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A.C. Sullivan

REPORT ON
TRAFFIC AND REVENUES
PROPOSED MACKINAC STRAITS BRIDGE

JANUARY 22, 1952

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COVERDALE & COLPITTS
CONSULTING ENGINEERS
120 WALL STREET
NEW YORK 5, N. Y.

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TRAFFIC AND REVENUES
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EXHIBITS

- Exhibit 1 - Map showing Routes Leading to Proposed Mackinac Straits Bridge and Zones Used in Traffic Survey
- Exhibit 2 - Map showing Location of Proposed Mackinac Straits Bridge and Present Ferry
- Exhibit 3 - Chart showing Traffic on Mackinac Straits Ferry and Estimated Traffic on Proposed Bridge

APPENDICES

- Appendix 1 - Mackinac Straits Ferry - Origin and Destination Survey - Traffic Pattern for 5 Days from 8:00 A.M. Friday, August 18, 1950, to 8:00 A.M. Wednesday, August 23, 1950, Expanded to a Full Week
- Appendix 2 - Coverdale & Colpitts Preliminary Report of January 8, 1951

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COVERDALE & COLPITTS

CONSULTING ENGINEERS

120 WALL STREET

NEW YORK 5, N. Y.

January 22, 1952

Mr. Prentiss M. Brown
Chairman of Mackinac Bridge Authority
2000 Second Avenue
Detroit 6, Michigan

Dear Sir:

In accordance with your instructions, we made a study of the probable gross and net revenues of the proposed bridge across the Straits of Mackinac, Michigan between Mackinaw City on the south and the vicinity of St. Ignace on the north, and submitted the results of this study to you in the form of a short letter report dated January 8, 1951, a copy of which is appended.

In accordance with your further instructions, we are presenting herewith in report form the conclusions shown in our letter report of January 8th, the principal data upon which they were based and the method by which we arrived at these conclusions.

The results of our study are shown in the following tabulations, the first of which shows the estimated traffic, gross and net revenues by years, and the rate at which a 3-1/2 per cent bond issue in the amount of \$87,000,000 could be paid off assuming that all of the net earnings were available for debt service. The second tabulation gives similar information assuming that the operating expenses are not charged against bridge revenues, but are paid from other funds. Although the estimates are stated by years, they are intended to forecast the trend over the period covered rather than the specific results for any particular year.

PROPOSED MACKINAC BRIDGE

ESTIMATE OF TRAFFIC AND GROSS AND NET REVENUES AND
 TABULATION SHOWING RATE AT WHICH A 3-1/2 PER CENT BOND
 ISSUE IN THE AMOUNT OF \$87,000,000 COULD BE RETIRED
 ASSUMING ALL NET REVENUES WERE AVAILABLE FOR DEBT
 SERVICE AND THE BONDS WERE RETIRED AT PAR

Year	Vehicles	Revenue	Operating Expenses	Available For Debt Service	Interest at 3-1/2%	Available for Amortization	Bonds Outstanding \$87,000,000
1956	1,850,000	\$3,700,000	\$400,000	\$3,300,000	\$3,045,000	\$ 255,000	\$86,745,000
1957	1,942,000	3,884,000	400,000	3,484,000	3,036,000	448,000	86,297,000
1958	2,034,000	4,068,000	400,000	3,668,000	3,020,000	648,000	85,649,000
1959	2,126,000	4,252,000	400,000	3,852,000	2,998,000	854,000	84,795,000
1960	2,218,000	4,436,000	400,000	4,036,000	2,968,000	1,068,000	83,727,000
1961	2,310,000	4,620,000	425,000	4,195,000	2,930,000	1,265,000	82,462,000
1962	2,402,000	4,804,000	425,000	4,379,000	2,886,000	1,493,000	80,969,000
1963	2,496,000	4,988,000	425,000	4,563,000	2,834,000	1,729,000	79,240,000
1964	2,586,000	5,172,000	425,000	4,747,000	2,773,000	1,974,000	77,266,000
1965	2,678,000	5,356,000	425,000	4,931,000	2,704,000	2,227,000	75,039,000
1966	2,770,000	5,540,000	425,000	5,115,000	2,626,000	2,489,000	72,550,000
1967	2,862,000	5,724,000	425,000	5,299,000	2,539,000	2,760,000	69,790,000
1968	2,954,000	5,908,000	425,000	5,483,000	2,443,000	3,040,000	66,750,000
1969	3,046,000	6,092,000	425,000	5,667,000	2,336,000	3,331,000	63,419,000
1970	3,138,000	6,276,000	425,000	5,851,000	2,220,000	3,631,000	59,788,000
1971	3,230,000	6,460,000	450,000	6,010,000	2,093,000	3,917,000	55,871,000
1972	3,322,000	6,644,000	450,000	6,194,000	1,955,000	4,239,000	51,632,000
1973	3,414,000	6,828,000	450,000	6,378,000	1,807,000	4,571,000	47,061,000
1974	3,506,000	7,012,000	450,000	6,562,000	1,647,000	4,915,000	42,146,000
1975	3,598,000	7,196,000	450,000	6,746,000	1,475,000	5,271,000	36,875,000
1976	3,690,000	7,380,000	450,000	6,930,000	1,291,000	5,639,000	31,236,000
1977	3,782,000	7,564,000	450,000	7,114,000	1,093,000	6,021,000	25,215,000
1978	3,874,000	7,748,000	450,000	7,298,000	883,000	6,415,000	18,800,000
1979	3,966,000	7,932,000	450,000	7,482,000	658,000	6,824,000	11,976,000
1980	4,058,000	8,116,000	450,000	7,666,000	419,000	7,247,000	4,729,000
1981	4,150,000	8,300,000	450,000	7,850,000	166,000	7,684,000	
1982	4,242,000	8,484,000	450,000	8,034,000			
1983	4,334,000	8,668,000	450,000	8,218,000			
1984	4,426,000	8,852,000	450,000	8,402,000			
1985	4,518,000	9,036,000	450,000	8,586,000			
1986	4,610,000	9,220,000	450,000	8,770,000			

