side of Mesa J	Ref. Fig. 1
Option 2	Eastern Rail extension with new yard along eastern escarpment of Mesa J	" 2 and 2a
Option 3	Rail extension as for Option 2 but with alignment of the southern portion of railyard moved 100m east off the escarpment	" 2 and 2b
Option 4	Eastern rail extension with yard positioned on eastern side of Jimmawurrada Creek.	" 3

Option 1

This rail alignment accesses the western margin of Mesa J and routes south-west from the alignment of the existing loadout/tail tracks at eastern deepdale through the Pot Pot Creek valley then swings south across the river to the western side of Mesa J, using the Marra Mamba Iron Formation escarpment that bounds Mesa J to maintain track elevation and grades.

This route requires extensive bridge abutments and a long high level bridge crossing of the Robe River Valley, similar to that proposed under Options 2 & 3, to gain necessary flood clearance across the Robe River Valley to a loadout structure situated some 2600m from the centre of mass of the ore reserves. Note: The original proposal which was initially studied in 1984/85 considered installation of a 600m long rail bridge as compared to the 300m bridge length now being considered.

This route which adds a 3km long 0.4% adverse grade against the loaded train in climbing out of the Robe River Valley and involves a 12.7km extension to the mainline is not recommended due to:-

a) Increased rail haul of 2.3km and adverse grade against the loaded train which adds considerably to locomotive power/running times in an already tight 6 train/day operating schedule.

b) Increase in the average haul distance within the pit of 1000± metres which adds two (2) trucks to fleet requirement for the life of Mine.

The comparable capital cost of the rail, bridge and Jimmawarra Creek for this option is $28.624m

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A fifth route has now been introduced at the request of the EPA. This route which places the rail alignment entirely on top of the Mesa is not considered as an alternative by Robe as the rail yard, the loadout and the loadout stockpile must then be positioned in a deep cutting 100-150 metres wide running on a N-S axis through the entire length of the ore body to the southern boundary and beyond - Ref. Fig 4.

This route which has a comparable construction cost of $27.345m is not considered viable by Robe, as it necessitates the pre-blasting and pre-mining some 12.3Mt of iron ore prior to the construction of the Mesa J rail extension and loadout.

This pre-mining and pre-blasting activity represents approximately 6 months production by a substantial portion of Robe's entire mining fleet and will present operations with a major undertaking as all of this material must be dumped, stockpiled/spread over a very large area of the Mesa top so that it can be re-handled following construction of the new loadout.

Further, after pre-mining and stockpiling of this ore, there would be a additional loss in revenue to the project arising from the quarantining of 16.53Mt of relatively high grade ore (by Robe standards) which would normally be blended with a lower grade ore to meet shipping specifications.

Thus to quarantine this ore results in a loss of a minimum of 18Mt of reserve grade ore which at a nominal price of $18/tonne represents a financial loss of $324,000,000 to the project and $17,000,000 (5.25%) in State revenues, due to loss of direct royalty payments, throughout the life of the Mine.

The routing of each of the options considered by Robe is discussed briefly below, with the advantages/disadvantages of each plus that proposed by the EPA, being considered under tables 1.1 through to 1.5.

Option 1

This rail alignment accesses the western margin of Mesa J and routes south-west from the alignment of the existing loadout/tail tracks at Eastern Deepdale through the Pot Pot Creek valley then swings south across the river to the western side of Mesa J, using the Marra Mamba Iron Formation escarpment that bounds Mesa J to maintain track elevation and grades.

This route requires extensive bridge abutments and a long high level bridge crossing of the Robe River Valley, similar to that proposed under Options 2 & 3, to gain necessary flood clearance across the Robe River Valley to a loadout structure situated some 2600m from the centre of mass of the ore reserves. Note: The original proposal which was initially studied in 1984/85 considered installation of a 600m long rail bridge as compared to the 300m bridge length now being considered.

This route which adds a 3km long 0.4% adverse grade against the loaded train in climbing out of the Robe River Valley and involves a 12.7km extension to the mainline is not recommended due to:-

a) Increased rail haul of 2.3km and adverse grade against the loaded train which adds considerably to locomotive power/running times in an already tight 6 train/day operating schedule.

b) Increase in the average haul distance within the pit of 1000± metres which adds two (2) trucks to fleet requirement for the life of Mine.

The comparable capital cost of the rail, bridge and Jimmawurrada Creek for this option is $28.624m

Option 2 and Option 3

These two options are variants of the same basic route which emanates, as for all options, at the existing loading/tail track area but runs south of the Option 1 route to pass just north of Mesa L, then traverses through the existing Mesa K workings south to the Mesa K scarp from where a moderately high bridge crossing carries the track across to the north-eastern margin of Mesa J, thence down the eastern escarpment of the deposit (Western margin of Jimmawurrada Creek) with the tail track extending to cross the Yarraloola-Millstream road.

The essential difference between the two options is the extent to which the route is nestled into the eastern escarpment of Mesa J. Option two (2) as shown in Figure 2a occupies a greater proportion of the deposit than does option three (3) as in the latter option the loadout site is moved 100 metres off the edge of the orebody and into the adjacent creek valley. To achieve this option, the track alignment is rotated a few degrees east from that of Option two (2) about a point on the Mesa J adjacent to the southern bridge abutment. Ref Fig. 2b

Both options require pre-mining of parts of the orebody down to and below the required track level and pre-blasting of adjacent ore. Ore below track level will be pre-mined to RL156m and back filled with waste up to track formation level RL163 with the ore below RL156 left in-situ and hence lost to mining. Waste from pre-stripping operations will be employed to fill across re-entrants and to construct the rail formation along the tail track section south of the loadout. This embankment will also serve as a flood levee to prevent Jimmawurrada Creek flood waters from entering the mine area.

A substantial quantity or ore is quarantined at the loadout and stockpile areas in both options, Option 3 having the least impact in this regard (refer Table 1.2 & 1.3).

The lengths of trackwork extension for Options 2 and 3 are identical at approx. 10.4km and the comparable rail and bridge works costs total $26.685m and $26.795m respectively.

Option 3 alignment involves premining of less ore, is further removed from the blast area and quarantines only 3.7.Mt as compared to 6.8Mt under option 2, it is therefore Robe's preferred route.

It is however acknowledged that with the positioning of the southern end of the rail yard within the Jimmawurrada Creek, more of the creek environment will be effected.

Option 4

The route for Option four (4) from the termination of the existing track is effectively that for Options 2/3 until Mesa K is reached. At this location the track passes to the east of Mesa K on along high level embankment across the northern flood plain of the Robe to cross the river on a bridge and/or culverted causeway crossing to the eastern bank of Jimmawurrada Creek (see Fig 3). From this point the track is set into the eastern bank (scarp) of Jimmawurrada Creek using cut to fill to maintain the required track elevation.

From the loadout, located on the eastern side of the creek, the tail track curves south then southeast parallelling the course of the main creek drainage. At the extreme southern end of the new yard the track is cut into the bed of Jimmawurrada Creek and therefore a 4 to 6m high levee is required along the western side of the rail formation between Ch.12450 back to the loadout at Ch.10380 approx. to prevent periodic flooding of the tail track and empty car line.

Haulroad access to the loadout and stockpile area requires a high level causeway crossing through Jimmawurrada Creek, and a road bridge across the rail constructed adjacent to the loadout. Alternatively construction of the loadout to the west of the new rail yard could be considered. This however places both the loadout and the ore stockpile in the Creek bed necessitating extensive embankment protection works to be carried out to minimise the exposure of the earth fill structures against scour during flood flows within Jimmawurrada Creek.

In addition to the rail formation and loadout being constructed along the eastern side of this Creek a flood levee is also required to be constructed along the western side of Jimmawurrada Creek from a point some 600 metres north of the loadout access causeway south to the southern limit of the mining area and then across the southern boundary of the mine area. This levee which will have a maximum height of 6 to 7m and a maximum base width of 23 to 25 metres.

