and 10.0 percent of time costs. Section (4) expresses time costs and taxes on time in terms of vehicle-hour costs. The weighted average taxes (including passenger and vehicle taxes) show the tax on time costs of heavy trucks at 8.0 percent of truck time costs; 3.58 percent of bus time costs; 27.3 percent of auto time costs; 5.50 percent of taxi time costs; and 8.4 percent of light truck time costs. The time costs of private auto operation related only to the time value of passenger-owner as no auto vehicle time costs were considered in estimating user savings. Having a relatively high income, the typical automobile owner was assumed to bear a relatively high tax.

The basis for determining the tax-less savings of vehicle operating costs is summarized in Table VIII-42. The tax deducted per kilometer of distance savings has been restated as combined total distance costs times the tax rate. Similarly, total time costs per vehicle-hour were multiplied by the applicable tax per vehicle-hour to obtain the tax amount per vehicle-hour. This was then deducted from total time savings. The method of applying these tax calculations is shown in a footnote of the table. The resulting rates for time cost taxes were: sedan (taxi and auto), 15.7 percent; heavy truck, 8.0 percent; light truck, 8.4 percent; and bus, 3.58 percent.

Tax-less savings were computed from the User Savings Tables for each road section according to the following method: the tax amounts on distance and on time savings were multiplied by the 1990 totals of such savings by vehicle type. The resulting distance taxes were added algebraically to the resulting time taxes. This total tax was then expressed as a percentage of total user savings for each vehicle type. The inverse of this percentage, when multiplied by the 1969-1990 values of savings, represented the value of such savings without taxes. Table VIII-43 indicates the results of eliminating these taxes from user savings, for each freeway alternative, in every section, and for the entire freeway.

Taxes were also deducted from the lesser benefits of the freeway, viz., traffic converted from the railway and value of cargo time savings, by using the same ratio between with-tax and without-tax values as was derived for user savings of the entire freeway.

ECONOMIC ANALYSIS OF ALTERNATIVE SOLUTIONS

The costs and benefits of the freeway, which have been estimated separately, must be compared to determine the relative worth of the highway improvement and freeway alternatives. An evaluation of a third alternative--an at-grade expressway--was also made.

Benefit-Cost Analysis

The undiscounted benefit-cost ratios for the freeway were estimated to be 3.21 with taxes left in both benefits and costs, and 3.35 with taxes taken out. The slightly higher ratio for the without-tax values indicated that tax incidence was somewhat higher on road construction than on the costs of operating road vehicles. Tables VIII-44 and 45 show the undiscounted benefit-cost ratios for the entire freeway, and for each freeway alternative in every one of the seven freeway sections. The user savings totals and "lesser benefits" totals shown in these tables, as in succeeding tables, exclude annual values for years prior to the scheduled opening of the freeway, as based on the capacity analysis. Since the various sections of the freeway were scheduled to be opened in different years, the totals of user savings shown in these and succeeding tables were garnered over various lengths of time and, therefore, are not directly comparable. User savings were recalculated for a common period of accrual, however, to compare sections for the purpose of arriving at investment priorities.

Any comparison of undiscounted freeway costs and benefits distorts the value of benefits, of course, since these would be realized to a large extent in the later years of the 1970-1990 period, whereas most freeway costs would be expended in the early years.

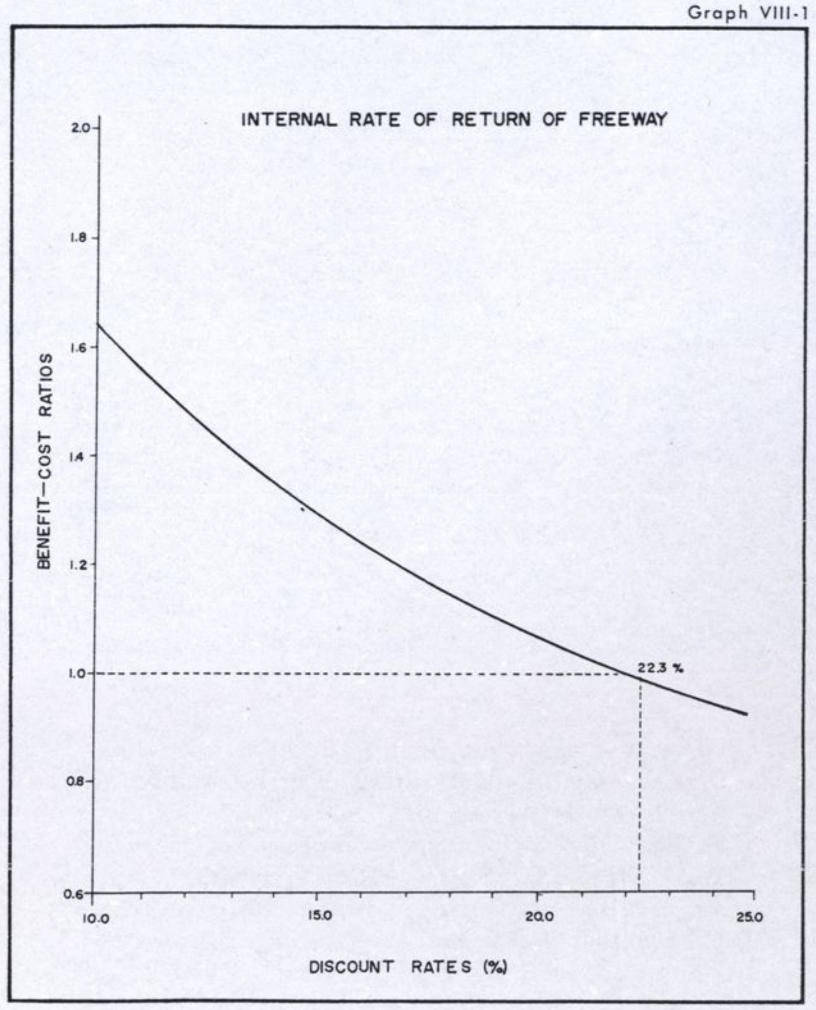
It would be desirable to consider all values in terms of the value of money in a common year. To eliminate the factor of timing related to costs and benefits, therefore, all values were discounted at rates of 10, 15, 20 and 25 percent, using 1970 as the zero year. To complete the rate of return analysis, the values in Sections 2, 3 and 7 also had to be discounted at 30 percent.

Tables VIII-46 through 50 show that Section 3 would have the highest benefit-cost ratios of any section. Although a short section, it would produce substantial distance savings (the Freeway would be about 15 percent shorter than the alternative north-south arterial). The section with the highest net present value of benefits, at lower rates of discount, would be Section 2; at higher discount rates, however, Section 7 would show the greater net present value. This change in relative position would be a consequence of alternative highway improvements constituting a higher percentage of total benefits in Section 7 than in Section 2. Since these benefits would be largely realized in the early years of the period, whereas user savings would grow larger as the period progressed, the discounted values of highway improvements would become more and more important relative to user savings, as higher discount rates were used.

Rate of Return Analysis

The benefit-cost ratios shown in the foregoing tables would result in internal rates of return ranging from 30.0 percent for Section 3 to 11.3 percent for Section

Graph VIII-1



5, Freeway East; the rate of return for the entire freeway would be 22.3 percent. Table VIII-51 lists these various rates of return, and Graph VIII-1 shows how the rate of return for the freeway was derived from a curve drawn with the calculated benefit-cost ratios at the various discount rates.

The freeway rate of return of 22.3 percent means that, at a discount rate of 22.3 percent, the benefits and costs of the freeway would be equal, and, thus, the benefit-cost ratio would be 1.00. It would also be true that, at discount rates below 22.3 percent, alternative highway costs would be greater than the freeway costs less the user savings and lesser benefits of the freeway, while, at rates above 22.3 percent, the alternative highway costs would be less than freeway costs less other benefits. Stated as equations, these relationships are as shown below with C_f being the freeway and related highway costs, B_s being the user savings, B_h being the alternative highways cost, and B_e being the lesser benefits of the freeway.

DISCOUNT RATES	EQUATIONS
$< 22.3\%$	$B_h > C_f - (B_s + B_e)$
22.3%	$B_h = C_f - (B_s + B_e)$
$> 22.3\%$	$B_h < C_f - (B_s + B_e)$

Thus, if only the benefits considered in the quantitative analysis were taken into account, the freeway would be the preferred investment if anything less than a rate 22.3 percent were deemed to be an adequate return on investment. If a rate of return above 22.3 percent were required, however, the highway improvements would be the preferred alternative.

The benefit-cost analysis indicates clear preference for the Freeway West alternatives in Sections 5 and 7. In Section 5, the rate of return for the West alternative is 15.0 percent (low, compared to other sections), while the East alternative shows only an 11.3 percent rate of return. In Section 7, the choice is even clearer, with the West alternative indicated as having a high 28.4 percent rate of return, and the East alternative expected to have a much lower 21.2 percent rate of return.

The choice between the two alternatives in Section 2, however, is not obvious; the rates of return are 26.0 and 26.5 percent for Freeway West (Alternative A) and Freeway East (Alternative B), respectively, and the difference is well within the margin of error of this study. The study's recommendation for choice of an alternative in this section, then, is not based on any preference indicated by the quantitative analysis. Rather, this study recommends the Freeway West alternative on the basis that, since there is no significant difference between the measured returns of the alternatives, Freeway West might be preferred for its less tangible benefits of aiding the development of Linkou Town and the international airport to be constructed near Taoyuan.

Comparison of Freeway with an Expressway-Type Facility

The term "Expressway" covers a wide range of facilities between the two extremes of major street and freeway. A freeway is, in fact, an expressway of the highest type with full control of access. It is, therefore, necessary to define the expressway facility considered in this analysis before comparing it with the freeway. The expressway considered here would have at-grade intersections with major roads; roadside interference would be reduced to a minimum by using fencing along both sides; and all railway crossings would be grade-separated. It could be defined as an expressway with partial control of access.

Economic comparison of the freeway with this type of expressway showed a higher rate of return for the freeway. See Table VIII-52. Benefits and costs for the expressway were estimated by making appropriate modifications in freeway benefits and costs. The total cost of interchanges (including property costs), road bridges, and 25 percent of the earthwork costs were deducted from the freeway costs to estimate the cost of the expressway. The 25 percent reduction in earthwork costs was estimated on the basis of the elimination of grade separations. The resulting costs for each section and for the total expressway are shown in Table VIII-53. The total cost of the expressway was then increased 15 percent for additional lanes to provide capacity equal to that of the freeway. An expressway would have approximately 20 percent less capacity than a freeway depending on a variety of factors. In order to provide the same capacity, the number of lanes would have to be increased proportionately. These additional lanes would involve additional right of way, earthwork, pavement and bridge costs which are the major cost items. Since certain minor cost items such as shoulders, median, and signing do not increase with the addition of lanes, it was estimated that the cost of the expressway should be increased approximately 15 percent.

Freeway benefits were also reduced to reflect the lower running speeds on expressways. Average freeway running speed was assumed to be 86 kilometers per hour while average highway running speed is actually 44 kilometers per hour. On an expressway, running speed might range from 50 to 70 kilometers per hour. An average running speed of 65 kilometers per hour (40 miles per hour) was assumed, and freeway benefits were reduced accordingly in estimating benefits for the expressway.

The economic analysis based on these modified benefits and costs indicated an internal rate of return of 18 percent. This was less than the freeway rate of return of 22.3 percent. Therefore, this analysis justifies the selection of a freeway-type facility. In addition, there are a number of intangible aspects of the freeway which strongly indicate the desirability of this type of facility. In connection with this, the following paragraphs are quoted from page 305 of the AASHO's "A Policy on Geometric Design of Rural Highways--1965". Although in these paragraphs controlled access highways are compared with highways without access control, the same arguments would apply to a great extent in comparing freeways with highways with partial control of access:

Cost of Access Control

"While the initial cost may be high, controlled access highways are economical in the long run. Whereas the highway without access control begins to lose capacity as soon as roadside interference begins (and deterioration in this regard progresses rapidly with time), the controlled access highway steadily retains its ability to handle traffic. This results in the non-controlled access highway becoming obsolete when it is most needed and in the necessity of relocating and constructing a new highway, whereas no such relocation or construction is necessary on a controlled access highway.

" Regarding initial cost, there is a general impression that controlled access highways cost considerably more than highways without access control. This may not be so. Where standards are the same the cost of construction is no more with control of access than without it and may be less because no allowance need be made for additional lanes due to expected reduction in capacity and because some costly details can be omitted.

"In addition to the long-range economy in control of access and little or no increase and possibly decrease in initial cost, there is the major economy in benefits to road users. Road users benefit by control of access in two ways: by reduction in cost of motor vehicle operation and by reduction in accidents. The reduction in vehicle operating cost results from operation at a uniform continuous speed as compared to the usual start and stop operation on highways without access control. An important part of the reduction in cost is the saving in time but there also are additional intangible benefits to drivers, such as relaxation and lack of strain in driving."

ECONOMIC JUSTIFICATION AND INVESTMENT PRIORITIES

Although the rates of return of the freeway and its several sections have been determined, the economic analysis is not complete unless measurement is made of the effects of some of the important determinants on the analysis, and the consequences of their varying from the forecasts are estimated. Moreover, several factors omitted from the quantitative analysis nevertheless have a bearing on the value of the proposed freeway investment, and should be considered. Finally, a schedule of investment priorities among the several freeway sections should be established.

The Sensitivity Matrix

In order to show how the freeway internal rate of return might vary if the estimates of costs and benefits were different, the sensitivity matrix shown as Table VIII-54 was developed. The matrix indicates that, even if the cost estimates proved to be 20 percent too low and benefits were overstated by 25 percent, the investment would still realize an 11 percent rate of return.

If, on the other hand, estimated costs were 20 percent too high while benefits had been underestimated by 25 percent, the project would earn a 55 percent rate of return.

Neither of these extremes is likely. Since care was taken to be conservative when estimating benefits, they might be much higher if the freeway were built. If so, and if the cost estimate proved to be accurate, the rate of return on the freeway would be higher than forecast; if, for example, the value of future benefits was 120 percent of the forecast, the rate of return would be 30 percent.

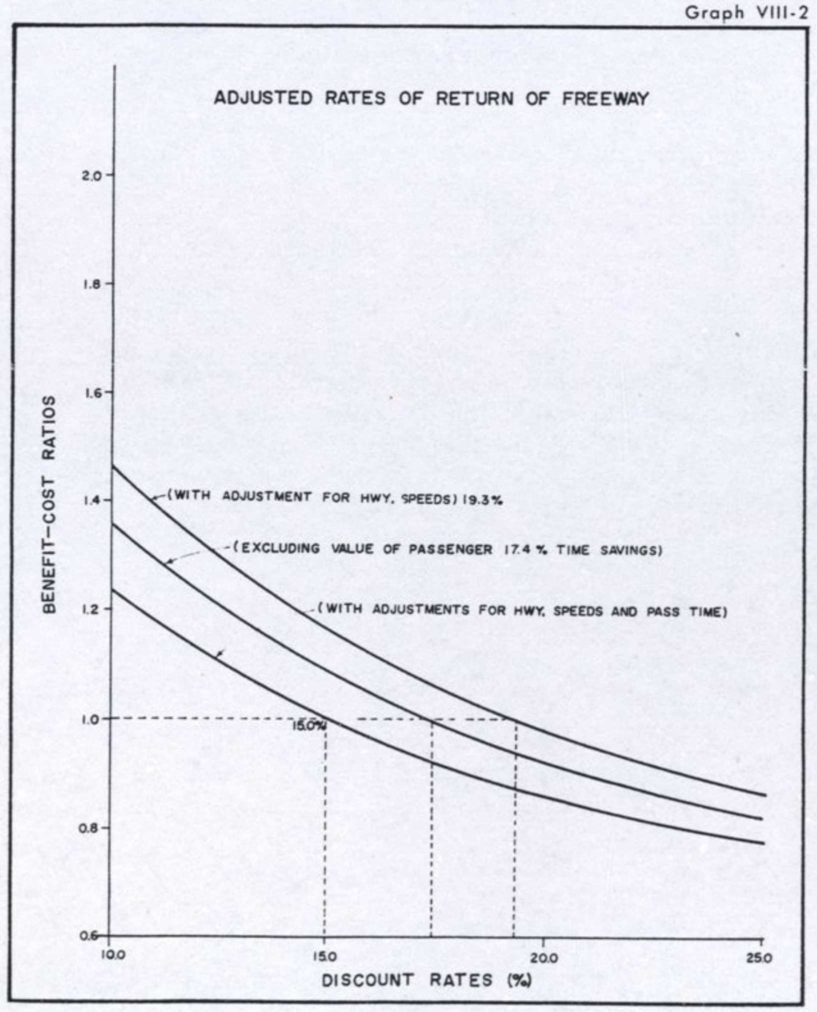
The sensitivity matrix was developed by determining a series of benefit-cost ratios for every cost-benefit combination. Thus, for example, when costs were 120 percent of the estimate and benefits were 110 percent, the benefit-cost ratios at discount rates of 10, 15, 20 and 25 percent would be, respectively, 1.52, 1.19, 0.98 and 0.85. By using a straight-line method to interpolate (accurate to the nearest whole percent), the rate of return in this example would be 19 percent.

The Elimination of Passenger Time Value from the Rate of Return

The minimum values of passenger time (see discussion of time value in Chapter III) were incorporated into the vehicle operating costs used for the computer; thus, the cost savings of highway users reflected inter alia the values of passenger time. Because it is a matter of conjecture, however, whether the saving of a passenger's time is worth as much to the economy as it is to the passenger himself, the passenger time values used may have overstated the benefits to the economy. For this reason, the freeway rate of return was recalculated by eliminating the value of all passenger time savings.

Passenger time savings would have a minimum value (to the passengers, themselves) of nearly NT $2 billion in 1990, and would have a cumulative, undiscounted total value of nearly NT $19 billion from the time of opening of the freeway through 1990. Table VIII-55 indicates the annual values of passenger time savings in every section of Freeway West, and for the entire freeway. Table VIII-56 indicates the resultant benefit-cost ratios when the value of passenger time savings were deducted from user savings. The rate of return derived from these lower user savings values would be 17.4 percent; this may be seen from the relevant curve in Graph VIII-2.

Graph VIII-2



Alteration of User Savings for an Adjustment in Highway Speeds

For the "without freeway" alternative, it was intended that highway traffic conditions would neither improve nor deteriorate from conditions prevailing at the time of the traffic survey. Thus, highway improvements were so scheduled that additional investment would be made in time to prevent conditions from deteriorating below the level of 1969.

Since traffic conditions of 1969 were to be maintained, highway speeds given to the computer for the "without freeway" alternative were those which existed at the time of the road survey. This understated the average speeds which should prevail over the entire 1969-1990 period, under the "without freeway" condition, since speeds could be expected to increase whenever a highway improvement was completed. They would deteriorate to the 1969 speeds again, but for some period of time, average speeds would be above the 1969 condition.

It was estimated that the maximum increase in average speed would be about 20 percent; since freeway speeds, according to the information fed to the computer, would be approximately twice the speeds of the alternative highway condition, a 20 percent rise in those average highway speeds would mean a 20 percent reduction in the highway-freeway speed differential, and a 20 percent reduction of time savings.

Total user savings might not be reduced by a full 20 percent, however, since increased highway speeds would reduce only the time savings of the freeway, while distance savings would remain as before. Nevertheless, to estimate the effect of increased highway speeds on the rate of return, user savings were reduced by a full 20 percent. The benefit-cost ratios which resulted from reducing the user savings in this manner are as shown in Table VIII-57. The resultant rate of return would be 19.3 percent as shown in Graph VIII-2.

When adjustments were made for both the increased highway speeds and the value of passenger time savings, the benefit-cost ratios were lowered as shown in Table VIII-58, and the rate of return became approximately 15.0 percent. This lower rate of return would have been selected as the forecast of the rate of return on the freeway investment only if it had been accepted that passenger time savings would be valueless to the economy and average highway speeds over the period might be as much as 20 percent above the values used by the computer. Actually, the value of passenger time will probably increase in the future since productivity per man-hour is expected to rise. As to highway speeds, they would rise on certain highways after improvement, but this study estimated conservatively the number of alternative highway lanes required to maintain 1969 traffic conditions. Thus, there would also be some deterioration of speeds below the level of 1969, and an average speed increase of 20 percent over the period would be highly unlikely.

Determination of Investment Priorities

Although the benefit-cost analysis permitted an evaluation of the investment in the freeway, and permitted the comparisons of two freeway alternatives in Sections 2, 5 and 7, the analysis, to this point, has not permitted accurate comparison of investments in two or more freeway sections. Such comparisons should be made to establish investment priorities among the several sections, although capacity analyses were also used for this purpose.

For these comparisons, it was necessary to adjust user savings on the assumption of a common year of opening for all sections. When this was done (1975 was chosen so that no section would show increased savings), the benefit-cost ratios and the rates of return were altered as shown in Table VIII-59. The ratios and rates of return did not change for Sections 4 and 5, since these sections were already scheduled to open in 1975.

Before comparing investment in the various sections, it was deemed advisable to adjust the alternative highway costs. Table VIII-60 shows the variation, among sections, between alternative highway costs and freeway costs. In Section 4, property cost for the highway alternative would be much higher relative to the freeway property cost than in other sections, and, in Sections 3 and 7, the construction costs of the highway alternatives would be higher relative to freeway construction cost than in other sections.

When the ratio of highway improvement costs to freeway costs was much higher in one section than in another, the former would tend to have higher benefits in the early years of the 1970-1990 period; also, the higher the discount rate that might be used for the benefit-cost analysis, the greater would be the advantage of these high values in early years. Table VIII-61 shows the effect that the highway improvement benefits would have at the approximate rates of return in the various freeway sections. Such benefits would represent only about 48 percent of the cost of Freeway East in Section 2, but would equal 72 percent of the Freeway West cost in Section 7. Table VIII-62 indicates that the same situation would prevail when all highway-to-freeway cost ratios were found to have a common discount rate.

Although the highway alternative costs in every section might be fully justified (see discussion of these costs in Chapter VII), for purposes of establishing investment priorities among the various sections, it would be preferable that alternative highway improvement costs have equal influence in determining the various net present values of benefits and the rates of return. Tables VIII-63 through 66 show the net present value of benefits and the benefit-cost ratios which resulted when highway improvements were kept as a constant function of freeway costs (the freeway averages at the various discount rates were used), and user savings were adjusted for a common opening year. Table VIII-67 indicates the rates of return which result from these adjustments. Even after the adjustments, Section 3 continued to show the highest rate of return, and the rate of return in Section 5 was still much lower than in other sections. The major difference was that Section 7 no longer showed a better return than Section 2.

These rates of return were used for determining investment priorities. Ranked on this basis alone, Section 3 would have the highest priority, with the remaining investment priorities, in descending order, being as follows: second, Section 2; third, Section 7; fourth to sixth, Sections 1, 4, and 6; and seventh, Section 5. When capacity requirements were also taken into consideration, however, the priorities of Sections 2 and 7 were ranked ahead of Section 3, and the revised schedule read as follows: first, Section 2; second, Section 7; third, Section 3; fourth, Section 1; fifth, Section 4; sixth, Section 6; and seventh, Section 5.

