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## New Jersey Interstate Bridge and Tunnel Commission

to the

LEGISLATURE OF THE STATE  
OF NEW JERSEY

1919

TRENTON, N. J.

MACCRELLISH & QUIGLEY CO., State Printers

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## REPORT.

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*To the Legislature of the State of New Jersey:*

The Interstate Bridge and Tunnel Commission created by and acting under acts of Legislature approved February 14th, 1918, known as Chapters 49, 50 and 51, of the Laws of 1918, respectfully submits for your consideration its first annual report. The undersigned constitute the original Commission appointed under the acts with the exception that Mr. Thomas N. McCarter who was originally appointed, resigned and was succeeded by Mr. T. Albeus Adams, who was a member of the previous Commission on August 2d, 1918.

It has long been recognized that the port facilities of the United States, particularly at the port of New York, have been entirely inadequate. These conditions in some instances have been brought about by the difficulty arising in obtaining the co-operation of the States of New York and New Jersey in the construction of interstate communications at public expense. Throughout the several States vast sums of public money are expended for intra-city and county communication, but comparatively nothing for interstate communication.

Every one will admit that this neglect of interstate communication should not exist. The United States is one nation, and imaginary boundary lines between States should not be allowed to constitute real barriers to public improvements affecting one, both or all States. The war has emphasized and demonstrated the fact that the interests of the several States are coincident, and the thoughtful co-operation between the States should be the key-note of their intercourse.

The war has revealed to us, not only our greatness in capacity but also our shortcomings. It has demonstrated our weakness in transportation owing to our lack of proper terminal equipment and facilities.

Vast quantities of food, merchandise and munitions destined for the army abroad, and for the civil population of foreign countries have been lying in the railroad yards of our ports of embarkation for long periods; not alone because of the lack of ships even when ships are available. This condition results in waste of time, by reason of delay in loading and unloading ships and consequently immeasurable financial loss to the nation is the result.

How easily the greatest port of the United States can be tied up by bad weather, terminal freight congestion, strikes of tug boat captains, firemen, or deck hands, was demonstrated at the Port of New York during last winter; resulting in consequences so serious as to cause the British Government to make representations to our Government through diplomatic channels by cable that unless the congestion could be relieved, Great Britain would not be responsible for the outcome of the war.

The necessities of war have brought into being and developed a large number of permanent industries of a capacity never before thought possible. In order to open the way for these industries to continue to develop, increased port facilities must be provided, and the present barriers to port development must be promptly removed. Indeed, the expansion and development of our foreign trade depends upon the efficiency of our port facilities. The easy and sufficient exit and entrance from and to the Hinterland of a great port is absolutely necessary to its development. Large reservoirs for water supply are useless, without a large and sufficient pipe line to properly distribute the supply. It is useless to build up a great shipping port when its exits and entrances are insufficient to fully distribute its traffic to and from the Hinterland. This needed feature can only be secured by the building of bridges and tunnels of sufficient capacity to furnish full and free communication of vehicular and passenger traffic and thus open up the way for motor truck routes; the means of short haul transportation, which is increasing at a prodigious rate. Every consideration of patriotism and of business interest, therefore, require this to be done.

#### THE PORT OF NEW YORK.

As to the solution of the problem with reference to the Port of New York your Commission has reached the conclusion that the first step to be taken is the construction of a vehicular tunnel under the Hudson River between Jersey City and New York City.

The project of constructing a tunnel has been recognized for some time as offering the quickest and most economical present solution. The history of these movements is interesting and enlightening and shows that this important matter has received full consideration from commissions previously appointed who have arrived at the same conclusions as your commission is now urging.

On March 1st, 1913, the New Jersey Interstate Bridge and Tunnel Commission submitted a report to your honorable body recommending the construction of a tunnel under the Hudson River, and submitting an elaborate report with maps, etc., for this purpose, prepared by the distinguished engineering firm of Jacobs and Davies, the builders of the Pennsylvania and other tunnels. Your commission respectfully refers to said report of March 1st, 1913, and appends an extract therefrom as Appendix A to this report.

At a subsequent time, the Public Service Corporation of New Jersey, seeing that the future of their properties depended upon the development of northern New Jersey, and that the development of northern New Jersey depended upon a connection for vehicular traffic with the City of New York, instituted through a corps of engineers, an inquiry into the subject, expending a very large sum of money in borings, drawings and engineering services by distinguished and capable engineers. The result of this investigation by the Public Service Corporation was the conclusion that the solution of the problem lay in the construction of a tunnel at the point suggested by Messrs. Jacobs and Davies.

In 1917 and 1918 the Hudson River Bridge and Tunnel Commission of New Jersey employed General George W. Goethals to consider the problem, with the result that General Goethals

reported in favor of the construction of a tunnel upon the same location selected by Messrs. Jacobs and Davies, varying, however, the mode of construction, due in part to a change in the cost of materials. General Goethals recommended the use of a large double-deck tunnel of concrete construction of sufficient capacity to accommodate three (3) trucks abreast going in one direction on the upper level, and three (3) trucks abreast going in the opposite direction on the lower level. General Goethals obtained estimates from a responsible contractor showing that the cost of the tunnel would be about \$12,000,000, of which the State of New Jersey would be expected to pay \$6,000,000 and the time required for construction would be about two years. The annual cost of maintenance being about \$125,000. The Hudson River Bridge and Tunnel Commission of New Jersey, on April 7th, 1918, made their report to the Boards of Chosen Freeholders of the Counties of Bergen, Hudson and Essex, embodying the report of General Goethals, and favoring the construction of the tunnel as recommended by him. Your Commission have adopted General Goethals recommendation and makes his report part of this report as Appendix B.

On March 12th, 1918, the New York State Bridge and Tunnel Commission submitted a report to the Legislature of the State of New York, upon the same subject, in which they reached the same conclusion, as had been reached by the New Jersey Commission, viz., in favor of the construction of a tunnel such as was recommended by General Goethals.

Demands for better terminal facilities have come from organized business groups, commercial bodies, and Labor Organizations in New Jersey, especially of Essex, Passaic, Bergen, Union and Hudson Counties—as well as from the Commercial bodies of the State and City of New York—including the Board of Trade and Transportation—Merchants Association—Central Mercantile Association—Chamber of Commerce. These demands have been insistent and it is imperative that they be promptly met. The pressure upon your Commission for a solution of the problem both from these and other quarters, has been very great and your Commission in addition to its regular

monthly meetings, has held many special meetings in its endeavors to satisfy these demands and make progress as rapid as possible.

On June 6th, 1918, the Chamber of Commerce of the State of New York, received a report of a Committee appointed by that body to consider this question. The Committee reported in favor of a vehicular tunnel such as was proposed by General Goethals, and submitted a report to that effect, which was unanimously adopted by the Chamber.

The report of the Chamber of Commerce emphasizes the fact that while the City of New York has doubled, its population in the last twenty years, has increased its capital invested in industrial enterprises from eight hundred million dollars to approximately two billion dollars, and has now gathered within its borders nearly one tenth of the wage earners of the country, and is producing yearly nearly three billion dollars' worth of manufactured goods—an amount almost equal to the entire output of Chicago, Philadelphia, St. Louis and Cleveland—still not a dollar has been spent on any comprehensive improvement of freight facilities during the last quarter of a century. The Chamber calls attention to the fact that it believes that the construction of a vehicular tunnel is part and parcel of a comprehensive movement for the improvement of our freight facilities, and that such an improvement can be made at the expenditure of the comparatively small amount of \$12,000,000.00 and that the only reason why the construction is not proceeded with is the fact that the needed legislation has not been passed by the Legislature of New York.

The report of this Committee, adopted by the Chamber after a most careful investigation on the part of the Committee, is submitted as a part of this report under Appendix C.

The construction of such a tunnel would be far-reaching in its benefits beyond all calculation. It would bring the food and the consumer and the work and the worker all together. It does not involve any radical change in the development of the port of New York, and does not interfere with any more elaborate and comprehensive plan which has been suggested or is



contemplated. On Manhattan Island it would immediately release a large number of valuable piers which are now used for freight terminals and for car floats, which could be used for foreign shipping, the natural use to which they should be put. It would, at the same time, reduce largely the expensive car-float traffic, and the antiquated, inadequate and expensive ferry traffic. The vehicular tunnel not only does not conflict with any general plan proposed for co-ordinating the facilities of the whole of New York Harbor, but it fits in with such plans admirably.

In 1918, your honorable body, recognizing the necessity of interstate communication between the States of New York, Pennsylvania and New Jersey passed acts authorizing the construction of interstate transit facilities between these States and providing the revenue by taxes extending over a period of years. These bills are known as Chapters 49, 50 and 51 of the Laws of 1918, the first three bills introduced in the Assembly for Speaker Charles A. Wolverton.

Your Commission has had the hearty support and co-operation of Governor Edge and it is due to his initiative and vigor that the project is in its present favorable position. The Commission has also had the approval and assistance of Ex-Governor Whitman and of Governor Smith, and a Committee of the U. S. Senate, after a hearing on the subject, has expressed a willingness to introduce a bill empowering the two adjacent States to construct the tunnel under the navigable waters of the Hudson River.

Your Commission feels that the outlook for the consummation of this project is most encouraging. The project has met with endorsement by every Committee which has considered it, and the only difficulty which has prevented its consummation has been the difficulty of obtaining co-operation between the States of New York and New Jersey. This co-operation seems now almost secured, as with the elaborate study which has been given to the subject, both by the Chamber of Commerce and by the several Commissions, favorable action should be shortly obtained by the Legislature of the State of New York, and with the favorable attitude which has been shown by your honorable

body, it seems safe to look for successful results in a reasonable time.

#### DELAWARE RIVER BRIDGE.

Thorough and careful investigation of all phases of the subject led the Commission to the conclusion that a bridge to span the Delaware between the cities of Camden and Philadelphia would best meet the demands of traffic. In this connection your attention is directed to the report of the Delaware River Bridge and Tunnel Commission, created under the law of 1914 and appointed in 1916, and which preceded this Commission. That report details and statistics gathered with respect to the traffic and prevalent conditions which led to the endorsement of the bridge project by unanimous vote. The elements of cost and all other considerations entered into this decision and the present Commission, after due deliberation, deemed it wise to take up the project where its predecessors left off and to continue all efforts toward the bridge project. In this decision the Commission met the unanimous support of the Delaware River Bridge and Tunnel Commission of Pennsylvania, appointed by the Governor under an act of the Pennsylvania Legislature of 1917.