Based on a causeway construction being used to across the Robe River the comparable estimated cost of this option which involves a 10.38km extension of the mainline is $28.23M.

The additional costs of replacing the causeway river crossing with a rail bridge and raising the top of rail level above the 1 in 100 year flood level is estimated at $38.668m.

This option requires no pre-mining ore pre-blasting, and quarantines no ore. However, as this option is prone to periodic interruption of the Mine/Rail activities due to flooding within the Jimmawurrada Creek/Robe River system and adds to truck fleet requirements to offset the additional haul distance which is added in crossing to the rail loadout on the eastern side of Jimmawurrada Creek, it is not a preferred option for mining of Mesa J reserves.

Also with the construction of a causeway across the Robe River and the rail embankment, levee and the haulroad across Jimmawurrada Creek there is no environmental advantage seen in pursuing this alignment.

Relocation of Millstream Access Road

The extent of the required relocation of the North West Coastal Highway/ Millstream access road for rail alignment option 2 & 3 and the mesa top alt are shown on Fig 5. No relocation of this road is required for the other options.

2.0 ROBE RIVER RAIL CROSSING TO MESA J

In considering the rail crossing of the Robe River to Mesa J two main alternatives have been reviewed namely:-

- High level bridge structure which elevates the rail such that the Operation of the Mine and Rail are unaffected by 1 in 100 year flood flows in either the Robe River or Jimmawurrada Creek.

- A causeway structure which is designed to overtop periodically in the event of a 1 in 10/20 year return period flood flow within the Robe River. Ref. Rail alignment Option 4.

  This latter alternative is rejected due primarily to the very high velocity of the water flows at the culvert entry and exits during the gradual build-up of the upstream water levels until overtopping of the causeway and the height of the downstream water has risen sufficiently.

  Also extensive embankment protection works are required without any guarantee of the integrity of this structure even under the very low flood condition which would be experienced in a 1 in 10 and above return flood flows.

  Construction of a causeway, despite the lower capital cost, is not a preferred alternative for the rail crossing of the Robe River due to the potential for loss of this structure through periodic flooding and overtopping of the causeway which also causes interruption to both the rail and mining operations for periods varying from 8 hours in the event of a 1 in 5 year flood to 42hrs for the 1 in 100 yr flood flows.

IMPACT OF BRIDGE

General Arrangement of Bridge

The length and location of the bridge proposed for Options 1, 2, & 3 together with the location and lengths of guide banks and levees is as shown on fig 6. Also shown are details of the proposed excavation under the bridge which is considered desirable to eliminate scour in this area and the probability of the scoured material being deposited in to existing pools downstream from the bridge.

The location of the southern abutment of the bridge which is controlled by the need to maintain a minimum length of rail to the north of loadout, protrudes approx. 400 metres into the channel of the Robe River.

This places the northern abutment in the existing low flow channel. Moving the abutment clear of this channel would necessitate increasing the bridge length by 50m at a cost of $750,000.

It is proposed that local re-alignment of the low flow channel be carried out as part of the bridge construction works and thereby eliminate the potential infilling of the downstream pools.

Water Surface levels

The bridge will have very little impact on downstream water levels, but will increase upstream water levels in both the Robe River and Jimmawurrada Creek. For the 100 year flood it is estimated that the backwater caused at the bridge will only be 1.29m after scour has occurred in the bridge opening. This will be lost some distance upstream.

Velocities

Velocities will be slightly lower upstream from the bridge because of the increase in water level due to backwater. The velocity through the bridge opening with the 100 year flood will be about 3.29m/sec, after scour has occurred. This will be quickly dissipated downstream as the width of the stream flow widens to occupy the full river width between embankments under unrestrained flow conditions.

Scour Under the Bridge

It is anticipated that scour under the bridge will be about 4m deep with the 100 year flood. This flow will only lower the bed to the invert level of the existing low flow channel at the bridge site. In addition it is proposed that excavation be carried out to just above ground water level in the bridge opening and the material used in embankment construction. This is equivalent to about 1.5m of scour, which is the scour that would occur with a flood with an ARI between 20 and 50 years. Removing this material will reduce the amount of bed material carried down the river with rare flood events.

Guide Bank at Southern Abutment

The guide bank at the southern abutment is designed to keep the flow from the Jimmawurrada Creek away from the approach embankment and guide it into the bridge opening. The levees along the approach embankment are also designed to perform a similar function. They will, however, restrict, the flow from Jimmawurrada Creek and will cause an increase in water levels upstream and increased velocities. Note:- The number of stream flow guide banks and their length with Jimmawurrada Creek have yet to be resolved.

Construction

Construction of the bridge will necessitate the removal of the vegetation adjacent to the bridge and approach embankments. This can, however, be kept to a minimum and the past experience of the Bridge Consultants Messrs Halpern Glick & Maunsell is that the vegetation will quickly re-establish itself.

CONCLUSION

Flow at the bridge site is controlled by the constriction in the river downstream from the bridge, where the incised valley necks down to a width of about 400 to 500m over some distance. Because of this, only a 300m long bridge is required which will have very little impact on velocities and water levels except in its immediate vicinity. With the exception of rare flood events it is expected that the bridge will have no more effect on the vegetation in the river bed than that which would occur with the existing situation.

It should be noted that the flood levels, backwater and velocities mentioned above are for the 100 year design flood and that floods with smaller return periods will have even less effect, as can be seen from the flow details given under the section heading "Hydraulics". It should also be recognised that the chance of the 100 year flood being equalled or exceeded in the life of the mine is only less than 20%.

It is anticipated that vegetation removed during construction of the bridge will quickly re-establish itself, as has been found with other bridges constructed in the Pilbara. This will be assisted by the plentiful supply of water in the alluvial bed of the river.

RIVER REGIMES IN THE PILBARA

High intensity rainfall generated by tropical cyclones can turn dry river beds into raging torrents in the Pilbara. Typically, flood waves sweep down the river beds removing debris, fallen trees and much of the natural vegetation. An example of a flood wave coming down a river is shown on the photograph shown in Fig 7 which shows a flood wave coming down the Fortescue River after the passage of cyclone "Joan" in December 1975. During such flood events it would be quite common for the whole character of the river bed to change with the removal of vegetation and movement of stream bed material.

DESIGN FLOOD ESTIMATES

The design flows for the proposed rail bridge over the Robe River have been estimated using the very latest hydrological data and computer modelling utilising the RORB program. The flood estimates for various average recurrence intervals (ARIs) are given below:-

ARI (years)	2	5	10	20	50	100
Peak Flow (cu.m/sec)	820	1,810	3,150	4,900	8,200	11,600

These flow are large by world standards being approximately 10 times larger than the peak flow from an equivalent catchment in the south of the State.

HYDRAULICS

Modelling a reach of the Robe River, either side of the bridge site and part way up the Jimmawurrada Creek, for the 100 year flood results in the following flows, water surface levels, average velocities and maximum flow depths:-

Section	Distance (m)	Flow (cu/m/sec)	Velocity (m/sec)	Flow Depths (m)	
1.	0	11,600	2.56	9.86	Robe River
2.	1,275	11,600	2.51	10.22	"
3.	2,345	11,600	2.81	9.87	"
4.	2,995	11,600	2.57	14.06	"
5.	3,855	11,600	1.43	14.29	Bridge Site
6.	4,845	8,450	0.68	11.86	Robe River
7.	5,345	8,450	0.73	9.04	"
8.	850	3,150	1.26	8.29	Jimmmaw. Crk
9.	1,750	3,150	1.43	7.34	"
10.	2,790	3,150	1.55	7.41	"

The distances given in the above table start in the Robe River from section 1 downstream and continue upstream to section 7. The distances up Jimmawurrada Creek commence at the bridge site. The incised river valley at the bridge site is about 800m wide, but downstream the valley decreases in width to about 400 to 500m. This has a throttling effect on the flow at the bridge site and is evident in the low velocities at sections 5, 6 and 7. Ref Fig 8.