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Bonds issued, say, 1952 (beginning)

Date of last maturity, 1981 (end)

Time to amortize - 30 years

Total bonds issued \$ 87,000,000

Total interest paid 54,845,000

Total debt service \$141,845,000 100.0%

Total revenues collected \$200,260,000 41.2%

Coverage over 35-year period 141.2%

PROPOSED MACKINAC BRIDGE

ESTIMATE OF TRAFFIC AND REVENUES AND TABULATION SHOWING RATE AT WHICH A 3-1/2 PER CENT BOND ISSUE IN THE AMOUNT OF \$87,000,000 COULD BE RETIRED ASSUMING ALL GROSS REVENUES WERE AVAILABLE FOR DEBT SERVICE AND THE BONDS WERE RETIRED AT PAR

Year	Vehicles	Revenue	Interest at 3-1/2%	Available for Amortization	Bonds Outstanding \$87,000,000
1956	1,850,000	\$3,700,000	\$3,045,000	\$ 655,000	\$86,345,000
1957	1,942,000	3,884,000	3,022,000	862,000	85,483,000
1958	2,034,000	4,068,000	2,992,000	1,076,000	84,407,000
1959	2,126,000	4,252,000	2,954,000	1,298,000	83,109,000
1960	2,218,000	4,436,000	2,909,000	1,527,000	81,582,000
1961	2,310,000	4,620,000	2,855,000	1,765,000	79,817,000
1962	2,402,000	4,804,000	2,794,000	2,010,000	77,807,000
1963	2,496,000	4,988,000	2,723,000	2,265,000	75,542,000
1964	2,586,000	5,172,000	2,644,000	2,528,000	73,014,000
1965	2,678,000	5,356,000	2,555,000	2,801,000	70,213,000
1966	2,770,000	5,540,000	2,457,000	3,083,000	67,130,000
1967	2,862,000	5,724,000	2,350,000	3,374,000	63,756,000
1968	2,954,000	5,908,000	2,231,000	3,677,000	60,079,000
1969	3,046,000	6,092,000	2,103,000	3,989,000	56,090,000
1970	3,138,000	6,276,000	1,963,000	4,313,000	51,777,000
1971	3,230,000	6,460,000	1,812,000	4,648,000	47,129,000
1972	3,322,000	6,644,000	1,650,000	4,994,000	42,135,000
1973	3,414,000	6,828,000	1,475,000	5,353,000	36,782,000
1974	3,506,000	7,012,000	1,287,000	5,725,000	31,057,000
1975	3,598,000	7,196,000	1,087,000	6,109,000	24,948,000
1976	3,690,000	7,380,000	873,000	6,507,000	18,441,000
1977	3,782,000	7,564,000	645,000	6,919,000	11,522,000
1978	3,874,000	7,748,000	403,000	7,345,000	4,177,000
1979	3,966,000	7,932,000	146,000	7,786,000	
1980	4,058,000	8,116,000			
1981	4,150,000	8,300,000			
1982	4,242,000	8,484,000			
1983	4,334,000	8,668,000			
1984	4,426,000	8,852,000			
1985	4,518,000	9,036,000			
1986	4,610,000	9,220,000			

Bonds issued, say, 1952 (beginning)

Date of last maturity, 1979 (end)

Time to amortize - 28 years

Total bonds issued \$ 87,000,000

Total interest paid 48,975,000

Total debt service 135,975,000 100.0%

Total revenues collected 200,260,000 47.3%

Covers over 35-year period 147.3%

Our report follows:

THE PROJECT

The proposed bridge crossing of the Straits of Mackinac (as shown on Exhibits 1 and 2) will extend from Straits Avenue, Mackinaw City, on the lower peninsula of Michigan to Route U.S. 2 in the vicinity of and west of St. Ignace, on the upper peninsula of Michigan, a distance of about five miles. Our study of this project has been made on the assumption that the state-owned ferry, now operating between Mackinaw City and St. Ignace on a route approximately two miles east of the proposed bridge, will cease to operate on the completion of the proposed bridge.