Other Considerations in Evaluating the Feasibility of Freeway Project

As mentioned, benefits of the freeway were conservatively estimated by this study. In particular, they were understated for the following reasons:

1. The forecast of economic growth may be too low. The forecast of seven percent per annum for the years 1969-1972 was indicated by the Development Plan as a minimum growth rate. Actual growth, over the first half of 1969, was at a rate of about ten percent per annum. Since highway ton-kilometers and passenger-kilometers were adjusted downward for the presumed economic slowdown over the Fifth Plan period, their expansion to 1990 would be understated if economic growth exceeds the forecast rate. Moreover, per capita income growth would also be understated with the result that the forecasts of autos per thousand population and total registered vehicles per thousand population would probably be understated.

2. The study period was short. Benefits accruing to highway users as a result of the freeway were measured from the date of freeway opening in each section through the year 1990. This meant that user savings were being measured for, on the average for the entire freeway, only 17 years. In studies concerned with highway investments, a 20-year period is normally used, and even a period of that length tends to understate benefits. User savings which might be expected to accrue over the years 1991-1993, could reasonably have been included in this study's quantitative analysis.

3. Alternative highway improvement costs may be understated. The estimated number of lanes required for the highway improvements without freeway were minimal, and the cost of additional lanes might have been justified.

4. The expansion of highway ton-kilometers was underestimated because it was based on private trucking freight service alone (the only data available), whereas, if the growth of truck registrations is an accurate index, freight hauling by manufacturing and mining companies owning their own truck fleets is growing more rapidly. The registration of such trucks rose by more than 37 percent in 1968, and over the first six months of 1969 alone, the number of registrations of such trucks expanded by nearly 25 percent.

   The rapid growth of truck ownership by manufacturing and mining companies would also improve the competitive position of the highway relative to the railway, since profits to the trucking companies would not be involved in the case of such "captive" fleets. Thus, the "without freeway" expansion of highway ton-kilometers may be further understated, while the forecast of railway ton-kilometer growth would be overstated.

5. The estimate of traffic which would be converted from the railway to the freeway and the resulting benefits would be understated to the extent that rail improvements (and lowered costs and charges) are not made as rapidly as scheduled.

6. User savings tended to be somewhat understated because the divergences from normal distance costs of operating on congested alternative highways or of operating at increased speeds on the freeway were assumed to be the same. Actually, the restricted movement and stop-and-go traffic conditions of the alternative highways would result in a greater distance cost rise (in fuel consumption and engine depreciation and maintenance), than the distance cost rise due to increased speeds (mainly fuel and tire consumption) of the freeway.

7. No benefits were calculated for induced traffic, i.e., trips which, without the freeway, would not be made by any transport mode. These benefits are difficult to measure since they are not

user savings, and would require, for example, the measurement of the increasing sizes of domestic markets of individual producers (with the result of increasing competition, larger-scale operations for the successful competitors, and lower unit costs of production). Since a transportation bottleneck presently exists in Taiwan, and expansion of markets is probably being hampered, induced traffic resulting from the freeway might be sizeable.

8. No benefits were quantified for reduction in total cost of traffic accidents. It is generally true that a freeway facility reduces the accident rate to approximately one-third that on ordinary highways. If this were true in Taiwan, where accident rates are quite high, the benefits would be substantial.

9. No cost reduction was made for the residual value of the freeway; nor, on the other hand, were benefits reduced for the residual value of the highway improvements. If both of these adjustments had been made, however, and the residual values 20 years hence had been discounted at rates of 20 and 25 percent, the resulting net adjustment in the analysis probably would have been negligible.

COMPARISON OF FOREIGN EXCHANGE COSTS AND SAVINGS

The total construction and maintenance costs of the freeway and related highways was estimated to be NT $18,290 million (US $457 million). Of this total, approximately 42.3 percent, or NT $7,737 million (US $193 million) would represent the foreign exchange costs of the project.

The foreign exchange savings of the project would derive mainly from the alternative highway costs and the foreign exchange component of user savings (with only an insignificant amount of foreign exchange savings deriving from the value of cargo time savings).

The construction and maintenance costs of the alternative highway improvements would amount to about NT

$15,540 million (US $389 million), of which approximately NT $6,573 million would represent payments in foreign exchange. The foreign exchange component of user savings would be equal to nearly eight percent of the total, or approximately NT $4,407 million over the 1974-1990 period. Total foreign exchange savings (excluding NT $67 million of cargo time savings) would be NT $10,980 million (US $275 million), and the surplus of savings over costs would be NT $3,243 million (US $81 million).

Just as with the benefit-cost analysis, however, some allowance must be made for the fact that a sizeable portion of the benefits would be received in later years. Thus it would be preferable to compare discounted values. For this purpose, a discount rate of eight percent was used.

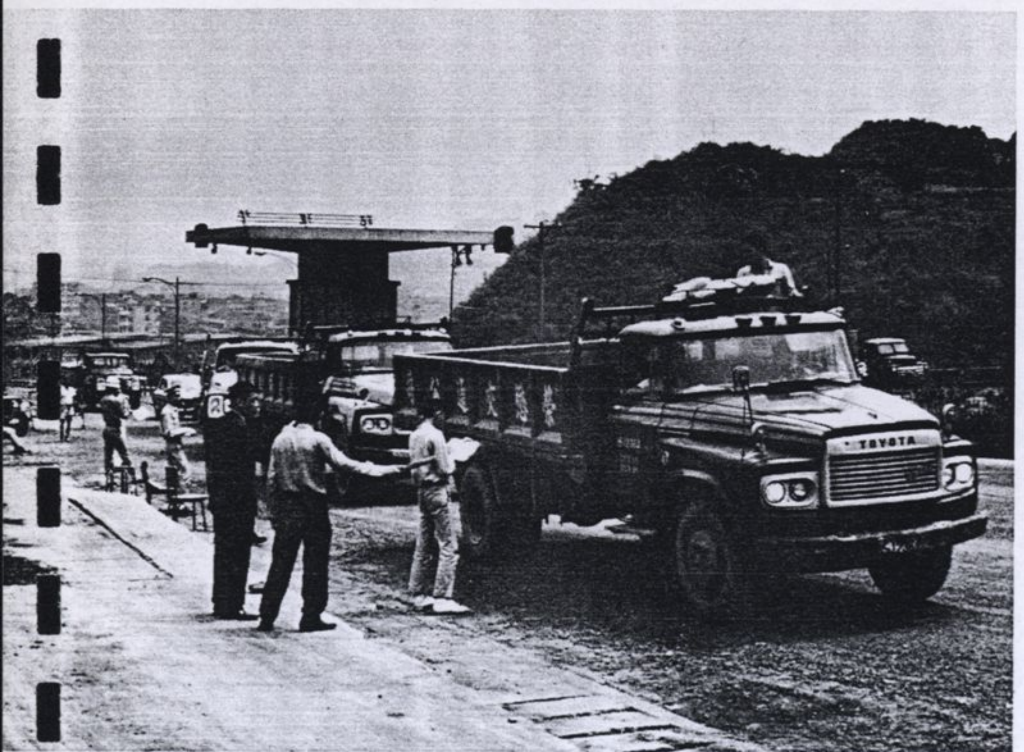
A foreign exchange deficit of NT $556 million (US $14 million) would result from comparing the discounted values (see Table VIII-68). Benefits would be reduced to NT $5,481 million, while the freeway alternative costs, most of which would be expended in early years, would decrease to a lesser extent to a value of NT $6,037 million.

The forecast deficit in present value foreign exchange is not regarded as serious since: (1) as calculated, it is a small amount; (2) foreign exchange savings may be conservatively estimated since freeway benefits were estimated conservatively, and also because no attempt was made to estimate foreign exchange savings resulting from traffic converted from the railway; and (3) Taiwan has an external economic position that is presently sound, and is foreseen to improve in the future.

Calculation of the Foreign Exchange Component of User Savings

The foreign exchange portion of vehicle operating savings are calculated by their distance and time cost components. In order to determine the applicable foreign costs contained in vehicle distance costs per kilometer and in vehicle time costs per hour, the basic total costs of each vehicle type are restated in Table VIII-69. These costs are shown as relative costs of gasoline, tires, depreciation, etc., to provide a basis for calculating the percentage of total costs estimated as representing foreign exchange costs. Depreciation and maintenance enter into both distance and time costs, as shown on original vehicle cost tables. The foreign costs are estimated for each component of total costs. For gasoline, oil and tires, the import percentages represented by crude oil and crude rubber were taken as the basic foreign exchange cost. Depreciation and maintenance costs were estimated to have a foreign component equal to the dependence on foreign vehicle imports (which varies by type of vehicle, as shown in the vehicle registration forecasts, shown separately by foreign and domestic production). The small foreign costs associated with sedans reflects the increasing production of cars in Taiwan, with early termination of imports in prospect. Interest costs bearing a foreign counterpart reflect the need to repay foreign loans used to finance the purchase of trucks, these being short-term credits extended to Taiwan buyers by foreign manufactures. Table VIII-70 shows the relations between foreign exchange components and total savings per vehicle-kilometer.

Foreign exchange savings were computed from time and distance vehicle operating savings on a without-tax basis. Using the User Savings Tables as a basis--as was done for the "without tax" calculation of total user savings--foreign costs, which are components of vehicle savings, could be computed from the relative foreign exchange values shown in Table VIII-70. As before, using the various vehicle categories of time and distance savings (or losses) of the selected alternate route, the foreign cost components were applied to the 1990 total savings in vehicle-hour time savings and vehicle-kilometer distance savings. Their algebraic sum was obtained for each type of vehicle, and these totals were taken as a percentage of the 1990 vehicle NT dollar savings. The resulting percentage of total values saved was then multiplied by each annual gain in savings, over 1969-1990, to obtain annual foreign exchange savings. See Table VIII-71. Foreign exchange savings as a component of user savings were found to average eight percent over the period.



Calculation of the Foreign Exchange Component of the Freeway and Related Highway Costs

Foreign exchange components of the freeway and related highway costs were calculated by analyzing the foreign exchange component of each main construction item. The main items selected for this analysis constitute approximately 96.5 percent of the total construction cost. The following summary table shows these items, the percentages of the total cost they represent, the foreign exchange component of each item, weighted amounts of foreign exchange percentages, and the total foreign exchange percentages for these items:

SUMMARY OF FOREIGN EXCHANGE PERCENTAGE OF COSTS

Items	Percentage of Construction Cost	Foreign Exchange Component Percentage	Weighted Amount of Foreign Exchange as Percentage of Total Construction Cost
1. Clearing and Grubbing	1.0	50.0	0.5
2. Surfacing	28.0	43.0	12.0
3. Guard Rail	0.7	58.0	0.4
4. Fencing	0.8	40.0	0.3
5. Earthwork	32.0	64.0	20.5
6. Lighting	1.0	64.0	0.6
7. Structures	33.0	24.0	8.0
Total	96.5		42.3
Miscellaneous	3.5		
	100.0		

Each item was analyzed by dividing its cost into labor, equipment, and material components. The foreign exchange requirements for these components were then estimated by including all direct or indirect (secondary) foreign costs.

The foreign exchange requirement thus found represented 42.3 percent of total construction cost. This percentage was applied to the construction and maintenance costs to find the foreign exchange portion of total costs.

chapter IX

FINANCIAL AND TOLL ANALYSES

FINANCIAL AND TOLL ANALYSES

It has been shown that the economy of the country would recover the cost of the proposed freeway in the form of user savings and other benefits. The object of the following analysis was to explore ways in which the Government could recover the original costs of the freeway more directly. This is a matter of interest principally to the officials of the Government concerned with finances.

The Consultant recommends that no tolls be charged on the freeway. Rather, it is recommended that the investment be recovered through imposition of new, or higher, vehicle sales taxes and import duties, or by other charges to vehicle owners which would be levied only once or infrequently (e.g., vehicle licenses). This conclusion was reached, however, only after full consideration of the advantages and disadvantages that would attend toll financing. In the discussion that follows, two postulated toll schedules are developed. If imposition of tolls would cause no loss of traffic, either schedule would recover all costs of the project including the costs of access roads and of construction, maintenance, and operation of toll collection facilities, but excluding related highway costs of the freeway alternative. Analyses were also made of the amount of traffic that would be diverted to toll-free routes under each of the toll schedules, and toll revenues were estimated.

The diversion analyses indicated that imposition of tolls on the freeway would divert substantial volumes of traffic to other highways. As a result, user benefits would be reduced and the costs of improving other highways would be greater. Moreover, past experience with tolls in Taiwan indicates that such charges result in marked underutilization of new facilities if parallel toll-free facilities are available. The underutilization of new facilities has usually continued until traffic volumes exceeded the capacity of parallel facilities.

As an alternative way to finance the freeway, therefore, this study examined the possibility of cost recovery from vehicle sales taxes and import duties. The analyses indicated that this method of financing would have little effect on traffic patterns. It was concluded that this avenue of recovering costs would be preferable to imposition of tolls.

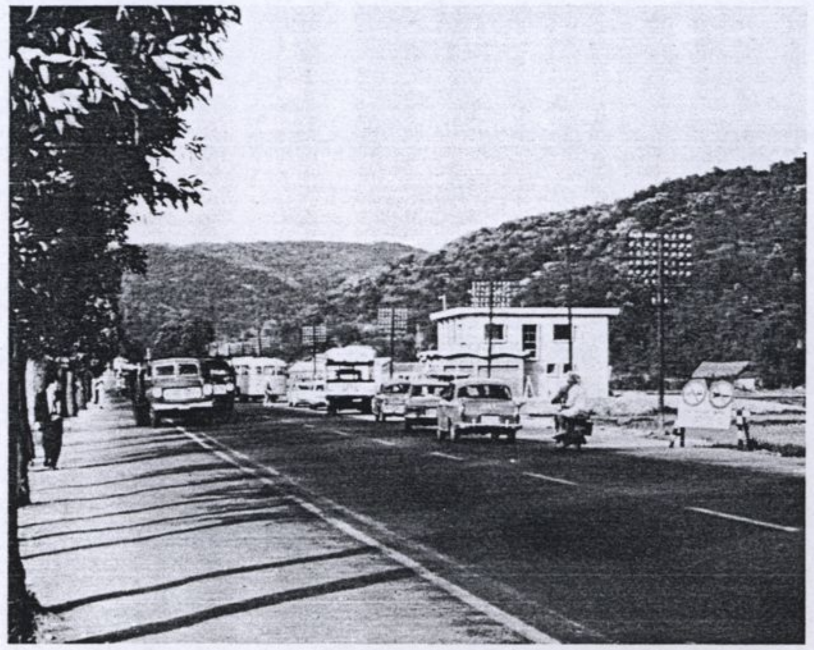
COST RECOVERY AND DEBT REPAYMENT BY TOLL CHARGES

Two different bases were used in developing cost-recovery toll schedules. One of these attempted to incorporate an element of "fairness" into the schedule by setting toll charges for the various types of vehicles in accordance with the estimated portion of total costs which the forecast volume of such vehicles would make necessary. The second toll schedule was intended to cause the least diversion from the freeway to other highways and still produce sufficient revenues.

Before preparing either schedule, it was necessary to revise estimated freeway costs to reflect the institution of tolls. The revised cost, without taxes (since these would not have to be recovered by the Government), was estimated at NT $21,221 million (US $530.5 million). This estimate, as shown in Table IX-1, includes construction, maintenance, and operation of toll-collection facilities. The Table also shows the revised costs discounted at eight percent which was the estimated average cost of capital for the project. The discounted total was estimated at NT $16,962 million (US $424 million).

Annual vehicle-kilometers by all types of vehicles on the freeway were projected to 1990 to determine the required average toll per vehicle-kilometer. See Table IX-2. These annual totals were then discounted at a rate of eight percent to make them comparable with the discounted costs. The average toll charge was calculated as the quotient of the discounted cost over the discounted total of vehicle-kilometers. The average charge would have to be NT $0.849 per vehicle-kilometer.

This fee would not be sufficient to recover costs, of course, if the forecast vehicle-kilometers on the freeway did not occur. A diversion analysis, discussed later in this section, indicated that such an average charge would cause substantial diversion from the freeway regardless of which schedule was used. Furthermore, even if there



would be no diversion from the freeway, usage of the freeway designed as a toll highway would be less than otherwise, since there would be fewer interchanges on a toll road than on a free road, and vehicles would have to travel farther on the average to reach the freeway. Thus, use of the toll highway would be impractical for many trips, even if the amount of the toll were no consideration.

The two toll schedules devised for this analysis were based on the average charge of NT $0.849 per vehicle-kilometer; thus, they were developed as if there would be no diminution of freeway patronage. Because of the fallacy in that assumption, these schedules would not actually yield sufficient revenue to cover costs of the freeway.

No adjusted toll schedule that could be expected to recover all costs was prepared. To derive such a toll schedule would require an iterative procedure. After estimating the number of vehicles diverted by a previously-devised schedule, the cost of the freeway would have to be reestimated (for a facility handling less traffic), and a new toll schedule devised to recover the lower costs. This analytical procedure would have been followed if a toll facility had been recommended. It was concluded on the basis of the initial analysis, however, that imposition of tolls at a level adequate to recover the investment would result in a substantial reduction in potential benefits to Taiwan, and a much lower rate of return on the investment.

The "Minimum-Diversion" Toll Schedule

A minimum-diversion toll schedule was devised which would result in least loss of potential benefits from imposing tolls on the freeway. In developing the schedule, it was assumed that diversion curves for all types of vehicles would be approximately the same. This would mean that when all vehicle types had a choice between two routes where the user costs of one alternative would be a common percentage of the cost of operating on the other route, the same percentage distribution between the more costly and the less costly routes would prevail for every type of vehicle. If this assumption were correct, then a toll schedule which would equate the ratio of user highway costs to freeway costs for all vehicle types would result in the same distribution of every vehicle type between the freeway and the toll-free highways.

This constant ratio for all vehicle types was estimated by finding the average cost per kilometer of operating each type of vehicle on the highways and on the freeway without toll. Table IX-3 shows the results of a computer analysis for 1969 and for 1990. From these figures, a cost comparison was made for 1982, the mid-year of freeway operation in the survey period. The table shows that buses would derive far greater benefits per vehicle-kilometer than other vehicles. This would be true both in terms of absolute cost savings per vehicle-kilometer and in terms of the percentage of arterial highway operating cost saved. A substantial portion of the bus cost savings would be represented by the value of passenger time savings; the inclusion of these savings in the calculations was deemed justified, however, since bus companies would probably take into account the value of time to their prospective passengers when deciding which of two or more alternative routes to travel as well as in setting fares.

As shown by the table below, if the required average toll charge per vehicle-kilometer (viz., NT $0.849, or, rounded, NT $0.85) were added to the average freeway operating cost of each vehicle type, only that of light trucks would be raised above the cost of operating on the arterials; the freeway cost of bus operation would remain substantially below highway operating cost.

	Cost per Vehicle-Kilometer in NT $			
	Autos	Light Trucks	Heavy Trucks	Buses
Arterial travel	3.01	3.07	4.19	9.96
Freeway travel with average toll	2.75	3.08	4.04	6.56
Saving via freeway	0.26	-0.01	0.15	3.40

Adding the average toll charge to the operating cost of each type of vehicle on the freeway resulted in varying ratios of user costs on freeways to user costs on highways. A toll schedule was devised, however, at which this ratio would be the same for all vehicle types. Table IX-2 showing the composition of total discounted vehicle-kilometers over the period from the opening of the freeway through 1990 was used to test the ratios. The composition was estimated to be: autos, 37.7 percent; heavy trucks, 47.8 percent; light trucks, 9.8 percent; and buses, 4.7 percent.

Having the composition of discounted vehicle-kilometers, the estimated toll schedules were tested with the following formula:

$$0.377\ T_s + 0.478\ T_h + 0.098\ T_l + 0.047\ T_b = T_a$$

Wherein T_s = the toll charge per kilometer for autos; T_h = the charge for heavy trucks; T_l = the charge for light trucks; T_b = the charge for buses; and T_a = the average per-kilometer charge for all vehicles.

At the "minimum diversion" schedule, T_a would equal NT $0.85.

For cost-recovery tolls, the approximate ratio of freeway cost per vehicle-kilometer to cost of operating on the highways would be 0.916, i.e., freeway operating cost would be 91.6 percent of the cost of operating on arterials for every vehicle type. At this ratio, the freeway costs per vehicle-kilometer and toll charges would be:

Cost per Vehicle-Kilometer in NT $

	Autos	Light Trucks	Heavy Trucks	Buses
Arterial travel	3.01	4.19	3.07	9.96
Freeway travel (91.6% of cost of operating on arterials)	2.76	3.84	2.81	9.12
Less tollway operating costs	1.90	3.19	2.23	5.71
Adjustment in freeway cost/km (tolls)	0.86	0.65	0.58	3.41

The average toll charge which would result from this toll schedule would be NT $0.852, or slightly higher than would actually be required for cost recovery at the forecast traffic volume. Table IX-4 indicates the cost recovery which would result from this schedule if there were no diversion of traffic from the freeway due to imposition of tolls.

Measurement of Diversion

To measure diversion, this study used a published diversion curve, which is described as ".....giving the distribution of private motor traffic in relation to transport costs assessed in user value, that is to say utility to the user, depending both on the distance and the travel time .....".[1] This curve is reproduced in Graph IX-1.

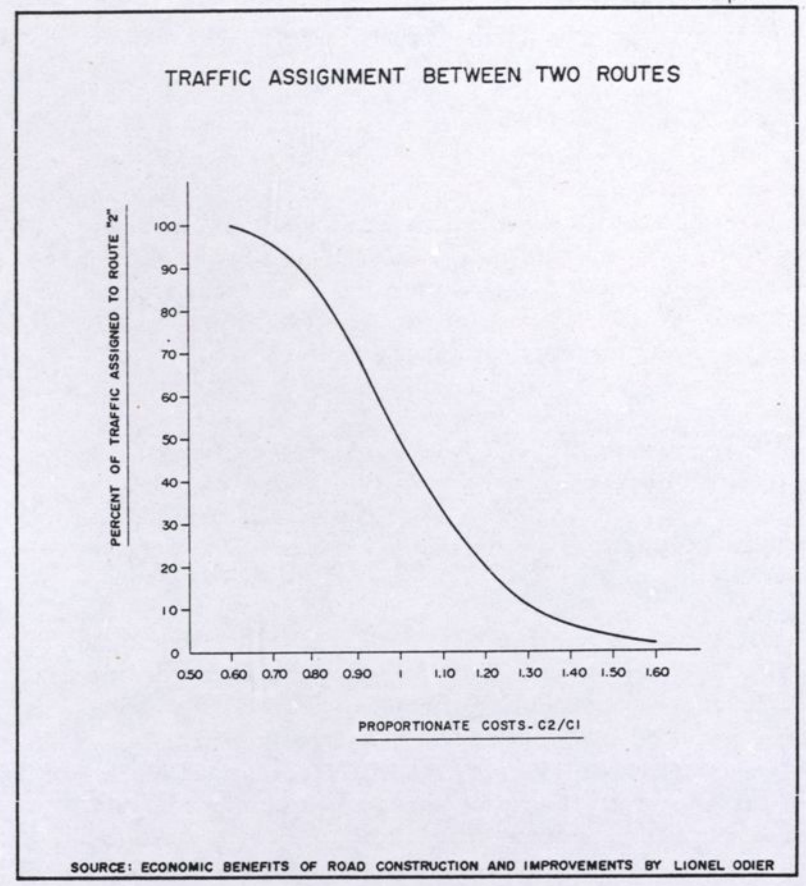
As the curve indicates, when the cost of operating on one route is about 92 percent of the cost of operating on an alternative route, the lower cost route would be expected to attract about 65-70 percent of total traffic. The traffic assignment studies indicated that the freeway, without tolls, could be expected to attract approximately 90-95 percent of all traffic. The minimum diversion due to tolls would probably be about 20 percent. The estimate that, as a toll-free facility, the freeway would attract 90-95 percent of all traffic is confirmed by the diversion curve. Table IX-3 indicates that savings on the freeway might average between 24 and 43 percent for the various types of vehicles, or about 30-35 percent as a weighted average. At this level of savings, the curve indicates that the less costly route might be expected to draw upward of 95 percent of the traffic.

