

1930.
NEW ZEALAND.

WAITEMATA HARBOUR TRANSIT FACILITIES

(REPORT OF ROYAL COMMISSION APPOINTED TO INQUIRE INTO).

Presented to both Houses of the General Assembly by Command of His Excellency.

COMMISSION.

Appointing a Commission to inquire into and report on the Waitemata Harbour Transit Facilities.

FERGUSSON, Governor-General.

To all to whom these presents shall come, and to FREDERICK WILLIAM FURKERT, Esquire, of Wellington, the Engineer-in-Chief and Under-Secretary of the Public Works Department; JAMES MARCHBANKS, Esquire, of Wellington, Engineer to the Wellington Harbour Board; and COLL McDONALD, Esquire, of Dunedin, Master Mariner, a member of the Otago Harbour Board: Greeting.

WHEREAS it is expedient that inquiry should be made into the Waitemata Harbour transit facilities, and into such questions arising thereout as are hereinafter more particularly set forth:

Now, therefore, I, General Sir Charles Fergusson, Baronet, Governor-General of the Dominion of New Zealand, in pursuance and exercise of the powers conferred upon me by the Commissions of Inquiry Act, 1908, and of all other powers and authorities enabling me in this behalf, and acting by and with the advice and consent of the Executive Council of the said Dominion, do hereby constitute and appoint you, the said

FREDERICK WILLIAM FURKERT,
JAMES MARCHBANKS, and
COLL McDONALD,

to be a Commission to inquire into and report upon the following matters:—

1. The present Waitemata Harbour transit facilities.
2. The present and future harbour transit requirements.
3. The means by which such requirements may best be provided, and in particular the following matters:—

(1) The necessity or otherwise for the building of a bridge across the Waitemata Harbour.

In considering this question the Commission shall take into consideration the adequacy, efficiency, and suitability of the existing harbour transit facilities, in view of the population, capital value of the North Shore boroughs and adjacent

Waitemata County areas, the travelling population, the number of motor-vehicles likely to require transport facilities across the harbour, the distances from the present ferry routes to the harbour-bridge sites suggested by the Auckland Harbour Bridge Association, Incorporated, or any other practicable site, the probable passenger fares and times taken from various termini by any proposed route to the city compared with the present ferry and vehicular charges and times, the liabilities of any proposed rating-area if rated to cover the whole or portion of the cost of the bridge and its approaches, or alternatively the probable tolls chargeable on those using the bridge.

If the former question is answered in the negative, then the Commission shall consider the period of time within which the probable growth of population and use of motor-vehicles, together with other methods of transport, shall so increase the necessity for increased transit facilities across the harbour as to render the bridge necessary.

(2) The following details concerning the bridge :—

- (a) The most suitable site at which the bridge should cross the harbour, taking into consideration the present location of the populations on each side of the water, the probable growth thereof, the main arterial highway system of the metropolitan and adjacent areas either now existing or likely to be adopted, and the extent to which such harbour is required for commercial or naval purposes, or for aviation, or otherwise, bearing in mind the future development of such harbour.
- (b) The type and general nature of the bridge which will be the most suitable, including minimum length of the main spans, the height above high water, spring tide, the width and the loading.
- (c) The location, width, and nature of the approaches to such bridge, and especially whether in addition to the bridge itself causeways should be constructed interconnecting Bayswater, Northcote, and Stanley Point, or other portions of either shore, and the land required for construction of approaches to bridgeheads.
- (d) The cost of the bridge on the recommended site, together with the costs of any other bridges which are investigated.

In arriving at the cost, the compensation for land required for the approaches, and for interference with rights (if any) injuriously affected, together with the cost of preliminary borings, surveys, &c., shall be taken into consideration.

(3) The method by which the construction of the bridge shall be financed.

(a) If in the ordinary way by loans raised, then—

- (i) The area which shall be rated to provide the necessary funds ;
- (ii) The proportions in which the various local authorities within the rating-area should contribute ;
- (iii) The proportion, if any, which should be found by the general Government ; or

(b) If by tolls, the approximate tolls which should be charged the various classes of vehicles and other traffic ; or

(c) If by a levy on the lands increased in value by the execution of the works, what lands should be levied on and in what proportions ; or

(d) If by contracting with any individual or company to construct the bridge, receiving as consideration therefor the right to collect tolls for a specific period, on the understanding that at the end of such period the bridge is handed over free of encumbrances to the controlling authority, then for what period, and to which authority, and under what special conditions ; or

(e) If partly by one of these methods, or partly by another, or by any other method, then which method or methods.

(4) Whether the construction and future control of the bridge shall be carried out by some existing local authority, and if so which, or by a special local authority having rating or other special powers over the proposed rating district, or by the Government.

(5) Should the Commission be of the opinion that the transit requirements of the district under consideration could be equally as well, or better, served by means of a tunnel or tunnels, then all the questions recited above with regard to the bridge shall, *mutatis mutandis*, be answered with respect to the tunnelling proposal in so far as applicable.

And generally any other matters arising out of the premises which may come under your notice in the course of your inquiries, and which you consider should be investigated in connection therewith.

And with the like advice and consent I do further appoint you, the said

JAMES MARCHBANKS,

to be the Chairman of the said Commission.

And you are hereby authorized to conduct any inquiry under these presents at such times and places as you deem expedient, with power to adjourn from time to time and place to place as you think fit, and to arrange for taking of soundings and boring in the Waitemata Harbour to the extent to which funds are available and to call before you and to examine on oath or otherwise such persons as you think capable of affording you information as to the matters aforesaid, and to call for and examine all such books, papers, writings, documents, and records as you deem likely to afford you the fullest information on any such matters.

And, using all due diligence, you are required to report to me, under your hands and seals, not later than the first day of May, one thousand nine hundred and thirty, your opinion on the aforesaid matters.

And you are hereby strictly charged and directed that you shall not at any time publish or otherwise disclose, save to me in pursuance of these presents or by my direction, the contents or purport of any report so made or to be made by you.

And it is hereby declared that this Commission shall continue in full force and virtue although the inquiry be not regularly continued from time to time or from place to place by adjournment.

And, lastly, it is hereby further declared that these presents are issued under and subject to the provisions of the Commissions of Inquiry Act, 1908.

Given under the hand of His Excellency, General Sir Charles Fergusson, Baronet, General on the Retired List and in the Reserve of Officers of His Majesty's Army; Doctor of Laws; Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George; Knight Commander of the Most Honourable Order of the Bath; Companion of the Distinguished Service Order; Member of the Royal Victorian Order; Governor-General and Commander-in-Chief in and over His Majesty's Dominion of New Zealand and its Dependencies; and issued under the Seal of the said Dominion at the Government House at Wellington, this nineteenth day of October, in the year of our Lord, one thousand nine hundred and twenty-nine.

GEO. W. FORBES,

For Minister of Public Works.

GOD SAVE THE KING!

Issued in Executive Council.

F. D. THOMSON,
Clerk of the Executive Council.
19/10/1929.

REPORT.

To His Excellency the Right Honourable Charles, Baron Bledisloe, Member of His Majesty's Most Honourable Privy Council, Knight Grand Cross of the Most Distinguished Order of Saint Michael and Saint George, Knight Commander of the Most Excellent Order of the British Empire, Governor-General and Commander-in-Chief in and over His Majesty's Dominion of New Zealand and its Dependencies.

MAY IT PLEASE YOUR EXCELLENCY,—

The Commission, dated the 19th day of October, 1929, entrusted to us by Your Excellency's predecessor, General Sir Charles Fergusson, directed us to inquire into and report upon the following matters:—

1. The present Waitemata Harbour facilities.
2. The present and future harbour transit requirements.
3. The means by which such requirements may best be provided, and in particular the following matters:—
 - (1) The necessity or otherwise for the building of a bridge across the Waitemata Harbour.
 - (2) The following details concerning the bridge:—
 - (a) The most suitable site at which the bridge should cross the harbour, taking into consideration the present location of the populations on each side of the water, the probable growth thereof, the main arterial highway system of the metropolitan and adjacent areas now existing or likely to be adopted, and the extent to which such harbour is required for commercial or naval purposes, or for aviation, or otherwise, bearing in mind the future development of such harbour.
 - (b) The type and general nature of the bridge which will be the most suitable, including minimum length of the main spans, the height above high water, spring tide, the width and loading.
 - (c) The location, width, and nature of the approaches to such bridge, and especially whether in addition to the bridge itself causeways should be constructed interconnecting Bayswater, Northcote, and Stanley Point, or other portions of either shore, and the land required for construction of approaches to bridgeheads.
 - (d) The cost of the bridge on the recommended site, together with the costs of any other bridges which are investigated.
 - (3) The method by which the construction of the bridge shall be financed.
 - (a) If in the ordinary way by loans raised, then—
 - (i) The area which shall be rated to provide the necessary funds;
 - (ii) The proportions in which the various local authorities within the rating area should contribute;
 - (iii) The proportion, if any, which should be found by the General Government: or
 - (b) If by tolls, the approximate tolls which should be charged the various classes of vehicles and other traffic: or
 - (c) If by a levy on the lands increased in value by the execution of the works, what lands should be levied on, and in what proportions: or

- (d) If by contracting with any individual or company to construct the bridge, receiving as consideration therefor the right to collect tolls for a specific period, on the understanding that at the end of such period the bridge is handed over free of encumbrances to the controlling authority, then for what period, and to which authority, and under what special conditions: or
- (e) If partly by one of these methods, or partly by another, or by any other method, then which method or methods.
- (4) Whether the construction and future control of the bridge shall be carried out by some existing local authority, and if so which, or by a special local authority having rating or other special powers over the proposed rating district, or by the Government.
- (5) Should the Commission be of the opinion that the transit requirements of the district under consideration could be equally as well, or better, served by means of a tunnel or tunnels, than all the questions recited above with regard to the bridge shall, *mutatis mutandis*, be answered with respect to the tunnelling proposal, in so far as applicable.

And generally to inquire into and report upon such other matters arising out of the premises as may come under your notice in the course of your inquiries, and which you consider should be investigated in connection therewith.

SITTINGS AND INVESTIGATIONS.

The Commission held its sittings for the hearing of evidence in the Chamber of Commerce Hall, Swanson Street, Auckland, where the proceedings were formally opened by the reading of the Commission on Thursday, 14th November, 1929. The various parties interested in the inquiry were represented as follows:—

- Mr. G. P. Finlay and Mr. R. P. Greville appeared for the Auckland Harbour Bridge Association (Incorporated).
- Mr. R. McVeagh appeared for the Auckland Harbour Board.
- Mr. E. H. Northcroft appeared for the Devonport Steam Ferry Co., Ltd.
- Mr. V. R. Meredith appeared for the Waitemata Bridge Inquiry Protection Association.
- Mr. J. Stanton appeared for the Auckland City Council.
- Mr. H. B. V. Richmond appeared for the Colonial Sugar-refining Co., Ltd.
- Mr. H. J. C. George appeared for the Northcote Borough Council.
- Mr. E. Aldridge (Mayor) represented the Birkenhead Borough Council.
- Mr. J. W. Williamson (Mayor) represented the Takapuna Borough Council.
- Mr. C. A. Cawkwell (County Clerk) represented the Waitemata County Council.
- Mr. J. W. Hayden (Chairman) represented the Waitemata Electric-power Board.
- Mr. W. H. Nagle represented the Mount Eden Borough Council.
- Mr. F. H. Powell represented the Auckland Automobile Association.
- Mr. N. G. Gribble (Secretary) represented the Waikato Waterways League.

