

ANNEX G
ALIGNMENT REPORT

Highways Department
Government of the Hong Kong
Special Administrative Region

Agreement No. CE 82/97

Route 10 - North Lantau to Yuen Long Highway

Investigation and Preliminary Design Assignment

REPORT ON R10 (NLYLH) ALIGNMENT

(Southern Section)

Report Number T524/15.02/S/0A

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**Report on R10 (NLYLH) Alignment
(Southern Section)**

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1.0 EXECUTIVE SUMMARY

1.1 Purpose of the Report

This Report on Route 10(NLYLH) Alignment has been prepared as part of the 'Route 10 - NLYLH Investigation and Preliminary Design Assignment' under the Highways Department Agreement No. CE 82/97.

The purpose of the Alignment Report is to examine in detail possible variations to the mainline alignment of the southern section of Route 10 (NLYLH) between North Lantau and So Kwun Wat (up to Ch. 13400); to evaluate and compare the merits and demerits of the Feasibility Study Alignment and an Alternative Alignment; and to recommend a single preferred alignment to take forward to preliminary design. The mainline alignment from Ch.13400 is included in the So Kwun Wat Interchange which is presented in the Report on Interchanges and Connections.

The Report on R10(NLYLH) Alignment was presented and endorsed by the 3rd Joint Land and Traffic & Transport Working Group at a meeting on 27 October 1998.

1.2 Alignment

The alignment proposed in the Sham Tseng Link Feasibility Study (FSA) has been reviewed and a Preferred Alternative Alignment (PAA) has been arrived at taking account of cost-effectiveness; topography and geology; engineering and technical constraints; construction risk and programme; environmental concerns; land issues; and operation and maintenance systems. A revised design speed of 100km/h has been adopted.

For ease of reference the route has been divided into geographical sections, namely : North Lantau; Tsing Lung Bridge; Tsing Lung Tau to Siu Lam (including Tai Lam Chung viaduct); and Siu Lam to So Kwun Wat. These geographical sections are shown on Figure No. 524/RPT/H140.

1.3 North Lantau

1.3.1 Key Issues

The review of the Feasibility Study Alignment (FSA) identified a number of key issues which had an adverse impact on construction and future development. These included:

- the construction of a major structure crossing the North Lantau Highway (NLH) which would be subject to the operational constraints of this primary route to the new airport;
- the location of the extensive portal works for the North Lantau tunnel immediately to the south of the NLH in difficult ground conditions over Airport Railway Tunnels which would require the adoption of stringent site safety procedures together with lane closures on the NLH to allow site access for portal excavation and tunnel construction;

- the southern portal works for the North Lantau tunnel, toll plaza and administration building would require the resumption of the majority of the village land in Tso Wan village and Fa Peng village. In the case of Fa Peng Village, the inhabitants have indigenous villagers rights; and
- the elevation of the toll plaza at Tso Wan would be approximately +40 mPD necessitating a substantial retained fill structure, which would be expensive and would visually dominate the landscape.

The Preferred Alternative Alignment adopts an alignment control point on the Fa Peng headland such that the Route 10 works do not encroach on the village land at Fa Peng. The toll plaza would be located within the bay adjacent to Tso Wan and Fa Peng at an elevation of about +11mPD. To the north of the toll plaza the route climbs initially in cutting and then on structure along the Sam Chuen and Yi Chuen headlands.

The route would pass, on elevated structure, under the second approach span of the Kap Shui Mun Bridge (KSMB) with a vertical clearance of 5.5m.

This alignment avoids the village land at Fa Peng and Tso Wan and it therefore satisfies all the expressed concerns of village resumption in respect of the FSA, and minimises, as far as practicable, the constraints upon the future port and associated developments.

1.3.2 Comparison of PAA and FSA

The advantages of the PAA over the FSA include:-

- no interface with the North Lantau Highway;
- no interface with the Airport Railway;
- deletion of a tunnel section;
- improved access and work site for construction of Tsing Lung Bridge;
- ease of upgrading alignment to 100km/h;
- no land resumption in Fa Peng;
- platform for toll plaza at +11mPD instead of +40mPD;
- savings in construction and land costs of approximately \$135 million; and
- savings in operating costs.

Against these are the landscape and visual impacts on Ng Kwu Leng and the natural shoreline, and the need to provide environmental mitigation measures to protect the residential population (which would have had to be re-sited under the FSA).

1.3.3 Working Groups

Working Paper No. 1: Route Alignment on North Lantau, July 1998, presented the PAA for North Lantau. This was presented to and endorsed by the 1st Joint Land and Traffic & Transport Study Working Group at a meeting on 14 August 1998.

1.4 Tsing Lung Bridge

1.4.1 Key Issues

Alignments both to the east and west of the FSA have been examined and an alignment 50 metres to the west is proposed as the PAA. This alignment locates the northern bridge pier on reclamation within the embayment to the west of Grand Bay Villa and has the advantages of:-

- reducing the impact on marine operations both during construction and in operation; and
- minimising the reduction in the effective cross-sectional area of the Ma Wan Channel which is of benefit in terms of water quality.

1.4.2 Working Groups

Working Paper No. 4: Tsing Lung Bridge, Marine Clearance and Related Environmental Issues August 1998, presented the tower location for the Tsing Lung Bridge north tower. This was presented to and endorsed by the 1st Tsing Lung Bridge Study Working Group at a meeting on 15 September 1998.

1.5 Tsing Lung Tau to Siu Lam (including Tai Lam Chung viaduct)

1.5.1 Key Issues

Modifications to the Feasibility Study Alignment from Tsing Lung Tau to Siu Lam are required due to a conflict with the Towngas pipeline at Tai Lam Chung. This pipeline is the only supply to Lantau and the new airport and cannot be shut down to facilitate a diversion.

1.5.2 Comparison of PAA and FSA

The PAA maximises clearance to the Towngas pipeline. Other modifications have also been incorporated which optimise construction and operation of the route:

- horizontal realignment of the Tai Lam Chung tunnel portal at Tsing Lung Tau to avoid areas of fill and give least risk option for tunnelling under Tuen Mun Road;
- increase in horizontal radii of the mainline route consistent with increasing the design speed from 85 km/h to 100 km/h;
- vertical profile through the Tai Lam Chung tunnel has been modified to be the minimum 0.7% so as to benefit the operation of the ventilation system; and
- vertical profile also modified through the Tai Lam Chung tunnel to eliminate the low point sump, providing further cost and operational benefits.

The modifications above combine to give further benefits:

- total tunnel length reduced by 300m;
- reduced noise impact at Tai Lam Chung valley;
- savings in construction and land costs; and
- savings in operating costs.

1.5.3 Working Groups

Working Paper No. 2: Route Alignment Tsing Lung Tau to Siu Lam, August 1998. presented the PAA from Tsing Lung Tau to Siu Lam. This was presented to the 2nd Joint Land and Traffic & Transport Study Working Group at a meeting on 2 September 1998 and the recommended PAA, with a raised vertical profile compared to the FSA was endorsed.

1.6 Siu Lam to So Kwun Wat

1.6.1 Vertical Alignment

The PAA's raised vertical alignment for the Tai Lam Chung Tunnel provides an opportunity to pass through Siu Lam ridgeline in cutting as opposed to the tunnel incorporated in the FSA.

1.6.2 Comparison of PAA and FSA

The tunnel option at Siu Lam will be advantageous from the standpoints of land resumption and environmental issues. The cutting option offers clear advantages over the tunnel in terms of cost, construction risk, geology, operation and maintenance. Mitigation measures can be provided to offset the majority of the negative environmental impacts of the cutting but the visual impact on the skyline within the ridgeline will remain. Also the ATV transmitter station on top of the ridgeline will need to be re-located.

1.6.3 Working Groups

Working Paper No. 2, referred to in 1.5.3, above also contained discussion on the open cut option through the ridgeline.

At the meeting of the 2nd Joint Land and Traffic & Transport Study Working Group on 2nd September 1998 the open cut through Siu Lam ridgeline was endorsed subject to a satisfactory outcome of discussions with Office of the Telecommunications Authority (OFTA) in relation to the relocation of the television transposer station.

Further discussion held with OFTA has confirmed the feasibility of this and that the relocation work could be completed prior to the start of construction work for this section of the Alignment.

2.0 INTRODUCTION

2.1 Background of the Project

This Project will provide a western road corridor from the future Chok Ko Wan Link Road (formerly known as the Lantau Port Expressway (Northern Section)) Interchange to Yuen Long Highway, with an intermediate link to Tuen Mun Road, to cope with the future development of the proposed Lantau Port and within the north-western New Territories (NWNT).

In 1979, the Lantau Fixed Crossing Feasibility Study established the need for two road links between north Lantau and the mainland, one via Ma Wan to Tsing Yi (i.e. the Lantau Link which opened to traffic in May 1997) and the other via Ma Wan to Sham Tseng (Sham Tseng Link). A Preliminary Feasibility Study conducted in March 1993 recommended that the Sham Tseng Link (STL) alignment should commence at an interchange with the road network planned for the Lantau Port development and end with a connection to the Route 3 Country Park Section and Tuen Mun Road at the Ting Kau Interchange.

The Territorial Development Strategy Review in 1996 identified the NWNT as a strategic growth area. The Second Comprehensive Transport Study Update forecasts that the STL will be required before 2006 in order to meet the demand of traffic generated by the new developments on Lantau and the Lantau Port Peninsula. The traffic forecasts indicated a need to extend the STL to Yuen Long to meet the future traffic demands and to better serve the needs of the NWNT. Following the Feasibility Study conducted by Highways Department, the constraint to connect the STL to Route 3 was removed, and the STL was extended to Yuen Long to meet the future traffic demands. Since the purview of the STL project has changed, the project title is now changed to Route 10 - North Lantau to Yuen Long Highway (R10(NLYLH)). The Study Area and the R10 (NLYLH) alignment proposed by the Feasibility Study is illustrated in Figure 524/RPT/H016.

The purpose of this Assignment is to carry out a review of the findings, conclusions and recommendations of the Feasibility Study, in particular, the recommendations for the northern section of R10(NLYLH) to cater for the findings of the Crosslinks Further Study. In addition, a detailed investigation of the various impacts resulting from the project, as identified in the Feasibility Study, will be carried out. Preliminary designs will subsequently be produced addressing identified constraints and maintenance strategy and defining more precisely the extent of the Project such that it can be implemented in well defined time frame and to an accurate estimate of the expenditure cash flow.

2.2 Purpose of the Report

This Report on R10(NLYLH) Alignment has been prepared as part of the 'Route 10 - NLYLH Investigation and Preliminary Design Assignment' under the Highways Department Agreement No. CE 82/97.

The purpose of the Alignment Report is to serve the following functions:

- To examine in detail possible variations to the mainline alignment of the southern section of R10 (NLYLH) between North Lantau and So Kwun Wat (up to Ch. 13400). The remaining portion of the southern section mainline is included in the So Kwun Wat Interchange which is presented in the Report on Interchanges and Connections.
- To evaluate and compare the merits and demerits of the Feasibility Study Alignment and an Alternative Alignment, and recommend a single preferred alignment for further refinement and detailed study.

The Report on R10(NLYLH) alignment was presented to and endorsed by the 3rd Joint Land and Traffic & Transport Study Working Group at a meeting on 27 October 1998.

The Report on R10(NLYLH) Alignment has been revised to take into consideration the comments raised by the working group members and the comments received on the following related working papers:

Working Paper No.1 : Route Alignment on North Lantau
Working Paper No.2 : Route Alignment Tsing Lung Tau to Siu Lam
Working Paper No.4 : Tsing Lung Bridge, Marine Clearance and Related Environmental Issues

Supplementary Environmental Considerations to Working Papers WP1 and WP2.

2.3 Structure of Report

The Alignment Report is divided into five further sections to address the above mentioned issues. The sections are summarised as follows:

- Section 3 : Outlines and briefly describes the Feasibility Study Alignment and the Preferred Alternative Alignment.
- Section 4 : Evaluates the two alignments in engineering, drainage, environmental, land, land use planning and landscape/visual impact terms
- Section 5 : Directly compares the two alignments in quantitative terms.
- Section 6 : Presents a summary of the key issues identified in Section 4.
- Section 7 : Makes a recommendation on the alignment to be taken forward to preliminary design.
- Appendix A: Contains estimates of land acquisition costs.
- Appendix B: Contains the revised Supplementary Environmental Considerations to Working Paper WP1 and WP2.
- Appendix C: Contain the comments and responses to the Report on R10(NLYLH) Alignment and the related working papers stated in Section 2.2.

3.0 ALIGNMENT OPTIONS

3.1 Introduction

The purpose of this section of the Alignment Report is to briefly outline the two alignment options; Feasibility Study Alignment (FSA) and Preferred Alternative Alignment (PAA).

3.2 Feasibility Study Alignment

The FSA was endorsed as part of the Sham Tseng Link Feasibility Study and is shown on the attached Figure No. 524/RPT/H117.

3.3 Preferred Alternative Alignment

Modifications to the alignment proposed in the Sham Tseng Link Feasibility Study derive from a review of the constraints and discussions with the relevant Government Departments and Utility Companies. Development of the PAA has taken account of:

- The Feasibility Study Alignment.
- Cost-effectiveness.
- Topography and geology.
- Engineering and technical constraints.
- Construction risk and programme.
- Environmental concerns.
- Land issues.
- Operation and maintenance.
- Potential impacts on marine traffic safety.

Following comments from Commissioner for Transport on Route 10 (NLYLH) draft Design Memorandum, the alignment design speed of 85km/h, adopted for the Feasibility Study, has been reviewed and revised to give a design speed of 100km/h.

Working Paper No. 1: Route Alignment on North Lantau, July 1998, presented the PAA for North Lantau. This was presented to and endorsed by the 1st Joint Land and Traffic & Transport Study Working Group at a meeting on 14 August 1998.

Working Paper No. 2: Route Alignment Tsing Lung Tau to Siu Lam, August 1998, presented the PAA from Tsing Lung Tau to Siu Lam. This was presented to the 2nd Joint Land and Traffic & Transport Study Working Group at a meeting on 2 September 1998 and the recommended PAA, with a raised vertical profile compared to the FSA was endorsed. The second recommendation for an open cut through Siu Lam ridgeline was also endorsed subject to a satisfactory outcome of discussions with Office of the Telecommunications Authority in relation to the relocation of the television transposer station.

Working Paper No. 4 : Tsing Lung Bridge, Marine Clearance and Related Environmental Issues, August 1998, presented the tower location for the Tsing Lung Bridge north tower. This was presented to and endorsed by the 1st Tsing Lung Bridge Study Working Group at a meeting on 15 September 1998.

The PAA is shown on the attached Figure 524/RPT/H122.

Supplementary Environmental Considerations to Working Paper WP1 and WP2, September 1998 provided additional details of the environmental issues which were summarised in WP1 and WP2. This was presented to the 1st Environmental Study Management Group at a meeting on 15 October 1998.

4.0 EVALUATION OF ALIGNMENT OPTIONS

4.1 Introduction

This section of the Alignment Report evaluates in engineering, environmental and planning terms the alignment options identified in Section 3.

For ease of reference the route has been split into the following geographical sections, between the following chainages:

Section	Feasibility Study Alignment	Preferred Alternative Alignment
North Lantau	Ch 6400 - 8600	Ch 6400 - 8800
Tsing Lung Bridge	Ch 8600 - 10200	Ch 8800 - 10400
Tsing Lung Tau to Siu Lam (including Tai Lam Chung Viaduct)	Ch 10200 - 12400	Ch 10400 - 12500
Siu Lam to So Kwun Wat	Ch 12400 - 13300	Ch 12500 - 13400

These sections are shown on Figure nos. 524/RPT/H117 to H121 for the Feasibility Study Alignment (FSA) and Figure nos. 524/RPT/H122 to H126 for the Preferred Alternative Alignment (PAA).

The remaining section of the mainline in the Siu Lam to So Kwun Wat section (i.e. Ch 13300 - 14400 for the FSA and Ch 13400 - 14500 for the PAA) is reported in the Connections and Interchanges Report under the So Kwun Wat Interchange section.

The key issues and constraints associated with both the FSA and PAA are illustrated in Figures 524/RPT/H131 to H134 for the FSA and H135 to H138 for the PAA.

4.2 North Lantau Section

4.2.1 Topographical and Geometrical Considerations

Feasibility Study Alignment

This alignment passes through the southern tower of the Tsing Lung Bridge and follows the ridge line of the Tsing Chau Tsai Peninsula from the Kwai Shek headland and crosses over the North Lantau Highway (NLH) on a viaduct. From a point immediately south of the NLH the route enters the North Lantau Tunnel, some 600 metres long, which passes beneath Fa Peng Teng. The southern tunnel portal is located just to the north of Tso Wan village. A toll plaza is located at Fa Peng and Tso Wan villages with an administration building at Fa Peng village.

If the alignment is to be designed to a design speed of 100km/h, the North Lantau tunnel would be subject to a severe sight-line constraint and would have to be constructed over size.

Preferred Alternative Alignment

The PAA adopts an alignment control point on the Fa Peng headland such that the road works do not encroach on the village land at Fa Peng. The route would pass, on elevated structure, under the second approach span of the Kap Shui Mun Bridge (KSMB) with a vertical clearance of 5.5m. To the south of the KSMB the route continues to descend initially on structure and then in cuttings at the Yi Chuen and Sam Chuen headlands. Further structures are provided where valleys and small embayments are intersected. The toll plaza is located within the bay adjacent to Tso Wan and Fa Peng. The elevation of the toll plaza varies from +8.5mPD to +12.5mPD.

This alignment avoids the village land at Fa Peng and Tso Wan and it therefore satisfies all the expressed concerns of village resumption in respect of the FSA, and minimises, as far as practicable, the constraints upon the future port and associated developments. The small area of embayment between the toll plaza and villages would be filled to a nominal formation level of +5.5mPD so providing an area for the Administration Building. Access would also be provided beneath the toll plaza from Fa Peng and Tso Wan villages to re-provisioned pier locations, until such time as the port development removes the marine access.

4.2.2 Geotechnical Considerations

Feasibility Study Alignment

The alignment passes in a general southerly direction along the spine of the Kwai Shek headland, through a 38m deep cutting. The geology is variable comprising granite and tuff which have been intruded by northeast-trending feldsparphyric rhyolite dykes. The soil-rock interface within the cutting varies between 10m and 30m below existing ground level and reflects the general ridge topography. Rock faces up to 15m high, standing at slopes of 2:1 (vertical: horizontal) would constitute the lower portion of the cut slopes on either side of the highway within the southern portion of the cutting; lower rock slopes would be formed in the northern part, where rock is

deeper. Above the soil-rock interface, slopes in completely decomposed rock, irrespective of type, would be formed at approximately 1:1.5 between berms at 7.5m vertical intervals.

Feasibility Study borehole P8 encountered a possible fault zone below the northern part of the cutting. Quartz veining is evident in areas of erosion along the ridge line and steep-sided, well-defined valleys, which may be the surface traces of faults or major discontinuities, fall from the ridgeline to the shores on either side. On the basis of this evidence, it may be concluded that localised bands of deep weathering within the cutting could require stabilisation or flattening of the slopes to meet design criteria for stability.

From the southern end of the cutting, the route passes over a deep valley on sidelong ground, about 25m above existing ground on the downslope side. The Feasibility Study proposes a retained embankment, such as reinforced earth through this section. However, there is evidence of local surface instability in the vicinity of the toe of the proposed wall and such a construction whether of reinforced earth or not, could be detrimental to the slope stability. Extensive stabilisation measures could be required. The use of an elevated structure as a continuation of the NLH crossing to support the northbound carriageway, with the southbound carriageway supported by retained fill would appear preferable.

The NLH crossing is located at the western end of the deep cutting on the approach to the KSMB. The adverse impact on traffic flow would prohibit the construction of an intermediate pier in the NLH median. A structure spanning the full 35m width of the NLH would require significant piling works at each abutment.

The route enters the North Lantau tunnel just south of the NLH with the portal located within the steep hillside where there is evidence of previous instability on the line of the major east-northeast fault. This fault is aligned with a significant thickness of weak fault breccia. A major collapse of the Airport Railway Tunnel occurred during construction as this fault breccia was encountered.

Portal construction and tunnelling would be in unfavourable ground conditions, particularly if the rock adjacent to the faulted region has been altered as a result of the faulting process. The alteration of the rock is likely to result in a finer soil grading and a lower effective shear strength envelope. Portal slopes constructed in such material would require additional measures to meet the current minimum standards of stability. The Marine Department Vessel Traffic Control Radar is located on the natural slope above the portal and this would inhibit the use of flatter slope angles. Therefore the use of soil slopes with soil nails as reinforcement would be necessary so as to control land-take and reduce the impact on the radar installation.

The fault system within this area of North Lantau comprises two dominant orthogonal series. Faults, encountered in the adjacent NLH rock excavations, are aligned at shallow angles to the North Lantau tunnels and would be particularly unfavourable. Shear zones associated with the major fault noted above may exist either side of the main structural feature. Rock within these zones is likely to be of poor quality and difficult for tunnel construction. The easier excavation would be offset by the need for heavy tunnel support and the risk of groundwater inflow through weak and weathered rocks may require ground treatment in advance of excavation. If the tunnel

was to be constructed, compilation of further structural geology mapping would be required to identify the major trending faults.

At the southern tunnel portal information indicates that the soil-rock interface is about 10m deep, in the general area. The Hong Kong Geological Survey 1:20,000 Sheet 10 shows a possible fault crossing the general area of the portal in a north-south direction. However, Hong Kong Geological Survey 1:5,000 Sheet 10-NE-A shows the same feature having been displaced and therefore not affecting the tunnel portal. Existing ground investigation information in the area of the portal is sparse and the geology complex. If north-south faulting is present in this area ground conditions would be difficult for the portal slopes.

From the portal the alignment follows an existing spur in shallow cutting before crossing Tso Wan village and the bay between Tso Wan and Ngam Hau Shek. The toll plaza is located on a 40m high embankment.

In order to avoid the private land at Fa Peng, the alignment would need to move about 100m to the east. This would place the reclamation sea wall centrally within a local deposit of marine mud, up to 20m thick, between the Sam Chuen headland and Ngam Hau Shek. It would be necessary to either dredge a considerable volume of mud from a 70m wide trench along the line of the sea wall or apply innovative foundation improvement techniques such as deep cement mixing or large-diameter sand piles to the mud below the proposed sea wall. The removal of all mud from beneath the toll plaza reclamation might be necessary in order to ensure that an embankment of this scale is stable. A suitable dumping site would need to be identified for the disposal of the marine mud.

Preferred Alternative Alignment

The PAA identified involves a series of cuttings through headlands, with viaducts across valleys and small embayments.

From the Lantau landfall of the Tsing Lung Bridge, the alignment turns eastward and passes above the coastline of Kap Shui Mun, dropping through a series of sidelong cuttings towards the KSMB. These cuttings are generally orthogonal to the geological and structural fabric of the area, and slope stability is unlikely to be a problem. The road then passes on viaduct above San Po Tsui, to cross the recently reclaimed bay at Tai Chuen and pass under the approach span to KSMB. The viaduct abutment at San Po Tsui is located above and northwest of the fault defining the western side of the bay at Tai Chuen. Piled foundations for the viaduct across the bay are expected to be about 30m to 40m deep, in slightly decomposed rock.

The viaduct continues south of KSMB as far as the headland at Yi Chuen where the northbound carriageway passes in shallow sidelong cutting. The southbound carriageway may remain on viaduct if it is determined that the crossing of the adjacent valley south of Yi Chuen is best achieved on viaduct, rather than on embankment. The route then passes in cutting through the headland at Sam Chuen.

The slopes above Yi Chuen and Sam Chuen are predominantly granite, with dykes of feldsparphyric rhyolite and quartz veining. There has been extensive erosion of the natural surface, resulting in "badlands" topography, with denuded ridges, shallow

scarps and deeper erosion gullies. Such geomorphology arises from a gradual process of erosion, and is not necessarily indicative of major instability within the natural slope. The erosion features can be stabilised and re-vegetated without difficulty during construction and is not considered to be a constraint on the PAA.

The country rock appears to have been hydro-thermally altered as a result of the quartz veining and similar constraints would apply to the soil cuttings here as for the proposed northern portal on the FSA. However, the depth of this cutting is expected to be less than at the portal and therefore the impact is less significant at this location.

Existing ground investigation information indicates that rock levels are generally about 20m below ground level in the upper part of the Sam Chuen headland. It is anticipated that the west side of the proposed cutting would comprise a 15m high rock batter at a gradient of 2:1 (Vertical; Horizontal), in order to minimise land-take and contain the excavation to the eastern side of the saddle behind the headland. The formed cut slope would be given landscape treatment. Photo-geological lineaments have been identified passing through the headland almost parallel to the proposed highway. These could have implications on slope stability if zones of shearing or faulting are confirmed within the cutting sides. However, a review of the available GI data suggests that such zones, if they exist, are likely to be to the west of the cutting. This will be confirmed by further site investigation results.

The PAA requires a sea wall between the outer edges of the headlands at Sam Chuen and Fa Peng. The cope line of the sea wall crosses marine mud up to 20m thick within the bay and the constraints imposed upon the foundation are similar to those discussed for the FSA. The embankment height under this scheme is between 4m and 8m above reclamation with a nominal formation level of +5.5mPD. Adequate surcharging can easily be incorporated and therefore drained reclamation construction is technically feasible. A suitably design seawall would be adopted to ensure reclamation work for the toll plaza would have minimal impact on the adjacent Ma Wan Fish Culture Zone.

4.2.3 Drainage

Feasibility Study Alignment

The 400m long open-cut is placed along the ridge of the Ng Kwu Leng mountain. Construction of the open-cut would require excavation, but the disruption to the existing surface watercourses in these areas would not be significant as the open-cut alignment is along the mountain ridge. The exposed cut faces of the excavation would require proper stabilization and/or protection and the requisite drainage would need to be designed in accordance with the relevant Hong Kong standards for slope drainage. Drainage provisions are required at the ends of the cuttings to drain stormwater collected from the open-cut faces to the existing stream or to the sea but the distances are relatively short and therefore the cost of the increased drainage provisions are not expected to be significant. The drainage capacity and the maximum flow velocity (for erosion protection) of the existing stream would need to be checked and upgraded if necessary.

There should be no direct changes in surface runoff characteristics in areas above the tunnel due to the construction and operation of the proposed tunnel, hence no adverse impacts on the existing drainage are likely. The construction of tunnel portals will

require excavation and the requisite slope drainage. At the northern portal of the Lantau Tunnel, a drainage pipe/box culvert would be required to drain stormwater collected from the slope drainage to the existing watercourse under the NLH. At the southern portal, a drainage pipe would be required to drain stormwater into the existing watercourse. The drainage capacity and the maximum flow velocity (for erosion protection) of the existing watercourse would need to be checked and upgraded if necessary.

The construction of the toll plaza embankment will cut across some existing natural streams that drain surface runoff collected from the Tso Wan sub-catchment into the sea. Drainage facilities, such as a box culvert/pipes would be required under the embankment. Similarly, a drainage pipe/box culvert would be required under the 200m long highway embankment at about Ch. 8100 to drain surface runoff into the sea along the existing steep stream. The drainage capacity and the maximum flow velocity (for erosion protection) of existing stream would need to be checked and upgraded if necessary.

Preferred Alternative Alignment

The proposed 600m long toll plaza would be built on reclamation. Box culverts would be required under the toll plaza embankment to drain stormwater collected from the inland catchment into the sea.

The open-cut section would require extensive excavation. The exposed cut faces of the excavation would require proper stabilization and/or protection, and a need to provide drainage provisions at the ends of the cuttings to drain stormwater collected from the open-cut faces to the sea. The lengths of the required drainage provisions would be relatively short and therefore the cost of the increased drainage provisions is not expected to be significant.

Construction of the viaduct would increase the paved areas resulting in increased runoff being discharged in the existing upland area, but the increased peak flow would drain into the sea via relatively short distances and no significant adverse drainage impacts are likely.

4.2.4 Environmental

Feasibility Study Alignment

Noise: Under the FSA both Fa Peng and Tso Wan villages would be resumed. No noise barriers were therefore proposed under the FSA in North Lantau.

Air Quality: For the FSA, the villages at Fa Peng and Tso Wan were to be resumed and thus no air sensitive receivers would be affected.

Water Quality: As the extent of infill in the Fa Peng bay is relatively small, no assessments were undertaken in the Feasibility Study since minimal water quality impact is expected.

Ecology: As the section of the FSA is in tunnel the required land take would be minimized, potential wildlife habitat loss is therefore minimal.

Fishery: The FSA consists of inland road and tunnel which avoids all coastal areas. this would give less impacts to fisheries and marine ecological resources.

Preferred Alternative Alignment

Noise: In North Lantau, noise sensitive receivers (NSR's) which have been identified through site visits include the Fa Peng and Tso Wan villages. Both villages are located at about 200 m from the PAA. On the basis of the traffic data available noise levels of around 76 dB(A) would be expected of the NSR's. The road traffic noise criteria of 70 dB(A) for domestic dwellings would be exceeded by 6 dB(A). As the village houses are low rise and located along the existing coastline, it is likely that a 500 m long 5m high vertical barrier along the proposed toll plaza would be necessary to protect the occupants of the two villages.

Air Quality: The villages of Fa Peng and Tso Wan would be affected by vehicle exhaust emissions. As the ASR's are located some 200m from the PAA, satisfying the recommended buffer distance stipulated in the Hong Kong Planning Standards and Guidelines (HKPSG), adverse air quality impacts on the two villages are therefore not expected.

Water Quality: As the area of embayment between the toll plaza and the villages would be filled to a nominal formation level of +5.5mPD, minimal water quality impact is expected.

During construction the impacts on the marine environment would need to be carefully controlled through definition of appropriate construction methods and minimisation through conditions of contract.

Ecology: The terrestrial habitats to be affected by this section of alignment are mainly shrubby in nature. A range of coastal habitat and small patches of lowland woodland have been identified along the coast, the habitat and woodland may be lost with the implementation of the PAA. Most of the species identified are common, widespread, and typical to the habitat type where they were recorded. However, five rare species of conservation interest, namely *Vitis balansaeana*, *Fimbristylis complanata*, *Diplarcum caricinum*, *Phymatodes scolopendria* and *Amorphophallus sp.* have been identified along the Route 10 (NLYLH) alignment. The former two are new records to Hong Kong and not listed in the Hong Kong checklist. Several rare or protected plant species were recorded in different habitat types along the whole alignment, particular the coastal habitat on Lantau Island section.

Fishery: The small reclamation will impact the existing coastal habitats of North Lantau. Impacts to fisheries resources are most likely to occur at the Ma Wan Fish Culture Zone located on the west side of Ma Wan Island through perturbations to water quality.

4.2.5 Land Matters

Feasibility Study Alignment

Table 4.2.5.1 summarises the features and land interests within North Lantau which has been identified as being affected by the land that is required for the Feasibility Study Alignment.

Table 4.2.5.1: Summary of Features and Land Interests within North Lantau Affected by the Feasibility Study Alignment

	Survey Sheet No.	Lot No./GLA No.	Licence/Short Term Waiver (No. of Structures affected)	Features Affected (No. of Features Affected)
Sub-section 1 (Chainage No. : 6,400-8,600)	10-NE-11B	<ul style="list-style-type: none"> • DD 357 Lot 1* • DD 361 Lot 18* 	<ul style="list-style-type: none"> • W 6129 (1)* • W 6071 (3) • W 5505 (3)* • W 4732 (1) • W 6077 (3)# • W 5552 (5) (Formerly known as W 5086) <ul style="list-style-type: none"> • W 6076 (4)# • W 7115 (6) • W 6426 (5)* • W 5504 (3) • W 6298 (1)# 	Pond Uncultivated Land <ul style="list-style-type: none"> • Piers (2)* • Graves (4)
	10-NE-6D	<ul style="list-style-type: none"> • DD 361 Lot 13* • DD 361 Lot 14* 	<ul style="list-style-type: none"> • W 6490 (1)* • W 6441 (7)* • W 5797 (10)* • W 5743 (5)* • TW 9543 (3) 	TS (2) TS (3) <ul style="list-style-type: none"> • Graves (5)
	10-NE-6C	<ul style="list-style-type: none"> • GLA-TW 267 		
	10-NE-6A	<ul style="list-style-type: none"> • MTRL2* • GLA-TTW-NTA/WLM D2813* 		Radio Telecom- munications System <ul style="list-style-type: none"> • Grave (1) • NANTPR 4A CL NO. NANT 5/90
	10-NE-1C			

* These affected features and land interests were inspected on 9th and 10th July 1998.

Though these three licences are not directly affected by the FSA, they are assumed to be cleared upon implementation of the FSA since all licences and private lots within Fa Peng Village are required to be removed upon implementation of the FSA.

Private Lots: It has been identified that two lots would be affected by the FSA in Tso Wan Village, namely Lots 13 and 14 in D.D. 361. These have been identified as being agricultural lots in the schedule of the relevant Block Government Lease and no building licences have been issued in connection with these lots. However, it has been established upon site inspection that two single-storey and three single-storey temporary structures have been erected on the respective lots. With regard to the two other lots affected by the FSA in Fa Peng, namely Lot 1 in D.D. 357 and Lot 18 in D.D. 361, these have been identified as mixed lots via land search.

Given that these two lots are within Fa Peng Village, which is a recognised village under the New Territories Small House Policy, the owners of the lots may be entitled to compensation in accordance with Village Removal Terms in the event of resumption by the Government. The criteria for entitlement of compensation under Village Removal Terms in the event of land resumption for building land is "Old Schedule lots and pre-war New Grant lots held by a villager, or an outsider who acquired the land pre-war, or the successor by inheritance of such a villager or outsider". The status of the landowners affected by the scheme would be subject to further investigation and confirmation with the DLO/Islands.

The land acquisition programme would also depend on whether private land is to be resumed. The lead time for resumption under the Roads (Works, Use and Compensation) Ordinance Cap. 370 is normally between eighteen and twenty four months. However, if Village Removal Terms are involved, a period of between twenty four and thirty six months would be essential.

Structures with licences: Based upon the information provided by DLO/Islands, most of the structures or houses granted under licence upon Government land are permitted to be utilised either as domestic accommodation or Chicken/Pigeon Farms. The preliminary investigation, based upon the survey plans and site inspection, has established that 16 licences, representing approximately 61 structures, would be affected by the FSA. All the structures inspected externally are constructed of stone, wood and concrete with bricks or iron sheet roof. Furthermore, all the affected Chicken/Pigeon Farms that were inspected were identified to have been abandoned.

The implications of the need for clearance of structures under licence, in terms of time and costs, as well as upon the overall implementation programme, will depend upon the terms of licences granted. Since all the private land and almost all licences (except three) will be affected by the FSA, all licences are assumed to be cleared upon implementation of the FSA. It is anticipated that legal domestic occupiers would be entitled to an ex-gratia allowance and permanent/interim rehousing as compensation for the loss of accommodation. With regard to those licences being utilised for poultry farms, an ex-gratia allowance would need to be paid to licencees if the criteria set by the Housing Department regarding the entitlement to compensation can be met.

Clearance of existing structures, which are held under licence, would be the subject of ongoing negotiations between the District Lands Office, the Housing Department and the affected parties with regard to rehousing arrangements or cash compensation.

Graves and Burial Areas: It has been identified from the survey plans that a total of 10 graves would be affected by the FSA. However, the exact number of graves or urns to be affected can only be ascertained by further detailed inspection after

clearance of overgrown vegetation along the proposed route. It would also depend upon the extent of the works that are required to be undertaken. It has been established that there is no gazetted burial area within the Study Area on North Lantau.

The significance of the impact of the graves upon the implementation of the road works would depend on the types of graves involved, the materials used to build the graves and the historic importance of the graves. Clearance of graves, and in particular, of clan graves of historical significance is difficult and should be avoided wherever possible. If clearance of such graves is necessary, measures would need to be taken to address the concerns of the villagers and lengthy consultation and negotiation with the respective village representatives and other affected parties is likely to be required. The affected parties are also entitled to cash compensation based upon the material, form, type and age of the graves or shrines to be cleared according to a scale of compensation adopted by the Government. Several graves which are located close to the proposed alignment would need to be protected from being damaged during the construction period although physical clearance may not be required.

It is envisaged that a period of more than a year may be required to serve notice to any affected parties for the clearance of graves. Under normal circumstances, ancestral graves of 'Fung Shui' significance which have existed for more than 60 years may cause clearance problems whilst impacts of other graves are relatively less significant.

Government Land Allocations: From a review of the land status plan, it has been identified that Government Land Allocation No. GLA-TW 267 would be affected by the FSA. This allocation has been granted to the Marine Department for the purposes of accommodating a vessel traffic management system.

Since the FSA will only pass through the GLA-TW267 by way of a tunnel below the site, the vessel traffic management system may not be affected. Further liaison with the Marine Department would be required regarding the engineering implications associated with the construction of a tunnel below GLA-TW267.

Radio-Telecommunications Systems on Hill-Top Site: Based upon the information provided by District Lands Office/Islands, a site granted under Government Land Allocation No. GLA-TTW-NTA/WLMD2813, currently accommodating a radio-telecommunications system which is managed by the Civil Aviation Department, would be affected by the FSA. However, it has been identified upon site inspection in the vicinity of this site that no structure has been erected thereon and thus further clarification with DLO concerned regarding the status of this Government Land Allocation will be necessary.

Piers: It has been identified that two piers in Fa Peng Village would be affected by the implementation of the FSA. Since clearance of the whole of Fa Peng village may be necessary due to the fact that most of the structures in the village will be affected by the FSA, temporary reprovisioning and permanent relocation of the affected piers may not be required, subject to clarification with the DLO/Islands.

MTR Lot 2: It has been established via desktop study of the land status plans that MTR Lot 2, the lot under which land for the Airport Railway is held, may be affected by implementation of the FSA.

However, it has been identified from Section 1B of Part 1 of the Schedule in the Government Lease under which MTR Lot 2 is held that the section of MTR Lot 2 affected by the FSA was granted to MTRC in the form of a stratum of land underground. Therefore, no easement may be required to be created if the alignment and associated structures are designed to avoid any impact upon this stratum of land, subject to confirmation that such is the case from DLO / Islands.

Pond: A pond within private lot, DD357 Lot 1, has been identified as being affected by the FSA. Any pond fish farmers affected by the implementation of the road works will be eligible for an ex-gratia allowance to be assessed by the Agriculture and Fisheries Department, which will take into account any loss of working capital, net income and cost of capital investment of the pond fish farmers.

Power Line: A power line has been identified as being affected by the FSA and any need for diversion of the power line will be subject to further discussion with China Light and Power Company Limited.

Preferred Alternative Alignment

Table 4.5.2.2 summarises the features and land interests within North Lantau which have been identified as being affected by the land that is required for the Preferred Alternative Alignment.

Table 4.5.2.2: Summary of Features and Land Interests within North Lantau Affected by the Preferred Alternative Alignment

	Survey Sheet No.	Lot No. / GLA No.	Licence/Short Term Waiver (No. of Structures affected)	Features Affected (No. of Features affected)
Sub-section 1 (Chainage No. : 6,400-8,800)	10-NE-11B	• DD 357 Lot 1*	<ul style="list-style-type: none"> • W 6298 (1) • W 5552 (5) (Formerly known as W5086) • W 6077 (3) • W 6076 (4) • W 6071 (3) • TWM2408A GN2594 • TWM2500 GN847 	<ul style="list-style-type: none"> • Piers (2)*
	10-NE-6D		<ul style="list-style-type: none"> • W 4042 (0) • W 5214 (3) 	<ul style="list-style-type: none"> • Piers (2)* • Grave (2)

Survey Sheet No.	Lot No. / GLA No.	Licence/Short Term Waiver (No. of Structures affected)	Features Affected (No. of Features affected)
10-NE-6B	<ul style="list-style-type: none"> GLA- TTW 638 MTRL2* 		<ul style="list-style-type: none"> NANTPR 4A CL. NO. NANT 5/90
10-NE-6A	<ul style="list-style-type: none"> GLA-TTW-NTA/WLMD 2813* 	<ul style="list-style-type: none"> TW 9600 	Radio-Telecommunications System <ul style="list-style-type: none"> Graves(2)
10-NE-1C			<ul style="list-style-type: none"> Power Line

* These affected features and land interests were inspected on 9th and 10th July 1998.

Private Lots: It has been identified that the PAA would involve resumption of a minor portion of Lot 1 in D.D. 357 with an area of about 130 square feet as measured on plan. However, the PAA will be slightly adjusted in order to avoid resumption of this lot if possible.

Reclamation Projects: It has been identified that the PAA passes the reclamation boundaries of two projects namely : Reclamation for Centralised Rock Borrow Area, Tsing Chau Tsai (GN847) and Penny's Bay Reclamation (GN2594). These have been taken into account in the development of the PAA and thus there is not anticipated to be any interface problem.

Structures with licences: The preliminary investigation, based upon the survey plans and site inspection, has established that 8 licences, representing approximately 19 structures, would be affected by the PAA. Details of these are similar to that of the FSA.

Negotiation regarding clearance of existing structures could have a potential impact upon the implementation programme of the road scheme. Therefore, implementation based upon the option, which affects a smaller number of structures, and population would minimise any impact upon the clearance programme. It has been established that the PAA would affect a smaller number of houses and therefore a smaller proportion of the population is likely to be affected.

Graves and Burial Areas: It has been identified from the survey plans that a total of 4 graves would be affected by the PAA. However, the exact number of graves or urns to be affected can only be ascertained by further detailed inspection after clearance of overgrown vegetation along the proposed routes.

The PAA, which involves the clearance of fewer graves, is considered to be preferable in the light of the reduced acquisition period that would be required in order to secure land occupied by graves. However, it is considered that the difference in the necessary acquisition period relating to the clearance of graves between the PAA and FSA may not be that great.