If minimum diversion (viz., 20 percent of total traffic) were to result from the imposition of the derived toll schedule, the freeway would initially lose about 22 percent (i. e., 20/90) of its potential traffic since it would have been handling at least 90 percent of all traffic. This diversion from a tollway, however, would continue only as long as there was sufficient capacity on alternate routes to accommodate the diverted traffic. In some sections of the freeway, traffic diversion from a toll facility might continue for only a few years since the alternative highways would soon be filled to capacity if they were to carry 30 to 35 percent of the corridor volume: especially in Section 2, the capacity of alternative highways would not be sufficient to enable them to accommodate the traffic volumes imposed for more than a very short period of time.

Diversion alone should not reduce user savings by as high a proportion as the share of traffic initially diverted. The reduction in user savings, moreover, would not only be less because diversion would not be expected to continue over the entire period, but also because the users who would be diverted would be those who were deriving the smallest benefits from use of the freeway.

User savings might be substantially reduced, however, because of loss of traffic due to fewer interchanges on a toll facility in comparison with a toll-free facility. Operating costs would also be increased by traffic having to come to a full stop at toll plazas. A separate study, not included in the feasibility report, indicated

Graph IX-1



that if the freeway were operated as a tollway in Section 2, the total reduction in user savings would be on the order of 12-13 percent.

Determination of a Toll Schedule Based on Freeway Cost Related to Vehicle Type

Good engineering requires that paving and structures be designed for maximum vehicle loads expected. Cost, therefore, is related to the magnitude and frequency of maximum loads. For example, in this study, it was determined that paving costs should be shared by the four vehicle types in the following proportions: autos, 15 percent; light trucks, 20 percent; heavy trucks, 45 percent; and buses, 20 percent. The cost of structures should be shared differently: 58 percent for buses and heavy trucks; and 42 percent for autos and light trucks.

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[1] See Odier, The Economic Benefits of Road Construction and Improvement, pp. 46 and 47.

The other highway costs were divided equally among the various vehicle types because these costs for a four-lane facility were determined by the minimum design requirements for a freeway. In those areas of the freeway where the lane requirements would eventually exceed the minimum requirement, the other highway costs might have been adjusted for capacity requirements of the various vehicle types; since the freeway was being considered as a whole, however, this adjustment was not made. Furthermore, since the consultant was recommending that no tolls be imposed on use of the freeway, a more complete analysis of the division of road costs was unnecessary.

With this information, it was possible to allocate to these vehicle types a proportionate share of the total cost of construction which should presumably be recovered from these same vehicles through appropriate tolls.

Table IX-5 presents the basis for such distribution of costs by vehicle type. Total cost was allocated among the principal construction items and the cost of each item computed as a percentage of total cost. Highway design criteria which gave rise to these costs were then attributed to the vehicle type responsible, and an average cost by vehicle type computed for six major construction items. The costs of toll plaza construction and administration constituted the fifth and sixth items. The weighted average of these total costs by vehicle type was computed and shown as a multiple of the automobile-related cost. These multiples of basic auto unit costs were: autos, 1.0; heavy trucks, 1.206; light trucks, 1.03; and buses, 1.08. With these measures of relative responsibility for cost, a basis was established for determining the relative toll level of each vehicle, but the toll level still had to be computed.

In Table IX-1 the combined costs of freeway construction, maintenance, and toll plaza operation, all reduced to an annual basis, constituted the sum to be recovered each year. Compared to this, the vehicle-kilometers of freeway travel by each of the four vehicle types could be stated as multiples, as shown above, of the basic auto unit, multiplied by its annual total vehicle-kilometers. Table IX-2 reproduces the total volume of vehicle-kilometers of each of the four vehicle types which were predicted to travel the freeway in each year between 1972 and 1990. These volumes provide a theoretical basis for toll revenues. These volumes are also restated as multiples of the basic auto unit in the toll analysis. That is, automobile vehicle-kilometers were multiplied by 1.0; heavy truck vehicle-kilometers by 1.206, etc. This procedure determined the unique volume of uniform vehicle-kilometers which could be compared with the equivalent costs by discounting both the time flow of costs and of vehicle-kilometers at 8.0 percent, the estimated average interest rate for the Project. The cost of borrowing money was thus included in the resultant required toll, and the different time stream of costs and the potential revenue base could be made comparable as present values. With comparable present values, the toll basis could be derived by division of the revenue basis (vehicle-kilometers stated as equivalent auto vehicle-kilometers) into the cost recovery requirement. A total discounted value for the revenue basis of NT$22,051 million was divided into the cost recovery basis of NT$19,783 million to derive a basic unit toll for the basic auto unit of NT$0.8972 per vehicle-kilometer.

The revenues which would result from application of these toll charges were then estimated. The unit toll charge for autos was multiplied by the vehicle-kilometers for each vehicle type in terms of equivalent autos. This gave total annual revenue by vehicle type. The estimated revenue was then discounted to check it against the discounted present value of freeway costs.

The derived tolls were relatively high, as shown below. The table compares tolls with the user savings per vehicle-kilometer.

	Autos	Heavy Trucks	Light Trucks	Buses
User savings per vehicle-kilometer as of 1982 in NT$	1.11	1.00	0.84	4.25
Toll charge per vehicle-kilometer in NT$	0.8972	1.082	0.9181	0.9774
Toll as a percentage of user savings	81%	108%	109%	23%

There are several reasons why tolls would have to approximate user savings. The length of the period over which the investment would be amortized would be a main determinant of the level of tolls required. This period, 19 years, is very short considering the useful life of the proposed highway. Government taxes on construction which would be collected during the construction period as well as taxes on maintenance expenditures which would be collected throughout freeway operation were included in the total costs used as a basis for toll rates.

The table below shows the toll rates with such taxes excluded from the cost basis.

Auto	Heavy Trucks	Light Trucks	Buses
NT$ per vehicle-kilometer			
0.7692	0.9313	0.7875	0.8397

These toll rates, lower of course than tolls which would recover all costs including taxes, would produce a lower percentage relationship to user benefits as follows: autos, 69.3 percent; heavy trucks, 93.1 percent; light trucks, 93.8 percent; and buses, 19.8 percent.

The ratios of freeway operating costs to the cost of operating on the arterial highways, for each of the vehicle types, would be as follows:

	Autos	Heavy Trucks	Light Trucks	Buses
Cost/km of operating on arterial highways	3.01	4.19	3.07	9.96
Cost/km of operating on the freeway with tolls	2.67	4.12	3.02	6.55
Freeway operating cost as a percentage of arterial highway operating cost	88.7	98.3	98.4	65.8

If there were no diversion from the freeway, this toll schedule would be sufficient to recover all costs excluding taxes as shown in Table IX-6.

Graph IX-2 shows, however, that with the imposition of this toll schedule, the freeway would probably retain only about 50-55 percent of both light and heavy truck traffic. The freeway would still handle about 75 percent of the auto traffic. There would be no significant diversion of buses from the freeway.

With the toll schedule above, however, buses would account for only 4.6 percent of total revenue, before allowing for diversion. Thus, retention of bus traffic on the freeway would have little effect on gross revenues. Light trucks would account for 9.0 percent, of which about half might initially be lost; autos would account for 34.1 percent, of which about one-quarter would initially be lost; and heavy trucks would account for 52.3 percent, of which, initially about one-fifth could not be collected. Thus, with the above toll schedule, net revenues of the freeway as a toll highway would cover only about 70 percent of discounted costs until diversion was reduced as alternative highway routes reached their capacity. This computation is summarized in the next table.

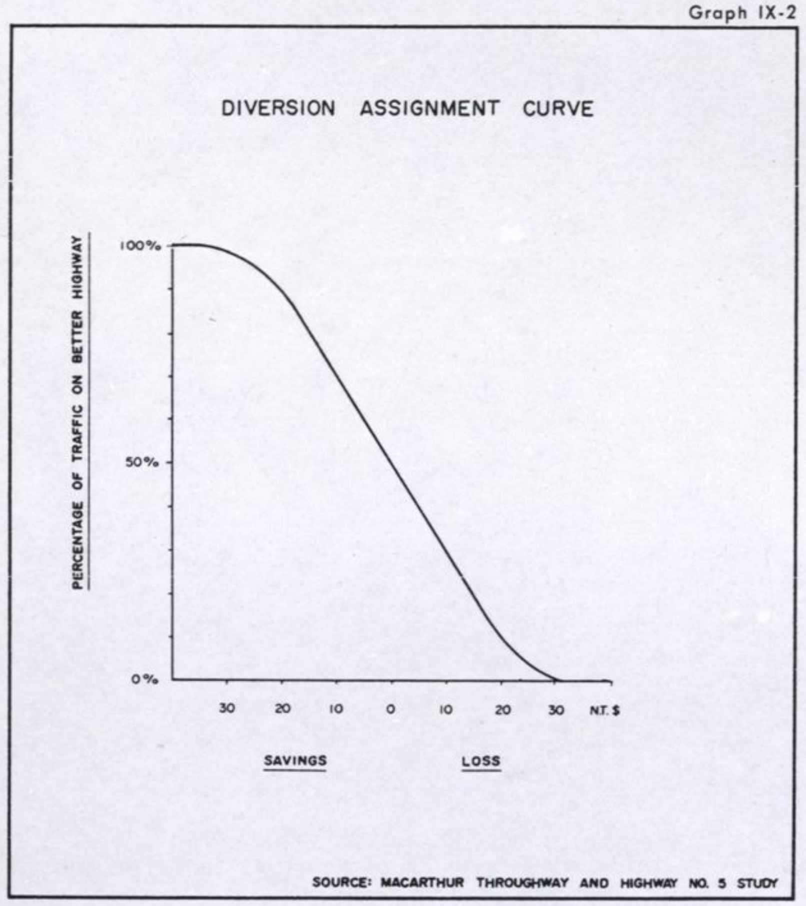
PERCENTAGE OF DISCOUNTED COSTS RECOVERED BY TYPE OF VEHICLE

Type of Vehicle	Before Diversion	Loss Due to Diversion	Net Recovered
Autos	34.1	5.0	29.1
Heavy Trucks	52.3	21.0	31.3
Light Trucks	9.0	4.0	5.0
Buses	4.6	0.0	4.6
Total	100.0	30.0	70.0

COST RECOVERY AND DEBT REPAYMENT BY OTHER METHODS

There are several methods, other than toll financing, by which the Government might finance the freeway. The costs could be recovered from income taxes, for

Graph IX-2



instance. In this case, cost recovery would have no direct effect on the transportation system nor on the users of various types of vehicles. While this alternative might produce the most efficient distribution of traffic, it was not given serious consideration since this method would likely encounter firm public opposition.

Another way to recover freeway costs would be to levy new, or increased, taxes on vehicle users as discussed below.

Vehicle User Taxes

Any charges imposed on the users of road vehicles would increase operating costs with the result that some traffic might be diverted to rail or other alternative transport modes. Such charges would not favor one highway as opposed to another, however, and highway traffic would not be distorted from its most efficient pattern.

Vehicle taxes in Taiwan consist mainly of five levies: import duties, vehicle sales taxes, license fees, fuel and oil sales taxes, and taxes on tires and spare parts. These taxes, are imposed once as in the case of import duties and vehicle sales taxes, annually as with license fees, or somewhat in proportion to vehicle use as in the case of sales taxes on fuel, oil, tires, and spare parts. The latter class of taxes tend to discourage full utilization of vehicles while taxes on ownership have little such effect.

For this reason, it is generally preferable that user taxes be connected directly with ownership rather than with the amount of vehicle use.

The present major vehicle taxes in Taiwan are listed below in summary form, according to their relative rate and volume, as calculated from vehicle user cost tables combined with tax tables.

Import Taxes:	35% (buses, trucks, parts, engines)
	50% (autos, gasoline, diesel fuel)
Sales Taxes:	15% (vehicles, parts, automotive equipment, tires, etc.)
Annual Vehicle License Fees (Average):	NT$ Autos, 6,660; heavy trucks, 5,040; light trucks, 4,200; buses, 6,600.
Tire Taxes:	Autos, 0.009 /km x 40,000 km life x 0.50 times purchased per year (40,000 km life and 20,000 km per year = NT$ 180/year)
	Buses, 0.11/km x 40,000 km life x 2.5 times purchased per year (40,000 km life and 100,000 km per year = NT$ 11,000/year)

Heavy trucks, same as buses.

Light trucks, 0.05/km x 40,000 km life x 1.9 times purchased per year (40,000 km life and 75,000 km per year = NT$ 3800/year)

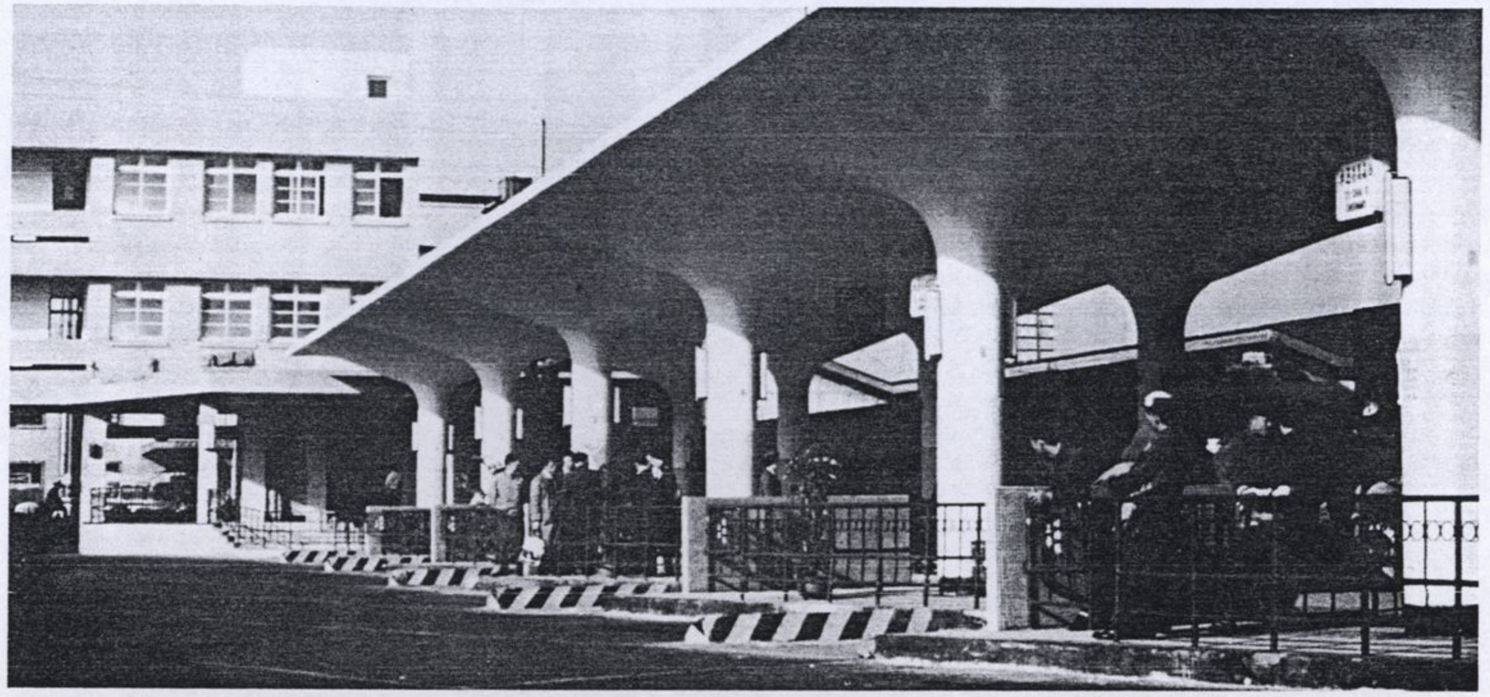
Fuel and Oil Taxes: Autos, 0.158/km x 20,000 km/year = NT$ 3,160/year

Buses, 0.305/km x 66,000 km/year (understated) = NT$20,130/year

Heavy trucks, same as buses

Light trucks, 0.0360/km x 75,000 km/year = NT$ 2,700/year

The foregoing calculations show that an average heavy truck or bus incurs taxes of NT$ 31,160 annually on licenses, tires, and fuel and oil. These costs exclude initial import and sales taxes of 35 percent and 15 percent, respectively, which must be amortized over the life of the vehicle.



Recovery of Freeway Costs from Vehicle Sales Taxes, Import Duties, and License Fees

If all costs were to be recovered from vehicle sales taxes and import duties, the average additional sales and import levy on all new vehicles, over the 1970 to 1990 period, would be about NT$ 33,300. Table IX-7 indicates the forecast number of new vehicles in Taiwan during this period, and the discounted totals, at eight percent, for each year to 1990.

If tolls were not selected as the method of paying for the freeway, there would be no costs for construction, maintenance, and operation of toll collection facilities. The discounted, without-tax cost would be lower, therefore, totaling NT$ 16,695 million. This figure was divided by the discounted total of new vehicles to obtain the additional levy of NT$ 33,300 per vehicle.

The 1969 prices of new vehicles were estimated to be approximately as follows: automobiles, NT$ 160,000; light trucks, NT$ 200,000; (one-ton trucks, NT$ 160,000 and three and one-half ton trucks, NT$ 240,000); heavy trucks, NT$ 300,000; and buses, NT$ 400,000. Using the composition of undiscounted vehicle requirements shown at the bottom of Table IX-7, it was calculated that the average cost of a new vehicle (at 1969 prices) would be NT$ 197,000. Thus, the average additional charge would be equivalent to approximately 16.9 percent of the cost (or rounded, 17 percent).

If, the additional tax were applied to all vehicles, as a constant percentage of value, the additional charge on heavy trucks would be about NT$ 51,000; interest on this price increment over a period of eight years (the estimated average useful life of a heavy truck) would amount to around NT$ 40,800 (20 percent per annum on an average outstanding amount of NT$ 25,500), and the total additional cost to purchasers of heavy trucks would average around NT$ 91,800.

This additional cost would be amortized over the eight-year life of the vehicle. Ton-kilometers during that period would approximate 3.44 million (100,000 truck-kilometers/annum x 8 years x an average load of 4.3 tons) for the average heavy truck. The average additional cost per ton-kilometer, therefore would be only about NT$ 0.027. The total cost of operation per ton-kilometer would increase from NT$ 0.914 to NT$ 0.941, or slightly less than three percent. An increase of such magnitude would be within the margin of error of this study. It would not affect the analysis of future rail-freeway competition.

If the Government deemed such additional taxes on vehicle sales to be too great, a portion of the freeway costs could be defrayed through increased license fees. Table IX-8 indicates the numbers of forecast registered vehicles in Taiwan discounted at eight percent together with the discounted revenues which would be collected at various levels of license fee increases. If an average increase of NT$ 800 (US$ 20) were charged, a discounted total of about NT$ 2,292 million would be received by the Government. Revenue in this amount would defray approximately 13.7 percent of the total discounted cost of the freeway.

In addition to the advantage of not disrupting the efficiency of the highway transportation pattern, cost recovery through higher vehicle sales taxes, import levies, and license fees would be preferable to tolls since collection of the former could begin even before the start of construction, rather than after completion. Were the calculated average increase in sales taxes (viz, NT$ 33,300) applied to all new vehicles beginning in 1970, for example, a discounted total of NT$ 1,340 million would be collected before the opening of any freeway section (viz, before Section 2 would be opened in 1972), and a discounted total of NT$ 3,404 million would be collected before the entire freeway was in operation (i.e., prior to 1975). If an average additional license fee of NT$ 800 was charged beginning in 1970, the cumulative discounted revenue from this source would be NT$ 443 million before completion of the freeway.

Comparison between Present Road Expenditures and Road User Taxes

Perhaps cost recovery of the freeway investment should not be through new charges alone, but also through reallocation of funds acquired through present road user charges. Expenditures on roads are currently much less than revenue from road user taxes. If a portion of road user taxes now diverted to other purposes were used for financing the freeway, new taxes on vehicle users to finance the freeway could be correspondingly lower.

In 1968, vehicle and vehicle use taxes exceeded road costs by NT$ 2,870 million, or 82 percent. See Table IX-9. This excludes the administrative costs of both THB and the tax collection authority, however. Table IX-10 shows these road taxes in relation to total general Government revenues and expenditures. Total Government revenues from all domestic sources and total Government expenditures between 1960 and 1967 indicate that road taxes during the period represented about nine percent of total domestic revenues and expenditures nationally. Vehicle taxes appear to be exceptionally high while other qualified income sources seem to be undertaxed. The transport system is taxed for the understandable purpose of obtaining Government revenues from reasonably controllable sources.

Comparison of Future Road Expenditures with User Taxes

Table IX-11 shows estimated future Government tax or toll revenues, some portion of which might be used to cover the costs of the freeway. The forecast road taxes are compared with a possible road budget for highways excluding the freeway in which expenditures for construction were anticipated to increase at NT$ 80 million per year while expenditures for maintenance would grow by NT$ 50 million per year. See Table IX-12. In the period 1970 to 1990, road taxes were projected to increase 3.99 times. The equivalent rise in road construction costs would be approximately 4.90 times, and in road maintenance costs, 5.34 times. At these expected future tax and road cost levels, there would be produced a surplus in every year of road taxes substantially higher than road costs for improvement. The road tax surplus, after road costs, was forecast to be as follows:

Year	Surplus
1975	NT$ 3,650 million
1980	5,333
1985	8,256
1990	11,229

chapter X

CONCLUSIONS AND RECOMMENDATIONS

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CONCLUSIONS

1. This study concludes that the proposed freeway from Keelung to Kaohsuing would be economically feasible and should be built as soon as possible. The internal rate of return on the required investment was estimated to be 22.3 percent. The Consultant's investigation of the value of the opportunity cost of capital in Taiwan did not yield satisfactory results. Therefore, it was not possible to compare the above rate of return with marginal cost of capital. Based on the experience of other countries with similar conditions, however, the result is deemed highly satisfactory.