The water surface elevations and velocities given above have been derived assuming that the trees growing in the river bed are not removed with the 100 year flood. Removal of the vegetation would have the effect of increasing velocities and lowering water surface levels. This would be particularly so in the narrower river valley downstream from the bridge.

Examination of the trees in the river bed adjacent to the bridge site shows that there are a few very large eucalyptus and malaleuca trees with diameters up to about 2m, whilst the majority of the trees have much smaller girths. This would indicate that the larger trees have survived some past flood event and the rest have grown since that time. This could have occurred in 1958 or earlier with the passing of cyclones close to the the Robe River catchment.

Details of natural stage heights, backwaters, depths of scour and velocities for various average recurrence intervals (ARIs) are given below, for the 300m long bridge.

ARI (yrs)	Flow (cu.m/sec)	Stage (m)	Scour (m)	Backwater (m)	Velocity (m/sec)
2	820	149.71	0.0	0.78	2.32
5	1,810	151.23	0.0	0.81	2.46
10	3,150	152.71	0.0	1.02	2.83
20	4,900	154.21	0.0	1.30	3.25
50	8,200	156.44	1.8	1.28	3.25
100	11,600	158.29	4.0	1.29	3.29

N.B. The limiting velocity when scour will cease has been estimated to be about 3.25m/sec. The slight discrepancy in backwater with increase in Average Recurrence Internal (ARI) is due to changes in slope caused by the throttling effect of the construction in the downstream channel. That is the slope decreases with increase in flood magnitude.

Embankment Protection Armour/Quarry

Due to the absence of an sizeable quantity of competent rock within the area of the mesas, a rock quarry will need to established at AMG co-ordinates E427,000 and N7603,000 as indicated on Fig 2.

Note: 1) The position of this quarry will be more accurately defined after preliminary drilling of this area to establish the nature of the rock.

2) The location of the proposed quarry site is outside the existing mineral lease.

T A B L E 1.1

RAIL OPTION 1 - EXTENSION OF RAIL TO WESTERN SIDE OF MESA J

Rail Route Option	Mainline Extension (km)	Estimated Cost incl. Bridgework	Ore quarantined	Merits of Option	Demerits of Option
Option 1	12.7km plus 11.8km of yardtrack for single loadout	$28.624M + $4M for additional loco & 3.2M for two (2) extra haul-truck.	Nil - Rail route off orebody	All rail loading and stockpile areas located off orebody	Route is longer, therefore construction cost high. Adds a very heavy lift of 3km at 0.4% grade against the loaded rail haul in climbing out of the Robe River valley. This adds considerably to rail trip time and hence ore car requirements. An additional locomotive is required. Loadout is positioned some 2.6km from the centre of mass of the orebody or 1000m further than options 2/3. Therefore cost of mining operation is increased considerably at $3.2M initial capital + $5M operation costs over Life of Mine. A flood levee is required along the western bank of Jimmawurrada Creek and across southern boundary to prevent flood waste from entering the mine. Loadout & workshops, would be located considerably removed from mining area.

OPTION 2 - EASTERN RAIL EXTENSION WIDTH MESA J YARD
ALONG EASTERN ESCARPMENT OF MESA J

Rail Route Option	Track Extension (km)	Estimated Cost incl. Bridgework	Ore quarantined	Merits of Option	Demerits of Option
Option 2 (High Road)	10.4km	$26,685M	Total quantity of ore which is quarantined or pretreated is 12.26Mt comprising:- <u>Quarantined ore below RL156</u> - Premined zone - 4.371Mt - Preblasted zone - (4.741)Mt (ie west of rail) x 90% Total = 8.64Mt <u>Premined ore</u> - Along rail alignment to RL 156 - 1.393Mt - Preblast zone east of rail - (4.741)Mt x 10% Total = 1.86Mt - Preblast ore ie West of rail to RL 156 - 1.735Mt	Alignment of the new Mesa J yard is set on top of and along the eastern escarpment of this mesa. Length of mainline rail haul added from E.Deepdale is minimal at 10.4km. Rail alignment and grades against the loaded train in climbing out of the Robe Valley are acceptable with a top of rail and bridge at RL. 164. Bridge & top of rail elevation is designed to pass 1 in 100 year flood in accord with the design criteria for the remaining 185km length of the Cape Lambert to Panna rail line.	Loadout structure will be more susceptible to fly rock damage during 1st 5/6 years of operation. Timing for erection of maintenance building on top of the Mesa and adjacent to the mining area will be delayed by a further 18 to 24 months (ie now in 1994/95 in lieu of 1993) due to need to premine. Considerably more ore (3.3Mt) is quarantined over that proposed under Option 3. Quarantine of 8.6Mt of high grade ore results in loss of approx. 10Mt of ore from reserves. Est. cost of $18/t = $180M lost from life of mine revenue. Estimated cost of pre-mining and preblasting of 3.6Mt of ore is $6M.

Option 2 ...

Rail Route Option	Mainline Extension (km)	Estimated Cost incl. Bridgework	Ore quarantined	Merits of Option	Demerits of Option
				Rail formation along the eastern escarpment of Mesa J also serves as flood levee. Alignment of rail is moved 100 metres west of Option 3 and sits on eastern boundary of ore reserves. This minimises extent of vegetation that must be cleared at the southern end of Jimmawurrada Creek. Average length of truck haul is lowest of all options and marginally improved over that of Option 3.	With loadout and rail alignment moved 100metres west this places these structures in a position where they are more susceptible to fly rock damage from blasting operations during the first 5/6 years of mining.

OPTION 3 - EASTERN RAIL EXTENSION AS FOR OPTION 2 BUT WITH THE LOADOUT MOVED 100m WEST (LOW ROAD)

Rail Route Option	Mainline Extension (km)	Estimated Cost incl. Bridgework	Ore quarantined	Merits of Option	Demerits of Option
Option 3 (Low Road)	10.4km	$26.795	Total quantity of ore which is quarantined or pre treated is 7.98Mt comprising:- <u>Quarantined below RL156</u> - Premined zone - 1.591Mt - Preblast zone -(4.131)Mt 90% west of rail x 90% Total = 5.31Mt <u>Pre Mined Ore</u> - Along rail & above RL156 - 0.837Mt - Preblast zone on east of rail - 4.131 x 10% Total = 1.25Mt Preblast ore west of rail above RL156 - 1.51Mt	Major portion of rail alignment and loadout s/pile areas located off orebody. Length of added rail from E. Deepdale is minimal at 10.4km. Rail alignment and grades against the loaded in climbing out of the Robe River Valley are acceptable as bridge elevation is set at RL164.00m. Bridge & top of rail elevation is designed to pass 1 in 100 year flood in accord with the design criteria set for the existing Cape Lambert/ Pannawonica rail line.	Width at base of rail formation in Creek bed varies from 64m to 40 as compared to 36m from flood levee. Therefore more clearing of vegetation in creek bed required. Average length of truck haul increased by 100m for life of Mine. Quarantining of 5.31Mt of high grade ore i.e. conservative loss of approx. 6.5Mt of ore from reserves. Est. loss in revenue at $18/t = $117M.

OPTION 3 - EASTERN RAIL EXTENSION AS FOR OPTION 2 BUT WITH THE LOADOUT MOVED 100m WEST (LOW ROAD)

Rail Route Option	Mainline Extension (km)	Estimated Cost incl. Bridgework	Ore quarantined	Merits of Option	Demerits of Option
				Estimated cost of premining and pre blasting is less than Option 2 at 2.72Mt at a cost of $4.5M. Rail formation along the western edge of Jimmawurrada also serves dual purpose of flood levee. Position of load-out structures is minimum distance of 200m from back face of blasts.	