Government Land Allocations: From a review of the land status plan, it has been identified that Government Land Allocation No. GLA-TTW638 would be affected by the implementation of the PAA. This allocation was formerly granted to the Highways Department and DLO/Islands has confirmed that this allocation has been cancelled.

Radio-Telecommunications Systems on Hill-Top Site: Similar to the FSA, a site granted under Government Land Allocation No. GLA-TTW-NTA/WLMD2813, currently accommodating a radio-telecommunications system which is managed by the Civil Aviation Department, would be affected.

Piers: The implementation of the PAA would obstruct the marine access to the two major villages of Fa Peng and Tso Wan. Therefore, both temporary reprovisioning and permanent relocation of the affected piers would be required to serve the marine access of the two villages of Tso Wan and Fa Peng. Marine access will be provided as stated in Section 4.2.1.

During inspection, it was identified that extension works associated with the northern pier in Tso Wan were being undertaken in accordance with the Rural Planning Improvement Strategy. These works are anticipated to be completed in July 1998 and were identified as being near completion upon inspection. It was observed that the southern pier in Tso Wan is currently redundant as all the ferries and private boats utilise the extended pier to the north.

MTR Lot 2: Similar to the FSA, the MTR Lot 2, the lot under which land for the Airport Railway is held, may be affected by the PAA.

However, it has been identified within the Section 2E(a)(i) of Part 1 of the Schedule in the Government Lease under which MTR Lot 2 is held that the section of MTR Lot 2 affected by the PAA was granted to MTRC in the form of a stratum of air space within the internal faces of the Railway Envelope in the Kap Shui Mun Bridge. Therefore, it is considered that an easement may not be required to be created if the alignment is designed to pass over or beneath the bridge, subject to further clarification and confirmation with District Lands Office / Islands.

Power Line: A power line has been identified as being affected by the PAA and any need for diversion of the power line will be subject to further discussion with China Light and Power Company Limited.

Reclamation to be undertaken for the implementation of the PAA : Under the Foreshore and Sea-bed (Reclamations) Ordinance, gazetting must be undertaken before reclamation is started. Where only road works are proposed, the Roads (Works, Use and Compensation) Ordinance only will apply and no action should be taken under the Foreshore and Sea-bed (Reclamations) Ordinance. In case it is necessary to invoke the Foreshore and Sea-bed (Reclamations) Ordinance, all the affected parties will be entitled to claim for compensation under the head of injurious affection for the loss in value of the retained land caused by the extinguishment of any interest, right or easement over the foreshore and sea-bed affected by the reclamation.

4.2.6 Utilities

The majority of the utilities within the North Lantau area are concentrated along the corridor of the existing NLH. These include China Light and Power (CLP) who have a number of low voltage cable routes which supply the Lantau Link. CLP also have various 11kV overhead supply lines, located on the slopes either side of the NLH, which feed the Yiu Lian Dockyard. Numerous telecommunications service providers are located within the Hong Kong Telecom ducts alongside the NLH.

Apart from the NLH area, both CLP and Hong Kong Telecom (HKT) have overhead supplies feeding various installations including the settlements at Fa Peng and Tso Wan.

Drainage Services Department (DSD), the Water Supplies Department (WSD) and Towngas do not have any significant installations within the project area.

Feasibility Study Alignment

The FSA would produce a number of interface issues with existing utilities. In addition to the telecommunications installations and CLP cables which run along both sides of the NLH, 11kV CLP cables also cross underneath the NLH immediately west of the proposed alignment. These underground cables are connected to the 11kV overhead lines on the adjacent slopes and are likely to require diverting for the abutments to the NLH crossing.

South of the North Lantau tunnel the alignment would cross the 11kV overhead Tso Wan supply feed line at several locations. However, the FSA assumes that Tso Wan would be resumed, therefore the supply feed would become redundant.

Preferred Alternative Alignment

The PAA would significantly reduce the impact on the existing utilities. As the PAA would pass beneath the NLH, at the KSMB, any potential conflict with CLP and HKT installations is avoided. As the alignment is further west than the FSA, the need for diversion of the Tso Wan supply is avoided.

Both CLP and HKT have existing utilities in the vicinity of the KSMB. CLP have an existing 11kV overhead supply which feeds the Sam Chuen low voltage feeder which is located on the proposed centre line of the alignment. HKT have a number of overhead and underground cable routes which supply isolated dwellings in the area and the former site offices for construction of the Lantau Link. As the alignment would be on elevated structure across this area the impact on these utilities is comparatively small.

4.2.7 Land Use Planning

Feasibility Study Alignment

The FSA would pass through the eastern edge of Fa Peng. Subject to further investigation, some of the settlements may need to be cleared.

The FSA would encroach on only a small area of the 'Other Specified Use (OU) - Boatyard, Marine-Oriented Industrial Use and Marine Services Support Area' Zone east of Fa Peng. The conflict between the FSA and this OU Zone is negligible.

The remaining section of the FSA at North Lantau would pass through a Green Belt (GB) zone. The impact on the GB is to be established through the landscape and visual assessments.

Preferred Alternative Alignment

The PAA avoids Fa Peng which is recognized by the Government as a permanent village. Although the PAA would not encroach directly on the village potential environmental and visual impacts may be caused to the villagers.

The PAA would traverse the edge of a potential reclamation area north of Fa Peng, which is zoned 'Other Specified Use (OU) - Boatyard, Marine-Oriented Industrial Use and Marine Services Support Area' under the Draft North East Lantau Port Outline Zoning Plan No. S/I-NELP/4. However, since the major part of OU Zone would not be affected, it is anticipated that the constraint to be imposed by the PAA for planning of the future uses would only be marginal. In any event, the potential constraint could possibly be addressed by adjusting the layout and proposed uses for the reclamation area, taking into account the requirements of port and port related facilities in the Northshore Lantau area to be reviewed in the recently commissioned Northshore Lantau Development Feasibility Study.

The Alignment would then pass through a GB zone and on reclaimed land along the northeastern coast of Lantau Island rising up to the Tsing Lung Bridge. The actual impact on the GB zone is to be established through the landscape and visual assessment.

4.2.8 Landscape and Visual Impact

Existing landscape and visual character

The north-eastern region and shoreline of Lantau Island are essentially undisturbed except for the areas of reclamation and earthworks around the western landfall of the KSMB, and the NLH. The natural landform is steeply undulating with narrow stream and river valleys leading to small natural inlets. The hillside vegetation is characterised by natural grass and low scrub with trees growing in the sheltered valleys. To the south of the study area are the valleys of Fa Peng and Tso Wan which contain clusters of isolated rural village settlement. Local walking trails over the hillsides connect these villages to Penny's Bay and North Lantau. The shoreline in the study area comprises steep exposed rock outcrops between the vegetated hillside and the water. Except for the area around the KSMB and the reclaimed area at San Po

Tsui, the area has a low level of disturbance to its natural landscape features resulting in a landscape quality that is high.

The shoreline south of the KSMB is visible from North West Tsing Yi and by marine traffic using the Ma Wan Channel and Kap Shui Mun Channel. The northern coastline, around Ng Kwu Leng, is clearly visible from the relocated village on Ma Wan as well as more distant VSRs in residential developments from Sham Tseng to Gold Coast and road users. As such it is an important landscape feature on the northern extremity of Lantau Island.

Feasibility Study Alignment

The replacement of the natural coastline by reclamation to 40mPD at Fa Peng, together with the extent of earthworks within the vicinity of Fa Peng and Tso Wan would have a significant impact on the natural landscape character of the local hills and coast. Additionally, there would be considerable disturbance to the natural vegetation in the Tso Wan Valley for the excavation of the Lantau tunnel entrance portal. The extensive stabilisation work that is required at the portal would have a significant visual impact

To the north of the NLH this alignment would require extensive cutting of the Ng Kwu Leng headland causing major impacts to the existing undisturbed ridgeline effectively dividing it in two. This would be particularly visible from the north-west.

Preferred Alternative Alignment

The reclamation required for the toll plaza would cause impacts to the existing landscape character of this open bay. The reclamation for the toll plaza would be highly visible to the residents of the villages of Fa Peng and Tso Wan. The earthworks to the north of the toll plaza would have a significant impact on the promontory at Sam Chuen. The section of viaduct over the Yi Chuen promontory would be a visually prominent structure along the coastline. The works would be highly visible from viewpoints to the east.

As with the Feasibility Study Alignment, Ng Kwu Leng would be severely affected by the extensive cutting along its ridgeline and, additionally, by the cutting required for the slip roads.

4.3 Tsing Lung Bridge Section

4.3.1 Topographical and Geometrical

Feasibility Study Alignment

The horizontal alignment over the Tsing Lung Bridge is straight from Kwai Shek and passes directly over Grand Bay Villa at Tsing Lung Tau.

From the Lantau end the vertical alignment ascends past the Kwai Shek anchorage at 3.0%. The alignment then climbs past the tower in a hog curve across the Ma Wan Channel reaching a maximum elevation of 73.301 mPD close to the centre of the channel. The descent to Tsing Lung Tau occurs at a maximum gradient of 3.0 %.

Preferred Alternative Alignment

The alignment climbs towards the Kwai Shek headland passing under the east cable of the Tsing Lung Bridge.

It is expected that the Kwai Shek tower will be located between Ch. 8760 and 8790, a final position would be confirmed upon further site investigation findings. Currently, the alignment shown is based on a tower location at Ch. 8780.

From the Kwai Shek tower the alignment climbs over the Ma Wan Channel to a maximum elevation of 75.3 mPD to achieve the marine clearance and sufficient hog of the bridge deck such that when full traffic load is applied there is still a visible hog in the deck.

The northern tower of the Tsing Lung Bridge is located approximately 50 metres from the coast, on reclamation constructed in shallow water of up to 8 metres depth. From the tower the alignment deviates eastwards towards the portal location for the Tai Lam Chung tunnel. The distance between the centrelines of the carriageways at the tower is 19 metres. There is insufficient distance to flare the carriageways from the cables to achieve a satisfactory portal separation. A bifurcation of the carriageways is required on either side of the north anchorage, as shown in Figure 524/RPT/H139. The deviation of the carriageways allows sufficient space to construct the anchorage and provide adequate protection for the cable.

On the northern shore of the Ma Wan Channel the working space available in which to construct the bridge tower on land is extremely limited. Similarly, the distance from the shoreline to the Tuen Mun Highway is inadequate to achieve an effective layout for the bridge anchorage and backspan together with a suitable transition into the tunnel portal. The position of the Tsing Lung Bridge north tower along the alignment and therefore the distance offshore of the tower is controlled by a number of factors:

- sufficient areas are required for the construction of the suspension bridge tower, the cable anchorages, the side spans and their supports, the bifurcation of the carriageway, the Tai Lam Chung tunnel portal with associated buildings and cross over, and the upgraded Castle Peak Road;

- the distance between the shoreline and Tuen Mun Highway is approximately 300 metres and varies in level from +4 to +100 mPD and the available working space for the construction of the above works within the steeply sloping terrain is extremely limited;
- there is a limitation on the slope of the backspan cable with respect to the main span cable, the angle of the backspan cable should not be steeper than 1 : 2.25;
- the alignment is constrained by the need to tunnel under Tuen Mun Highway at an optimum location;
- the tower should be founded at a geologically favourable location with adequate space for its construction.

Taking account of the above factors, the tower has been located 50 metres offshore to the west of Grand Bay Villa.

4.3.2 Geotechnical

The seabed topography of the Ma Wan Channel is fully documented in the Feasibility Study Working Paper No. 14.

It is currently proposed to locate the northern tower on a nearshore reclamation area in the Ma Wan Channel. A preliminary assessment during the Feasibility Study indicated that rock conditions within the general area are suitable for the foundation of a suspension bridge tower.

The Hong Kong Geological Survey Sheet 6: Yuen Long (Solid and Superficial Geology) indicates that the proposed tower location is presently underlain by sublittoral marine sands of the Hang Hau Formation overlying beach deposit. The apparent absence of marine mud at the location of the tower, if confirmed by further ground investigation, represents a significant benefit to the project as the reclamation can be constructed with little or no dredging.

The north-east trending Sham Tseng Fault passes through the Ma Wan Channel beneath the span of the bridge, as does a parallel fault offset 80m to 100m to the north-west. The Sham Tseng Fault has resulted in a major fault zone and associated deep weathering profiles within the bed of the channel. Associated shears could extend towards the foundations of the northern tower and this aspect will be investigated by inclined drilling.

The geology of the Kwai Shek headland comprises coarse ash tuff intruded by a succession of east-north-east trending dykes of quartzphyric rhyolite. Shear zones or areas of faulting within the tuff and rhyolite are likely to be present at some locations and the areas of shoreline erosion to the east and west of the headland may be indicative of the coastal outcrops of such features.

Quartz veins are evident along the ridge above the headland. Field observation suggests that most of the veins are thin, and that they may be associated with hydrothermal alteration and consequent deep weathering. The surface traces of these veins are characterised by heavily eroded landforms, with local minor scarps and washouts.

Geophysical seismic surveys of the Kwai Shek area, together with the results of the feasibility study site investigations, suggest the depth of weathered rock (Grade IV to VI) varies from approximately 20m at the ridge line to approximately 3m towards the North Lantau coastline. Drillhole P3 from the Feasibility Study, the most northerly drillhole and inclined to the northwest at approximately 45°, indicates the presence of Debris Flow Deposits up to 6.5m thick, comprising clayey, sandy silt, underlain by moderately decomposed coarse ash tuff. Vertical drillhole P7 from the Feasibility Study encountered strong to very strong slightly decomposed quartzphyric rhyolite at shallow depth with no evidence to suggest sheared zones or faulting.

Vertical and inclined drillholes would be undertaken to further investigate the engineering geology at the anchorage and tower locations, with particular emphasis on the establishment of rock mass quality and the identification of significant structural features. These exploratory holes would provide information relating to the bearing capacity of the rock at the tunnel location and the ability of the rock mass to withstand the applied loads from the cable anchorages.

4.3.3 Drainage

The two abutments of the Tsing Lung Bridge would be built on the uplands of natural slopes. Excavation would be required for the construction of bridge abutments but the disruption to the surface watercourses due to the excavation is not anticipated to be significant.

The exposed cut faces of the excavation would require proper stabilization and/or protection and the requisite drainage would need to be designed in accordance with the relevant Hong Kong standards for slope drainage. Drainage provisions over the relatively short distances from both abutments to the sea would be required to drain the surface runoff collected from the slope drainage of the abutments.

4.3.4 Environmental

Feasibility Study Alignment

Noise: In the Feasibility Study, noise levels were predicted using traffic data for 2011 (cf. 2016 as required under the current study).

In Tsing Lung Tau, the sensitive receivers including Grand Bay Villa, Dragon View and Hong Kong Garden would be affected by the traffic noise from Route 10 and the surrounding road networks. The Feasibility Study Report indicated that noise levels at these receivers would reach 80 dB(A) and a 320 m inverter - L barrier (5 m high) is required for the FSA.

Air Quality: The effects of vehicle emissions on sensitive receivers at Hong Kong Garden were considered to be acceptable based on the traffic forecasts modelled. The conclusions of the FSA need to be reviewed based on current traffic forecast (when these are agreed).

Marine Ecology and Fisheries: The caisson for the pier was located in water of a depth of 20m and intruded at the edge of the main tidal flows, thereby creating relatively stagnant water between the caisson and the coastline. The effects on marine ecology may be relatively minor but any diminution in dissolved oxygen could affect the viability of the coastline for fish nursery zones.

Water Quality: Water Quality impacts were considered to be acceptable according to the results of the modelling study which was conducted. The reduction in cross sectional area is around 3.4% of the total area due to the positioning of the pier and ship protection outwith the embayment.

Preferred Alternative Alignment

Noise: The noise generated by traffic traversing the Tsing Lung Bridge would affect the receiving environment. Detailed noise modelling would be undertaken as part of the EIA to determine the noise levels experienced at the nearest noise sensitive receivers (Grand Bay Villa and Hong Kong Garden). It is expected that the noise levels would exceed the acceptable levels. Noise mitigation measures would be examined in detail as part of the EIA process.

Air Quality: As with noise the air quality impacts would be determined by the vehicle traffic flows and the mix of vehicles assumed to cross the bridge at peak hours. The EIA will assess in detail the potential effects in air quality.

The PAA is similar to the FSA in this section. The construction of anchorage and work sites for the Tsing Lung Bridge would require a smaller area for the PAA and the dust impact at the air sensitive receivers in Tsing Lung Tau would be smaller with lower dust emission from the site.

Marine Ecology & Fisheries: Marine ecology may be affected through the provision of ship protection in the form of reclamation around the northern pier of the bridge. Site inspections have indicated a relatively imperishable beach although the sheltered embayment may play host to some fish fry and other benthic biota.

Water Quality: The PAA requires the northern pier to be founded within the embayment with significant ship protection to be provided. Care has been taken to minimise the extent of the reclamation and the reduction in cross sectional area. The reduction in cross sectional area is less than 1.5%. This implies that the effects on bulk water exchange may be minimal and that the effects of infilling the embayment (up to the 10m contour line only) should have minimal effect on receiving water quality especially as the reclamation neither protrudes into the main tidal stream nor does it cause a stagnant body of water to develop.

4.3.5 Land Matters

Feasibility Study Alignment

Table 4.3.5.1 summarises the features and land interests within the section of the alignment occupied by the Tsing Lung Bridge which have been identified as being affected by the land requirement associated with the Feasibility Study Alignment.

Table 4.3.5.1: Summary of Features and Land Interests within the vicinity of the Tsing Lung Bridge Affected by the Feasibility Study Alignment

	Survey Sheet No.	Lot No./GLA	Building License/Short Term Tenancy	Area (m ²)	Features Affected
Subsection 2 (Chainage No. : 8600 - 10200)	6-SW-25D	DD 388 Lot 97* (Grand Bay Villa)	STT 1163 TW* (pleasure garden of Grand Bay Villa)	1,777.59	

* These affected features and land interests were inspected on 30th July, 1998

Private Lots: Lot 97 in D.D.388, Grand Bay Villa, would have to be resumed upon the implementation of the FSA. Grand Bay Villa which is developed under the provisions of GN364, comprises twelve two-storey houses under single ownership, subject to a number of tenancy agreements. According to verbal advice obtained from Sino Real Estate Limited on 4th August 1998, House 11, 12 and 15 are now vacant. Resumption of this lot would involve a significant sum in terms of compensation. It should also be noted that the lead time for resumption under Cap. 370 is normally between eighteen and twenty four months and therefore the need for resumption could have an impact upon the implementation programme for the bridge.

Short Term Tenancy: A strip of land held under STT 1163 TW, which is a pleasure garden and is located next to Grand Bay Villa, would be permanently affected by the FSA. The details of this short term tenancy need to be verified with the District Lands Office/ Tsuen Wan although in the majority of cases, Short Term Tenancies can be terminated by serving three months notice in advance to the tenant and compensation payment would not be necessary.

Preferred Alternative Alignment

It has been identified that under the Preferred Alternative Alignment, no features or land would be affected. Since the Tsing Lung Bridge north tower has been relocated 50 metres offshore to the west of Grand Bay Villa, no resumption of the property would be required. However, due to the close proximity of the bridge alignment, there could be significant environmental impacts to the residents during construction and operation of the Tsing Lung Bridge, such impacts may result in a requirement for resumption of the property.

4.3.6 Utilities

The effect of the Tsing Lung Bridge on existing utilities is relatively minor. Along the northern coastline at Tsing Lung Tau, CLP have two 11kV overhead lines that supply Woodland Heights and the Kwan Tang Construction Company. Detailed information is not available from CLP although preliminary investigation has indicated that the supply to Woodland Heights will require diversion. Sufficient clearance should exist to the Kwan Tang Construction Company supply as such diversion would not be required. Detailed information regarding the layout of the HKT ducts after the widening of the

Castle Peak Road would be sought. Diversion of these ducts may be required to avoid the piers of the approach span.

Construction of the tower at Tsing Lung Tau would affect the existing CLP submarine cables from Tsing Lung Tau to Kwai Shek. Discussions with CLP have indicated that these cables are no longer in use and diversion would not be economically feasible. Should these cables conflict with any construction activities they should be removed.

Utilities on the Kwai Shek headland in the vicinity of the tower are limited to the landing point of a 33kV CLP submarine cable. According to CLP records, this cable is no longer in use and has been capped. At the Kwai Shek headland there is the submarine cable previously connected into a 33kV overhead line which, has been removed. Discussions with CLP have stated that diversion of these abandoned cables would not be economically feasible and should this cable be encountered during construction, it should be removed.

4.3.7 Land Use Planning

The bridge landings at North Lantau are the same for both the FSA and PAA. They are located within a 'GB' Zone and the actual impact is to be established in the landscape and visual assessments.

The Tsing Lung Bridge has no material impact in the land use planning term, except for the areas around the bridge landings.

For the PAA, the bridge landing at Tsing Lung Tau would be located at the western portion of the ex-Tsing Lung Tau Quarry which is zoned 'Undetermined' (U) under the Approved Tsuen Wan West OZP No. S/TWW/7. It is understood that no development/land use has been designated for this portion of the Quarry Site. However, there is a proposal of rezoning an area of approximately 5,870m² at the eastern portion of Quarry Site to 'Residential (Group C)' (R(C)). The proposed plot ratio is 0.4 and it is scheduled to be available by 2002. Both alignments are unlikely to encroach upon this proposed R(C) Zone but the potential environmental implications on the future development should be a subject of further investigation.

The PAA avoids direct encroachment on a private low-rise residential development, Grand Bay Villas.

4.3.8 Landscape and Visual Impact

The northern tip of Lantau Island, Kwai Shek, is a visually prominent and natural landscape feature with a high point further south at Ng Kwu Leng. The hillsides support a grass and scrub vegetation down to a steep rocky shoreline. The low level of human disturbance on this headland results in a high landscape quality. The shoreline north of the KSMB and Kwai Shek peninsula are highly visible to the residents of Ma Wan and the future theme park on the site of the old fishing village together with the more distant residential developments on Castle Peak Road. The shoreline will also be viewed by users of Ma Wan Channel, Kap Shui Mun Channel and Lantau Link.

The Tsing Lung Tau area is characterised by steep slopes falling from the Tai Lam Chung Country Park down to a rugged, vegetated shoreline. These slopes are bisected by Tuen Mun Road and Castle Peak Road. Grand Bay Villa is located on a rocky promontory between Dragon Beach and a small, inaccessible (unnamed) sandy beach. An abandoned quarry lies to the west of the high-rise residential development of Hong Kong Garden and the low-rise developments at Ka Loon Tsuen which are Visually Sensitive Receivers (VSR).

Both alignments cut through Ng Kwu Leng, the highest point on the peninsula resulting in significant impacts to the landform.

The bridge, associated engineering and earthworks and the tunnel portal at the northern landfall would have great impact on the views from the adjacent VSRs, some of which are in close proximity to the bridge. The visual and landscape context adjacent to Hong Kong Garden would be in complete contrast causing a reduction in the visual and landscape quality. The visual impacts on Grand Bay Villa would also be severe under the PAA.

The PAA shows more disturbance to the Kwai Shek peninsula because of the extent of the slip roads that are required for the connections to Road P1. However, similar slip roads would be required for the FSA.

4.3.9 Marine

The comparison of the two options for the alignment of the Tsing Lung Bridge from the marine traffic perspective involves both construction and operational elements with the main areas for consideration being:

- Marine based construction activities relating to the north pier and bridge superstructure;
- Overall marine impacts presented by the alternative bridge arrangements;
- Marine based maintenance activities for the works.

Feasibility Study Alignment

Construction Activities: The main issue of concern for the FSA is the extent and complexity of the offshore works associated with the north tower. The works extend some 100m offshore and will require considerable marine support craft activity. With allowance for the manoeuvring of the floating craft a further 50m intrusion into the Ma Wan Channel could be anticipated during the construction period.

The alignment will have impacts during the initial positioning of the support cables and the raising of the bridge deck units into position.

Operational Period: Whilst the FSA does not significantly impinge on the deepwater navigation channel of Ma Wan, the physical presence of the tower and its proposed vertical sided protection cells is believed to create a psychological narrowing of the available navigation width as vessels increase the margin on the safe passage past the "hard" structure. The apparent narrowing of the channel could, in turn, lead to increased congestion and reduced manoeuvring space within this already restricted area.

Preliminary vessel simulations would also suggest that tower position for the feasibility study alignment could force a vessel approaching Ma Wan to move further offshore to obtain a good alignment for the safe navigation of Ma Wan. The tower base foundation at some 80m by 60m could have an impact on localised water movements with trailing eddies having the potential to effect safe navigation during high water flow periods.

Maintenance Period: The proposed cellular pier protection is less structurally robust than a conventional rubble mound revetment and it must be anticipated that marine based inspection of the structure would be required at regular intervals. Equally, more substantive remedial or replacement works would be required following a collision with the protection works with the risk of such an occurrence being exacerbated by the increased offshore position of the feasibility study alignment tower.

Preferred Alternative Alignment

Construction Activities: In contrast to the FSA, the land platform for the north tower under the PAA has the scope for a substantial portion of the construction to be undertaken by shore based equipment with the main marine requirement being limited to the seawall construction prior to filling.

As with the FSA, there would be impacts during the initial positioning of the support cables and the raising of the bridge deck units into position. The full marine impact assessment would include details of the lifting cycle and emergency clearance periods for these works. An assessment of the increased risk whilst the barges are on station for the lifting of the deck units would also be covered by the assessment.

Operational Period: Many of the issues identified above for the FSA are eliminated through the adoption of the PAA with its reduced water area requirements and revetment slopes.

Maintenance Period: The conventional rubble mound revetment is more structurally robust than the FSA's cellular pier protection, therefore, less risk of remedial or replacement works being required following a collision.

4.4 Tsing Lung Tau to Siu Lam Section

4.4.1 Topographical and Geometrical

Feasibility Study Alignment

The Feasibility Study has shown a straight alignment from the bridge to the tunnel portals through the main cables of the bridge. The portal to the southbound tunnel appears to be located in the area of the fault and fill area on the east side of the hill. Further, with the tunnel alignments constrained between the bridge cables, the resulting 6m wide rock pillar at the portals would require extensive tunnel support measures. The FSA does not represent the least-risk solution.

At the North portal, the Correctional Institute Dental Clinic to the north and Tai Lam Chung Tsuen to the south define the horizontal tunnel alignment. The Feasibility Study horizontal alignment placed the tunnel portal equidistant from these constraints.

The noise enclosure on the Tai Lam Chung viaduct proposed in the FSA requires tunnel safety guidelines to apply for the 2620m length from Tai Lam Chung south portal to the Siu Lam west portal. For this length of tunnel, with a 3% gradient and a high proportion of HGV's in the traffic mix, an intermediate air exchange ventilation station would be required.

Tunnel safety guidelines will be required for the route length from Tsing Lung Tau to Siu Lam west portal. The implications for incident control and rescue are delays in reaching the incident scene, access problems, and extra ventilation requirements. The FSA also includes a tunnel sump in the Tai Lam Chung tunnel. Tunnel sumps are generally undesirable due to the need to carefully control ventilation and flushing of the sump tanks, adding to the operation and maintenance costs.

Preferred Alternative Alignment

The horizontal alignment for the PAA is similar to the FSA, the principal difference is in the vertical profile.

The PAA would maximise the rock cover to the areas of fill adjacent to Tuen Mun Road. Based upon the available geotechnical information the south portal of the Tai Lam Chung tunnel has been relocated some 55m west of the position shown in the FSA. The modified position would be reviewed when further site investigation data are available.

Carriageway separation into the tunnel has been improved by aligning the southbound carriageway to the east of the bridge anchor cable. The rock pillar between the tunnel portals is then approximately 20m, significantly reducing portal and tunnel support requirements in this area.

The PAA locates the north portal within an area of rock exposures above Tai Lam Chung Tsuen, in order to reduce the extent of site formation works and expedite the establishment of the portals so that tunnel construction can commence at the earliest opportunity.

Minimum gradients and avoidance of tunnel sumps optimises ventilation and drainage systems. The raised alignment precludes the need for a noise enclosure over Tai Lam Chung Viaduct

4.4.2 Geotechnical

Reference is made to the Topography and Geology Report (Southern Section) T524/10.05/S3/00 and the Hong Kong Geological Survey Sheet 1:20,000 Geological Map Sheet 6. The Tai Lam Chung tunnel south portal would be located in megacrystic fine-grained granite. Northeast- and northwest-trending quartz veins and basalt dykes are evident within the granite in the general vicinity of the portal. The presence of either within the portal could have significant implications for design. Ground investigation would focus on locating quartz and basalt dykes. Discontinuities within the granite tend to be medium to wide, becoming closely spaced near major structural lines, such as faults.

Holes drilled near the portal indicate that the transition from completely or highly decomposed to moderately or less decomposed granite generally occurs within 12m of the ground surface, although variations of 8m above or below this depth have been recorded.

A suspected fault crosses the proposed tunnels at the Tuen Mun Road. The fault follows a steep-sided stream valley to the northwest of the portal and deeper weathering is suspected in this area. In order to mitigate the adverse influence of this fault on the Tai Lam Chung tunnel and the Tuen Mun Road, the PAA of the tunnels passes below the road at the crest of its vertical curve, in order to maximise the rock cover to the tunnel crown.

A detailed description of the rock mass properties at the anchorage and portal area is presented in GEO Report No. ADR 8/92, Preliminary Engineering Geological Study For An Underground Sewage Treatment Plant At Sham Tseng. Detailed mapping of the portal areas carried out for GEO Report No. ADR 8/92 has confirmed that rock material strength follows the general correlation with grade of decomposition as indicated between Table 2 and Table 4 in Geoguide 3 and shows a general increase with decreasing levels of decomposition

The Tai Lam Chung Tunnel would be driven through megacrystic, fine-grained granite for most of its length, with a 500m long section at the north portal being excavated in fine to medium-grained granite. The fine-grained granite tends to be more closely jointed than the medium or coarse-grained granite, as was shown during construction of the Shing Mun Tunnels. Tunnels driven for the North West New Territories Sewerage Scheme found that the fine-grained granite is generally of fair to good quality.

Faults and photogeological lineaments dissect the hillsides in the southern area of the Country Park. All are evident as valleys or depressions on the ground surface. Quartz veins are ubiquitous on the surface above the tunnel and ridges are denuded and heavily eroded. All this indicates that the tunnel could encounter zones of deep weathering through the Tai Lam Country Park. The most significant fault within the area is that which extends from the main dam at Tai Lam Chung Reservoir southeastward to Tsing Lung Tau. The PAA maintains a minimum clearance of about 100m from this feature to avoid potentially difficult tunnelling conditions.

4.4.3 Drainage

The highway alignment within the section runs across two sub-catchments, namely the Tsing Ling Tau sub-catchment and the Tai Lam Chung sub-catchment. The sub-catchments are within the Sham Tseng Basin.

Although the Tai Lam Chung Tunnel would be located within the Tai Lam Chung sub-catchment where surface runoff collected from most areas of the sub-catchment drains into the Tai Lam Chung Reservoir, the surface runoff collected from the areas above the tunnel would drain into the Tai Lam Chung Nullah. The impact on the yield of groundwater to the reservoir due to the construction and operation of the proposed tunnel is unlikely to be significant. This will be confirmed during the course of the assignment and monitoring of the tunnelling works will be a requirement of the construction contract. There should be no direct changes in surface runoff characteristics due to the construction and operation of the tunnel, hence no significant adverse drainage impacts on the existing drainage are likely.

The Tai Lam Chung viaduct would be built across the Tai Lam Chung Nullah and would be located approximately 800m downstream of the Waterfall Dam and the spillway of the Tai Lam Chung Reservoir. The dams of Tai Lam Chung reservoir were built decades ago and potential failure of the dam could cause significant increases in flood level and impact forces on the piers of the viaduct. A hazard and risk assessment of the dam is recommended to identify potential impacts caused by a dam-break and, thus provide information for the design of the deck levels of the viaduct and pier structures. The hydraulic impact of the pier structures in Tai Lam Chung Nullah on flood levels should be assessed.

Seepage from the tunnel would discharge into the highway drainage at the tunnel portals. The construction of tunnel portals would require excavation and the requisite slope drainage. Drainage provisions are required at tunnel portals to drain stormwater collected from the slope drainage to the existing watercourses. The drainage capacity and the maximum flow velocity (for erosion protection) of the existing watercourses would need to be checked and upgraded if necessary.

4.4.4 Environmental

Feasibility Study Alignment

Noise: After emerging from the Tai Lam Chung tunnel, the receivers at Tai Lam Chung area may be impacted by the open section of the alignment.

Air Quality: The sensitive receivers at Tai Lam Chung would be affected by the vehicle exhaust emission from the open section of the road. Sensitive receivers located in the vicinity of the tunnel portal ends such as Tai Lam Chung Tsuen would also be impacted by the tunnel portal emissions. Provided that the portal and ventilation shaft emissions specified in the Feasibility Study Report could be achieved, the AQO would be satisfied at the sensitive receivers.

Ecology: Route 10 goes through a variety of natural habitats, mainly grassy or shrubby in nature. They are grassland-scrubland mosaic, and scrubland in various height. The species found in the scrubland habitat are typical to that habitat type in

Hong Kong and dominated by the shrub *Rhodomyrtus tomentosa* and *Backea frutescens*, as well as herbaceous plant *Arundinaria cantorii*, *Gahnia tristis*. The height of the scrubland is generally taller in low attitude and around village area, where they usually emerged with the plantation and with more shade tolerant species.

The grassland-scrubland mosaic is one of the dominant habitat type in the Tai Lam Country Park, and the species composition is similar to that of other scrubland but tend to be shorter in height as a result of the frequent disturbance (hill-fire).

Most of the species recorded in this section are well-representative and typical to such habitat type elsewhere in Hong Kong, and the species of conservation interest include *lespedeza cuneate* (*l. Juncea* var. *Sericea*), *nepenthes mirabilis*, *enkianthus quinqueflorus*. The former species is rare in Hong Kong and usually be seen on small islands; whereas the latter two are all protected in Hong Kong with a restricted distribution.

Several rare or protected plant species were recorded in different habitat types along the whole alignment, particularly the scrubland on Tai Lam Section. Although no wildlife of ecological/conservation importance were observed during the field visits, given the naturalness and close proximity to the Tai Lam, such habitats may be used by a variety of wildlife for different purposed (such as foraging or movement corridor), the habitat loss of such scale may be resulted in severe impact to the associated wildlife. Based on the preliminary findings, transplant of the species and recreation habitats would be required.

Risk: The FSA passes within the Consultation Zone of Tai Lam Chung Pre-Chlorination House (PCH) which is a Potentially Hazardous Installation (PHI) on account of storing and using liquid chlorine in 1 tonne drums. At its closest point of approach, the alignment lies approximately 500m from the PCH. However, the risks arising from the presence of the PCH were acceptable for the alignment, as identified in the Feasibility Study Report.

Water Quality: No effects are anticipated as water quality except those of groundwater which are discussed under the drainage section in the report.

Fisheries: The coastal line would not be affected by the FSA and therefore, the fisheries and marine ecology would not be impacted.

Preferred Alternative Alignment

Noise: As the PAA is emerged at a higher elevation (about 53mPD), the low level villages houses in Tai Lam Chung Valley would be protected with the attenuation of the structure itself.

Mitigation measures such as 5m vertical barrier or inverted "L" barrier may be required for the PAA in this section of the road to protected the planned CDA zone to the west of Psychiatric Centre (30 storeys) in Siu Lam.

Air Quality: The PAA is similar to the FSA in this section and their air quality are similar.

Ecology: The ecology impact for the PAA is similar to the FSA.

Risk: The PAA passes within the Consultation Zone of Tai Lam Chung Pre-Chlorination House (PCH). At its closest point of approach, the open road lies approximately 500m from the PCH zone. Whilst this will increase the risk to road users, it is not anticipated to invalidate the findings of the hazard assessment study identified in the FS Report. No risk effects are anticipated.

Water Quality: No effects are anticipated as water quality except those of groundwater which are discussed under the drainage section in the report.

Fisheries: The coastal line would not be affected by the PAA and therefore, the fisheries and marine ecology would not be impacted.

Waste Disposal: Spoil disposal is relevant to the construction phase only. Construction wastes that are wholly inert may be taken to public filling areas. Public filling areas usually form part of land reclamation schemes and are operated by the Civil Engineering Department. In accordance with Government policy on waste disposal excavated material will, whenever possible be re-used on this project. Subject to the finalisation of the alignment large quantities of fill may be required for the future Toll Plaza on Lantau Island. The overall balance of fill required will be reviewed at a later stage in the assignment but this would depend on the construction programme.

4.4.5 Land Matters

The land issues relating to the proposed road corridor between Tsing Lung Tau and Siu Lam have been evaluated within two different sections, namely the Tsuen Wan Section and Tuen Mun Section, in order that the affected land interests and features can be separated in accordance with the geographical areas falling within the administrative boundary of the District Lands Office/ Tsuen Wan and District Lands Office/ Tuen Mun respectively.

Feasibility Study Alignment

Tsuen Wan Section

Table 4.4.5.1 summarises the features and land interests within the section of alignment between Tsing Lung Tau and Siu Lam (Tsuen Wan Section) which have been identified as being affected by the land take for the Feasibility Study Alignment.

Table 4.4.5.1: Summary of Features and Land Interests between Tsing Lung Tau and Siu Lam (Tsuen Wan Section) Affected by the Feasibility Study Alignment

	Survey Sheet No.	Lot No./GLA No.	Building License/Short Term Tenancy	Features Affected
Subsection 3 (Tsuen Wan Section)	6-SW-25D			<ul style="list-style-type: none"> • Temporary Structures
(Chainage No. : 10200 - 10900)	6-SW-25B			<ul style="list-style-type: none"> • Catchwater* • Part of Tai Lam Country Park* • TWCP 181 CL. NO. TW 16/93 • TWCP 204 CL. NO. TW 13/94
	6-SW-25A			<ul style="list-style-type: none"> • Part of Tai Lam Country Park*

* These affected features and land interests were inspected on 30th July 1998

Private Lots: It has been established that no private lot would be affected by the FSA.

Catchwater: It has been identified from the land status plans that the southern part of a catchwater pipe and a road would be permanently affected by the FSA.

Land Requirements within Country Park Boundary: The FSA falls within the boundary of Tai Lam Country Park. Pursuant to the Country Parks Ordinance (CAP. 208), the prior approval of the Director of Agriculture and Fisheries would need to be sought for the implementation of the section of the alignment falling within the Country Park. It is also envisaged that consultation with the Country Park Board that was formed as part of the Ordinance would be necessary to obtain endorsement of the form and the extent of the alignment.

Graves and Shrines: Since several locations within this section of the FSA were inaccessible because of a lack of footpaths, the identification of graves affected has been based on desktop study of plans. Based upon analysis of the land status plans, it has been identified that no grave, shrine or urn would be affected by the implementation of the FSA and it is therefore anticipated that there would not be any cost implication associated with the removal of graves. District Office (Tsuen Wan) will be consulted on Fung Shui and Shrines issues.

Tuen Mun Section

Table 4.4.5.2 summarises the features and land interests between Tsing Lung Tau and Siu Lam (Tuen Mun Section) which have been identified as being affected by the land take for the Feasibility Study Alignment.

Table 4.4.5.2: Summary of Land interests and Features between Tsing Lung Tau and Siu Lam (Tuen Mun Section) Affected by the Feasibility Study Alignment

	Survey Sheet No.	Lot No./GLA No.	Building License/Short Term Tenancy	Features Affected
Sub-section 3 (Tuen Mun Section) (Chainage No. : 10,900 - 12,400)	6-SW-25A			<ul style="list-style-type: none"> Part of Tai Lam Country Park
	6-SW-20C		<ul style="list-style-type: none"> STT 1181 NAL33 (Licence to Towngas) 	<ul style="list-style-type: none"> Part of Tai Lam Country Park
	6-SW-19D	<ul style="list-style-type: none"> GLA-TTM320* GLA-TM370* (Proposed) 		<ul style="list-style-type: none"> Graves (3)* Urn (1) Access road NANTT 16-DF* Part of Tai Lam Country Park* Burial Ground 17* NANTM 81 GN 1399

* These affected features and land interests were inspected on 30 th July, 1998.

Private Lots: No private lot would be affected by the FSA.

Licences: As indicated upon the land status plan provided by the District Survey Office/Tuen Mun, Licence No. NAL 33, granted to Towngas for laying of the pipeline, would be affected by the FSA. The area held under licence could not be inspected as there is no footpath to the licence area. The particulars of the licence will need to be clarified with the New Airport Section of the Lands Department in order to assess the implications of any impact relating this licence upon the implementation of the FSA.

Graves and Burial Areas: Graves, an urn and the Permitted Burial Area No. 17 would be affected along the route within the west of the Tai Lam Country Park. Since the majority of the route would be built in the form of tunnels, it is considered that the impacts upon the three graves affected would be minimal, subject to confirmation from the contractor that the construction works would not lead to any damage to the graves. The significance of the impact of the graves upon the implementation of the road works is detailed in Section B1 of this Appendix. District Office (Tsuen Wan) will also be consulted on Fung Shui and Burial Area issues.

It is envisaged that a period of more than a year may be required to serve notice to any affected parties for the clearance of graves. Under normal circumstances, ancestral graves of 'Fung Shui' significance which have existed for more than 60 years may cause clearance problems whilst impacts of other graves are relatively less significant.

Government Land Allocations: Two Government Land Allocations, GLA-TTM 320 and GLA-TM 370 as indicated on plan, would be affected by the FSA and details of these Government Land Allocations would be subject to clarification with the DLO/Tuen Mun. Preliminary findings during site inspection have established that GLA-TTM 320 is now occupied by the Correctional Services Department for storage purposes and GLA-TM 370 is vacant.