Numerous meetings and conferences have since been held by the Commission of the two States, with the result that in June a joint contract was entered into with Dr. Warren P. Laird, Director of the Architectural Department of the University of Pennsylvania, to make a survey and study upon both sides of the Delaware with a view to the placement of the proposed bridge to accomplish the most satisfactory results for all interests. The contract price for this service was \$10,000, divided equally between the two States.

Dr. Laird's deductions of his exhaustive study and analysis of the subject covering the five months in which he was engaged in it, resulted in a report to the Commission, which is herewith submitted as Appendix. The report was unanimously endorsed at a meeting of the Commission in its Camden office on December 26th. The recommendations have met the support of all interests on the New Jersey side of the River and, while there has been

some opposition in certain circles in Philadelphia, the Commission is assured that they will also have endorsement there.

As this report is prepared there is every indication that the Legislature of Pennsylvania will at its present session pass the legislation required to bring that State to a level with the legislation already enacted by New Jersey and under which it will be possible to bring that great project to early consummation. So soon as the Pennsylvania Legislature has taken the necessary steps it will be incumbent upon New Jersey to make the special tax levy, provided under the law of 1918 creating this Commission and giving its power to enter into contracts for construction available to make it financially practicable.

Reference to the report of the Delaware River Bridge and Tunnel Commission which preceded this Commission will show a careful estimate of the cost of the proposed bridge as submitted by Waddell & Sons, Consulting Engineers of New York, in June, 1917. This estimate was based upon a suspension type of bridge with the main span of 1740 feet, center to center of piers, or 145 feet longer than the Williamsburg Bridge over the East River and therefore the longest suspension bridge in the world. This also provided a vertical clearance above mean high water of 150 feet at mid-span and 135 feet at the piers. It also suggested the novel plan of providing spiral approaches to the bridge to minimize the cost of land and property damages for long approaches required for a bridge of this dimension, in all 3,000 feet at each end. Such a bridge would give a curvature barely noticeable, the engineers state, and a grade for ascending vehicles of 3% on the outside and 4% on the inside for descending vehicles, the roadway making in all three turns around the spiral. Such construction it was suggested would also provide space for storage, warehouses and other purposes, a source of revenue for the proposed structure.

The width of the bridge as thus planned would be 114 feet, providing a central roadway and two outside promenades, each 12 feet wide.

Detailed estimates of the cost of such a structure thus proposed were given by the engineers and are included in the report of

the Delaware River Bridge and Tunnel Commission. The grand total of the cost, including real estate, was \$9,940,000, of which New Jersey's share would be \$4,570,000. These figures included for real estate condemnation and damages on the Camden side in all \$400,000 and on the Philadelphia side, \$1,200,000. With straight or direct approaches this latter item would amount to a very much larger sum, a matter of great consideration in the project. The same engineers, Waddell and Sons, submitted to the Delaware River Bridge and Tunnel Commission in November, 1917, an estimate of cost of two tunnels under the Delaware River, between Camden and Philadelphia, which it was estimated would be necessary to provide the same or nearly the same volume of traffic as would be cared for by a bridge of the same dimensions. Full details of this project are also given in the above-mentioned report and are accessible to anyone interested in the subject. The estimate of cost of these tunnels was \$14,222,000.

One item which entered into the estimates of the engineers for the tunnels was that of maintenance, including \$112,000 per year to provide sufficient ventilation to make these tubes available for automobile traffic. The engineers state, "without going into further detail it may be stated that the difference in annual expenses for operating, lighting, maintenance and repairs, between tunnels and bridge, amounts to more than \$125,000. Assuming these round figures to be correct and that the prevailing rate of interest is five (5) per cent. per annum it is evident that two and a half millions of dollars will have to be added to the various total costs of the two tunnels when comparing the said combined costs with that of a bridge."

## APPENDIX A

February 25, 1913.

*New Jersey Interstate Bridge & Tunnel Commission:*

GENTLEMEN:—Following your request that we should report to you in respect of the construction and use of tunnels for connecting the highways systems of the States of New Jersey and New York, we beg to advise you as follows:

The proper location of such connecting link between the highway systems of the two States should be such as to connect in the most direct manner the existing centres of traffic so as to enable it to serve the convenience of the greatest number of users. Within the State of New York the centre of gravity for vehicular traffic is unquestionable in the downtown section of Manhattan, where access can be had to the wholesale distributing centres, the steamship piers, and connection made with the existing lines of communication over the East River bridges to the manufacturing commercial and distributing centres of Brooklyn. Likewise, in New Jersey the centre of vehicular traffic is about abreast of the same point, the origin or destination of most of the traffic being in the lower sections of Jersey City and Hoboken and in the City of Newark, Essex County, practically on a direct line to the west.

We have obtained, either by actual count or from official returns statistics of wagon travel on the various ferries crossing the Hudson River, which indicate that a vital vehicular traffic of some 19,660 vehicles daily in both directions, not more than 2,000 per day use the ferries for the uptown districts north of 23d Street. The great density of traffic for commercial vehicles is in the downtown district, the uptown ferries being used for the most part by pleasure vehicles.

Physical conditions in the downtown district are also favorable to tunnel and adverse to a bridge, while in the uptown districts the reverse obtains. Considering the topographical conditions; the existence of the high lands in the Borough of Manhattan along the Hudson River commencing approximately at 50th Street and extending northward and the Palisades on the New Jersey side opposite; the construction of a bridge is feasible at

locations north of, say 57th Street, as the high banks shorten the approaches and the geological conditions are such as to enable foundations to be secured at a reasonable depth. On the other hand, due to the recession of the Palisades to the westward at Hoboken and Jersey City, and the low level of the land in lower Manhattan, as well as to the geological conditions, tunnels are the only practical and feasible means of crossing the river at any point south of, say 50th Street.

In view, therefore, of the requirements of the traffic and the physical conditions, we recommend as a location for the first tunnels, of a line from the foot of Canal Street, Manhattan, to intersect the shore line of Jersey City at approximately the extended line of 12th Street, Jersey City, which is the line of division between the properties of the Erie and Lackawanna Railroads, and extending thence to a portal in the block between 12th and 13th Streets and Provost and Henderson Streets so that the surface of the street is reached at Henderson Street, which is the first continuous street parallel to the river connecting Jersey City and Hoboken. This location will not interfere with the various projected rapid transit tunnels or subways; or with the developments and improvements contemplated by the railroads or by the cities; and will not obstruct or interfere with public streets or private property other than in its outlet upon Canal Street, where the widening of the street for one block would be necessary. The approach would reach the grade of the street at the line of the new extension of Seventh Avenue and the widening of Varick Street. This location permits of direct connection along Canal Street to Manhattan Bridge and is in close proximity to the Williamsburg and Brooklyn Bridges; to the new 1,000 foot steamship piers; and to the main arteries to uptown Manhattan. Canal Street, it should be noted, is the widest Crosstown street in the downtown district, and its surface is also the lowest, making the approaches shorter than they would be in any other street. The maximum adverse gradients eastbound would be 3.7 per centum and westbound 3 per centum; these being practically the same rates that prevail on the East River Bridges.

On the New Jersey side this location gives immediate access to either the low sections of Jersey City and Hoboken or to



Jersey City Heights by the 13th Street viaduct. There is consequently no reconstruction of any of the highways in New Jersey required to give access to this tunnel. This location is in immediate proximity to all railway yards and freight stations, to the warehouse and manufacturing district and to the steamship piers. .

We recommend on the above location that a pair of tunnels be provided with a roadway in each of approximately 17 feet width; one tunnel being for eastbound movement and the other for westbound movement. Such a pair of tunnels would have capacity for 5,000,000 vehicles per annum, which is approximately the entire vehicular traffic now crossing the Hudson River by ferries.

If the river frontage traffic necessitated, shafts with elevators could be placed at the water front in addition to the inclined approaches extending inland, at comparatively little additional expense, which would effect a saving in distance and energy.

Additional tunnels could be constructed as the necessity arose, at other suitable locations, giving efficient and complete distribution of vehicular traffic in different districts instead of concentrating it at any one particular point.

The construction of such tunnels is perfectly assured and thoroughly understood; they would differ in no degree, excepting in dimensions, from the six tunnels constructed by the members of the firm for the Pennsylvania Railroad and Hudson and Manhattan Railroad across the Hudson River at various points. The geological conditions met with in the construction of the above tunnels indicate that similar conditions would prevail on the line of the suggested highway tunnel, and that they are such as to enable the work to be carried out in a safe, cheap and rapid manner, and there is, therefore, nothing speculative in relation to the feasibility of this project.

Two such tunnels as these are in successful operation under the River Thames in London—the Blackwell Tunnel and the Rotherhithe Tunnel, one under the harbor at Glasgow and one under the Elbe in Hamburg. The Blackwell Tunnel is 6,200 feet long and the Rotherhithe Tunnel is 6,883 feet long; and

each of these tunnels consists of a single tube providing for traffic in both directions in one tunnel, and in the last year each of these tunnels accommodated almost exactly one million vehicles, including automobiles. The Glasgow and Hamburg Tunnels have separate tubes for the traffic in each direction, and are provided with shafts, with elevators, for access to the surface.

None of the above tunnels is equipped with mechanical ventilation apparatus, as it has not been found necessary, although provision was made in the Blackwell Tunnel so that it could be installed if required. In the present case, we recommend that mechanical ventilating plants, with the necessary air ducts, be installed.

The interior of the tunnels above the roadway would be lined in a sanitary manner to permit of the utmost cleanliness and so as to reflect the greatest amount of light. A solid, hard resisting roadway surface would be provided, that could be maintained at the minimum of expense.

The cost of such a pair of tunnels, with approaches to the surface, including easements for right of way, carrying charges, engineering and contingencies, we estimate would be \$11,000,000.

The time needed for construction we estimate at three (3) years; and, bearing upon this, it will be of interest to know that the two tunnels of the Pennsylvania Railroad crossing the Hudson River were constructed in eighteen (18) months actual elapsed time; so that this allowance is reasonable and liberal.

In respect to connection of the Borough of Richmond, New York, with Bayonne, or with the main Jersey coast below Newark Bay, the character of the geological formation, the topographical conditions and the conditions of the waterways make these locations peculiarly fitted for connection by tunnel between the two States at any points where it might be desirable to so connect the highway systems.