As the result of a general discussion on the opening day it appeared that the representatives of the Auckland Harbour Bridge Association were not prepared to proceed immediately with their evidence. It was therefore decided to defer the taking of evidence, and it was arranged that in the meantime the Commissioners should make inspections of the harbour and districts affected.

In the course of their investigations the Commissioners, accompanied by representatives of the interested parties, made an examination by water on the Harbour Board's tug, inspecting possible bridgeheads and viewing suggested bridge-sites. Subsequently the Commissioners spent two days upon an examination by motor of the North Shore boroughs, the Waitemata County, and the more remote northern area, visiting Stanley Point, Cheltenham Beach, Narrow Neck Beach, Duder's Point, Shoal Bay, Birkenhead, Northcote, Takapuna and Milford Beaches,

Brown's Bay, Albany, Birkdale, Silverdale, Waiwera, Warkworth, Matakana, Kaipara Flats, Tauhoa, Glorit, and Kaukapakapa. The Commissioners also examined several possible bridgehead sites, and the streets giving access thereto, on the southern side of the harbour.

The Commission resumed its sittings for the hearing of evidence on Monday, 2nd December, and continued sitting until the afternoon of Tuesday, 10th December, when the available evidence was concluded. Altogether some sixty-two witnesses were examined, and in addition counsel submitted statutory declarations by certain witnesses who were unable to attend. Counsel for the various parties addressed the Commission at some length. A verbatim shorthand note of the evidence and addresses of counsel was taken by the secretary of the Commission, and the transcript covers 550 foolscap pages of typewritten matter.

RÉSUMÉ OF EVIDENCE.

A very large amount of evidence, led by the Auckland Harbour Bridge Association, was placed before the Commission by the various interests in favour of the construction of a bridge. Considerable evidence was also submitted by the officials of the Auckland Harbour Board, by those opposed to the project, and by others having a general interest in the question. Much of the evidence was of a general character and dealt with the inconvenience at present suffered by residents on the North Shore, the slow rate of progress of the northern suburbs, and the great benefit that would accrue to these districts if a bridge were constructed, by way of increased value of properties and increase in the population.

On behalf of the Auckland Harbour Bridge Association it was stated that the growth of the movement for a bridge over the harbour was due to the want of convenient access to the North Shore from the city, and the lack of development of the North Shore and hinterland as compared with Auckland City and its southern suburbs situated the same distance from the business area. A large number of graphs and returns were put in setting out the rate of progress of the northern boroughs as compared with that of the eight southern boroughs. It was contended that the latter had increased in population in the eighteen years, 1911–1929, by 159 per cent., while in the four North Shore boroughs the increase during the same period was only 100 per cent.; also that the southern boroughs, Mount Albert, Mount Eden, Onehunga, and Ellerslie, had increased in capital value by 168 per cent. during the twelve years 1916–1928, while the capital value of the North Shore boroughs had increased by only 98 per cent. It was pointed out that the proportion of motor-vehicles to population in Auckland City and southern suburbs was 1 in 8, while on the North Shore it was 1 in 27·7. A return was also put in showing the motor registration in Nos. 1 and 2 Main Highways Districts. At the present time 780 cars per day, counting both directions, were being carried by the Ferry Company, and it was estimated that at the same rate of growth 1,100 cars per day would be carried in 1935. The Bridge Association also estimated that 1,500 cars per day would cross the bridge each way, or 3,000 trips per day, and thereafter that the increase would be 10 per cent. the first year, 20 per cent. the second year, 15 per cent. the third year, 10 per cent. the fourth year, and 10 per cent. the fifth year. Great stress was laid on the results obtained on the Second Narrows Bridge, Burrard Inlet, Vancouver, where, it was stated, 3,000 vehicles and 7,000 passengers per day were handled. The Vancouver bridge is a toll bridge. The ordinary charges are said to range from 7½d. in the case of a car to 4s. 2d. for a lorry, with concessions for commutation tickets. This bridge, which was built by a private company at a cost of approximately £400,000, is a low-level trestle bridge with an opening span, 150 ft. in width, to enable vessels to pass beyond it. The bridge was financed by grants, by debentures guaranteed by the local authorities and shares taken up by them, and a small amount taken up by private individuals. For the Auckland harbour bridge it is suggested that 8 per cent. on cost would be required to cover charges, made up of interest, 5 per cent.; sinking fund, 1 per cent.; operation, maintenance, and depreciation, 2 per cent. Evidence was subsequently submitted to the Commission showing that the Vancouver bridge paid less than 2½ per cent. on its total cost. The Bridge

Association submitted that as the Auckland harbour bridge would be part of the main highway system the cost should be either subsidized or contributed to by the Main Highway Board. The association advocated a toll bridge on the basis of the user paying; it also proposed that a special local authority should be set up, with power to raise the necessary funds by bond or debenture issue guaranteed by the State. This virtually means that the Government would build the bridge. The sites favoured by the Bridge Association were (1) from Beaumont Street to Shoal Bay, with causeways across Shoal Bay to Northcote, Bayswater, and thence to Stanley Point; and (2) from Jellicoe Street to Northcote. The association did not favour site No. 3, from Point Erin to Northcote, nor that from Point Erin to Birkenhead.

The position of the Auckland Harbour Board in respect to the proposed bridge was clearly set out by the Chairman and officials of the Board, and was to the effect that the Board was not antagonistic towards the construction of a bridge, provided that it did not in any way prevent or interfere with the fullest development of the port, or involve the Board in any expense. At the present time, apart from the sugar-refinery at Chelsea, there were no important works beyond the Western Wharf, but, looking to the future, it was likely that this portion of the harbour would be utilized, and the erection of any structure that would in any way interfere with the free passage of large vessels to and from the upper reaches of the harbour would be strongly opposed by the Board. The Harbourmaster showed very clearly, with the aid of a large-scale map and model, that a serious objection to the manoeuvring of large vessels in the vicinity of the Western and other main wharves would be caused, on flood tide during easterly weather, by the construction of a bridge on site No. 1 or site No. 2. No objection, however, would be raised by him to a bridge from Stokes Point, Northcote, on a line 195° to Ponsonby, provided that a vertical clearance of 150 ft. for a width of 800 ft. over the navigable channel was given. He added that there was now a considerable amount of large shipping up the harbour to Chelsea, and that there was ample deep water between Northcote and Kauri Point for some two miles in length and for 1,600 ft. in width, which area was most valuable for anchorage and for future wharf accommodation, and that any bridge which now or in the future restricted or endangered navigation would impair the progress and expansion of the port, and would act detrimentally to the whole province. The Treasurer and Accountant to the Board produced a statement showing that the capital cost of the ferry wharves was £155,951, and that of the breakwater at the Western Boat-harbour was £51,360. The Engineer to the Board stated that while the principal harbour-works planned for the near future did not extend west of Freeman's Bay Reclamation, the Board would be lacking in appreciation of its responsibilities if it allowed this waterway to be shut off by a bridge of short span and inadequate vertical clearance. It was impossible to say what developments would take place in fifty or a hundred years, and he was of the opinion, speaking generally, but subject to revision for any particular site, that a bridge across the harbour between Kauri Point and North Head should have a clear span over the full width of the channel defined from the 5-fathom lines, and a clear headway of 150 ft. over the middle 800 ft. of this span. He submitted that the present ferry service was capable of meeting the requirements of the North Shore boroughs, and that the cost of a bridge which would be acceptable from the harbour standpoint would make it impracticable for many years to come. If causeways were built across Shoal Bay and Ngataranga Bay, about 2,000 ft. to 2,500 ft. of openings would be needed, with a clearance of 7 ft. above high-water mark. The Secretary and Superintendent of the Harbour Board pointed out the value of the deep water in the harbour, part of which would be cut off by the proposed bridge, and stressed the desirability of in no way hampering the access of shipping thereto. He also submitted copies of correspondence which had passed between the Marine Department and the Harbour Board in days gone by, touching the undesirability of diminishing the flow of the tide by any extensive reclamation.

The Engineer to the Waitemata County Council stated that the vehicular ferry service was inadequate for the summer traffic, that there was no all-night service, and that the ferry charges were too high. The cost of bringing the rural waste land into production was about £10 per acre, and he estimated that the provision of a

bridge would mean a direct saving to the residents of the county of about £4,000 per annum over existing charges, principally in freight on dairy-produce outwards, and on manures, &c., inwards.

The Mayor of Takapuna stated that his Council supported the construction of a bridge, as it would give a stimulus to the growth of population, would improve business, and would result in a substantial appreciation in property-values. His Council was in favour of a toll bridge on the principle of the user paying, a local authority to be set up with power to raise the necessary money on the security of the bridge and tolls, guaranteed by the State, or the granting to a construction company of a charter to construct a bridge, the company taking the tolls to cover interest, sinking fund, and maintenance for a fixed term, at the end of which the bridge to be handed over to some local authority for administration as a free bridge.

The Mayor of Devonport presented the official view of the Devonport Borough Council. After submitting borough statistics, he stated that the ferry service was efficient and satisfactory, though at times there was congestion on the vehicular ferry, and no vehicular ferry was available between 11 p.m. and 7 a.m. The Council considered that existing financial obligations precluded the ratepayers undertaking new commitments in respect of a bridge. Estimates of fares via bridge and causeway across Shoal Bay, and by ferry, were furnished, and attention was drawn to the large capital expenditure that would be required to provide buses to carry over the bridge passengers now travelling by ferry. Comparison was also made of the estimated cost of carrying goods via bridge to Devonport and by ferry. Summarized, the Devonport Borough Council's view regarding Devonport's interest in the bridge project was: (a) The effect would depend upon the site selected; (b) no route would produce any advantage for general passenger transport, but diversion of Takapuna passengers now travelling by bus to ferry might cause curtailment of Devonport service or increase of fares; (c) the owners of motor-cars would use the bridge route, but (d) the vehicular ferry would be the most economical.

The Mayor of Northcote, on behalf of the Northcote Borough Council, put in borough statistics. He set out the advantages likely to accrue from the construction of a bridge, as follows: The unsettled areas on the North Shore, up to eight miles from the Chief Post Office, would become populated; the east coast beaches would become health resorts for city dwellers; the Waitemata County would become settled in small farms up to twenty miles away; the metalling of the main highway to Whangarei would cause traffic to be diverted via Northcote, which was the most suitable location for the northern bridgehead. Regarding finance, the witness considered that this should be provided by the State, failing which a company should be allowed to build the bridge, recouping itself from tolls. The cost of the bridge should be found by the State in a similar manner as provision was made for main traffic routes from the Public Works Fund. A toll bridge would be the last alternative.

The Mayor of Birkenhead submitted borough statistics. His Council was of opinion that a bridge would be of great value to the North Shore boroughs and also to the development of North Auckland. The Council supported the erection of a bridge in whatever location was considered desirable, but regarded the Point Erin-Birkenhead site as the most suitable. He favoured the charging of tolls, but the Council would not object to a flat rate struck over the whole area to be served, as security for any deficiency. He was opposed to the application of the betterment principle.