Description of the Proposed Bridge

The bridge structure itself will be approximately four miles long with a main suspension span 3,800 feet long, a side span on either side 1,500 feet long, and truss spans. The crossing between Straits Avenue, Mackinaw City and the side span, about 1.3 miles in length, is made up of about .1 of a mile of approach road on fill and fifteen truss spans varying in length from 160 feet to 560 feet supported on concrete piers. The crossing between the side span and Route U.S. 2 in St. Ignace is made up of a series of fourteen truss spans with a length of approximately .8 of a mile, a series of plate girder spans approximately .7 of a mile in length, and approximately .8 of a mile of approach road in fill and cut. The plate girder spans will be located on a rock mole constructed in 1940. (It was thought at that time that this mole could serve as a temporary ferry terminal and that, if a bridge were constructed later, it could be used in the approach.)

Connections will also be provided on the St. Ignace side to Graham Street, which runs along the edge of the lake approximately .6 of a mile south of Route U.S. 2. The minimum clear height of the center of the main span above

mean lake level is 150 feet, and the minimum clear height over the main channel, which is 3,000 feet wide, is 135 feet.

The present designs for the bridge call for a four-lane structure with a low barrier not over 2 feet in width separating the traffic directionally. The inner lanes would be 11 feet in width and the outer lanes 12 feet. Three-foot walkways for maintenance and emergency use are provided on the outside of the outer lanes. The approach grades to the main span are easy with a maximum not exceeding 2.5 per cent. The toll plaza will be located on the St. Ignace side of the bridge. Twelve lanes will be provided of which the center four will be reversible in direction.

PRESENT FERRY

History

The present ferry operates between the eastern shore of Mackinaw City and the eastern shore of St. Ignace. The immediate approach from the south is by Route U.S. 31 and from the southeast by Routes U.S. 23 and U.S. 27 which join Route U.S. 31 approximately .4 of a mile south of the entrance to the ferry dock. The majority of the traffic uses Route U.S. 27. The landing in St. Ignace is on Route U.S. 2 which leads directly north 52 miles to Sault Ste. Marie and also south and west through the city to points along the northern shore of Lake Michigan.

Automobile ferry service was first inaugurated across the Straits by an act of the State Legislature which authorized the Michigan State Highway Department to operate a ferry. This service was started on July 31, 1923 with a small wooden steam ferry capable of carrying twenty vehicles. During the remainder of the calendar year 1923, it carried a total of 10,351 vehicles. This vessel proved unsuited to the rough weather of the Straits and, after the purchase of two other steam ferries, was taken out of service. In 1928,

a third ferry, the "Straits of Mackinac", a side loading vessel with a capacity of 48 cars, which is operating at the present time, was put into service.

Prior to 1936, service from December 15 to about April 15 of each year was always discontinued because of ice conditions. In that year, however, the railroad ice breaker ferry, "Sainte Marie", with a capacity of about 90 automobiles, was chartered from the Mackinaw Transportation Company which operated the railroad car ferry service, and year-round service inaugurated. This vessel is now chartered during the winter season as an ice breaker and during the summer months of June, July, August and September and the hunting season in November to augment the state-owned fleet. A second railroad car ice breaker ferry, the "Chief Wawatam", also owned by the Mackinaw Transportation Company, is available for service, subject to the prior demands of the railroad, when the "Sainte Marie" is temporarily out of commission for any reason. This vessel is also used to augment the fleet during the peak traffic periods around July 4th, Labor Day, and the deer hunting season in November. The railroad ferries dock at the railroad docks, and vehicles using them must travel from the ferry parking lots to the railroad docks. In winter, however, when only the railroad ice breaker ferry is operating, fares are collected on the boat and vehicles drive directly to the railroad docks.

In 1937, the "City of Cheboygan", with a capacity of 76 cars, and the "City of Munising", with a capacity of 102 cars, converted Great Lakes car ferries, were added to the fleet; and in 1940 a similar vessel, the "City of Petoskey", with a capacity of 102 cars, was obtained. The two older steam ferries were disposed of in 1940 leaving a fleet of four state-owned vessels which are operating at the present time. A contract for a new diesel ice breaker ferry with a capacity of 133 vehicles was awarded in 1949. This vessel is expected to go into operation early in 1952. It will aid in maintaining winter schedules as well as reducing the ferry waiting time at peak periods.

Terminals

The present state-owned ferries with the exception of the oldest, the "Straits of Mackinac", are both end and side loading, and the state-owned docks provide for both types of loading. Arrangements were made for the docking of the railroad ice breaker car ferries which are end loading only at the railroad docks both in Mackinaw City and St. Ignace at the time they were chartered. These docks are within 800 feet of the ferry docks in both places.

Parking space is provided at the Mackinaw City ferry terminal for approximately 1,100 vehicles and at St. Ignace for between 250 and 300 vehicles, the number depending upon how they park, the lot being of irregular shape and not adapted to the layout of parking lanes.