We have the honor to be

Very respectfully yours,

JACOBS & DAVIES, INC.

(Signed) J. J. DAVIES,

*Vice-President.*

## APPENDIX B.

GOETHALS, JAMIESON, HOUSTON & JAY, INC.,  
40 WALL ST.

## REPORT ON HUDSON RIVER VEHICULAR TUNNEL.

November 24, 1917.

*To the New York State Bridge & Tunnel Commission and the  
Hudson River Bridge & Tunnel Commission, 115 Broad-  
way, New York City:*

GENTLEMEN—You desire me, by resolution adopted at the meeting held on September 6th, 1917, "to examine plans already made of tunnels and to report as to the best type of tunnel to be built." The tunnel under consideration is to extend under the Hudson River from Canal Street, New York City, to 12th Street, Jersey City, for the use of vehicles and foot passengers.

The plans already made are two in number, and are of different types of construction; one to be built by what is known as the shield method, and the other by the open-trench method. Of the types proposed the trench method is the more attractive and has advantages which make it the preferable one, provided there are no construction difficulties which make its adoption undesirable.

To build the tunnel it is proposed to excavate a trench, the bottom of which is to be 80 feet below mean low water, and to have a width of 40 feet; to drive piles in this trench, 5-foot centers across it, and 8-foot centers longitudinally, these piles to be from 40 to 70 feet long after they have been cut off at the proper elevation, so that the tunnel will have under it a rock or a pile foundation, thus assuring the greatest stability.

Borings were made over the section of the river that the tunnel will occupy, in order to determine the character of material and the depths to rock; test piles were driven to ascertain the practicability of their use for a foundation in those portions of the section where rock was not available; methods were studied for cutting off the piles at the proper elevation, with assurances that such results could be secured, but, unfortunately, no steps

were taken to determine the practicability of securing the trench and maintaining it for a time sufficient to drive the piles, to cut them off, and to sink into place the tunnel sections—assumed to be 80 feet long.

The material through which the trench must be dug is soft silt and mud. Some idea of the fluidity of the material may be had from tests made by dropping a pole 48 feet long, weighing 85 pounds, of which 38 feet was of wood 2½ inches in diameter, 10 feet of ⅝-inch diameter steel; under its own weight it penetrated the material to a depth of from 27 to 36 feet. The upper strata in close proximity to the water is in such a liquid state as to be set in motion by the passage of deep-draft vessels. It is true that the material becomes more compact at the greater depths, yet it is equally true that water admitted to the lower strata reduces these to the same consistency as the upper strata, which will be the case if they are reached during the progress of the dredging operations. It is a significant fact that while making the borings to rock, referred to above, no drive samples could be secured at any depth through the silt and mud. When dredging for increased depths of channel, much more material must be removed than prism calculations indicate, yet such deepening is in the direction of the currents; the side slopes are not sufficiently defined to be determined. To cut a deep trench across the tidal currents through material which reduces to a practically fluid state when water has access to it becomes a more serious and difficult task.

The so-called Hudson River silt consists of minute particles of trap, granite sand—the result of erosion of the rock formations found along its banks. It overlies the rock as an unstable mass, affected by tidal fluctuations and temperature changes. It can be handled easily by dredges, but the very character of the material precludes the possibility of securing a trench of the dimensions required within a reasonable time and at a reasonable cost.

Consideration has been given to the use of sheet piling so arranged and disposed as to give a uniform slope from the

surface of the mud to the bottom of the trench, and also to the freezing method, but both were abandoned.

Under these circumstances I regret that I am forced to the conclusion that the trench method is impracticable for constructing the tunnel on the site selected, and I recommend the adoption of the shield method.

While collecting data and investigating the material through which the trench must be dug, consideration was given to the varying sections proposed, together with other details of construction noted in the report to the Public Service Corporation; the location of the tunnel in the slip under the pier, and other matters dealt with by the report, but in view of the conclusions reached concerning the method, a discussion of them is not necessary.

A question has been brought up in connection with vehicular tunnels for motor-driven vehicles which merits consideration, since it has been asserted that such tunnels are not practicable, based on the belief that carbon monoxide will be present in dangerous quantities. The insidious and deadly effects of the poisonous gases are not to be depreciated. By theoretical discussion attempts have been made to show that the air in a tunnel permeated by such gasses would be injurious to health. The fact remains, however, that motor vehicles operate through the tunnels under the Thames River without disastrous results, and these have no artificial ventilation. That the tunnels in question have not the length of the proposed Hudson tunnel is a scarcely valid objection, since by ventilation the sections of the former can be duplicated in the latter, and it would be fair to assume the results will be the same.

As a matter of fact, the air can be withdrawn from and introduced at as many points along the line of the tunnel as desired, thus subdividing the structure into a number of small sections. The tests made by the Public Service Corporation of New Jersey, combined with opinions of engineers versed in the subject, confirm my belief that a proper system of ventilation will maintain the air sufficiently pure to remove any apprehension on this score.

As between a single or a pair of tunnels, I would advocate the former, made large enough to provide for slow trucking below and the faster, lighter motor cars above. The cost can be reduced by using concrete blocks moulded as voussoirs of an arch or ring, properly keyed in lieu of steel or cast iron. It is estimated that such a tunnel can be constructed at present market prices for material and labor for a sum not exceeding \$12,000,000.00.

Respectfully submitted,

(Signed) GEORGE W. GOETHALS.

GOETHALS, JAMIESON, HOUSTON & JAY, INC.,  
40 WALL ST.

NEW YORK, December 18th, 1917.

*New York State Bridge & Tunnel Commission and the Hudson  
River Bridge & Tunnel Commission, 115 Broadway, New  
York City:*

GENTLEMEN—As the result of the discussion at the session of the Commission which considered my report for a vehicular tunnel under the Hudson River, the general plan, herewith, provides for an unsupported horizontal partition or floor, thus allowing for three lines of vehicles. As noted in the proposal of Mr. J. F. O'Rourke, under date of November 24th, 1917, he will undertake and complete such structure for a sum not exceeding \$12,500,000, and he has signed the plan connecting it with his proposition of that date.

It is estimated that the cost of maintenance and operation will not exceed \$125,000 per annum.

Because of traffic conditions in the streets at the extremities of the tunnel and the necessity for providing access by wagon to adjoining property if the roadways enter the existing thoroughfares, I have concluded that more satisfactory results will be secured by adopting plazas for the entrances, as proposed by the plans of the Public Service Corporation of New Jersey, with such modifications as final detailed study may determine to be advisable; under the circumstances the amount for land and easements given in this report should be adopted, it being the

sense of the last meeting of the Commission that this was sufficient.

The plan and general specifications desired are herewith.

Yours very truly,

(Signed) GEORGE W. GOETHALS.

GOETHALS, JAMIESON, HOUSTON & JAY, INC.,  
40 WALL ST.

NEW YORK, January 21st, 1918.

*New York State Bridge & Tunnel Commission and the Hudson River Bridge & Tunnel Commission, 115 Broadway, New York City:*

GENTLEMEN—As a result of the interview which Mr. George M. Wells, a member of my firm had with Mr. Lester Pach, Secretary to your Commission, on the 2d instant, he wrote Mr. Pach, with my approval, the letter of the 2d instant covering the points at issue. This letter I understand was read at the Commission's meeting of that date.

In accordance with the fourth paragraph of that letter I have had further studies made of location and design of the proposed tunnel entrances and exits, and now submit herewith the following plans:

Sheet No. 1—General Plan and Profile.

Sheet No. 2—Longitudinal and Transverse Sections.

Sheet No. 3—Detail of Portals.

Sheet No. 4—Property Lines.

It will be noted from Sheets Nos. 1 and 3 that it is now proposed to start the entrance ramp of the lower level of the tunnel on the Jersey side at the east building line of Provost Street and on the center line of 12th Street. This in effect shortens the tunnel approximately 1,000 feet, the distance between Provost and Grove Streets, at which latter street it was originally proposed to locate the tunnel entrance. This change gives an approach grade of 3.5 per cent., which is identical with the approach grade on the New York side where the entrance to the lower ramp is located in Canal Street on the westerly building line of Varick Street.

On the Jersey side this change has the additional advantage in that the amount of real estate to be required is greatly reduced as the right of way requirements are confined to a relatively unimportant section of the railroad yards of the Erie and Lackawanna Railway Companies. Within the area involved a minimum of interference with tracks and structures will result, a comparatively small amount of property will be required from each company, and each will have equal and convenient access to the tunnel.

It happens that the ground elevations at the entrances on both sides of the river under this plan are identical, thus permitting entrances, portals and ramps to be made exactly alike in design. The details as shown on Sheet No. 3 therefore apply to both the New York and Jersey sides.

Sheet No. 4 shows the proposed location on each side of the river and the limits of the property required to be taken.

On the Jersey side it will be noted that the property line between the Erie and Lackawanna Railroad property, is the center line of the tunnel. The width of the right of way, as well as the width of the sub-surface rights to be acquired is clearly indicated, and results in a widening of 12th Street.

On the New York side, Canal Street is shown widened 50 feet between Varick and Greenwich Streets, including a small additional area on Watt Street, which seems desirable to acquire. Such widening is most essential in order to provide for two roadways on each side of the tunnel ramps 40 feet in width, a minimum which should be considered in view of the large additions to traffic that will result in an already heavily traveled street. In this connection it is suggested that the widening of Canal Street be effected throughout the distance between West Broadway and West Street. This would involve acquiring property in addition to that actually required for tunnel purposes of three block fronts of private property and one block front of the Park fronting on West Street.

The location and layout of entrances on Canal Street, New York, and 12th Street, Jersey City, as outlined above, eliminates the necessity or desirability of plazas, as it is proposed to pave throughout the distance from curb to curb, thus giving 114 feet

width of street, which should provide ample space for traffic control, segregating tunnel-bound from street-bound traffic. It will also be noted that the distance from the beginning of the ramp leading to the upper level to the coping wall over the lower level is 125 feet.

In my letter to the Joint Commission, dated December 18th, 1917, I stated that the tunnel as proposed could be constructed for a sum not to exceed \$12,500,000. As a result of shortening the tunnel 1,000 feet, placing the entrance on the Jersey side at Provost Street, I am informed by Mr. O'Rourke that a reduction in cost of \$500,000 will be effected, making the total cost \$12,000,000, exclusive of the cost of land and easements.

Yours very truly,

(Signed) GEORGE W. GOETHALS.