The Chairman of the Town-planning Committee of the Auckland City Council, by direction of the Council, presented the report of the committee on the question of the bridge. If the bridge would be an advantage to the trade of the city and province the Council would favour its construction, subject to satisfactory arrangements for its construction and maintenance, and to its location harmonizing with city development. While the bridge would be a great advantage, it was not a present necessity for the development of the city area, and would not be so for some time to come. For present needs and for the maintenance of the present rate of progress, for some time to come there was abundant land available on the south side of the harbour, which should be utilized fully before any additional inducement was offered for the population to spread on the north side of the harbour. Whether a bridge

should be regarded as a necessity or a convenience depended largely upon its cost ; at a high cost it might be a possibility but also a decided disadvantage. The Town-planning Committee was of opinion that the principle of betterment should be applied, and that part of the cost of construction and maintenance should be raised by a levy or rate on lands advantaged by the bridge ; also that the cost of approaches and street works rendered necessary by the construction of a bridge should be included in its cost. The work of erection should be undertaken by the Government, and, when erected, the control of the bridge should be vested in an appropriate authority.

The Acting City Engineer put in tables showing the vacant building-lots available, and the additional population that could be absorbed thereon. The total number of building-lots in the residential area still unbuilt on within the city area, in a radius of six miles from the Chief Post Office, was 36,712, and 334 commercial sites in the city proper, sufficient with a density of 4.5 persons per lot for an additional population of 164,825 people. This did not include 770 acres in Tamaki and 720 acres in Avondale, which was beyond the six-mile limit. It was estimated that the population on the 1st April, 1929, was 102,000, and that the ultimate population within the six-mile limit was 266,800, which, if the present rate of increase was maintained, would take twenty-six years before all vacant land within the four-mile limit was developed, forty-nine years for the five-mile limit, and ninety-eight years for the six-mile limit. There was no need for a bridge to facilitate accommodation for city ratepayers, and if a bridge were built settlement on the south side of the harbour would be retarded. He was of opinion that the southern bridgehead should not be at Point Erin but at Fanshawe Street, which was a wide thoroughfare, and from which point there were several streets 90 ft. wide which were carrying little traffic. The traffic could be accommodated from that point without much expense. The road across Shoal Bay would be more expensive to construct than the waterfront road. Fifty feet would be ample for the width of the bridge, including two 8 ft. footpaths, but if trams were provided the bridge should be 60 ft. or 66 ft. wide.

Mr. J. Hislop, member of the Devonport Borough Council, said that the residents of Devonport were opposed to paying a rate on their properties as security for the bridge. The bridge was not likely to be of service to the people of that borough. The bridge, if it took 50 per cent. of the ferry traffic, would so seriously affect the ferries that the residents would lose the present excellent service. The ferry service was adequate, the only necessary improvement being the provision of a continuous all-night service. The population of the northern boroughs was about 25,000, and the bridge was a matter for motor-owners' convenience. The witness did not think that the traffic was sufficient to pay interest, sinking fund, and expenses on a bridge at the present day. He suggested that the only satisfactory way of linking up the northern and southern shores of the harbour was by a tunnel between Mechanic's Bay and Devonport—similar to that between Alameda and Oakland.

The Chairman of the Auckland Transport Board said that if a bridge across the harbour were built the Transport Board would run a transport service over it, but the Board would not be prepared to pay for the right to run over the bridge, and any charge would have to be included in the fares. Fanshawe Street seemed a reasonable site for the bridgehead on the city side.

The General Manager of the Auckland Transport Board said that a grade of 1 in 20 on the bridge would present difficulties. He would rely on buses across the bridge at present in preference to trams. If a bridge to Stokes Point were built he thought the ferry service would still carry a great many passengers and be more economical.

The Chairman of the Waitemata Electric-power Board said that great inconvenience was caused through the inability of the Board's Engineer to obtain access to all parts of the Board's district during the hours when the ferry service was not running. The business of the Board necessitated the use of seventeen motor-vehicles, some of which would not be required if a bridge were available. The provision of a bridge would increase the efficiency in the administration of the Board's affairs, and the mobility of transport would enable more work to be done by the existing staff. In spite of the present good service provided by the Ferry

Company, he was quite satisfied that the retarded development of the Waitemata County was in a large measure due to the objection of many people to crossing the harbour in a boat, and to the fact that an uninterrupted transport service was not available.

The secretary to the Auckland Automobile Association stated that his association was in favour of the construction of a bridge. Its construction and maintenance should be undertaken by the State out of the Public Works Fund. He was in favour of the collection of betterment by the State, and also a contribution by users. The southern bridgehead should not be further west than the western end of Fanshawe Street. Under cross-examination he agreed that a toll bridge would be preferable to the present ferry service, and thought that the proportion of motor-cars to population would increase from one in eight to one in six in five years.

The chairman of the Auckland Town-planning Association pointed out that if the site of the bridge were fixed now it might have the effect of making the plans for town-planning fit the bridgehead, instead of the bridge fitting the plans. The cost of construction of new traffic routes, and the reconstruction of old routes, should be considered as part of the general cost of the bridge. Should the bridge be considered warranted the work should be under Government control, and in the allocation of cost the betterment principle should be made to apply. A bridge was necessary for the full development of the Auckland region, but he considered that development of this nature should not take place until the available areas on the southern shore were more fully utilized. The bridge would be of immense importance to the traffic routes to the northern districts, but the requirements of the harbour were paramount to all others.

The chairman of the Technical Committee of the Auckland Town-planning Association undertook to prepare a plan of street alterations and access to the southern bridgehead. He considered that the betterment principle should be made to apply. A minimum width of 60 ft. should be provided on the bridge, including footpaths.

The Secretary of the Devonport Steam Ferry Co., Ltd., put in statements showing—(1) Scale of passenger fares; (2) scale of vehicular fares; (3) vehicular time-tables; (4) passenger time-tables; (5) table showing licensed capacity of company's vessels; (6) schedule of passengers carried for ten-year period from 1920 to 1929 (inclusive); (7) schedule of vehicles carried for ten-year period from 1920 to 1929 (inclusive); (8) tally of passengers carried during morning peak loads during last week of September, 1929, on various vessels, with comparative capacity of steamers used; (9) schedule giving cost, age, &c., of company's fleet; (10) analysis of vehicular traffic for twelve months ending October, 1929; (11) schedule of daily trips; (12) comparative table showing cost of travel from Devonport and Stanley Bay to General Post Office, Auckland—firstly by ferry, and secondly by proposed bridge from Shoal Bay to Freeman's Bay; (13) comparative table showing cost of travel from Birkenhead, Northcote, and Bayswater to General Post Office, Auckland—firstly by ferry, and secondly by proposed bridge from Shoal Bay to Freeman's Bay; (14) schedule from Government Statistician giving particulars of population of Auckland City and adjoining suburbs.

Mr. S. W. Jones, M.Inst.C.E., M.I.Mech.E., submitted designs of two bridges—(1) Bridge with southern portal in line with Jellicoe Street: bridge of steel on concrete foundation; vertical clearance, 80 ft.; 370 ft. lateral clearance in navigation span; roadway, 40 ft. wide; two footpaths, each 5 ft. wide; grades, 1 in 39; estimated cost, £718,050, exclusive of causeways; interest and all other charges estimated at £57,000 per annum. (2) Bridge from Point Erin to Stokes Point, south bridgehead south of Point Erin Park: bridge to start at Shelly Beach, 60 ft. above high water, spring tide; cross the boat-harbour with a 200 ft. span, rising 1 in 36 to the navigation span, where the vertical clearance would be 135 ft.; navigation span, 760 ft. or 535 ft. clear width; grade, 1 in 27 to Northcote end of bridge; estimated cost, £815,850, without causeways; estimated annual charges, £63,550. The possibility of a bridge with a lifting-span was mentioned, and the witness estimated that the approximate cost would be about £730,000. The witness did not favour a tunnel, on account of its cost and disabilities.

Mr. G. T. Murray, Assoc.M.Inst.C.E., submitted that the best site for the northern bridgehead was at Northcote Point, and for the southern bridgehead at St. Mary's Bay, the approach to start from Fanshawe Street. He proposed a bridge with 60 ft. clear height, 40 ft. roadway, a swing-bridge, 115 ft. clear on each side of pivot pier to accommodate shipping; grade from St. Mary's Bay, 1 in 63; spans, 150 ft., in concrete; piers constructed as caissons and floated out, sunk on site, and filled to springing level of arches; estimated cost, with causeways, £1,280,000. He believed that a high-level bridge would cost £7 per square foot.

Mr. R. Moore, C.E., submitted a sketch-plan of a bridge from Freeman's Bay (Beaumont Street) to Shoal Bay; maximum spans 200 ft., rising to 86 ft. above high water; two causeways from Shoal Bay bridgehead, one to Northcote and the other to Bayswater; piers on steel cylinders; total cost, without embankment at Shoal Bay, estimated at £454,000; original estimate over £650,000, leaving nearly £200,000 for contingencies; bridge, 66 ft. wide. A bridge with one 400 ft. span and eighteen 200 ft. spans, and an embankment 40 ft. wide from Stanley Point through Bayswater to Northcote, would cost £941,000.

Mr. F. E. Powell, C.E., favoured the Shoal Bay site, and a high-level bridge as against an opening span. A width greater than 400 ft. in the navigating span was unnecessary. The overall width of bridge, with footpaths, should be 66 ft. He estimated the cost of the bridge at £1,000,000. He was not in favour of a tunnel.

Mr. D. E. Harkness, Lecturer in Civil Engineering at Auckland University, produced reports on the Holland Tunnel. If a bridge at Northcote would not cater for the Devonport traffic he thought that an estimate of 3,000 vehicles per day was unwarranted, but considered that some improved form of transport across the harbour by bridge or tunnel should be provided. He pointed out that a tunnel could be constructed as easily at the lower side of the harbour as on the upper side. The Oakland-Alameda Tunnel, 37 ft. wide and 4,000 ft. long, cost £900,000.

Captain T. V. Hill, of the "Niagara," said that in his opinion the vertical clearance under the navigation span of the bridge should be not less than 150 ft., and there should be a horizontal clearance of 500 ft. on each side of the central pier. When the ship was lightly loaded the masthead of the "Niagara" was between 134 ft. and 138 ft. above water-level. It was not the present tendency to decrease the height of masts, except for special trade. A bridge built on No. 1 or No. 2 site would be too close to the wharves, and would interfere with the manœuvring of vessels when berthing, especially with spring flood tide and easterly wind. Site No. 3, from Point Erin to Northcote, would be more reasonable.

Captain C. A. Berndtson, of the "Malolo," said that in his opinion a bridge on No. 1 site would be a serious handicap to a captain in berthing or unberthing a vessel such as the "Malolo," especially when swinging round on a flood tide with a strong wind. Indeed, he believed that a bridge across the harbour so close to the wharves would be a serious handicap in getting to a berth at the wharves under normal conditions. These remarks would apply also to a bridge on No. 2 site. Site No. 3 was, in his view, the logical place for a bridge. The vertical clearance should be 150 ft. above high water, and the lateral clearance from 700 ft. to 1,000 ft. To allow scope for navigation off the wharves there should be a clearance, without obstruction, of from 1,500 ft. to 2,000 ft. The height of the "Malolo's" mast above the water-line was 132 ft.