When the new ice breaker ferry is put into operation, we understand it is proposed to rebuild the Mackinaw docks and construct a new dock in St. Ignace south of the present dock so that all boats can dock at the state-owned terminals. The new terminal will reduce the length of ferry travel from approximately 7-1/4 miles to 6 miles and the time from approximately 45 minutes to 38 minutes.

Ferry Tolls

The toll charges on the ferry are based primarily on the length of the vehicle. Passenger automobiles are charged \$1.00, \$1.25, or \$1.50 per one-way trip depending on the length of the vehicle, the majority being at the last rate, which charges include transportation of the driver. Additional adult passengers are charged at the rate of 25 cents per trip, and children 10 cents. Trucks under two tons are \$2.00; two tons and under three tons, \$2.50; and three tons and over, \$3.00. Passenger rates apply to all persons on trucks except the driver. Trailers are charged on the basis of length added to the towing vehicle, those under 10 feet of added length \$1.00; 10 to 15 feet, \$1.25; 15 to 20 feet, \$1.50 with lengths above this at five cents for each additional foot. There are no round-trip or commutation rates.

The toll rates and their application to the different classes of vehicles as estimated for the year 1949 are shown below, together with a reconciliation of the estimated number of vehicles and the reported number of vehicular units:

<u>1 9 4 9</u>			
6,015	Automobiles	@ \$1.00	\$ 6,015
133,185	Automobiles	@ 1.25	166,481
<u>371,583</u>	Automobiles	@ 1.50	<u>557,375</u>
510,783			729,871
15,206	Automobile trailers (Est.)	@ 1.00	15,206
7,409	Automobile trailers (Est.)	@ 1.25	9,261
<u>4,631</u>	Automobile trailers (Est.)	@ 1.50	<u>6,947</u>
27,246			31,414
934,856	Automobile passengers (Est.)	@ .239*	223,730
510,783	Automobiles	@ 1.93	985,015
28,802	Single-unit trucks	@ 2.00	57,604
1,516	Single-unit trucks	@ 2.50	3,790
<u>219</u>	Single-unit trucks	@ 3.00	<u>657</u>
30,537			62,051
5,583	Truck tractors	@ 2.00	11,166
7,083	Truck tractors	@ 2.50	17,708
<u>3,360</u>	Truck tractors	@ 3.00	<u>10,080</u>
16,026			38,954
16,026	Semitrailers (Est.)	@ 1.60	25,685
16,026	Semitrailer trucks	@ 4.03	64,639
46,563	Trucks	@ 2.72	126,690
4,305	Buses		12,502
86,100	Bus passengers (Est.)	@ .239*	20,578
4,305	Buses	@ 7.78	33,080
1,050	Motorcycles		528
562,701	Vehicles (Est.)	@ 2.04	1,145,313
<u>43,272</u>	Trailer units (Est.)		
605,973	Vehicles reported (actually vehicular units)	@ 1.89	1,145,313

* The toll for adults is 25 cents, and for children 10 cents

From the foregoing statement, it will be seen that the actual number of vehicles carried is equivalent to approximately 93 per cent of the vehicular units carried and that the average toll per vehicle is \$2.04 and per vehicular unit \$1.89. In our estimate of total revenue, we have used the estimated number of vehicles and the estimated average toll per vehicle. If the estimate of the number of vehicles is not exact, it will not change the total revenue as the revenue per vehicle used has been obtained by dividing the total actual revenue by the estimated number of vehicles.

Ferry Service

Prior to 1928, the ferry operated on a 1-1/2-hour schedule between 6 A.M. and 9 P.M. The addition of the third boat in that year allowed hourly service to be provided during the summer months between the same hours.

In 1931, the summer service was increased by adding an extra trip morning and night and additional trips at midnight and 3 A.M. This service was maintained with minor exceptions through 1936.

1937 was the first calendar year in which the ferry operated during the entire year. The chartering of the railroad ice breaker ferry "Sainte Marie" in December 1936 made this possible. In 1937, the "City of Cheboygan" and the "City of Munising" were put in service, and special truck trips operated during the summer.

In 1940, the "City of Petoskey" was put in operation completing the state-owned fleet of four boats now operating. There has been little change in the schedule between 1937 and the present time and no change in the capacity of the boats since 1940.

The ferry boats themselves are well maintained, and the terminal areas are kept in good condition. As the boats do not have any restaurant facilities, many motorists leave their cars in the parking lot to patronize

restaurants in the vicinity with the assurance that they will not lose their place in the waiting line.

The 1950-51 operating schedule is as follows:

Winter Schedule - December 16 through April 15
1-1/2-hour service from Mackinaw City
between the hours of 7:30 A.M. and 10:30 P.M.

Spring Schedule - April 16 through May 31
1-1/2-hour service from Mackinaw City
between 6:00 A.M. and 10:30 P.M. with
additional trips at 1:30 A.M. and 4:30 A.M.

Summer Schedule - June 1 through September 18 (approximately)
1-hour scheduled service from Mackinaw City
between 6:30 A.M. and 11:30 P.M. with
additional trips at 1:30 A.M. and 4:30 A.M.