GOETHALS, JAMIESON, HOUSTON & JAY, INC.,  
40 WALL STREET.

*General Specifications for North River Highway Tunnel.*

The object of these specifications is to secure a completed vehicular and passenger tunnel under the Hudson River, extending from Canal Street, New York City, to 12th Street, Jersey City. The tunnel is designed for two roadways, one above the other, each with a capacity for three lines of vehicles and for one sidewalk for pedestrians and with suitable pavements and adequate lighting and ventilation as in the opinion of the engineer will secure safety, comfort and efficiency.

In accordance with the permit granted by the War Department for the construction of this tunnel under the Hudson River, and the top of it shall not extend above the elevation of fifty feet below mean low water, and the approaches shall be such as to provide grades not exceeding  $3\frac{1}{2}$  per cent.

It is the intention of these specifications to provide for the construction of a tunnel of the best material, workmanship, and equipment; shall conform to the specifications of the North River Tunnels of the Pennsylvania, New Jersey and New York Railroad Company and of the East River Tunnel of the Public

Service Commission for the first district, and in so far as these specifications are applicable, they are made part thereof. All manners of design, materials and workmanship shall be under the direction of the engineer, and his decisions in all cases shall be final and binding on both parties.

The part of the tunnel extending under the river and in shore as far as the subsurface structures and street-surface conditions permit, shall be of circular cross-section, 42 feet at outer diameter, built of concrete blocks 3 feet in thickness. The tunnel shall be driven with a shield of sufficient power for the purpose. It shall be similar to those which were used in the construction of the Pennsylvania Tunnels under the North River, having in addition facilities for passing gravel through the tails under pressure in a manner to be satisfactory to the engineers. The gravel consists of a mixture of bird sand and grits, or such other loose compactable materials as the engineer may direct blown into the space at the back of the shield as fast as the shield moves forward, so that the tunnel and the walls of the excavation shall be immediately and securely supported. This support of the concrete blocks shall extend around the entire circumference of the tunnel.

The parts of the tunnels between the portals and the ends of the circular sections shall consist of two one-level tunnels at each end, each leading to a separate portal. They shall be 34 feet between the side walls, with groups of semi-circular arches constructed of concrete blocks, 18 inches in thickness, supported on the side walls. Should conditions require any other form it shall be as determined by the engineer.

The two roadways in the circular tunnel shall be 24 feet 6 inches wide in the clear between the walls, and 22 feet 6 inches between wheel guards. Air ducts in the top of the tunnel will furnish the fresh air to be distributed through the tunnel at short intervals, through adjustable openings, graduated to furnish a uniform supply of fresh air from each opening into the roadways. There shall be an exhaust air duct on each side of the tunnel of sufficient capacity to carry the air from the exhaust blower to the flues in the shaft at a rate sufficient to renew all the air in the tunnel every ten minutes.

There shall be a gallery on the level of the upper roadway of sufficient size to provide space for all the blowers necessary, in addition to the blower plant in the shafts. To exhaust the amount of air prescribed above from the openings to the roadway pavements and force it into the exhaust ducts. The size, character and number of these blowers to be determined by the engineer.

The gallery on the other side of the tunnel will contain a sidewalk for foot passengers.

The fresh air for the tunnel shall be forced in by the blowers at the shafts on each side of the river near the bulkhead lines. These shaft shall be constructed of reinforced concrete caissons, connected with masonry joints, of the size and form of structure to be determined by the engineer containing chambers for housing the machinery. The flues from the tunnels shall extend upward sufficiently to insure that the fresh air supply shall be pure, and that the exhaust air shall not annoy the public or re-enter the tunnel.

The engineer shall also determine the system and method of supplying and controlling the power for the blowers necessary for the operation of the ventilation plant.

The ventilation of the approach tunnels shall be accomplished by exhausting the air from the tunnels in the roadway pavement connected to ducts leading to the blowers and thence to specially designed electric-light poles to above street level. The bottom parts of these poles shall contain cylinders of sufficient size and length for the purpose.

Underneath the lower roadway duct spaces shall be provided for electric light and power cables and for water and drainage pipes and for such other purposes as telegraph or telephone cables and pneumatic tubes as may be desired.

An adequate water supply, draining and pumping system shall be installed for fire and flood protection and for flushing the pavement, and water pipes fitted with hose connections at short intervals shall be installed in each roadway. A pumping plant shall be installed in each shaft, together with pumps and drainage pipes, according to the direction of the engineer. Pro-

vision shall also be made for emergency doors in the side walls of the exhaust ducts and in the upper level galleries above them to be opened in case of fire for the quick elimination of smoke.

The details of the design of the interlocking concrete blocks as well as the character of the cement, proportion of ingredients and method of manufacture, shall be made in accordance with the instructions of the engineer, and, where necessary, shall provide the means of containing asphalt or other waterproof mixture at the outer side of the joints against the entrance of water or mud. The face of the joints on the inside of the tunnel shall be provided with caulking seams to be filled with tarred oakum and pointed on the outside with cement mortar, or as may be otherwise directed by the engineer. The whole interior of the joint between the blocks and the space in the recesses shall be filled with mortar introduced under pressure after the manner of grout, but of greater consistency.

The inner face of the tunnel shall be coated with white cement, hydrolithic type, or as may otherwise be determined by the engineer.

In driving the river tunnels, should the amount of cover be insufficient additional cover should be provided of suitable quality to be determined by the engineer, subject to the permission and regulations of the War Department. The pavement shall be granite blocks 4 inches and 6 inches in depth, with special blocks of cast iron at the sides of the roadway and also in the parts of the roadway overlying the ventilation openings. All curbs shall be of concrete with steel angles at the top front. The sidewalks for pedestrians shall be of concrete and of such design and thickness as may be determined by the engineer.

The lighting of the tunnel shall be of electricity. The feed cables and wiring, and the character, number and location of lamps, together with the switchboards and controls, shall be determined by the engineer.

All sewers, water pipes and gas mains, or other substructures which may be interfered with by the construction of the tunnel, shall have their service maintained during the construction of the tunnel, or rebuilt in other locations.



The contractor shall be responsible for the safety of all structures along the line of the tunnel, and for all damage to persons or property due to his operation.

(Signed) GEORGE W. GOETHALS.

## APPENDIX C.

### CHAMBER OF COMMERCE OF THE STATE OF NEW YORK.

At the regular monthly meeting of the Chamber of Commerce of the State of New York, held June 6, 1918, the following report from its Committee on Internal Trade and Improvements was unanimously adopted:

#### VEHICULAR TUNNEL UNDER HUDSON RIVER.

##### *To the Chamber of Commerce:*

Your Committee on Internal Trade and Improvements has given consideration to the question of vehicular transportation across the Hudson River. The necessity for connecting Manhattan with New Jersey by a bridge or tunnel has been much discussed for a number of years. As a result of the local traffic congestion since the war began and of the coal famine last winter, the imperative need has been brought home to every one that appropriate plans be adopted and put into execution as soon as possible, either to tunnel or bridge the Hudson River as a means of furnishing quick and continuous connection, unhampered by weather conditions, between the New York and the New Jersey shores, for all kinds of vehicular traffic.

It is obvious that vehicular transportation by ferries is antiquated and inadequate for present-day needs, to say nothing of the future. Exhaustive studies show ferry traffic has been normally increasing at the rate of 5 per cent. each year. At the present time long lines of trucks wait for hours at the ferry entrances until room can be found on the boats to transfer them across the river. This entails large expense upon the business

community, as well as hampering Government undertakings. The congestion at ferries is likely to grow larger, for the use of motor trucks for short hauls is expected to increase with great rapidity during the next few years. At the same time, valuable water-front space needed for terminals for ocean and inland waterway shipments is occupied in handling the traffic of ferry-boats, car-float lighters and other craft used in transporting freight between New York City and New Jersey. It is estimated much of this traffic could be diverted to a vehicular tunnel, with the result of materially relieving the congestion at the very piers most adjacent to the center of business density on Manhattan Island.

At the present time the cost per ton of handling freight and foodstuffs on Manhattan Island is more than in any other city in the United States. Also, New York is looked upon as one of the most expensive ports in the world for the transshipment, transferring, handling and rehandling of freight. The reason for this is that improvements in terminal facilities and methods have not been made to keep pace with the growing commerce of this city. The situation is summed up in the following quotation from the report to the New York Legislature, last January, by the Commission appointed by Governor Whitman to investigate the West Side problem:

"The necessity for immediate action and broad planning of terminal facilities on the basis of present and future requirements is further emphasized by the fact that New York City has in the last twenty years doubled in population, has increased its capital invested in industrial enterprises from about \$800,000,000 to approximately \$2,000,000,000, has now gathered within its borders nearly one-tenth of the wage earners of the country, and is producing annually nearly \$3,000,000,000 worth of manufactured goods—an amount almost equal to the entire output of Chicago, Philadelphia, St. Louis and Cleveland. Notwithstanding these amazing facts, not a dollar has been spent on any comprehensive improvement of freight facilities on the Island of Manhattan during the past quarter of a century."

Your Committee believes that the construction of a vehicular tunnel is part and parcel of a comprehensive improvement in our

freight facilities; and that this improvement concerns the people not alone of New York, but of the entire country, as over 50 per cent. of the nation's foreign trade annually passes through this port. Also, your Committee believes that construction of such tunnel should be begun as early as possible. The necessity and practicability of such an undertaking is confirmed by the reports of commissions and consulting engineers, and the studies of various experts and organizations. In addition, an investigation of the tunnels under the River Thames shows a subroadway for the Hudson River would be exceedingly serviceable in solving some of our important traffic problems. General George W. Goethals, the consulting engineer for the New York Bridge and Tunnel Commission, as well as several other eminent engineers, who have made official reports upon tunneling the river, have uniformly agreed that the construction of a vehicular tunnel is entirely feasible, and can be built far more quickly than a bridge; that the ventilation of such a tunnel can be satisfactorily accomplished; that the complete cost would be around \$12,000,000, about one-fourth the cost of a bridge; and that the collection of reasonable tolls would, within twenty years, more than completely pay a bond issue for the entire cost of construction.

Your Committee finds that progress towards actual construction of a tunnel is now delayed by lack of appropriate legislation in the State of New York. In the year 1906 both the States of New York and New Jersey passed laws authorizing the appointment of State Commissions to study the subject of vehicular highways between the States, with a view to an ultimate construction of such highways, each State sharing equally the cost. The two Commissions procured offices in New York City, and since that time have given themselves to an exhaustive study of the proposition: first, of building bridges across the Hudson River at various possible points, and, later, of constructing a tunnel exclusively for vehicular traffic, which would afford more immediate and practical relief.