Short Term Tenancies: A short term tenancy, STT 1181, would be affected as identified upon the land status plan Nos. 6-SW-19D and 6-SW-20C. Moreover, there is an access track directed to this short term tenancy which may also be affected. The details of this Short Term Tenancy are subject to clarification with the New Airport Section of the Lands Department. Since this section of road is to be constructed by way of the Tai Lam Chung Tunnel, it is considered that the impact of the need to address this issue would not be significant in terms of the implementation of Route 10.

Land Requirements within Country Park Boundary: Part of the Tai Lam Chung Tunnel falls within the boundary of Tai Lam Country Park. Approval of the Director of Agriculture and Fisheries would need to be sought as detailed under the Tsuen Wan Section.

Preferred Alternative Alignment

Tsuen Wan Section

Table 4.4.5.3 summarises the features and land interests within the section of alignment between Tsing Lung Tau and Siu Lam (Tsuen Wan Section) which have been identified as being affected by the land take for the Preferred Alternative Alignment.

Table 4.4.5.3: Summary of Features and Land Interests between Tsing Lung Tau and Siu Lam (Tsuen Wan Section) Affected by the Preferred Alternative Alignment

	Survey Sheet No.	Lot No./GLA No.	Building License/Short Term Tenancy	Features Affected
Subsection 3 (Tsuen Wan Section)	6-SW-25D	<ul style="list-style-type: none"> GLA-TTW 607* (storage of pipes) 		<ul style="list-style-type: none"> Temporary Structures
(Chainage No. : 10200 - 10900)	6-SW-25B			<ul style="list-style-type: none"> Catchwater* Part of Tai Lam Country Park* TWCP 181 CL. NO. TW 16/93 TWCP 204 CL. NO. TW 13/94
	6-SW-25A			<ul style="list-style-type: none"> Part of Tai Lam Country Park*

- These affected features and land interests were inspected on 30th July 1998

Private Lots: It has been established that no private lots would be affected by the PAA.

Government Land Allocation: Discussions with the relevant Government Departments would be required in order to determine the need for the reprovisioning and relocation of GLA-TWW 607 upon implementation of the PAA.

Catchwater: Similar to the FSA, the southern part of a catchwater pipe and a road would be permanently affected by PAA.

Land Requirements within Country Park Boundary: The PAA also falls within the boundary of Tai Lam Country Park and approval of the Director of Agriculture and Fisheries would need to be sought for the implementation of the alignment.

Graves and Shrines: Since several locations within this section of the alignment were inaccessible because of a lack of footpaths, the identification of graves affected has been based on desktop study of plans. Based upon analysis of the land status plans, it has been identified that no grave, shrine or urn would be affected by the implementation of the PAA.

Tuen Mun Section

Table 4.4.5.4 summarises the features and land interests between Tsing Lung Tau and Siu Lam (Tuen Mun Section) which have been identified as being affected by the land take for the Preferred Alternative Alignment.

Table 4.4.5.4: Summary of Land Interests and Features between Tsing Lung Tau and Siu Lam (Tuen Mun Section) Affected by the Preferred Alternative Alignment

	Survey Sheet No.	Lot No./GLA No.	Building License/Short Term Tenancy	Features Affected
Sub-section 3 (Tuen Mun Section) (Chainage No.: 10,950 - 12,500)	6-SW-25A			<ul style="list-style-type: none"> Part of Tai Lam Country Park
	6-SW-20C			<ul style="list-style-type: none"> Part of Tai Lam Country Park
	6-SW-19D	<ul style="list-style-type: none"> GLA-TTM320* GLA-TM 370* (Proposed) DD 385 Lot 138* 	<ul style="list-style-type: none"> STT 1181 	<ul style="list-style-type: none"> Graves (3)* Urn (1) Access road NANTT 16-DF* Part of Tai Lam Country Park* Burial Ground 17* NANTM 81 GN 1399

* These affected features and land interests were inspected on 30 th July, 1998.

Private Lots: One private lot, namely Lot 138 in DD 385, would be affected by the proposed alignments as identified upon the land status plan. The encroachment of Lot 138 in DD 385 by the PAA is very minor in nature with the area encroached being less than 25m². It was also identified from site inspection that the lot was uncultivated and no structure was present upon the lot. Since the alignment in this section is in the form of a tunnel (Tai Lam Chung Tunnel) which would pass through the Tai Lam Country Park, it is considered that resumption of this lot would not be necessary.

Licences: No licence will be affected by the PAA.

Graves and Burial Areas: Similar to the FSA, graves, an urn and the Permitted Burial Area No. 17 will be affected along the route within the west of the Tai Lam Country Park. Since the majority of the route would be built in the form of tunnels, it is considered that the impacts by the three graves affected would be minimal, subject to confirmation from the contractor that the construction works would not lead to any damage to the graves. The significance of the impact of graves upon the implementation of the road works is detailed in Section 4.2.5 of this Report. District Office (Tuen Mun) will also be consulted on Fung Shui and Burial Area issues.

Government Land Allocations: The same two Government Land Allocations affected by the FSA would also be affected by the PAA.

Short Term Tenancies: Similar to the FSA, a short term tenancy, STT 1181, and the adjacent access track may be affected.

Land Requirements within Country Park Boundary: As with the FSA, part of the PAA also falls within the boundary of Tai Lam Country Park and the prior approval of the Director of Agriculture and Fisheries would need to be sought.

4.4.6 Utilities

Feasibility Study Alignment

The vertical alignment of the tunnel route is constrained between the WSD catchwater tunnel above and the Towngas pipeline below.

The recently completed Towngas pipeline supplying Lantau Island is a 750mm diameter high pressure main that passes within 4m of the FSA. The Feasibility Study proposed a diversion of the pipeline, to give approximately 30m clearance to the Tai Lam Chung Tunnel. Towngas have subsequently commented that diversion work for this pipeline would be unacceptable. The FSA has thus been reviewed in light of the above, with the objective of providing the maximum possible clearance to the Towngas pipeline.

Preferred Alternative Alignment

For the PAA, the minimum radial distance between the Towngas pipeline and road tunnel excavation is 43m. A blasting restriction of 25mm/s, agreed with Towngas, will require construction restrictions on charge weights per delay when tunnelling past the pipeline.

The permissible clearance to the WSD catchwater tunnel has been determined as 9.5m based on an allowable particle velocity limit of 25 mm/s in accordance with WSD DI 1038 and adopting the blast energy propagation equation and average material constants from Geoguide 4. During construction, restrictions on tunnel excavation local to the WSD tunnel would be expected.

4.4.7 Land Use Planning

Feasibility Study Alignment

As the FSA would be mostly in tunnel, it is anticipated that a small area of land would be affected.

Preferred Alternative Alignment

The Alignment travels approximately 1800m in tunnel from Tai Lam Chung and emerges south of the Tai Lam Correctional Institution. Two sections of a 'Government, Institution/Community' (G/IC) Zone jut southwards out of the main area of the Correctional Institution and both sections are encroached by the Alignment (on viaduct). Consultation with the Correctional Services Department would be necessary to confirm the feasibility of the Alignment.

Between the two southward jutting sections of G/IC are the Tai Lam Chung Nullah and a GB Zone. A viaduct is used to traverse this section before going into cutting. The impact on the GB Zone is to be established through the landscape and visual assessments.

4.4.8 Landscape and Visual Impact

Much of the eastern part of the Tai Lam Chung area is defined by the naturally vegetated, undulating hillsides of Tai Lam Country Park and the dam of the Tai Lam Chung Reservoir. This is an area of little human disturbance and high landscape quality. To the west, the hills form the backdrop to the Tai Lam Chung valley. This is a narrow valley defined by steep slopes, with natural woodland on the east and grassland on the west. The upper section, adjacent to the Tai Lam Chung Reservoir dam, is developed as a Correctional Institution facility. To the south, a disused quarry has disturbed the eastern valley-side. The village of Tai Lam Chung Tsuen is oriented to the south, towards the sea. Houses on the western periphery of the village will be VSRs. A temple is present in the village. A watercourse in the base of the valley serves as an outflow for the reservoir and is trained for most of its length within a rockfill bed. The valley bottom is lined by development including low-rise houses, open storage and unused development areas. The valley landscape is heavily disturbed and is of low landscape quality. To the east of the valley is a relatively undisturbed knoll separating Tai Lam Chung valley from the neighbouring Siu Lam valley. The sides of this knoll are steep and vegetated primarily by rough grass and scrub and, unlike many of the hills in the area, has not been eroded. This landscape feature has high landscape quality.

At the Tai Lam Chung tunnel, the horizontal alignments of both the FSA and PAA alignments are similar so impacts are confined to the differences in vertical alignment and engineering design. Additionally, as both alignments are enclosed within tunnel

sections up to the eastern slope of the Tai Lam Chung valley, there would be no landscape and visual impacts to this point.

Feasibility Study Alignment

The main impacts would arise from the disturbance to the local topography and vegetation caused by the construction of the tunnel portals and associated earthworks on both sides of the valley, together with introduction of a low level viaduct at 15-20mPD between the two. The level of disturbance to the valley would be dependent on the method of construction and support of the bridge or viaduct, that is, the number and type of supporting columns. The inclusion of the Siu Lam tunnel minimises impacts on the eastern knoll which, is an area of high landscape quality. The road profile of the FSA is approximately the same height, or slightly lower, than the height of the reservoir dam. This would result in less significant impact to the distant views from the south. However, the visual impacts may be significant locally as lower relative height of the road may make it more visible in the surrounding area. The village of Tai Lam Chung Tsuen, in particular, will be affected, although the intermediate wooded knoll north of the village, together with the houses orientation facing south west, will screen some of the impacts.

Preferred Alternative Alignment

In general, the vertical alignment is considerably higher than the FSA rising from 49 to 56 mPD. This would cause a different impact to that caused by the FSA on the eastern side of the valley. The level of disturbance to the valley would be dependent on the method of construction and support of the bridge or viaduct, that is, the number and type of supporting columns as well as its scale.

4.5 Siu Lam to So Kwun Wat Section

4.5.1 Topographical and Geometrical

Feasibility Study Alignment

In the section from Siu Lam to So Kwun Wat, the FSA from Ch. 12860 to 13120 consists of the Siu Lam Tunnel and a viaduct (Siu Lam Viaduct) crossing over an existing village. This section of the FSA is climbing with a constant gradient of 3%. The level of this section ranges from +32.6 mPD to +41.2 mPD. The viaduct runs at a constant radius of 700m horizontally to Ch 13250.

Following the Siu Lam viaduct, the FSA from Ch 13120 to 13300 is completely located in a cutting through the existing platform allocated for G/C uses. After climbing at a constant gradient of 3% to Ch 13300, the vertical profile reaches a high point of +87.804 mPD with a crest curve of k value 33.3. The vertical difference between the existing ground level and the FSA ranges from 30m to 40m. This involves a cutting of the natural hillside from +87.8 mPD to +44.6 mPD.

The western 250m length of the Siu Lam tunnel is a 700m radius horizontal curve. This curve complies with TPDM sight distance requirements to the tunnel wall only for an 85km/h design speed.

For the FSA, the low elevation from the Siu Lam tunnel west portal across Siu Lam valley through to the Siu Lam quarry platform requires extensive cutting of the quarry platform. The extent of the cutting is constrained by WSD Raw Water Feed reserve on the north.

Preferred Alternative Alignment

Generally the PAA is very close to the FSA horizontally. By raising the vertical alignment through the Tai Lam Chung Tunnel, there is scope to provide a 300m open cut through the Siu Lam ridgeline. In cutting, the alignment gives a maximum depth from the highway to the ground level through the Siu Lam ridgeline section of 76m at Ch. 12725. This is approximately 20m higher than the FSA. The cutting option for Siu Lam shows significantly lower risk from a public safety viewpoint as Emergency Services response can be more efficient.

Horizontally, from Ch 12960 to 13250, the PAA is on elevated viaduct consisting of curved sections with radius of 900m and 2336.10m respectively. Vertically, the alignment from Ch 12960 is at a gradient of 3%, reaching a high point at Ch 13017 of +68.05 mPD. The gradient changes to -0.7% at Ch 13060.

After spanning over the valley between Siu Lam and So Kwun Wat, the PAA lands on the existing platform in the vicinity of So Kwun Wat from Ch 13250 to 13450. The vertical level of this section goes through from 66.4 mPD to 65.4 mPD, while the existing ground level ranges from 82.1 mPD to 51.2 mPD in large platform areas.

4.5.2 Geotechnical

At Siu Lam ridgeline the slopes on the east side of the ridge overlooking Tai Lam Chung are characterised by numerous large exposures of moderately and slightly decomposed granite, with siliceous veining. The exposures show evidence of persistent sheeting joints parallel to the existing ground surface, probably induced by stress relief. It is inferred that rock is at or very close to the surface over the length of proposed highway from the west abutment of the Tai Lam Chung viaduct to a bluff of rock just to the west of the ridge peak.

Below the rock bluff on the western side of the ridgeline, the ground surface is uneven and disturbed. The topography is indicative of previous ground movements and instability in the area. There is evidence of quartz veining, with alteration and erosion of denuded or sparsely vegetated ridgelines.

There are no faults shown on Hong Kong Geological Survey (HKGS) Sheet 6 within the hillside itself but the major north-east trending Siu Lam fault is located at the foot of the hill, in the adjacent Siu Lam valley. A crush zone more than 10m wide, infilled with quartz veinlets, is typically associated with this fault. Inspection of aerial photographs of the area indicates a north-south aligned feature that extends from the reservoir to the coast, passing just to the west of the rock bluff.

It is suspected that this lineament is a fault, possibly associated with the Siu Lam Fault, which has lowered the rock level on its eastern side and, from the evidence of quartz veining and deep erosional scars on this side of the ridge, has been associated with secondary quartz intrusion and hydrothermal alteration of the granite country rock. This would result in a generally weaker ground mass, which supports the observations that the whole west side of the ridge resembles a meta-stable relict backscarp. If this is the case, then the lower reaches of the valley would be underlain by significant thickness of debris flow deposit.

The high rock levels on the eastern side would present difficulties in excavating a 76m deep cutting, but geotechnical considerations support a cutting on the western side of the ridge if postulations about past instability in the area are shown by investigation to be correct.

4.5.3 Drainage

Feasibility Study Alignment

The alignment within this section runs across Siu Lam sub-catchment, which is a sub-catchment of the Sham Tseng Basin. No major flooding records have been reported within this study area, except for a flooding blackspot near the So Kwun Wat Tsuen due to the insufficient capacity of existing drainage. The following major drainage impact issue will need to be considered for the proposed alignment.

The surface runoff collected from areas above the Siu Lam Tunnel would drain into the Tai Lam Chung Nullah and the existing streams within the Siu Lam sub-catchment. As a result, no adverse impacts on the yield of groundwater to the Tai Lam Chung reservoir are expected due to the construction and operation of the proposed tunnel. There should be no direct changes in surface runoff characteristics

due to the construction and operation of the tunnel, hence no adverse drainage impacts on the existing drainage are likely.

The 600m long open-cut through the quarry platform will require extensive excavation but the disruption to the surface watercourses in these areas will not be significant due to the contours of the slopes adjoining the cutting. The exposed cut faces of the excavation will require proper stabilization and/or protection and the requisite drainage will need to be designed in accordance with the relevant Hong Kong standards for slope drainage. Drainage provisions will be required at the northern end of the cutting to drain stormwater collected from the open-cut faces to the existing watercourses within the So Kwun Wat sub-catchment. The drainage capacity of existing downstream watercourses will need to be checked and upgraded if necessary.

Preferred Alternative Alignment

The viaduct starts from the Siu Lam open-cut where the proposed highway level is about 70mPD. This alignment layout will result in the viaduct passing over existing watercourses that are downstream of the Low Gap Dams No.1 and No.2. No significant adverse drainage impacts are expected on the existing drainage conditions due to the construction and operation of the viaduct. However, it would be necessary to check the drainage capacity of existing watercourses within the sub-catchment due to the increased peak runoff from paved areas of viaduct.

The Siu Lam cutting under the PAA, a 300m long open-cut, would require extensive excavation. Disruption to the surface watercourses in these areas would not be significant due to the contours of the slopes adjoining the cutting. The exposed cut surfaces of the excavation would require proper stabilization and/or protection and the requisite drainage would need to be designed in accordance with the relevant Hong Kong standards for slope drainage. A drainage provision is required at the western end of the cutting to drain stormwater collected from the open-cut faces to the existing watercourses within the Siu Lam sub-catchment. It is noted that a residential housing development is currently under construction in the downstream portion of the sub-catchment, and it appears that the existing drainage is being upgraded in association with this development. The drainage capacity of the existing downstream watercourses would need to be checked and upgraded if it is found to be necessary.

4.5.4 Environmental

Feasibility Study Alignment

Noise: The FSA will be in tunnel in the Siu Lam area and its noise impact could be minimized in the Siu Lam area.

Air Quality: The sensitive receivers at So Kwun Wat would be affected by the vehicle exhaust emission from the open section of the road.

In the Siu Lam area, the FSA is in tunnel and the receivers located in the vicinity of the tunnel portal could be affected by the portal emissions. Appropriate air ventilation system would be required for the FSA to satisfy the tunnel air quality requirements and the ambient Hong Kong Air Quality Objectives at the ASR's.

Ecology: The ecology impact is similar to that reported in Section 4.4.4 of this Report for the Tsing Lung Tau to Siu Lam Section.

Water Quality: No effects are anticipated as water quality except those of groundwater which are discussed under the drainage section in the report.

Fisheries: The coastal line would not be affected by the FSA and therefore, the fisheries and marine ecology would not be impacted.

Preferred Alternative Alignment

Noise: Although this section of the alignment is opened, the increase in vertical road alignment could potentially increase the noise shadow zone of the alignment structure itself and the low level villages in Siu Lam would be protected. It is envisaged that with the use of mitigation measures such as 5m high vertical barriers or inverted "L" barriers the noise impacts at the NSRs could be mitigated to accepted levels.

Air Quality: The PAA is an open cut section along Siu Lam, the ASRs would potentially be affected by the open section of the alignment. But since the PAA runs on a higher elevation and open structure, air quality of the area will be improved with better dispersion of pollutants at higher elevation. In addition, the local areas in Siu Lam will be improved without the portal emission of the Siu Lam tunnel

Ecology: The ecology impact for the PAA is similar to the FSA, however, the PAA would give a slightly greater scale of impact as the Siu Lam section would be in open cut. Based on the preliminary findings, transplant of the species and recreation habitats would be required.

Risk: The PAA involves an additional 400 meters of open road within the Consultation Zone of the WTW. Whilst this would increase the risk to road users, it is not anticipated to invalidate the findings of the earlier hazard assessment study identified in the Feasibility Study Report. The alignment is likely to be acceptable with respect to the Government Risk Guideline.

Water Quality: No effects are anticipated as water quality except those of groundwater which are discussed under the drainage section in the report.

Fisheries: The coastal line would not be affected by the PAA and therefore, the fisheries and marine ecology would not be impacted.

Waste Disposal: Spoil disposal is relevant to the construction phase only. The open cut option requires a significantly larger volume of spoil to be disposed of than the tunnel option. Construction wastes that are wholly inert may be taken to public filling areas. Public filling areas usually form part of land reclamation schemes and are operated by the Civil Engineering Department. In accordance with Government policy on waste disposal excavated material will, whenever possible be re-used on this project. Subject to the finalisation of the alignment large quantities of fill may be required for the future Toll Plaza on Lantau Island. The overall balance of fill required will be reviewed at a later stage in the assignment but this would depend on the construction programme.

4.5.5 Land Matters

Feasibility Study Alignment

Table 4.5.5.1 summarises the features and land interests between Siu Lam and So Kwun Wat which have been identified as being affected by the land take for the Feasibility Study Alignment.

Table 4.5.5.1: Summary of Features and Land Interests between Siu Lam and So Kwun Wat Affected by the Feasibility Study Alignment

	Survey Sheet No.	Lot No./GLA No.	Building Licence /Short Term Tenancy	Features Affected
Subsection 4 (Chainage no. : 12400-13300)	6-SW-19C	<ul style="list-style-type: none"> • GLA-TM66 • DD384 Lot 463 	MNT 473	TV Transmission Station
		<ul style="list-style-type: none"> • DD384 Lot 46 • DD384 Lot 43RP* • DD384 Lot 33 • DD384 Lot 34 • DD384 Lot 36 • DD384 Lot 37 • DD384 Lot 32* • DD384 Lot 50RP • DD384 Lot 54 • DD384 Lot 55 • DD384 Lot 462* 	MNT 474	
			<ul style="list-style-type: none"> • PM 841 • PM 5 • PM 1320 • STT 588* 	Access Footpath
	6-SW-19A			<ul style="list-style-type: none"> • Graves (2) • Temporary Structures • Tank • SHAI/SPHT/S SSI • Powerline
	6-SW-18B			TM A 59/6-DF

* These affected features and land interests are inspected on 30th July 1998

Private Lots: It has been identified that 12 private lots would be affected by the Feasibility Study Alignment within the Siu Lam to So Kwun Wat Section. Other than Lots 36, 37 and 46 in DD 384, upon which structures are currently situated, it has been established that the remainder of the sites which were inspected comprise uncultivated agricultural land without any structures. A village type house has also been identified upon Lot 462 in DD 384 and although this lot is not directly encroached upon by the alignment, the only access to this lot may be blocked by the alignment and reprovisioning work would be required.

Some fruit trees were also identified upon some of the affected lots which are summarized above. However, the exact number of fruit trees that would be affected

would be subject to a detailed tree survey at a later stage. The owners of the fruit trees are entitled to cash compensation in the event of resumption by the Government.

It should be noted that the lead time for resumption under Cap. 370 is normally between eighteen and twenty four months. Therefore, the need for land resumption may have implications upon the implementation programme for Route 10.

The private lot, namely Lot 463 in DD 384, which is located upon the hill-top at a level of approximately 140m above HKPD, with an area of approximately 94 m², was granted to Asia Television Limited for the purposes of wireless television transmitting station in 1993. The grant under which the site is held has a lease term up to November 2000 and contains no provision for renewal of the lease. Any structures to be erected in this lot are confined to the approved building plans as referred to within the lease and there is also a resumption clause in the lease such that the Government can resume all or part of the lot for the improvement of Hong Kong or for any other public purpose by serving the Grantee 12 months' notice in advance. Compensation would be paid to the Grantee on the basis of the market value of the site assuming that the use is restricted to industrial purposes only, as stipulated in the lease.

It is considered that this private lot would not be affected by the FSA as the alignment will run underneath this lot, it may only be necessary to create an easement for the length of the tunnel.

However, it should be noted that the term of the lease expires in November 2000, and therefore it may not be necessary for the creation of easement of the lot to take place if the lease is not renewed.

Structures with Licences: It has been identified that licences numbered MNT473, MNT474, PM5, PM841 and PM1320 would be affected by the FSA. The details of the licences and associated structures would be subject to further confirmation with DLO/Tuen Mun. Clearance of those structures may require compensation to the licencees and the amount of such compensation would be subject to the nature of the licences and the type and form of the structures.

Graves and Burial Areas: It has been identified from the survey plans that 2 graves would be affected by the Feasibility Study Alignment. However, the exact number of graves or urns to be affected can only be ascertained by further detailed inspection along the proposed routes and would also depend upon the extent of the works that are required to be undertaken. It has been established that there is no Gazetted Burial Area within the Study Area in Tuen Mun, subject to confirmation with DLO/Tuen Mun.

The significance of the impact of the graves upon the implementation of the road works is detailed in Section 4.2.5 of this Report under the North Lanau section.

Government Land Allocation : Government Land Allocation no. GLA-TM 66, as indicated on plan, would be encroached by the FSA and details of this Government Land Allocation would be subject to clarification with the DLO/Tuen Mun. However, it is considered that this Government Land Allocation may not be affected by the FSA as the alignment will run underneath this lot.

Short Term Tenancy: It has been identified that a site under a Short Term Tenancy numbered STT 588, which encircles DD 384 Lot 462 upon which is built a 3-storey village type house, would be permanently affected by the FSA. Details of the affected Short Term Tenancy including the terms, the site area and the use would need to be confirmed with District Lands Office/Tuen Mun. Initial investigations suggest that the STT is a garden STT for the Lot owner and renewed on 20 August 1998. Termination or amendment of the Short Term Tenancy would be subject to arrangement and negotiation between the DLO and the tenant.

Temporary Structures: During site inspection, it was identified that certain temporary structures of a single storey structure and a covered carport were situated upon the site to the immediate south-west of the site occupied by GLA no. TM/LM87. This area would be affected by the FSA. Rehousing and compensation may be necessary to be implemented by the Housing Department in the event of the clearance of these structures.

Preferred Alternative Alignment

Table 4.5.5.2 summarises the features and land interests between Siu Lam and So Kwun Wat which have been identified as being affected by the land take for the Preferred Alternative Alignment.

Table 4.5.5.2: Summary of Features and Land Interests between Siu Lam and So Kwun Wat Affected by the Preferred Alternative Alignment

	Survey Sheet No.	Lot No./GLA No.	Building License/Short Term Tenancy	Features Affected
Subsection 4 (Chainage No.: 12500-13400)	6-SW-19C	<ul style="list-style-type: none"> • GLA-TM66 • GLA-TM 122* • DD384 Lot463 • DD384 Lot 462* 	<ul style="list-style-type: none"> • STT 588* • PM 1320 	ATV Transmission Station Access Footpath <ul style="list-style-type: none"> • SHAI/SPHI/SSS 1 • Graves (3) • Temporary Structures • Powerline
	6-SW-19A			
	6-SW-18B			

* These affected features and land interests were inspected on 30th July 1998

Private Lots: It has been identified that 2 private lots, namely Lot 462 in DD384 and Lot 463 in DD384, would be affected by the Preferred Alternative Alignment. Lot 462 in DD 384, which is a village type house as defined in the Feasibility Study Alignment section. This lot would require its access footpath to be re-provisioned.

Lot 463 in DD 384, which was described in the Feasibility Study Alignment section would definitely be affected in the implementation of the open cut option of the

Preferred Alternative Alignment, as this alignment involves extensive open slope cutting to form the new road, whereas in the case of the tunnel option, which would run underneath this lot, it may only be necessary to create an easement for the length of the tunnel. It should be noted that the lead time for resumption of the affected lot under Cap. 370 is normally between eighteen and twenty four months and the need for resumption could therefore have an implication upon the implementation programme for Route 10. However, it should be noted that the term of the lease expires in November 2000, and therefore it may not be necessary for the resumption of the lot to take place if the lease is not renewed.

Structures with Licences: With regard to the Preferred Alternative Alignment, only PM1320 would be affected and the details of this licence are subject to further clarification with the DLO/Tuen Mun.

Graves and Burial Areas: It has been identified from the survey plans that 3 graves would be affected by the PAA. However, the exact number of graves or urns to be affected can only be ascertained by further detailed inspection.

Government Land Allocations: Two Government Land Allocations, namely GLA-TM 66 and GLA-TM 122, would be affected under the PAA as this section of the route would be constructed at grade. Therefore, termination or relocation of these Government Land Allocations may be necessary in case the Preferred Alternative Alignment is pursued. It is envisaged that reprovisioning may be necessary and therefore early discussions with the relevant Government Departments should be initiated.

Short Term Tenancy: As with the FSA, a Short Term Tenancy numbered STT 588, which encircles DD 384 Lot 462 upon which a 3-storey village type house is built, would be permanently affected.

Temporary Structures: Similar to the FSA.

4.5.6 Utilities

Feasibility Study Alignment

A high voltage cable runs across and above the FSA just east of the Siu Lam Tunnel. The alignment at that location is restricted between two cable pylons. In addition, electricity distribution wires along the valley from Tai Lam Chung Reservoir are located underneath the FSA at Ch 13100. Although these high voltage cable and electricity distribution wires conflict with the location of the alignment vertically and horizontally, there is still ample room for the FSA to keep a minimum safe distance from these elements.

In the area of the Siu Lam quarry platform, there is a WSD Desalter Tunnel that runs approximately 24m under the alignment. Although the Tunnel is abandoned, construction restrictions may apply through the reserve.

There are no gas mainline or major drainage pipes located within the alignment in this section.

Preferred Alternative Alignment

For the PAA, a similar high voltage cable situation exists as the FSA. The alignment conflicts vertically with the power supply cables and horizontally with the pylons. Based on preliminary information supplied by CLP there will be insufficient clearance between the alignment and the 33kV overhead power line at the Siu Lam Viaduct. Subject to confirmation of this information, diversion of the power line would probably be necessary. Diversion will require approximately 18 - 24 months.

The reserve for the WSD Desalter Tunnel crosses under the PAA. As the vertical alignment of the PAA clears the WSD Desalter Tunnel by approximately 40m, construction restrictions are not expected to apply.

The route is constrained to the north by the WSD Castle Peak Raw Water. A WSD fresh water service reservoir, a Home for the Aged and Siu Lam village, including new developments located to the south. A television transposer station is located on the high point on the Siu Lam ridge. Office of the Telecommunications Authority has conducted initial investigation on the relocation of the station and has advised that the relocation could be completed by the start of construction work for this section of Route 10.

As with the FSA, no gas mainline or major drainage pipes would be affected.

4.5.7 Land Use Planning

Feasibility Study Alignment

Most of this Section of the route would pass through a GB zone and the actual impact is to be established through the landscape and visual assessments.

Approximately 1km west of the Tai Lam Correctional Institution (at Ch.13400) is an abandoned Quarry Site which is zoned G/IC under the Draft So Kwun Wat Outline Zoning Plan No. S/TM-SKW/1. The alignment would bisect this G/IC Zone in a southeast/northwest direction. It is understood from Planning Department that this G/IC Zone has been earmarked for the use of a Hospital, Primary School and Indoor Recreation Centre. However, no details and development programs for these proposed uses have been fixed. In any event, the relevant Government departments would need to be consulted to confirm the need and requirements of re-provisioning of an alternative site(s). Hospital Authority has confirmed that there is currently no programme for hospital development in the G/IC area.

Preferred Alternative Alignment

The horizontal alignment in this section is the same as the FSA but the vertical profile differs. The PAA has less encroachment to land due to the higher vertical alignment resulting in smaller cuttings.

4.5.8 Landscape and Visual Impacts

This part of the study area primarily comprises a large knoll between the Siu Lam and So Kwun Wat valleys. Sections of this knoll are naturally vegetated with grass and scrub on the more exposed areas and dense tree and scrub in the river courses, however, large areas are heavily disturbed by the formation of earthworks platforms and some development.

The Siu Lam valley is narrow and bounded by steep slopes vegetated with a mix of grass and scrub on the upland areas and woodland in the more sheltered watercourses. There are villages and agricultural land in the upper sections towards the reservoir. The lower parts of the valley are heavily disturbed with the ongoing high-rise residential development adjacent to Tuen Mun Road.

Feasibility Study Alignment

A viaduct at 35 to 41 mPD is proposed over the Siu Lam valley together with extensive earthworks and cutting (up to 50 metres high) required across the knoll and along the So Kwun Wat valley side, additionally, causing the loss of substantial areas of woodland. This would be a significant impact to the existing high quality landscape.

The visual impact is likely to be greater to adjacent VSRs but less significant from distant viewpoints due to the lower profile of the alignment. The north facing units (VSRs) of the new high rise residential developments at the southern end of the valley will suffer severe intrusion due to the height and scale of the viaduct across the wooded valley.

Preferred Alternative Alignment

The viaduct across the Siu Lam valley would be at 57 to 66mPD. The alignment would pass across the knoll at 66mPD and require less extensive cutting thereby reducing the impact across the knoll relative to the FSA. The impacts along the side of the So Kwun Wat valley side would still be significant. The visual impact is likely to be greater as the alignment would be more visible from distant viewpoints due to the higher profile and the large scale of the structure would be out of keeping with the scale of the landscape in this area. The structure would be particularly dominant from the high-rise developments at the southern end of the valley.

On the western side of the valley, it is proposed that a cutting up to 76 metres deep, rather than a tunnel, would be required for the road through the knoll to Siu Lam. This would bisect the high point of the Siu Lam knoll and would result in greater impacts on an area of high quality landscape. Additionally, the higher road alignment may result in the visual impacts being more significant both within the local vicinity and wider visual context as more of the road would be visible.

5.0 COMPARATIVE COST ESTIMATE

5.1 Comparison of Construction Costs

The estimates have been derived from the Base Estimate – Package 1, given in Table 9.1 of the Sham Tseng Link, Feasibility Study Final Report. The unit rates used are as the Feasibility Study but updated to allow for inflation from December 1996 to December 1997, the base date for the current study. The rates have been increased by 8.7% as advised by Finance Bureau.

From a review of the quantities presented in the Feasibility Study Base Estimate, it would appear that some of the quantities quoted in the Feasibility Study, are under measured. The quantities have been corrected and presented as the Remeasured Feasibility Study Estimates.

5.1.1 North Lantau Section

Comparative construction cost estimates between the Feasibility Study Estimate, (FSE), Remeasured Feasibility Study Estimate (RFSE), Preferred Alternative Alignment Estimates (PAAE) are given in Table 5.1. Thus all costs are measured between equivalent topographical locations between Ch 6400 - 8600 for both the FSA and PAA as defined on Figure 524/RPT/H118 (FSA) and Figure 524/RPT/H123 (PAA).

The cost estimate allocates unit rates to broad construction categories and therefore do not, at this stage make allowance for a number of factors. These include the reduced quantity of excavation/filling required in constructing the toll plaza at +6m instead of +40m and, for the FSA, the additional costs of traffic control on the NLH and the risks associated with the portal construction adjacent to the Airport Railway.

On this basis the PAAE shows a comparative construction cost saving of HK\$107.1M when compared with the remeasured RFSE construction cost of HK\$1168.9M.

5.1.2 Tsing Lung Bridge Section

In terms of the capital cost for construction of the Tsing Lung Bridge there is little difference between the FSA and PAA. Detailed cost information is contained in the Report on Re-evaluation of Suspension Bridge Options.

5.1.3 Tsing Lung Tau to Siu Lam Section

Comparative construction cost estimates between the Feasibility Study Estimate, (FSE), Remeasured Feasibility Study Estimate (RFSE), Preferred Alternative Alignment Estimates (PAAE) are given in Table 5.2.

The net effect of correcting for the FSE is to reduce the cost of the FSE by HK\$ 484.7M. Therefore by modifying the vertical and horizontal alignment of the Tai Lam Chung tunnel there is a comparative cost saving of HK\$107.7M compared with the remeasured FSE.

5.1.4 Siu Lam to So Kwun Wat Section

Comparative construction cost estimates between the Feasibility Study Estimate (FSE), Remeasured Feasibility Study Estimate (RFSE), Preferred Alternative Alignment Estimates (PAAE) are given in Table 5.3. Thus all costs are measured between equivalent topographical locations between Ch 12400 - 13300 for the FSA and Ch 12500 - 13400 for the PAA as defined on Figure 524/RPT/H121 (FSA) and Figure 524/RPT/H126 (PAA).

With an open cut option through Siu Lam ridgeline there is a comparative cost saving of HK\$198.8M compared with the remeasured FSE of HK\$686.5M

5.2 Comparison of Land Costs

Details of the total land acquisition costs are presented in Appendix A and summarised below.

5.2.1 North Lantau Section

The total acquisition costs are estimated to be approximately as follows:

Feasibility Study Alignment: HK\$ 50.6M

Preferred Alternative Alignment: HK\$ 1.22M

5.2.2 Tsing Lung Bridge Section

The total acquisition costs are estimated to be approximately as follows:

Feasibility Study Alignment: HK\$ 77.4M

Preferred Alternative Alignment: Nil *

Note

* Impacts from the construction and operation of Tsing Lung Bridge may result in the need for resumption of Grand Bay Villa.

5.2.3 Tsing Lung Tau to Siu Lam

The total acquisition costs are estimated to be approximately as follows:

Feasibility Study Alignment: Nil

Preferred Alternative Alignment: Nil

5.2.4 Siu Lam to So Kwun Wat Section

The total acquisition costs are estimated to be approximately as follows:

Feasibility Study Alignment: HK\$ 6.4M

Preferred Alternative Alignment: HK\$ 0.5M

5.3 Operation and Maintenance Costs

The cost per annum attributable to the Operation and Maintenance costs have been estimated as a percentage of the construction costs identified in Tables 5.1 to 5.3. The costs have been derived from percentages used in the Feasibility Study as follows:

Earthworks/Roadworks	-	1.0%
Bridges	-	0.5%
Tunnels	-	2.3%
E&M	-	0.6%

The costs for the respective routes are as follows.

5.3.1 North Lantau

Feasibility Study Alignment: HK\$ 12.9M/year

Preferred Alternative Alignment: HK\$ 3.6M/year

5.3.2 Tsing Lung Tau to Siu Lam

The cost per annum attributable to the Operation and Maintenance costs have been estimated as a percentage of the construction costs identified in Table 5.2. The costs for the respective options are as follows:

Feasibility Study Alignment HK\$ 36.3M/year

Preferred Alternative Alignment HK\$ 31.8M/year

5.3.3 Siu Lam to So Kwun Wat

The cost per annum attributable to the Operation and Maintenance costs have been estimated as a percentage of the construction costs identified in Table 5.3. The costs for the respective options are as follows:

Feasibility Study Alignment HK\$ 9.4M/year

Preferred Alternative Alignment HK\$ 2.03M/year

5.4 Relocation of Television Transposer Station Cost

The cost of relocating the television transposer station at the Siu Lam ridgeline has been estimated by ATV to be HK\$10.0M.

Table 5.1 : Comparative Construction Cost Estimate for North Lantau

Description of Works	Unit	Rate (HK\$)	Feasibility Study Alignment Estimate		Remeasured Feasibility Alignment Estimate		Preferred Alternative Alignment Estimate	
			Quantity	Total (HK\$000's)	Quantity	Total (HK\$000's)	Quantity	Total (HK\$000's)
Highway (at grade)	m ²	2000	3635	7270	30888	61776	28160	56320
Highway (Elevated)	m ²	12773	-	-	-	-	19200	245242
Highway (High Viaduct)	m ²	17935	4625	82949	2067	37072	9600	172176
Tunnels (585m)	m ³	2511	187560	470963	157950	396612	-	-
Portals	m ²	4728	-	-	14000	66192	-	-
Road Platform	m ²	1870	-	-	14040	26255	-	-
Electrical & Mechanical	m	30436	-	-	3430	104395	3958	120466
TCSS	m	9370	1563	14645	3430	32139	3958	37086
Toll Plaza	Item			285000		285000		285000
Site Clearance	Item			4500		4500		4500
Environmental Mitigation	Item			2500		2500		2500
Sub-Total				867828		1016441		923290
General Preliminaries	15%			130174		152466		138493
Package Total				998002		1168908		1061783

O & M Costs	11407	12871	3596
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Table 5.2 : Comparative Construction Cost Estimate for Tsing Lung Tau to Siu Lam

Description of Works	Unit	Rate (HK\$)	Feasibility Study Alignment Estimate		Remeasured Feasibility Alignment Estimate		Preferred Alternative Alignment Estimate	
			Quantity	Total (HK\$000's)	Quantity	Total (HK\$000's)	Quantity	Total (HK\$000's)
Highway (at grade)	m ²	2881	1480	4263	855	2463	3567	10277
Highway (Elevated)	m ²	12773	3951	50465	4032	51501	-	-
Highway (High Viaduct)	m ²	17935	-	-	-	-	6174	110731
Tunnels (TLC)	m ³	2511	689370	1731008	542700	1362720	464400	1166108
Portals	m ²	4728	14000	66192	14000	66192	14000	66192
Road Platform	m ²	1870	71489	133684	48240	90209	41280	77194
Electrical & Mechanical	m	30436	4820	146707	4400	133918	4200	127831
TCSS	m	9370	3992	37408	4400	41228	4200	39354
Site Clearance	Item			55688		55688		83430
Environmental Mitigation	Item			54239		54239		83430
Sub-Total				2279656		1858158		1764547
General Preliminaries	15%			341948		278124		264682
Package Total				2621604		2136882		2029229

O & M Costs		4710	36273	11778
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Table S.3 : Comparative Construction Cost Estimate for Siu Lam to So Kwun Wai

Description of Works	Unit	Rate (HK\$)	Feasibility Study Alignment Estimate		Remeasured Feasibility Alignment Estimate		Preferred Alternative Alignment Estimate	
			Quantity	Total (HK\$000's)	Quantity	Total (HK\$000's)	Quantity	Total (HK\$000's)
Highway (at grade)	m ²	2881	11838	34104	7394	21303	13765	39658
Highway (Elevated)	m ²	12773	5934	75795	7670	97974	-	-
Highway (High Viaduct)	m ²	17935	-	-	-	-	13456	241326
Tunnel (SL)	m ³	2511	149870	376324	110160	276612	-	-
Portals	m ²	4728	14000	66192	14000	66192	-	-
Road Platform	m ²	1870	14511	27136	9792	18311	-	-
Electrical & Mechanical	m	30436	1972	60017	1800	54785	1800	54785
TCSS	m	9370	1633	15303	1800	16866	1800	16866
Site Clearance	Item			22782		22782		35756
Environmental Mitigation	Item			22189		22189		35756
Sub-Total				699841		597013		424146
General Preliminaries	15%			104976		89552		63622
Package Total				804817		686565		487768

O & M Cnsts	11974	9438	2011
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6.0 SUMMARY

6.1 Introduction

This section presents a summary of the key issues and constraints identified and discussed for each option in Section 4.

A score is applied to the impact of the issues within the disciplines against which the option can be evaluated. The scoring system is applied as follows: 1 = Very Bad; 2 = Bad; 3 = Medium; 4 = Good; and 5 = Very Good.

Summation of the scores presents a comparative assessment of each option.