Fall Schedule - September 19 (approximately) through
November 6 (approximately)
Same as Spring Schedule.

Hunting Season Schedule - November 7 (approximately)
through November 30
No fixed schedule, boats operate as rapidly as possible -
average headway of 35 minutes with 5 boats operating

Early Winter Schedule - December 1 through December 15
1-1/2-hour service from Mackinaw City
between 6:00 A.M. and 10:30 P.M.

Seasonal Fluctuation of Traffic

Yearly traffic is highly seasonal due to the fact that a large part of the motorists using the ferry are making recreational trips. The northern peninsula of Michigan is a well-known recreational and vacation area, and this general region has been well established as a vacation territory for residents living in the industrial and urban areas to the south. Winter traffic is restricted not only by the infrequent sailings but also to the uncertainty of the schedule due to ice conditions. The Straits of Mackinac become iced over regularly every winter, and despite the use of an ice breaker ferry, the schedule is occasionally interrupted. There is no doubt that many people who might visit the area during the winter season are restrained from doing so by these conditions.

The seasonal fluctuation of traffic is shown in the following tabulation of the reported traffic by months for the years 1939 and 1949:

Month	Vehicles 1939	Per Cent of Year	Vehicles 1949	Per Cent of Year	Per Cent Increase
January	4,017	1.4	9,839	1.6	145
February	2,445	0.9 ³¹	8,650	1.4	254
March	3,933	1.4	12,543	2.1	219
April	7,301	2.6	20,183	3.3	176
May	15,000	5.4 ¹¹	37,868	6.2	152
June	25,498	9.1 ¹¹	56,890	9.4	123
July	63,258	22.6 ⁶⁰⁹	130,573	21.5	106
August	71,796	25.6 ⁶⁰⁹	141,602	23.4	97
September	35,611	12.7 ⁶⁰⁹	72,545	12.0	104
October	15,537	5.5	40,339	6.7	160
November	26,491	9.5 ^{8,3}	59,075	9.8	123
December	9,356	3.3 ^{8,3}	15,866	2.6	70
Total Year	280,243	100.0	605,973	100.0	116

It will be noted that traffic in the summer months accounts for the greater part of the traffic for the entire year. It should also be noted, however, that traffic during these months does not make up as great a per cent of the year's traffic now as in 1939.

Traffic during the summer months of July and August has increased on the average about 100 per cent during the above period, while during the winter months with the exception of December, traffic has increased between 145 and 254 per cent. We believe this tendency for traffic to increase more rapidly during the off-peak months will continue and that the proposed bridge will accelerate the trend.

Ferry Traffic

The volumes of ferry traffic as reported by years from 1924 through 1950 are shown in graphic form in Exhibit 3 and in tabular form following. Vehicles are classed as passenger cars, trucks, trailers, and others including motorcycles, busses, wagons, and special vehicles. The reported figures are actually vehicular units, as tractors and trailers are recorded as separate vehicles, and hence overstate the actual number of vehicles.

REPORTED VEHICLES
(Actually Vehicular Units)

Year	Passenger Cars	Single Unit Trucks	Trailers and Truck Tractors	Buses and Other Vehicles	Total Vehicles	Per Cent Increase Over Previous Year
Operation Suspended in Winter						
1924	37,251	839	309	69	38,468	
1925	57,813	987	581	103	59,484	54.6
1926	72,886	1,379	821	93	75,179	26.4
1927	89,820	1,726	1,245	172	92,963	23.7
1928	103,634	2,215	1,528	139	107,516	15.7
1929	125,427	3,138	2,166	211	130,942	21.8
1930	125,223	4,364	2,816	230	132,633	1.3
1931	121,353	4,455	3,872	178	129,858	-2.1
1932	90,316	4,666	3,960	179	99,121	-23.7
1933	94,496	6,417	6,016	241	107,170	8.1
1934	121,940	6,919	9,007	436	138,302	29.0
1935	143,882	9,454	10,873	639	164,848	19.2
1936	180,208	10,555	13,849	1,475	206,087	25.0
Operation 12 Months of Year						
1937	242,533	12,073	18,521	1,622	274,749	33.3
1938	223,920	11,690	17,577	1,881	255,068	-7.4
1939	243,734	13,598	20,890	2,021	280,243	9.9
1940	256,098	14,390	23,875	2,399	296,762	5.9
1941	326,444	14,664	28,996	2,740	372,844	25.6
Gasoline Rationing						
1942	218,022	14,856	26,002	2,518	261,398	-29.9
1943	73,641	10,373	18,386	2,811	105,211	-59.8
1944	88,719	9,407	19,999	3,471	121,596	15.4
1945	173,905	11,694	26,630	4,554	216,783	78.3
No Gasoline Rationing						
1946	367,192	21,954	45,489	5,686	440,321	103.1
1947	421,869	25,031	48,557	5,652	501,109	13.8
1948	461,917	29,889	54,707	5,891	552,404	10.2
1949	510,783	30,537	59,297	5,356	605,973	9.7
1950*	507,000	33,000	60,000**	5,000	605,000	-

*Estimated on basis of first 10 months

**Estimated to include 43,000 trailers

It will be noted from the previous tabulation that from 1924 to 1929 traffic increased at a very rapid rate. The depression following 1929 caused a recession, but by 1933 traffic volumes were back to the 1929 levels. From 1933 to the present time, traffic has continued to increase except during the years of gasoline rationing following the outbreak of war and in the year 1938, when traffic in general throughout the country declined.