OPTION 4 - EASTERN RAIL EXTENSION WITH YARD POSITIONED ON EASTERN SIDE OF JIMMAWURRADA CREEK

Rail Route Option	Track Extension (km)	Estimated Cost incl. Causeway	Ore quarantined	Merits of Option	Demerits of Option
Option 4	10.36km	$28.22M causeway or $38.77M bridge	Nil - entire route off orebody	Length of rail extension is comparable to that of Options 2 & 3. All rail loading and stockpile areas located off orebody & positioned along eastern edge of Jimmarurrada Creek. By construction of a causeway across the Robe River in lieu of a bridge the capital cost of this option is reduced considerably by lowering top of rail RL.159.5m.	With rail causeway across Robe River the rail is susceptible to seasonal flooding & interruption of the Mine and Rail operations for periods of 8 to 42 hours following cyclones at average of 2-3 times per year. Causeway likely to be extensively damaged in event of a 1 in 10 year flood or larger, totally disrupting Mine/Rail activities until repairs can be effected. A causeway and major road bridge must be constructed across Jimmawurrada Creek for haul truck access to the loadout. Option here is to construct loadout in centre of Jimmawurrada Creek. Length of truckhaul increased by nominal 600m & 500m for Life of Mine respectively for either options 2 or 3.

OPTION 4 - EASTERN RAIL EXTENSION WITH YARD POSITIONED ON EASTERN SIDE OF JIMMAWURRADA CREEK

Rail Route Option	Track Extension (km)	Estimated Cost incl. Causeway	Ore quarantined	Merits of Option	Demerits of Option
					Levee along western side of Jimmawurrada Creek. South end of tail track is cut into creek bed and also requires a levee. A bridge in lieu of causeway across the Robe River results in 2600m of very high rail formation which requires protection and therefore the cost increases substantially.

OPTION 5 - HYPOTHETICAL MESA TOP RAIL ROUTE
AS REQUESTED BY EPA OFFICERS
I.E. EASTERN RAIL EXTENSION WITH COMPLETE YARD ON TOP OF MESA J

Rail Route Option	Mainline Extension (km)	Estimated Cost incl. Bridgework	Ore quarantined	Merits of Option	Demerits of Option
Option 5	10.4	$27.345M * * This cost does not include for the cost of premining which is estimated to be equivalent to ½ the cost of Robe current annual mining capacity.	100% of rail route on Mesa top sterilizes or requires the pre-treatment of 28.825Mt iron ore. Due to the impracticality of premining and or preblasting below RL156 and the contruction of rail formation below the water table, the estimated quantities of this ore which must be quarantined or prehandled is:- Quarantined ore below RL156:- - Premined Zone 10.295 Mt - Preblast Zone 9.629 Mt Less ore on eastern side to bench RL which is pre-blasted but must be hauled to loadout S/ pile prior to construction of rail - Allow bench 2 ore x 50%. (6.798)/2 Mt	All rail loading and stockpile areas located on orebody and thus minimal physical damage will be done to vegetation within Jimmawurra-da Creek.	All rail including the loadout and loadout stockpile will be located on mesa top vertically cutting through the ore body. Impossible to preblast to RL132 max. will be 20-25m depth in any one blast. Therefore a considerable portion of the ore in the lower benches will be impractical to Mine. With loadout and rail squeezed in between the main orebody to the west and an outcrop to the east these facilities are totally exposed to damage by fly rock for most (10-12 years) of the Life of Mine. All blasting within 3/500 metres of the loadout/rail or truck service facilities will have to be carried out at times that the rest of the Mine is not working. This will be impracticable once we move to a 6/7 day per week operation.

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OPTION 5 - HYPOTHETICAL MESA TOP RAIL ROUTE
AS REQUESTED BY EPA OFFICERS
I.E. EASTERN RAIL EXTENSION WITH COMPLETE YARD ON TOP OF MESA J

Rail Route Option	Mainline Extension (km)	Estimated Cost incl. Bridgework	Ore quarantined	Merits of Option	Demerits of Option
		$27.345M	Total quarantined = 16.50Mt Ore to be Premined comprising:- - Rail alignment to RL156 2.511Mt - Preblasted east 2.035Mt i) Bench 1 ii) Bench 2 3.399Mt - East of rail 2.218Mt Total 10.24 Mt - Ore to be preblasted west of rail above RL156 - 2.06Mt.	Haulroad bridge will be required for truck access to be gained to the loadout for all ore to east of the rail unless it is pre-mined. Truck maintenance buildings cannot be located on mesa top for first 6 to 8 years of mining. Quarantining of some 16.50Mt of ore causes a loss of a min of 18Mt from total usable ore reserves at an estimated loss of $324M in revenue over total life of Mine. Estimated costs of premining and preblasted ore to be won and stockpiled on mesa top is $16.9M.	

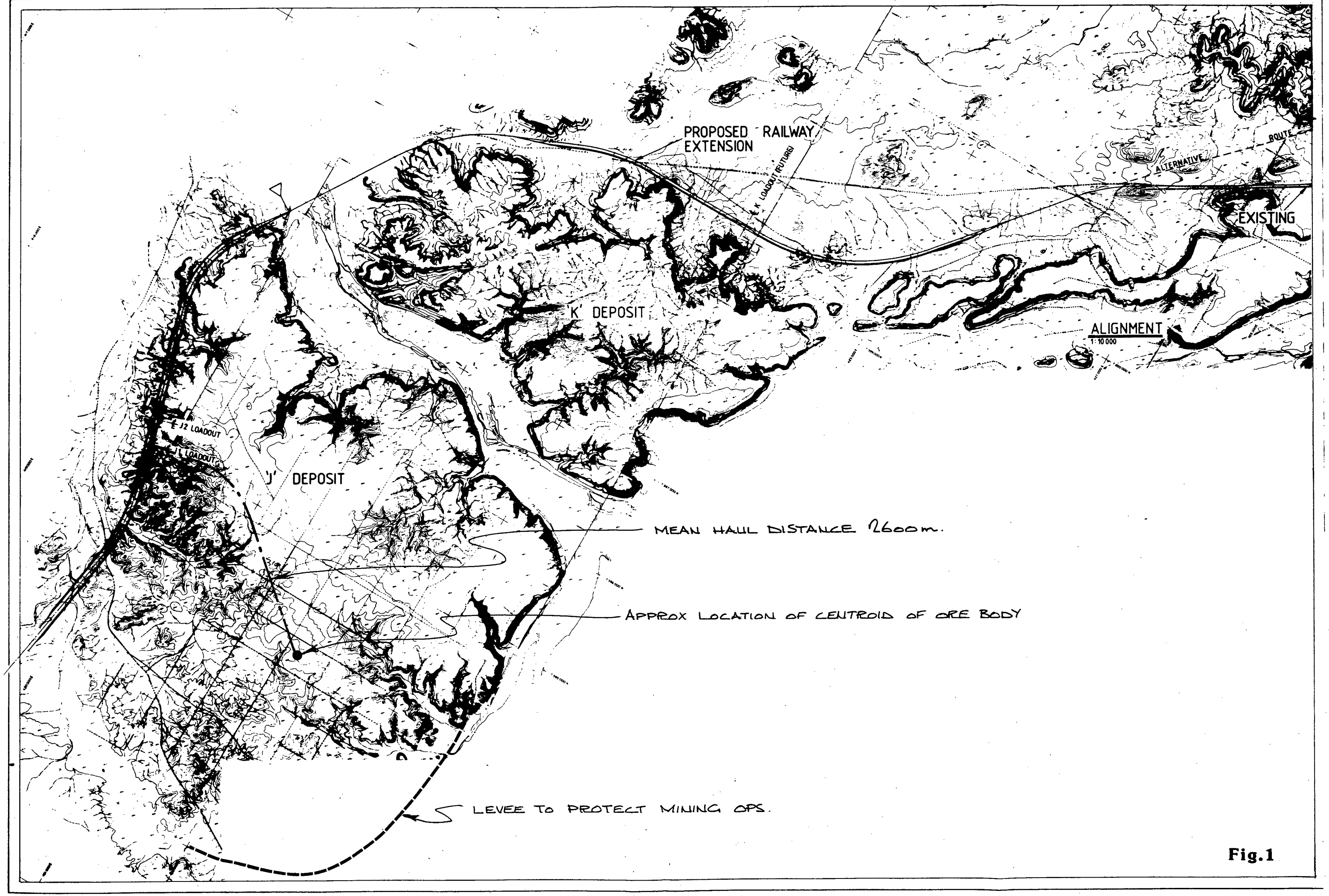

PROPOSED RAILWAY EXTENSION
K LOADOUT (FUTURE)
ALTERNATIVE ROUTE
EXISTING ALIGNMENT
1:10 000
K' DEPOSIT
J2 LOADOUT
J LOADOUT
J' DEPOSIT
MEAN HAUL DISTANCE 2600m.
APPROX LOCATION OF CENTROID OF ORE BODY
LEVEE TO PROTECT MINING OPS.