Captain Robert Crawford, of the "Aorangi," in a statutory declaration, said that a bridge from Beaumont Street to Shoal Bay would be detrimental to the working of the wharves by large vessels—particularly the Western Wharf, but also Princes Wharf—as with a flood tide there would be a danger of drifting on to the bridge-piers when manœuvring from a berth. In view of developments in other large ports, it would be a fatal mistake to put any possible obstruction in the way of shipping working a port like Auckland, which would cut off communication by large ships to any deep-water frontages. Even a bridge from Point Erin to Northcote should provide adequate height above the light-line. The Sydney Bridge would give 170 ft. clearance, but even with this provision the masts of the "Aorangi" had had to be cut down below the original design to give the necessary clearance when the ship was lightly loaded. It had cost so much in many places to make harbours that any interference with a natural harbour likely to restrict its usefulness should

be jealously guarded against, and the authorities should err on the side of caution in considering any proposal which even remotely was likely to restrict water facilities. The 86 ft. clearance provided in the design of the proposed bridge was totally insufficient when the size of present-day vessels was considered. On account of the present tendency to increase the size of vessels the horizontal clearance should be at least 400 ft.

Mr. V. R. Meredith, counsel for the Waitemata Bridge Inquiry Protection Association, submitted statutory declarations covering a report on the Bridge Inquiry, Second Narrows, Vancouver ; a declaration by C. H. Webster *re* Vancouver population and statistics ; a declaration by S. J. Remnant *re* number of motor-cars in Vancouver ; a declaration by E. Brydone-Jack *re* tariff and tolls, Second Narrows Bridge ; a declaration by Percy Ward giving particulars of Second Narrows Bridge—Auditor's Report and Balance-sheet, Second Narrows Bridge, to 31st December, 1927 ; Auditor's Report and Balance-sheet, Second Narrows Bridge, to 31st December, 1928 ; Report by Manager and Analysis of Operations of Second Narrows Bridge to 31st December, 1927 ; Report by Manager and Analysis of Operations of Second Narrows Bridge to 31st December, 1928. The statements put in showed that the Second Narrows Bridge at Vancouver was built for approximately 1,916,000 dollars, of which 1,189,136 dollars was found by various Governments—Dominion, State, and local. The balance-sheets showed losses for the years ending December, 1926, and December, 1927, and an apparent profit of 13,506 dollars for 1928. The interest paid amounted to £48,790, which was under 2·5 per cent. on the cost of the bridge. The daily average of persons using the Vancouver Bridge for the year ending December, 1928, was 6,419, and vehicles 2,709. The proportion of trucks to motor-cars was 1 to 6·4. It has been suggested that any deductions drawn from the construction and operation of the Vancouver Bridge might be taken as a fairly safe guide as to what would happen in Auckland.

Mr. A. Harris, M.P. for Waitemata, advocated the raising of a special loan by the Government for the construction of the bridge : the Main Highways Board to pay interest upon the same ratio as was its custom for bridges exceeding £10,000 in cost ; the users of the bridge to find the balance of the interest, plus two-fifths of the cost of maintenance, and sinking fund at 1 per cent. to liquidate the cost of the bridge in 36½ years, by way of tolls. He would advocate the expenditure of a sum up to £1,500,000 on the bridge, if the funds were obtained as suggested. He did not think that the four North Shore boroughs should provide the whole cost of the bridge, but that Auckland should contribute materially, also the back country.

The Hon. J. B. Donald, Postmaster-General (formerly head of Messrs. A. B. Donald and Co., Auckland, and one of the earliest members of the Auckland Harbour Bridge Association), strongly advocated the construction of a bridge, contending that within five years of its completion the population of the North Shore would be doubled. Fruit and produce, if grown in that area, could be brought in approximately a month earlier than was possible on the southern side of the harbour. An increase of population on the North Shore would tend to an increase in business in the city. The bridge would be a payable proposition. Though it had been suggested that it would cost £800,000, in his opinion if it cost £1,500,000 it would be well worth while. On good authority he knew that there was one firm which would build the bridge without any security, expecting the bridge to return it 6 per cent. over a period of, say, twenty years, and even then the tolls would not be as high as those on American toll bridges. As a result of the construction of the bridge all the land from Waiwera to Takapuna might increase tenfold in value. Those who would benefit should contribute towards the cost of construction and maintenance. Auckland would benefit indirectly as well as directly, but not so much as the North Shore ; still, Auckland should be prepared to accept its share of the liability. The rate which the city would be prepared to pay would not be very heavy, but for the benefit of the whole community the city should pay some proportion if there were a loss on the bridge. Tens of thousands of acres behind Takapuna would be brought into cultivation, which at the present time were lying idle. That land could be used for cropping, but it was not profitable to use it without fertilizers.

Dr. J. W. Craven, practising at Birkenhead, said that at present the chief difficulty was the transport of patients at night-time, though this also held good to some extent during the day. At night-time, after the last boat had left, the only way of getting a patient to the Auckland Hospital was to take him in the ambulance to Devonport, wait there for the launch coming, transfer him to the launch, take him across the harbour, retransfer him to another ambulance, and thence to the hospital. In cases of serious illness or severe accident this system was extremely detrimental to the patient. There had been some cases where the weather had been all against a patient crossing in a boat. The points he desired to place before the Commission were the delay, the rough weather, and the difficulty in getting patients across. Under cross-examination the witness admitted that at the request of a medical practitioner the Ferry Company would turn out a vehicular ferry to carry an ambulance to or from any of the North Shore boroughs, but it took some time to get the crew together and to get steam up.

Mr. S. J. Elliott, barrister and solicitor, practising at Auckland and Warkworth, drew attention to the condition of the roads to the north from Auckland. Large stretches of clay rendered them impassable in wet weather. When the roads were improved a large volume of traffic would come down by the main highway via the northern boroughs to Auckland.

The foregoing *résumé* of evidence covers principally the official views of organized bodies, officials, and public men. In addition, a considerable amount of evidence was tendered by private citizens, members of local authorities, and business men having a general interest in the project, and while this latter has not been included in the *résumé* it has been carefully examined and considered by the Commission.

CONCLUSIONS.

With respect to the several matters submitted to us for inquiry, we have the honour to report as follows:—

1. The present Waitemata Harbour transit facilities.

The present Waitemata Harbour transit facilities are provided by a well-organized fleet of vessels owned and controlled by the Devonport Steam Ferry Co., Ltd. The fleet comprises nine passenger ferry-boats and four vehicular ferries. There are landing-places at five points on the North Shore and three on the city or southern side of the harbour, to and from which these vessels ply. Of these landing-places two on the city side and three on the North Shore are available for embarkation and disembarkation of vehicles.

The evidence showed that the passenger ferry service in the daytime is very efficient, entirely adequate, and extremely cheap. The passenger-carrying facilities after midnight, however, are meagre, though a small vessel is always kept available for emergencies.

As regards vehicle transport, this is carried on to Devonport until midnight, and the regular services to Northcote and Birkenhead cease at 11 p.m., and in the reverse direction earlier. As was shown by a considerable amount of evidence led for the purpose, this causes great inconvenience, even though the Ferry Company guarantees, in the case of a request from a medical practitioner or in the event of an accident, to run a vehicular ferry immediately it can be brought into service after the alarm is given; and during the sitting of the Commission in Auckland the Commissioners had an actual demonstration of this being done. Nevertheless, the weight of evidence indicated that passenger and vehicular facilities should be provided by a regular service operating continuously throughout the twenty-four hours.

Although the present provision for vehicle-transport is adequate under normal conditions, delays occur in dealing with the exceptional week-end, holiday, and Takapuna race traffic. This could be obviated by the provision of additional landing-places and extra vessels; one additional landing-place and one more vessel would adequately meet the present position. While this additional vessel would

probably not earn its upkeep for the company, but would be a source of expense considerably beyond any revenue it might earn, we feel that the travelling public are justly entitled to expect these additional facilities. The Harbour Board has already expended a large amount of money in providing landing-places for both passengers and vehicles, and has expressed its willingness to keep pace with any reasonable demand which may be made in this direction.

Having personally seen ferry services operating in various parts of the world, your Commissioners have no hesitation in saying that the ferry service on the Waitemata Harbour compares favourably with similar services in other countries.

Quite apart from the ferries it is possible to reach any point on the North Shore by roads around the harbour, but these are very circuitous and do not provide reasonable access except to places a considerable distance to the north, and even in these cases the route via the ferry—and, of course, via any bridge likely to be built—will be considerably shorter. For instance, the distance from Auckland to Helensville via the North Shore is 35 miles, while via the present main road it is 37½ miles; the distance from Auckland to the Hobsonville aerodrome is 21 miles, but via Northcote, Birkdale, and Greenhithe it would be only 10 miles if a bridge were constructed and also two short bridges across other arms of the harbour; the country in the vicinity of Kaukapakapa and Wainui would be 24 miles closer to the city via Northcote than via the railway or the present roads via Helensville and Henderson.

2. The present and future harbour transit requirements.

For a considerable number of years it will be possible to adequately provide for the requirements of harbour transit at Auckland by a progressive increase, both in size and numbers, in the ferry fleet, plus further landing-stages at each end. A time will arrive, however, as it has arrived within recent years in Sydney, and in New York in respect to the ferry services between Staten Island and New Jersey and between Manhattan and New Jersey, when no increase in the number of ferry-boats will adequately cope with the demand, and then provision for unrestricted traffic between the northern and southern shores of the harbour by bridge or tunnel will become imperative. The time when such provision will become necessary at present appears to be well in the future, especially when one considers the size to which such cities as Sydney, New York, &c., grew before the large expenditure involved in the construction of bridges was entertained.

3. The means by which such requirements may best be provided, and in particular the following matters: (1) The necessity or otherwise for the building of a bridge across the Waitemata Harbour.

After careful consideration of the whole question, your Commissioners are of the opinion that the day has not yet arrived when a bridge is necessary. The only instance which has come under our notice where a bridge has been erected across a harbour, and where the conditions are in any way comparable with those of Auckland and the Waitemata Harbour, is the Second Narrows Bridge, Burrard Inlet, Vancouver; but in that case the population in and around Vancouver is considerably greater than that which would be directly served or materially benefited by the construction of a bridge across the Waitemata Harbour. Moreover, the construction of the Vancouver Bridge cost less than one-fourth of the sum which we estimate would be the cost of the necessary works linking up Auckland with the North Shore.

With the only practicable site for a bridge, the distance to be travelled by road and bridge between Queen Street and the centre of Devonport—which is by far the most populous of the North Shore suburbs—would be so great that a bus service could not be carried on except at a figure very much in advance of the present ferry charges; further, the time occupied on the journey would be longer. With regard to private motor-cars, though these would have the advantage of being able to go and come across the harbour at any time if a bridge were constructed, the running-costs on a mileage basis would exceed the charge for which cars are now carried on the ferries.