6.2 North Lantau

Discipline	Feasibility Study Alignment		Preferred Alternative Alignment	
	Key Issues	Score	Key Issues	Score
Topographical & Geometrical	<ul style="list-style-type: none"> Route crosses North Lantau Highway and Airport Railway tunnel. Toll plaza to be constructed at elevation +40mPD part on marine mud (full dredging required). Fa Peng and Tso Wan Valleys in filled for Admin Building and tunnel portal. Route cannot be integrated with main bridge construction site, separate site access route to south tower and anchorage location is required. Tunnel would be subject to a severe sight-line constraint and would have to be constructed oversize if alignment designed to 100km/h. 	1	<ul style="list-style-type: none"> No crossing over the North Lantau Highway. Toll plaza constructed at elevation +11.5mPD (average) wholly on marine mud. (partial dredging likely to be adequate) Some marine work required by Yi Chuen: Complies with 100km/h design speed. 	4
Geotechnical	<ul style="list-style-type: none"> Extensive stabilisation measures could be required at the southern end of the cutting. Portal construction in unfavourable ground conditions above Airport Railway Tunnel; will require agreement from MTRC. Tunnelling in unfavourable ground conditions. Localised bands of deep weathering within northern part of cutting may require stabilisation or flattening of the slopes to meet design criteria for stability. 	1	<ul style="list-style-type: none"> Slope stability at cutting towards KSMB unlikely to be a problem. Erosion features of "Badlands" topography above Yi Chuen not considered to be a constraint. Photo-geological lineaments identified passing through the Sam Chuen headland could have implications on slope stability if zones of shearing or faulting confirmed within cutting sites. 	3

Discipline	Feasibility Study Alignment		Preferred Alternative Alignment	
	Key Issues	Score	Key Issues	Score
Drainage	<ul style="list-style-type: none"> Impact of 40m high Toll Plaza embankment on existing drainage. 	2	<ul style="list-style-type: none"> Impact of significant reclamation on existing tidal flow and conditions. 	3
Environmental	<ul style="list-style-type: none"> Resumption of Fa Peng and Tso Wan villages. 	5	<ul style="list-style-type: none"> Mitigation measures required so as to reduce impact on resident population Potential noise impact on villages of Fa Peng and Tso Wan Some transplant of rare species will be required. 	2
Land Matters	<ul style="list-style-type: none"> Private lots in Fa Peng village will be resumed and village removal terms would apply. Private lots in Tso Wan village will be affected and some licences will be affected. 10 graves will be affected. 2 Government land allocation will be affected. 	1	<ul style="list-style-type: none"> Piers in the Fa Peng and Tso Wan villages would have to be reprovided. Some licences will be affected. 4 graves will be affected. 1 Government land allocation will be affected. 	3
Utilities	<ul style="list-style-type: none"> Disruption to utilities within NLH reserve serving the new Airport. 	2	<ul style="list-style-type: none"> Some local diversion of minor electric and telecom services will be required. 	4
Land Use Planning	<ul style="list-style-type: none"> Possible constraint to Port Works Development. Some impact on Fa Peng. High route elevation will increase length of elevated ramp connections to P1 and increase land requirements. Encroachment of GB Zone. 	3	<ul style="list-style-type: none"> Some constraint to Port Works Development. Minor impact on Fa Peng. Minor impact on Boatyard, Marine - Oriented Industrial Use and Marine Services Support Area Zone. Encroachment of GB Zone. 	3

Discipline	Feasibility Study Alignment		Preferred Alternative Alignment	
	Key Issues	Score	Key Issues	Score
Landscape & Visual Impact	<ul style="list-style-type: none"> Landscape impact due to 40m high reclamation and earthworks at Fa Peng and Tso Wan. Landscape impact to natural land form and vegetation due to tunnel portal. Landscape and visual impact at Ng Kwu Leng due to extensive cutting bisecting the natural ridgeline of the wall. 	3	<ul style="list-style-type: none"> Impact to Fa Peng and Tso Wan due to 11m high reclamation, although some coastline is retained. Visual impact to residents of villages as they will not be resumed. Impact at Sam Chuen due to earthworks. Visually prominent viaduct over Yi Chuen. Landscaping and visual impact at Ng Kwu Leng due to extensive cutting bisections natural ridgeline of the hill. 	1
Cost	<ul style="list-style-type: none"> Estimated construction cost of HK\$1168.9M. Estimated land acquisition cost of HK\$50.6M. Operation and Maintenance Cost of HK\$12.9M/ annum. 	2	<ul style="list-style-type: none"> Estimated construction cost of HK\$1061.7M. Estimated land acquisition cost of HK\$1.22M. Operation and Maintenance Cost of HK\$3.6M/ annum. 	4

	FEASIBILITY STUDY ALIGNMENT	PREFERRED ALTERNATIVE ALIGNMENT
SCORE	20	27

6.3 Tsing Lung Bridge

Discipline	Feasibility Study Alignment		Preferred Alternative Alignment	
	Key Issues	Score	Key Issues	Score
Topographical & Geometrical	<ul style="list-style-type: none"> Height of tower controlled by the Hong Kong Airport (Control of Obstructions) Ordinance. Distance between the centreline of the carriageway of the tunnel, at the portal, and the tower are 32.0 and 19.3m respectively. As the cable must remain straight there is insufficient distance between the anchorage and tunnel portal to achieve an acceptable alignment. Shipping envelope dictates the tower location and deck clearance. On northern shore of the Ma Wan Channel the working space available in which to construct the bridge tower is extremely limited. 	3	<ul style="list-style-type: none"> Height of tower controlled by the Hong Kong Airport (Control of Obstructions) Ordinance. The position of Tsing Lung Tau tower is controlled by a number of factors including: relative angle of the backstay to the main span cable and the distance between the tunnel portal and the highway. Shipping envelope dictates the tower location and deck clearance. 	3
Geotechnical	<ul style="list-style-type: none"> Rock conditions at proposed location of northern tower suitable Apparent absence of marine mud significant benefit Associated shears could extend towards the foundations of the northern tower Shear zones or areas of faulting within Kwai Shek headland. 	3	<ul style="list-style-type: none"> Rock conditions at proposed location of northern tower suitable Apparent absence of marine mud significant benefit Associated shears could extend towards the foundations of the northern tower Shear zones or areas of faulting within Kwai Shek headland. 	3
Environmental	<ul style="list-style-type: none"> Impact of construction and operational noise at sensitive receivers including Dragon View and Hong Kong Garden along the northern shore of the channel. Potential impacts on tidal flow and water quality regimes resulting from pier construction and ship protection. Vehicle emissions on sensitive receivers at Hong Kong Garden. 		<ul style="list-style-type: none"> Impact of construction and operational noise at sensitive receivers including Grand Bay Villa, Dragon View and Hong Kong Garden along the northern shore of the channel. Smaller potential impacts on tidal flow and water quality regimes resulting from reduced size of reclamation. Vehicle emissions on sensitive receivers at Hong Kong Garden. 	

Discipline	Feasibility Study Alignment		Preferred Alternative Alignment	
	Key Issues	Score	Key Issues	Score
	<ul style="list-style-type: none"> • Caisson for the pier could result in diminution in dissolved oxygen which could affect the viability of the coastline for fish nursery zones. • Marine ecology may be affected through the ship impact protection (reclamation) etc. 	3	<ul style="list-style-type: none"> • Marine ecology may be affected through the ship impact protection (reclamation) etc. 	3
Land Matters	<ul style="list-style-type: none"> • Grand Bay Villa comprising twelve two-storey exempted houses would have to be resumed and a Short Term Tenancy will also be affected. • Lead time for resumption is normally between eighteen and twenty four months, resumption which could have an impact upon the implementation programme. 	2	<ul style="list-style-type: none"> • Resumption of Grand Bay villa will be avoided, which will have both cost and programme benefits. (Impacts from the construction and operation of the TLB may result in the need for resumption). 	3
Utilities	<ul style="list-style-type: none"> • Diversion of utilities along Castle Peak Road may be required to avoid the piers of the approach span. 	3	<ul style="list-style-type: none"> • Diversion of utilities along Castle Peak Road may be required to avoid the piers of the approach span. 	3
Landscape and Visual Impact	<ul style="list-style-type: none"> • Prominent location of the bridge will necessitate the aesthetics being carefully considered. • Works for bridge footing at Kwai Shek may cause landscape impacts to landform and vegetation. • Bridge and northern landfall would cause impact to adjacent Hong Kong Garden VSRs. 	3	<ul style="list-style-type: none"> • Prominent location of the bridge will necessitate the aesthetics being carefully considered. • Works for bridge footing at Kwai Shek may cause landscape impacts to landform and vegetation. • Bridge and northern landfall would cause impact to adjacent Hong Kong Garden VSRs (and Grand Bay Villa if it is not resumed). 	3
Land Use Planning	<ul style="list-style-type: none"> • Relatively closer to a proposed R(C) Zone. 	3	<ul style="list-style-type: none"> • Relatively further from a proposed R(C) Zone. 	3

Discipline	Feasibility Study Alignment		Preferred Alternative Alignment	
	Key Issues	Score	Key Issues	Score
Marine	<ul style="list-style-type: none"> • Extensive offshore working required. • Complex bridge protection works. • Possible requirement for shore link via causeway during construction. • Potential psychological impact of channel narrowing. • Potential for increased vessel congestion. • Modified alignment for vessel approach from west. • Some potential for localised water flows to effect vessel manoeuvring. • Major reconstruction works following impact. 	3	<ul style="list-style-type: none"> • Potential for shore based construction works. • Minimum sea area required for reclamation works. • Minimal impact on available waterway. • Minimal increased congestion on marine traffic. • Revetment slope appearance to slope protection. • Minimal impact on water flows effecting vessel manoeuvring. • Short reconstruction period to pier following ship impact. 	4

	FEASIBILITY STUDY ALIGNMENT	PREFERRED ALTERNATIVE ALIGNMENT
SCORE	23	25

6.4 Tsing Lung Tau to Siu Lam

Discipline	Feasibility Study Alignment		Preferred Alternative Alignment	
	Key Issues	Score	Key Issues	Score
Topographical & Geometrical	<ul style="list-style-type: none"> Alignment constrained at Tsing Lung Tau by bridge cables. Resulting 6m wide rock pillar at the portals will require extensive tunnel support measures. Designed to comply with 85km/h design speed. Proximity of WSD catchwater and water feed tunnels. 	3	<ul style="list-style-type: none"> Reduced length of Tai Lam Chung Tunnel construction (300m less compared to FSA). Optimization of tunnel ventilation and drainage systems. Complies with 100km/h design speed. Proximity of WSD catchwater and water feed tunnels 	4
Geotechnical	<ul style="list-style-type: none"> High risk due to tunnelling in unfavourable ground conditions under Tuen Mun Road. 	2	<ul style="list-style-type: none"> Avoids potential fill areas. 	3
Environmental Matters	<ul style="list-style-type: none"> Full noise enclosures will be required on Tai Lam Chung Viaduct. 	2	<ul style="list-style-type: none"> Tai Lam Chung Tsuen not affected by traffic noise. No noise enclosure hence ventilation system not required and air quality better. 	3
Land Matters	<ul style="list-style-type: none"> 2 Government Allocations will be affected. Section of alignment falls within Tai Lam Country Park. 3 graves and 1 urn may be affected. Permitted Burial Ground No. 17 will be affected. 1 Short term tenancy may be affected. A licence No. NAL 33 may be affected. 	2	<ul style="list-style-type: none"> 3 Government Land Allocations will be affected. Section of the alignment falls within Tai Lam Country Park. 3 graves and 1 urn may be affected. Permitted burial ground no. 17 will be affected. 1 private lot may be affected. 1 Short term tenancy may be affected. 	2

Discipline	Feasibility Study Alignment		Preferred Alternative Alignment	
	Key Issues	Score	Key Issues	Score
Utilities	<ul style="list-style-type: none"> Alignment requires a diversion of the large diameter, high pressure Towngas pipeline which Towngas have ruled out. Inspection and possible strengthening of WSD catchwater tunnel required. 	1	<ul style="list-style-type: none"> Optimisation of clearance to WSD Reserve and Towngas pipeline. Inspection and possible strengthening of WSD catchwater tunnel required. 	4
Land Use Planning	<ul style="list-style-type: none"> Encroachment of Tai Lam Correctional Institution. 	3	<ul style="list-style-type: none"> Encroachment of Tai Lam Correctional Institution. 	3
Landscape & Visual Impact	<ul style="list-style-type: none"> Disturbance to landform and vegetation of Tai Lam Chung Valley due to tunnel portals. Viaduct across valley will cause visual impact locally although the Tai Lam Chung Tsuen is partially screened. 	3	<ul style="list-style-type: none"> Disturbance to landform and vegetation of Tai Lam Chung Valley due to tunnel portals. Road alignment will result in less visual impacts for Tai Lam Tsuen villagers. 	3
Cost	<ul style="list-style-type: none"> Construction cost of HK\$2136.8m Cost of operation and maintenance HK\$36.2m/annum 	3	<ul style="list-style-type: none"> Construction cost of HK\$2029.2m Cost of operation and maintenance HK\$31.7m/annum 	4

	FEASIBILITY STUDY ALIGNMENT	PREFERRED ALTERNATIVE ALIGNMENT
SCORE	19	26

6.5 Siu Lam to So Kwun Wat

Discipline	Feasibility Study Alignment		Preferred Alternative Alignment	
	Key Issues	Score	Key Issues	Score
Topographical & Geometrical	<ul style="list-style-type: none"> Designed to comply with 85 km/h design speed. Extensive cutting of the Siu Lam quarry platform will be required. Tunnel safety guidelines will apply from Tsing Lung Tau to Siu Lam. 	2	<ul style="list-style-type: none"> Complies with 100km/h design speed. Access to, and control of emergency situations improved by reducing lengths of tunnel overall. 	4
Drainage	<ul style="list-style-type: none"> Increases of hydraulic load on Siu Lam sub-catchment area due to increased paved areas. Highway structures may be at risk from any breach in Low Gaps Dams No. 1, No. 2 and No. 3 of the Tai Lam Chung Reservoir. 	3	<ul style="list-style-type: none"> Increases of hydraulic load on Siu Lam sub-catchment area due to increased paved areas. Highway structures may be at risk from any breach in Low Gaps Dams No. 1, No. 2 and No. 3 of the Tai Lam Chung Reservoir. Existing drainage facilities will need to be reviewed in light of increased run off due to paved areas. 	3
Environmental Issues	<ul style="list-style-type: none"> Low level Viaduct across Siu Lam valley and cutting in quarry platform will result in a loss of substantial areas of woodland. 	2	<ul style="list-style-type: none"> Cutting across Siu Lam ridgeline will result in a loss of substantial area of woodland. Air quality improved by elimination of Siu Lam Tunnel 	2
Land Matters	<ul style="list-style-type: none"> 12 private lots and 2 graves will be affected. 1 Government land allocation will be affected. Some licences and a Short Term Tenancy No. STT588 will be affected. 	2	<ul style="list-style-type: none"> 2 private lots and 3 graves will be affected. 2 Government land allocations will be affected. Alignment will affect a licence and a Short Term Tenancy STT 588. 	3

Discipline	Feasibility Study Alignment		Preferred Alternative Alignment	
	Key Issues	Score	Key Issues	Score
Utilities	<ul style="list-style-type: none"> • Diversion of the 11kV O.H.L. at Siu Lam will be required. • Alignment will cross above WSD Desalter tunnel reserve. Construction restrictions may apply. 	3	<ul style="list-style-type: none"> • Diversion of the 11kV O.H.L. at Siu Lam will be required. • Alignment will cross above WSD Desalter tunnel reserve. Construction restrictions unlikely. • Television transposer station will need to be relocated. 	2
Land Use Planning	<ul style="list-style-type: none"> • Encroachment on a G/C zone on quarry platform. 	3	<ul style="list-style-type: none"> • Encroachment on a G/C zone on a quarry platform. 	3
Landscaping and Visual Impact	<ul style="list-style-type: none"> • Visual impact to local VSRs from viaduct at 35 to 41mPD over Siu Lam Valley. • Impact to Siu Lam and So Kwun Wat due to 50m high cutting through quarry platform. 	3	<ul style="list-style-type: none"> • Visual impact to local and wider VSRs from viaduct at 57 to 66 mPD over Siu Lam valley. • 76m high cutting through the Siu Lam knoll will have a high visual impact. 	2
Cost	<ul style="list-style-type: none"> • Estimated construction cost HK\$686M. • Estimated land acquisition cost of HK\$6.4M. • Operation and Maintenance cost of HK\$9.4M. 	3	<ul style="list-style-type: none"> • Estimated construction cost HK\$487M. • Estimated land acquisition cost of HK\$0.5M. • Operation and Maintenance cost of HK\$2.03M. • Estimated television transposer station relocation cost of HK\$10M. 	4

	FEASIBILITY STUDY ALIGNMENT	PREFERRED ALTERNATIVE ALIGNMENT
SCORE	21	23

7.0 RECOMMENDATIONS

7.1 Introduction

The Preferred Alternative Alignment (PAA), when compared with the Feasibility Study Alignment (FSA), offers improvements in terms of cost, construction risk, environment, land resumption, topography, geology, operation and maintenance as illustrated by the comparison of the issues given in Section 6.0 of the Report.

7.2 North Lantau

Based on the comparison given in Table 5.1 and the summary presented in Section 6.2, it is recommended that the Preferred Alternative Alignment passing below the approach span of the Kap Shui Mun Bridge be endorsed as the study alignment to replace the Feasibility Study Alignment.

The preferred alternative alignment adopts an alignment control point on the Fa Peng headland such that the Route 10 (NLYLH) works do not encroach on the village land at Fa Peng and Tso Wan. It therefore satisfies all the expressed concerns in respect of the Feasibility Study Alignment, and minimise as far as practicable, the constraints upon the future port and associated developments.

The preferred alternative alignment eliminates the risks involved during construction over the North Lantau Highway that would be required under the Feasibility Study Alignment scheme. The PAA also avoids the need to tunnel through difficult ground conditions, in particular, at the north portal area where the presence of fault had led to a construction collapse of the Airport Railway Tunnels.

7.2 Tsing Lung Bridge

Based on the comparison summary presented in Section 6.3, it is recommended that the Preferred Alternative Alignment west of Grand Bay Villa be endorsed as the study alignment to replace the Feasibility Study Alignment.

The location of the Tsing Lung Bridge north tower under the preferred alternative alignment is 50 metres offshore to the west of Grand Bay Villa. This would minimise the impact of the bridge upon the marine navigation and the water quality in the Ma Wan Channel.

7.3 Tsing Lung Tau to Siu Lam

Based on the comparison given in Table 5.2 and the summary presented in Section 6.4, it is recommended that the Preferred Alternative Alignment, with a raised vertical profile compared to the Feasibility Study Alignment be endorsed as the study alignment to replace the Feasibility Study Alignment.

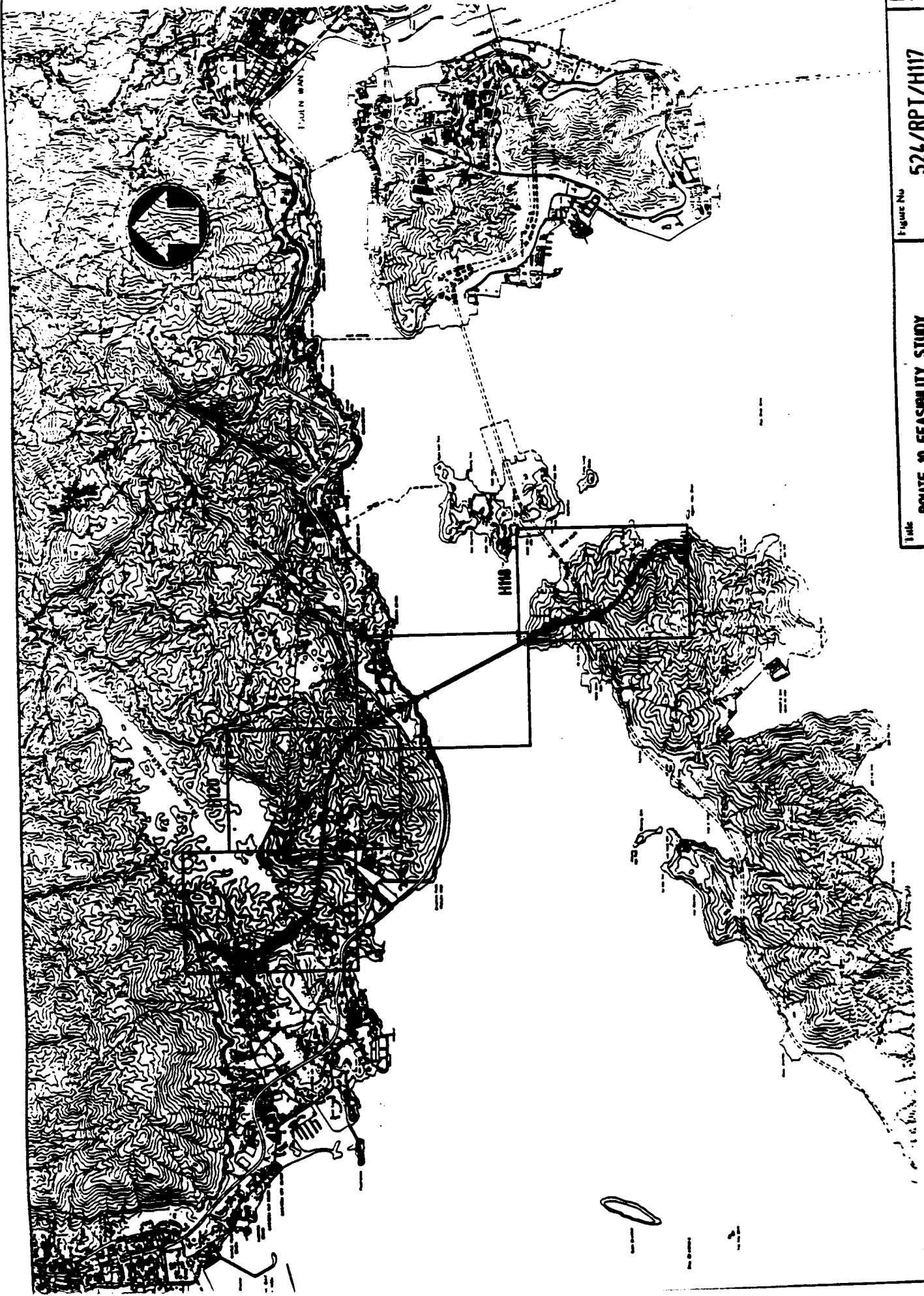
The preferred alternative alignment maximises the clearance to the Towngas pipeline hence eliminates the risk of damaging it during construction. The PAA has also been developed to avoid the areas of fill and give least option for tunnelling under Tuen Mun Road.

7.4 Siu Lam to So Kwun Wat

Based on the comparison given in Table 5.3 and the summary presented in Section 6.5, it is recommended that the Preferred Alternative Alignment, with an open cut through Siu Lam, be endorsed as the study alignment to replace the Feasibility Study Alignment.

The cutting option offers clear advantages over the tunnel in terms of cost, construction risk, geology, operation and maintenance. In particular, the adoption of a cutting will avoid the somewhat disconcerting change in lighting, from the drivers' perspective, when entering such a very short tunnel. Mitigation measures can be provided to offset the majority of the negative environmental impacts. Further discussion held with OFTA has confirmed the feasibility of relocation of the TV transposer station on top of the ridgeline.

FIGURES



1 mile

ROUTE 10 FEASIBILITY STUDY

Figure No

524/RPT/H117





Figure No. 524/RPT/H118

ROUTE 10 FEASIBILITY STUDY

0 100 200 300 400 500m

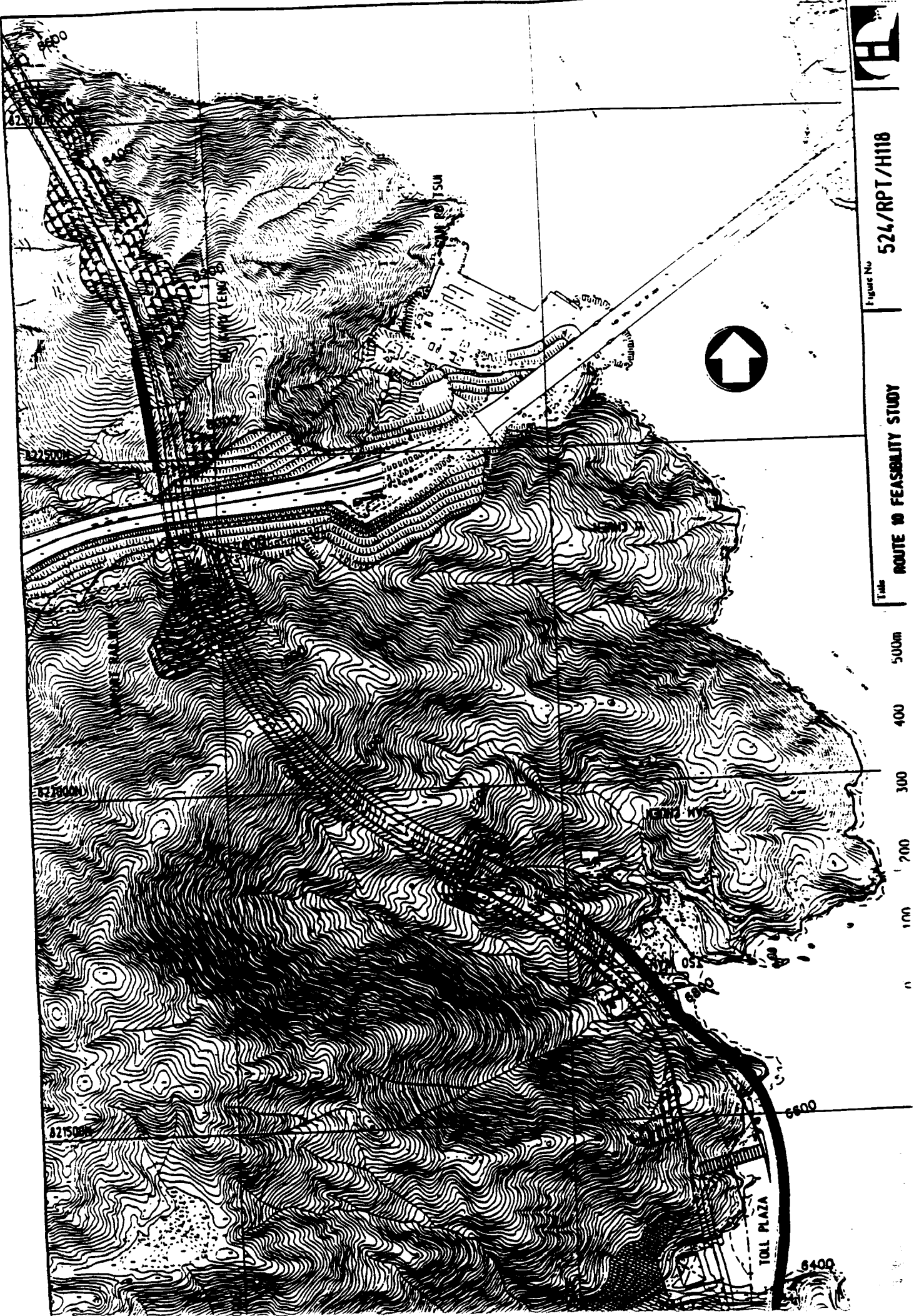




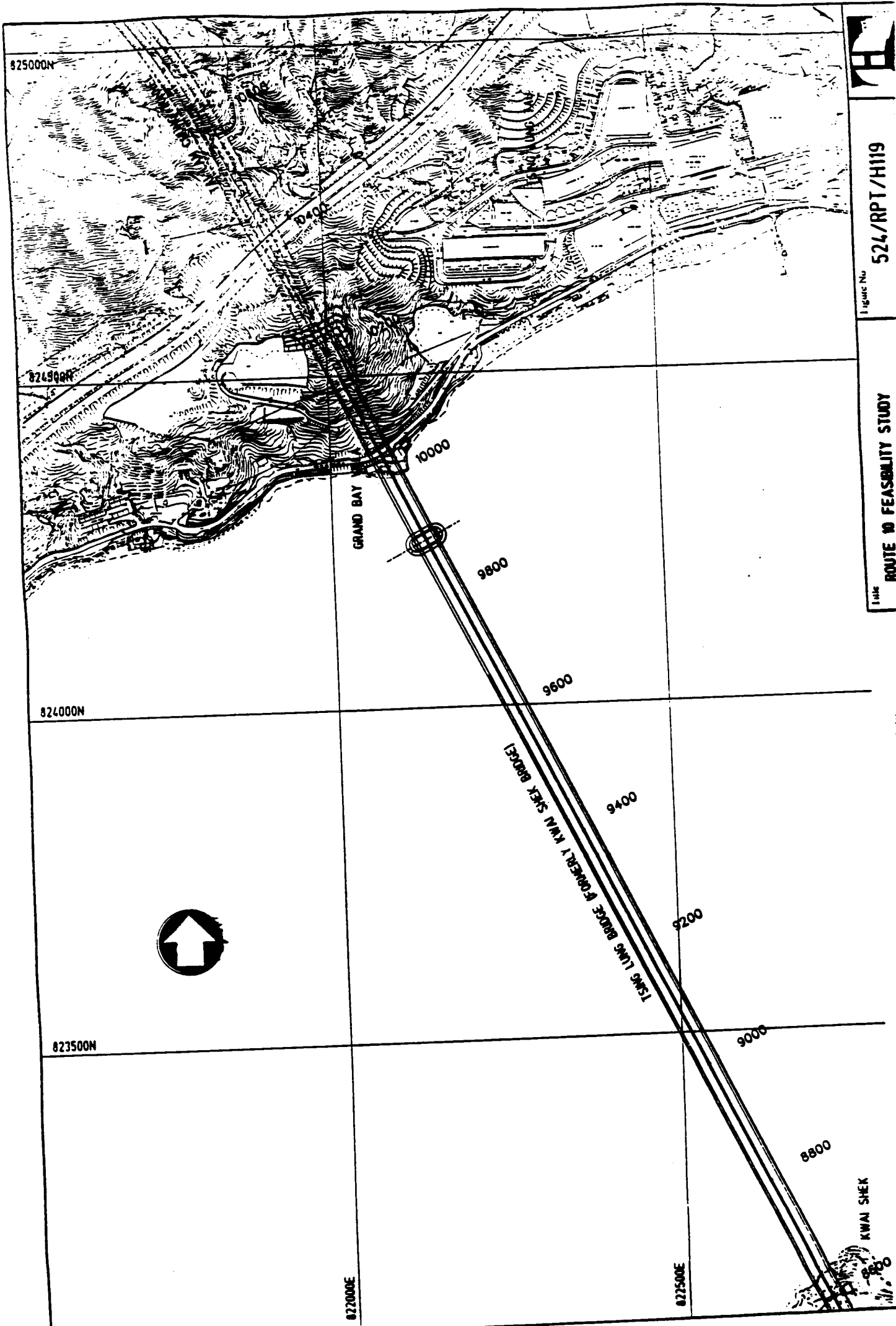
Figure No. 524/RPT/H119

ROUTE 10 FEASIBILITY STUDY

1:10k

4/10/11

1:10k



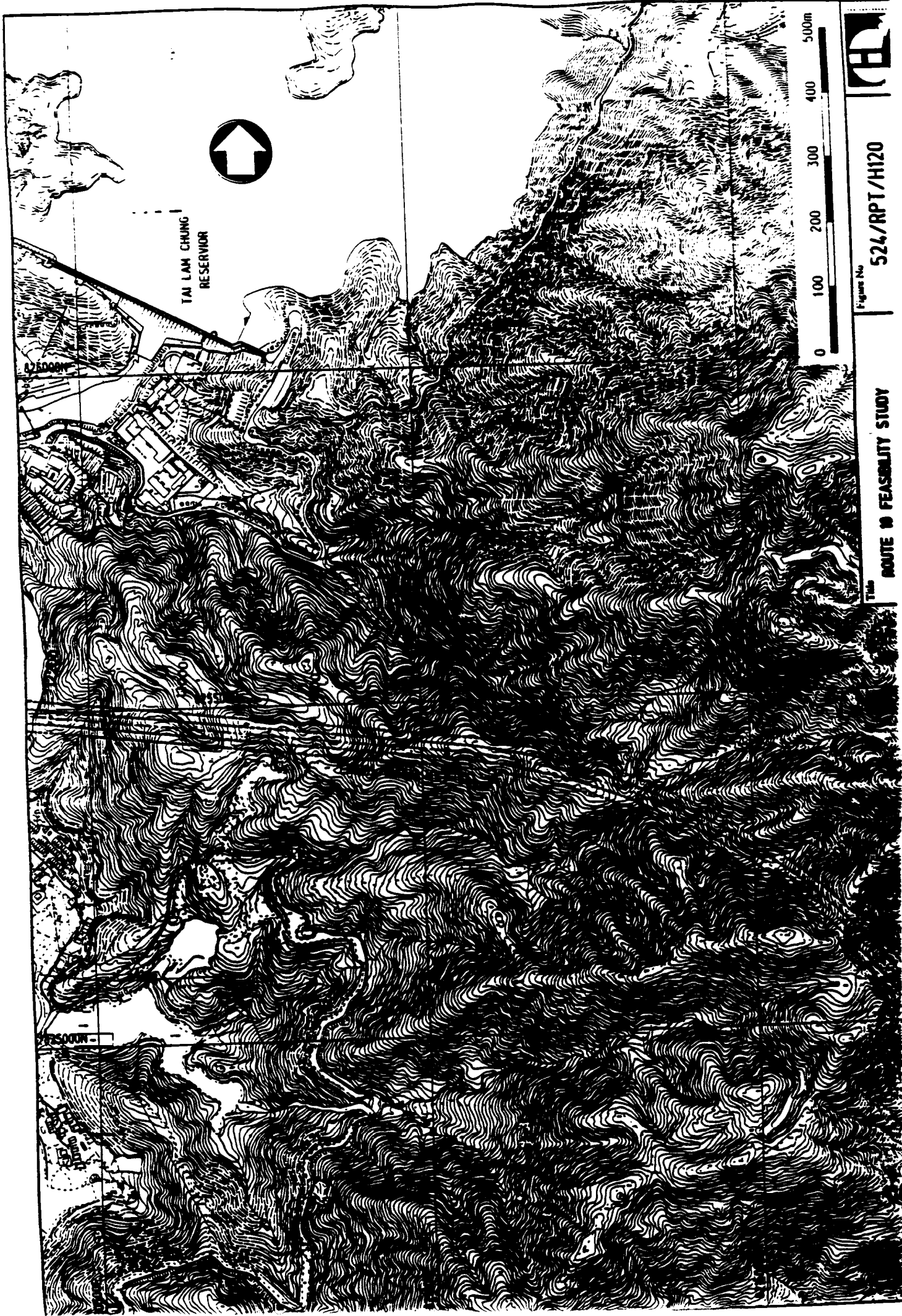


Figure No. 524/RPT/H120

ROUTE 10 FEASIBILITY STUDY

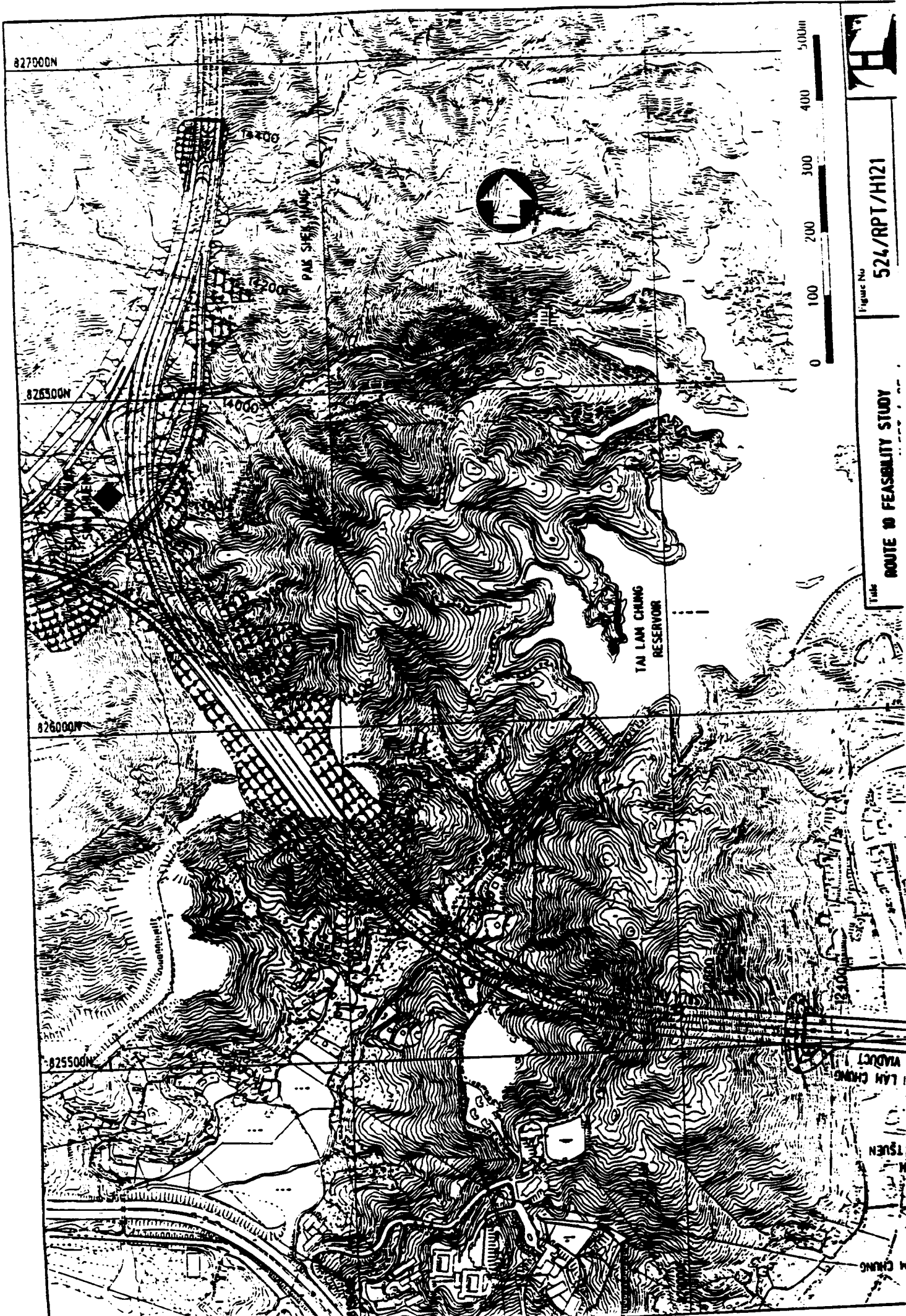


Figure No 524/RPT/H121

ROUTE 10 FEASIBILITY STUDY

Title

TAI LAM CHUNG

TSUN

CHUNG

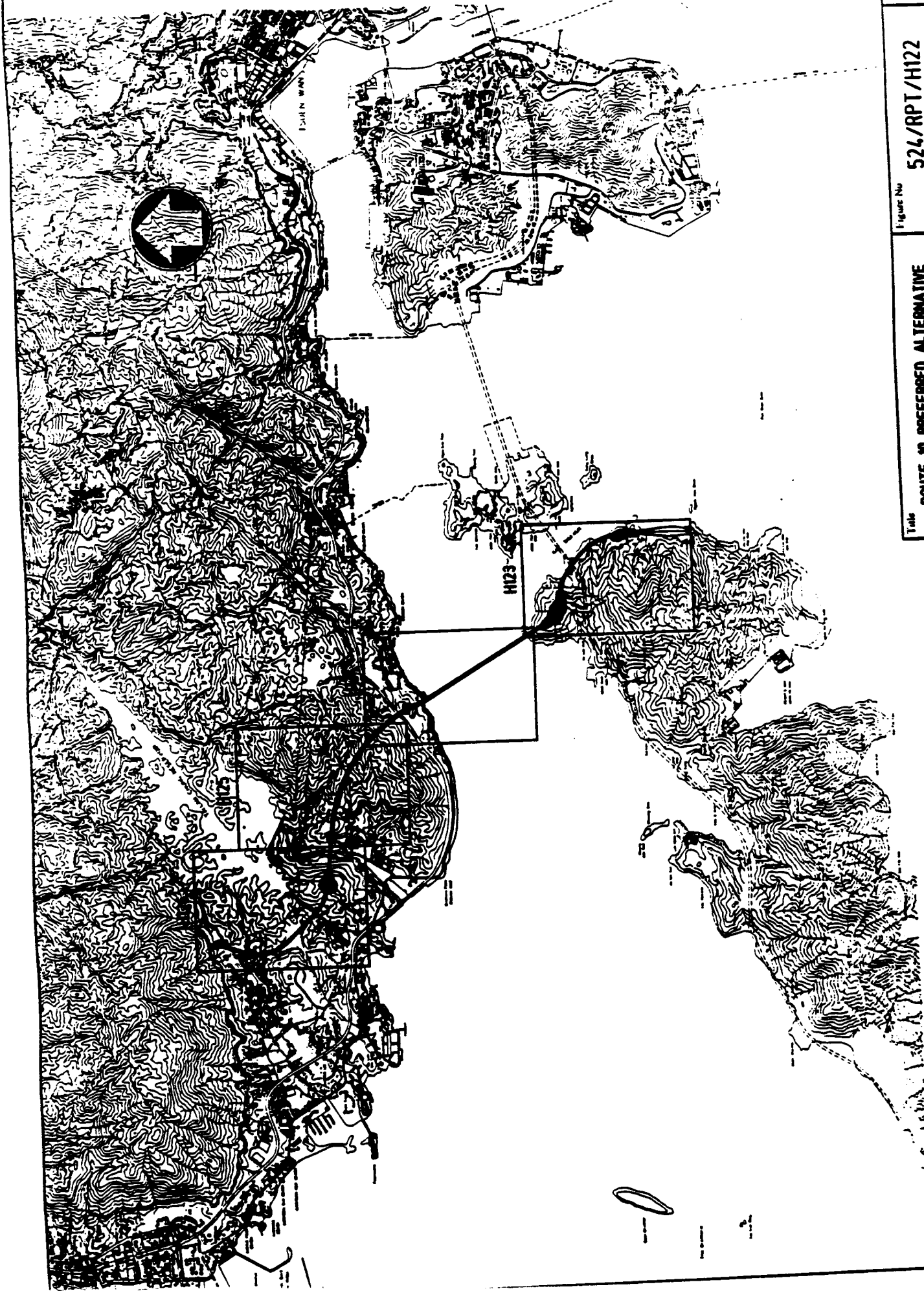


Figure No

524/RPT/H122

ROUTE 10 PREFERRED ALTERNATIVE

.....