Fig.1


ML 248 S.A.
Part Sec.107
ROCK QUARRY
END OF EXIST. RAIL YARD
EXIST. LOADOUT
EXIST. HAUL ROAD
DENOTES LEASE BOUNDARY (TYP.)
EXISTING 33kV POWERLINE
EXISTING MESA 'K' SUBSTATION
NEW ACCESS ROAD
NEW 33kV POWERLINE
SECURITY BUILDING
RAIL BRIDGE
MINE SERVICES SUBSTATION
LOADOUT SUBSTATION
TO END OF TRACK AT CH 1295/2.61
ML 248 S.A.
Part Sec.105 & 106
MEAN HAUL DISTANCE 1600 m.
APPROX LOCATION OF CENTROID OF ORE BODY
428 000 E
427 000 E
426 000 E
425 000 E
423 000 E
7 602 000 N
7 600 000 N
7 597 000 N
7 595 000 N
7 593 000 N
ROBE
ROBE RIVER IRON ASSOCIATES
CAPE LAMBERT/W.A.
MESA 'J' DEVELOPMENT
GENERAL AREA PLAN SHOWING
LEASE BOUNDARIES
1:10 000
25-1-91
C

Fig.2

EXCLUSION ZONE
(MUNGAROOMA POOL)

HIGH ROAD OPTION

PRE-BLAST BUFFER ZONE

PRE-BLAST BUFFER ZONE

STOCKPILE

MAP SCALE
SCALE 1:5000.
0 50 100 150 200 250 300 350 400 450 500

LEGEND
ULTIMATE PIT LIMIT
WASTE STRIPPING LIMIT
PROPOSED RAILWAY

ROBE RIVER MINING CO.PTY.LTD.
DEEPDALE MINE DEVELOPMENT
MESA J OREBODY
OFFICE | DEPARTMENT

PROPOSED RAILWAY ROUTE
OPTION No.2 (HIGH ROAD)

DATE	SCALE	DRAWING NUMBER
08-11-91	1:5000. M	

Fig.2a

Fig.2a

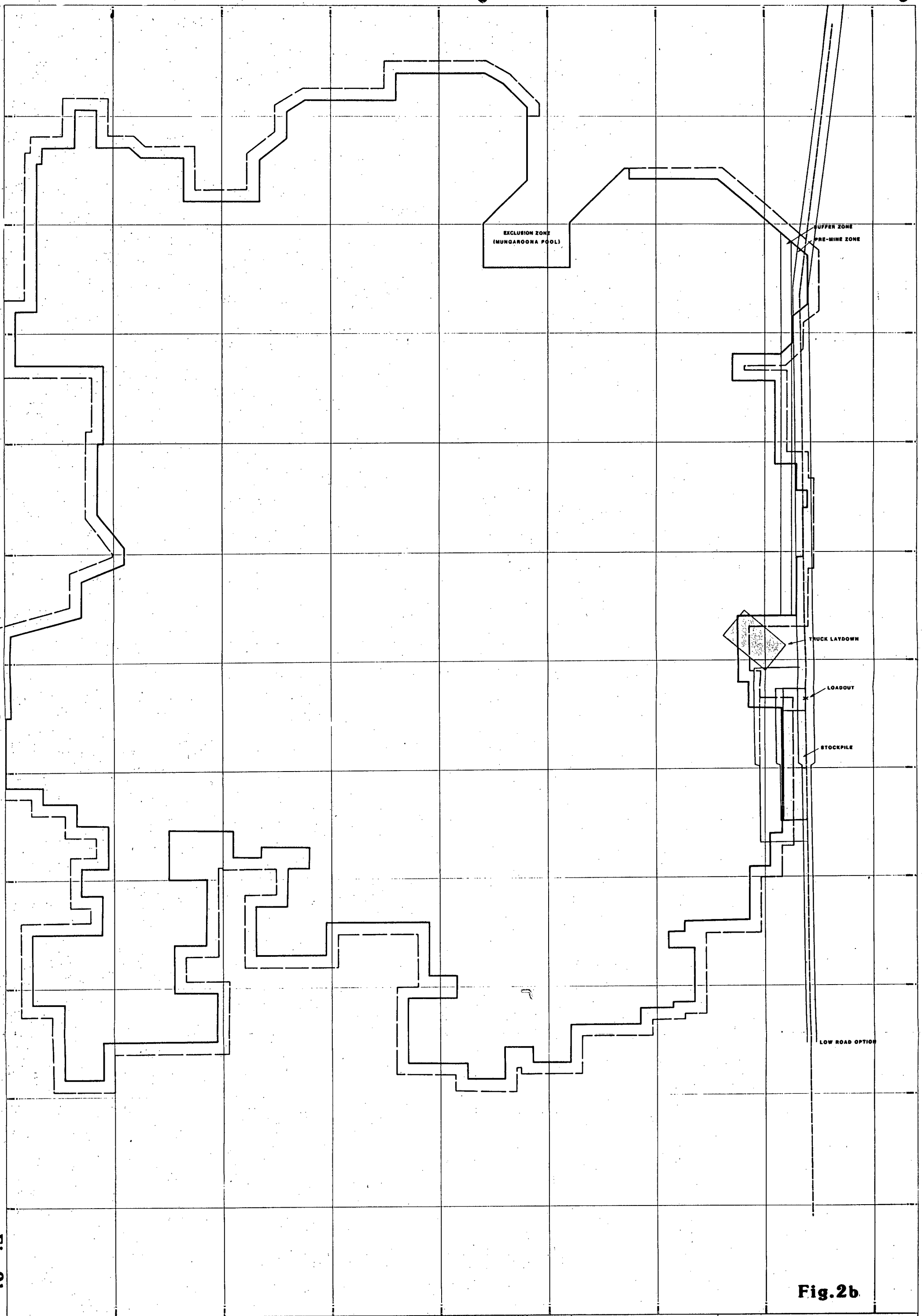

EXCLUSION ZONE
(MUNGAROONA POOL)
BUFFER ZONE
PRE-MINE ZONE
TRUCK LAYDOWN
LOADOUT
STOCKPILE
LOW ROAD OPTION
MAP SCALE
SCALE 1:5000.
0 50 100 150 200 250 300 350 400 450 500
LEGEND
ULTIMATE PIT LIMIT
WASTE STRIPPING LIMIT
PROPOSED RAILWAY
ROBE RIVER MINING CO.PTY.LTD.
DEEPDALE MINE DEVELOPMENT
MESA J OREBODY
OFFICE
DEPARTMENT
PROPOSED RAILWAY ROUTE
OPTION No.3 (LOW ROAD)
DATE
SCALE
DRAWING NUMBER
08-11-91
1:5000. M

Fig.2b

Fig.2b

N

EXISTING LOADOUT

RAILROAD EXTENSION

CH 1000

CH 2000

CH 3000

CH 4000

CH 5000

CH 6000

CH 7000

CH 8000

CH 9000

CH 10000

CH 10340

RAIL CAUSEWAY ACROSS ROBE RIVER FLOOD PLAIN WITH T.O.R. AT RL 159.5

LEVEE TO PROTECT TAIL TRACK

HAULROAD BRIDGE ACROSS YARD TRACKS

HAULROAD CAUSEWAY ACROSS IMMAMURRADA CREEK

MEAN HAUL DISTANCE 2100m.