2. Both traffic and economic analyses indicated that the freeway should be built earlier than originally planned. Traffic forecasts and capacity analyses showed that almost all sections of the freeway would be needed by 1975. The analyses assumed maximum utilization of the capacity of existing north-south highways in the corridor. The following priorities were developed by combining capacity requirements, priorities established by the economic analyses, and judgment factors:

Study Section	Study Section Limits	Completion Priority
1A	Keelung-Neihu	4
1B	Neihu-Erhchung	1
2	Erhchung-Yangmei	1
3	Yangmei-Hsinchu	3
4	Hsinchu-Taichung	5
5	Taichung-Tounan	7
6	Tounan-Tainan	6
7	Tainan-Fengshan	2

3. An expressway-type facility with partial control of access was analyzed for the entire route and found to be less satisfactory than a freeway-type facility, for both economic and engineering reasons. In Taiwan, with extremely high population density, an expressway would not provide necessary speed and capacity in the future.

4. The freeway should be operated as a toll-free facility. Detailed analyses showed that the economy of the country would lose potential benefits if tolls

were charged. The numerous interchanges needed to properly serve the populated western region would accentuate this loss by requiring excessive toll collection facilities and staff. In addition, the users would be delayed and inconvenienced by the stops at toll plazas. The analyses further indicated that the forecast user taxes resulting from increased vehicle registration and motor fuel consumption would yield sufficient revenue.

5. Major alternative routes in Study Sections 2, 4 and 7 were analyzed by comparing the present worth of net benefits. These analyses showed that the "West" alternatives in Study Sections 5 and 7 were clearly superior to the "East" alternatives. In Study Section 2 (Erhchung-Chungli Section), the results did not show a clear superiority for either alternative. This confirmed the findings of the Interim Report.[1] The difference between the present worth of net benefits and also between internal rates of return were very small and well within the margin of error. This required that the selection be based on intangible aspects of both alternatives. The "West" alternative, in addition to serving main corridor traffic, would help the realization of two important projects: (1) the proposed new international airport at Taoyuan; and (2) the proposed Linkou community. Thus, it would help to achieve the regional plan objective of dispersing the population into the satellite cities in the Taipei region. These and other intangible benefits indicate advantages of the "West" alternative.

[1] The Interim Report was prepared in July, 1969. Its purpose was to provide a basis for authorizing design work in Study Section 2. Four alternatives were studied in this section. Two adequate choices were resolved from this report, the Red Line (Freeway West) and the Blue Line (Freeway East). This early report recommended a freeway facility be built along the Red Line (Freeway West).

6. In all sections, the costs of other highway improvements needed for the proper operation of the freeway were estimated and included in the economic analysis. These items consisted of frontage roads, access roads, and improvement of some other highways parallel to the freeway. They should be considered part of the project and be built concurrently with the freeway or at the dates indicated in this study.

7. Foreign exchange components for construction and maintenance of the freeway and related facilities were estimated at approximately 42 percent of total costs. This portion included all direct and indirect foreign costs. Foreign exchange savings, which would be greater than costs before discounting, would be nearly equal to costs at discounted levels. This indicated that the project would be a sound investment, also, in regard to the external economic position of the country.

8. Induced traffic was not considered in this study since it could not be estimated accurately. Induced traffic consists of trips which would be made only if the freeway were built. Substantial volumes of such traffic would probably develop. The wide median suggested in the following "Recommendation" section was deemed justified by the likelihood that additional lanes will be needed at some time in the reasonably near future to serve induced traffic together with that in excess of the conservatively estimated future volumes.

9. If the recommendation that the freeway be a toll-free facility is not acceptable to the Government for reasons of budgetary policy, freeway costs should be rescheduled to take into account the slower growth of freeway traffic that a tollway would experience. Such a rescheduling might contemplate building a two-lane facility initially on some portions of the route. On the other hand, if the Government finances the freeway in some other manner, as recommended, the forecast traffic growth on the toll-free facility and calculations of capacity indicate that there should be no two-lane sections since a minimum of four lanes would be required within four or five years.

There would be some reduction in construction cost if only two lanes were constructed initially, but this saving would be largely counterbalanced by higher contractor's overhead, by costs of later modification of interchanges, and by the expense of maintaining traffic during widening. Moreover, the economy would lose a portion of user benefits because of lower average speed on a two-lane facility, and the accident rates would be higher than on a four-lane divided facility.

RECOMMENDATIONS

1. The freeway should be given top priority among all transportation projects. In this study, the analysis of freeway-railway competition was based on a hypothetically improved railway in order not to overestimate traffic diversion and resulting benefits. Without such a highly improved rail system, the freeway would attract more cargo and passenger traffic than the forecast volumes, as it would be less costly, even for long distance travel.

2. The general route of the freeway should be approved as soon as possible and necessary rights of way should be reserved, especially in urban areas.

3. Comprehensive transportation studies for Taipei and Kaohsiung should be undertaken as soon as possible. These will be essential for the proper planning of a freeway through these cities as well as for determining all other urban transportation requirements in these two communities.

4. Regional plans should be coordinated with the freeway project to take advantage of the excellent highway transportation which would be made available by construction of the freeway. New industrial and residential developments should take place on non-productive or marginally productive lands but close to labor markets, thus reducing social costs and problems of family relocation.

5. This study indicates, in general, the need for access roads, frontage roads, and highway improvements parallel to the freeway. Improvement of other transverse and feeder roads should also be undertaken as needed to provide service to all of the Western region. Need for improvement of these roads and of highways mainly serving local traffic in urban areas was not part of this study but should be investigated as a separate study.

6. Slow-moving traffic, such as three-wheeled vehicles, cycles, and animal and hand-drawn carts, should not be allowed on any part of the freeway. The mixing of such vehicles with motor vehicles would create hazardous conditions for both types of traffic. Slow-moving vehicles generally make short trips and should use other highways which are better suited to their needs. Existing highways parallel to the freeway would have ample capacity, in most areas, to handle vehicles if faster vehicles were served by a freeway.

7. The desirability of operating buses on the freeway should be investigated before designing the facility. If such service is found feasible, the design should incorporate separated bus bays, deceleration and acceleration lanes, and sidewalks and stairs for passengers. Such bus operation might help to attain regional planning objectives by reducing transportation costs.

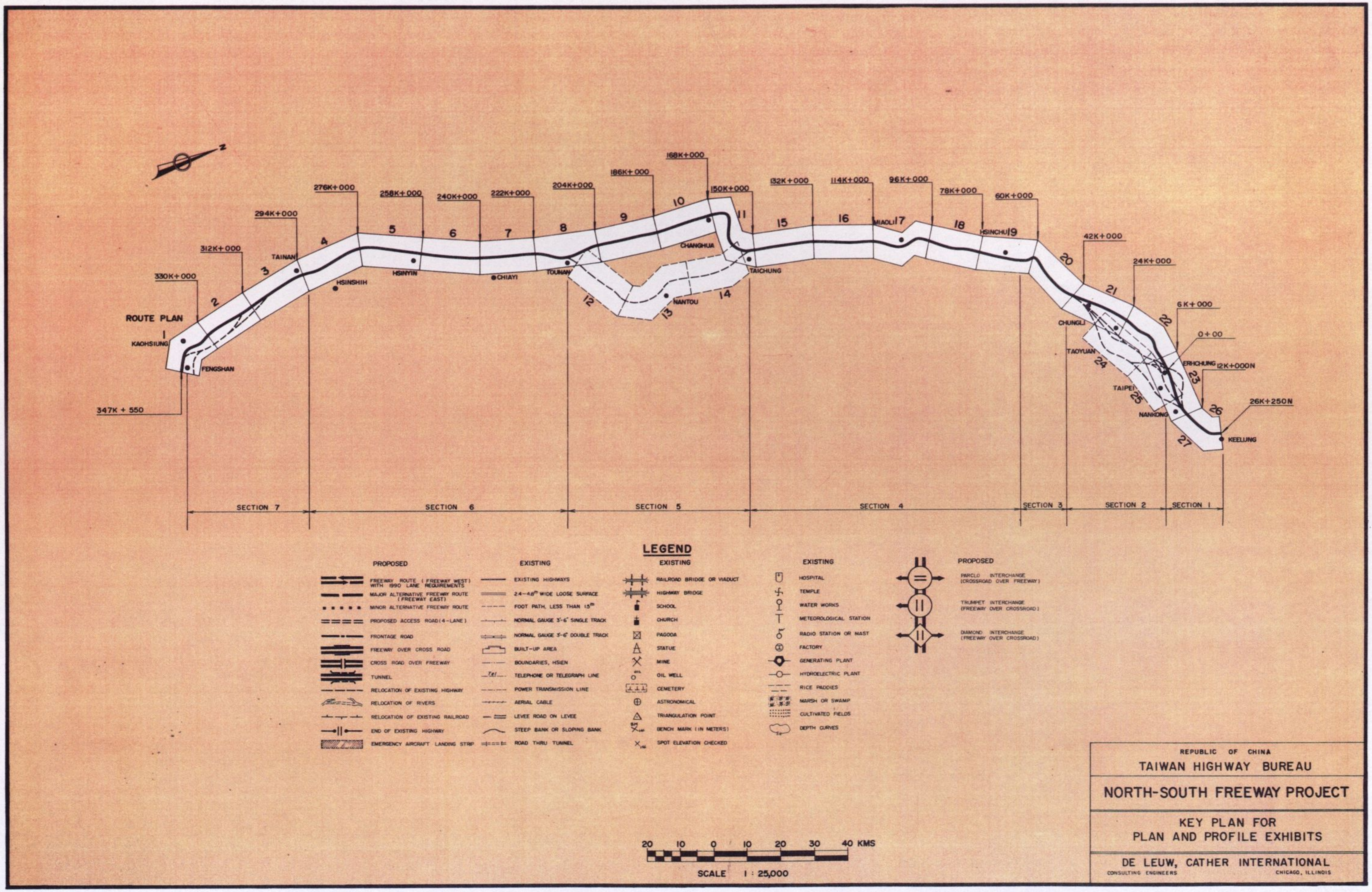
8. Wide medians are recommended to permit future widening. The number of freeway lanes was calculated to accommodate the forecast 1990 traffic at a reasonable level of service. Although this is standard procedure for a feasibility study, a longer period should be considered for planning purposes. Wide medians would allow further widening of the freeway to eight lanes in six-lane sections, and to six lanes in four-lane sections after 1990.

9. The proper operation and maintenance of a freeway demands more careful and prompt attention than do those functions on ordinary highways. Well-trained and adequately equipped highway patrols, maintenance crews, and towing services would be imperative to obtain all of the inherent advantages of a freeway.

10. Rest and service areas should be planned to serve vehicles and their occupants. Such facilities should be convenient, scenic, and well-equipped to encourage motorists and truckers to relax at regular intervals--an important safety aspect of freeway operation.

APPENDIX

ROUTE PLANS FOR PROPOSED FREEWAY


ROUTE PLAN
KAOHSIUNG
FENGSHAN
TAINAN
HSINSHIH
HSINYIN
CHIAYI
TOUNAN
CHANGHUA
NANTOU
TAICHUNG
MIAOLI
HSINCHU
CHUNGLI
TAOYUAN
TAIPEI
ERHCHUNG
NANKONG
KEELUNG
347K + 550
330K+000
312K+000
294K+000
276K+000
258K+000
240K+000
222K+000
204K+000
186K+000
168K+000
150K+000
132K+000
114K+000
96K+000
78K+000
60K+000
42K+000
24K+000
6K+000
0+00
12K+000N
26K+250N
1
2
3
4
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6
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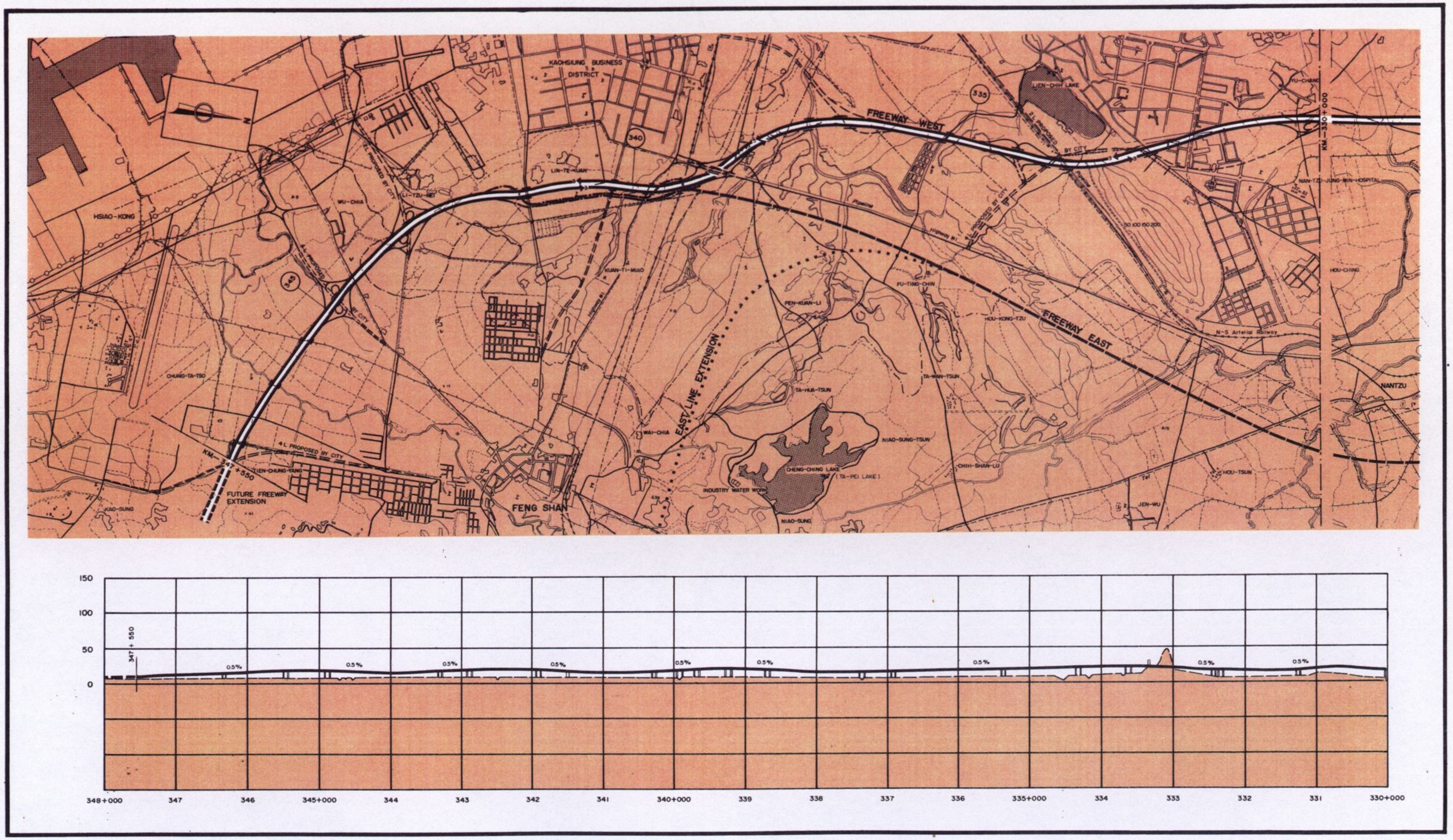
SECTION 7
SECTION 6
SECTION 5
SECTION 4
SECTION 3
SECTION 2
SECTION 1
LEGEND
PROPOSED
FREEWAY ROUTE (FREEWAY WEST) WITH 1990 LANE REQUIREMENTS
MAJOR ALTERNATIVE FREEWAY ROUTE (FREEWAY EAST)
MINOR ALTERNATIVE FREEWAY ROUTE
PROPOSED ACCESS ROAD (4-LANE)
FRONTAGE ROAD
FREEWAY OVER CROSS ROAD
CROSS ROAD OVER FREEWAY
TUNNEL
RELOCATION OF EXISTING HIGHWAY
RELOCATION OF RIVERS
RELOCATION OF EXISTING RAILROAD
END OF EXISTING HIGHWAY
EMERGENCY AIRCRAFT LANDING STRIP
EXISTING
EXISTING HIGHWAYS
2.4-4.8m WIDE LOOSE SURFACE
FOOT PATH, LESS THAN 1.5m
NORMAL GAUGE 3'-6" SINGLE TRACK
NORMAL GAUGE 3'-6" DOUBLE TRACK
BUILT-UP AREA
BOUNDARIES, HSIEN
TELEPHONE OR TELEGRAPH LINE
POWER TRANSMISSION LINE
AERIAL CABLE
LEVEE ROAD ON LEVEE
STEEP BANK OR SLOPING BANK
ROAD THRU TUNNEL
EXISTING
RAILROAD BRIDGE OR VIADUCT
HIGHWAY BRIDGE
SCHOOL
CHURCH
PAGODA
STATUE
MINE
OIL WELL
CEMETERY
ASTRONOMICAL
TRIANGULATION POINT
BENCH MARK (IN METERS)
SPOT ELEVATION CHECKED
EXISTING
HOSPITAL
TEMPLE
WATER WORKS
METEOROLOGICAL STATION
RADIO STATION OR MAST
FACTORY
GENERATING PLANT
HYDROELECTRIC PLANT
RICE PADDIES
MARSH OR SWAMP
CULTIVATED FIELDS
DEPTH CURVES
PROPOSED
PARCLO INTERCHANGE (CROSSROAD OVER FREEWAY)
TRUMPET INTERCHANGE (FREEWAY OVER CROSSROAD)
DIAMOND INTERCHANGE (FREEWAY OVER CROSSROAD)
20 10 0 10 20 30 40 KMS
SCALE 1 : 25,000
REPUBLIC OF CHINA
TAIWAN HIGHWAY BUREAU
NORTH-SOUTH FREEWAY PROJECT
KEY PLAN FOR PLAN AND PROFILE EXHIBITS
DE LEUW, CATHER INTERNATIONAL
CONSULTING ENGINEERS
CHICAGO, ILLINOIS