Title



524/RPT/H123

Figure No.

Tolls ORITE or PREFERRED ALTERNATIVE

5.11.110

4.11.110

3.11.110

2.11.110

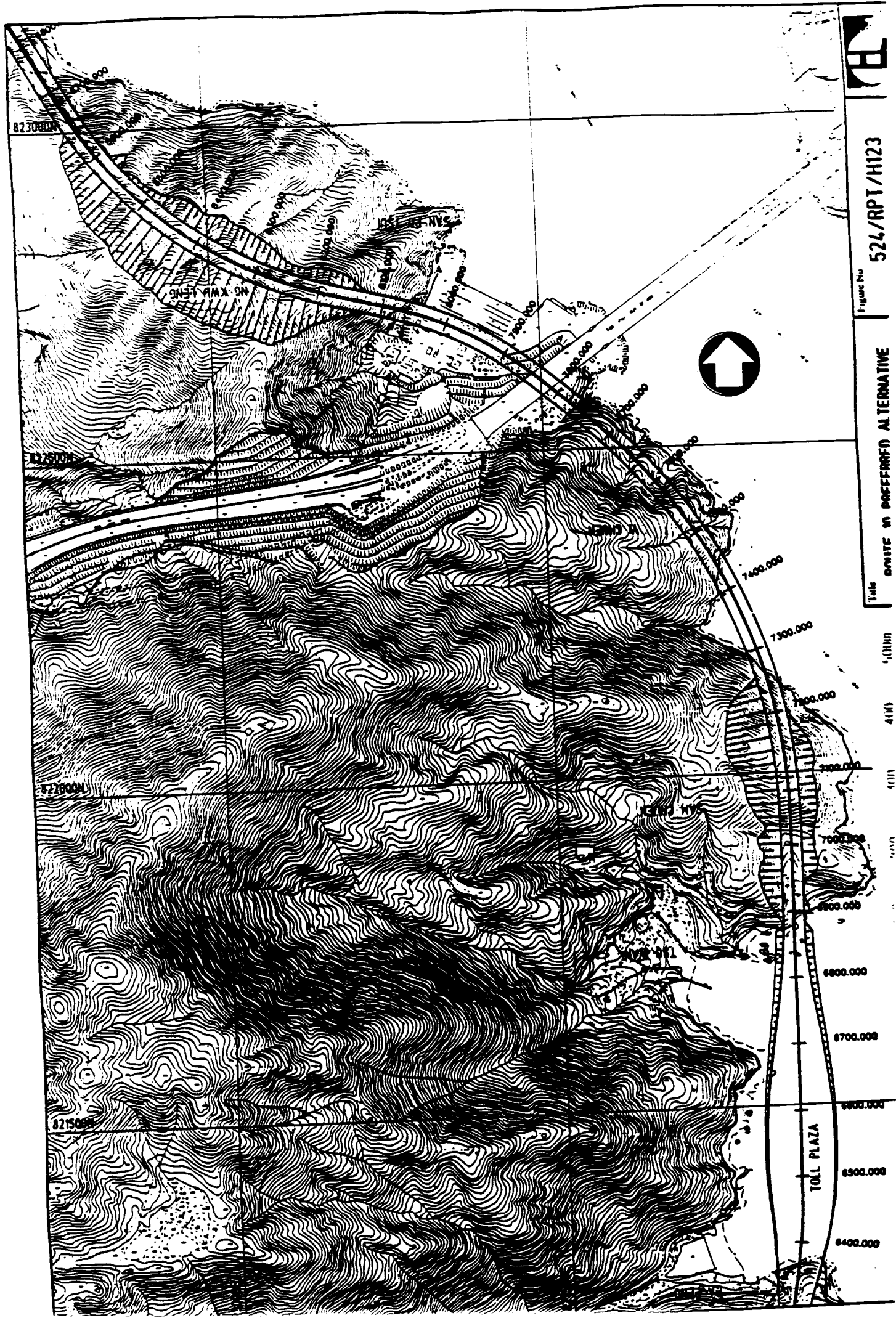
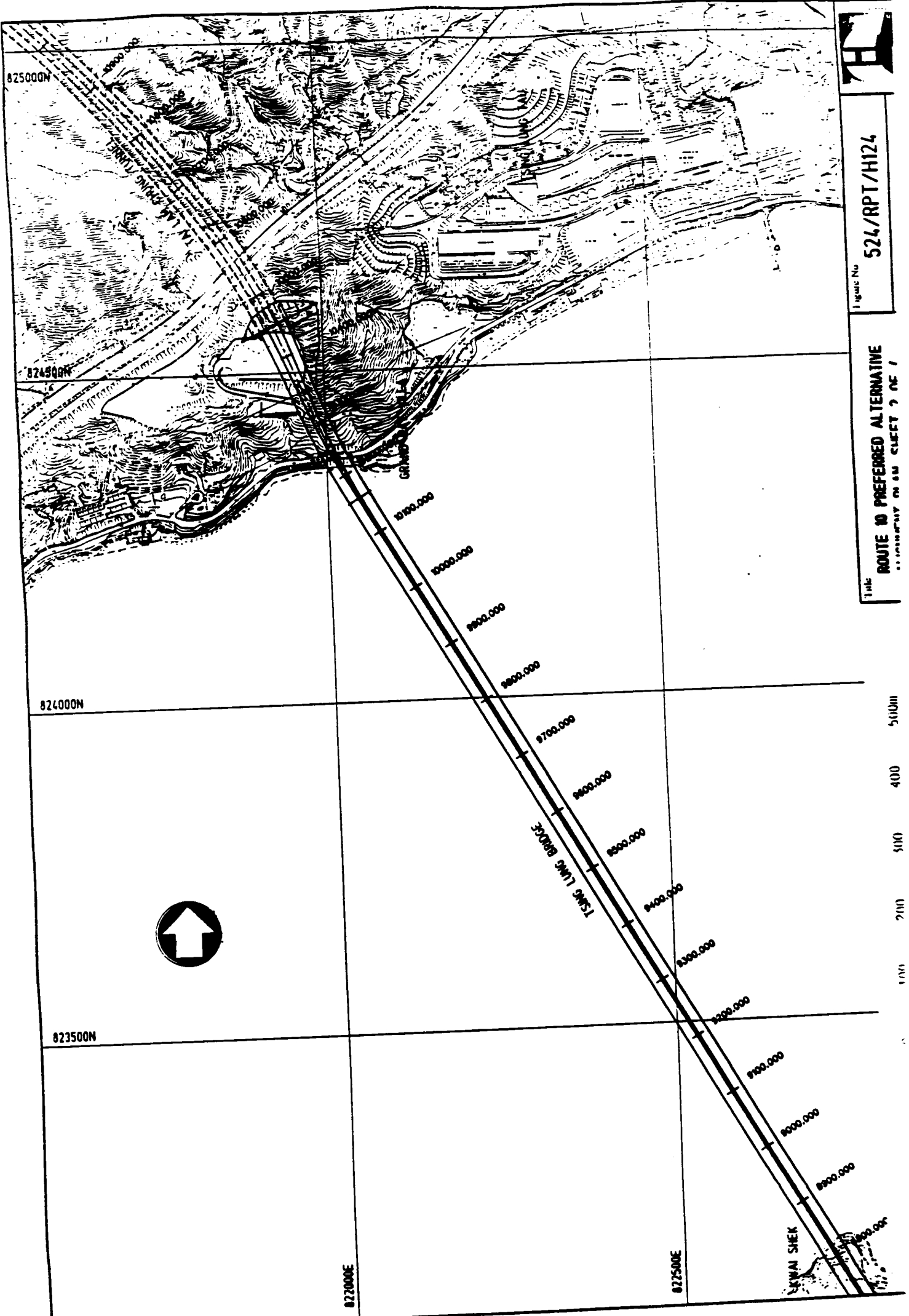




Figure No 524/RPT/H124

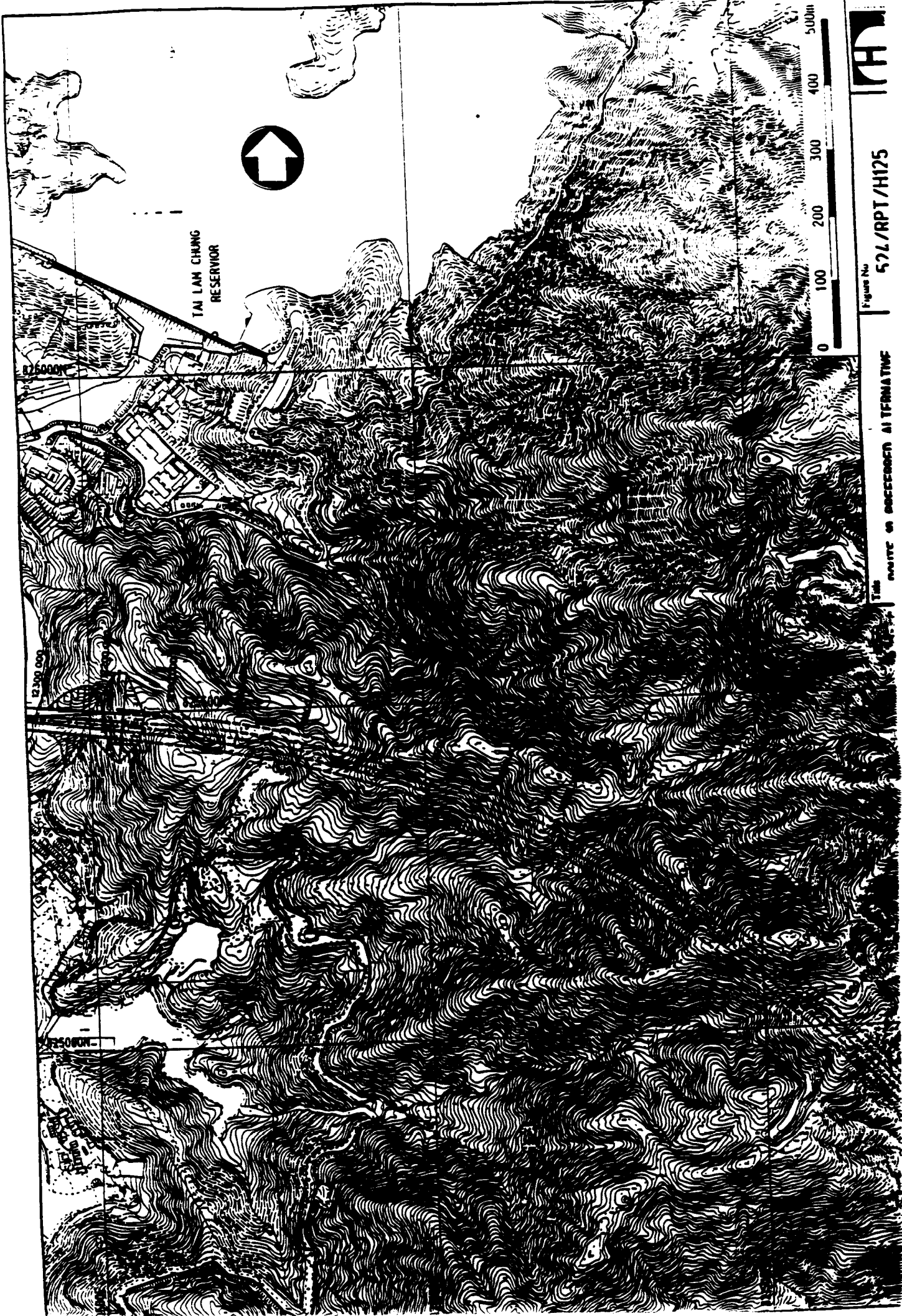
ROUTE 10 PREFERRED ALTERNATIVE
... IN THE VICINITY OF ...



Scale

0 100 200 300 400 500m

KWAI SHEK



TAI LAM CHUNG
RESERVOIR

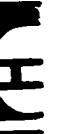
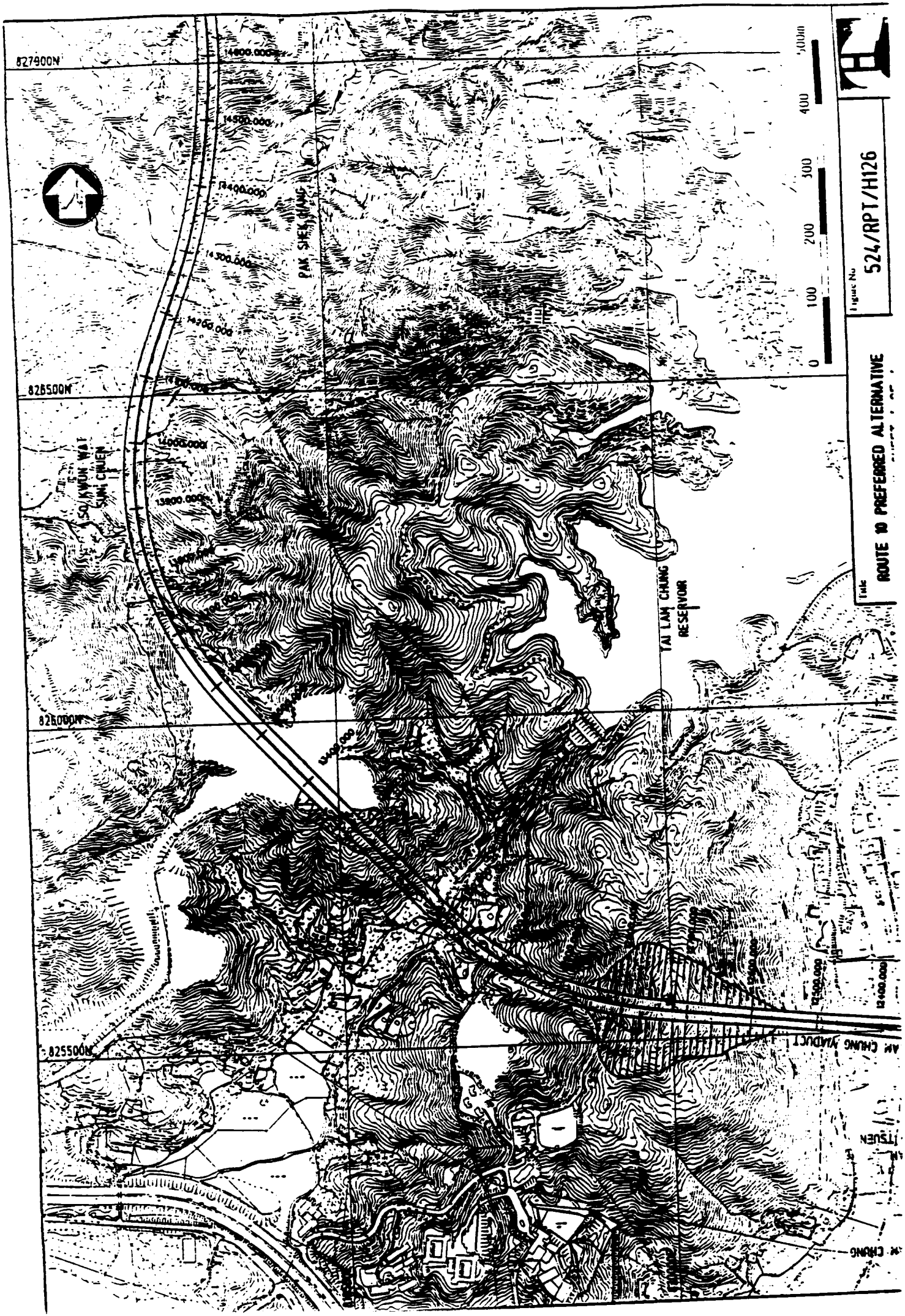


Figure No
57L/RPT/H125

ROUTE OR OFFERED ALTERNATIVE

TAI



827900N

14400.000

14500.000

14600.000

14700.000

14800.000

14900.000

15000.000

15100.000

15200.000

15300.000

15400.000

15500.000

15600.000

15700.000

15800.000

15900.000

16000.000

826500M

826000M

825500M

0 100 200 300 400 500M



Figure No 524/RPT/H126

ROUTE 10 PREFERRED ALTERNATIVE

Title

TSUEN

CHONG

AM CHUNG MANDUCT



Figure No. 524/RPT/H128

ROUTE 10 PREFERRED ALTERNATIVE

HORZI. 1 : 5000

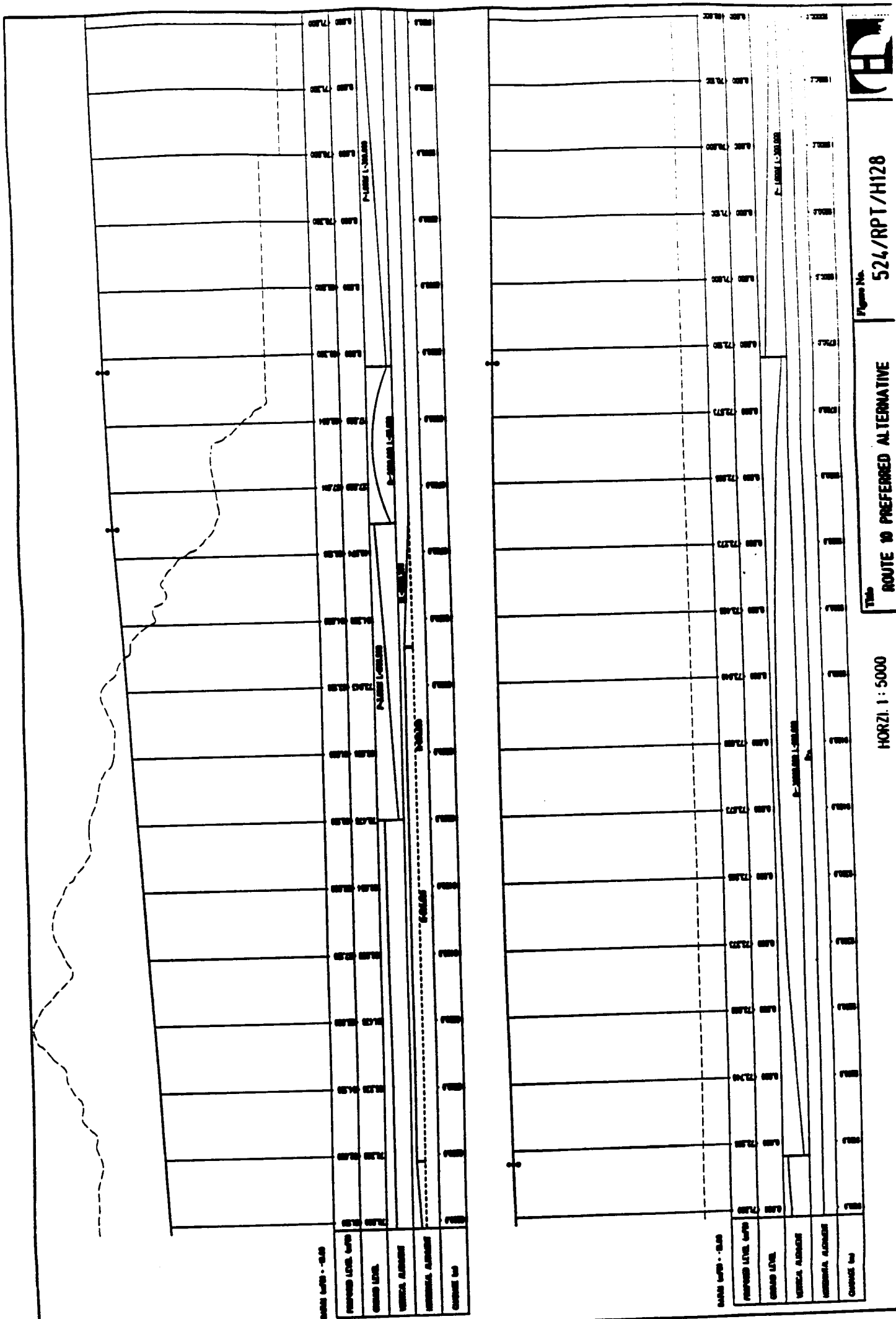


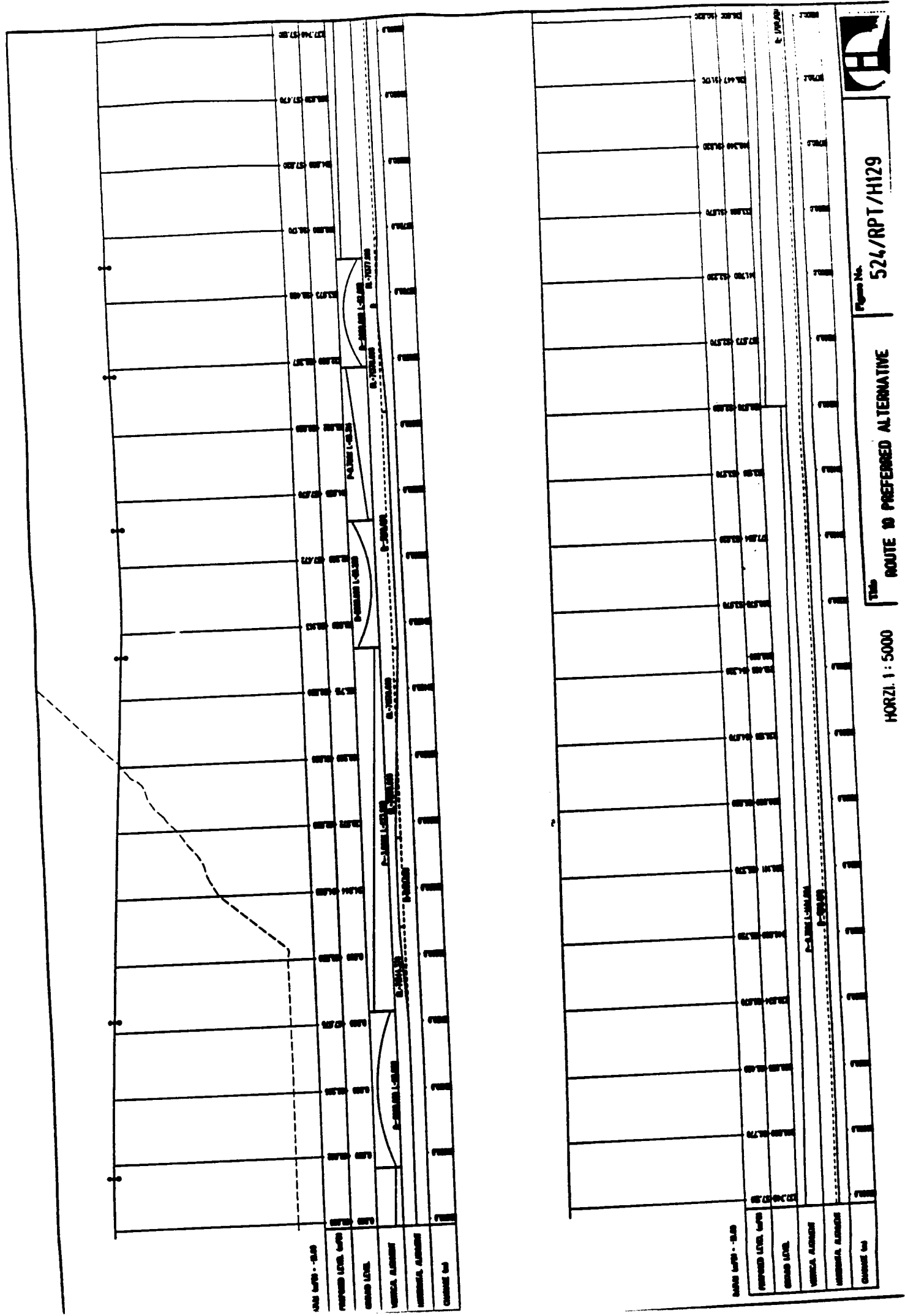


Figure No. 524/RPT/H129

ROUTE 10 PREFERRED ALTERNATIVE

HORZI. 1 : 5000

Scale



ROAD LEVEL - 24.00
 PROPOSED LEVEL - 24.00
 GRAND LEVEL
 VERTICAL ALIGNMENT
 CORONA 60

ROAD LEVEL - 24.00
 PROPOSED LEVEL - 24.00
 GRAND LEVEL
 VERTICAL ALIGNMENT
 CORONA 60

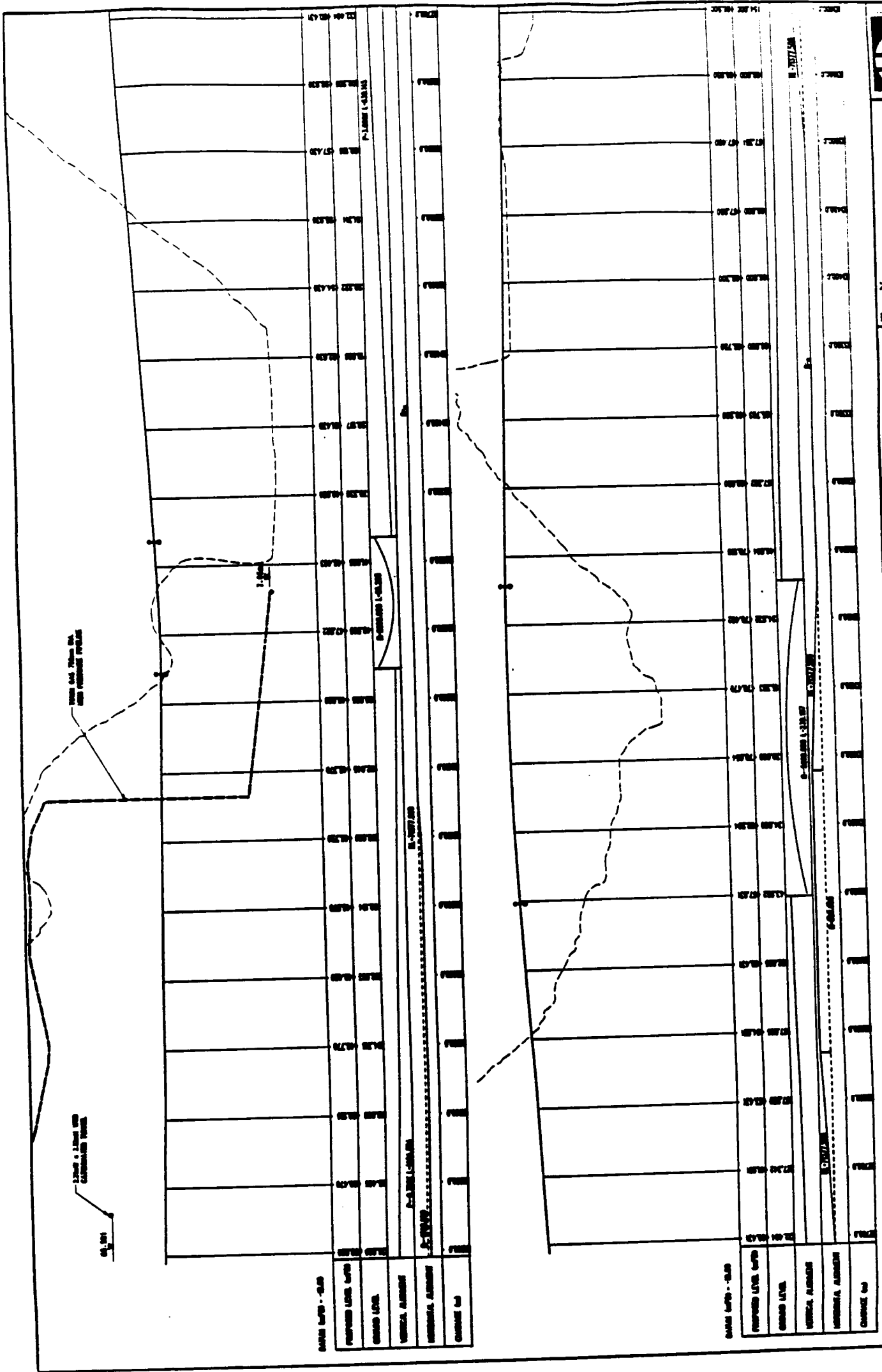
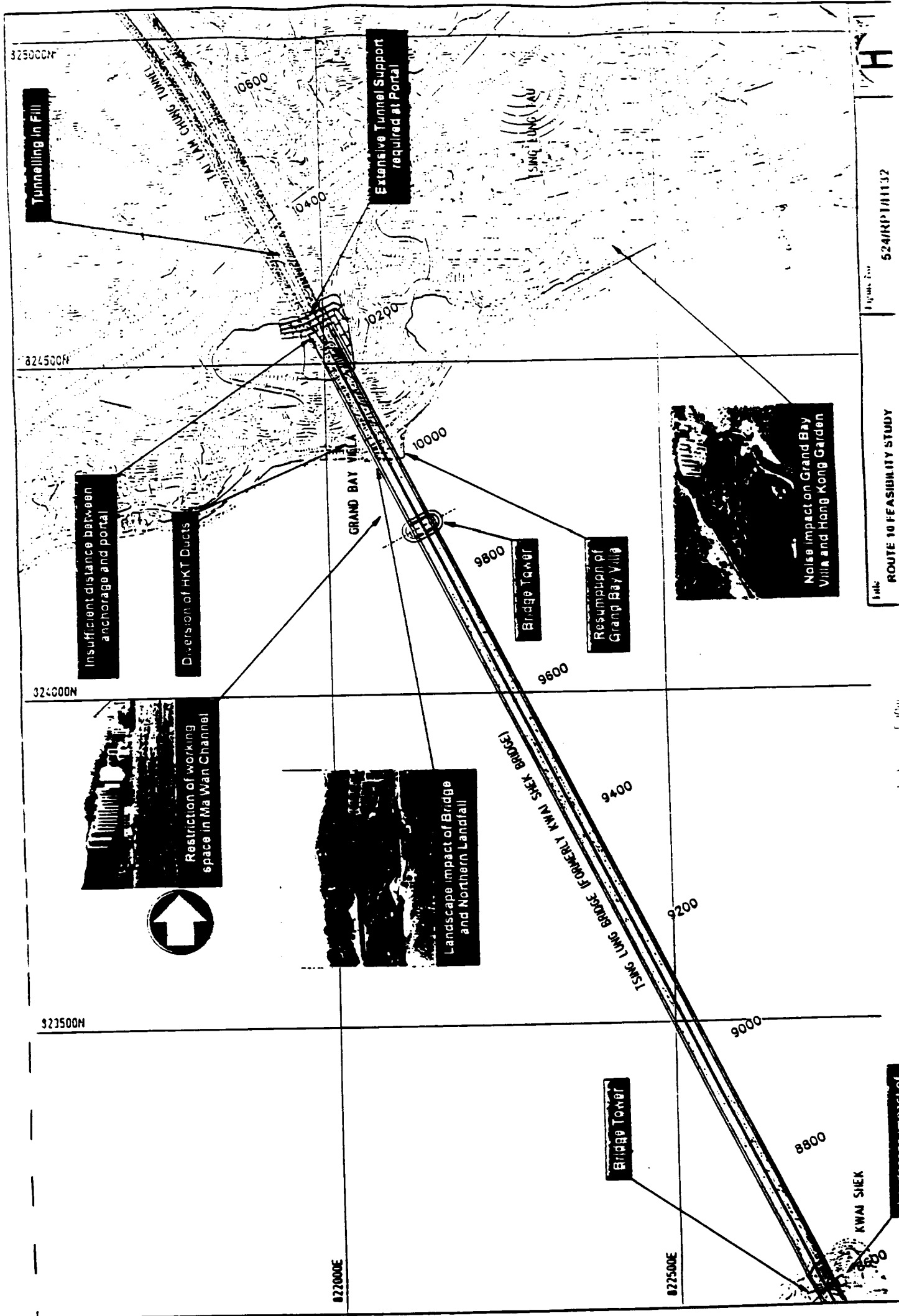


Figure No. 524/RPT/H130A

ROUTE 10 PREFERRED ALTERNATIVE

THIS



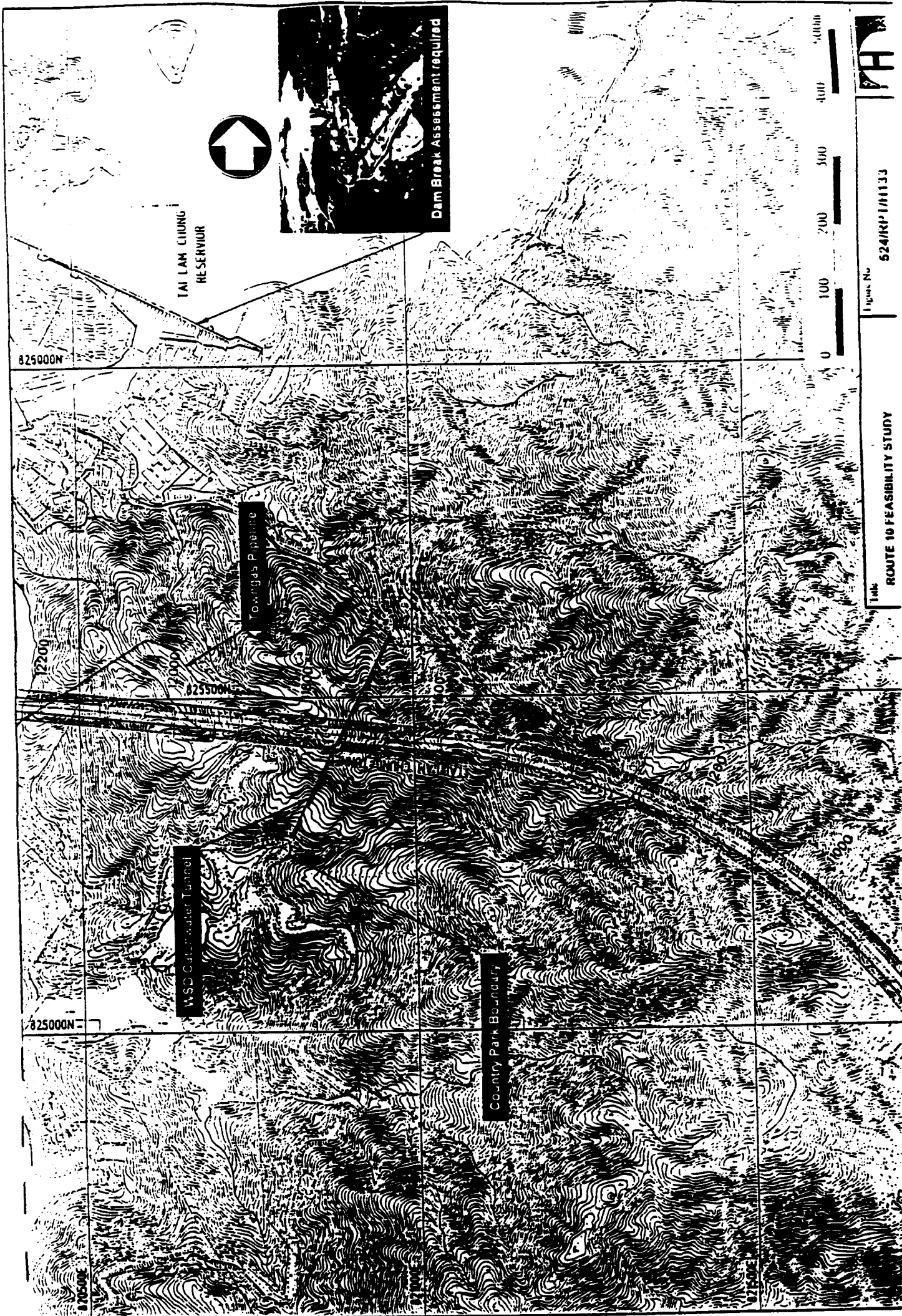
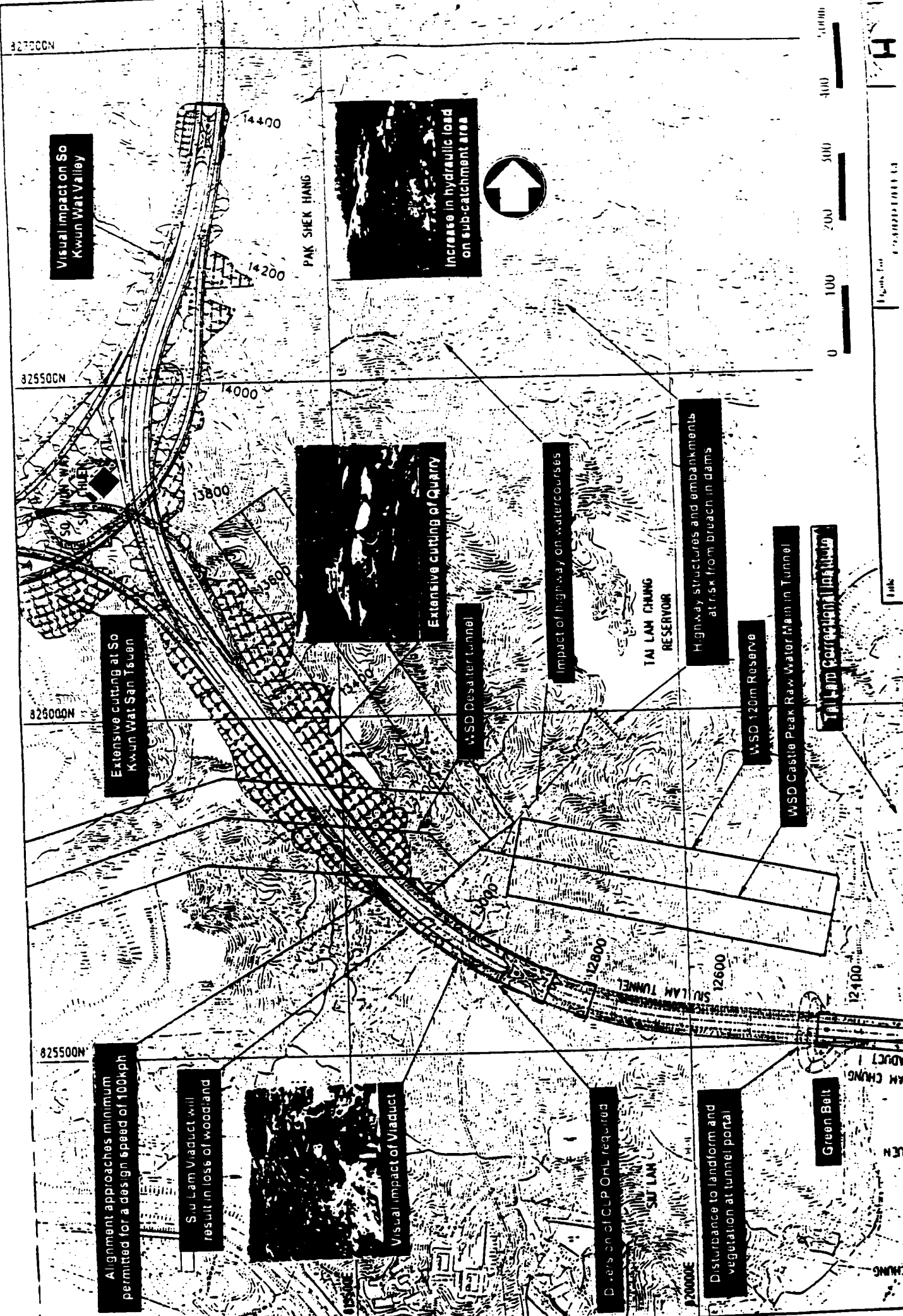


Figure No. 524(HK/P/11133)

ROUTE 10 FEASIBILITY STUDY

Scale



Visual impact on So Kwun Wat Valley

Increase in hydraulic load on sub-catchment area



Extensive cutting at So Kwun Wat San Tsuen

Extensive cutting of Quarry

WSD Desalter tunnel

Impact of highway on watercourses

TAI LAM CHUNG RESERVOIR

Highway structures and embankments at risk from breach in dams

WSD 120m Reserve

WSD Castle Peak Raw Water Main in Tunnel

Tai Lam Correction (1st stage)