With respect to Takapuna the position is different, and the benefit which its inhabitants would gain from the bridge is much greater than that accruing to the residents of Devonport; but even in the case of Takapuna residents it is quite unlikely that the bus fare for the total distance would be lower than the present combined bus and ferry fares, while the saving in time would be very little. With the bridge there would, of course, be the advantage that no transfer from ferry to bus, and *vice versa*, would be necessary, with its unavoidable delay.

With regard to the other boroughs, Northcote and Birkenhead, these would undoubtedly receive a benefit through the construction of a bridge, in that they would be able to carry on with bus transport more rapidly, and probably at no greater cost, than many of the residents of these suburbs now incur by the combined bus and ferry services. Unfortunately, these two boroughs constitute only a small proportion of the population of the North Shore.

Touching the position of the inhabitants generally of the ridings of the Waitemata County which abut on the North Shore boroughs, the total advantage which these would receive from the construction of a bridge, if any, would be so small as to weigh very little in the general consideration of the problem.

A great deal of evidence was submitted to the Commission in support of the probability of vast development taking place in that portion of the Waitemata County immediately adjacent to the North Shore boroughs, as a result of the construction of a harbour bridge. We examined this area of country and found that it was in a very backward state. This is explainable by two causes, quite unconnected with the present lack of bridge connection with the City of Auckland. Firstly, the land in parts is extremely poor in quality, and, secondly, the roads are in a very backward condition, there not being even one continuous first-class metalled road in this area. This latter condition is, of course, being rapidly overcome. The very well reasoned evidence submitted to the Commission by the Engineer to the Waitemata County Council indicated that by the construction of a harbour bridge a considerable direct saving would be effected in the cost of carriage of all produce from the area south of Kaukapakapa, and upon manures and other goods taken into that area. This witness assumed that the whole of the land lying in the county ridings which the bridge would immediately serve would be intensively farmed, more particularly for dairying purposes, and that the total direct saving in carriage on the maximum possible produce, and also upon goods both inwards and outwards, would amount in the course of a year to £4,000. This appears to be a disappointing sum as representing the saving likely to be effected as a result of the construction of a bridge, and even if we considered it so conservative that we increased it to £10,000 it would still only represent under 3s. per acre on the land under consideration, or about 6s. per annum per cow, based upon the County Engineer's estimate of one cow for every 2 acres. We feel that it cannot be argued that such a small annual benefit per acre would have any appreciable bearing upon the development or non-development of the land in that area.

The greater part of the advantage derived from the construction of a bridge would be reaped by the owners of motor-vehicles resident in Auckland desiring to visit points on the North Shore for recreation purposes, which factor was greatly stressed in the evidence, and to a lesser degree by motor carrying firms engaged in the delivery of goods from merchants' warehouses in the city to customers on the North Shore. The bridge would provide no advantage to the ordinary passengers, as apart from the motorist driving his own vehicle. It would also enable a considerable number of comparatively well-to-do people resident on the North Shore to own and drive their own motor-vehicles; these people are at present deterred from investing in cars by the fact that they would in practice be restricted to a very small mileage of road unless they incurred the inconvenience, risk, and delay of ferry transport.

The representatives of practically every shade of opinion who gave evidence, while expressing the general view that the bridge would be a great convenience, repudiated any willingness to contribute towards its cost. It appeared to be the generally accepted view that the bridge should be financed with tolls levied on motor-vehicles; but the official representative of the organized Automobile Association repudiated any willingness on the part of his members to pay tolls for

crossing the bridge, submitting that the motor-vehicle was already sufficiently taxed, and that the bridge should be regarded as portion of the roading system of the Dominion, and should be constructed and maintained by the State out of the Public Works Fund. Under cross-examination, however, this witness stated that he would prefer a toll bridge to the continuation of the existing system, which is in effect a toll.

The official representatives of almost every local authority who were examined stated that their Councils were opposed to any proposal to levy rates for financing the bridge, and expressed the opinion that the necessary funds should be obtained by tolls, both for the upkeep of the bridge and as security for the raising of the requisite capital for first construction.

After careful consideration of all the evidence, and after investigations made in the districts, your Commissioners are of the opinion that the time for the erection of a bridge across the Waitemata Harbour will not arrive in less than twenty years, though it might be advisable in, say, ten years' time to have the position reviewed again.

(2) The following details concerning the bridge : (a) The most suitable site at which the bridge should cross the harbour, taking into consideration the present location of the populations on each side of the water, the probable growth thereof, the main arterial highway system of the metropolitan and adjacent areas, either now existing or likely to be adopted, and the extent to which such harbour is required for commercial or naval purposes, or for aviation, or otherwise, bearing in mind the future development of such harbour.

Five sites were considered by your Commissioners, viz.—

- (1) From Beaumont Street to Shoal Bay, thence by causeways to Bayswater, Stanley Point, and Northcote ;
- (2) From Jellicoe Street to Stokes Point, Northcote ;
- (3) From Point Erin to Birkenhead ;
- (4) From Point Chevalier to Kauri Point ; and
- (5) From Fanshawe Street Extension to Stokes Point, Northcote.

With regard to site No. 1, this site—apart from the difficulty in construction in Shoal Bay, where a vast depth of mud was found but no rock bottom—is too close to the main wharves, and a bridge at this point, unless with a very great span—so great as to be impracticable—would interfere with the berthing and unberthing of vessels.

With regard to site No. 2, the objection regarding navigation indicated above in respect to site No. 1 would apply here also, though in less degree. But, apart from that objection, there is the fact that the city end of the bridge would be at a point from which and to which traffic would be very congested, and access to the bridge would be rendered difficult. Secondly, in advocating this site, the representatives of the Auckland Harbour Bridge Association presupposed the bridging of Freeman's Bay and the free use of this bridge by the public as a thoroughfare. In this assumption they were not justified, as to carry the heavy traffic—which alone would justify a harbour bridge—across the face of all the wharves would create intolerable congestion, and in addition, until such time as Freeman's Bay is reclaimed—which might never take place—an opening span in the bridge would be necessary.

With regard to site No. 3, this is a good site, with high land at each bridgehead, and from a constructional point of view it has considerable advantages. The approaches would not be costly, the grades would be comparatively easy, and a bridge at this site would avoid the deepest water. But access to the southern bridgehead would involve the traffic passing through a number of narrow, steeply-graded streets in the Ponsonby area, and would therefore probably require eventually a great deal of expense in reconstruction of streets and alterations to properties, all of which would be a charge against the bridge. This site has one disadvantage which outweighs all its advantages—viz., it is too far to the west to be convenient or useful to the great majority of the residents of the northern suburbs. In so far as it would serve the main road to the north it would be a very suitable site.

With regard to site No. 4, this site is suitable from an engineering point of view, but it is too far to the westward to be of practical value.

With regard to site No. 5, this site commends itself to us as being the most suitable. The southern approach would be a continuation of Fanshawe Street towards St. Mary's Bay, thence curving to the right across the boat-harbour to Stokes Point, Northcote. This location is sufficiently far to the westward not to interfere with the navigation of vessels to or from the main wharves in Auckland at any condition of the tide or weather. Fanshawe Street is a wide thoroughfare with fairly good connections which can be improved at a moderate cost. The distance from the southern bridgehead to Queen Street is 120 chains. There are good road connections at Northcote to the north and west. A road from the northern end of the bridge can be graded down to Shoal Bay, where suggested causeways across Shoal Bay and Ngataranga Bay would give communication with Takapuna and Devonport. We therefore recommend the adoption of site No. 5— from Fanshawe Street Extension to Stokes Point, Northcote.

The replanning of the main avenues of traffic through the city to the southern bridgehead of site No. 5 has been considered by the Auckland Town-planning Association, and the Chairman of the Association's Technical Group has submitted a plan showing that the traffic either from within the city or arriving from north, south, or west can be made to converge on the southern bridgehead with reasonable facility, and that the alterations of existing roads which would be so necessitated would fit in very well with the scheme to improve the internal traffic arrangements of Auckland City itself.

Your Commissioners are of the opinion that no variation in the distribution of the population on either shore of the harbour will alter the suitability of the recommended site. The tendency on the northern side will be for the population to increase north of Birkenhead and Northcote, because Takapuna and Devonport, particularly the latter, are already fairly well built upon. In addition, the main arterial system of the metropolitan and adjacent areas will fit in very well with this site.

In recommending site No. 5 as the one to be adopted we realize that it will be necessary, both for naval and commercial purposes, that large vessels should be able to make full use of the portion of the harbour divided from the open ocean by the erection of the bridge, but this difficulty can be overcome by the provision of a channel span of adequate height and width.

The evidence given by the aviation authorities indicated that the span which we recommend for naval and commercial purposes will be ample also for aviation purposes.

(b) The type and general nature of the bridge which will be the most suitable, including minimum length of the main spans, the height above high water, spring tide, the width, and the loading.

The type of bridge which we recommend is one composed of concrete piers, the smaller ones founded on concrete piles and the larger and deeper ones founded on cylinder piers of varying diameters according to the weights of the superincumbent spans. The difficulty in connection with the foundations involves such expensive piers that long spans are the most economical, and therefore it will not be practicable to utilize reinforced-concrete superstructure to any material extent. The superstructure will consist in the main of steel girders with a concrete deck, and in the case of the central opening there should be a cantilever structure with a clear span of not less than 800 ft., and a clear height above high water, spring tides, of 135 ft.

Borings made along the proposed line indicate that foundations exceeding 100 ft. below high-water mark will be involved, and therefore that special construction by steel caissons, afterwards to be filled with concrete, will be required. As the rock has been swept almost clear by the tidal currents, difficulty will be experienced in pumping out the caissons, and therefore for the purposes of the estimate we have provided for the blanketing of the site for a considerable depth with suitable material in which the caissons can be sunk by grabbing until rock is encountered, with a reasonable expectation that it will then be possible to lower

the water sufficiently by pumping to enable divers to do the necessary excavation to permit of the caissons being entered into the rock and thereafter pumped out.

In adopting for the bridge a vertical clearance of 135 ft. we have to some extent disregarded the weight of evidence, believing that the modern tendency in the design of cargo-vessels is not towards an increase in the height of masts. Further, we are advised by the naval authorities that such warships as have higher masts could without difficulty lower their top hamper should it be desired to proceed under the bridge at the top of high water. It must be remembered that the depth of water in the main channel is such that no cargo-ship would have any difficulty in proceeding up the harbour at dead low water, which would give another 5 ft. of clearance at neap tides, increasing to 12 ft. at spring tides. The cost of the bridge would be materially increased if the clearance was made, say, not less than 150 ft., and the proposed grades maintained.

It will be necessary to protect the channel piers with heavy fendering, so that no damage will be done to the bridge and so that the damage to any vessel touching them would be minimized. Owing to the great depth of water this will be an expensive matter, and it will, we think, be advisable to place rubble filling around these piers up to a level of about 30 ft. below ordinary low-water spring-tide level, into which a sufficient number of piles to support the fendering can be driven for this purpose.

An outline plan has been prepared which shows the type of bridge we recommend as being the most suitable for the site and conditions obtaining (Appendix No. 2).

On the bridge we have provided for a width of 40 ft. of clear roadway and two 6 ft. footpaths, the latter to be carried outside the trusses on the channel spans. The details of the design have not been worked out sufficiently to enable us to fix the entire over-all width of the bridge, but it should approximate 62 ft. on the channel spans and 52 ft. on the balance.