TAIWAN HIGHWAY BUREAU

NORTH–SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

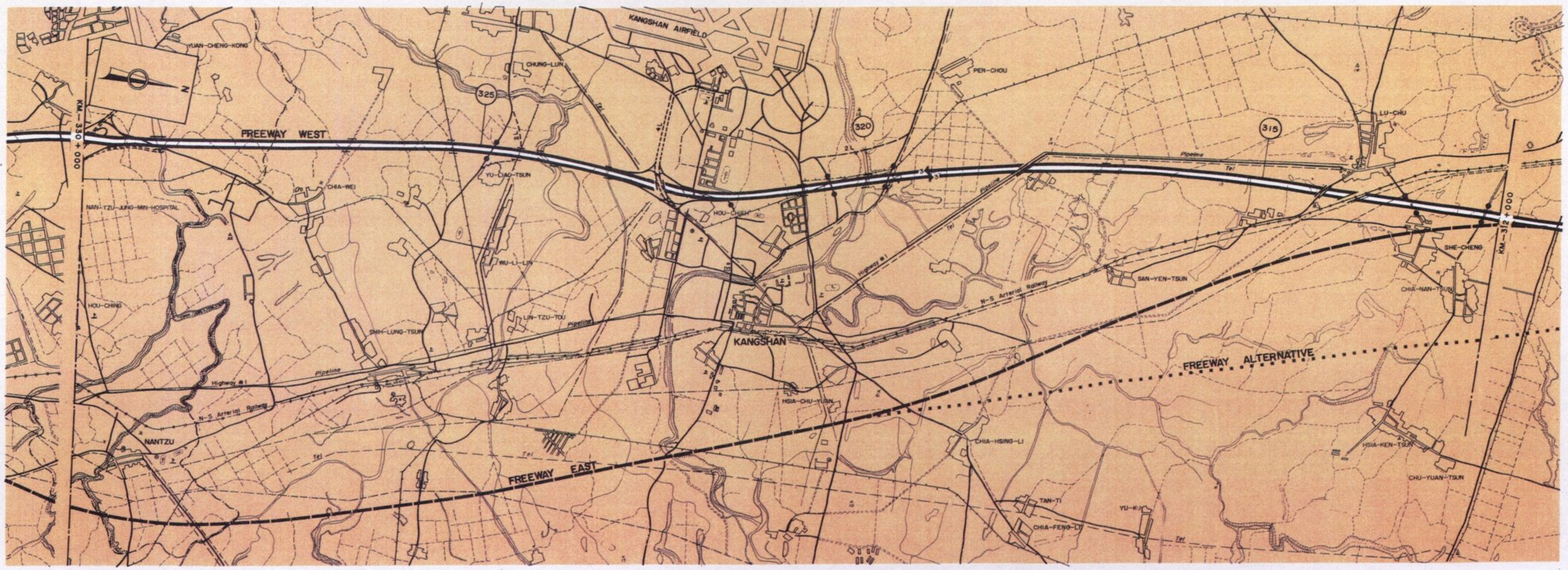
VERTICAL 0 100 200 300 M

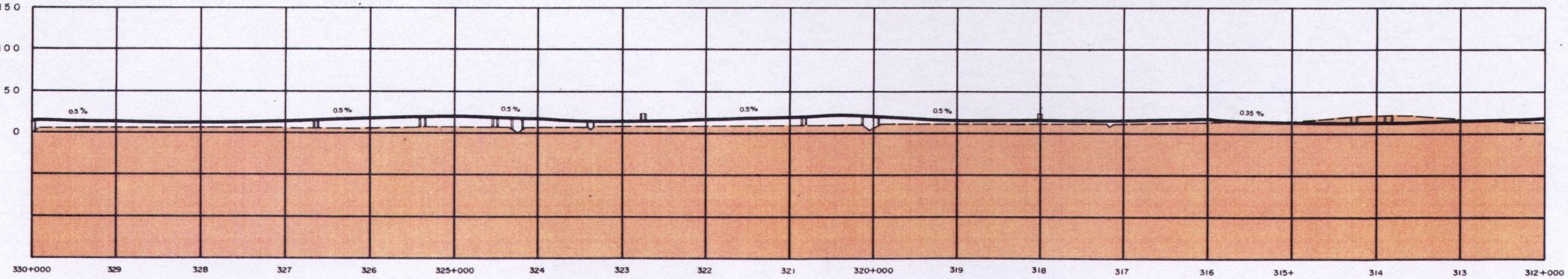
SCALE 1:2,500

FREEWAY ROUTE

STA. 347+550 TO STA 330+000

SECTION 7





TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

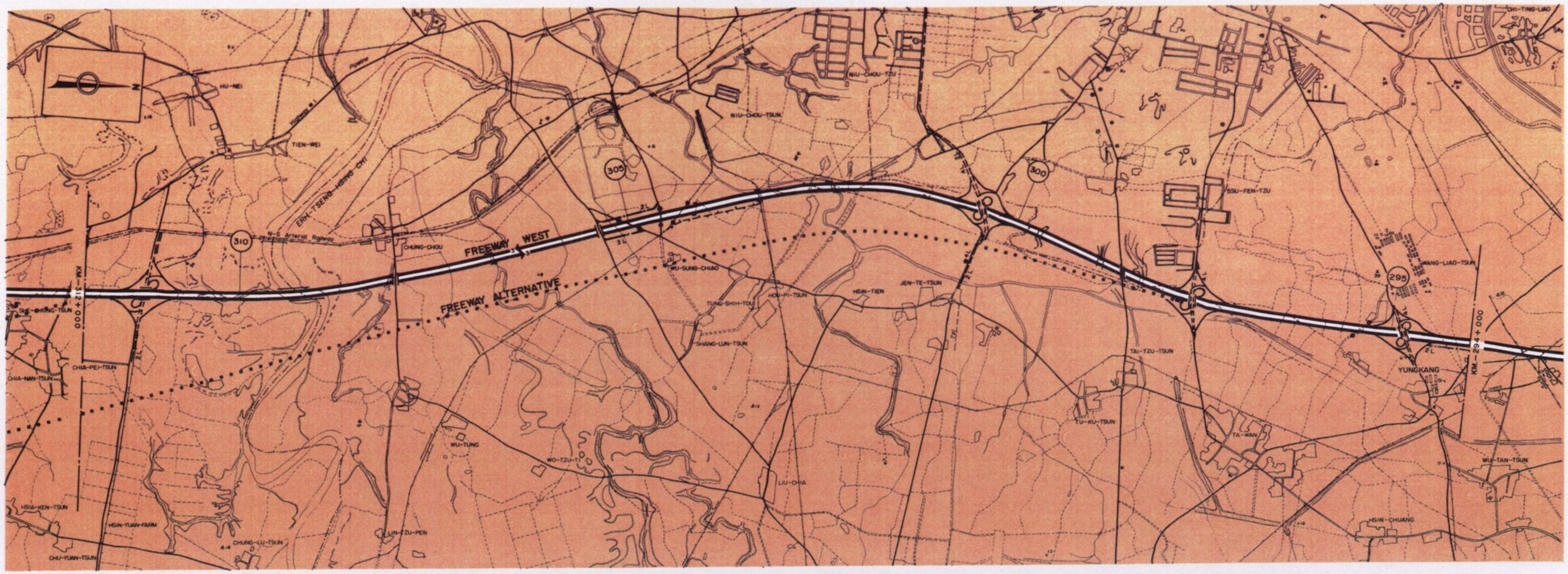
VERTICAL 0 100 200 300 M

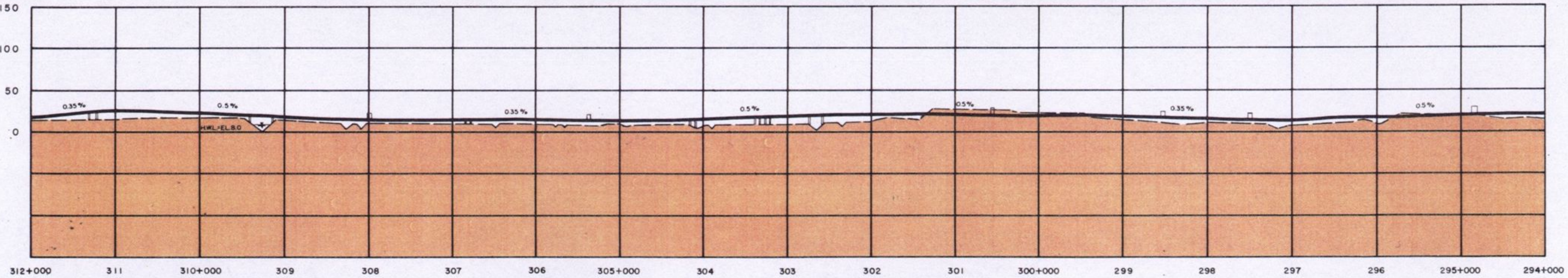
SCALE 1:2,500

FREEWAY ROUTE

STA.330+000 TO STA.312+000

SECTION 7





TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW CATHER INTERNATIONAL

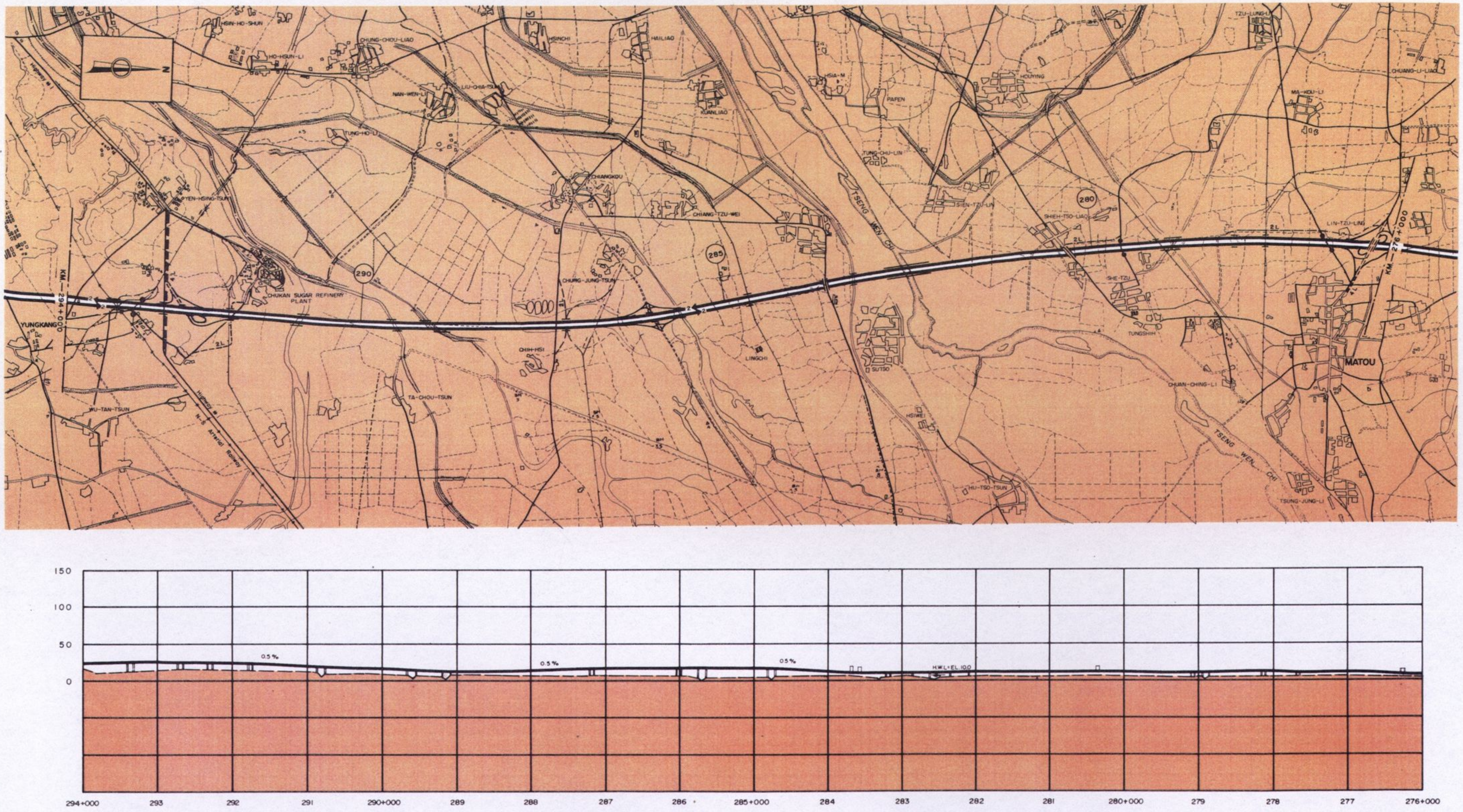
HORIZONTAL 0 1 2 3 KMS
SCALE 1:25,000

VERTICAL 0 100 200 300 M
SCALE 1:2,500

FREEWAY ROUTE

STA.312+000 TO STA.294+000

SECTION 7



TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

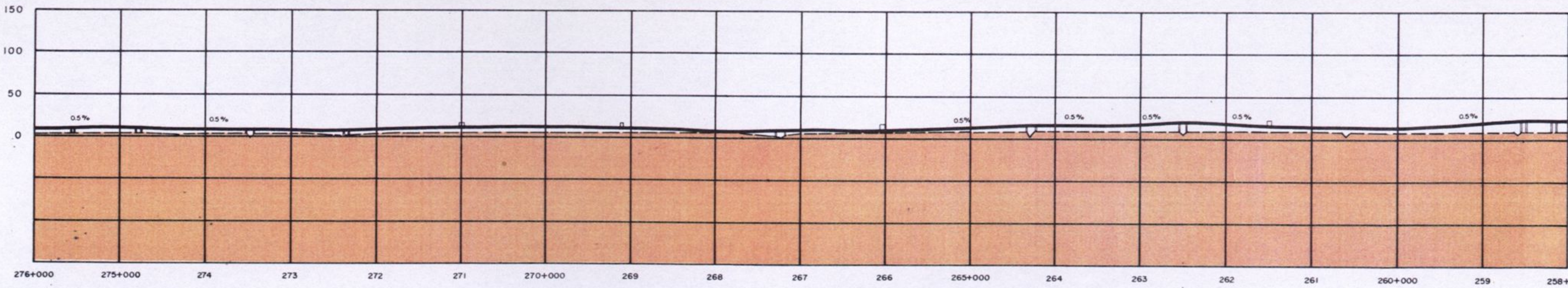
VERTICAL 0 100 200 300 M

SCALE 1:2,500

FREEWAY ROUTE

STA.294+000 TO STA.276+000

SECTION 6



TAIWAN HIGHWAY BUREAU

NORTH–SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

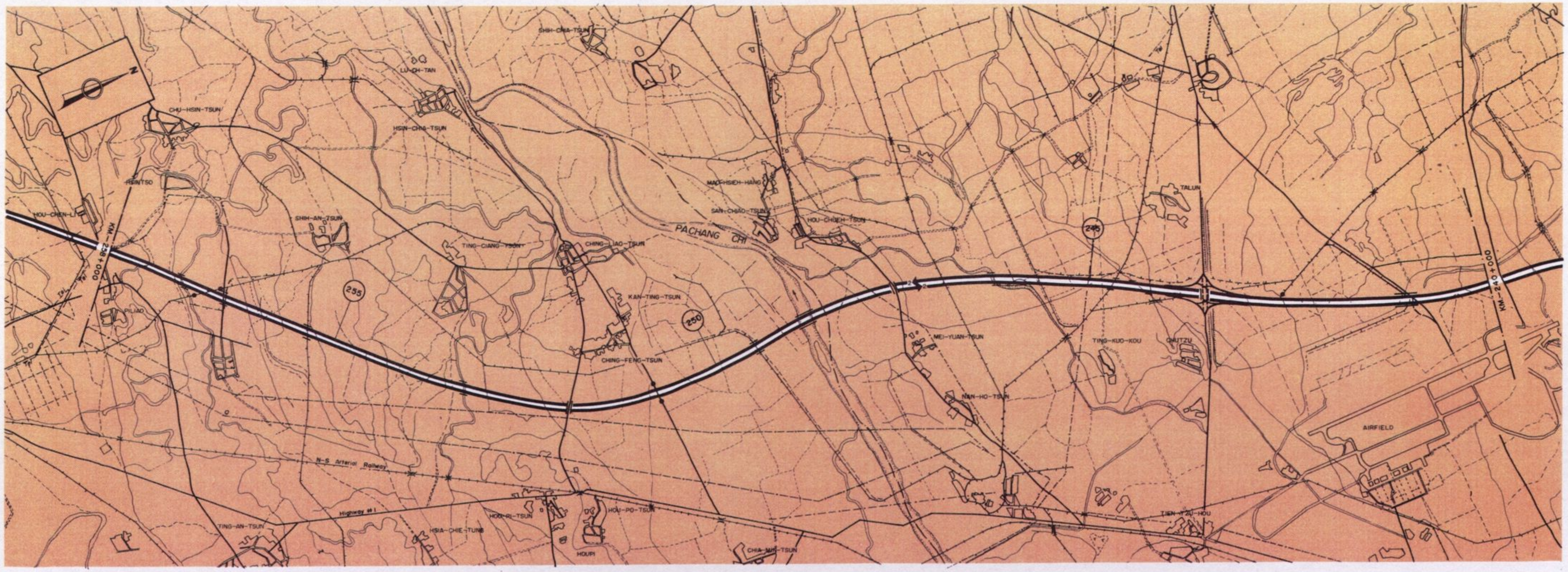
VERTICAL 0 100 200 300 M

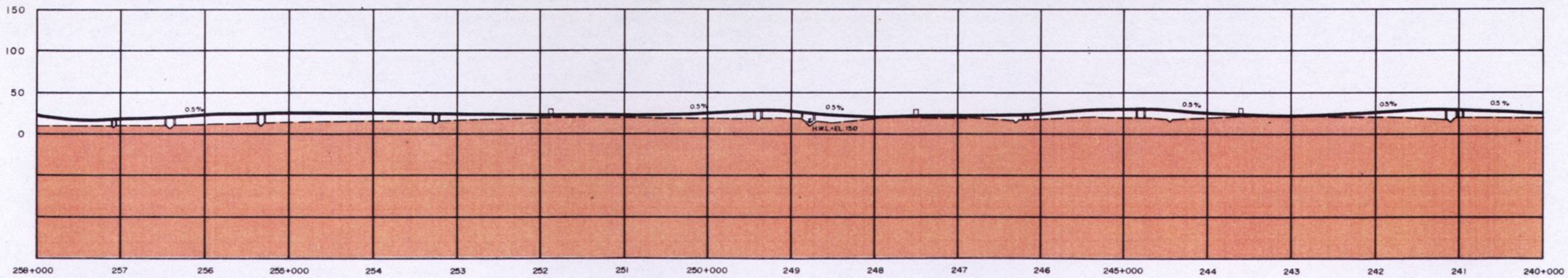
SCALE 1:2,500

FREEWAY ROUTE

STA. 276+000 TO STA. 258+000

SECTION 6





TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

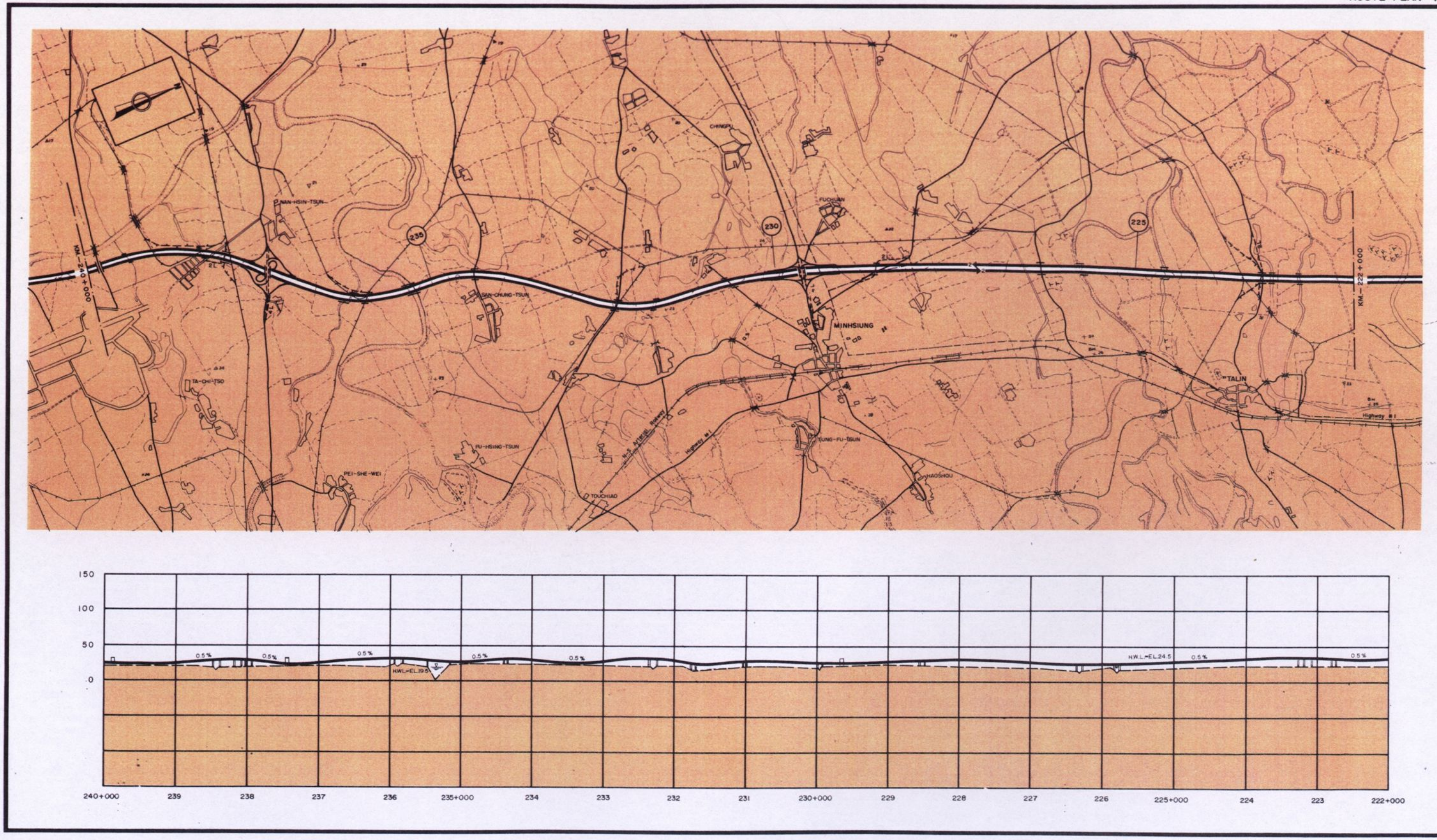
HORIZONTAL 0 1 2 3 KMS
SCALE 1:25,000

VERTICAL 0 100 200 300 M
SCALE 1:2,500

FREEWAY ROUTE

STA.258+000 TO STA.240+000

SECTION 6



TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

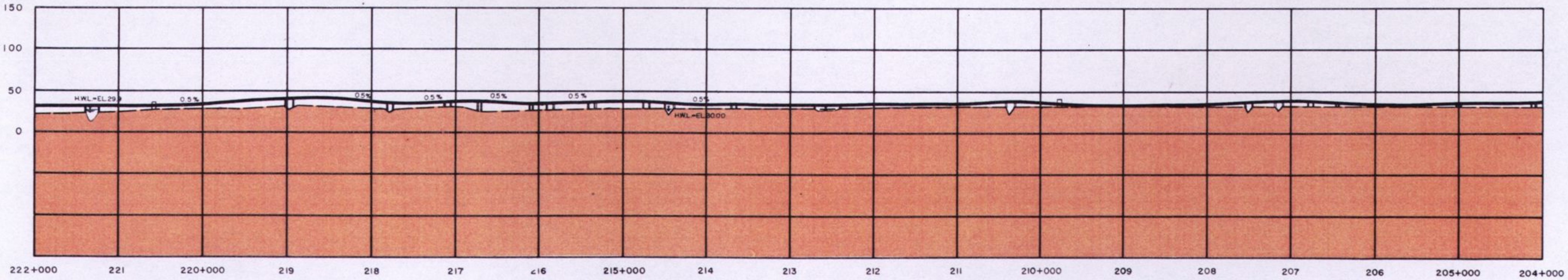
VERTICAL 0 100 200 300 M

SCALE 1:2,500