In 1913 New York State passed legislation broadening the powers of the Commission so as to enable it to devote its atten-

tion to tunnel construction. The new powers coincided with those already possessed by the New Jersey Commission. The name of the New York Commission was at the same time changed from the New York Interstate Commission to the New York Bridge and Tunnel Commission. Thus the New York and the New Jersey Commissions became similar, both in name and in purpose. The Commissioners serve without compensation, and the appropriations made at different times for the use of the Commissions have been expended in engineering investigations of sites for bridges and tunnels, which have now been definitely determined upon.

At the last session of the New Jersey Legislature laws were enacted providing for an annual State tax to provide funds upon a pay-as-you-go principle for the construction of a tunnel. Also, a new Commission was created consisting of eight members to take complete charge of tunnel construction, and this Commission has been appointed with powers to proceed. The State of New Jersey, therefore, has performed all the important conditions precedent to beginning actual construction of a tunnel under the Hudson River.

It remains for the Legislature of the State of New York to act. The annual report of the New York State Bridge and Tunnel Commission, transmitted to the Legislature March 12th, of this year, specifically recommends that enabling legislation be enacted permitting the immediate construction, by a Commission to serve without compensation, of a tunnel for vehicular and pedestrian traffic under the Hudson River. The Commission states in its report that "All that is needed is the approval of your Honorable Body and an agreement between the Commissions of the two States as to details." The Commission also advises that Federal assistance seems likely, as the importance of the situation is realized by the Federal Government.

Your Committee, as a result of the facts above outlined, is led to offer for your adoption the following resolution:

*Resolved*, That the Chamber of Commerce of the State of New York is of the opinion that a vehicular tunnel under the Hudson River between the New Jersey shore and New York

City should be constructed as soon as feasible, and respectfully suggests to the Governor and the members of the Legislature of the State of New York that enabling legislation be passed to that end.

SAMUEL W. FAIRCHILD, *Chairman*,  
JAMES O. BLOSS,  
CHARLES A. SHERMAN,  
DELOS W. COOKE,  
FRANCIS H. SISSON,  
WILLIAM MCCARROL,

*Of the Committee on Internal Trade and Improvements.*

Attest:

CHARLES T. GWYNNE,

*Secretary.*

New York, June 7, 1918.

ALFRED E. MARLING,  
*President.*

## APPENDIX D

### DR. LAIRD'S REPORT.

#### THE PLACEMENT OF THE DELAWARE RIVER BRIDGE.

By DR. WARREN P. LAIRD, SC. D., Consulting Architect,  
Fellow of the American Institute of Architects, Professor of  
Architecture, University of Pennsylvania.

#### I. GENERAL ASPECTS OF THE PROBLEM.

##### *Underlying Conditions.*

The proposed Delaware River Bridge will form a new highway which must be merged with the street systems of two cities, long since crystallized into form by influence in which the expectation of a bridge played no part. The placement of the bridge therefore becomes a problem involving its usefulness to the communities to be served by it, whose solution is as essential to the success

of the project as will be those of its financing and construction.

At the outset it may be accepted as a governing principle that the position of the bridge should be determined with regard to the public interests affected by it. These may be expressed as facility of travel and economy of cost and they require that, as nearly as may be possible, the bridge shall provide for its traffic the most convenient routing at the least practicable sacrifice of existing values and utilities.

It is not to be expected that a location will be found, yielding both of these advantages to the full; on the contrary any location must involve compromise through some sacrifice of each. Therefore that site should be sought in which a balancing of the factors of convenience and cost will secure to the bridge the greatest possible public usefulness consistent with reasonable changes in existing conditions.

The location recommended in this report is believed to best realize the foregoing requirements and its choice was indicated by the following considerations:

#### II. THE BROAD VIEW OF THE PROJECT.

##### *A Utility of the First Importance.*

Metropolitan Philadelphia and Southern New Jersey now contain approximately three and one-half millions of people; constitute the greatest industrial region in the United States; hold one of its chief ports, and comprise one of the world's largest cities and a vast area of market gardens indispensable to its food supply. The relation between these two great communities necessarily is one of interdependence in which readiness of intercommunication is of first importance, but no direct and rapid means of travel as yet exists between them, separated as they are by the Delaware River and restricted in communication to ferries and an indirect railway route of limited capacity.

The utter inadequacy of this connection, both to present needs and to the vast possibilities of future development, is so obvious and its betterment so vital to the interests of both communities

that the States concerned are moving by co-ordinate action to the construction of an adequate means of communication in the proposed Delaware River Bridge. And the strategic position of these communities, as well as their internal needs, will make of the bridge a public utility of the first importance because it will complete a great highway system, serving national and interstate as well as local interests.

The bridge thus assumes a more than local significance and requires that the study of its location take account of its relation to nations and interstate interests as well as to those of the cities in which it is to be placed.

#### *Part of a National Highway.*

The Atlantic Seaboard, in time of war, becomes the chief strategic ground of national measures for either defence or foreign action, for upon it would fall the first and heaviest blow in event of foreign invasion and through it would flow the bulk of men and equipment for overseas service. Obviously its communications are of the very highest importance. Composed as they are of railways and motor highways and potential inland waterways, they roughly parallel the coast connecting on the one hand with lines from the interior and on the other with seaports and coast defences. Thus they constitute life-ways of national safety.

Their importance in time of peace, to the development of commerce and industry, is no less notable owing to their relations to centers of industrial activity and points of distribution in national and international trade.

In this system of communication, and only second to rail lines in usage, is the public highway whose importance within a few years past has been multiplied a thousand-fold by the development of motor vehicles. Of these, the motor truck is passing from the stage of an emergency mode of hauling and may even become its substitute on a vast scale. Highway improvement has responded to that of motor vehicles and both have developed with such amazing rapidity that they promise to become as vital and extended a factor in national life as the railroads.

The value of the bridge to the Atlantic coastal highway system arises from the fact that it must cross the Delaware River and does so now by bridge only at Trenton. An alternative route on the easterly side of the river would be created by a bridge crossing at Philadelphia and the improvement of a very short section of highway in New Jersey on the direct route from Camden to New York (Map A. Atlantic Coastal Highway System).

It is stated on the best authority that probably ninety-five per cent. of the motor traffic between Philadelphia and New York passes over the Delaware at Trenton. In all probability it constitutes a substantial part of the total vehicle traffic at that point, which was measured in a test census taken in the summer of 1918 by the New Jersey State Highway Department (Addenda 4). This census indicated that the number of vehicles annually crossing at this point was approximately 865,000 and their tonnage 2,320,000. The alternative route would thus accommodate a very considerable national highway traffic.

#### *An Interstate Highway Link.*

The bridge will also form a part of an Interstate Highway, linking two State systems which focus at Philadelphia and Camden counties and now make junction by the antiquated method of ferriage. This is the weak link in a chain otherwise far advanced in modern efficiency. In this relation the bridge will serve considerable portions of two States having reciprocal relations in the production, distribution and consumption of food and merchandise, the interchange of materials and finished products of industry, the general transaction of business and the seeking of homes and of health and recreation.

The present facilities for railroad traffic across the river at Philadelphia, involving as they do either lighterage or indirect routing, will render a direct route by bridge of great convenience to interstate traffic by motor and should actively stimulate its growth. (Map B. Interstate Highway System.)

*To Complete a Metropolitan Highway Plan.*

In the next place the bridge will complete a metropolitan highway system. The full meaning of the term "Metropolitan" as applied to Philadelphia and Camden is the meaning of their combined future possibilities; of the clearly attainable destiny of both cities considered as a single economic entity and forming a vast commercial metropolis.

The region of which these cities form the nucleus is today the scene of the greatest industrial production in the United States, a leadership which, established before the war and greatly advanced by it, should remain when peace is re-established.

This industrial supremacy now outstrips its commercial importance, whose full possibilities await the development of the Delaware River harbor and tributary transportation agencies into a port of the first magnitude. That this is entirely possible is the belief of broad-minded and far-seeing citizens generally, a belief visualized and demonstrated in the recent plan-study by a committee of the Philadelphia Chapter of the American Institute of Architects.

Other plan studies by the same committee of architects, of the highway system of metropolitan Philadelphia, clearly indicate the possibility of developing motor traffic connections between the Delaware River industrial region and such industrial centers as Bethlehem and Allentown, Reading, Coatesville and intermediate points, the effect of which would be to make tributary to the port and its cities much traffic now directed to New York.

These routings as well as those of the port development study are indicated in Map C, Metropolitan Highway System, Philadelphia-Camden Region, showing the convergence upon each of these cities of a vast network of traffic arteries.

By the tying together of these great systems the bridge will become a factor of conspicuous value in the development of the "Port of Philadelphia" and the cities to be prospered by it.

In this development of a world port, the harbor formed by the Delaware becomes the area of junction between international commerce and one of the world's chief producing and distribut-

ing centers. The activities of this center must perforce lie on both sides of the harbor and lead to a wide extension of the city and suburban growth recently observed along the Delaware in regions heretofore sparsely settled.

This development means that Philadelphia and Camden, although politically distinct, will grow with a common impulse and share a common destiny. Like all cities separated by a navigable river they are similarly affected by its benefits and disadvantages. This creates a community of interest requiring free business interchange in order that natural advantages of geographical location may be realized in full. The first essential of such interchange is transportation, useful in proportion as it is direct and unobstructed.

*General and Local Benefits.*

Thus the bridge has a range of usefulness extending far beyond the cities in which it will find terminal locations. Its local benefits will be varied and abundant, touching upon every aspect of activity in either community requiring communication with the other. The possibilities of usefulness of the new connecting highway may be expressed by saying that it is required to link two adjacent regions now separated by a wide river and dependent upon the archaic ferry mode of communication. Each has something needed by the other and which can be obtained more readily with the bridge than without it. One has a vast city population, the other unlimited power of food production. One is a scene of prodigious activity in the affairs of commerce and industry, the other offers a hundred miles of sea-coast resort for rest and recreation. And the great city, compelled to seek suburban life through an ever lengthening radius, can find outlet in the near-by territory to be made easily accessible. Each community is both producer and consumer, each can provide what the other requires, the relation is reciprocal. If Philadelphia is very largely the buyer and southern Jersey the seller, the advantage is mutual because the economic welfare of the whole region rests as fully upon an adequate supply of necessities as upon the demand for them. Thus the bridge will serve equally both communities.