In placing the 800 ft. span we have not shown this span in what is at present the best position for navigation, because the sailing course now is diverted to the northern side of the harbour by reason of a shoal which exists between Birkenhead and Point Erin. However, borings made show that this shoal consists of easily dredged material, and therefore we have been able to place the 800 ft. span of the bridge fairly centrally in the harbour, thereby assisting the grading down on the northern side, which presented some difficulty upon first consideration of the problem. The dredging of this shoal will enable a first-class sailing-course to be obtained under the bridge as we have indicated it. The extent of this dredging is not large, being approximately 300,000 cubic yards to 35 ft. at low water, spring tide (Appendix No. 5).

The total length of the bridge is 4,740 ft. in the main structure, together with 1,700 ft. of bridging across Shoal Bay and Ngataranga Bay in connection with the causeways. The total length of the works from the present end of Fanshawe Street to the proposed junction with the Devonport roading opposite Stanley Bay wharf is 19,840 ft.

With regard to the loading to which the bridge should be designed: In calculating the stresses in the stringers, transomes, and hangers we have adopted the British Ministry of Transport standard loading for each 10 ft. width of roadway. This gives a greater loading than would be given by two lines of tram-cars and two traction-engine trains side by side, so that although no special attention was given to the tram aspect the bridge would be amply strong enough to carry tram traffic. In addition to the above a load of 100 lb. per square foot has been adopted for the footways.

For calculating the stresses in the trusses and plate girders a roadway load varying from 100 lb. per square foot of roadway on the 60 ft. spans to 50 lb. per square foot in the 800 ft. span has been adopted, and a footway load of 25 lb. per square foot on both sides throughout.

The above loading will allow of the bridge being used by 20-ton traction-engines and trailers in any probable combination. The New Zealand standard loading is less than the British Ministry of Transport standard, but in a structure expected to last for a great many years it is desirable to make allowance for possible future developments. Some bridges in industrial centres in England have been

designed for vehicle-loads of 50 tons or more on four wheels. We think that if a load of this description should require transportation across the harbour this transportation could be better and more cheaply provided by the Harbour Board's floating crane. With a bridge of this length it would not be economical to construct it to a standard which would admit of such very unusual and infrequent loads being carried.

- (c) **The location, width, and nature of the approaches to such bridge, and especially whether in addition to the bridge itself causeways should be constructed interconnecting Bayswater, Northcote, and Stanley Point, or other portions of either shore, and the land required for construction of approaches to bridgeheads.**

To construct the bridge alone would, in our opinion, be of limited advantage to the district, and very considerable ancillary works are necessary at each end. From the northern end of the bridge a new road should be constructed grading down to Sulphur Beach, whence a causeway 60 ft. wide across Shoal Bay should be built on a somewhat curved line to O'Neill's Point, Bayswater, and from there across Ngataringa Bay to a point near the root of the Stanley Bay jetty, where it would connect with Calliope Road, and thus lead direct into Devonport. The point where the causeway would touch O'Neill's Point would give direct connection to Bayswater, and by King Edward Avenue and Victoria Road to Takapuna. The tidal openings referred to subsequently under (d) would be required.

At the southern or city bridgehead, embankments will be necessary from the end of the bridge to connect on to the end of Fanshawe Street, and to give a further connection on to Shelly Beach Road.

A comprehensive report regarding necessary alterations to the general arterial roading system of the city, referred to previously as having been prepared by the Technical Group of the Auckland Town-planning Association, is attached hereto (Appendix No. 6), and appears, from our limited knowledge of the local conditions, to present a workable solution of the question of access to the southern bridgehead. However, a large portion of this report has other objects in view, concerning which we desire to express no opinion.

- (d) **The cost of the bridge on the recommended site, together with the costs of any other bridges which are investigated.**

We estimate the cost of the bridge on the recommended site, together with the causeways and the bridges therein, to allow free tidal flow into Shoal Bay and Ngataringa Bay, at £1,956,000. The fixed charges—based on interest at $5\frac{1}{2}$ per cent., sinking fund $\frac{1}{2}$ per cent., and depreciation, maintenance, and operation, $1\frac{1}{2}$ per cent.—amount, on a round figure of £2,000,000, to £150,000 per annum.

As the figure just given is very much in advance of any estimate which was named by witnesses at the inquiry, we think it advisable to give some particulars of other bridges, similarly situated and of about the same class, which have been erected in recent times.

Carquinez Bridge, San Francisco: This bridge has a length of 4,482 ft., as against 4,740 ft. in the case of the Auckland bridge, and with negligible approaches; width, 38 ft. effective roadway, as against our proposed 52 ft.; cost, £1,278,000. The approaches to this bridge are very short, having cost only 25,000 dollars, but the spans are 1,100 ft., and the foundations are very similar to those proposed for the Auckland bridge, the depth of water being the same. It is quite unlikely that New Zealand, with its limited resources, would be able to erect a structure of this kind as cheaply as it could be done where the resources of a continent could be drawn upon with facility, and in any case the steelwork would be more expensive to the extent of the freight from overseas, even if all other conditions were equal.

The two bridges over the Arthur Kill Strait, dividing Staten Island from New Jersey, built by the New York Port Authority, have characteristics, particularly as regards the channel span, very similar to what we propose for the Auckland bridge, in one case the central span being 672 ft. and in the other case 750 ft. But, apart from the channel spans—neither of which is situated in very deep water, and the foundation work in connection with which was not difficult—the rest of the structures consist of comparatively small plate-girder spans on concrete piers largely supported on piles and on mass concrete piers built on dry land.

It is interesting to note that out of a total length in one case, of 8,718 ft., 6,618 ft. was built over dry land; and in the other case, out of a total length of 7,109 ft., no less than 6,437 ft. was built over dry land; no piers in either case being in water. In regard to these two bridges we unfortunately are unable to give the cost of each separately, but, as will be seen from the foregoing description, the types of the bridges do not greatly vary. The cost of the two bridges was £3,528,000. In this case, as the bridges were built at New York, the cost would be considerably lower than the figure for which they could be erected in New Zealand. The Kill Bridges are 50 ft. wide, and their approaches are short.

The Second Narrows Bridge, Burrard Inlet, Vancouver, concerning which a good deal of evidence was given, provides in the middle portion for railway and road traffic, and this portion is 43 ft. 6 in. wide; but the trestle portion is divided into two parts, one carrying a single line of railway and the other an 18 ft. roadway, the latter being very low, for a large part of the distance about 10 ft. high. The only long span is one of 300 ft. Out of its 2,600 ft. in length only 1,100 ft. is built of steel, the balance being wooden trestle. The cost of the bridge was about £400,000. A bridge of this type cannot be compared with the one proposed for Auckland.

By the adoption of the recommended route there should be very little compensation payable, as interference with private property is reduced to a minimum. Owing to the height of the bridge it will not be possible to grade down on to the head of Stokes Point. The grade will extend some distance shoreward, and in order to overcome a number of involved compensation claims for depreciation of house property we recommend that the whole of the land interfered with should be purchased, the bridge erected, and whatever land or buildings are still available for occupation should be sold.

Not having had before us when in Auckland the proposed connection with Ponsonby via Shelly Beach Road, as shown on the Auckland Town-planning Association's plan, we have not made any detailed estimate for this, but towards the cost of the works which appear to be necessary and advisable—not only for the provision of suitable access to the southern bridgehead but for the general improvement of the city traffic system—we have allowed in our estimate the sum of £100,000.

The causeways across Shoal Bay and Ngataringa Bay cannot be constructed without the provision of adequate openings for the ingress and egress of the tide. For purposes of our estimate we have assumed a total length of opening of 1,700 ft., with a head-room of 7 ft. above high water, spring tide. This, however, would be subject to further review when the construction of the bridge is seriously entertained, and weight would have to be given to the statement made by the Engineer to the Auckland Harbour Board that from 2,000 ft. to 2,500 ft. of opening is required. These openings would be constructed of reinforced concrete.

Regarding the direction contained in this section of the order of reference that we should report upon the cost of any other bridge which might be investigated by us, we desire to say that the consideration of the problem has pointed so definitely to the recommended site as being the most suitable that the cost of any alternative bridge was not investigated in detail, but we are quite sure that on no other site could a bridge be erected at so low a figure as to justify the abandonment of the several advantages which the recommended site possesses.

(3) The method by which the construction of the bridge shall be financed: (a) If in the ordinary way by loans raised, then (i) the area which shall be rated to provide the necessary funds.

As to the rating district, upon first consideration we were inclined to recommend the inclusion of all the land between Whangarei in the north and Hamilton in the south; but after study of the difficulty that would be experienced in securing unanimity amongst so many diverse interests, and the practical impossibility of arriving at a fair division of the cost over the various districts—bearing in mind the necessity for the contributions tapering off to a vanishing-point at each end—we have come to the conclusion that the special-rating district should consist of the four eastern ridings of the Waitemata County and Eden County, together with all the cities, boroughs, town districts, and Road Board districts contained within their boundaries, as indicated on plan attached (Appendix No. 1).

(ii) **The proportions in which the various local authorities within the rating-area should contribute.**

As an indication that anything in the nature of a flat rate as between Auckland and the North Shore suburbs would be inequitable, let it be assumed that 3,000 vehicles per day pass over the bridge, of which 2,500 are cars and 500 lorries: these at an average of 1s. and 2s. respectively per trip would produce a total revenue of £63,875 per annum, leaving £86,125 to be collected in another way. If a rate of $\frac{1}{2}$ d. in the £1 on the unimproved value were struck in the suggested district to cover this, Auckland and the adjoining suburbs and other lands would contribute £71,024, and the North Shore boroughs, including Devonport (which is not in favour of a bridge) and the four ridings of the Waitemata County, would contribute £8,483. The halfpenny-in-the-pound rate produces less than is required. The inclusion of the Manukau County would make the position so much worse as between north and south.

If based upon the population proportion, then the south would have to find nearly seven times as much as the north.

If based upon the number of motor-cars owned on the two sides of the harbour, the burden would probably be twenty-two to one against Auckland, and possibly more. There is difficulty in obtaining figures as to the exact distribution of cars.

When it is considered that, in addition to this money to be derived from taxation, the vast majority of the cars crossing the bridge would be owned by persons resident on the south side, it will be seen that Auckland's contribution through this channel would in the aggregate be out of all proportion to that to be found by the North Shore users of the bridge.

The greater part of the advantage will be reaped by the owners of vacant land on the North Shore, and motorists desiring to go from Auckland to the North Shore, mostly on pleasure bent. It can be assumed that the latter will have adequately paid for the use of the bridge by the payment of the toll, and therefore the deficiency, after this toll has been paid, should be mainly recouped from the landowners on the northern side, particularly from the owners of vacant land.

Tolls alone, to be sufficient, will have to be so high as to preclude the possibility of any large number of people using the bridge in preference to the present ferries (see the following table):—

Number of cars daily at 1s. per car to give £150,000 per annum = 8,219.

				s.	d.
Average rate per car for 3,000 cars daily	..	..	..	2	9 per trip.
" 4,000 "	..	..	..	2	1 "
" 5,000 "	..	..	..	1	7 $\frac{1}{2}$ "
" 6,000 "	..	..	..	1	4 "
" 7,000 "	..	..	..	1	2 "
" 8,000 "	..	..	..	1	0 $\frac{1}{4}$ "

Similarly, if any large proportion of the deficiency after the levying of any practicable toll were to be loaded on to the landowners on the northern side, it is quite evident that they could not at present carry it.