FREEWAY ROUTE

STA. 240+000 TO STA. 222+000

SECTION 6



TAIWAN HIGHWAY BUREAU

NORTH–SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

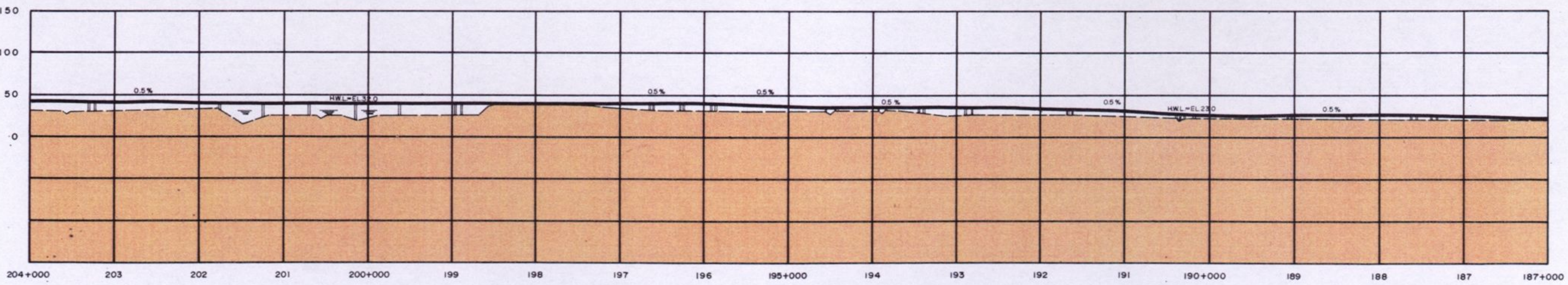
HORIZONTAL 0 1 2 3 KMS
SCALE 1:25,000

VERTICAL 0 100 200 300 M
SCALE 1:2,500

FREEWAY ROUTE

STA.222+000 TO STA.204+000

SECTION 6 AND 5



TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

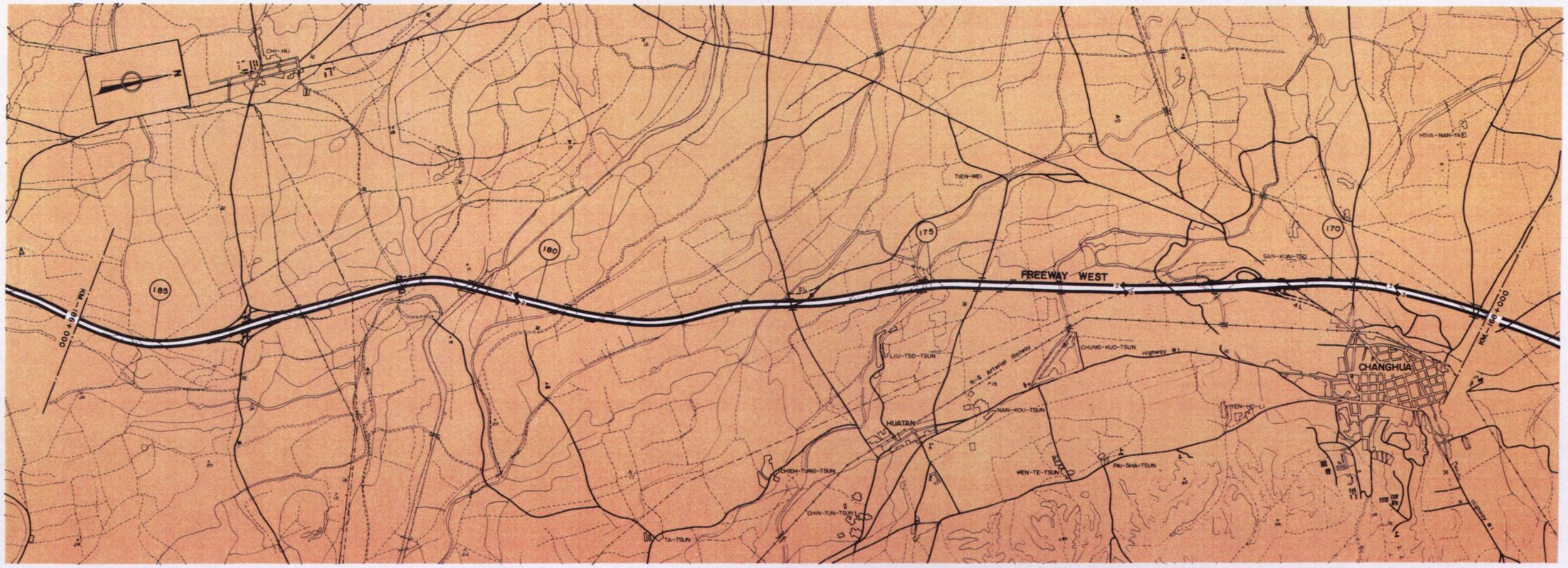
VERTICAL 0 100 200 300 M

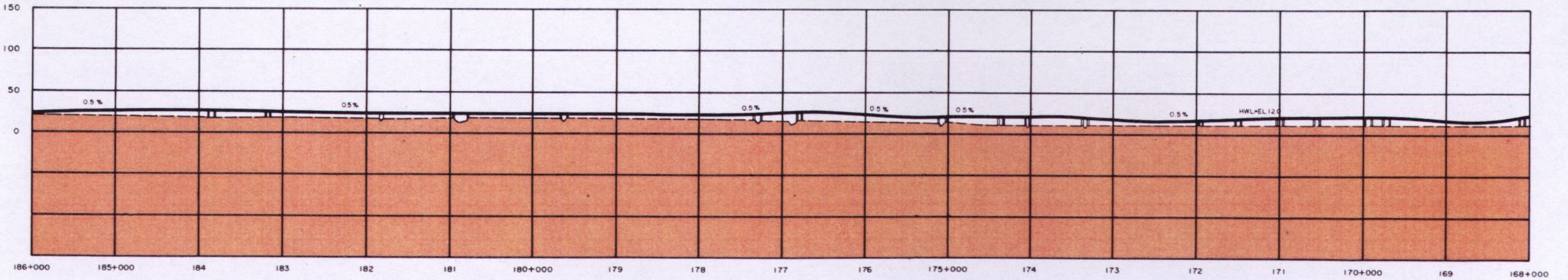
SCALE 1:2,500

FREEWAY ROUTE

STA. 204+000 TO STA. 186+000

SECTION 5





TAIWAN HIGHWAY BUREAU

NORTH–SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

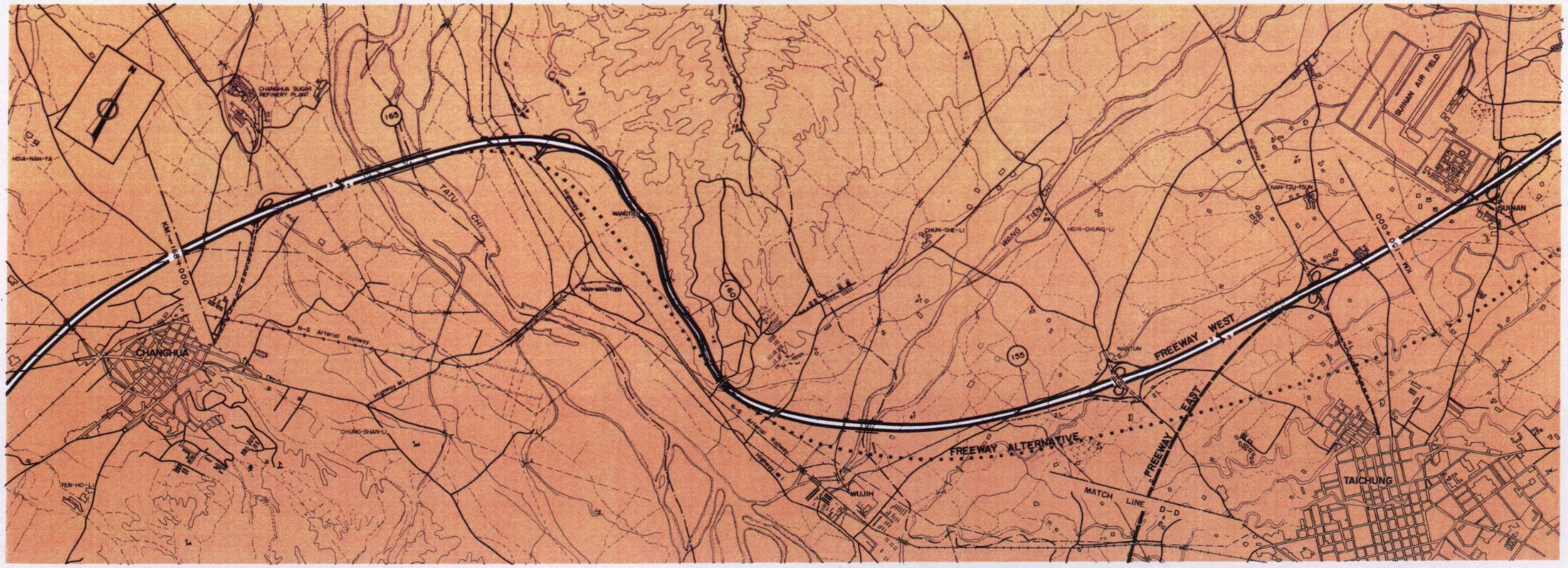
HORIZONTAL 0 1 2 3 KMS
SCALE 1:25,000

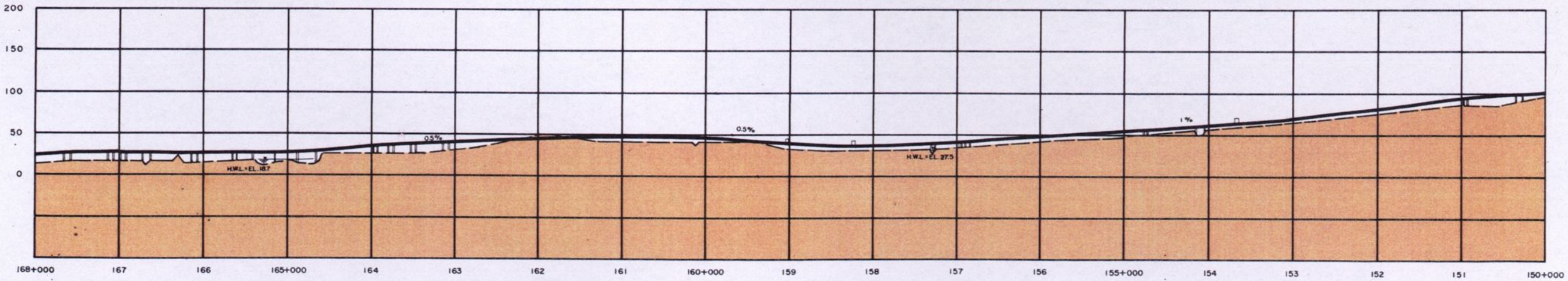
VERTICAL 0 100 200 300 M
SCALE 1:2,500

FREEWAY ROUTE

STA.186+000 TO STA.168+000

SECTION 5





TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

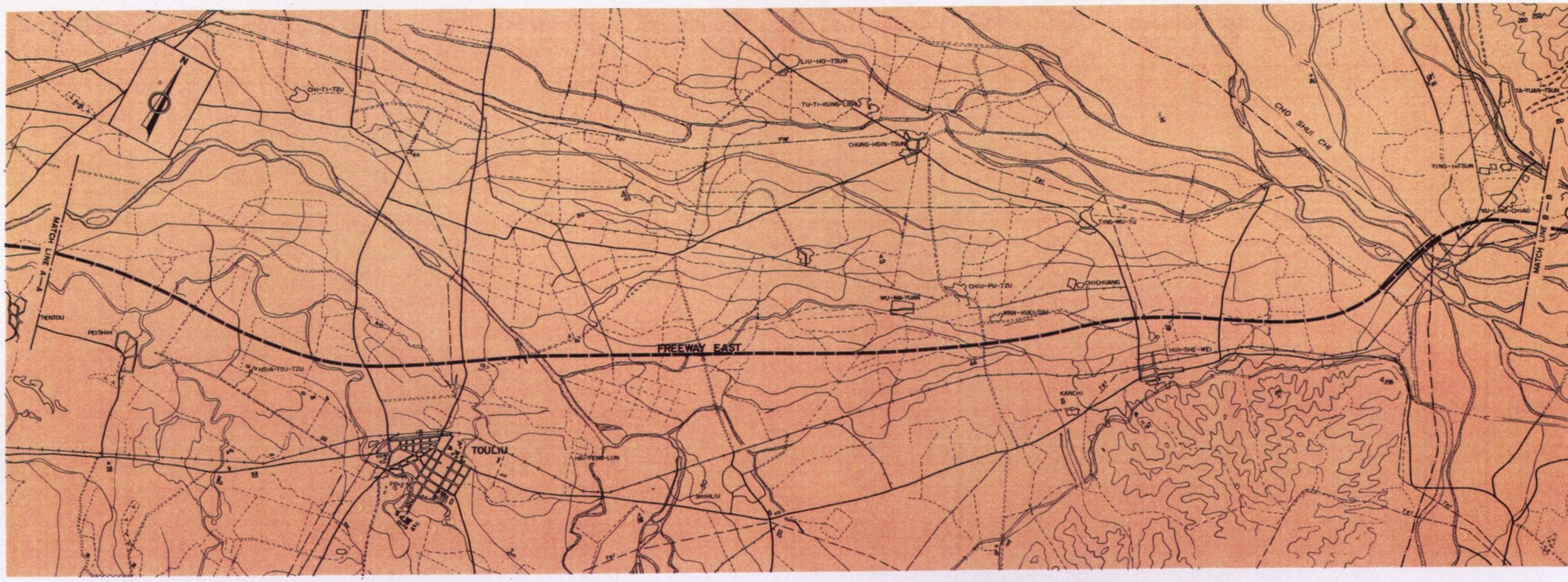
VERTICAL 0 100 200 300 M

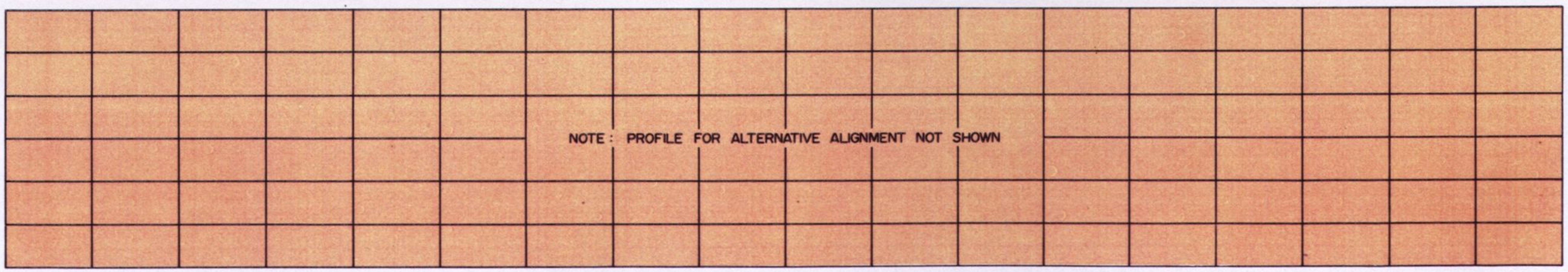
SCALE 1:2,500

FREEWAY ROUTE

STA.168+000 TO STA.150+000

SECTION 5





TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

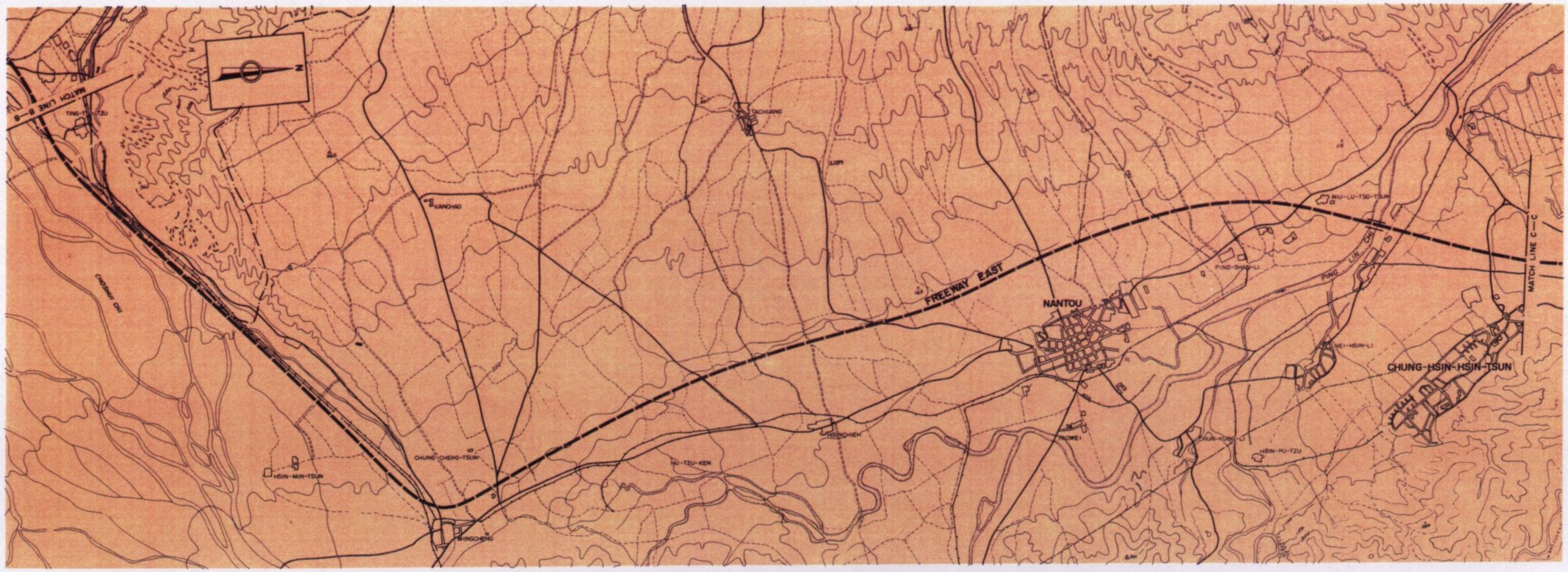
VERTICAL 0 100 200 300 M

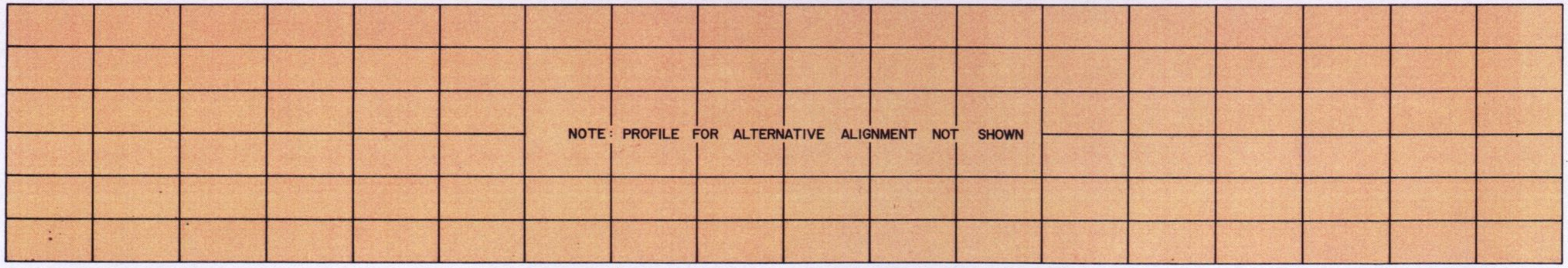
SCALE 1:2,500

FREEWAY ROUTE

FREEWAY EAST

SECTION 5





TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

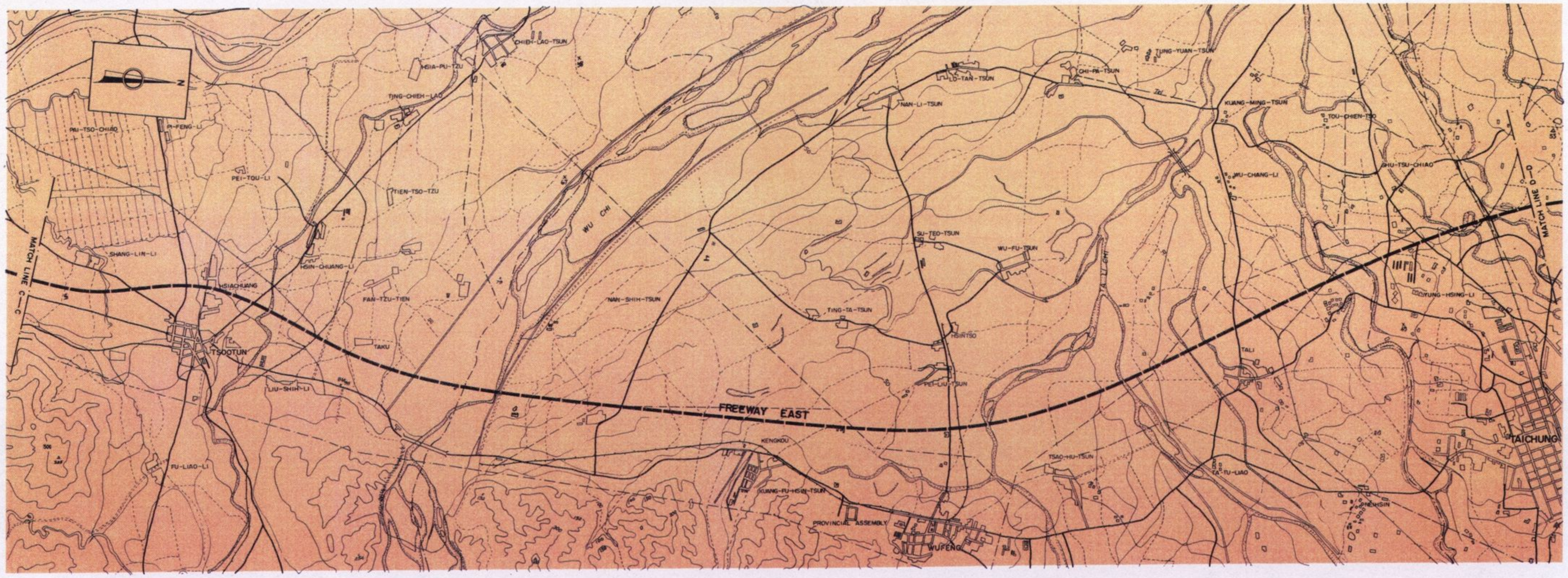
VERTICAL 0 100 200 300 M

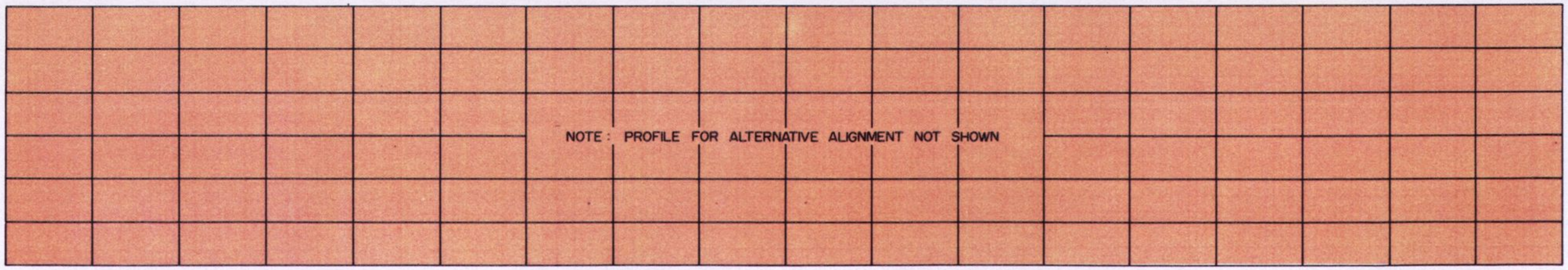
SCALE 1:2,500

FREEWAY ROUTE

FREEWAY EAST

SECTION 5





TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