Passenger cars constitute approximately 84 per cent of the total traffic on the basis of reported vehicles, but over 90 per cent of the actual vehicles (counting a truck tractor and its trailer as one vehicle). Buses make up most of the volume shown under the heading "others".

Estimated Past and Future Rate of Growth

Traffic has increased approximately 62 per cent in the nine years between 1941, the year of highest traffic before the war, and 1950, or at an average annual rate of 5.5 per cent. In the 13-year period between 1937, the first year of continuous operation, and 1950, it increased approximately 220 per cent or at an average annual rate of over 6.2 per cent. Although traffic in 1950 is about at the same level as in 1949, in no previous year, except those affected by the 1930 depression, the gasoline rationing in the past war and the year 1938, has traffic increased at a rate less than 5.9 per cent. In the 21-year period from 1929 to 1950, it has increased approximately 463 per cent, or at an average annual rate of over 7.5 per cent.

In making our estimate of future traffic we have used an average annual increase of 6 per cent from 1950 to 1956, which we have taken as the first full year of operation of the proposed bridge. This rate of increase does not reflect any increase in traffic that may be induced by the operation of the new and larger boat and possible accompanying changes in terminal location and schedules.

Any such increase in traffic is included in our estimate of induced traffic for the bridge, which is based upon ferry operations in 1950.

Origin and Destination of Traffic

In order to determine the composition of traffic now using the ferry and to ascertain its origin and destination for the purpose of estimating the potential bridge traffic, the volume of induced traffic, and future growth, we made an origin and destination study of the vehicles now using the ferry. We interviewed practically all passenger automobiles and trucks at both sides of the Straits as the vehicles lined up in the parking area to wait for the ferry. This origin and destination study began at 8:00 A.M. Friday, August 18, 1950, and continued without stopping to 8:00 A.M. Wednesday, August 23. By adding the early morning hours of Wednesday to the latter part of the previous Friday, we obtained the equivalent of five calendar days. To build up the traffic volume and pattern for a full week, we added the equivalent of double the Tuesday traffic as the ferry records indicated that traffic volumes on Wednesday and Thursday were approximately the same as on Tuesday.

During the five-day period in which traffic was surveyed, we actually interviewed 21,663 vehicles. During the five-day period from midnight Thursday to midnight Tuesday, the ferry company reported 23,887 vehicular units carried, and we estimate that approximately 22,512 vehicles were carried. In other words, we interviewed approximately 96 per cent of the traffic.

The results of the origin and destination survey, shown in Appendix 1, indicate that most of the vehicles using the ferry are making long trips. Less than 10 per cent of those interviewed during the survey had their origin or destination within a 40-mile radius on the south, and only about 20 per cent had their origin or destination within a radius of 135 miles on the south. On the north, about 57 per cent of the vehicles had their origin or destination beyond a 60-mile

radius. Only about five per cent of the total vehicles were making trips of less than 40 miles.

The extreme southern part of the lower Michigan peninsula with the cities of Detroit, Pontiac, Flint, Lansing, Jackson, Kalamazoo and Battle Creek contributed approximately 47 per cent or almost half of the traffic of the ferry. The south central portion of the peninsula with the cities of Saginaw, Bay City, Grand Rapids and Muskegon contributed about 16 per cent, and the north central and northern part of the peninsula contributed about 21 per cent. The balance, or approximately 16 per cent, of the traffic had its origin or destination in states other than Michigan.

On the upper or northern peninsula, approximately 43 per cent of vehicles had the origin or destination in Chippewa and Mackinac counties at the eastern end of the peninsula, 21 per cent in the central peninsula counties of Luce, Schoolcraft, Alger, Delta and Menominee, and 17 per cent in the western counties of the peninsula. About 10 per cent of the total vehicles had their origin or destination in Canada and the balance of 9 per cent in Wisconsin or the northwestern states.

This study indicates that the ferry is primarily a link in a through route between the northern and southern peninsulas of Michigan and points beyond rather than a facility serving local areas.