The greater portion of any toll that is imposed would necessarily be collected from Auckland motorists, and in view of the fact that there is ample vacant land within the boundaries of Auckland City available for occupation when required, and as the construction of a bridge might have the effect of depreciating the value of this land, it is quite unlikely that Auckland City could be induced to contribute largely by way of rate to make up any deficiency in the tolls collected. (In this sentence the term "Auckland City" is used in its widest sense, and includes all the southern suburban boroughs, &c.)

The North Shore boroughs are not in a position to pay any large amount in special rates for this purpose.

It therefore follows that until Auckland City is desirous of having a harbour bridge, and is willing to contribute the greater portion of the deficiency, there does not seem to be any method of securing the necessary revenue.

We have considered a scheme whereby the suggested tolls might be increased by about 50 per cent. and the deficiency met in equal shares by the areas north and south of the bridge. This, based upon the unimproved value, would involve the

imposition of a rate of $\frac{1}{8}$ d. in the £1 on the south side, and approximately $1\frac{1}{2}$ d. in the £1 on the north side. This is a burden which it is very unlikely the North Shore boroughs would be willing or able to carry. In fact, we have the definite evidence of the Devonport Borough Council—whose population approaches in number that of the other three North Shore boroughs combined—that Devonport residents would receive practically no benefit, and would not be willing to pay any rate. If Devonport was left out of the rating-area, then on the remaining portions of the district the rate would be nearly doubled.

We do not agree with the statement made on behalf of Devonport that that borough would receive no benefit; the benefit would be small, but it would be none the less real.

(iii) **The proportion, if any, which should be found by the General Government.**

We do not consider that the General Government should find more than £250,000 as its share of the cost of the bridge. We arrive at this conclusion in the following way: For the sum suggested the Government could provide and operate a free ferry, running continuously between two convenient points, one on each shore, to connect with the main arterial highways, which should be more than ample to satisfy through traffic. In making the above assumption we are not laying it down as the duty of the General Government to provide this road or its equivalent, because the Government has in the past provided roads, admittedly circuitous, whereby all this land can be served, and will no doubt continue in the future, as in the past, to assist in the making of other roads, and in the improvement of those already existing. A grant of the sum mentioned would reduce the overhead charges by £13,750 per annum.

(b) **If by tolls, the approximate tolls which should be charged the various classes of vehicles and other traffic.**

Your Commissioners are of the opinion that the bridge, when built, should be financed partly by tolls and partly otherwise. We consider that if tolls sufficient to pay all costs were charged they would be so excessive that the whole scheme would break down. We think that a scale of tolls somewhat as follows would be reasonable:—

						s.	d.
Motor-cars	..	..	..	..	..	1	0 per trip.
Motor-lorries—carrying-capacity	1 ton	..	..	..	..	1	6 „
„	2 tons	..	..	..	..	2	0 „
„	3 tons	..	..	..	..	3	0 „
„	4 tons	..	..	..	..	5	0 „
„	5 tons	..	..	..	..	7	6 „

For the purpose of comparison we might mention that the tolls charged on the Arthur Kill Bridges, between Staten Island and New Jersey, where there is a large population, are as follows:—

						s.	d.
Passenger-automobile	..	..	..	..	..	2	1
Motor-truck, under 2 tons	..	..	..	..	..	2	6
„ 2 to $4\frac{1}{2}$ tons	..	..	..	..	..	3	0
„ over 5 tons	..	..	..	..	..	4	2
Buses	..	..	..	..	..	4	2
Pedestrians and vehicular passengers	..	..	..	..	..	0	$2\frac{1}{2}$

On the Vancouver Bridge the following ordinary tolls are charged, with reductions for commutation tickets:—

						s.	d.
Passenger-automobile	..	..	..	..	..	0	$7\frac{1}{2}$
Trucks, under $1\frac{1}{2}$ tons	..	..	..	..	..	0	$7\frac{1}{2}$
„ $1\frac{1}{2}$ tons to $2\frac{1}{2}$ tons	..	..	..	..	..	1	0
„ $2\frac{1}{2}$ tons to $5\frac{1}{2}$ tons	..	..	..	..	..	2	0
„ $5\frac{1}{2}$ tons to 8 tons	..	..	..	..	..	4	2
Pedestrians and vehicular passengers	..	..	..	..	..	0	$2\frac{1}{2}$
Buses at a varying daily rate.							

We are of the opinion that no toll should be charged on passengers travelling on cars or lorries, or on pedestrians.

The tolls to be charged on motor-omnibuses, which would presumably run at frequent intervals, should be the subject of special negotiations between the transport authorities and the authority controlling the bridge.

The Harbour Bridge Association assumed that the traffic over the bridge would total 3,000 vehicles per day, and would rapidly increase. From the experience obtained at Vancouver, with a large population and, it is believed, with a greater density of motor-vehicle ownership, this figure has not been reached after more than two years of operation. However, if we assume that the traffic would amount to 3,000 vehicles per day, of which 500 would be motor-trucks, this would give a revenue of £63,875 per annum, and the traffic might be assumed to increase to 4,000 vehicles per day, producing £85,167 per annum, in ten years. It will be seen from these figures that there would still be approximately £65,000 to be found from other sources.

(c) If by a levy on the lands increased in value by the execution of the works, what lands should be levied on, and in what proportions.

Excluding a large part of Devonport, which is already adequately served, and which is too remote from the bridge to obtain much benefit, we are of opinion that a considerable increase in values will accrue at Northcote, Birkenhead, Takapuna, and the southern portion of the Waitemata County.

Several witnesses stressed the desirability of applying the betterment principle laid down in the Town-planning Act. In this proposal we see very considerable difficulty, but, provided the experience gained in the operation of the Act during the years which will elapse between the present day and the date of the building of the bridge indicates that the betterment provisions of the Act can be applied without friction and hardship, then this principle should be taken advantage of.

We have already mentioned that it does not appear to us that it is likely that at present the lands in Auckland City would receive such a benefit as to justify their being loaded with any considerable portion of the cost of the bridge. In actual practice the greater part of the revenue from the bridge tolls will be derived from Auckland residents and Auckland business houses.

(d) If by contracting with any individual or company to construct the bridge, receiving as consideration therefor the right to collect tolls for a specific period, on the understanding that at the end of such period the bridge is handed over free of encumbrances to the controlling authority, then for what period, and to which authority, and under what special conditions.

In the course of our inquiry we were told by the representatives of the Auckland Harbour Bridge Association that they preferred that the Government should build the bridge, but that if that were not done they were convinced that an organization could be induced to erect the bridge at its own cost, recouping itself from the tolls over a specified period, and at the end of such period handing over the bridge in good order to whatever authority was authorized to control it. This view was supported by others. We doubt very much whether this is feasible; but, in view of our definite statement that we do not think the bridge should be built at the present time, either by the Government or by local authorities, we are of the opinion that no obstacle should be placed in the way of the bridge being constructed by the means indicated.

We consider that if such an arrangement is completed, the company or individual building the bridge should have the sole right to the tolls for a period of twenty-five years, and that at the end of that time the bridge should be handed over to the City of Auckland on the condition that it should abolish the tolls.

(e) If partly by one of these methods, or partly by another, or by any other method, then which method or methods.

As indicated above in detail, we are of opinion that the bridge should be financed partly by tolls, partly by a charge on the lands to be benefited, and partly by a grant from the General Government, unless it should prove possible to have the bridge erected free of cost to the country, as has been suggested by the Auckland Harbour Bridge Association (see remarks under (d)).

- (4) Whether the construction and future control of the bridge shall be carried out by some existing local authority, and, if so, which, or by a special local authority having rating or other special powers over the proposed rating district, or by the Government.

We do not consider that any existing local authority possesses such a paramount interest to itself undertake the work, nor has any local authority the powers of controlling other local authorities which would be necessary. We therefore consider that, when the time approaches for the construction of the bridge, a special local authority, to be called "The Waitemata Harbour Bridge Authority," should be constituted for this purpose. This special local authority should be constituted by Act, which should, *inter alia*, lay down its powers to levy rates, assess betterment, and collect tolls.

- (5) Should the Commission be of the opinion that the transit requirements of the district under consideration could be equally as well, or better, served by means of a tunnel or tunnels, then all the questions recited above with regard to the bridge shall, *mutatis mutandis*, be answered with respect to the tunnelling proposal, in so far as applicable.

Your Commissioners are of the opinion that the requirements of transport between the two shores of the Waitemata Harbour could be met by the provision of a double tunnel, which would have the advantage of being situated at the best possible point to serve the bulk of the population; but the cost of such a tunnel would be so much in excess of that of a bridge that we do not think it necessary to pursue the subject.

Finally, your Commissioners are directed to report upon any other matters arising out of the premises which might come under their notice in the course of their inquiries and which should, in their opinion, be investigated in connection therewith. Under this heading we desire to say that, generally speaking, it seems to us that, apart from the advantage in time saved and in independence of travel to individual motorists, the City of Auckland will not gain any material benefit from the construction of the bridge, when one bears in mind the large areas of land on the south side of the harbour which are available for residential purposes, together with transit, drainage, water-supply, electric light, and other services which are already provided in these areas. Any large increase in the population of the North Shore district will be almost entirely reflected in a slower growth on the Auckland City side of the harbour. Furthermore, the building-up of large communities on the North Shore will tend to the establishment there of retail and other businesses which must inevitably take trade from the business houses already established on the city side of the harbour.

Viewed from the national standpoint, we do not think the construction of the bridge would increase the production or facilitate the travel of the Dominion population as a whole to such an extent as to bring the bridge into the category of what may be termed important national works.

When the day comes for the construction of the bridge, the erection of two other bridges would be well worthy of close investigation—the one over the main Waitemata Harbour at Hobsonville, and the other over Hellyer's Creek. These two bridges, in combination with the harbour bridge, would greatly improve the access to Hobsonville, Greenhithe, and other land in that direction.

This, our report, which has been unanimously adopted, we have the honour to respectfully submit for the consideration of Your Excellency, together with the transcript of the evidence taken by us in the course of our investigation, and the following plans, &c., illustrating our report:—

Appendix No. 1: Locality plan.

Appendix No. 2: Plan and section of suggested bridge.

Appendix No. 3: General plan showing the recommended route and access to bridgeheads.

Appendix No. 4: Longitudinal section, showing grades.

Appendix No. 5: Chart showing dredging recommended.

Appendix No. 6: Report by Technical Group of Auckland Town-planning Association on access to Bridgehead at Fanshawe Street.

We return herewith Your Excellency's Commission.

Given under our hands and seals, this 22nd day of April, 1930.

J. MARCHBANKS, M.Inst.C.E., Chairman.
 F. W. FURKERT, }
 COLL McDONALD, } Commissioners.

APPENDICES.

[Appendices Nos. 1 to 5 not printed.]

APPENDIX No. 6.

REPORT BY TECHNICAL GROUP OF AUCKLAND TOWN-PLANNING ASSOCIATION ON ACCESS TO
BRIDGEHEAD AT FANSHAWE STREET.