LEVEE TO PROTECT MINING OPS.

APPROX. LOCATION OF CENTROID OF ORE BODY

NOTES

1 ALIGNMENT SHOWN IS ALTERNATIVE 1A. ROUTE FOR ALTERNATIVE 1B IS IDENTICAL BUT STARTS AT THE END OF E.D TAILTRACK AT CH 2000

ROBE

ROBE RIVER IRON ASSOCIATES
CAPE LAMBERT/W.A.

MESA J DEVELOPMENT
R.O.M.
ALTERNATIVE RAIL EXTN.
ROUTE

1:10 000

Fig.3

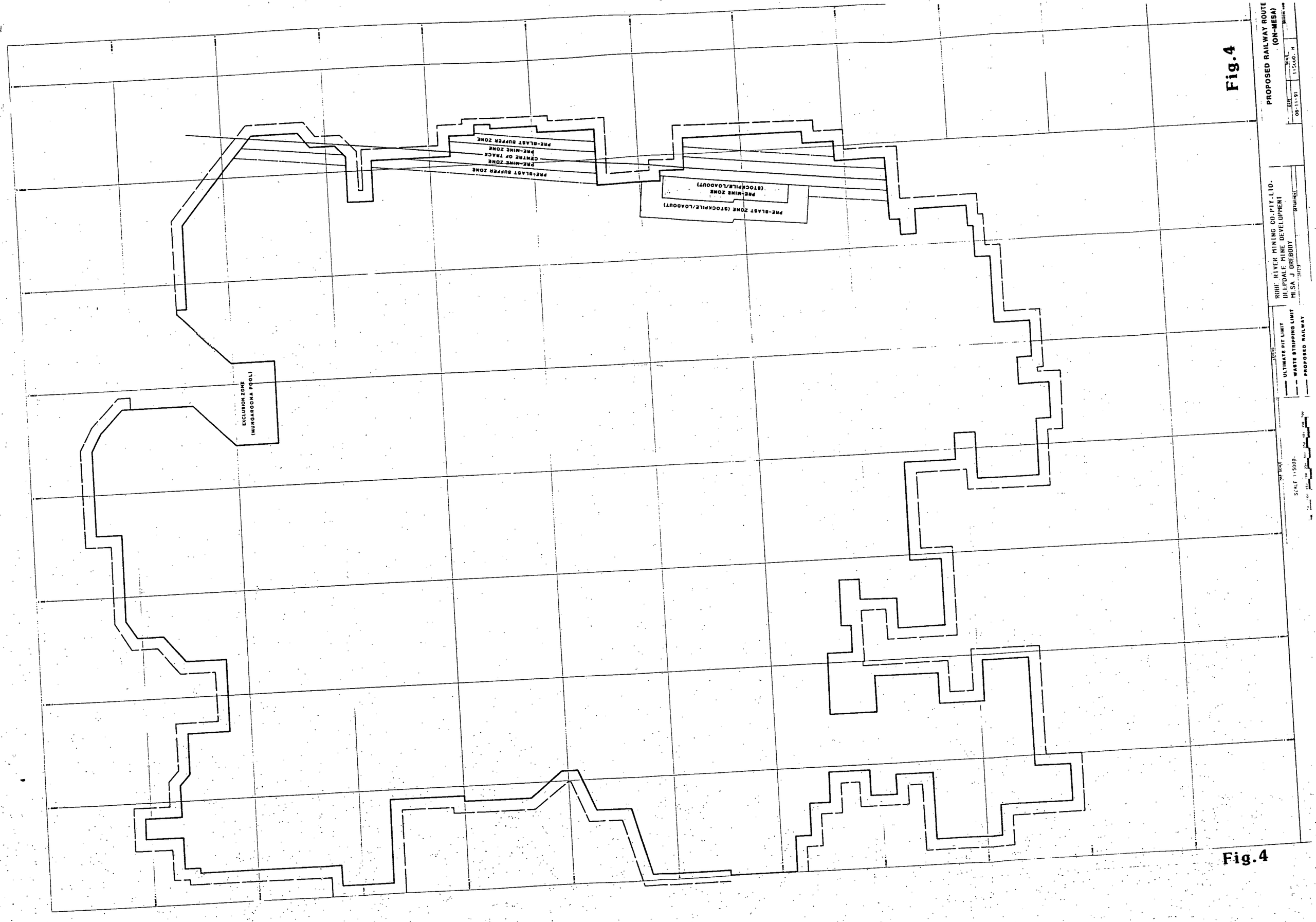

PRE-BLAST BUFFER ZONE
PRE-MINE ZONE
CENTRE OF TRACK
PRE-MINE ZONE
PRE-BLAST BUFFER ZONE
PRE-BLAST ZONE (STOCKPILE/LOADOUT)
PRE-MINE ZONE
(STOCKPILE/LOADOUT)
EXCLUSION ZONE
(MURGAROOHA POOL)
PROPOSED RAILWAY ROUTE
(ON-MESA)
ROBE RIVER MINING CO.PTY.LTD.
DILPIDALE MINE DEVELOPMENT
MESA J OREBODY
ULTIMATE PIT LIMIT
WASTE STRIPPING LIMIT
PROPOSED RAILWAY
SCALE 1:5000.
08-11-91
1:5000.