And by way of emphasis it may be repeated that the bridge will not be a mere local utility, serving a single type of traffic or business interest or simply providing a more convenient connection between two localities. On the contrary, it will complete far-reaching highway systems, facilitate traffic of numerous types between many points of origin and destination; facilitate business of whole cities as well as of Government and State, permit readier access to wholesome living conditions for city workers and for local growth and commercial union of two inter-dependent regions now handicapped by slow means of communication.

The bearing of these facts upon the location of the bridge lies in the fact that it will serve both communities, not only equally, but in a comprehensive way, covering all aspects of a community life. It must not be conceived as serving one locality or interest, any single group of activities or type of traffic. It should not necessarily be so located as to merely connect river banks or trolley terminals or districts of retail or wholesale trade or to lie upon a system traffic routes to or from particular localities. On the contrary, the bridge location should be determined by the common interests of all users, with due regard to economy of costs and the minimum disturbance of existing conditions.

Thus the broad aspect of the case may be summarized as a basis for determining the placement of the bridge. We turn now to certain technical considerations which require attention before the question of location can be answered.

### III. SPECIAL CONSIDERATIONS FOR WEIGHT.

#### *Choice Between High and Low-Level Bridge Types.*

The choice of bridge type, whether of high level to clear all navigation or shore level with draw spans, is a first consideration in determining upon location. Primarily the question is one of conflict of interest between river and land traffic. The normal movement of either requires a broad, unobstructed course. For river traffic, this is provided by the high-level, single-span bridge, clearing the full width of the river and highest of ship

mast. On the one hand, the gradients of and length of approach to such a bridge mean increased expenditure of energy to every user of the structure, while the cost of its site and construction far greater than those of the low-level type. The latter, on the other hand, in spite of its lower course, imposes a constant delay upon both land and river traffic, because of the operation of draw spans and a bridge of intermediate height is open to both objections, although in a less degree as to each.

In a careful balancing of both land and river traffic leads to the conclusion that the high-level type of bridge should be used. Were the river traffic unimportant such choice would not be warranted. But it is of material consequence and destined to grow with the development of the port and the completion of the projected inland waterway, of whose route the Delaware at this point forms a part. The number of vessels in the harbor, reduced in recent years because of the greater size of individual bottoms, is bound to increase under these conditions. Navigation in tidal waters, such as compose the channel of the Delaware, is made difficult by the presence of river piers and draw spans. It is, moreover, doubtful if the government would approve of the construction of a bridge offering these obstacles to river traffic. And the frequent interruption to land traffic, due to open draws, renders the low-level bridge hardly less objectionable to land traffic.

In view of these considerations, and notwithstanding its gradients and the greater cost of its approaches, the choice of a high-level bridge type is believed to be imperative.

This will involve a long approach, either on or near the axis line of the bridge, as is usual, or bilateral or spiral. A careful consideration of the questions involved in each leads to the conclusion that the first named should be adopted.

#### *Length of Approaches.*

The gradients of the bridge must not exceed four and need not be less than three feet in rise for each hundred feet in length of approach. Under similar conditions the government has re-



quired a clearance of not less than 135 feet above the channel at mean high tide, which would place the bridge floor at the pier-head line at least 140 feet above mean high tide, thus, from the approximately 25-foot ground level on the Philadelphia side, a nearly 120-foot rise must be made, requiring an approach of between three and four thousand feet from the river tower at the pier-head line. To yield a favorable gradient the length should be not less than 3,400 feet, carrying the bridge terminal to a point between 6th and 7th Streets.

On the New Jersey side the street level is lower as the government may require, as for the East River bridges, in New York, a clearance of 135 feet over the channel only, a gradient close to the minimum should be filed without carrying the terminal east of 5th Street.

#### *Street Congestion in Philadelphia.*

A second consideration having vital bearing upon the location of terminals is that of free circulation of traffic. The greatest problem in the street administration of our cities is that of traffic congestion. In Philadelphia this is serious and steadily growing worse in what may be called the central business district, lying between Arch and Walnut Streets, and extending from about 16th Street well toward the Delaware River. Especially is the condition bad between Market and Chestnut Streets. The gravity of this condition was in 1914 pointed out by the Committee on Comprehensive Plans, through a report which suggested as a remedy the construction of a Central Traffic Circuit by the widening of 16th, Race, 8th and Locust Streets; a radical but necessary measure which it is to be hoped will be carried into effect (Plan F. The Central Traffic Circuit). The proposed bridge will gather up and carry to and from Philadelphia a heavy volume of traffic, which should not be directed into this congested region. Rather ought it to be assembled and discharged at a point outside but yet conveniently related to the central business district. The importance of the conclusion cannot readily be over-emphasized, for if the bridge were to pour into already overcrowded streets, the great stream of traffic

which it is to generate, it will prove in a large measure a detriment instead of a benefit to Philadelphia.

#### *Philadelphia Terminal to the South.*

Philadelphia Terminal, therefore, should be so located as to relieve the congestion of the central business district. This would require a position either north of Arch Street or south of Walnut Street. The present volume of travel by ferry, both by vehicles and pedestrians, measured by arrivals and departures on the Philadelphia side of the river, is much heavier at South Street than at Vine and Shakamaxon Streets, placing its center of gravity well south of Market Street rather than north of it (Map D. Ferry Traffic).

A bridge placed north of the central business district must terminate in Camden far north of its natural and convenient position in an isolated situation; removed from normal currents of traffic, in the direction exactly contrary to the tendencies of growth of that city.

On the contrary, placing of a bridge on the southern border of the central district would conform to the prevailing movements of traffic and the growth of population on both sides of the river, and would permit the most favorable placement of a Camden terminal. It would, moreover, favor motor routing from the southward on the national coastal highway and communication with the great industrial developments taking place in the metropolitan Philadelphia along the Delaware toward Chester.

#### *Freedom from Congestion in Camden.*

The congestion of traffic in Philadelphia, which excludes the bridge terminal from a central district, fortunately does not exist in Camden. Business there has developed its most active centers in two regions, in part because of smaller population and in part because of geographical conditions. The original area of development, forming a small part of modern Camden and centering approximately at the Court House, is encircled on three sides by water front now occupied by a steadily growing number of in-

dustrial establishments, and it seems certain eventually to be given over to a manufacturing and commercial activity. A very considerable expansion of the city, both industrial and residential, is available in territory toward the southeast, and a new center of commercial activity is developing in that region, along Broadway, opposite Kaign's Point, which already rivals the other older section and volume of retail business, and will probably outgrow it.

#### *Natural Position of Camden Terminal.*

Through one or the other of these sections pass the chief highways of southern Jersey, forming traffic routes of the vast movement of produce, manufactures and commodities, and of pleasure and business travel between the territories and Camden and Philadelphia. This motor traffic is extraordinary in volume, and the major part of it passes through Camden en route to Philadelphia, by ferry. Each of the principal highways followed by it make connection with two or more ferries, but all lead directly to the older parts of Camden in the vicinity of the Court House, where they feed into an arrangement of streets which permits their diversion into two thoroughfares leading to the Market Street Ferry. Principal long-distance trolley lines from numerous and growing suburban towns also follow the same routing, carrying a heavy movement of passenger traffic to and from the Philadelphia ferries. The existence of this natural focus of State highways in a region now free from traffic congestion, and evidently safeguarded from it in the future by the strong southward tendencies of growth, indicates it as the Camden terminal of the bridge.

#### *Terminal Traffic Plazas.*

The definite placing of a bridge terminal involves a third consideration—that of the traffic plaza. The heavy current of traffic borne by a great inter-city bridge cannot be discharged immediately into the channel afforded by one or even more existing streets without causing congestion. It should first be passed into an area of distribution to allow it to seek outlet in several direc-

tions and, in reverse, to be gathered from several directions before entering the bridge. Unless this plaza is provided, the growth of traffic will create a congestion increasingly difficult of remedy by the creation of open space because of the inevitable enhancement of land values.

#### IV. RECOMMENDATION OF SITE.

##### *Bridge Site Recommended.*

In view of the foregoing considerations, and after careful and extended study of the problem in its many aspects, I beg to advise that the bridge be placed to extend from Washington Square, in Philadelphia, to Court House Plaza, in Camden (Map E. The Delaware River Bridge, Joining the Highway Systems). Between these localities the bridge can be carried across the river in a direction very slightly oblique to the pier-head lines, with favorable position for river towers and anchorages, and with approaches very slightly divergent from the axis of the main structure (Plan of Site as Recommended).

#### V. DESCRIPTION OF PROPOSED LOCATION.

##### *Relative Economy of Site.*

The cost of properties in this location required to provide for space for approaches, anchorage and towers, and for the new roadways which should flank them, will be reasonable considered in relation to property values generally, for no properties of high value, and very few of more than an average value, are affected in either city, and a considerable part is of distinctly low value.

##### *Minimum Public Sacrifice.*

Nor does the site require sacrifice either of public utilities or buildings of historical consequence. The Philadelphia tower would occupy a small fraction of the area of pier 10, at its outer end; the Camden tower would allow a navigable clearance of ferry slips at the foot of Federal and Market Streets, and neither

anchorage would encroach upon a public street. While the removal of old buildings will be inevitable to the clearing of any bridge site in old Philadelphia, it is believed that none of Colonial dating, even where historically unimportant, are here affected. St. Joseph's Church lies to the north of the proposed flanking street, and the Caspar Wistar and Powell mansions are well to the south.

#### *Character of Proposed Traffic Plazas.*

Ample space for traffic plazas will be found at each terminal in the locality recommended, as the form of each plaza and its traffic arrangements, like the bridge structure, are subject to detailed study at a later stage of the project. This report must be restricted to the finding of sites capable of development to meet the requirements of the bridge.

#### *Treatment of Philadelphia Plazas.*

For the Philadelphia terminal it is proposed that Washington Square be enlarged by its extension to Spruce Street at its present width. The bridge structure would then be brought to 6th Street on its eastern side, opposite Locust Street.

While Washington Square thus enlarged would be simply replotted to provide the circulation necessary to the bridge terminals, a more advisable treatment would be to extend the approach structure into the Square, carrying 6th Street under it. This could be accomplished by such adjustment of levels and architectural devices as are usual in the best city-park design, with the result that approach structure could be rendered low and inconspicuous and made part of the adornment of the Square. In either case the Square would yield a larger net area of actual park space than the total of its present area.