Technical Group, Auckland Town-planning Association,

202 Southern Cross Building, Chancery Lane, Auckland, 28th January, 1930.

DEAR SIR,—

In reference to yours of the 14th ultimo, in regard to access to possible bridge-sites across Auckland Harbour, we regret that, owing to interruption by holidays, some delay has occurred in replying.

The Technical Group of the Auckland Town-planning Association, to whom this matter was referred, considered that owing to the limited time available it was preferable to concentrate on the most probable bridge-sites. We have accordingly eliminated proposals Nos. 1 and 4.

Even proposal No. 2 appears to us unsuitable, owing to its interference with navigation, and to the excessive depths of rock foundation, so that we have actually confined our attention to proposal No. 3, with bridgehead at Fanshawe Street.

Up to the present time all traffic trended and was intended to trend towards the business centre of the city, of which the heart is situated around lower Queen Street, and all streets were laid out with this objective. Now that a harbour bridge is projected it is found that the traffic routes are mostly trending in wrong directions, or that the configuration of the terrain is unfavourable for streets or routes leading to the bridgehead at Fanshawe Street, and that it would be impossible under any practicable scheme to make the existing streets suitable for this altered trend to traffic. Any suggestion that it is possible to utilize the existing wide streets, such as Albert, Hobson, Nelson, Union, Fanshawe, and Victoria Streets, is quite impossible, as they do not tap the sources of the congestion.

We are therefore of the opinion that, without an entirely new system of by-pass roads, the greatly increased north-bound traffic, converging from all points of the isthmus, would tend to still further trouble at the southern bridgehead through having to traverse the already congested sections along Upper Symonds Street, Karangahape Road, Queen Street, and Customs Street. We therefore suggest that this traffic be picked up at suitable points beyond the congested areas and be conducted by new routes to its objective.

A study of the existing traffic routes indicates that there is no suitable lead to the bridgehead for the accumulation of arterial traffic feeding from the Edendale, Dominion, Mount Eden, and Manukau Roads, the Great South Road (and its feeders), as well as roads from the eastern areas. Consequently all this traffic tends to be forced into "bottle-necks." With a properly devised scheme of arterial roads there is no occasion for this mass of traffic passing into and through the already congested city areas.

We therefore suggest, as integral parts of the bridge cost, that new routes be provided as hereinafter described, and as shown in red on accompanying map.

It is quite apparent that the opening-up of these new routes will involve heavy expenditure, but we maintain that their completion is absolutely essential to a satisfactory and permanent solution of the ever-increasing traffic problem. The complexity of the existing traffic problem will be greatly accentuated by the opening-up of the bridge, and we maintain that a large proportion of the cost of these new traffic routes should be a direct charge against the bridge, and that it would be absolutely unjust that the city should be called upon to pay more than its fair share.

The Technical Group has already evolved an eastern outlet via Hobson Bay and Panmure to catch much of the Great South Road and Remuera traffic, and thus relieve traffic congestion at Newmarket and elsewhere. This scheme, however, does not affect to any great extent the matter now under discussion, but is merely mentioned in passing to show that a wide purview has been taken of the whole question.

The principal entirely new route suggested is one starting from Customs Street West, following up Nelson Street for 57 chains, tunnelling for 18 chains under Karangahape Road (twin tunnels, each 25 ft. wide), emerging near Cobden-Oxford Street junction, following down Newton Gully, joining New North Road at Morningside (114 chains) and the Great North Road at Western Springs (50 chains), with offshoots to the Great South Road via Seccombe Street (116 chains), and to Dominion Road via Onslow Street (43 chains).

The particular function of these proposed roads is to "by-pass" all traffic from encroaching on the already congested areas. Thus the Newton Road tunnel will take all western and south-western traffic by tunnel under the heavily trafficked Karangahape Road, and lead it by Nelson or Hobson Streets to the business centre of the city, or to the bridgehead via Union Street, while the Onslow Road would lead all Dominion Road through traffic into Newton Gully, instead of disgoring it into the already congested sections around Upper Symonds and Queen Streets. It would pass under

New North Road by a 5-chain "cut-and-cover" tunnel. Similarly, the Seccombe Street proposal leaving Broadway, Newmarket, traversing Seccombe Street, proceeding via Grammar School and Mount Eden School, crossing under New North Road by a 5-chain twin tunnel and joining Newton Gully at Newton Road, would by-pass all the eastern and south-eastern traffic and prevent it from passing through the congested areas. All these proposals would be entirely free from contact with tram routes—a very important consideration to all motor traffic, and making both for speed and safety.

Almost two years ago the city authorities suggested a new traffic route via Queen Street, Belgium Street, and Exmouth Street, at an estimated cost of £290,000, but the alleviation to the traffic problem by this scheme would be only local and temporary. It would certainly ease the conditions along Upper Symonds Street, but would only shift the congested points farther out, while we claim that the Newton Gully proposal will effect a satisfactory and permanent solution. Attached is a summary of a report on the proposed Newton Gully by-pass route as presented to the association on the 26th August, 1929.

The opening up of these routes would entail extensive resumptions of land, and heavy expense would thereby be incurred; on the other hand, these new roads would soon be instrumental in improving the residential and business values of what are now more or less slum areas along the upper portion of Newton Gully. Consequently, the application of the principle of betterment would be eminently applicable to this proposition, thus very materially reducing the cost.

The alignment and grades of these new routes would be particularly favourable, while the widths contemplated would be at least 100 ft. throughout, preferably 120 ft. along Newton Gully. In passing, it may be remarked that the suggested railway deviation from Auckland City Station to Morningside would have followed down this same gully.

The cost of the major connections with Morningside (114 chains) and Western Springs (50 chains) will run into £280,000, while the lesser connections with Dominion Road via Onslow Street and the Great South Road via Seccombe Street, lengths being 45 chains and 116 chains respectively, costing approximately £45,000 and £75,000, thus making a total of £400,000.

It is difficult to state what proportion of this sum could reasonably be considered as an integral part of the bridge proposals, but a sum of £100,000, or 25 per cent. of the total amount, would appear to be quite reasonable.

In No. 3 bridge proposal, starting from Fanshawe Street, there would require to be considerable improvement in alignment at Freeman's Bay Park, between Beaumont Street and Patteson Street, involving a cost of £50,000, all of which should be a direct charge against the bridge proposals.

It is hoped that the foregoing explanations will make it clear that the existing traffic routes would prove to be quite inadequate for the enormously increased traffic incidental to the completing of the bridge, and that it would be quite reasonable to charge a proportion of the expenditure on new and adequate outlets against the bridge proposals. The total cost suggested as being reasonably chargeable against the bridge on the southern or city side would therefore be £150,000.

On the northern side, all schemes would eventually involve causeways connecting Birkenhead, Northcote, Bayswater, and Stanley Bay. The cost of these new works necessitated by reason of the bridge would be directly chargeable against the bridge. The approximate cost of these causeways would be £270,000.

Thus the total estimated cost of access or improved access to the proposed harbour bridge is—Southern side, £150,000; northern side, £270,000: total, £420,000.

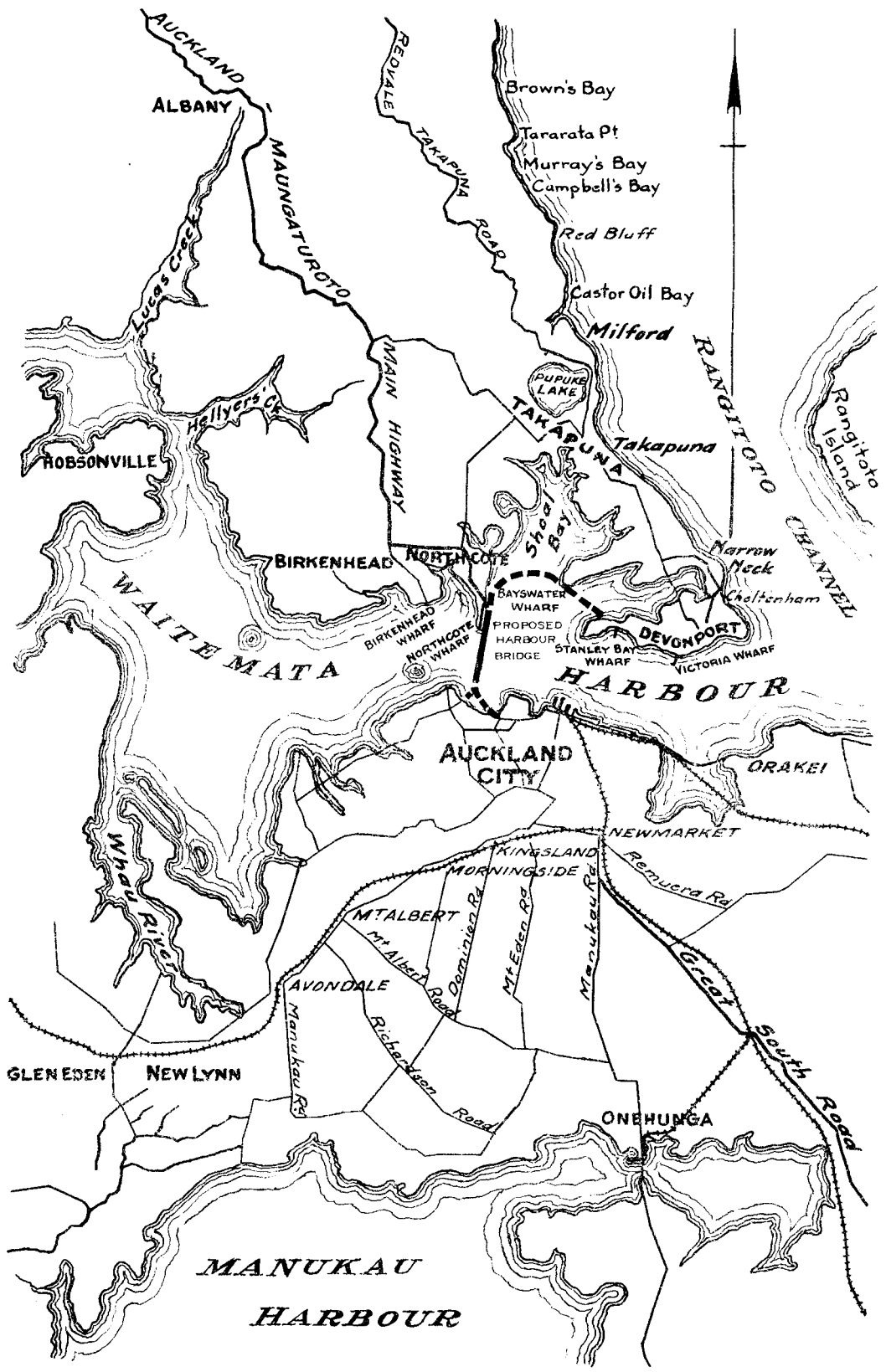
Yours faithfully,
E. V. BLAKE,
For Technical Group.

F. W. Furkert, Esq., Engineer-in-Chief, P.W.D., on behalf of Bridge Commission, Wellington.

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— PLAN SHOWING LOCATION —
 OF
 — PROPOSED HARBOUR BRIDGE —
 — AND APPROACHES. —