ADVANTAGES OF THE PROPOSED BRIDGE OVER THE PRESENT FERRY

Time Saved in Traveling

The proposed bridge will reduce the present time of crossing the Straits from approximately 60 minutes to 10 minutes, a saving of 50 minutes excluding any waiting time for the ferry. This estimate of time saved is derived as follows:

Ferry

Loading time	- 13 minutes	(equivalent to 7.6 seconds
Casting off time	- 1 minute	per car for 102 cars)
Trip time	- 45 minutes	
Tying-up time	- 1 minute	
	60 minutes	

Bridge

Mackinac Ferry Dock to Route U.S. 22 - 5.9 miles at
35 miles per hour = 10 minutes

Time Saved by Elimination of Waiting Time for the Ferry

The ferry operates on a 1-1/2-hour interval during the fall, winter and spring seasons, with the exception of the two-week hunting season in November. During this period, which accounts for approximately two thirds of the year, approximately one third of the vehicles are carried. As most vehicles travel many miles before reaching the ferry, it is difficult for the drivers to schedule their arrival accurately enough to avoid an average wait of half the ferry headway interval or 45 minutes. Hence, during this period, the use of the bridge rather than the ferry to cross the Straits will save vehicles on the average 95 minutes (50 + 45) or approximately an hour and a half.

During the summer season extending from June 1 through September 18 when vehicles line up to get on the ferry, the waiting time is much longer. In 1950, the ferry parking facilities at Mackinac were enlarged to provide for 1,100 vehicles, which represents the estimated total carrying capacity of the ferry for about 5-1/2 hours. This estimate is based on a study of the actual number of vehicles carried per hour northbound on a day in August when there was a continuous waiting line. This study indicated that with five boats operating and making departures on the average of about every half-hour, the hourly capacity was approximately 200 vehicles. (The intervals between departures varied from 5 to 45 minutes.)

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On the above basis, therefore, with the parking lot operating at 100 per cent capacity, all arriving vehicles must wait 5-1/2 hours, and with the parking lot operating at 50 per cent capacity, all arriving vehicles must wait 2-3/4 hours. During weekdays in summer the lot may operate at from 50 per cent to 75 per cent of capacity during the late morning and early afternoon hours. Over the week ends it may operate at up to 100 per cent of capacity and for a longer period of time.

On holidays, exceptionally fine days and during the hunting season in November, traffic volumes are such that the waiting time is much longer. During the hunting season in November, waits of from 8 to 17 hours have been reported. Eliminating the exceptionally long waits, the average wait in the summer during the hours that most people desire to drive, is at least 1-3/4 hours. A wait of this length is necessary for any car arriving after there are 220 cars in the lot, which is equivalent to 20 per cent of capacity (15 minutes or one-half headway interval plus 30 minutes for first 100 cars plus 30 minutes for second 100 cars plus 30 minutes for third 100 cars).

The use of the proposed bridge in crossing the Straits will make possible a total average saving of 2-1/2 hours (1-3/4 hours waiting time plus 45 minutes crossing time) during the summer months.

Convenience

The bridge will make possible the crossing of the Straits at any hour of the day or night. The present schedules provide no night service from Mackinaw City after 10:30 P.M. between December 1 and April 15 and only two trips, one at 1:30 A.M. and the other at 4:30 A.M. between 10:30 P.M. and 6:00 A.M. in the spring and fall seasons. In the summer, there is a third trip at 11:30 P.M. and during the hunting season the ferry operates all night to take care of the waiting line.

The proposed bridge will also eliminate the effect of ice conditions in the winter when service is occasionally interrupted or delayed and in the spring when with only one ice breaker it governs the beginning of the spring schedule, which calls for two boats.

INDUCED TRAFFIC

The provision of any new facility, as well as the improvement of any existing facility, always creates new or additional traffic that did not exist prior to the improvement. This traffic is entirely separate from that diverted from other facilities or other routes.

The amount of such induced traffic is directly related to the degree of improvement of the new or improved facility. The volumes of induced traffic created by other bridges replacing ferries have ranged in many instances from 65 per cent to 75 per cent of that before the improvement. However, the proposed bridge offers benefits so much greater than those provided by other projects which have induced traffic in the above amounts that these measures of induced traffic cannot be used in the present instance except comparatively.

Our studies indicate that the volume of induced traffic on the San Francisco-Oakland Bay Bridge was approximately 64 per cent of that on the existing ferries, on the Tacoma Narrows Bridge, recently opened, 81 per cent, on the Philadelphia-Camden Bridge 72 per cent, and on the Golden Gate Bridge 78 per cent. All of these bridges replaced ferries giving excellent service. The San Francisco-Oakland Bay ferries offered departures every 12 minutes during the daylight hours, as well as continuous service although at longer intervals during the night. The crossing time was only 20 minutes. The Sausalito ferries, which served the traffic taken over by the Golden Gate Bridge, provided service during the daylight hours approximately every 20 minutes with continuous service

through the night. The crossing time was about 24 minutes. The ferries serving the traffic taken over by the Philadelphia-Camden Bridge operated at frequent intervals. The crossing time was less than 10 minutes. The ferry whose traffic was taken over by the Tacoma Narrows Bridge operated on a 20-minute schedule during the daylight hours and less frequently through the night. The crossing time was approximately 11 minutes.

The bridges in the above instances replaced ferries with frequent sailings and relatively small crossing time, yet they created additional traffic estimated at between 64 per cent and 78 per cent of the existing ferry traffic. The proposed bridge will replace a ferry which offers service at intervals on the average two or three times as long, and has a crossing time over twice as great as the ferries in the above instances. Measured by the advantages offered by the proposed bridge over the existing ferry, which are so much greater than those offered by the above bridges over the ferries they replaced, we are of opinion that the induced traffic in this instance will amount to 125 per cent of the existing ferry traffic.