Alignment approaches minimum permitted for a design speed of 100kph

Sui Lam Viaduct will result in loss of woodland

Visual impact of Viaduct

Diversions of CLP OHL required

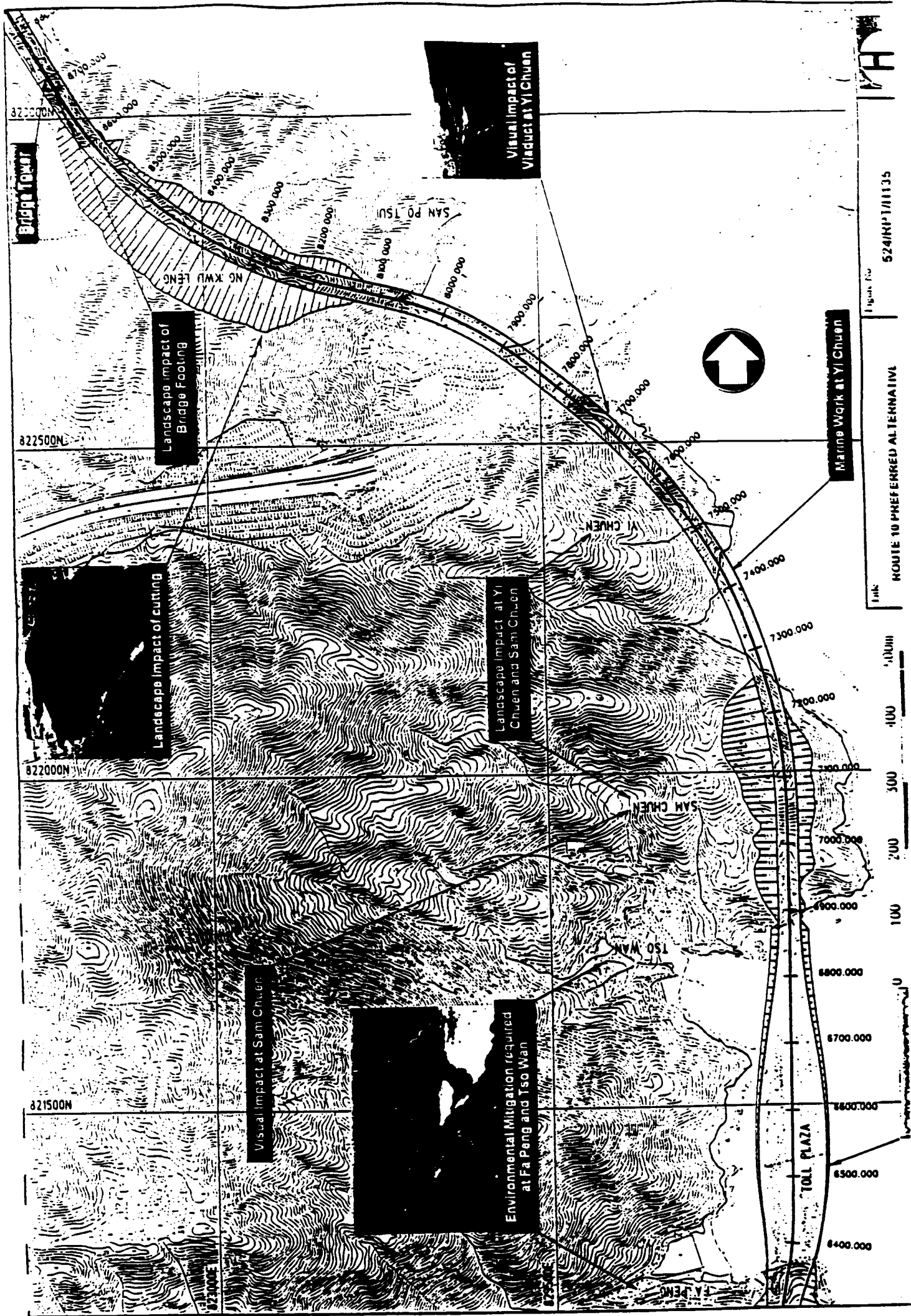
Disturbance to landform and vegetation at tunnel portal

Green Belt

Scale bar: 0, 100, 200, 300, 400, 500, 1000m

TAI LAM CORRECTION (1st stage)

H



Bridge Tower

Landscape Impact of Bridge Footing

Landscape Impact of cutting

Visual Impact at Sam Chuen

Environmental Mitigation required at Fa Peng and Tso Wan

Landscape Impact at Yi Chuen and Sam Chuen

Visual Impact of Viaduct at Yi Chuen

Marine Work at Yi Chuen

822000N

822500N

822000N

821500N

SAN PO TSUI

NG KWU LENG

YI CHUEN

SAM CHUEN

TSO WAN

FA PENG

TOLL PLAZA

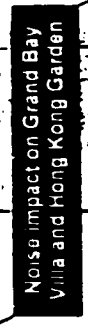
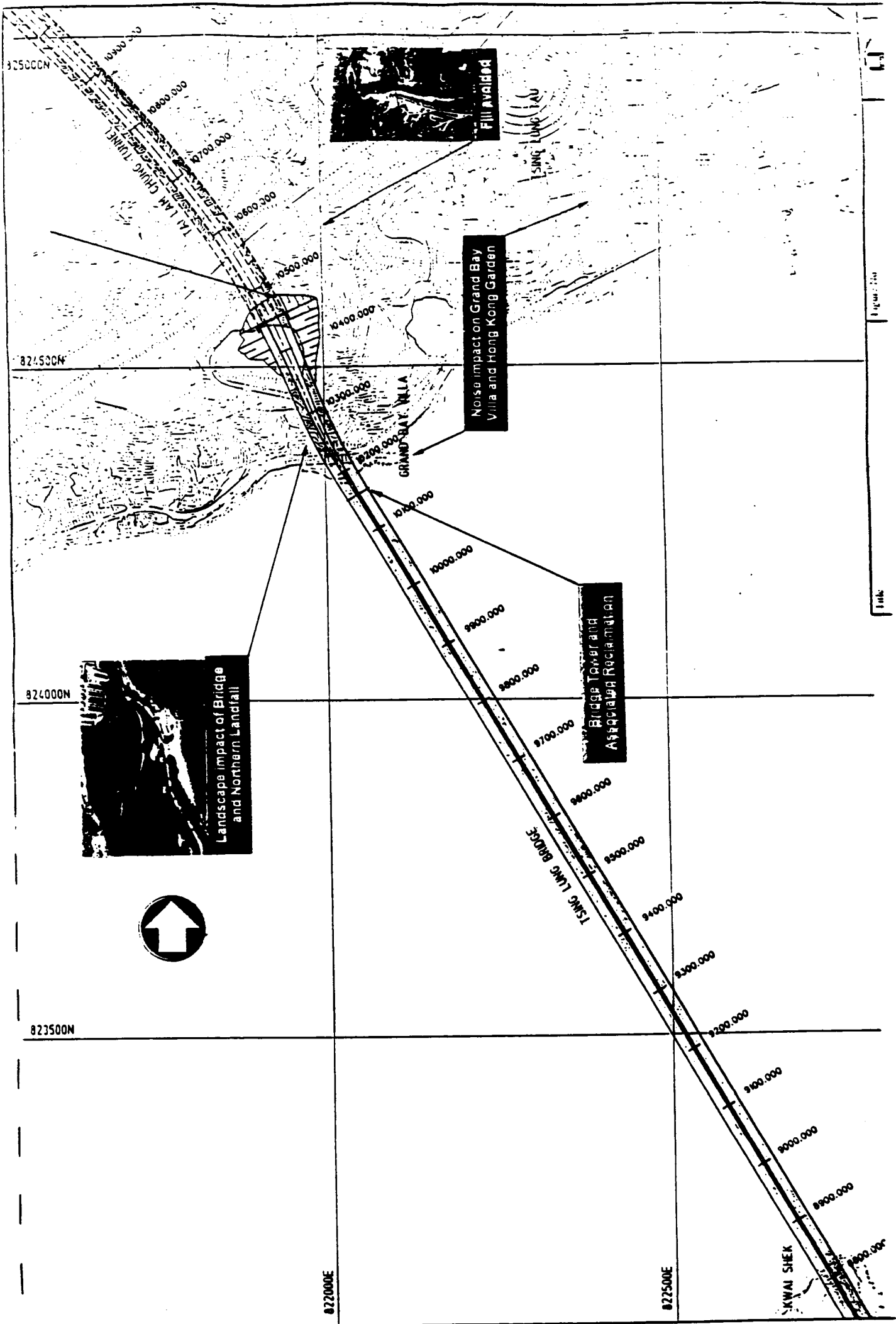


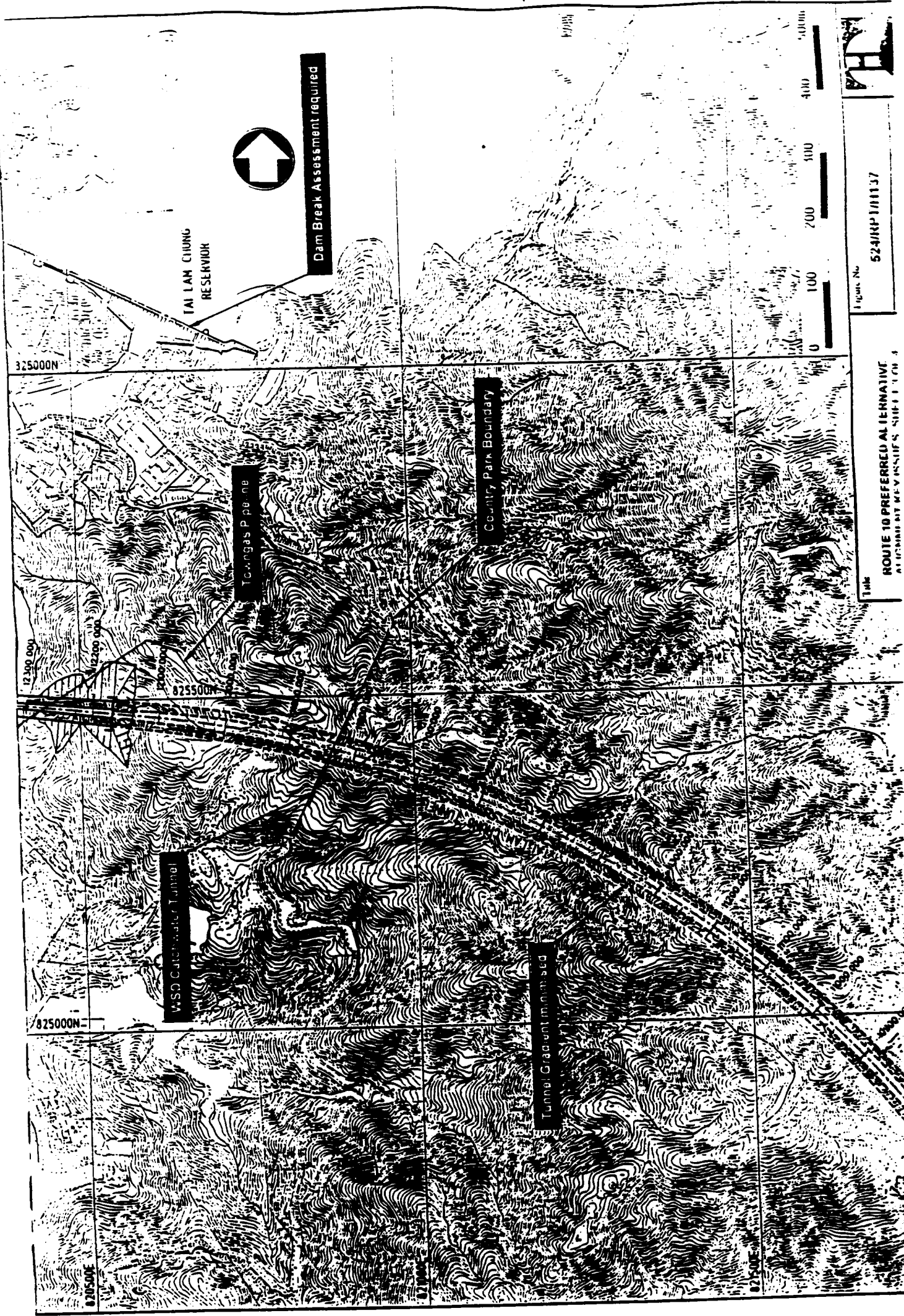
Figure No. 524(KP)T/11135

ROUTE 10 PREFERRED ALTERNATIVE

Scale: 1:10000

Scale: 1:10000





325000N

12300 000
12200 000

TAI LAN CHIUNG
RESERVOIR



Dam Break Assessment required

Lewegas p.p. on

City Park Boundary

USO Construction Tunnel

Tunnel Gradient Imposed

825000N

825000E

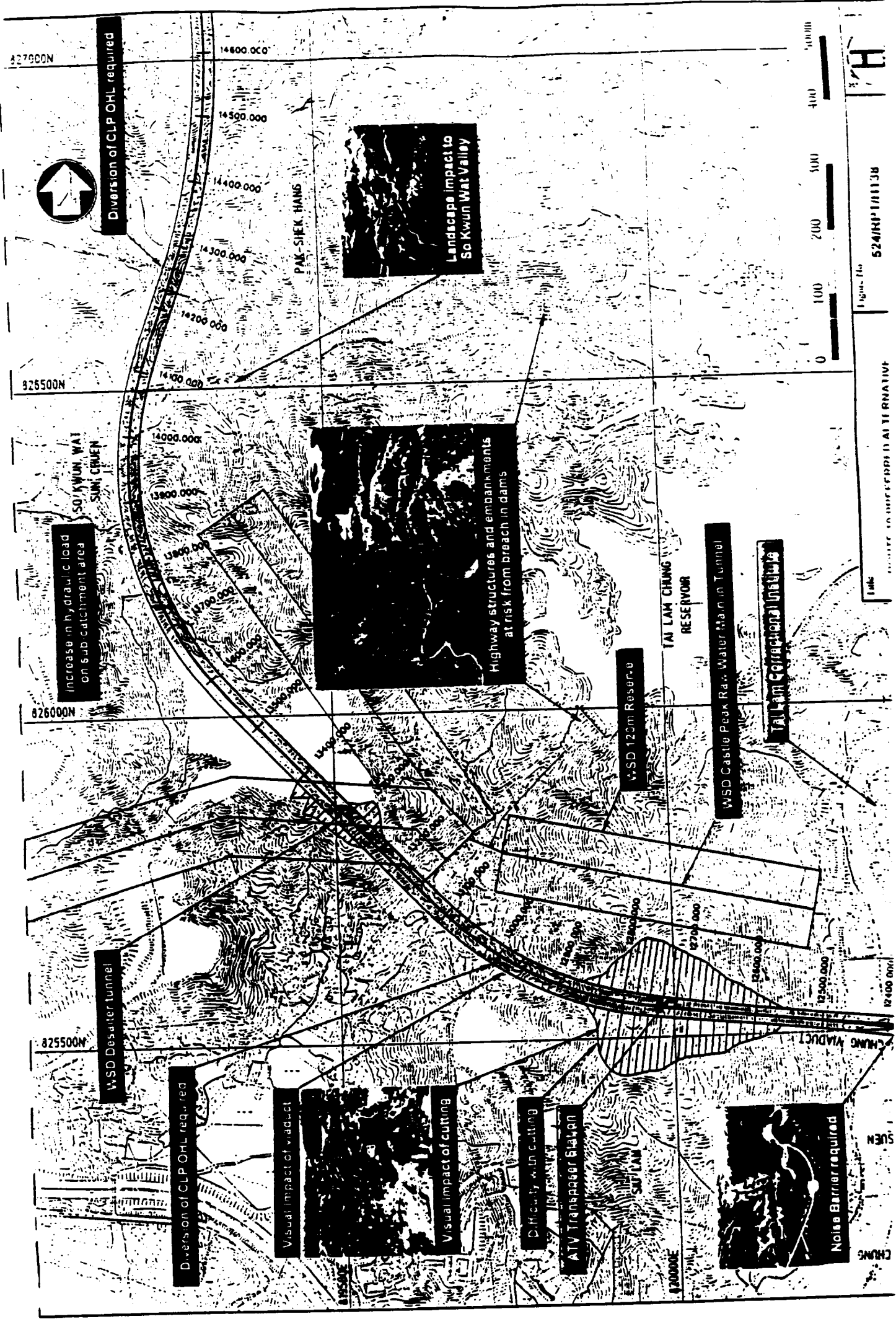


Figure No.

524/KP/1/1137

ROUTE 10 PREFERRED ALTERNATIVE
As shown by M&P/ENR/1/5, 5/11/11/137

Title



Division of CLP OHL required

Increase in hydraulic load on sub-catchment area SO KWUN WAT SUMI CHUEN

Highway structures and embankments at risk from breach in dams

Landscape impact to So Kwun Wat Valley

WSD Desalter Tunnel

Division of CLP OHL required

Visual impact of viaduct



Visual impact of cutting



Difficulty with cutting

ATV Transport Station

WSD 120m Reservoir

TAI LAM CHUNG RESERVOIR

WSD Castle Peak Raw Water Main Tunnel

Tai Lam Correctional Institute



Noise Barrier required

827000N

825500N

826000N

825500N

14600.000'

14500.000'

14400.000'

14300.000'

14200.000'

14100.000'

14000.000'

13900.000'

13800.000'

13700.000'

13600.000'

13500.000'

13400.000'

13300.000'

13200.000'

13100.000'

13000.000'

12900.000'

12800.000'

12700.000'

12600.000'

12500.000'

12400.000'

12300.000'

12200.000'

12100.000'

12000.000'

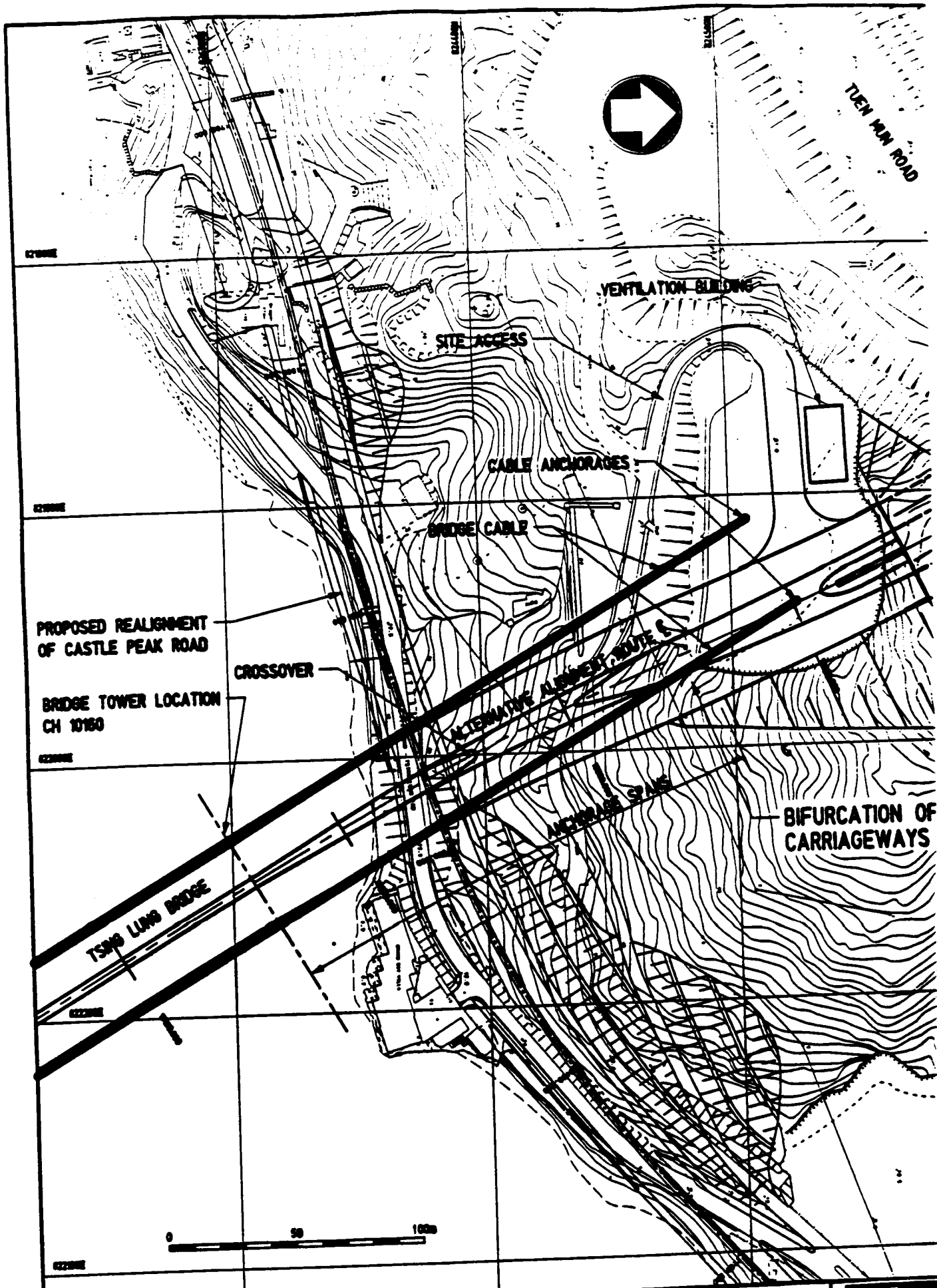
0 100 200 300 400 500M

1:1

Figure No. 524/NP/1/113B

Scale

CHUNG SUEN

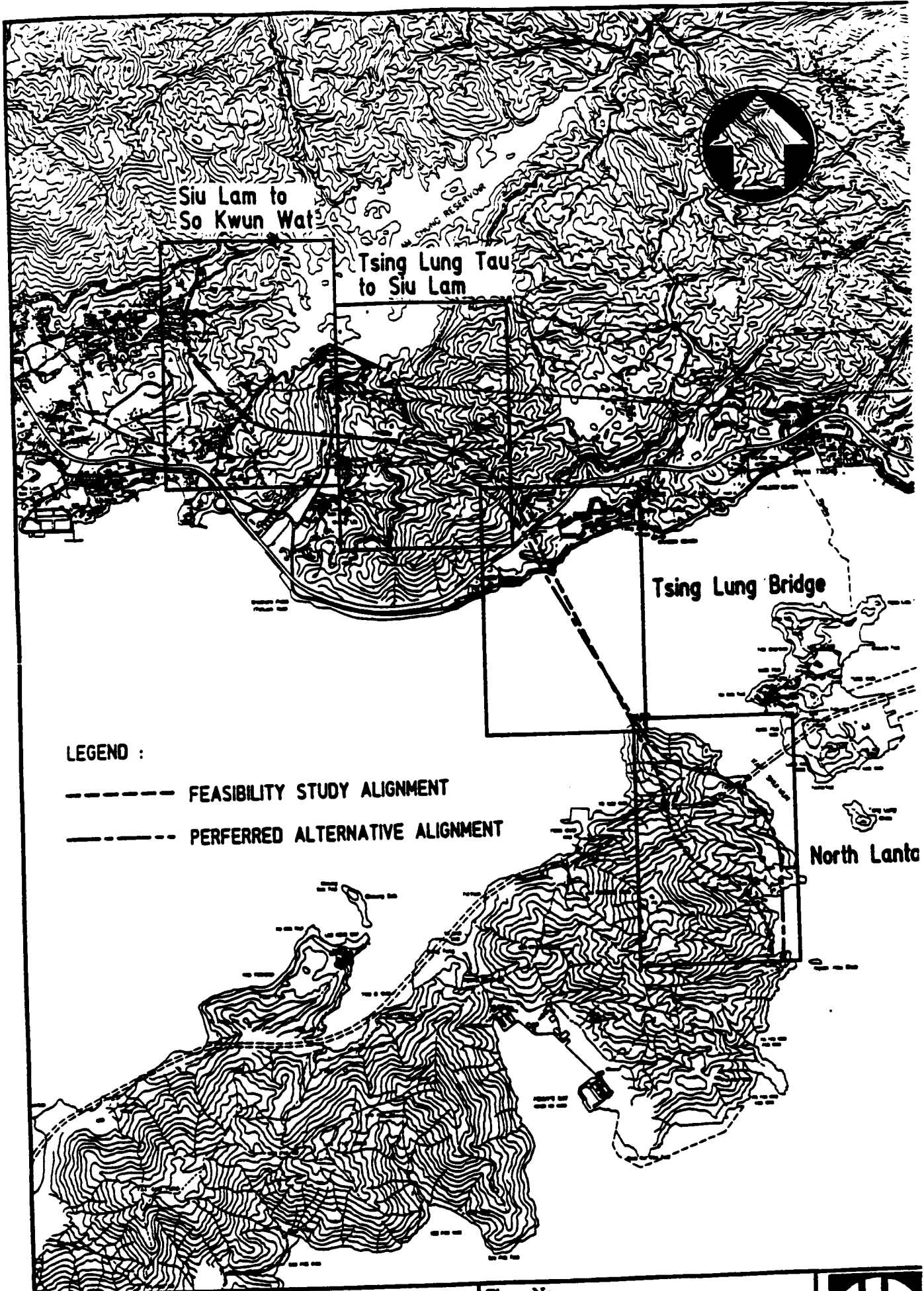


Title
**BIFURCATION OF CARRIAGEWAYS AT
 TSING LUNG BRIDGE NORTH ANCHORAGE**

Figure No.
524/RPT/H139

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Title

**ROUTE 10 ALIGNMENTS PLAN
KEY PLAN**

Figure No.

524/RPT/H140

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APPENDIX B
SUPPLEMENTARY ENVIRONMENTAL CONSIDERATIONS
TO WORKING PAPERS WP1 AND WP2

Highways Department

**Government of the Hong Kong
Special Administrative Region**

Agreement No. CE 82/97

**Route 10 - North Lantau to Yuen Long
Highway Investigation and Preliminary Design Assignment**

Supplementary Environmental Considerations

to

Working Papers WP1 & WP2

Report Number T524/83.03/0A

November 1998

Supplementary Environmental Considerations Working Papers WP1 & WP2

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- 3.4 Feasibility Study Alignment Lantau
- 3.5 Outline Zoning Plan (Plan No. S/I-NELP/4)
- 3.6 Sensitive Receivers
- 3.7 Location of Locally Restricted or Rare Plant Species Identified (North Lantau)
- 3.8 Location of Locally Restricted or Rare Plant Species Identified (North Lantau)

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- 5.2 Sensitive Receivers

- 6.1 Outline Zoning Plan (Plan No. S/TM-SKW/1)
- 6.2 Sensitive Receivers
- 6.3 Sensitive Receivers
- 6.4 Location of Locally Restricted or Rare Plant Species Identified (Tai Lam Chung to So Kwun Wat)
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1.0 SUPPLEMENTARY ENVIRONMENTAL CONSIDERATIONS TO WP1 AND WP2

1.1 Introduction

The Study Area for Route 10 - North Lantau to Yuen Long Highway is illustrated in Figure 1.1. Assessments have been undertaken for the selection of the alignment on the North Lantau Section which are detailed in WP1 and between Tsing Lung Tau and So Kwun Wat, details of which are contained in WP2.

This Supplementary Note has been prepared to provide more details relating to the environmental issues which are summarised in WP1 and WP2. Specifically it aims to outline in greater detail the environmental impacts of two alignment options for Route 10, which are referred to as the Preferred Alternative Alignment (PAA) and the Feasibility Study Alignment (FSA). The environmental impacts associated with the FSA and the proposed mitigation measures have been identified in the *Final EIA Report, Sham Tseng Link Feasibility Study, 1998*.

2.0 DESIGN STANDARDS AND ASSESSMENT CRITERIA

2.1 Background

An Environmental Impact Assessment (EIA) is being undertaken for this Assignment with the primary objective being to identify and evaluate the potential impacts on the surrounding environment arising from the construction and operation of Route 10 (NLYLH). In addition to which, the EIA will seek to examine and evaluate mitigation measures on environmental, engineering and cost effectiveness grounds, and to recommend an optimum package of mitigation measures for incorporation into the Preliminary Design. Throughout the course of the Assignment, environmental inputs will also be required to permit engineering and other decisions to be made.

An Environmental Monitoring and Audit (EM&A) programme will be developed for the construction phase in accordance with the guidelines specified by the Environmental Protection Department (EPD). The EM&A Manual will provide specifications for the monitoring programmes, define baseline monitoring studies and the requirements for compliance monitoring to determine the effectiveness of the recommended mitigation measures.

Design Standards and assessment criteria are fundamentally governed by the Environmental Impact Assessment Ordinance (EIAO) and its Technical Memorandum (TMEIA) as described in the following sections.

2.2 Air Quality

2.2.1 Design Standard

Design standard for the protection of air quality relates specifically to :

- Technical Memorandum on Environmental Impact Assessment Process (TMEIA) with the implementation of mitigation measures.
- the Hong Kong Planning Standards and Guidelines (HKPSG)
- the Air Pollution Control Ordinance (APCO) (Cap. 311)
- Control of Air Pollution in Vehicle Tunnels, EPD (Nov 95)
- The Air Pollution Control (Construction Dust) Regulation.

Under the Air Pollution Control Ordinance, 1983 Cap.311, Air Quality Objectives have been declared for each Air Control Zone as given in Table 2.1.

Table 2.1 Hong Kong Air Quality Objectives

Pollutant	Concentration $\mu\text{g}/\text{m}^3$ (i)				
	Averaging Time				
	1 Hour	8 Hours	24 Hours	3 Months	1 Year
	(ii)	(iii)	(iii)	(iv)	(iv)
Sulphur Dioxide	800		350		80
Total Suspended Particulate (v)			260		80
Respirable Suspended Particulate (v)			180		55
Nitrogen Dioxide	300		150		80
Carbon Monoxide	30000	10000			
Photochemical Oxidants (as ozone (vi))	240				
Lead				1.5	
(i) - Measured at 298°K (25°C) and 101.325 KPa (one atmosphere). (ii) - Not to be exceeded more than three times per year. (iii) - Not to be exceeded more than once per year. (iv) - Arithmetic means. (v) - Respirable Suspended Particulate means suspended particulate in air with a nominal aerodynamic diameter of 10 micrometers and smaller. (vi) - Photochemical oxidants are determined by measurements of ozone only.					

Source : Air Pollution Control Ordinance

The TMEIA also stipulates that a maximum hourly level of $500 \mu\text{g}/\text{m}^3$ Total Suspended Particulates should not be exceeded.

In addition to the AQOs, certain specified processes are named under the APCO and have specific controls attached. Specified processes which could be relevant to this Project include concrete batching. A special licence is required to operate such plant.

2.2.2 Tunnel Air Quality Guidelines

The regulation of air quality within vehicle tunnels is governed by the Tunnel Air Quality Guidelines which were endorsed by the Hong Kong Environmental Pollution Advisory Committee on 26th October 1993.

The environmental design standards to be adopted are given in Table 2.2

Table 2.2 Tunnel Air Quality Guidelines

Air Pollutants	Averaging Time	Maximum Concentration	
		microgram/m ³	Ppm
Carbon monoxide	5 minutes	115,000	100
Nitrogen dioxide	5 minutes	1,800	1
Sulphur dioxide	5 minutes	1,000	0.4

Note: All limits are expressed as at reference conditions of 298°K (25°C) and 101.325 KPa (one atmosphere)

2.3 Noise

2.3.1 Construction Noise

Design standards for Construction Noise, other than percussive piling, include:

- TMEIA
- the Noise Control Ordinance (NCO)
- the Technical Memorandum (TM) on Noise from Construction Work Other Than Percussive Piling
- the Technical Memorandum on Noise from Construction Work in Designated Areas

The TMEIA provides noise standards for daytime construction activities as given in Annex 5. Daytime noise limit of 75 dB(A) Leq (30 min) at the facades of dwellings, and 70 dB(A) at the facades of schools (65 dB(A) during examinations) between 0700 to 1900 hours on normal day.

The restricted hours of the NCO on general construction work other than percussive piling also include the period from 07:00 to 19:00 on a general holiday including Sundays. The applicable noise limits depend upon the existing noise environment in which an NSR is located, and are reflected by the Area Sensitivity Rating (ASR).

If percussive piling is required, the *Technical Memorandum on Noise from percussive Piling* should be followed. Diesel hammers are not allowed for percussive piling under the Works Branch Technical Circular No. 6/97.

The construction activities of Route 10(NLYLH) may cause exceedances of the TMs and ProPECC guidelines at some of the Noise Sensitive Receivers (NSRs). The daytime construction noise impacts could be mitigated to meet the criteria by standard noise mitigation measures such as mobile noise barriers, but specific measures such as the reduction of the number of powered mechanical equipment (PME) and the use of quiet PME may be required. However, a set of more stringent noise control requirements will be necessary for restricted hour construction works. The use of PME during restricted hour will require a Construction Noise Permit (CNP) from the EPD, Local Control Office.

Applications for CNP will be assessed by the Noise Control Authority (EPD). The CNP is a statutory document issued under the NCO and may include conditions, such as permitted hours of operation, type and number of equipment items allowed to be used, and noise control measures to be adopted, which must be observed.

Table 2.3 Construction Noise: Basic Noise Limits

Time Period	Acceptable Noise Level dB(A)		
	ASR = A	ASR = B	ASR = C
All days during the evening (19.00-23.00), and general holidays during the daytime and evening (07.00-23.00)	60	65	70
All days during the night-time (23.00-07.00)	45	50	55

Percussive piling is subject to controls during the daytime, and is prohibited between 19.00 and 07.00 on normal weekdays and all day on public holidays (including Sunday). Permitted hours of piling depend on the noise levels as perceived at the worst-affected NSRs. The Acceptable Noise Level (ANL) for piling is 85 dB(A), based on the assumption that the NSRs have windows and no central air-conditioning. The permitted hours of piling are shown in the following Table 2.4.

Table 2.4 Construction Noise : Permitted Hours of Operation for Piling

Amount by which noise from piling* exceeds the ANL	Permitted hours of operation on any day not being a general holiday
More than 10 dB(A)	08.00 - 09.00 and 12.30 - 13.30 and 17.00 - 18.00
1 to 10 dB(A)	08.00 - 09.30 and 12.00 - 14.00 and 16.30 - 18.00
No exceedance	07.00 - 19.00

* A CNP is required for percussive piling

The Technical Memorandum on Noise from Construction Work in Designated Areas serves to control noise from construction works conducted inside the boundary of indicated areas caused by Specified Powered Mechanical Equipment (SPME) and/or Prescribed Construction Work (PCW). SPME includes particularly noisy items of plant such as handheld breakers, bulldozers and dump trucks. PCW includes erection or dismantling of formwork, handling rubble and hammering. For any such activities conducted outside the hours of 07:00 to 19:00, the TM applies and contractors are required to obtain a CNP from the Noise Control Authority for all SPME and PCW. CNPs are issued at the discretion of the Noise Control Authority, and conditions which may be attached to such CNPs must be strictly adhered to.

The Technical Memorandum on Noise from Construction Work in Designated Areas defines Basic Noise levels (BNLs) for evening, night-time and holiday works as shown in Table 2.5.

Table 2.5 Basic Noise Levels Within Designated Areas

Time Period	Basic Noise Level dB(A)		
	ASR = A	ASR = B	ASR = C
All days during the evening (19.00-23.00), and general holidays during the daytime and evening (07.00-23.00) ¹	45	50	55
All days during the night-time (23.00-07.00) ¹	30	35	40

NOTES: ¹ From the NCO Technical Memorandum on Noise Construction Work in Designated Areas (measurement period 5 minutes).
² Does not apply to noise from percussive piling

2.3.2 Traffic Noise

Design standards for road traffic noise during the operational phase will follow the:

- Hong Kong Planning Standards and Guidelines (HKPSG); and
- the TMEIA recommend specific noise criteria at noise sensitive receivers.

The relevant noise criteria at NSR are shown in Table 2.6.

Table 2.6 Noise Standards : Road Traffic Noise

Use	Road Traffic Noise dB(A)
Domestic premises	70
Offices	70
Educational institutions including kindergartens and nurseries	65
Hospitals, clinics, convalescences and homes for the aged	55

Notes: The above standards apply to uses which rely on opened windows for ventilation Facade noise levels in terms of L₁₀ (peak hour)

For existing Noise Sensitive Receivers (NSRs) affected by Noise from the new road, direct noise mitigation should be provided as far as practical when the noise limits contained in the TMEIA are likely to be exceeded.

If, after implementation of direct technical remedies, any facades of existing sensitive uses remain that are still exposed to predicted noise levels exceeding the requirements set out in the TMEIA, their eligibility for indirect technical remedies (appropriate glazing and air conditioning) will be determined if the following criteria are met (requires ExCO approval):

- the predicted overall noise level from the new road, together with other traffic noise in the vicinity, must be above 70 dB(A) L₁₀ (1 hr) for domestic premises and 65 dB(A) L₁₀ (1 hr) for schools;
- the predicted overall noise level is at least 1.0 dB(A) more than the prevailing noise level, i.e. 1.0 dB(A) more than the total traffic noise level existing before the works to construct the road commence; and
- the contribution to the increase in the predicted overall noise level from the new road must be at least 1.0 dB(A).

2.3.3 Ventilation Noise

Noise generated by the operation of the Route 10 ventilation buildings is under the control of the NCO. The appropriate Acceptable Noise Levels (ANL) for a particular NSR are specified in the *Technical Memorandum for the assessment of Noise from Places Other Than Domestic Premises, Public Places or Construction Sites*. The TMEIA stipulates 5 dB(A) less than ANL as a criterion for fixed noise sources. Design of all ventilation buildings should incorporate noise control measures to ensure compliance with the standards set.

2.4 Water Quality

Design standards for the protection of marine water quality during and following construction is:

- the Water Pollution Control Ordinance (WPCO) (Cap. 358) established in 1980
- the Technical Memorandum to the WPCO on the Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters.
- Water Quality Objectives (WQO's) ascribed to the North Western Water Control Zone (NWWCZ). Relevant Water Quality Objectives are given in Table 2.7

Table 2.7 Marine Water Quality Objectives for the North Western Waters Water Control Zone

Water Quality Objective	Part or Parts of Zone
A. AESTHETIC APPEARANCE	
(a) Waste discharges shall cause no objectionable odours or discolouration of the water.	Whole zone
(b) Tarry residues, floating wood, articles made of glass, plastic, rubber or of any other substances should be absent.	Whole zone
(c) Mineral oil should not be visible on the surface. Surfactants should not give rise to a lasting foam.	Whole zone
(d) There should be no recognisable sewage-derived debris.	Whole zone
(e) Floating, submerged and semi-submerged objects of a size likely to interfere with the free movement of vessels, or cause damage to vessels, should be absent.	Whole zone
(f) Waste discharges shall not cause the water to contain substances which settle to form objectionable deposits.	Whole zone
B. BACTERIA	
(a) The level of <i>Escherichia coli</i> should not exceed 610 per 100mL, calculated as the geometric mean of all samples collected in a calendar year.	Secondary Contact Recreation Subzones
(b) The level of <i>Escherichia coli</i> should be less than 1 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones
(c) The level of <i>Escherichia coli</i> should not exceed 1,000 per 100 mL, calculated as the running median of the most recent 5 consecutive samples taken at intervals of between 7 and 21 days.	Tuen Mun (C) Subzone and other inland waters
(d) The level of <i>Escherichia coli</i> should not exceed 180 per 100 mL, calculated as the geometric mean of all samples collected from March to October inclusive. Samples should be taken at least 3 times in one calendar month at intervals of between 3 and 14 days.	Bathing Beach Subzones

Water Quality Objective	Part or Parts of Zone
C. COLOUR	
(a) Waste discharges shall not cause the colour of water to exceed 30 Hazen units.	Tuen Mun (A) and Tuen Mun (B) Subzones and Water Gathering Ground Subzones
(b) Waste discharges shall not cause the colour of water to exceed 50 Hazen units.	Tuen Mun (C) Subzone and other inland waters
D. DISSOLVED OXYGEN	
(a) Waste discharges shall not cause the level of dissolved oxygen to fall below 4 mg per litre for 90% of the sampling occasions during the whole year, values should be calculated as water column average (arithmetic mean of at least 3 measurements at 1m below surface, mid-depth and 1m above seabed). In addition, the concentration of dissolved oxygen should not be less than 2mg per litre within 2m of the seabed for 90% of the sampling occasions during the whole year.	Marine waters
(b) Waste discharges shall not cause the level of dissolved oxygen to be less than 4mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones, Water Gathering Ground Subzones and other inland waters
E. pH	
(a) The pH of the water should be within the range of 6.5-8.5 units. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.2 unit.	Marine waters excepting Bathing Beach Subzones
(b) Waste discharges shall not cause the pH of the weather to exceed the range of 6.5-8.5 units.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones

Water Quality Objective	Part or Parts of Zone
(c) The pH of the water should be within the range of 6.0-9.0 units.	Other inland waters
(d) The pH of the water should be within the range of 6.0-9.0 units for 95% of samples collected during the whole year. In addition, waste discharges shall not cause the natural pH range to be extended by more than 0.5 unit.	Bathing Beach Subzones
F. TEMPERATURE	
Waste discharges shall not cause the natural daily temperature range to change by more than 2.0°C.	Whole zone
G. SALINITY	
Waste discharges shall not cause the natural ambient salinity level to change by more than 10%.	Whole zone
H. SUSPENDED SOLIDS	
(a) Waste discharges shall neither cause the natural ambient level to be raised by more than 30% nor give rise to accumulation of suspended solids which may adversely affect aquatic communities.	Marine waters
(b) Waste discharges shall not cause the annual median of suspended solids to exceed 20 mg per litre.	Tuen Mun (A), Tuen Mun (B) and Tuen Mun (C) Subzones and Water Gathering Ground Subzones
(c) Waste discharges shall not cause the annual median of suspended solids to exceed 25 mg per litre.	Other inland waters
I. AMMONIA	
The un-ionized ammoniacal nitrogen level should not be more than 0.021 mg per litre, calculated as the annual average (arithmetic mean).	Whole zone
J. NUTRIENTS	
(a) Nutrients shall not be present in quantities sufficient to cause excessive or nuisance growth of algae or other aquatic plants.	Marine waters
(b) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.3 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1m below surface, mid-depth and 1m above seabed).	Castle Peak Bay Subzone
(c) Without limiting the generality of objective (a) above, the level of inorganic nitrogen should not exceed 0.5 mg per litre, expressed as annual water column average (arithmetic mean of at least 3 measurements at 1m below surface, mid-depth and 1m above seabed).	Marine waters excepting Castle Peak Bay Subzone

Water Quality Objective	Part or Parts of Zone
K. 5-DAY BIOCHEMICAL OXYGEN DEMAND	
(a) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 3 mg per litre.	Tuen Mun (A), Tuen Mun (B) an Tuen Mun (C) Subzones and Water Gathering Ground Subzones
(b) Waste discharges shall not cause the 5-day biochemical oxygen demand to exceed 5mg per litre.	Other inland waters
L. CHEMICAL OXYGEN DEMAND	
(a) Waste discharges shall not cause the chemical oxygen demand to exceed 15 mg per litre.	Tuen Mun (A), Tuen Mun (B) an Tuen Mun (C) Subzones and Water Gathering Ground Subzones
(b) Waste discharges shall not cause the chemical oxygen demand to exceed 30 mg per litre.	Other inland waters
M. TOXINS	
(a) Waste discharges shall not cause the toxins in water to attain such levels as to produce significant toxic, carcinogenic, mutagenic or teratogenic effects in humans, fish or any other aquatic organisms, with due regard to biologically cumulative effects in food chains and to toxicant interactions with each other.	Whole zone
(b) Waste discharges shall not cause a risk to any beneficial use of the aquatic environment.	Whole zone
N. PHENOL	
Phenols shall not be present in such quantities as to produce a specific odour, or in concentration greater than 0.05 mg per litre as C ₆ H ₅ OH.	Bathing Beach Subzones
O. TURBIDITY	
Waste discharges shall not reduce light transmission substantially from the normal level.	Bathing Beach Subzones

Beneficial Uses for surface waters are described as follows :

- Group A abstraction for potable water supply (includes water gathering grounds and Country Parks)
- Group B irrigation (mainly in the agricultural areas of North West New Territories)
- Group C pond fish culture (mainly in Yuen Long)
- Group D general amenity and secondary contact recreation (including those draining to marine waters via nullahs) (refer to Table 2.8).