Fig.4

Fig.4

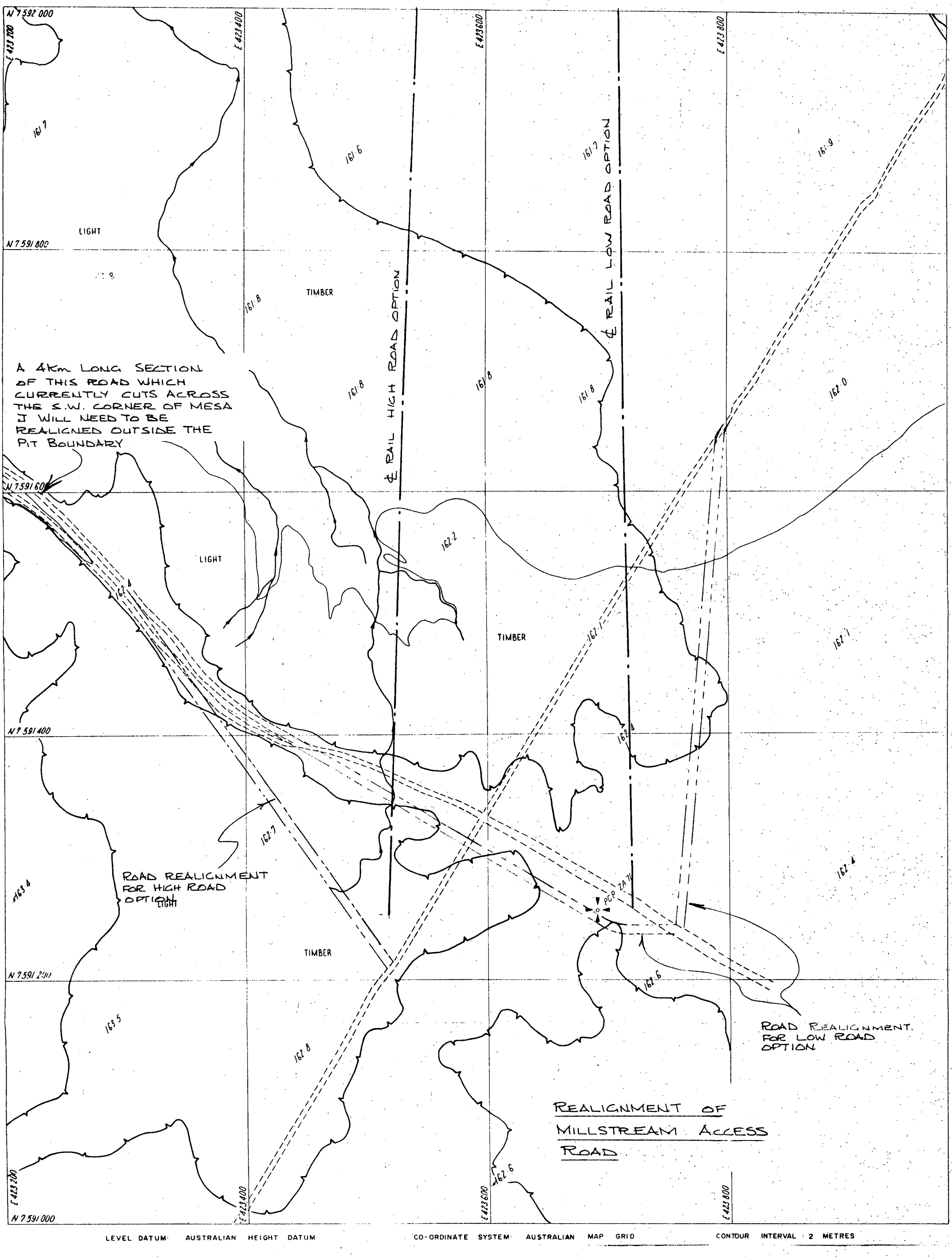
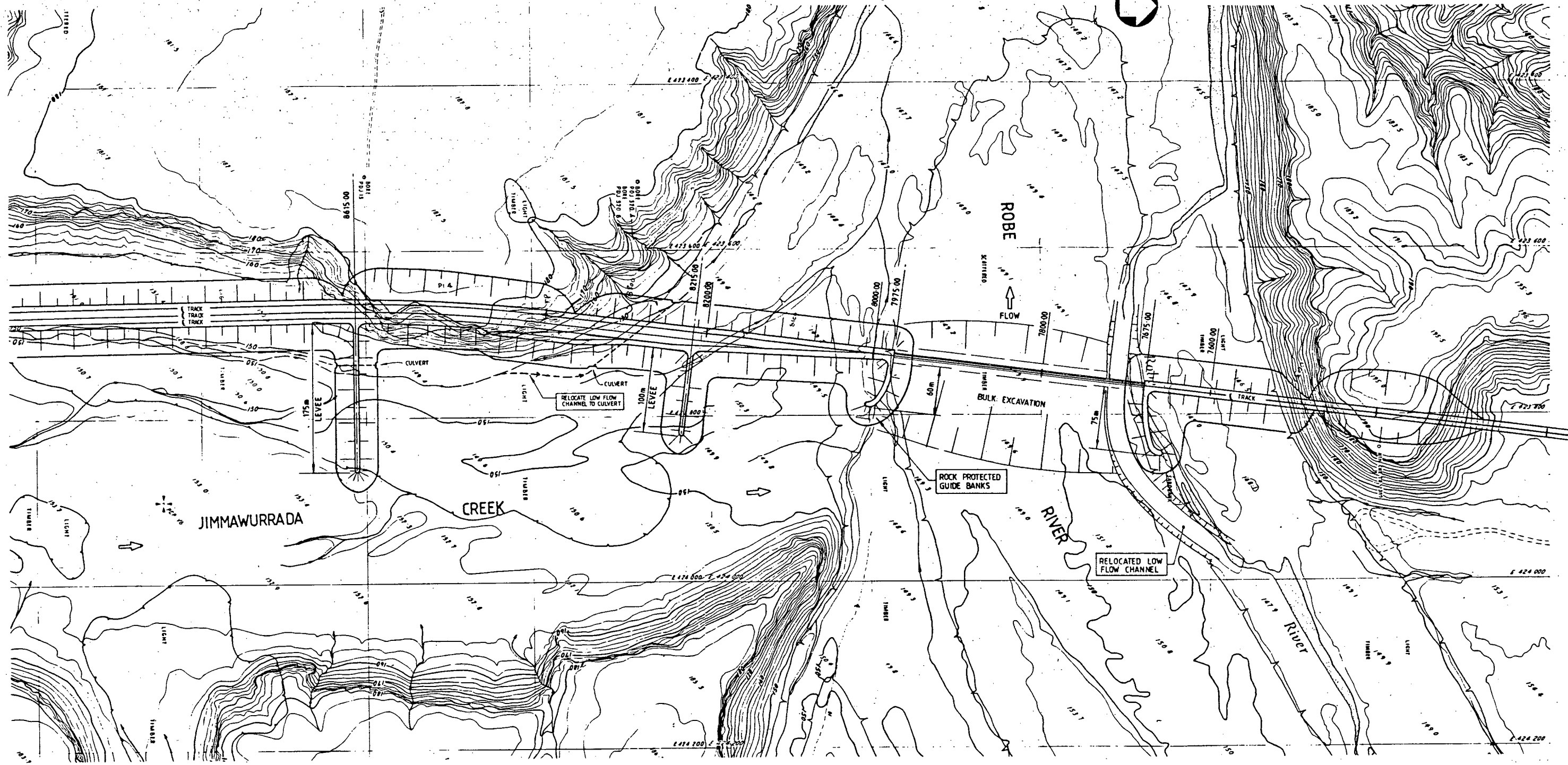
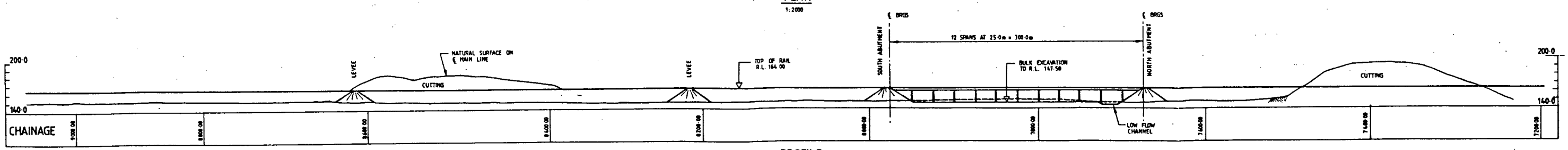

N 7592 000
E 423 200
E 423400
E 423600
E 423 800
N 7591 800
N 7591 600
N 7591 400
N 7591 200
N 7591 000
LIGHT
TIMBER
161·7
161·6
161·5
161·9
161·8
162·0
162·2
162·4
162·1
162·7
162·4
163·4
163·5
162·8
162·6
A 4km LONG SECTION OF THIS ROAD WHICH CURRENTLY CUTS ACROSS THE S.W. CORNER OF MESA J WILL NEED TO BE REALIGNED OUTSIDE THE PIT BOUNDARY
℄ RAIL HIGH ROAD OPTION
℄ RAIL LOW ROAD OPTION
ROAD REALIGNMENT FOR HIGH ROAD OPTION
PCP 2A 7
ROAD REALIGNMENT FOR LOW ROAD OPTION
REALIGNMENT OF MILLSTREAM ACCESS ROAD
LEVEL DATUM: AUSTRALIAN HEIGHT DATUM
CO-ORDINATE SYSTEM: AUSTRALIAN MAP GRID
CONTOUR INTERVAL: 2 METRES