It is to be expected that each bridge terminal will be marked by a monumental portal in a suitable setting. In such case the treatment of the approach above suggested for Philadelphia would form part of the scheme. But, with or without the portal, the result would be a glorified Washington Square, enlarged as to

its green spaces and thus more than fulfilling the purpose for which it was intended by Penn, improved in beauty (as in the case of Rittenhouse Square) and thus greatly enhanced in value as a public asset.

#### *Camden Plaza Treatment.*

The Camden Traffic Plaza, while wholly different in character, could be made equally an honor to its city by appropriate architectural treatment. It possesses a striking advantage in the fact that the Court House, facing the proposed Square, is of a monumental type of architecture, and would form a dignified background of fine proportions and grace of outline. The bridge terminal and its portal could be placed in a new square, at its southerly side, facing the Court House and the space between it and the south side of Federal Street. The street could here be widened to the Court House Terrace, and in the center on the axis of the building could be placed a monument to divide the traffic. Thus the bridge portal would be opened to view on Federal Street for some distance from the east, while the bridge approach to Camden would lead for its entire length almost directly toward the dome of the Court House. If a less than channel height is permitted to the bridge over the Camden side of the river, then the bridge gradient can start on the western side of the square, in which the latter should be extended to cover the whole area between 5th and 6th, Arch and Market Streets.

#### *Traffic Facilities of Both Plazas.*

For the Washington Square terminal seven channels of exit and approach are possible, leading directly to Walnut, Spruce, 6th, 7th and 8th Streets, and by the proposed new roadways at the bridge sides eastward toward Dock Street and the water front.

In Camden the new Court House Square on the widened Federal Street would afford direct communication with Federal, Arch and Market Streets, Broadway, 6th and 5th Streets. This

could be amplified further by widening two short streets, as shown in the plan of site, to accommodate eastbound bridge traffic destined for Broadway.

#### *Traffic Facilities of New Streets.*

In Philadelphia a roadway is proposed to flank each side of the bridge approach to be widened enough for two-way traffic, and to serve not only the routing between the bridge terminal and the streets eastward to the water front, by properties which would be built to face the bridge and the structures which may be built under it.

In Camden the approach, being nearly as wide as the blocks through which it lies, will be flanked by existing streets widened, except between 3d and 5th Streets, where, to preserve the present width of Arch Street, some vacating of property will be necessary. Thus eleven of the twenty-block intersections made by both sides of the approach require no change.

#### *River-Front Access to Bridge.*

The possibility exists of affording access to the bridge from districts in both cities between bridge terminals and water-front, by elevator service for motor trucks and by escalators. While an elevator service may not prove to be commercially warranted as to motor traffic, escalators would offer a convenience to the considerable numbers of persons who would use either the bridge trolleys or roadway to reach the districts referred to.

#### *Uses for the Approach Structures.*

The structures to be built between terminals and anchorages as approaches should also be made available for income-producing uses, whether as shops, markets, warehouses for cold or other storage, or otherwise. The need of such facilities and the example afforded by the practice of New York in its policy as to bridge approaches will suggest the possibilities here of revenue production.

#### *The Bridge and Rapid Transit.*

The bridge is not intended to carry railroad traffic, and a long-distance routing of steam or electric lines to connect New Jersey cities with Philadelphia railway terminals must be left to future tunnel and subway development. Nor is it probable that through routing of trolleys between the Philadelphia and New Jersey Transit systems will prove to be practicable, although it could be carried by the bridge.

But the extension of either system over the bridge to a loop terminal at the other end should be wholly feasible, in addition to a shuttle service confined to the bridge. The loop terminals of both services could be elevated or placed at or under the surface as circumstances might dictate. In Philadelphia a subway loop as suggested by the proximity of the bridge to the through-routing subway line proposed by the Department of City Transit for construction on 8th and Walnut Streets. This would limit to the shuttle trolley the use of park surfaces for terminal purposes, although this system could also terminate below ground.

In Camden the proposed plaza would allow space for a shuttle trolley loop, and if given full area as suggested, would also accommodate a terminal for the extension of Philadelphia lines. A further and potentially important possibility in Camden is that of carrying Philadelphia trolleys to an elevated loop near the present Broadway station of the Pennsylvania Railroad, which could be enlarged to meet it. This would permit passengers destined by either steam or electric line for Atlantic City and other New Jersey points to reach trains in Camden by a single trolley trip from Philadelphia.

#### *Relations to Central Traffic Circuit.*

Should the Central Traffic Circuit be constructed, the Philadelphia Terminal would face Locust Street as widened, and thus acquire a placing of great dignity of effect, especially valuable to the setting of a monumental portal, which thus would lie

on the axis of a broad avenue of approach. And the eastern arm of the circuit could be formed by the widening of either 8th Street, or as has also been suggested, of 7th Street, without affecting the position or effectiveness of the bridge terminal.

#### VI. GENERAL OBSERVATIONS ON SITE.

##### *Origin and Destination of Traffic.*

Vehicular traffic between Philadelphia and Camden in both directions has attained great proportions, and must unquestionably grow, possibly very considerably, under the stimulus of the direct, rapid and unobstructed facilities to be afforded by the bridge. It is certain that present means of crossing the river have not narrowly determined the point in which the local part of this traffic originates or to which it is distributed, but, rather, that it comes from a wide territory on either side of the river, and is equally well distributed on the other. Thus it is not probable that any bridge location, if reasonably central to the whole range of traffic, will unsettle existing conditions or regional occupation. The site here recommended meets this probability while offering a striking advantage over a site in the congested central business district of Philadelphia, namely, that vehicle traffic now passing through that region to and from Market Street Ferry would concentrate at the bridge terminal outside the congested district instead of within it at the ferry entrance. Also, this position more nearly facilitates the delivery of Jersey produce to Dock Street than could any other, thus favoring an important element in the whole traffic movement.

##### *Produce Shipments an Index to General Routing.*

While the origin and distribution of the entire vehicle traffic between Philadelphia and Camden has not been determined, an interesting index is afforded by a single element of this movement—the vehicle transport of produce to Philadelphia from Burlington, Camden and Gloucester counties. This is shown in an estimate made in 1918 by the Bureau of Markets of the New

Jersey State Department of Agriculture, through reports of its local reporters and trained observers (Map G. Interstate Traffic, Indicated by Routing of Produce, and Addenda 3).

This estimate indicates the annual volume of shipments by truck-loads, the highways over which they are routed and the ferries taken to Philadelphia. The proportion to each road and ferry is shown on Plan G, which also indicates the destination in Philadelphia, based upon unofficial, but expert, opinion of local observers.

The routing of this type of traffic from through New Jersey to the Philadelphia side of the Delaware River (as distinct from its objective in Philadelphia), may be taken as an index of commercial routing generally for a considerable quantity of manufacturing and merchandising is carried on in the same region and would normally use its highways. Pleasure travel will follow them but in differing proportions, largely because of coast-resort destinations.

Thus the indication is that vehicular traffic from Philadelphia would find a natural distribution to its present highways from the proposed Camden terminal of the bridge and that the volume of traffic in reverse flow, whose center of gravity at the point of arrival in Philadelphia is well south of Market Street, would be favorably distributed from the traffic plaza proposed at Washington Square.

##### *Passenger Traffic Routing.*

The Routing of Passenger Traffic is less susceptible of determination than that of vehicles, as regards origins and destinations. But the numbers of persons using the various points of arrival and departure from each side of the river are known and the tendency of the whole indicates an average destination on the Philadelphia side well south of Market Street, and indicates on the Camden side the use of trolleys passing the proposed Court House traffic plaza. This affords confirmation of the advisability of placing the bridge terminals at the points recommended (Plan D. Ferry Traffic, and Addenda Z).

*Tower and Anchorage Foundations.*

A factor of great importance in the cost and construction of the bridge is the depth at which suitable foundation may be found for construction of the great weight here required for towers and anchorages. Borings for artesian wells and other operations along the Camden water-front show a formation of hard gneiss rock, capable of carrying any load, at a depth of approximately one hundred feet below surface level. Other borings indicate that this depth is slightly less on the Philadelphia side. Thus a suitable foundation at a reasonable depth is assured for the entire region traversed by the proposed bridge; a conclusion supported by indications developed in foundation work of piers and other constructions on both sides of the rivers.

*The Bridge a Creator of Values.*

The bridge, as a great public utility, will be a creator of values, for the considerable flow of traffic gathered from all directions and distributed through the locality in which it is placed must contribute directly to the prosperity of such regions. This should be especially true of the districts in both cities through which it is here proposed to carry the bridge approaches, for portions of these districts have for years been stagnant or retrograde in value and none have enjoyed the development of many prosperous regions.

*Monumental Character of Bridge.*

The Delaware River Bridge will be one of the world's greatest spans and a witness to the enterprise of one of the world's chief communities. The building of a structure of this character dedicated to the service of Nation and State and conferring benefits upon millions of people, becomes a monumental undertaking through its very magnitude and purpose and invites its builder to conceive it as a great work of architecture: created for public service, but typifying that service by a nobility of form and ex-

pression which would place it among great achievements of architectural art. This can be accomplished only if the monument is created by a master mind in architecture, working in co-ordination with the best engineering skill. This opportunity for great achievement is here emphasized because the position advised for the bridge, and dictated by purely practical considerations, is most happily adapted to the setting of a great public monument.

*Importance of Right Location.*

For one hundred years the bridging of the Delaware has engaged public attention because of the obvious benefits of a closer connection between the communities concerned. With their growth the project has assumed ever greater proportions as a public undertaking, requiring careful consideration because of its demands upon public resources. Finally the necessity of a direct and rapid means of intercommunication has become so insistent that even its great cost will be far more than justified by the resultant gain; both States urgently need the connection and will be made richer by the investment through the certain developments which will follow its construction. To this end a right determination as to the location of the bridge will be no less essential to the success of the project than measures to be taken for its financing, designing and ultimate construction.

It is therefore my hope that the conclusions stated in this report, based upon extended investigation and careful study, may be of substantial aid to the Commission in reaching a decision as to the placement of the bridge.

Very respectfully submitted,

(Signed) WARREN P. LAIRD,

November 30th, 1918.