Table 2.8 TM Standards for Discharges to Group D Water

	≤200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤2000	>2000 and ≤3000	>2000 and ≤3000
pH (pH units)	6-10	6-10	6-10	6-10	6-10	6-10	6-10	6-10
Temperature (°C)	30	30	30	30	30	30	30	30
Colour (lovibond units) (25mm cell length)	1	1	1	1	1	1	1	1
Suspended solids	30	30	30	30	30	30	30	30
BOD	20	20	20	20	20	20	20	20
COD	80	80	80	80	80	80	80	80
Oil & Grease	10	10	10	10	10	10	10	10
Iron	10	8	7	5	4	2.7	2	1.3
Boron	5	4	3.5	2.5	1	1.5	1	0.7
Barium	5	6	3.5	2.5	1	1.5	1	0.7
Mercury	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001
Cadmium	0.1	0.05	0.001	0.001	0.001	0.001	0.001	0.001
Other toxic metals individually	1	1	0.8	0.8	0.5	0.5	0.2	0.2
Total toxic metals	2	2	1.6	1.6	1	1	0.5	0.4
Cyanide	0.4	0.4	0.3	0.3	0.2	0.1	0.1	0.05

	≤200	>200 and ≤400	>400 and ≤600	>600 and ≤800	>800 and ≤1000	>1000 and ≤2000	>2000 and ≤3000	>2000 and ≤3000
Phenols	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1
Sulphide	1	1	1	1	1	1	1	1
Sulphate	800	600	600	600	600	400	400	400
Chloride	1000	800	800	800	600	600	400	400
Fluoride	10	8	8	8	5	5	3	3
Total phosphorus	10	10	10	8	8	8	5	5
Ammonia nitrogen	20	20	20	20	20	20	20	10
Nitrate + nitrite nitrogen	50	50	50	30	30	30	30	20
Surfactants (total)	15	15	15	15	15	15	15	15
E. coli (count/100ml)	1000	1000	1000	1000	1000	1000	1000	1000

Design criteria for surface waters are defined by :

- the Technical Memorandum on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters

The major design standards for the construction phase water quality are stipulated in a Technical Memorandum (TM) on Standards for Effluents Discharged into Drainage and Sewerage Systems, Inland and Coastal Waters which was issued under the WPCO and gives guidance on the permissible effluent discharges based on the type of receiving waters (foul sewers, storm water drains, inland and coastal waters). The limits control the physical, chemical and bacterial quality of effluents.

Any person(s) discharging into the receiving waters should apply for a licence and must ensure that the quality of the effluent meets the requirements stipulated in the licence issued. In the absence of any licensing conditions at this stage, the TM standards can be adopted as a reference. Relevant TM standards for Group D waters (generally encountered in the Study Area) for selected parameters are listed in Table 2.8.

2.5 Ecology

Design criteria are set out in the following:

- Chapter 10 (Landscape and Conservation), HKPSG which addresses the importance of woodlands (natural, plantation, and fung shui) as a priority for conservation;
- the Forestry Regulations which protect listed protected plant species;
- the Wild Animal Protection Ordinance (Cap. 170) which protects wild animals by prohibiting the disturbance, taking or removal of animals and/or their nests or eggs; and
- the TMEIA

2.6 Solid Waste Management

The TMEIA requires relevant requirements under the *Waste Disposal Ordinance* (WDO) and its regulations to be met. The WDO restricts the disposal of wastes at a licensed site and prohibits the unauthorised disposal of wastes, with waste defined as any substance or article which is abandoned. Construction waste is not directly defined in the Ordinance but is considered to fall within the category of "trade waste". Disposal and handling of construction wastes should follow relevant legislation and guidelines, including:

- Waste Disposal Ordinance (Cap 354);
- Waste Disposal (Chemical Waste) (General) Regulation (Cap 354);
- Crown Land Ordinance (Cap 28); and
- Public Health and Municipal Services Ordinance (Cap 132) - Public Cleansing and Prevention of Nuisances (Urban Council) and (Regional Council) By-laws.

Disposal of marine mud is governed by the procedures outlined in Works Branch Technical Circular No. 22/92. The Circular encompasses the requirements for the disposal of both contaminated and uncontaminated marine mud in designated marine disposal grounds or exhausted marine borrow pits. The criteria for the classification of marine mud is defined in the EPD Technical Circular No. (TC) No. 1-1-92.

Other 'guideline' documents which detail how the Contractor should comply with waste disposal regulations are as follows:

- Waste Disposal Plan for Hong Kong (December 1989), Planning, Environment and Lands Branch Government Secretariat.
- Environmental Guidelines for Planning In Hong Kong, Hong Kong Planning and Standards Guidelines, Hong Kong Government.
- New Disposal Arrangements for Construction Waste (1992), Environmental Protection Department & Civil Engineering Department.
- Code of Practice on the Packaging, Labeling and Storage of Chemical Wastes (1992), Environmental Protection Department.
- Works Branch Technical Circular No. 2/93, Public Dump (Public filling area).

2.7 Mitigation Measures

2.7.1 Friction Courses

Where a reduction in road traffic noise is required, the use of friction courses will be considered as an option. The design criteria for the friction course will be :

- relatively level road
- relatively free flowing traffic
- minimum vehicle speed should be 50 km/h
- percentage of heavy vehicle should be low.

2.7.2 Noise Barriers

The design of noise barriers or partial enclosures will follow the general requirements stipulated in Structures Design Manual for Highways and Railways.

The geometry of the partial enclosures will be governed by headroom and width, as to suit carriageway widths or width of elevated road parapets. Also, the sight lines provided should comply with the requirements stated in the *Transport Planning and Design Manual Vol.2*.

Noise barriers and partial enclosures are to be designed as an integral part of the highway and its structures. All structural design criteria to be complied with are contained with Section 5.0 of the Design Memorandum. Where noise enclosures are considered to be equivalent to a "tunnel" the requirements of the Code of Practice for Minimum Fire Service Installations and Equipment and Inspection and Testing of Installation and Equipment March 1994 will be followed.

3.0 INITIAL ASSESSMENTS ON NORTH LANTAU

3.1 Description

Preferred Alternative Alignment (PAA)

The PAA, illustrated on Figures 3.1 to 3.3 consists of a route running along the coastline of Tso Wan, Sam Chuen, Ti Chuen and passing under the Kap Shui Mun Bridge. The alignment then runs along the coast of Tai Chuen and connects to the Tsing Lung Bridge at Kwai Shek. A toll plaza is proposed at the strip of reclamation in the embayment between Tso Wan and Fa Peng. Three options are presented (A, B and C) for the toll plaza which have been considered in detail.

Feasibility Study Alignment (FSA)

The FSA shown in Figure 3.4 was designed to connect with the Chok Ko Wan Link Road, traverse the eastern coastline at grade near Tso Wan with a toll plaza proposed along the coast. It then passed over two tunnels and entered a 600 m tunnel. After leaving the tunnel, the alignment passed over the North Lantau Highway to connect to the Tsing Lung Bridge at Kwai Shek.

3.2 Existing Land Uses

The existing land uses are illustrated in the Report on R10(NLYLH) Alignment with planned uses contained in Figure 3.5 (OZP No. S/I-NELP/3). It can be seen that the majority of land uses in this Section are uncultivated land, ponds and grave sites with future use zoned as greenbelt. The number of villagers officially living in Tso Wan and Fa Peng is around 7.

3.3 Noise and Air Quality

Preferred Alternative Alignment

Compared to the FSA, the PAA has been moved further east and runs along the coast of North East Lantau passing Fa Peng and Tso Wan at grade before entering an open cut section. Both Fa Peng and Tso Wan consist of existing scattered village type houses and associated buildings. In the Feasibility Study report, it was assumed that the capacity of the road will be 8700 veh/hr. Until the traffic forecasts for the current Assignment are confirmed this same figure (and vehicle mix) has been used for comparative purposes in this initial assessment.

The locations of potential sensitive receivers and their horizontal distance from the PAA are shown in Table 3.1 and Figure 3.6.

Table 3.1 NSRs Near North Lantau PAA

Receivers	Name	Horizontal Distance (m)	
1	Tso Wan	A	100
		B	100
		C	270
2	Fa Peng	A	100
		B	200
		C	250

As the villages are located more than 100m from the PAA, it may be surmised that they satisfy the recommended buffer distance stipulated in the Hong Kong Planning Standards and Guidelines (HKPSG). It is therefore not anticipated that vehicle traffic emissions will adversely affect air quality at the two villages.

On the assumption the PAA will carry the same volume and mix of traffic as the FSA, the road traffic noise levels at Fa Peng and Tso Wan will be in the region of 76 to 80 dB(A). Therefore, the road traffic noise criterion of $L_{10, \text{peak hour}}$ 70 dB(A) for domestic dwellings would be exceeded by 6 to 10 dB(A). As the village houses are low rise in nature, it is likely that a 5m high vertical barrier of approximate 500m in length would need to be erected along the proposed toll plaza to protect the two villages. This is subject to confirmation during the detailed EIA studies.

The two villages would also be affected by the construction activities of the PAA. Given the large separation of the two villages and the PAA, it is expected that with the implementation of good engineering measures and site practice the noise and dust emissions from the site could be controlled to acceptable levels during construction. No insurmountable noise and dust impacts are therefore not expected.

Feasibility Study

Under the Feasibility Study Alignment (FSA), both Fa Peng and Tso Wan villages would be resumed, no noise and air sensitive receivers were identified in the North Lantau and thus no mitigation measures were defined.

3.4 Water Quality

Preferred Alternative Alignment

As the area of embayment between the toll plaza and the villages would be filled to a nominal formation level of +5.5mPD, minimal water quality impact is expected.

The effects of constructing the toll plaza on water quality will be locally confined and the infilling should not adversely affect the external tidal flow regime. In addition to which the pollution load to the embayment is relatively small as the hinterland is undeveloped save for the few dwellings (19 living quarters and the population of 7 persons), and the area is within the Prohibited Area for Livestock Activities.

Feasibility Study

No assessment was undertaken for this section in the FS.

3.5 Terrestrial Ecology

Preferred Alternative Alignment

Preliminary ecological surveys were undertaken along the alignment. The terrestrial habitats along the alignment are mainly grassland and scrubland, with most of the plant species identified common, widespread, and typical to such habitat types in Hong Kong such as *Arundinaria cantorii*, *Lantana camara*, *Litsea rotundifolia*, *Aster baccharides* and *Baeckea frutescens*. There are also a few small areas of typical young lowland secondary woodlands (species such as *Celtis sinensis* and *Ficus hispida*) and orchards adjacent to villages and ravines, as well as past farmlands now completely covered by common weed (*Branchiaria mutica* & *Panicum sp.*). Typical back-shore vegetation is found at rocky shore habitats, such as *Clerodendrum inerme* and *Ficus superba*. In the small sandy shore areas, plant species recorded are also common.

Five restricted/rare species of conservation interest, namely *Amorphophallus sp.*, *Phymatodes scolopendria*, *Fimbristylis complanata*, *Diplarcum caricinum* and *Vitis balansaeana* were recorded along the alignment, the locations of which is shown in Figures 3.7 & 3.8. All the species are outside the current alignment scheme except *Vitis balansaeana* which has a restricted distribution in Hong Kong.

The preliminary surveys did not record any animal wildlife with ecological interest. Common birds such as Blue Magpie, Magpie Robin, Chinese Bulbul and Pied Kingfisher were observed.

For the purpose of alignment options evaluation, only the primary impact due to direct landtake and therefore habitat loss is discussed. It is estimated that the areas of scrubland/grassland habitat loss in relation to the Preferred Alternative Alignment are approximately 13 ha.

Taking reference from the EIAO TM impact assessment criteria, the potential ecological impact is considered low mainly because the habitat quality is low and species present are all common in Hong Kong except the few individuals of *Vitis balansaeana*.

Mitigation measures such as transplanting the *Vitis balansaeana* where necessary are recommended, and no insurmountable ecological impact is expected from the Preferred Alternative Alignment.

Feasibility Study Alignment

The habitats affected by the FSA is similar to that of the PAA and approximately 6 ha of mainly scrubland/grassland habitats would be affected, similar to the scale of impact of the PAA. The FSA would affect the rare plant species *Amorphophallus* sp. at Tso Wan.

3.6 Fisheries & Marine Ecology

Preferred Alternative Alignment

The alignment runs along the northeastern coast Lantau Island between Fa Peng and Kwai Shek. Some parts of this stretch of coastline have been affected through the reclamation for the landing point of the Tsing Ma bridge. The remaining areas are natural coastline. This coastline consists a mixture of gently sloping boulder shores interspersed sandy shores at Fa Peng, Tso Wan and Kwai Shek. Preliminary field surveys indicate that the shores support assemblages typical of semi-exposed rocky shores in Hong Kong with notable quantities of chitons and anemones. Approximately 5 ha of coastal habitats would be directly loss. Moderate to low impact from the alignment is considered given the moderate to low habitat quality and common community assemblages of these natural coastal habitats affected. Measures such as provision of seawalls that facilitate the colonisation of assemblages that are similar to those presently existing on the shores would effectively mitigate the impact and insurmountable impact is not expected.

Information indicates that fisheries resources are not abundant in the area. However indirect impacts to fisheries resources may occur at the Ma Wan Fish Culture Zone located on the west side of Ma Wan Island, through perturbations to water quality if controlled. Typical water quality control measures such as silt curtains, checked by water quality monitoring and audit, will ensure meeting the statutory criteria at the Fish Culture Zone.

Feasibility Study Alignment

The FSA consists of inland road and tunnel which avoids all coastal areas of P.A.A. FSA would lead to approximately 1 ha of coastal habitat loss and therefore have lower impacts to fisheries and marine ecological resources.

4.0 INITIAL ASSESSMENTS OF TSING LUNG BRIDGE

4.1 Existing Land Uses

The bridge is founded on an undeveloped headland at Kwai Shek, with the future use designated as greenbelt.

4.2 Noise and Air Quality

Preferred Alternative Alignment

In the current Assignment the air quality assessment will focus on integrating the environmental and engineering design of the tunnel ventilation systems to ensure that both internal and external air quality satisfies the AQO's and guidelines. In connection with the implementation of the Tsing Lung Bridge specific attention will be given to ensuring the AQO's at Grand Bay Villa and Hong Kong Garden are achieved as these are the closest ASR.

The key elements of the current Assignment will focus on the noise impacts at Grand Bay Villa as this will be the critical sensitive receiver. The impacts predicted at Hong Kong Garden due to the construction works for the bridge will nonetheless be reviewed and any mitigation measures will be defined. Severe impacts are expected at Grand Bay Villa which may be difficult to mitigate except by provision of at least 6mm thick double glazed windows and use of air conditioners. This is a key issue which will be addressed in the EIA process during which detailed modelling will be undertaken to determine the scale of the impact, and thus the extent of mitigation measure required.

Careful consideration will need to be given to the noise mitigation measures required to comply with the standards set. Attention will be focussed on the need for and design of noise mitigation measures on the bridge near Grand Bay Villa especially during construction.

Feasibility Study

In the Feasibility Study the operational air quality impacts were assessed by, inter alia, assessing the effects of pollution loads from the tunnels and the emissions generated on open road. The conclusion drawn was that AQO's would be exceeded unless mitigation measures were applied. The mitigation measures included the use of tunnel ventilation systems which would allow all ASR's to achieve the AQO's. It should be noted that the assumptions upon which the air quality study for the FS was based need to be reviewed in detail to ensure the assumptions are fully understood, particularly with respect to the gradient in tunnels.

In the Feasibility Study it was assumed that there were no sensitive receivers on Lantau Island therefore no assessments were conducted. The construction phase impacts predicted for Hong Kong Garden was 68 dB(A) for the unmitigated scenario. Grand Bay Villa does not appear to have been assessed at on the presumption that this land would be resumed.

In the FS many noise sensitive receivers were identified as being subject to noise levels in excess of the permitted standards. The key element contributing to high noise levels were roads "other than Sham Tseng Link" in the area to the west of Hong Kong Garden. The proposed noise mitigation measures were "inverted L shaped barriers". A 5m high inverted L shaped noise barrier was also proposed for the Tsing Lung Bridge.

4.3 Water Quality

Preferred Alignment Alignment

Assessments for the current Assignment will focus on the potential impacts relating to dredging and placing of fill for the piers. The assessment will consider the potential water sensitive receivers (intakes, marine life, the mariculture zones at Ma Wan and bathing beaches refer to Figure 4.1) and will quantify the potential effects of dredging/filling on water quality. The impacts are expected to be lesser than those predicted in the FS as the areal extent of dredging will be considerably reduced and the location of the reclamation is in shallower water (therefore outwith the main tidal stream) than previously assumed.

As part of the current Assignment an assessment has been made to quantify the changes in cross sectional water area over the length of the Tsing Lung Bridge. A sketch Figure 4.2 has been prepared which illustrates the relative changes in the cross sectional area and which includes both the FS and the current alignments.

The changes in cross sectional area under the FS scheme (shown on Figure 4.1) was calculated to be 3.5% while the revised alignment of the current Assignment is less than 1.5%.

Feasibility Study

Marine water quality impacts were assessed in the FS and the conclusion drawn that with the adoption of good site management and construction practices the impacts would be within acceptable limits. In the FS it was stated that "water quality impacts during operation will be within acceptable levels". It was also recommended that "obstruction of the bridge pier to tidal flows can be compensated by local over dredging during construction and the extent of over dredging required will be examined in the next stage of the EIA to be undertaken in the preliminary design".

4.4 Fisheries and Marine Ecology

Preferred Alternative Alignment

The PAA will have to remove the natural embayment which will be infilled to provide a foundation for the northern bridge pier. Initial examination of the natural embayment area comprising boulder/sandy shore habitats suggests that they are typical of such semi-exposed coastal habitats in Hong Kong. The loss of subtidal habitat is not considered a key issue due to the low ecological value of the subtidal assemblages expected from previous relevant studies. Direct loss of the coastal habitats, approximately 3 ha, would be effectively mitigated by appropriate seawall design to facilitate colonisation of similar assemblages affected.

There may be impacts to Chinese White Dolphin that utilise the North Lantau waters, through disturbance due to increased marine traffic and underwater noise from construction works, or disruption to food supply as fisheries resources may be impacted by perturbations to water quality. Effective mitigation measures such as use of bubble curtains to control construction noise, temporary cessation of work when the dolphin is observed near the construction site, and water quality control measures will ensure no unacceptable residual impact to the dolphin.

Feasibility Study Alignment

The FSA had potential for affecting over 0.5 ha of marine water habitats but due to the fact that the caisson and ship protection was in the main stream no coastal habitats would be affected.

5.0 INITIAL ASSESSMENT OF TSING LUNG TAU

5.1 Existing Land Uses

The major land uses in Tsing Lung Tau are 'Residential (R)', 'Village Type Development (V)' and 'Green Belt (GB)' as stipulated on the approved Tsuen Wan West Outline Zoning Plan No. S/TWW/7. The existing land uses may be affected by the Route 10 include residential developments (Grand Bay Villa), roads and Green Belt areas. The OZP Plan No. S/TWW/7 (illustrated in Figure 5.1) has designated the areas as residential (Group C), greenbelt and "undetermined" at the portal of the tunnel.

5.2 Noise and Air Quality

Preferred Alternative Alignment

In the Tsing Lung Tau area, a number of sensitive receivers such as Grand Bay Villa, Dragon View and Hong Kong Garden would potentially be affected by the road traffic noise and vehicle exhaust emissions from Route 10 as well as the surrounding road network. The locations of potentially sensitive receivers and the horizontal distances from the FSA and PAA are shown in Table 5.1 and Figure 5.2.

Table 5.1 NSRs and ASRs Near Tsing Lung Tau

Receivers	Name	Distance from FSA (m)	Distance from PAA (m)
3	Hong Kong Garden	235	250
4	Grand Bay Villa	0	15
6	Dragon View	180	130
7	Squatter Area at NW of Hong Kong Garden	60	60

It is expected that due to the increase of separation distance between the alignment and Hong Kong Garden, the noise and air quality impact at this sensitive receiver would be slightly less than the FSA option.

The elevation of the PAA is approximately 30m higher than Grand Bay Villa and Dragon View which suggests that these low rise houses will fall within the noise shadow zone of the alignment itself, and will receive lower noise impact.

The construction of anchorages and work sites for the Tsing Lung Bridge will require a smaller area for PAA, therefore the dust impact at the ASRs in Tsing Lung Tau such as Grand Bay Villa and Hong Kong Garden will be smaller with lower dust emission from the site.

Feasibility Study

The Feasibility Study Report indicated that NO₂ levels at the ASRs in Tsing Lung Tau would reach 285 µg m⁻³ at some ASRs. Emission limits for the Tai Lam Chung tunnels has been proposed in the Feasibility Study Report. It is expected portal emission limits will be similar for the PAA and FSA.

The Feasibility Study Report also indicates that noise levels at these receivers would reach 80 dB(A) and a 320 m inverted - L barrier (5 m high) is required for the for the FSA.

5.3 Water Quality

Water quality issues have been discussed under Section 4.3.

6.0 INITIAL ASSESSMENT OF TAI LAM CHUNG TO SO KWUN WAT

6.1 Existing Land Uses

Existing land uses include country park, village housing, burial grounds and water gathering grounds. The land is zoned as village, Government and institutional and greenbelt as illustrated in Figure 6.1 (OZP Plan No. S/TM-SKW/1).

6.2 Noise and Air Quality

Preferred Alternative Alignment

In Siu Lam, a number of sensitive receivers such as Correctional Institution, Clinic, Tai Lam Chung Tsuen, village houses, Psychiatric Centre, CSD Staff Quarters and Home for the Aged would potentially be affected by the road traffic noise and vehicle emission from Route 10 and the surrounding road networks. The locations of the sensitive receivers and the horizontal distances from the FSA are shown in Table 6.1 Figures 6.2 and 6.3.

Table 6.1 NSRs and ASRs near Siu Lam

Receivers	Name	Horizontal Distance (m)
8	Correctional Institution (Staff Quaters)	130
9	Clinic	70
10	Tai Lam Chung Tsuen	110
11	Scattered Development at West of Tai Lam Chung Road	220
12	CDA zone to the South of Tai Lam Chung Viaduct	290
13	"V" zone to the south of Tai Lam Chung Viaduct	130
14	Psychiatric	360
15	CSD Staff Quarters at Hong Fai Road	180
16	Village Houses at Siu Lam	250
17	Home for the Aged at Siu Lam	180

As the PAA will emerge at a higher elevation than the FSA, dispersion will be enhanced and the air quality at the lower level receivers ASRs at Tai Lam should improve.

After emerging from the Tai Lam Chung tunnel, the PAA will run on a viaduct emerged at a higher elevation when compared to the FSA before entering an open cut section along Siu Lam. NSRs and ASRs as identified above will potentially be affected by the open section of the alignment.

As the PAA runs on a higher elevation and open structure, air quality of the area will improve with better dispersion of pollutants at this higher elevation. In addition, the local area near Siu Lam will improve without the emissions from the Siu Lam Tunnel portal.

Although this section of the alignment is opened, the increase of elevation could potentially increase the noise shadow zone of the alignment structure itself and the low level villages houses in Siu Lam would be protected. It is envisaged that with the use of mitigation measures such as 5m vertical barrier or inverted "L" barrier, the noise impacts at the NSRs that are located at a similar elevation could be mitigated to acceptable levels.

Village houses in So Kwun Wat Sun Tsuen could be affected by the PAA. The FSA and PAA are similar in this section except that the PAA is on a higher elevation. It is expected that the air quality of the area will be improved with better dispersion of pollutants at higher elevation. Also, it is expected the increase of elevation could potentially increase the noise shadow zone of the alignment and hence providing a general improvement to the extent of noise impacts at the nearby receivers.

In addition, the slant distance between the elevated PAA and NSRs will be increased, which would further improve the noise impacts at the nearby NSRs. It is likely the height of the noise barriers could be reduced for PAA.

Feasibility Study

The Feasibility Study Report has identified that the NO₂ impact at Tai Lam Chung Chuen would reach 273 µgm³. Appropriate air ventilation system has been proposed for the FSA to satisfied the tunnel air quality requirements and the AQO at the ASRs.

The FSA will be tunnelled in the Siu Lam area and thus the noise impact will be minimized. However, the air sensitive receivers located in the vicinity of the tunnel portal could be affected by the portal emissions.

6.3 Water Quality

Water quality impacts associated with this section will be minor and confined to the traversing of streams and other minor water courses. All necessary measures will be taken for the diversions and subsequent re-instatement of the water courses during the detailed design and construction phases.

6.4 Terrestrial Ecology

Preferred Alternative Alignment

The Route 10 alignment will mainly go through habitats of grassy or scrubby in nature, based on preliminary field surveys undertaken. They include grassland-scrubland mosaic, and scrublands in various heights. The plant species found in the scrubland habitats are dominated by the shrub *Rhodomyrtus tomentosa* and *Backea rutescens*, as well as herbaceous plant *Arundinaria cantonii*, *Gahnia tristis*. The heights of the scrubland is generally taller in low altitude and around village areas.

Most of the species recorded in this section are well-representative and typical to such habitat types elsewhere in Hong Kong. Three plant species of conservation interest were recorded in the scrubland areas in the Tai Lam Section, including *Lespedeza cuneata* (*L. Juncea* var. *Sericea*), *Nepenthes mirabilis* and *Enkianthus quinqueflorus* (locations see Figures 6.4 & 6.5). The first species is rare in Hong Kong and usually found on small islands; whereas the latter two are all protected in Hong Kong with a restricted distribution.

No animal wildlife of ecological importance were observed during the field visits. Common bird species were recorded such as Red-whiskered Bulbul, Common Tailorbird and Great Tit.

For the purpose of alignment options evaluation, only the primary impact due to direct landtake and therefore habitat loss is assessed, estimated to be under 10 ha in relation to the Preferred Alternative Alignment.

Taking reference from the EIAO TM impact assessment criteria, the potential ecological impact is considered moderate mainly because although the habitat quality is low and species present are mostly common in Hong Kong, there are three rare or protected plant species that would be directly affected.

Where possible the three plant species should be avoided such as by reducing the cut slope area. Mitigation measures in the form of transplanting affected individuals where necessary are recommended as a last resort. No insurmountable ecological impact is expected from the Preferred Alternative Alignment.

Feasibility Study Alignment

The loss of scrubland/grassland impact in relation to the FSA is similar in nature to the PAA, but the scale of the impact will be smaller as the Siu Lam section will be tunnelled. Estimated habitat loss is just over 4 ha.

6.5 Risk

Preferred Alternative Alignment

The proposed alignment passes within the Consultation Zone of Tai Lam Chung Pre-Chlorination House (PCH) which is a Potentially Hazardous Installation (PHI) on account of storing and using liquid chlorine in 1 tonne drums. At its closest point of approach, the alignment lies approximately 500m from the PCH.

The PAA involves an additional 400 meters of open road within the Consultation Zone of the WTW. Whilst this will increase the risk to road users, it is not anticipated to invalidate the findings of the earlier hazard assessment study identified in the Feasibility Study Report.

Feasibility Study

The risks arising from the presence of the PCH were acceptable for the alignment, as identified in the *Feasibility Study Report*. Both options are likely to be acceptable with respect to the Government Risk Guidelines.

7.0 CONCLUSIONS

Table 7.1 summarises the environmental implications of each alignment:

Table 7.1 Environmental Implications of the Alignments

	Alternative Alignments	Feasibility Study Alignment
Noise	<p>North Lantau Noise levels up to 80 dB(A) is expected at the receivers. The village houses are low rise and it is likely that a noise barrier of 5 m would be required to protect the villagers. In Alignment C would be best from noise perspective as the toll plaza is furthest from the sensitive receivers.</p> <p>Tsing Lung Tau Bridge Vehicles using bridge will cause noise impacts at sensitive receivers including Grand Bay Villa and Hong Kong Garden. A noise barrier may be required.</p> <p>Tai Lam Chung to So Kwun Wat Higher elevation of alignment improves noise shadow zone and initial modelling has shown that noise barriers may not be required for NSRs that are located below the alignment.</p>	<p>On Lantau Island, the villages at Fa Peng and Tso Wan were resumed and no sensitive receivers were identified. Thus no noise impact assessments were conducted.</p> <p>Noise barrier proposed inverted L, 5m high</p> <p>Noise problems as alignment is lower and barriers proposed.</p>
Air Quality	<p>North Lantau Air sensitive receivers are located more than 100m from the alignment which should provide sufficient setback. In general, none of the three alternatives are expected to create adverse air quality impacts at the ASRs.</p> <p>Tsing Lung Tau Air quality issues being considered in detail, improvements made especially with respect to lower gradients of road in tunnel. Detailed modelling still to be undertaken.</p>	<p>The villages of Fa Peng and Tso Wan were to be resumed and no sensitive receivers were identified. The adverse air quality impacts on the ASRs, therefore, were not expected.</p> <p>AQO's expected to be exceeded due to vehicle flow, mix and tunnel gradients.</p>

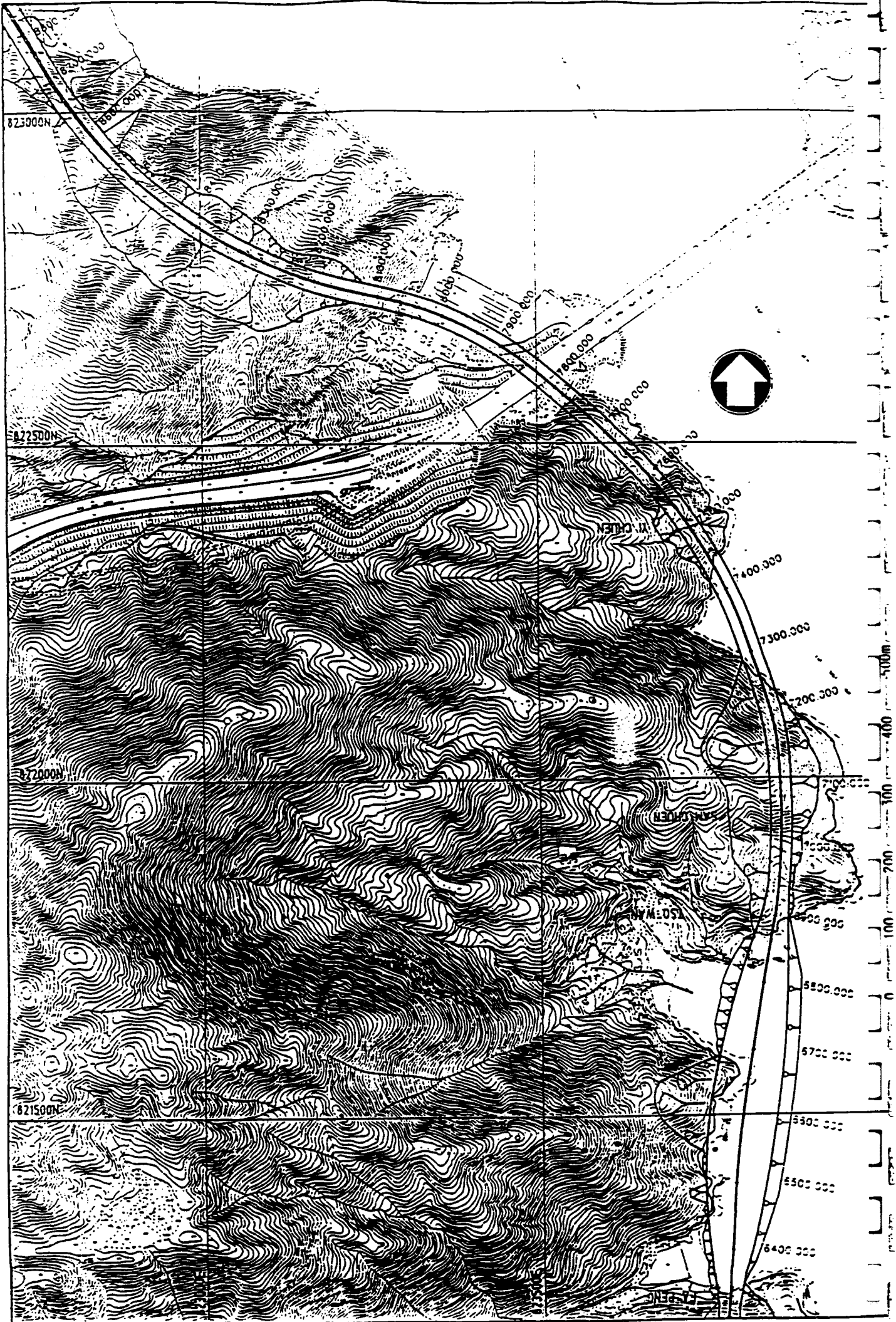
	Alternative Alignments	Feasibility Study Alignment
Air Quality (Cont'd)	Tai Lam Chung to So Kwun Wat Alignment on higher elevation than FS which was in the valley and better dispersion of pollution expected (to be confirmed in the ELA)	
Water Quality	<p>North Lantau</p> <p>Provision of a route through Tso Wan would affect the villagers but, unlike the FS proposal where the route was at +40mPD, the alternative at +10mPD would allow the way of life within the village to be preserved. An underpass could be provided, until port construction takes place, to give local access. It has been noted, through site visits, that a new jetty is currently being constructed at the eastern headland of the bay. This could be relocated depending on the design of the road linkage.</p> <p>Water quality impacts associated with the construction phase would be relatively similar for all three alignments. Once operational the far field effects would be very similar. Impacts on small local stream courses are anticipated.</p>	No assessments were undertaken but it may be surmised that minimal water quality impact expected as the extent of infill in the Fa Peng bay is relatively small. Impacts on small local stream courses are possible.
	<p>Tsing Lung Bridge</p> <p>Land formation required to found northern pier of Tsing Lung Bridge. Impacts expects to be able to mitigated to acceptable levels. Reduction in cross sectional area of marine water <1.5%. Detailed assessments to be carried out.</p>	Assessments undertaken considered water quality impacts were acceptable. Reduction in cross sectional area of marine water 3.5%.

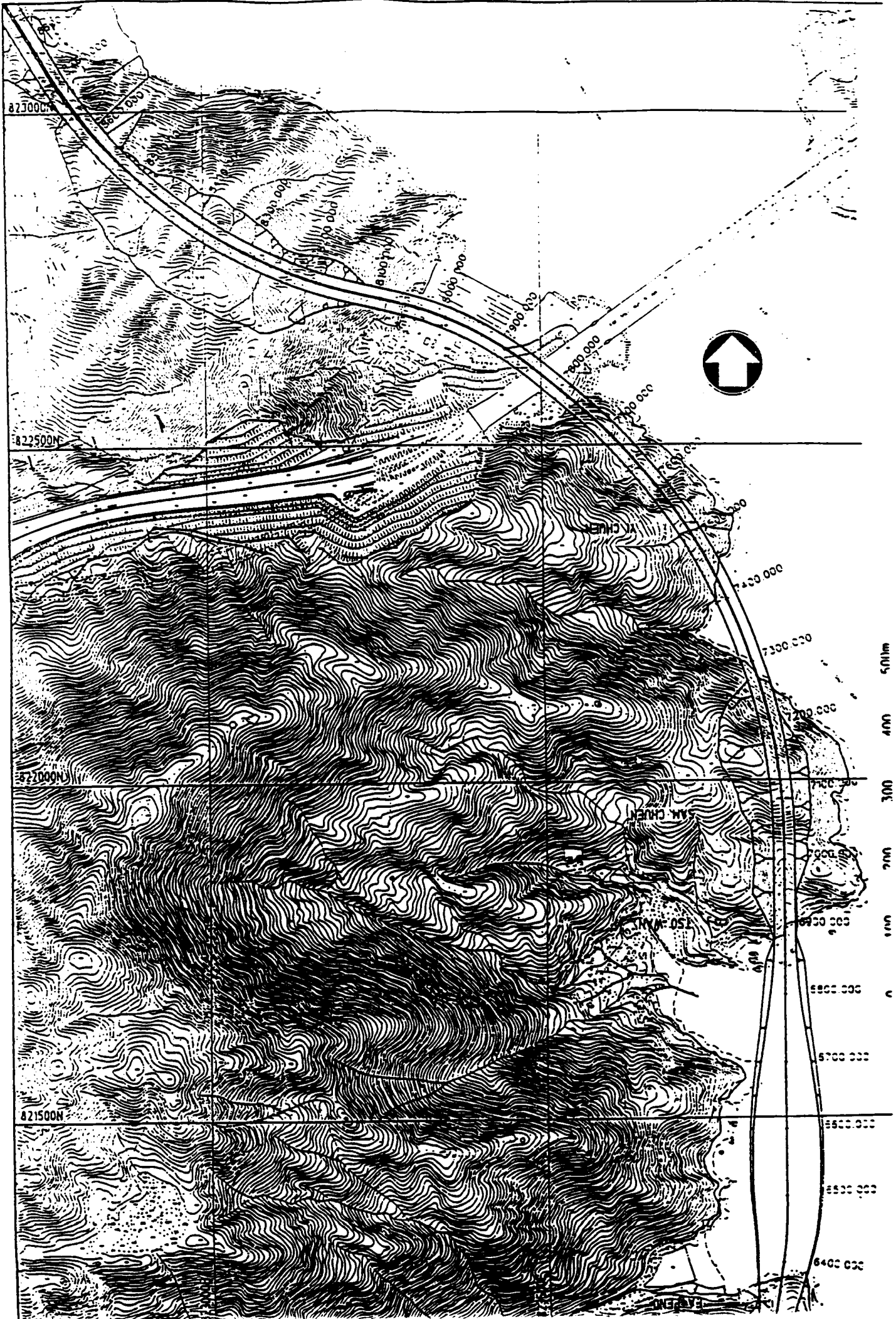
	Alternative Alignments	Feasibility Study Alignment
<p>Ecology</p>	<p>North Lantau</p> <p>The terrestrial habitats along the alternative alignments are mainly shrub. A range of coastal habitat and small patches of lowland woodland have been identified along the coast, this habitat and woodland may be lost with the implementation of the project. Most of the species identified are common, widespread, and typical to the habitat type where they were recorded. However, five rare species of conservation interest, namely <i>Vitis balansaeana</i>,</p> <p><i>Fimbristylis complanata</i>, <i>Diplarcum caricinum</i>, <i>Phymatodes scolopendria</i> and <i>Amorphophallus sp</i> have been identified along the alignment. The former two are new records to Hong Kong and not listed in the Hong Kong checklist.</p> <p>Transplant of these rare species and woodland replanting would be required to compensate for the habitat loss. There is little difference between the three alternative alignments.</p> <p>Tai Lam Chung to So Kwun Wat</p> <p>Rare or protected plant species identified in this section. All to be confirmed through detailed site inspections.</p>	<p>Several rare or protected plant species were recorded in different habitat types along the whole alignment, particularly the coastal habitat on Lantau Island section. The alignment is tunnelled and the required land take would be minimized. Potential wildlife habitat loss is therefore less than the alternative alignments.</p>
<p>Hazard</p>	<p>Alignment passes through consultation zone of Tai Lam Chung Prechlorination House.</p>	<p>Risks identified as acceptable.</p>
<p>Fisheries</p>	<p>The alignment runs along the northeastern coast Lantau Island between Fa Peng and Kwai Shek. Some parts of this stretch of coastline have been affected through the reclamation for the landing point of the Kap Shui Mun bridge. The remaining areas are natural coastline. This coastline consists of a mixture of gently sloping boulder shores interspersed with sandy shores at Fa Peng, Tso Wan, and Kwai Shek, and Tsing Lung Tau.</p>	<p>Minimal impact on fisheries as the FS alignment infilled only on small part of the Fa Peng Bay.</p>

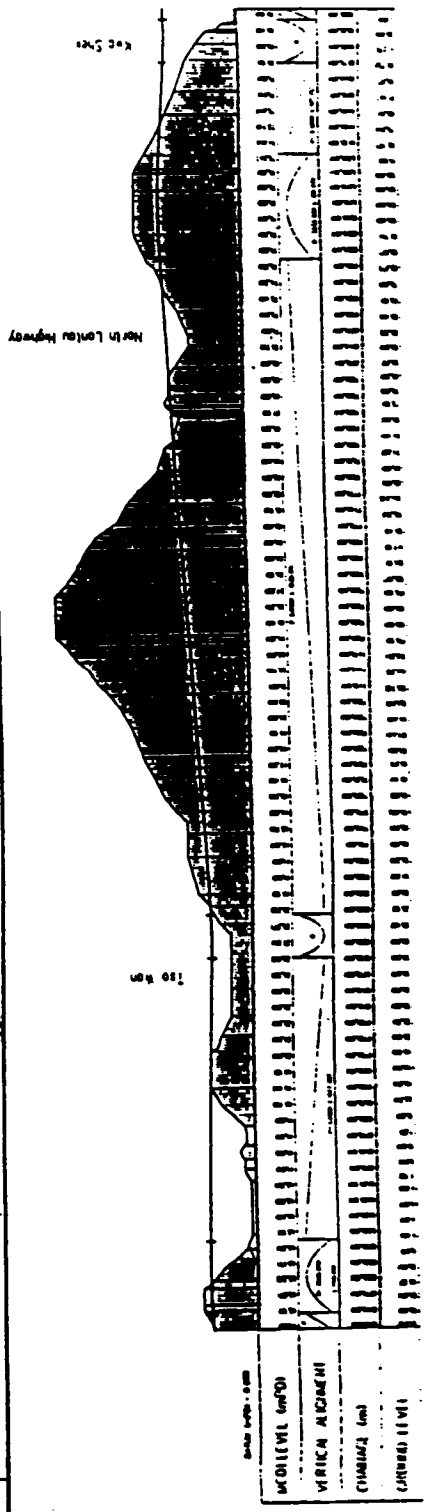
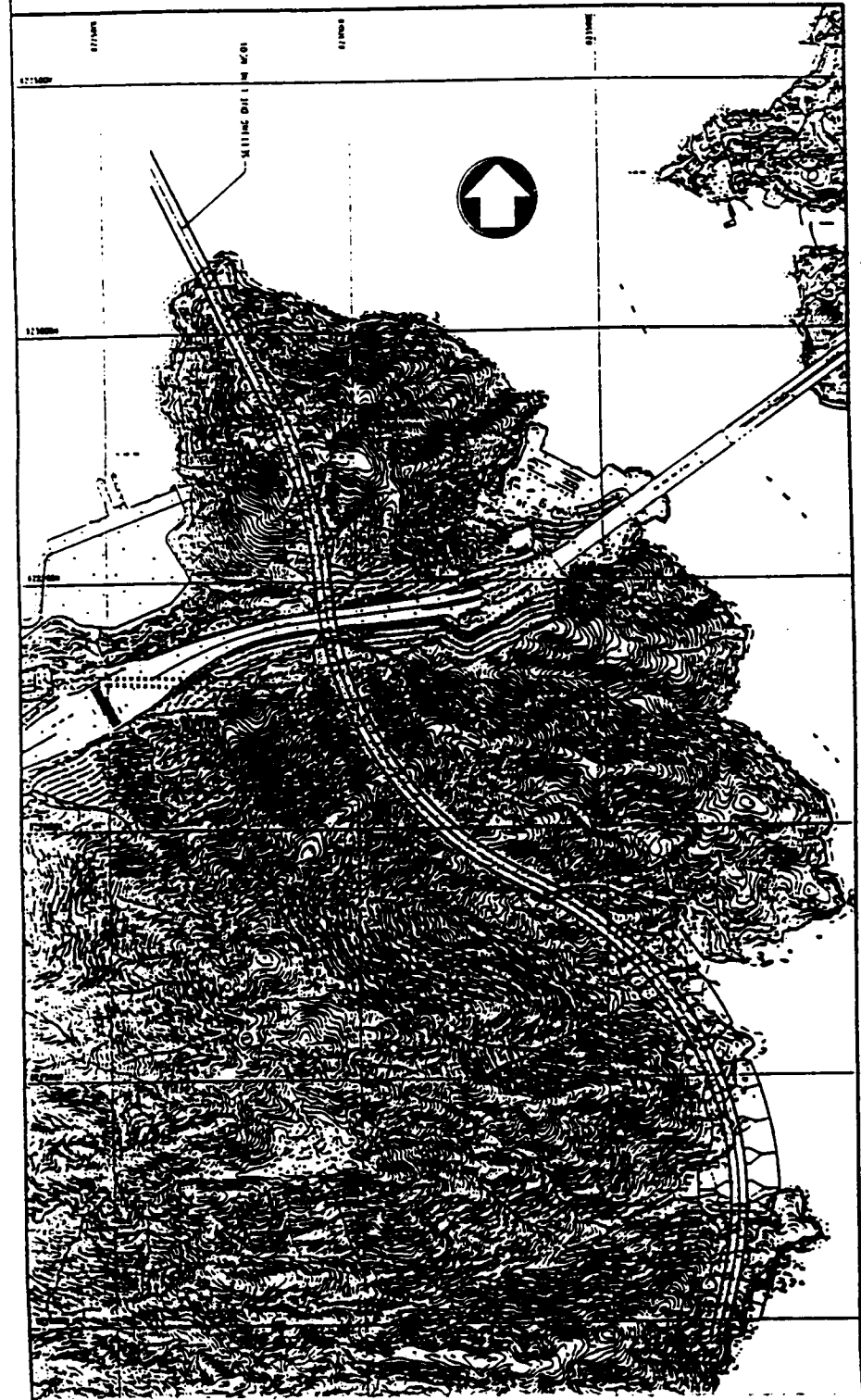
	Alternative Alignments	Feasibility Study Alignment
	<p>The small reclamations would impact the existing coastal habitats of North Lantau. Impacts to fisheries resources are most likely to occur at the Ma Wan Fish Culture Zone located on the west side of Ma Wan Island. Any impacts to culture fisheries are most likely to occur through perturbations to water quality. The impact of the Alternative Alignments A and B are broadly similar except for minor local effects. The impact of the Alternative Alignment C is likely to be more severe.</p>	

The conclusions which have been drawn are:

- The FSA is the most environmentally acceptable in terms of ecology, hazard and fisheries.
- The air quality impacts of the two options are deemed to be relatively similar although this needs to be confirmed through detailed assessment.
- Improvements have been made in the PAA with respect to noise (at Tsing Lung Tau and Tai Lam Chung to So Kwun Wat) and water quality (at Tsing Lung Tau).
- Based on preliminary findings and survey data, it may be surmised that neither option will cause insurmountable impacts to the environment and could be controlled within acceptable limits.