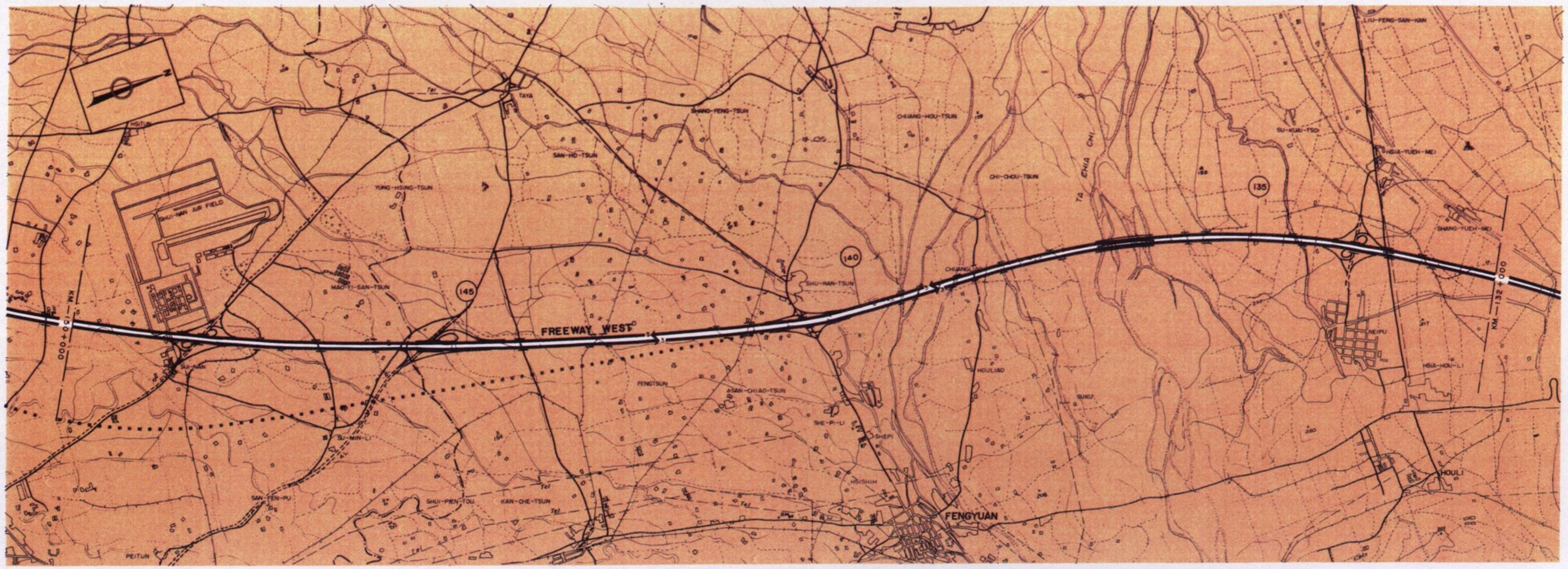
VERTICAL 0 100 200 300 M

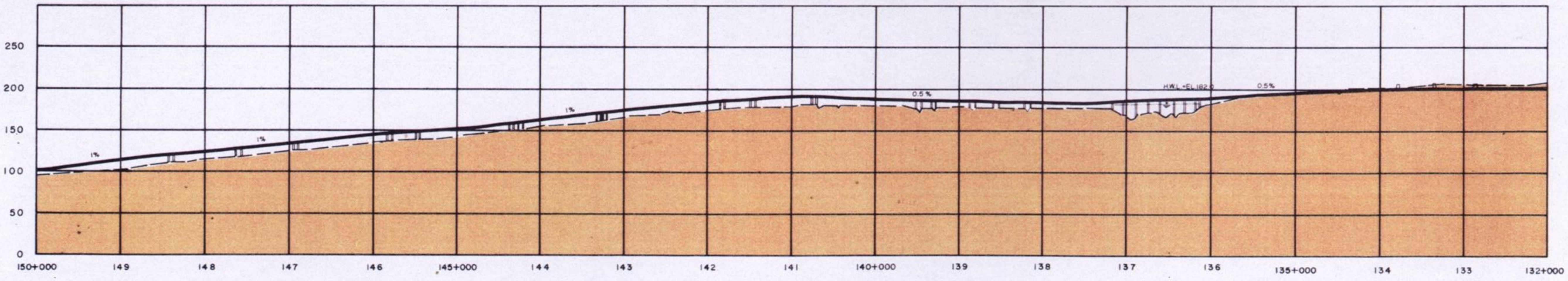
SCALE 1:2,500

FREEWAY ROUTE

FREEWAY EAST

SECTION 5





TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

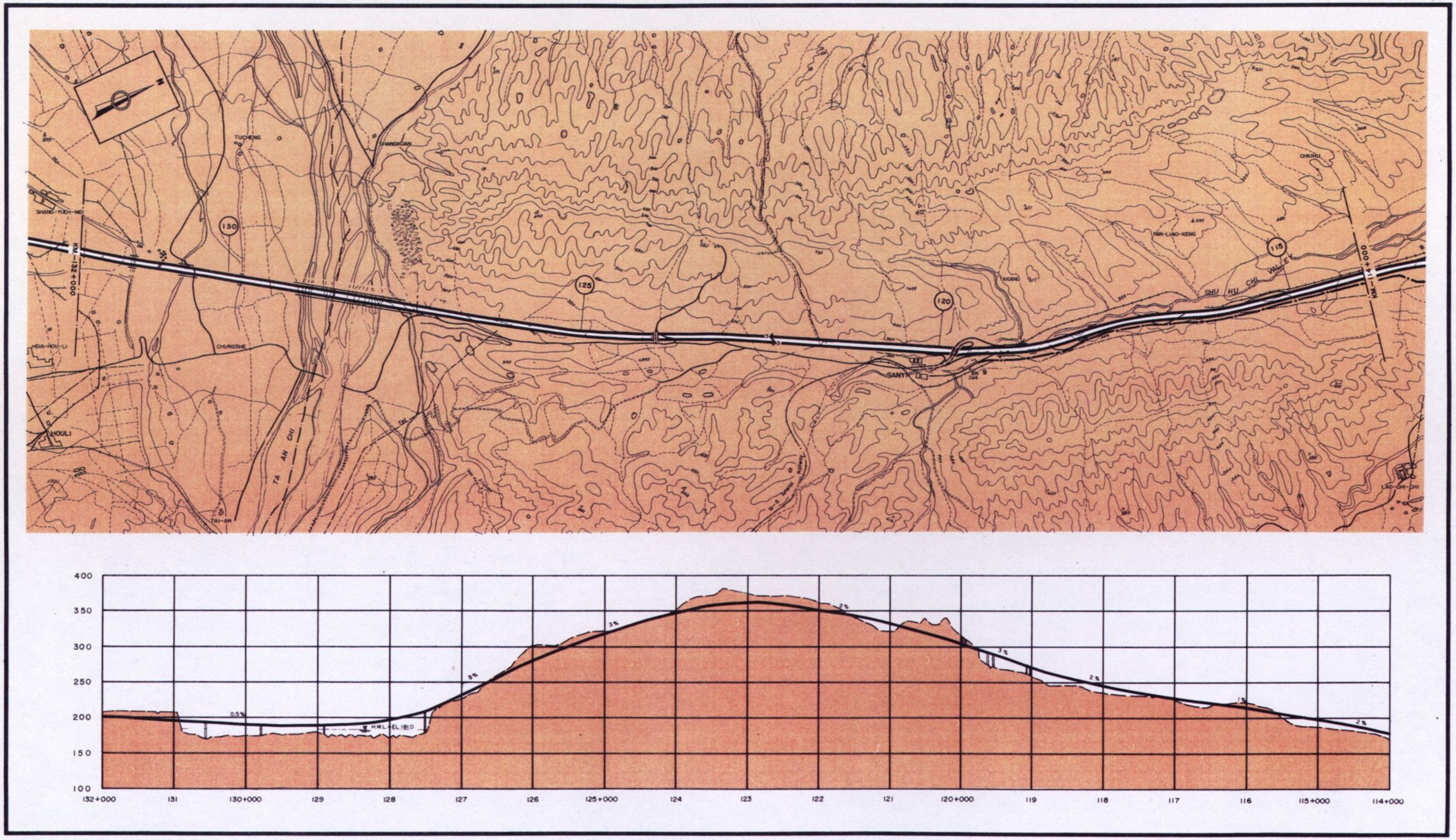
VERTICAL 0 100 200 300 M

SCALE 1:2,500

FREEWAY ROUTE

STA. 150+000 TO STA. 132+000

SECTION 4



TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

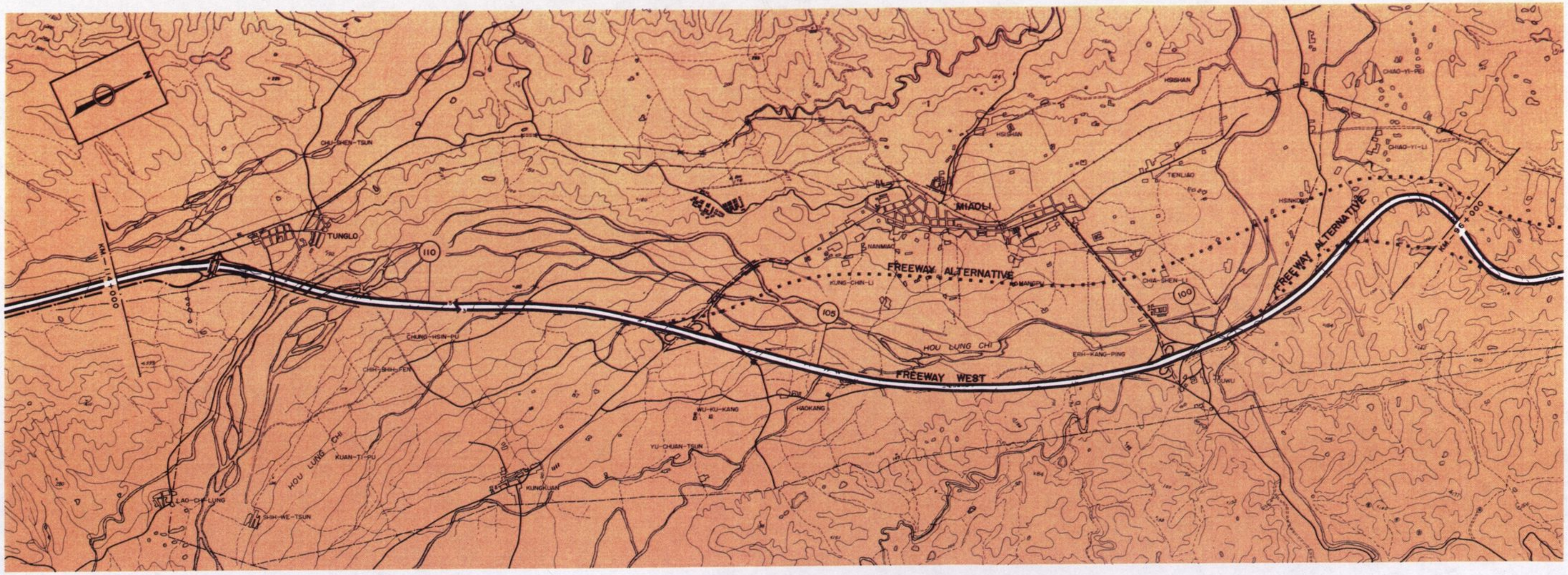
HORIZONTAL 0 1 2 3 KMS
SCALE 1:25,000

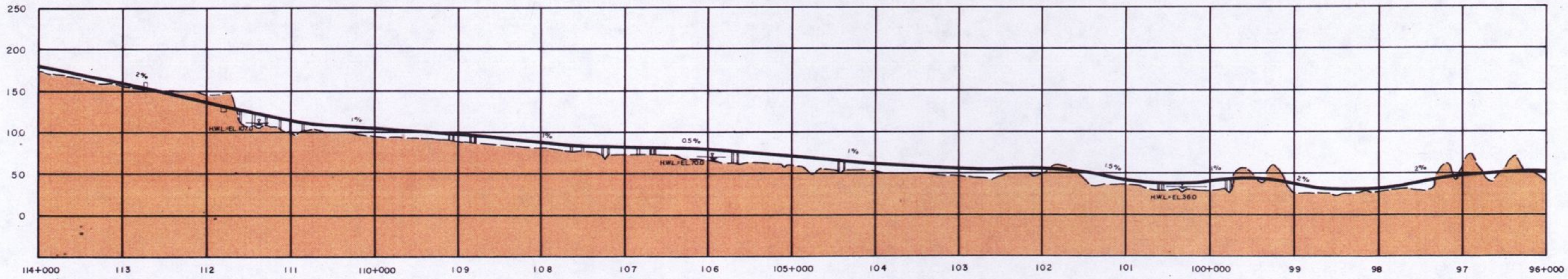
VERTICAL 0 100 200 300 M
SCALE 1:2,500

FREEWAY ROUTE

STA.132+000 TO STA.114+000

SECTION 4





TAIWAN HIGHWAY BUREAU

NORTH–SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

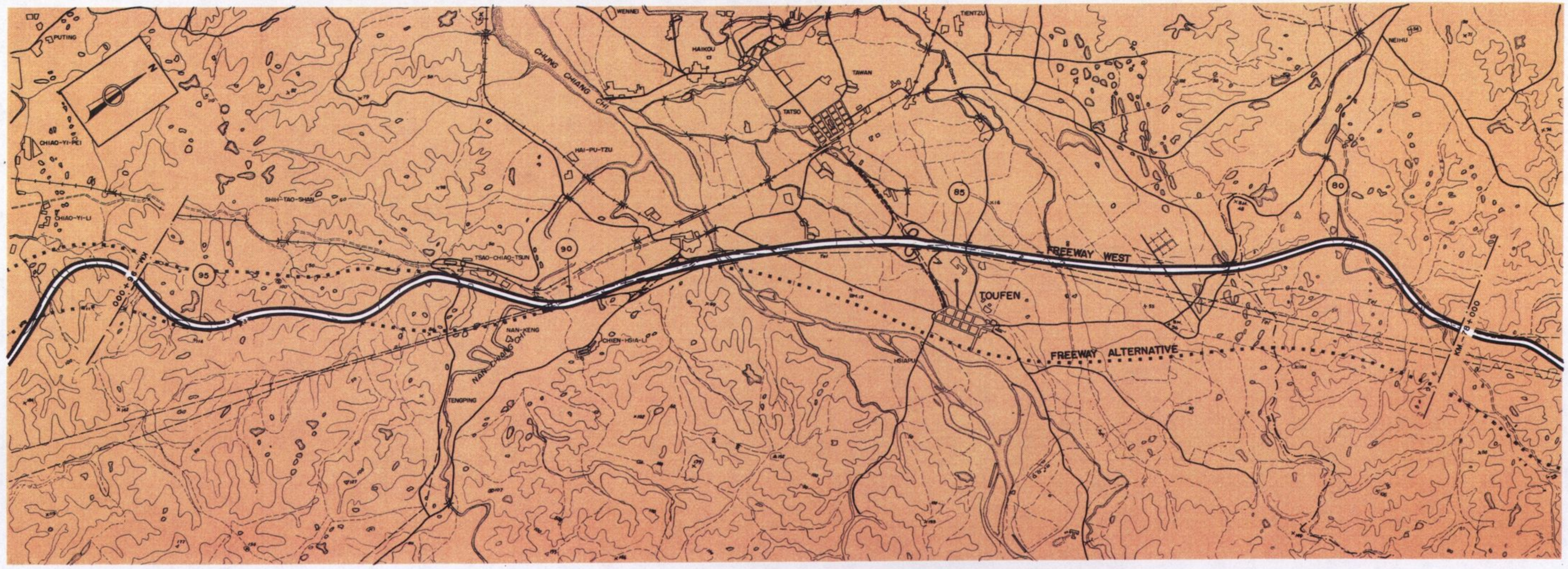
VERTICAL 0 100 200 300 M

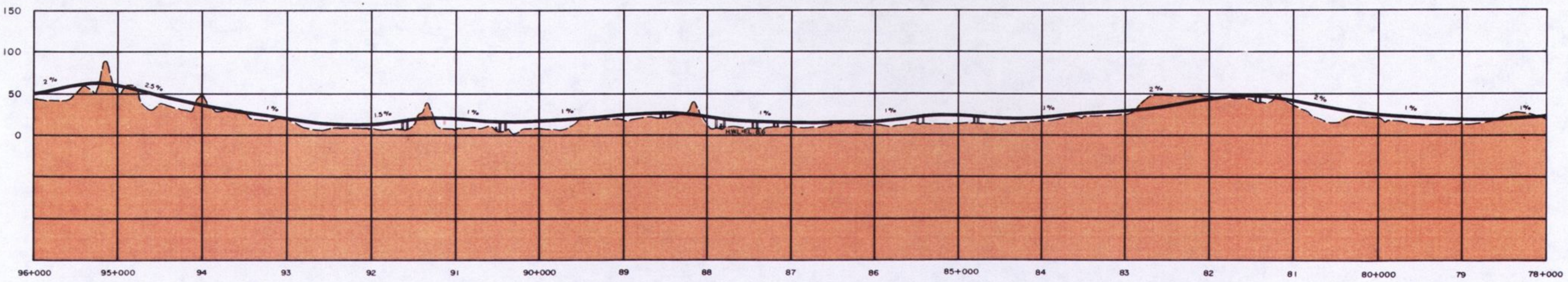
SCALE 1:2,500

FREEWAY ROUTE

STA.114+000 TO STA.96+000

SECTION 4





TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

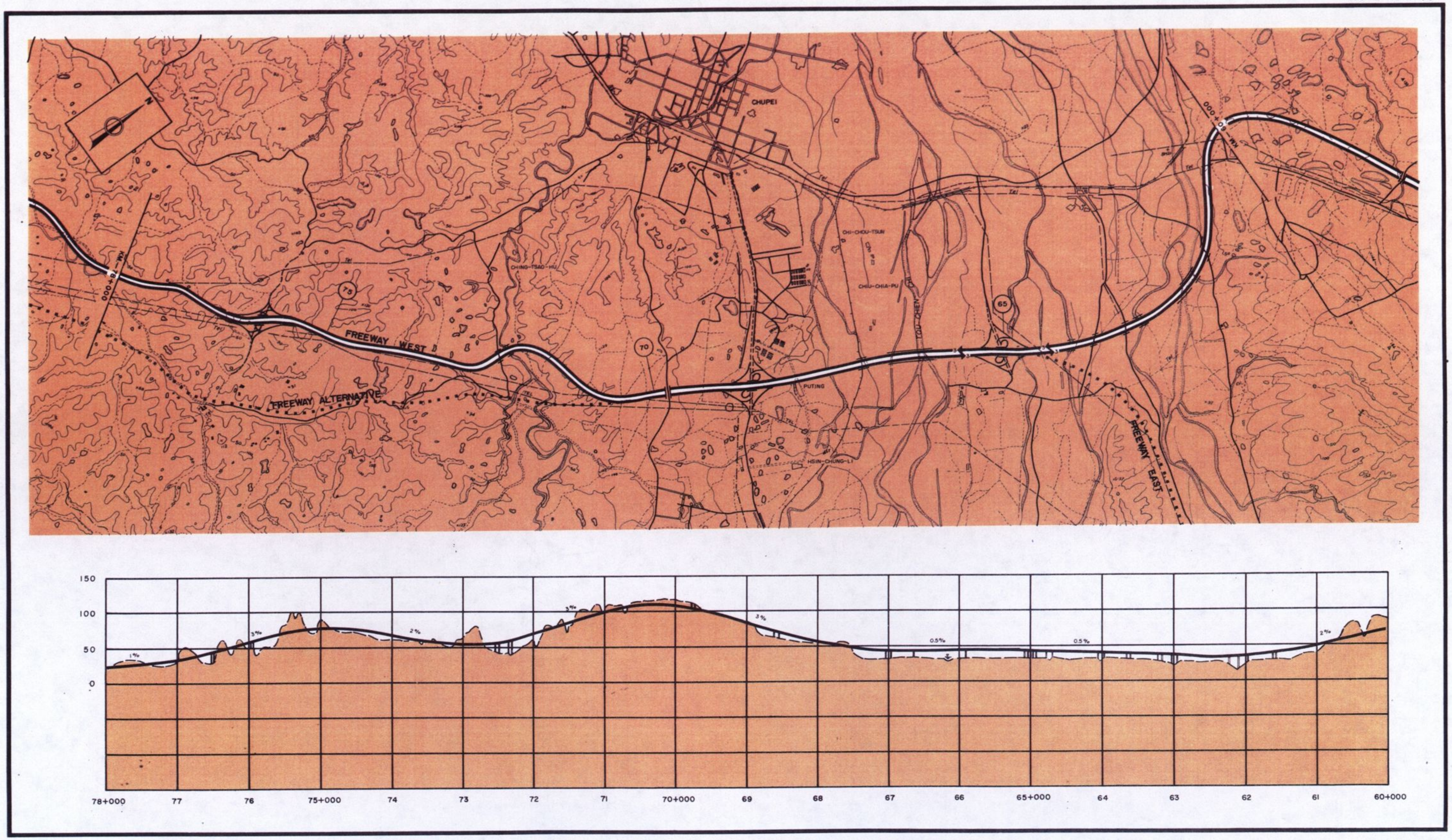
VERTICAL 0 100 200 300 M

SCALE 1:2,500

FREEWAY ROUTE

STA.96+000 TO STA.78+000

SECTION 4



TAIWAN HIGHWAY BUREAU

NORTH–SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

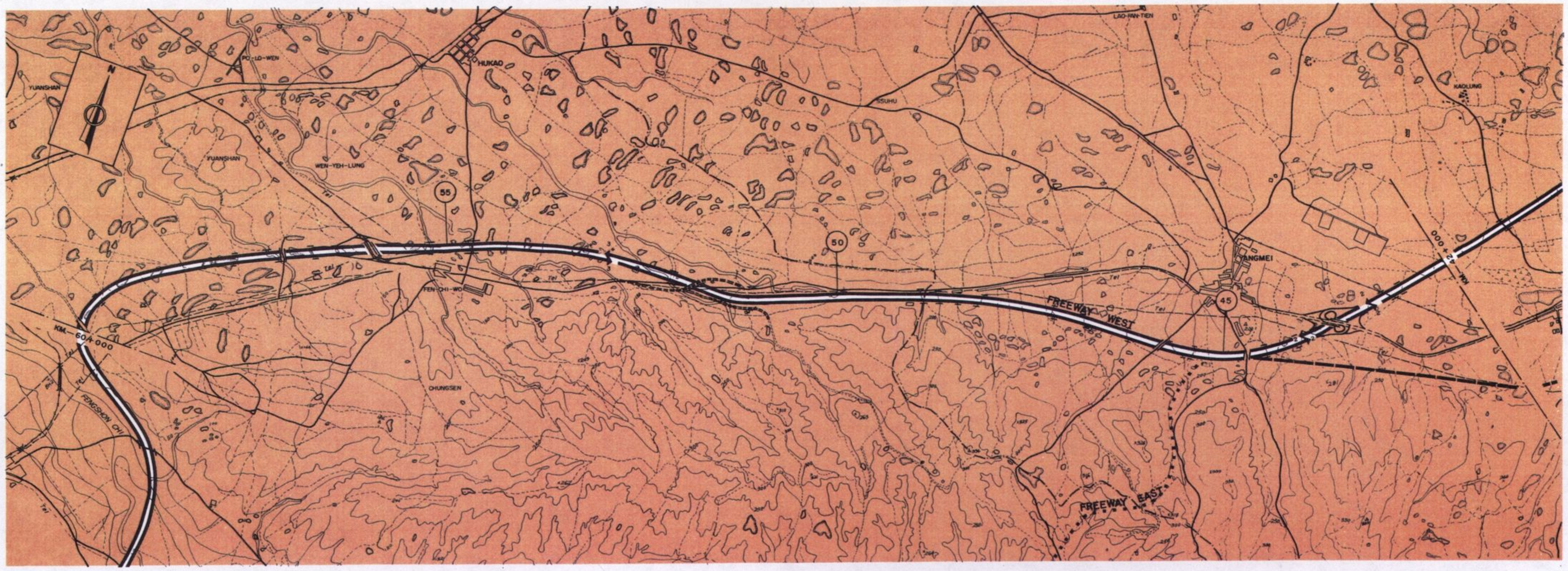
VERTICAL 0 100 200 300 M

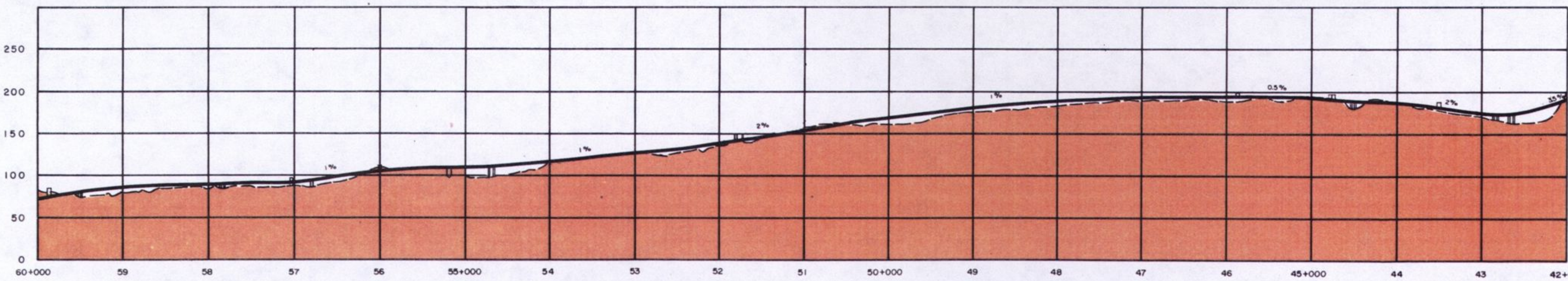
SCALE 1:2,500

FREEWAY ROUTE

STA. 78+000 TO STA. 60+000

SECTION 4





TAIWAN HIGHWAY BUREAU

NORTH–SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

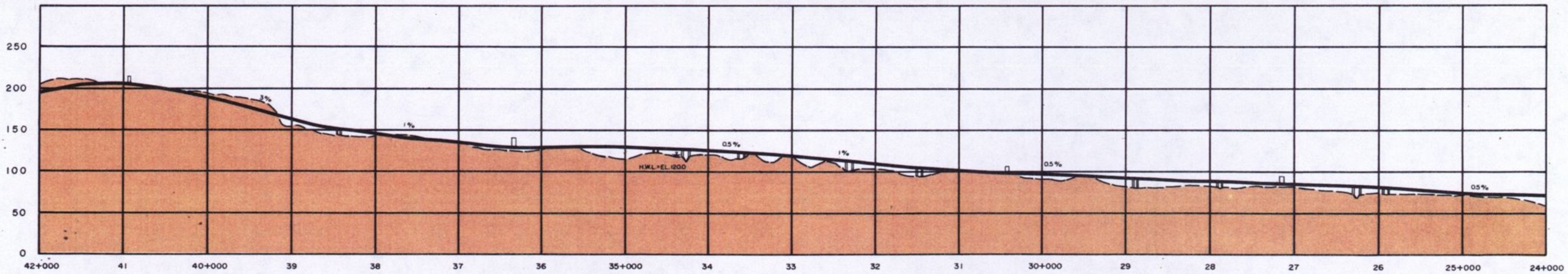
VERTICAL 0 100 200 300 M

SCALE 1:2,500

FREEWAY ROUTE

STA.60+000 TO STA.42+000