Fig.5

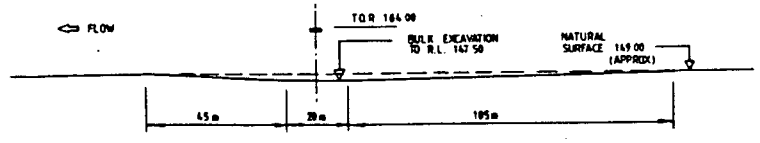
Fig.5



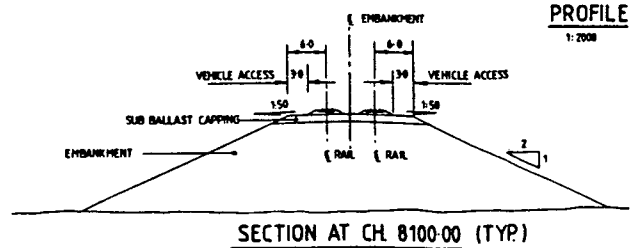
PLAN
1: 2000



PROFILE
1: 2000



SECTION AT CH. 7800·00
1: 1000



SECTION AT CH. 8100·00 (TYP.)
1: 500

ITEM	SUB ITEM	No OFF	DESCRIPTION	LENGTH	WEIGHT	MAT'L	RRIA PT No	REMARKS

REV	DATE	REVISIONS	BY	DFTG SUPV	ENG	CONST ENG	CLIENT

REF DRG No

TOLERANCES
UNLESS OTHERWISE STATED ALL DIMS ARE ± 1 mm

ROBE

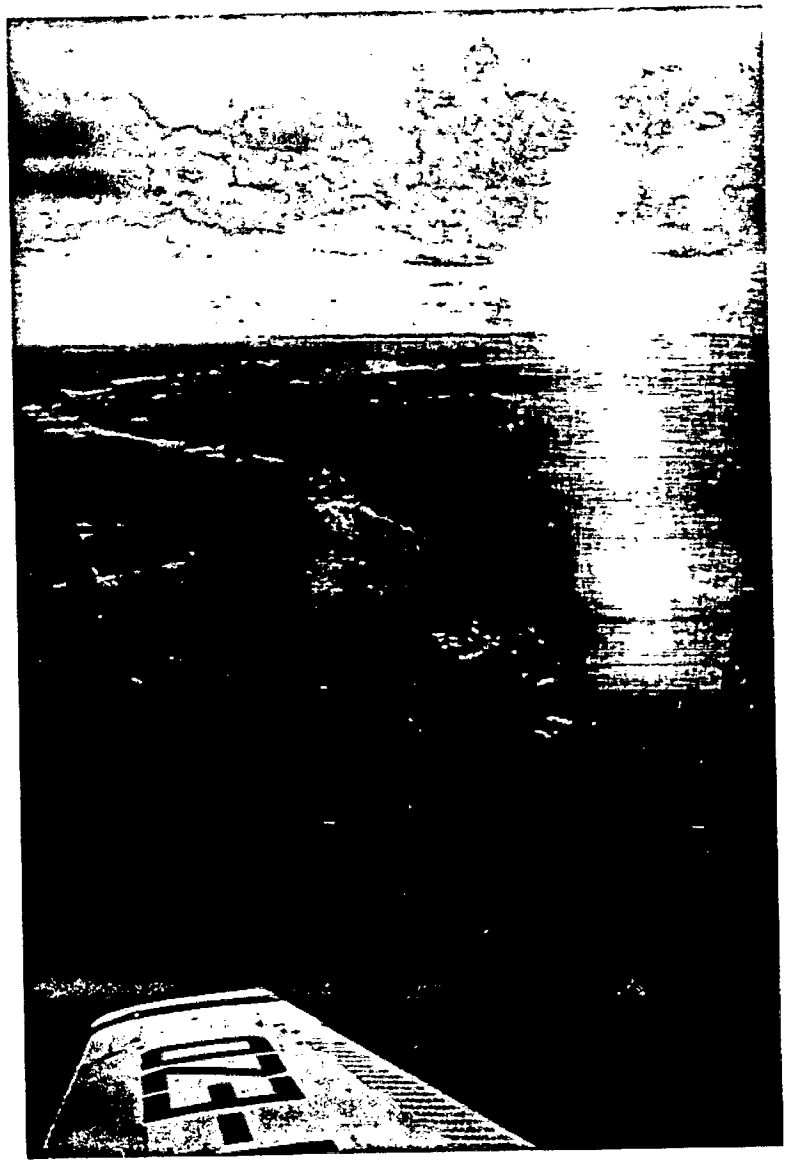
ROBE RIVER IRON ASSOCIATES
CAPE LAMBERT / W.A.

ROBE RIVER RAIL CROSSING
GENERAL ARRANGEMENT

SCALE 1: 2000 | DRAWN BY | DATE

FILE No | CAD No | REV

Fig.6



FLOOD WAVE IN THE FORTESCUE

FIG 7

FIG 7 cont.

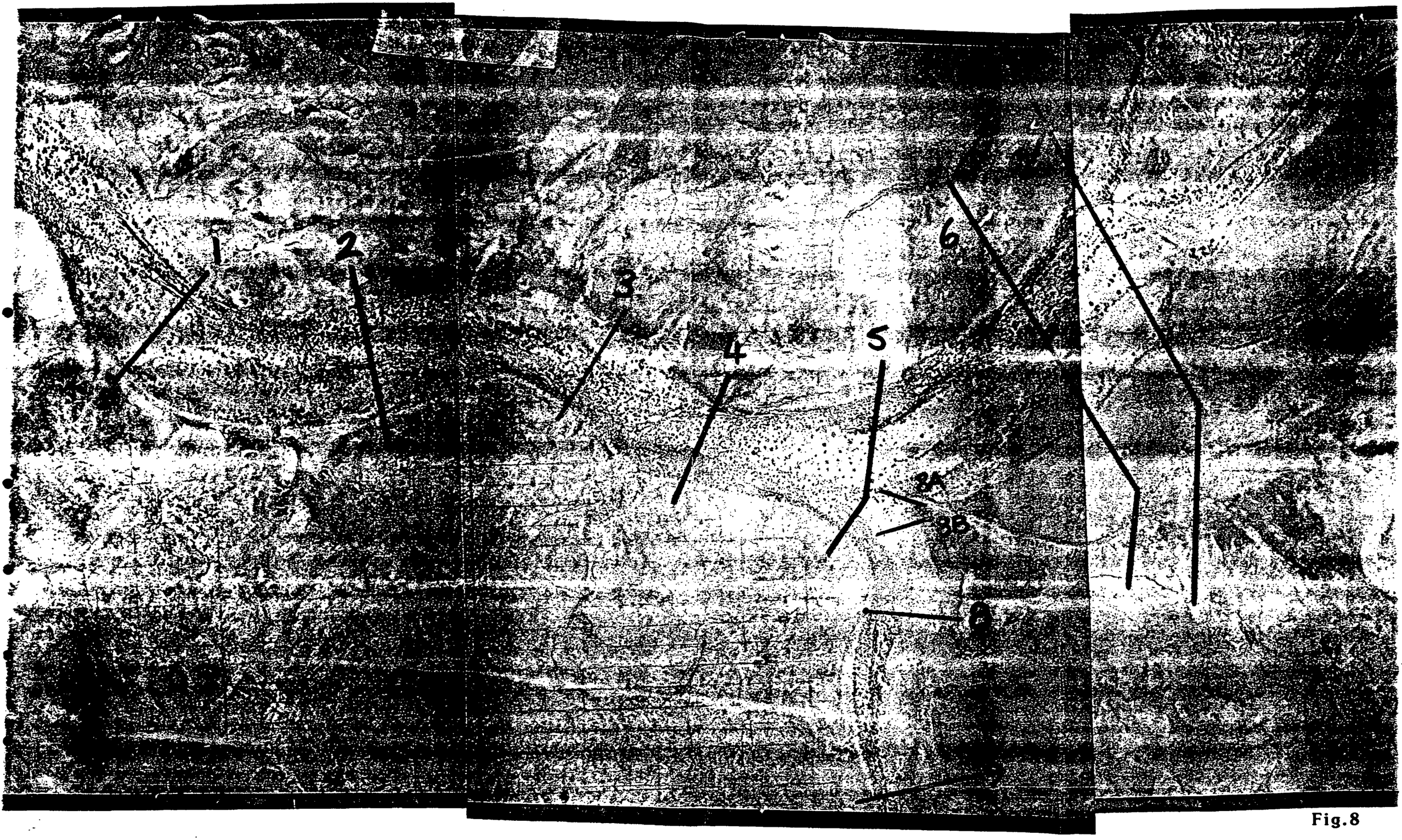


Fig.8