ROUTE 10 VERTICAL PROFILE

Figure 3-4 Feasibility Study Alignment - Lantau

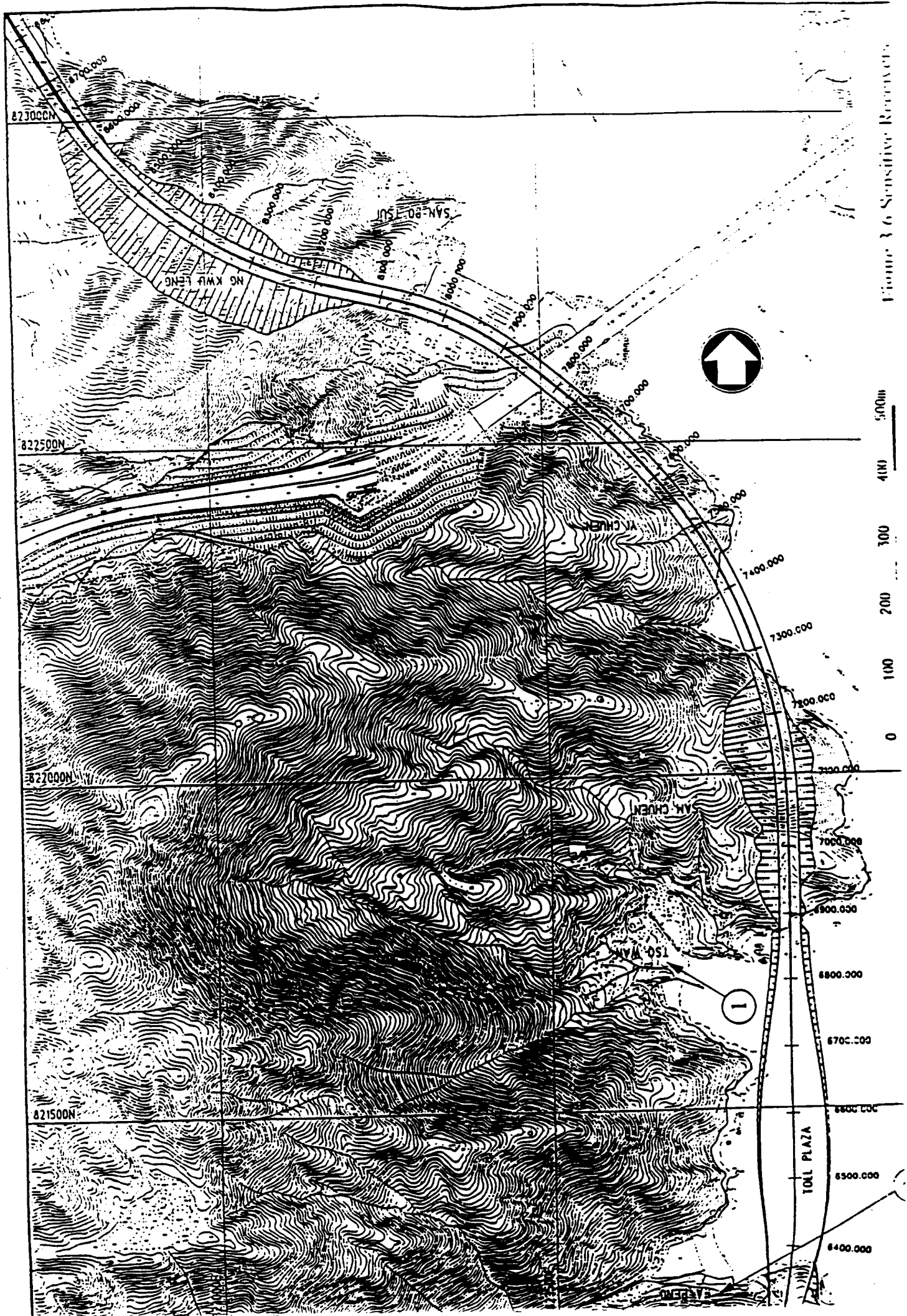


Figure 3-6 Sensitive Receptors

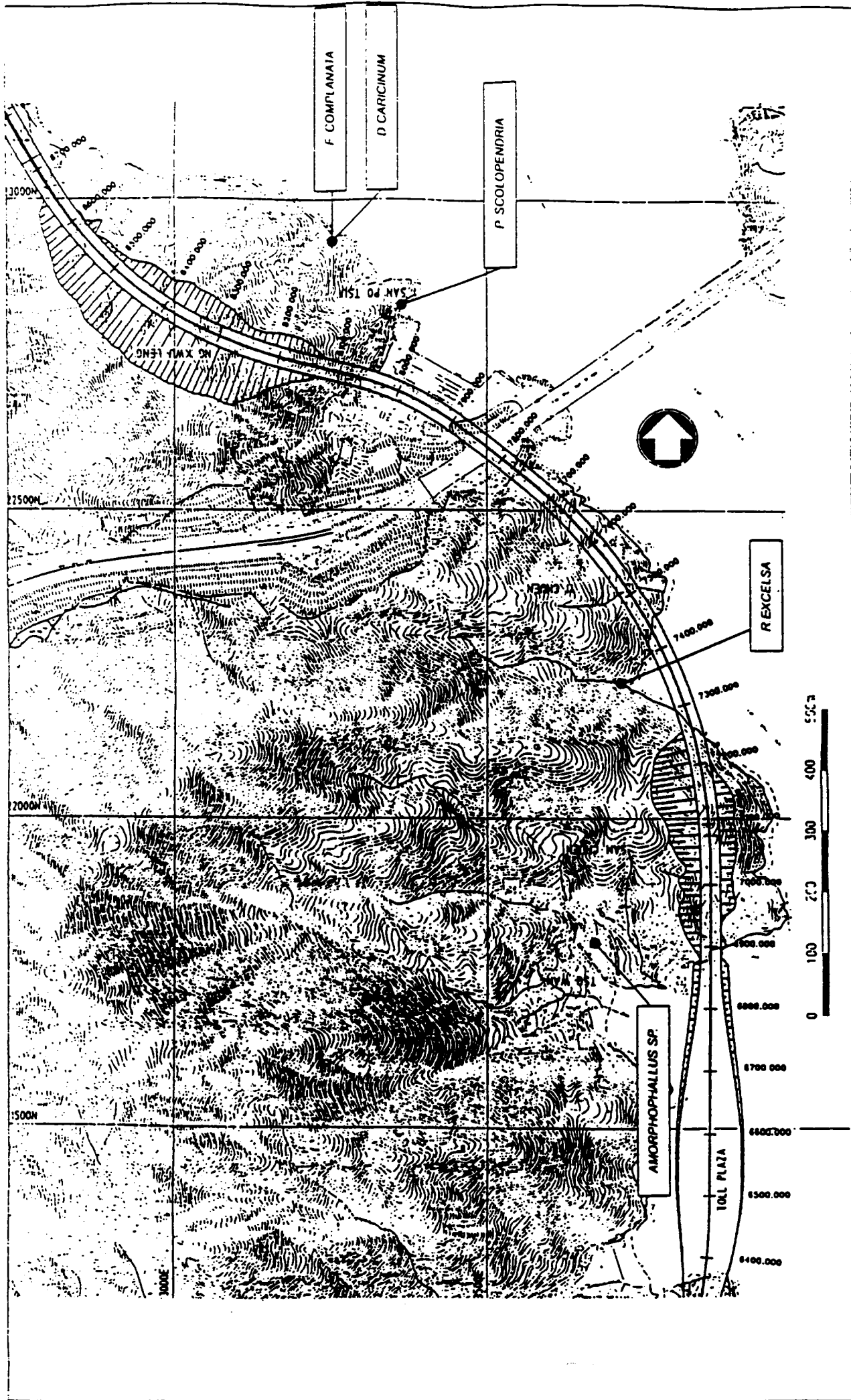
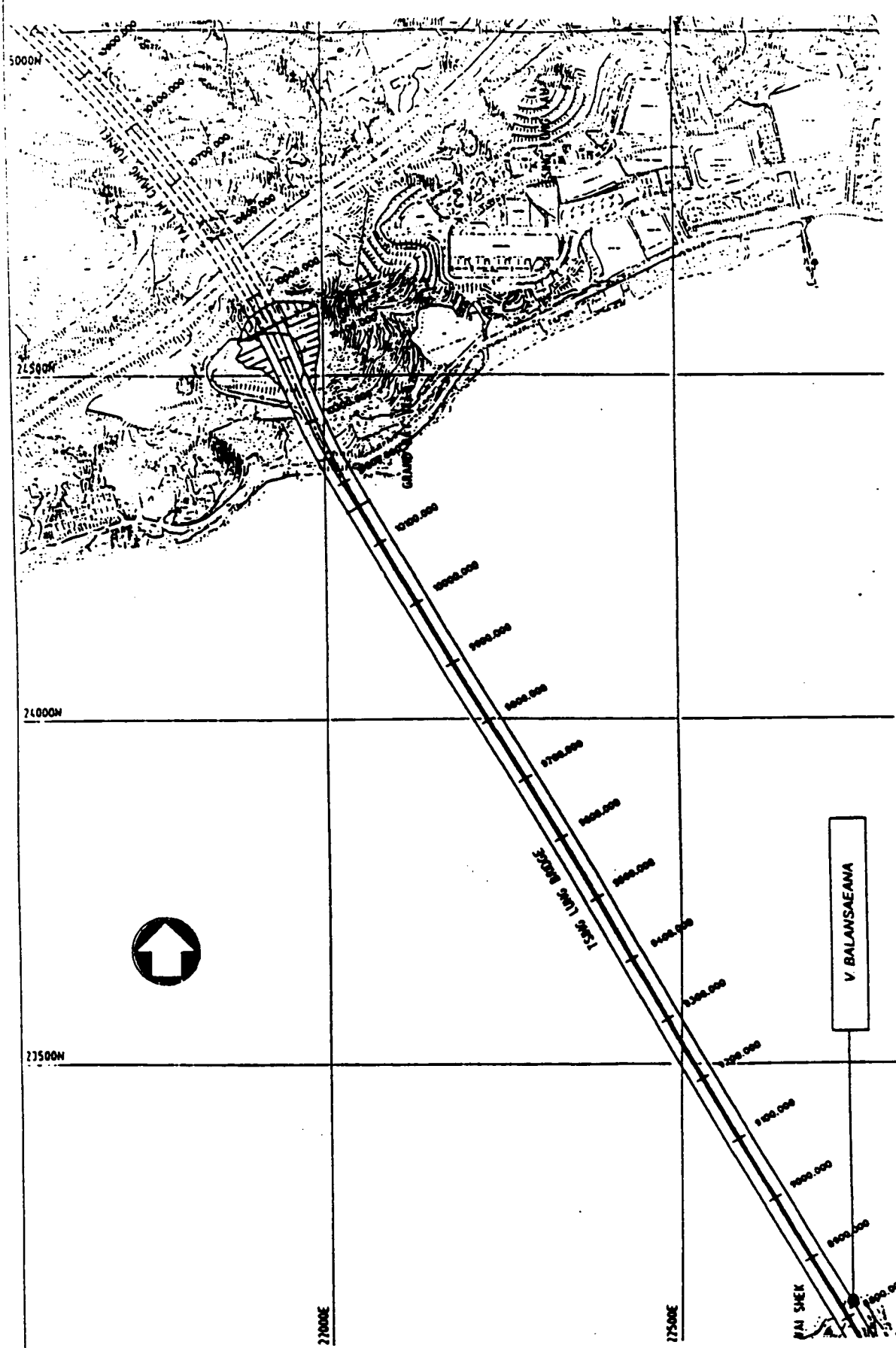


FIGURE 3.7

LOCATION OF LOCALLY RESTRICTED OR RARE PLANT SPECIES IDENTIFIED



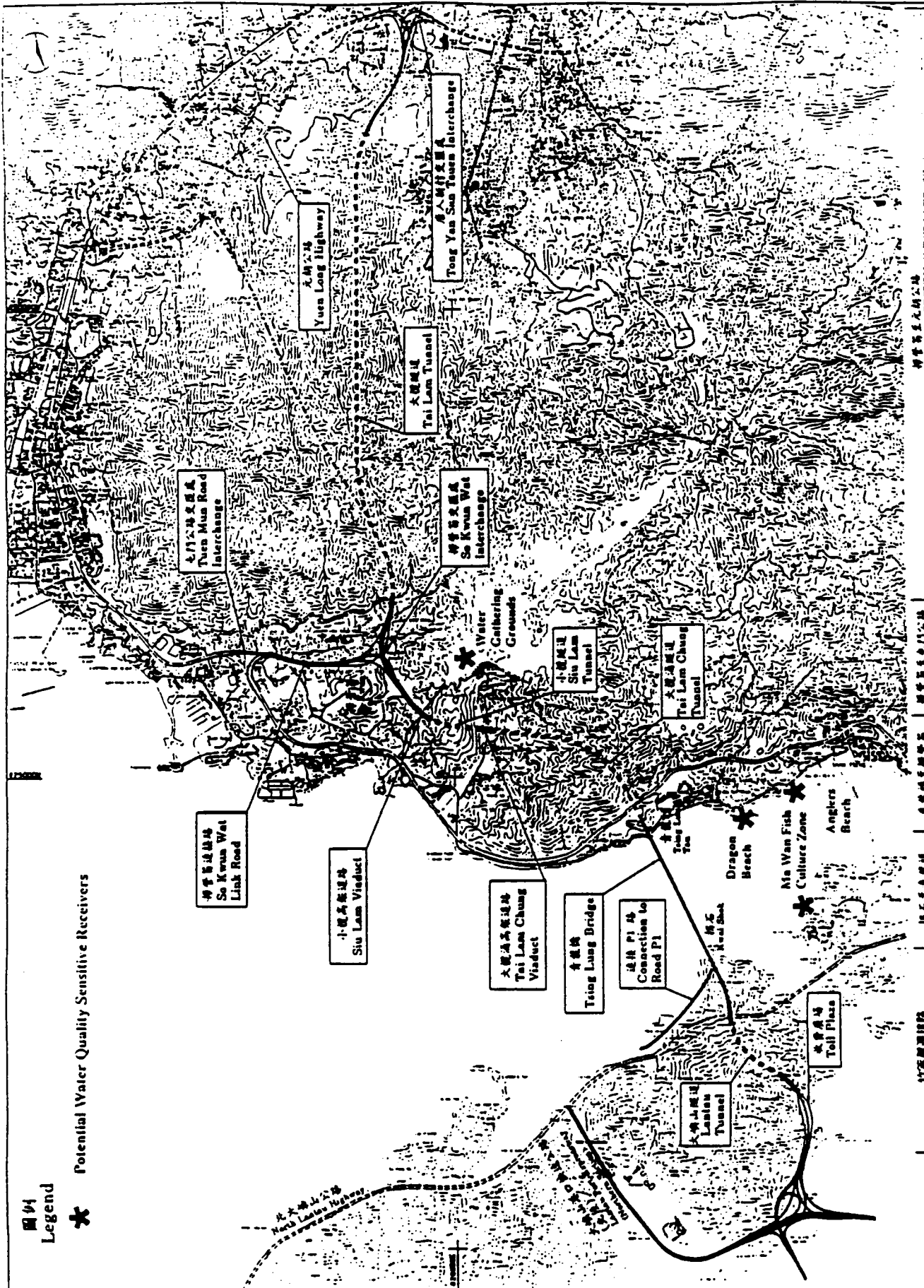


LOCATION OF LOCALLY RESTRICTED OR RARE PLANT SPECIES IDENTIFIED

FIGURE 3.8

圖例
Legend

★ Potential Water Quality Sensitive Receivers



神學至元朗公路
So Kwun Wat to Yuen Long Highway

神學至元朗公路
So Kwun Wat to Yuen Long Highway

竹篙灣道路
Chok Ke Wan Link Road

神學至元朗公路
So Kwun Wat to Yuen Long Highway

神學至元朗公路
So Kwun Wat to Yuen Long Highway

神學至元朗公路
So Kwun Wat to Yuen Long Highway

神學至元朗公路
So Kwun Wat to Yuen Long Highway

神學至元朗公路
So Kwun Wat to Yuen Long Highway

神學至元朗公路
So Kwun Wat to Yuen Long Highway

TSING LUNG TAU
TOWER
(PROPOSED)

+5.0mPD

-20.0mPD

2.5

PREFERRED ALTERNATIVE ALIGNMENT

SEABED

TSING LUNG TAU
TOWER
(FEASIBILITY STUDY)

SHP IMPACT
CAISSON

TOWER CAISSON

SHP IMPACT
CAISSON

+5.0mPD

-20.0mPD

FEASIBILITY STUDY ALIGNMENT

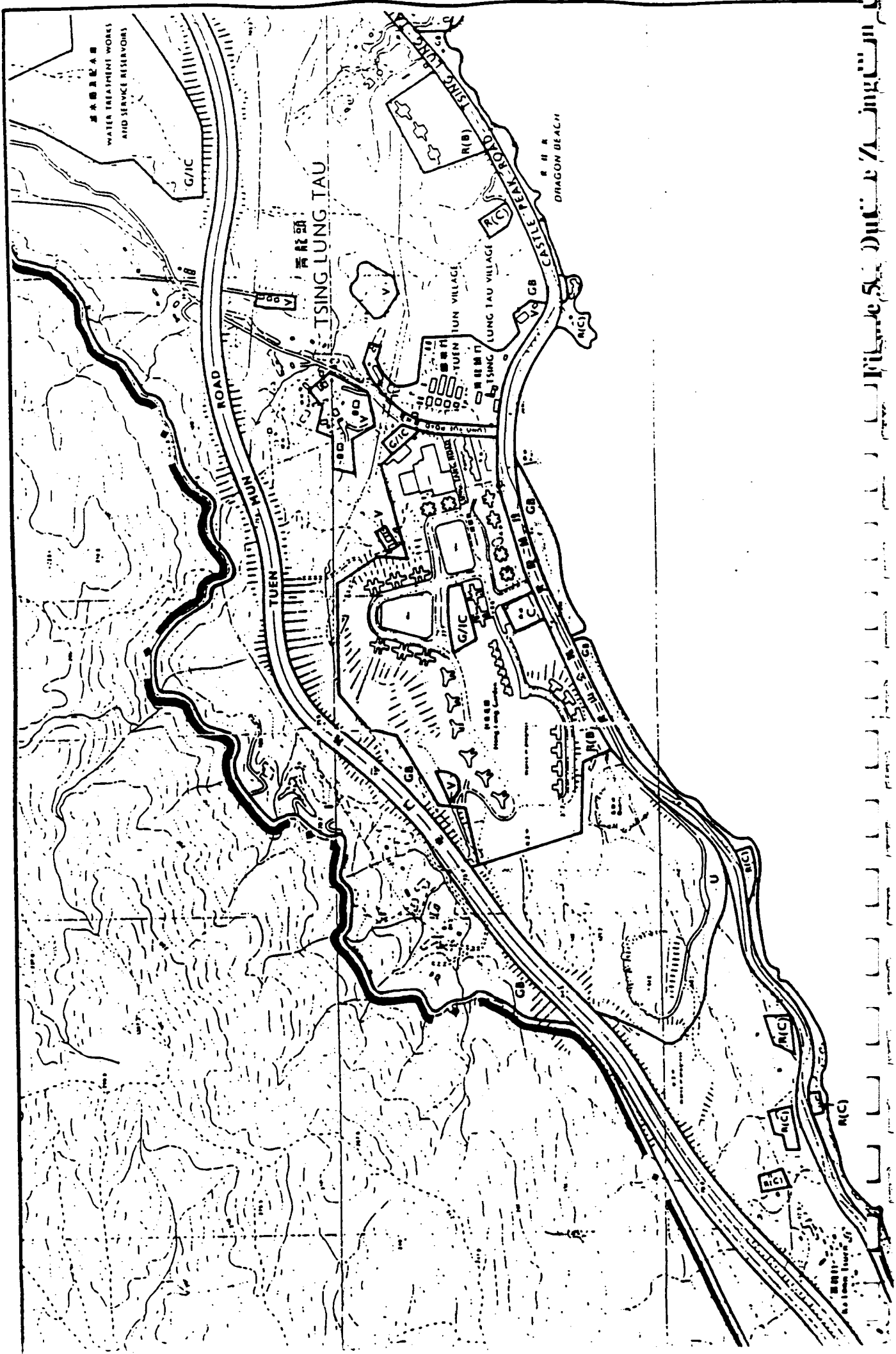
SEABED

0

50

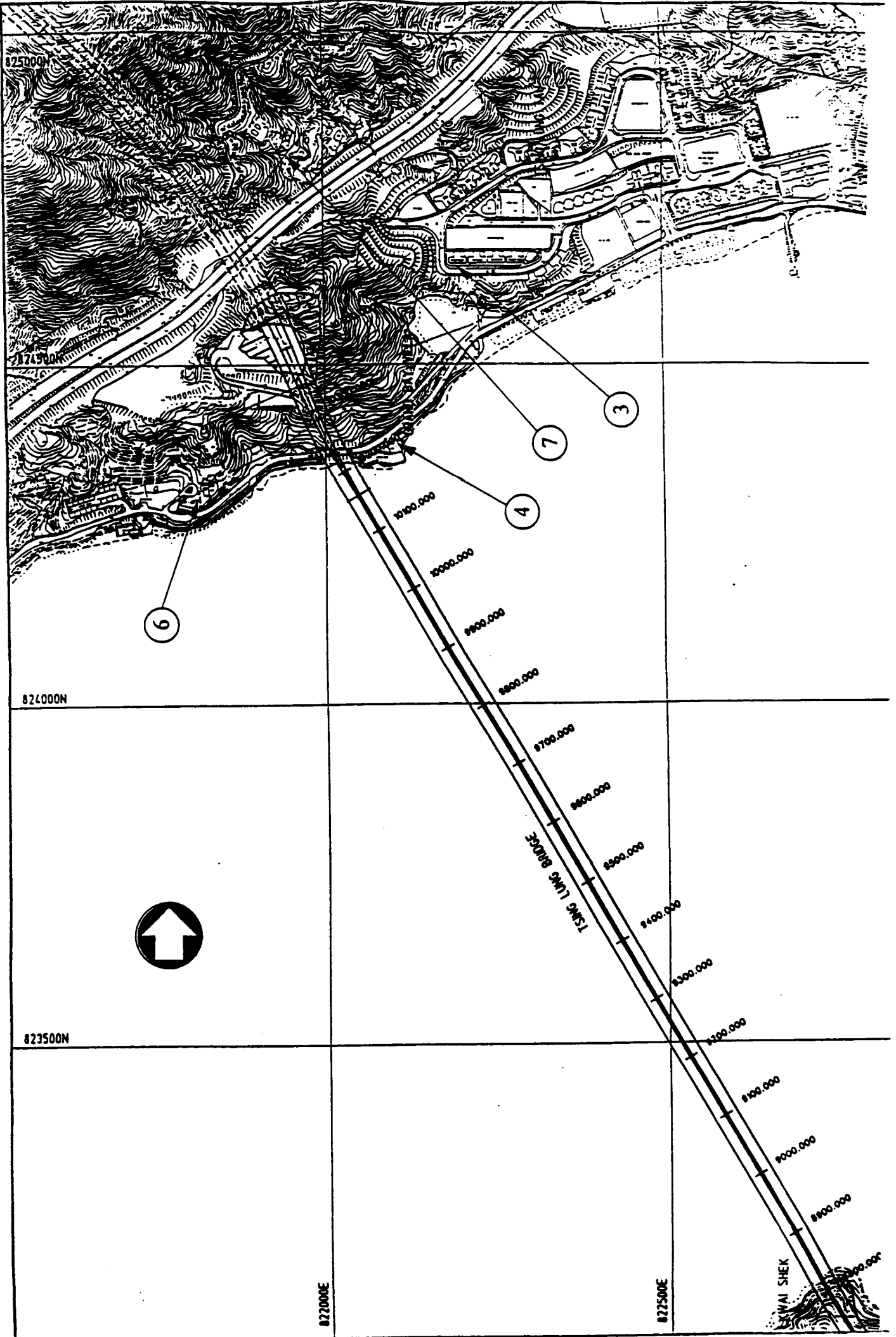
100m

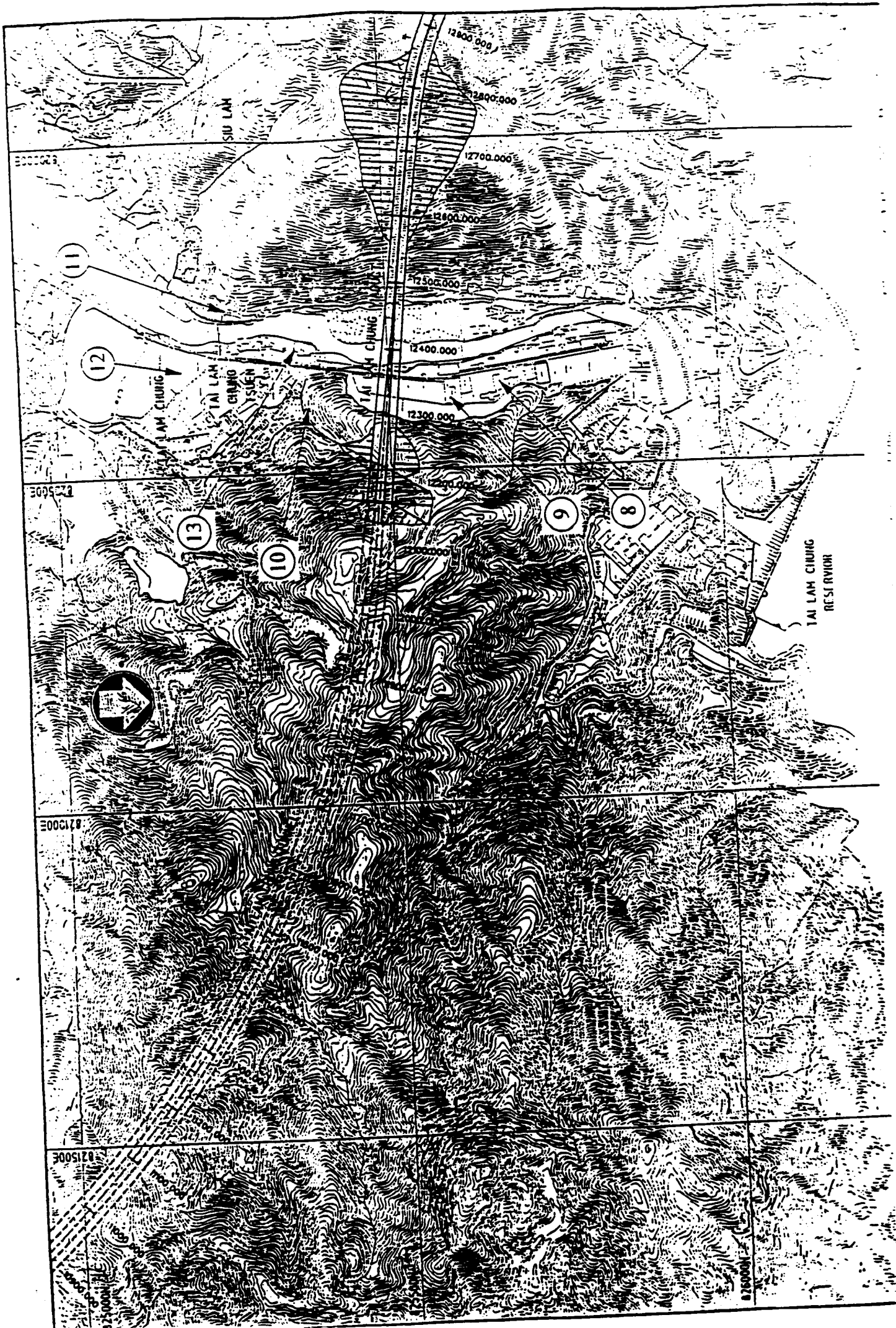
Figure 4.2A Tsing Lung Bridge - Cross Section of Ma Wan Channel



Ising Lung Tau

Scale 1:50,000





870000N



SO KWUH
WAI CHUOH

8265000E

14500.000

14400.000

PAK SIEK HING

8260000E

8255000E

TAI LAN CHUNG
RESERVOIR

14700.000

17

15

16

1

14



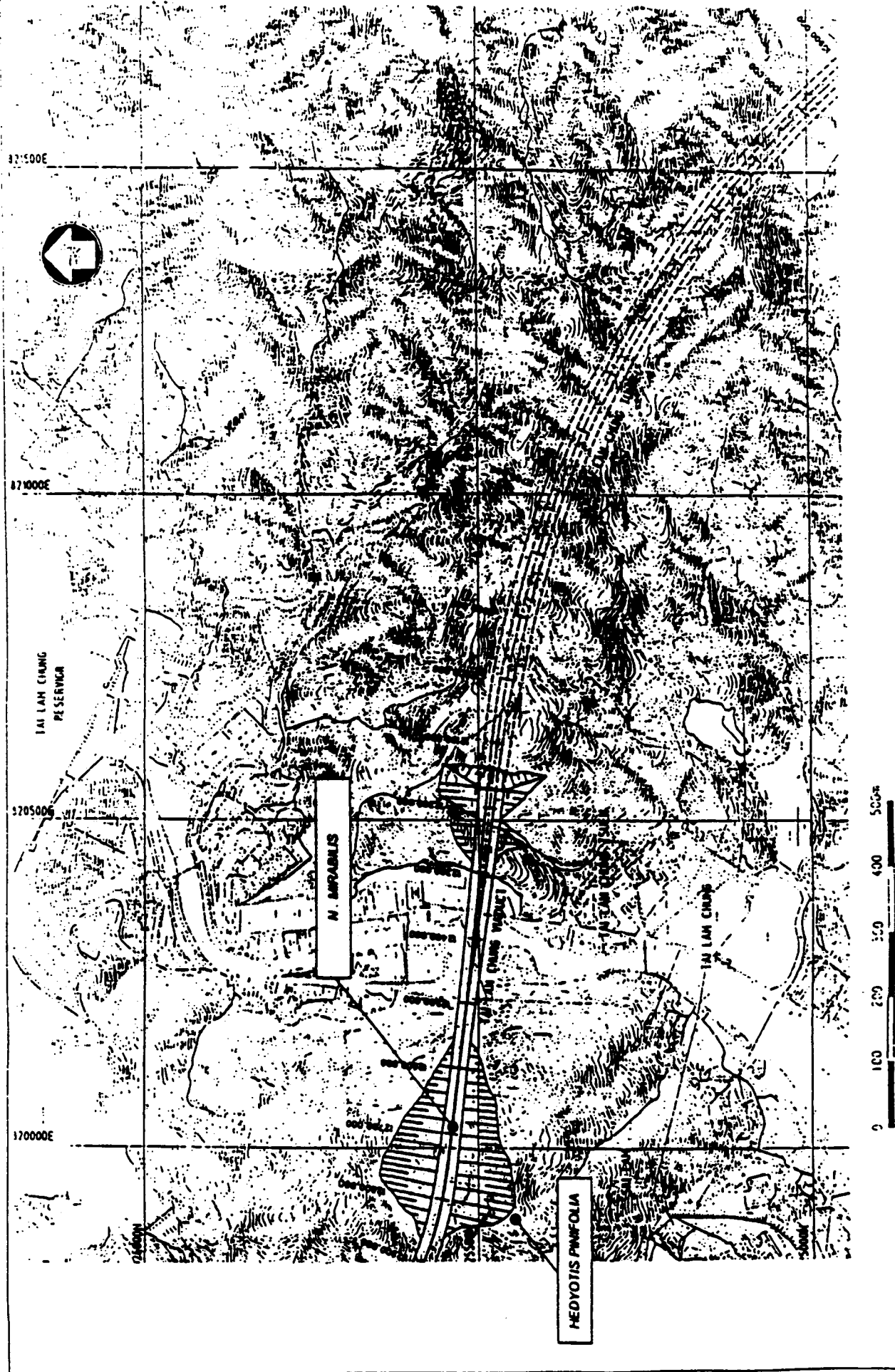


FIGURE 6.4 LOCATION OF LOCALLY RESTRICTED OR RARE PLANT SPECIES IDENTIFIED

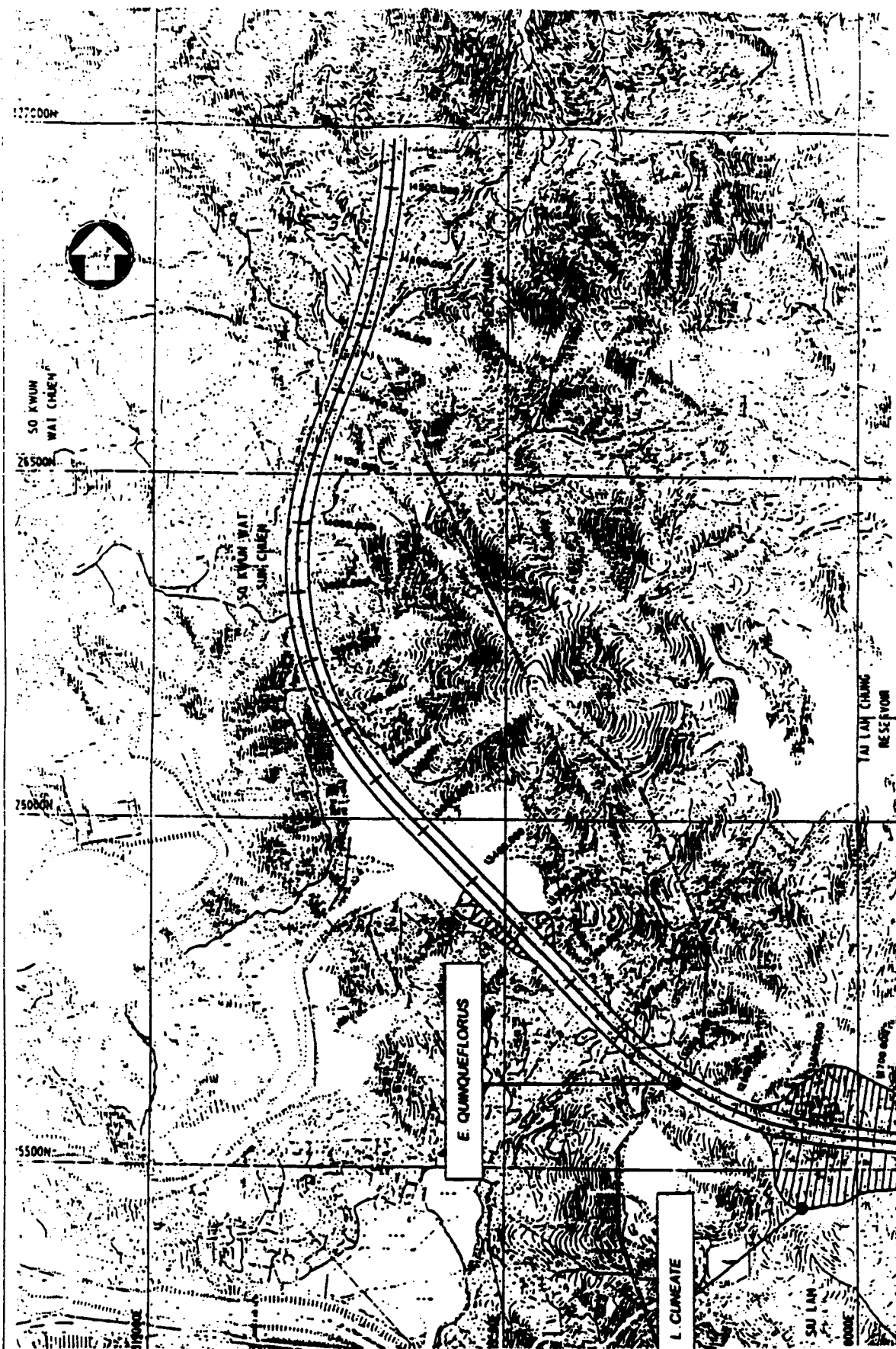


FIGURE 6.5 LOCATION OF LOCALLY RESTRICTED OR RARE PLANT SPECIES IDENTIFIED