*Consulting Architect.*



## ADDENDA 1.

## VEHICULAR TRAFFIC BY FERRY BETWEEN PHILADELPHIA AND CAMDEN.

<i>Ferry Terminals—Philadelphia &amp; Camden.</i>	<i>Annual Total of Vehicles.*</i>	<i>Approximate Percentage of Total.</i>
Shakamaxon St.—Vine St., .....	118,464 (1917)	6.3%
Vine St.—Vine St., .....	119,415 "	6.4%
Market St.—Federal St. and Market St., ...	1,076,990 "	58.2%
Chestnut St.—Kaighn's Point, .....	251,033 " †	13.6%
South St.—Kaighn's Point, .....	136,262 " †	7.4%
South St.—Gloucester, .....	150,000 ‡	8.1%
	<hr/> 1,852,164	<hr/> 100 %

## ADDENDA 2.

## PASSENGER TRAFFIC BY FERRY BETWEEN PHILADELPHIA AND CAMDEN.

<i>Ferry Terminals—Philadelphia &amp; Camden.</i>	<i>Annual Total of Passengers.*</i>	<i>Approximate Percentage of Total Traffic.</i>
Shakamaxon St.—Vine St. ....	507,648	1.3%
Vine St.—Vine St., .....	1,024,704	2.6%
Market St.—Federal and Market Sts., .....	29,481,439	76 %
Chestnut St.—Kaighn's Point, .....	7,319,483	18 %
South St.—Kaighn's Point, .....		
South St.—Gloucester, .....	480,000	1.2%
	<hr/> 38,813,274	<hr/> 100 %

\* Total of two-way traffic.

† The official report shows an annual total of 123,487 from Chestnut Street terminal, 67,028 from South Street (combined total, 190,515), and from Kaighn's Point terminal, 196,780. The above two-way totals are estimated for this report by a proportional distribution of the Kaighn's Point excess (6,265) over the two routes.

‡ Estimated official figures for a full year not being available.

\* Total of two-way traffic for year ending June 30th, 1918, from records of United States Steamboat Inspection Service.

## ADDENDA 3.

## ROUTING OF FARM PRODUCTS FROM NEW JERSEY TO PHILADELPHIA.

New Jersey State Department of Agriculture, Bureau of Markets, Report of Farm Products Raised in Burlington, Camden and Gloucester Counties, N. J., and Hauled to the Ferries in Camden for Transportation to Philadelphia.

## BURLINGTON COUNTY.

<i>Loads Per Year.</i>	<i>Crops.</i>	<i>Peak Month and Loads.</i>	<i>Highways.</i>	<i>Ferries.</i>
12,200	White Potatoes, ...	August, 6,000	Marlton	Market St.
2,684	Sweet Potatoes, ...	October, 1,500	30%	75%
800	Tomatoes, .....	August, 300	Burlington	Vine St.
25,000	Truck Crops, .....	August, 8,000	39%	20%
1,200	Apples, .....	Sept., 400	Moorestown	Kaighn Ave.
975	Peaches, .....	August, 700	31%	5%
600	Small Fruits, .....	June, 500		
<hr/> 43,459			<hr/> 17,400	

## CAMDEN COUNTY.

5,334	White Potatoes, ...	August, 3,000	White Horse	Market St.
1,866	Sweet Potatoes, ...	October, 1,000	30%	70%
1,200	Tomatoes, .....	August, 300	Blackwood	Kaighn Ave.
12,000	Truck Crops, .....	August, 3,000	25%	25%
250	Apples, .....	Sept., 100	Marlton	Gloucester
442	Peaches, .....	August, 300	30%	5%
800	Small Fruits, .....	June, 500	Moorestown	
<hr/> 21,892			<hr/> 8,200	

## GLOUCESTER COUNTY.

9,167	White Potatoes, ...	August, 8,000		Gloucester
7,934	Sweet Potatoes, ...	October, 4,000	Westville	70%
1,000	Tomatoes, .....	July, 1,000	70%	Kaighn Ave.
10,000	Truck Crops, .....	August, 3,500		25%
800	Apples, .....	Sept., 300	Blackwood	Market St.
917	Peaches, .....	August, 500	30%	5%
600	Small Fruits, .....	June, 400		
<hr/> 30,418			<hr/> 17,700	

## DEDUCTIONS.

The following compilations are made for this report from the above official tabulation:

Total loads per year from three counties named, .....	95,769
Total loads hauled in peak months, .....	43,300
Percentage of annual total hauled in peak months, .....	45%

## HIGHWAY ROUTING OF TRAFFIC.

<i>Highway.</i>	<i>Loads Per Year.</i>	<i>Approximate Percentage of Total.</i>
Burlington Rd., .....		17.7%
Marlton Pk., .....		20.4%
Moorestown Pk., .....	16,756	17.5%
White Horse Pk., .....	6,567	7 %
Blackwood Pk., .....	14,593	15.2%
Westville, .....	21,293	22.2%
	<hr/> 95,769	<hr/> 190 %

## FERRY DESTINATION OF TRAFFIC.

<i>Ferry Terminal in Camden County.</i>	<i>Loads per Year.</i>	<i>Approximate Percentage of Total.</i>
Market-Federal Streets, .....	49,439	51.6%
Vine Street, .....	8,692	9.1%
Kaighn Avenue, .....	15,251	16.0%
Gloucester, .....	22,387	23.3%
	<hr/> 95,769	<hr/> 100 %

## ADDENDA 4.

## VEHICLE TRAFFIC CROSSING DELAWARE RIVER AT TRENTON.

From Records of Observation made by the New Jersey State Highway Department in 1918.

AUGUST 22-28, 1918.

<i>Bridge.</i>	<i>No. of Vehicles per Day.</i>	<i>Tonnage per Day.</i>
Free Bridge, .....	1,720	4,136 tons
Toll Bridge, .....	649	1,707 "
Total, .....	<hr/> 2,639	<hr/> 5,843 "

Annual totals at above rate: Vehicles, 864,885.  
Tonnage, 2,132,695.

The following is an analysis of traffic by types of vehicles crossing in one day:

FREE BRIDGE, SEPTEMBER 18TH, 1918.

		<i>Percentage of Total.</i>
Total of Vehicles, .....	1,145	
Foreign (licensed outside of New Jersey), .....	89	7.75
U. S. Army Q. M. C., Ord. D. & War Work, .....	62	5.40
Total Foreign and U. S., .....	<hr/> 151	<hr/> 13.15
Horse-drawn, .....	154	13.4
Motorcycle, .....	35	3.0
Pleasure Motor Cars, .....	670	58.6
Motor Trucks, .....	286	25.0
	<hr/> 1,145	<hr/> 100.0

TOLL BRIDGE SEPTEMBER 19TH, 1918.

		<i>Percentage of Total.</i>
Total number of Vehicles, .....	584	
Foreign (licensed outside of New Jersey), .....	153	26.2
U. S. Army, Q. M. C. Ord. D. & War Work, .....	17	2.8
Total Foreign and U. S., .....	<hr/> 170	<hr/> 28.0
Horse Drawn, .....	29	4.95
Motorcycles, .....	26	4.45
Pleasure Motor Cars, .....	407	69.80
Motor Trucks, .....	122	20.90
	<hr/> 584	<hr/> 100.00

## ADDENDA 5.

## A CENTRAL TRAFFIC CIRCUIT FOR PHILADELPHIA.

Extracts from a Report of the Permanent Committee on Comprehensive Plans submitted in 1914, proposing the creation of such circuit by the widening, to about 134 feet, of Race, Eighth, Locust and Sixteenth Streets:

"The idea of a Central Traffic Circuit—or quadrangle of broad avenues encircling the principal business district of Philadelphia—has been for some years a subject of deep consideration by the Bureau of Surveys, Department of Public Works.

"As explained in the appended report, Philadelphia has had a rapid growth, and in the development of its industrial and commercial activities there has

been a strong tendency toward the concentration of trade and traffic in one great center, an experience common to all large cities.

"To relieve the resulting intensity of congestion has been the aid and intent of this project, and a sub-committee of the Permanent Committee on Comprehensive Plans, after having made an exhaustive study of the entire proposition, submitted the report herein contained.

"This report was adopted by the Permanent Committee on Comprehensive Plans, and a resolution authorizing the Department of Public Works, Bureau of Surveys to make further investigations, plans and estimates of cost for its establishment was passed by Councils and approved by the Mayor on December 24th, 1914.

"The particular project upon which this report is based is the result of studies carried on by the Bureau of Surveys during several years with a view of working out a practical plan for the relief of traffic congestion and the enlargement and improvement of the business area in the central section of the city. Several locations for the circuit have been considered, and the project herewith recommended is one which seems to offer the greatest advantages when all the purposes it is intended to fulfill are considered, and which also seems possible of accomplishment.

"Philadelphia has had a rapid growth, and in the development of her industrial and commercial activities there has been a strong tendency toward the concentration of trade and traffic in one great center. This tendency toward concentration is common to all large cities and vastly complicates the problem of municipal administration, and adds to the difficulties and burdens of providing for the efficient and economic promotion of both public and private enterprise. The evils of too great concentration are being keenly realized in many cities, and efforts are being made to find the ways and means for relieving the unfortunate conditions it has created and to prevent its further increase. All present signs indicate the commencement in Philadelphia of a new and intensely active era of constructive progress, and if we are to reap the utmost benefit from the great undertakings now contemplated there must be a general broadening of the facilities and opportunities for economic business expansion.

"The millions to be spent upon the construction of rapid transit to lines and the enlargement of the harbor facilities will greatly stimulate those lines of industrial and commercial activity which thrive most where transportation is best; increase of business is certain to be reflected most quickly and most strongly in the already more or less congested central section of the city, especially as the new lines of communication will center there. If a great volume of new business is to be thrown into the central section it would seem wise to take some effective measures to enlarge the facilities of surface travel upon the streets beyond those provided by the plan of William Penn for a green country town two and a quarter centuries ago, for it must be observed that there has been little change from the plan of his surveyors in the widths and arrangements of the system of main streets in the area planned by him, now the central business section of one of the world's greatest cities. If the city's transportation facilities by rail and water are to be greatly increased and improved, so also should the facilities for general

travel and circulation be increased and improved in that section of the city which will feel the earliest, strongest and most permanent benefits from increased business enterprise."

Respectfully submitted,

W. H. NOYES,

*Chairman.*

PALMER CAMPBELL.  
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CHARLES R. BACON,

*Secretary.*