SECTION 3



TAIWAN HIGHWAY BUREAU

NORTH–SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

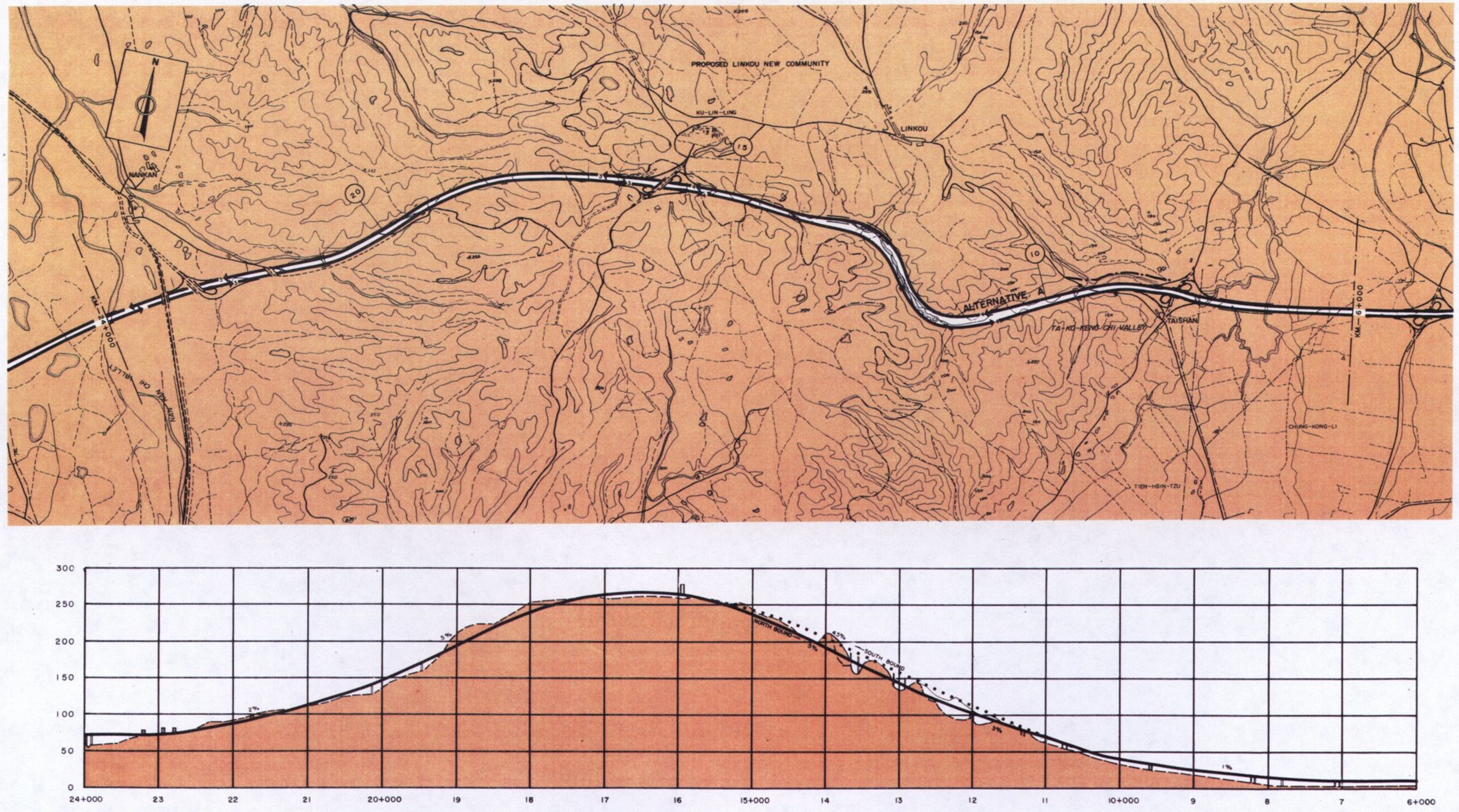
VERTICAL 0 100 200 300 M

SCALE 1:2,500

FREEWAY ROUTE

STA. 42+000 TO STA. 24+000

SECTION 2



TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

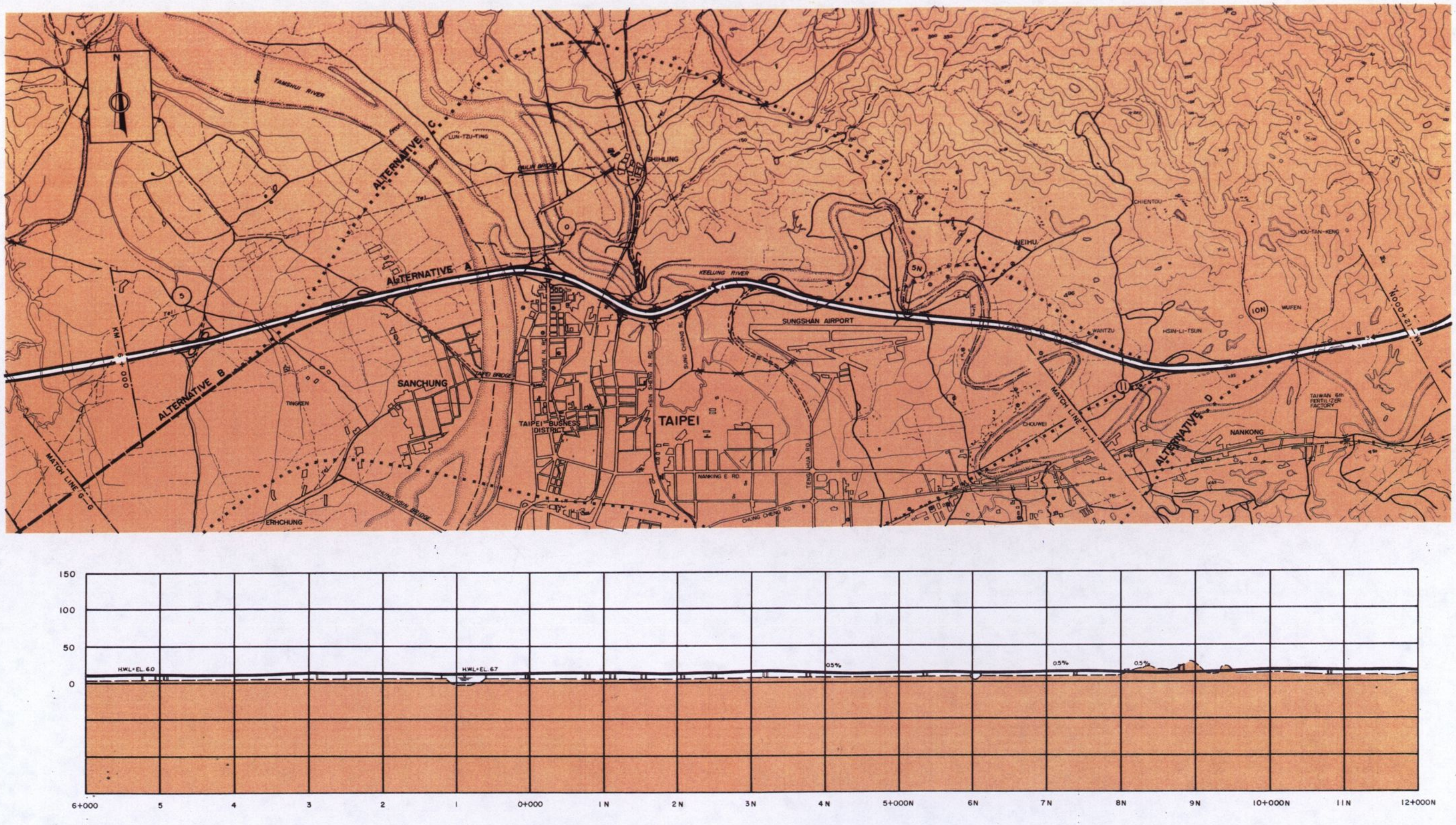
VERTICAL 0 100 200 300 M

SCALE 1:2,500

FREEWAY ROUTE

STA. 24+000 TO STA. 6+000

SECTION 2



TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

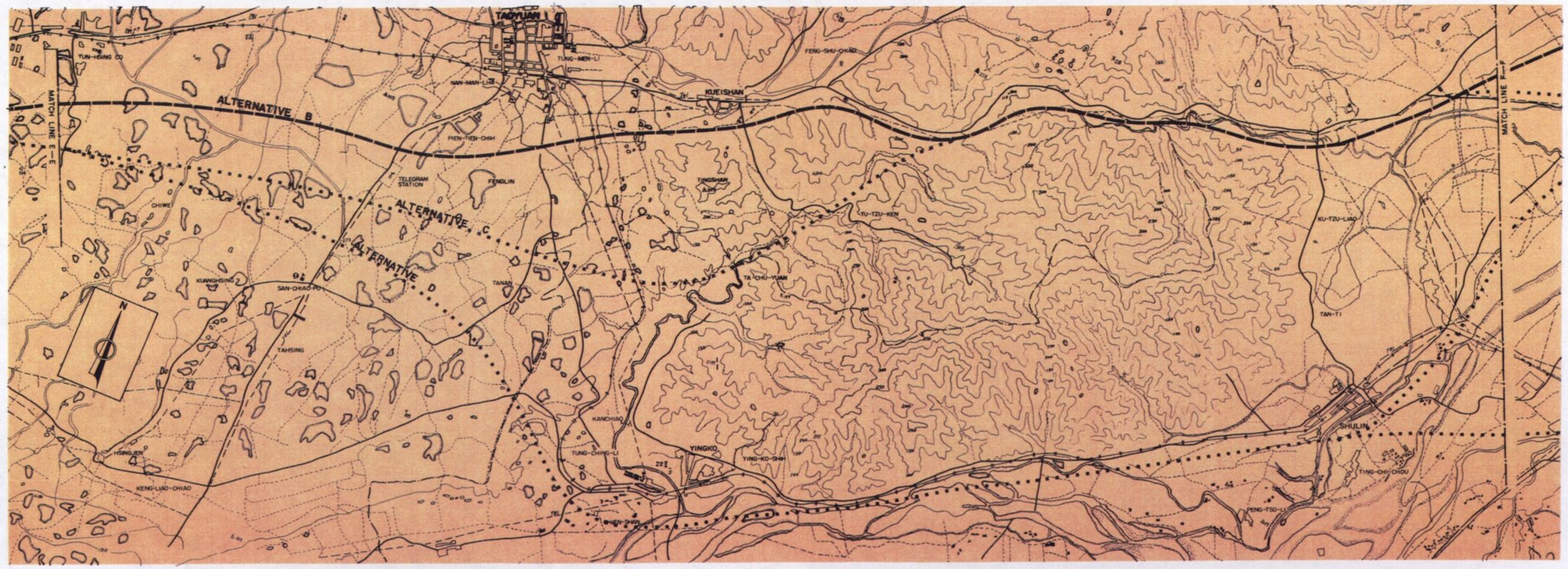
VERTICAL 0 100 200 300 M

SCALE 1:2,500

FREEWAY ROUTE

STA. 6+000 TO STA. 12+000N

SECTION 2



NOTE : PROFILE FOR ALTERNATIVE ALIGNMENT NOT SHOWN

TAIWAN HIGHWAY BUREAU

NORTH–SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

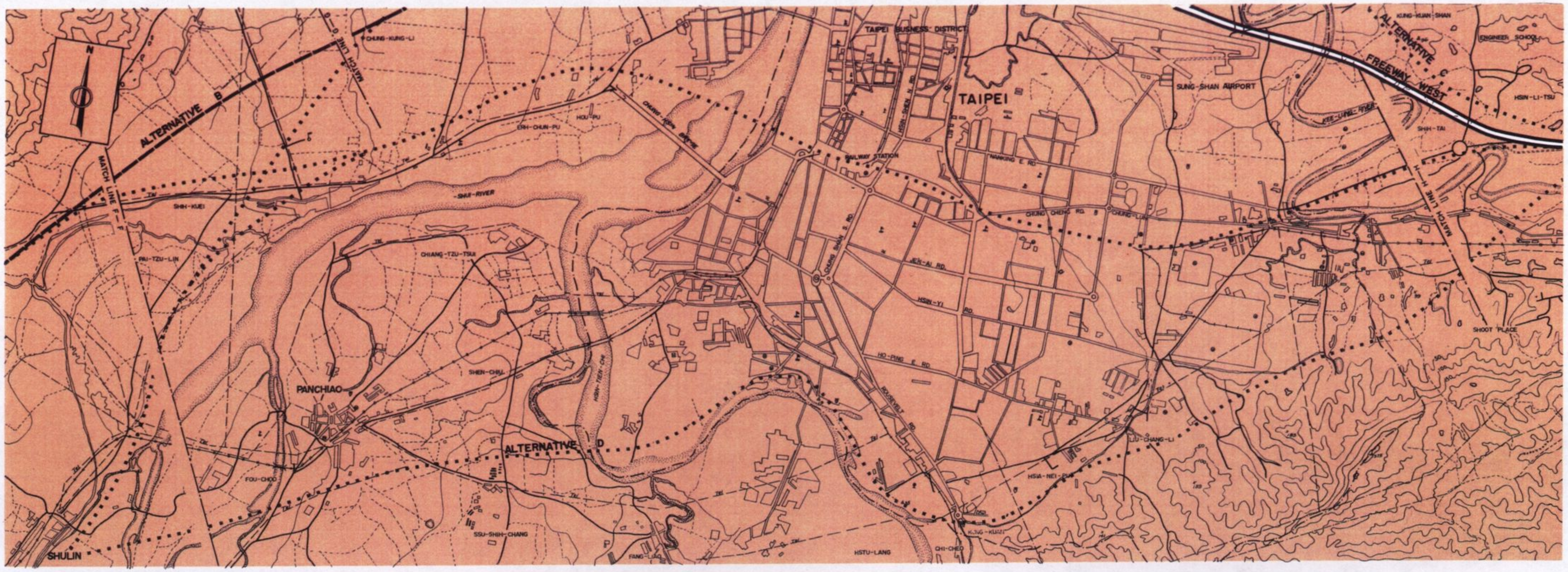
VERTICAL 0 100 200 300 M

SCALE 1:2,500

FREEWAY ROUTE

ALTERNATIVES B, C AND D

SECTION 2



NOTE : PROFILE FOR ALTERNATIVE ALIGNMENT NOT SHOWN

TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS

SCALE 1:25,000

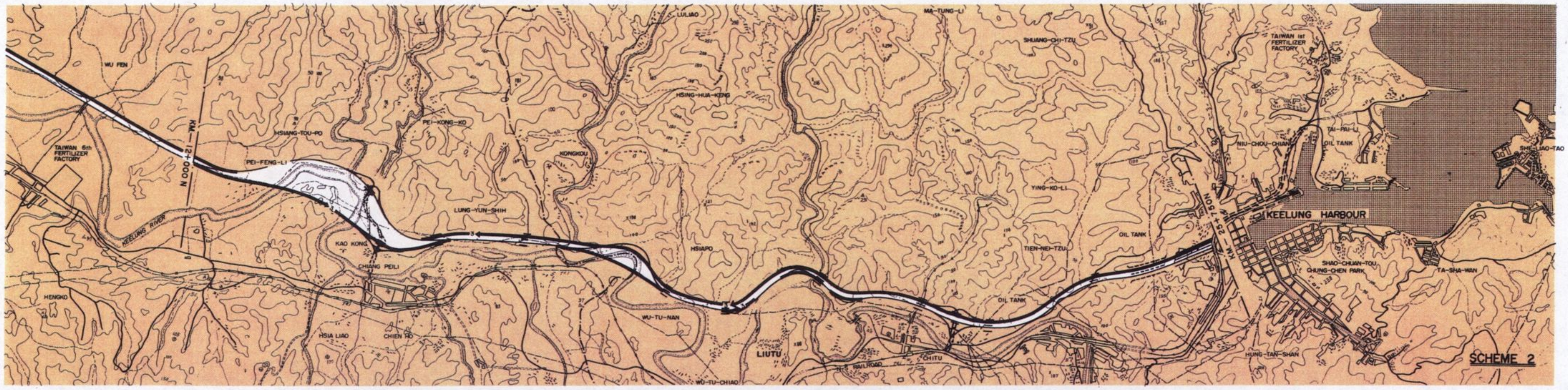
VERTICAL 0 100 200 300 M

SCALE 1:2,500

FREEWAY ROUTE

ALTERNATIVES B, C AND D

SECTION 2



TAIWAN HIGHWAY BUREAU

NORTH—SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

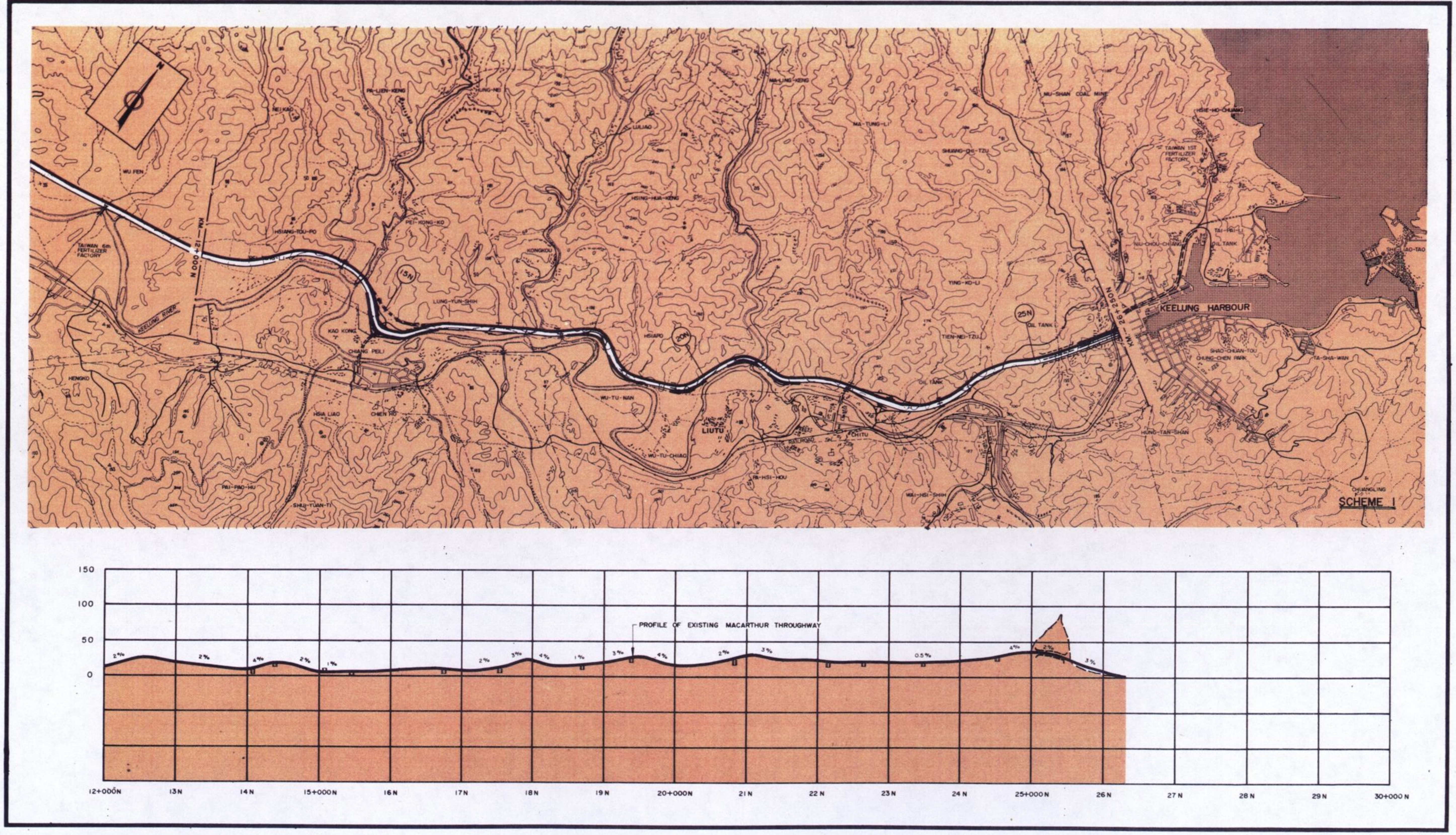
20 10 0 10 20 30 40 KMS

SCALE 1 : 25,000

FREEWAY ROUTE

ALTERNATIVES

SECTION I



TAIWAN HIGHWAY BUREAU

NORTH–SOUTH FREEWAY

FEASIBILITY STUDY

DE LEUW, CATHER INTERNATIONAL

HORIZONTAL 0 1 2 3 KMS SCALE 1:25,000

VERTICAL 0 100 200 300 M SCALE 1:2,500

FREEWAY ROUTE

STA.12+000 TO STA.26+250

SECTION I