To realize induced traffic, however, there must always be a volume of potential traffic of sufficient size to create this additional traffic. In the instances cited where by far the greater part of the traffic on the ferries was composed of vehicles making local trips, there was a relatively large population in the territory adjacent to one or both terminals of the ferry. In the present instance, there is a large volume of potential traffic in the large and rapidly growing population of the lower Michigan peninsula where approximately 84 per cent of the traffic originates. In 1940, the population of the counties we have included in the southern zone of the peninsula, which contributed about half of the ferry traffic, was 3,676,000. In 1950, it had increased to 4,587,000 or approximately 25 per cent. The population of the central section which contributed about 16 per cent of the traffic increased from 973,000 in 1940 to 1,123,000 in 1950 or over 15 per cent, and the population of the northern

section of the lower peninsula which contributed about 21 per cent of the traffic increased from 283,000 to 290,000, about 24 per cent.

Our origin and destination survey indicated that about 10 per cent of the present ferry traffic has its origin or destination in Canada. Vehicular traffic between Canada and the United States by way of the Sault Ste. Marie Ferry has been increasing at a rate somewhat greater than that of the Straits Ferry. During the period between 1937 (the peak traffic year before the war) and 1949, the last year for which we have complete figures, traffic on the Soo Ferry increased 132 per cent (approximately 7.3 per cent per year) and on the Straits Ferry 122 per cent (approximately 6.9 per cent per year). Between the years 1946 and 1949, traffic increased on the Soo Ferry 140 per cent and on the Straits Ferry 138 per cent. As of 1949, vehicular traffic on the Soo Ferry was approximately 36 per cent of that on the Straits.

We believe the proposed bridge will be a great incentive for vehicles to use this route to Canada, and this prospective traffic is included in our estimate of induced traffic.

TRAFFIC POTENTIAL TO THE PROPOSED BRIDGE
OTHER THAN THAT FROM MACKINAC FERRY

During the course of our study, we found that due to congestion and waiting at the ferry, there were a number of Michigan vehicles traveling to and from the northern peninsula by way of the west side of Lake Michigan which might use a bridge across the Straits, if one were available.

The distances and times from Jackson (Zone 12A), Grand Rapids (Zone 11), and Battle Creek (Zone 16) to Menominee are approximately the same by the route along the west side of Lake Michigan as by the Straits Ferry. Although it is possible to travel faster on the ferry route, the ferry wait offsets the time that would otherwise be saved. The proposed bridge which will eliminate the wait will make the Straits route approximately 2-1/2 hours quicker and should divert this traffic.

In order to determine the volume of such traffic, we made a count of northbound vehicles on the northern peninsula on State Routes 35 and 41 north of Menominee.

We recorded Michigan passenger cars by license plate prefix letters which identified the counties in which they were registered and other cars by the state of registration. The survey was made for 16 hours on Saturday, November 11, 24 hours on Sunday, November 12, 17 hours on Monday, November 13, and 17 hours on Tuesday, November 14, and the vehicles coded in accordance with the zones used in the origin and destination survey at the ferry and expanded to full 24-hour days.

The results of this survey are shown in the following tabulation:

	Northbound Vehicles on Ferry		Northbound Michigan Vehicles on Routes 35 & 41 North of Menominee			
			From Zones 11-12A-16		From Zones 12-13-14-15	
	No.	Per Cent	No.	Per Cent	No.	Per Cent
Saturday, Nov. 11	4,378	100	137	3.1	402	9.2
Sunday, Nov. 12	3,650	100	198	5.4	590	16.2
Monday, Nov. 13	2,217	100	174	7.8	508	22.9
Tuesday, Nov. 14	2,243	100	87	3.9	287	12.8
	12,488	100	596	4.8	1,797	14.4

During the period of our count which included the peak days of the hunting season, the number of northbound Michigan vehicles from zones 11, 12A and 16 counted north of Menominee was equivalent to 4.8 per cent of the ferry traffic.

It will be noted that on Saturday, November 11, which with the exception of July 4 was the peak Saturday of the year, the traffic around the Lake from zones 11, 12A and 16 was equivalent to 3.1 per cent of the ferry traffic and on Sunday, November 12, which was a peak Sunday of the year, to 5.4 per cent

of the ferry traffic. It will also be noted that on Monday and Tuesday, days in which the traffic was substantially less, the per cent of traffic around the Lake comprised a larger portion of the ferry traffic than in the previous two days.

We have assumed for the purposes of this estimate that the traffic around the Lake from the southern part of the lower peninsula is equivalent to 3 per cent of the ferry traffic for the year.

It will be noticed that there were almost three times as many Michigan vehicles traveling around the Lake from zones 12, 13, 14 and 15 in the south central part of the lower peninsula as from the extreme southern portion of the peninsula. These vehicles obviously had to travel a longer distance than by the Straits Ferry. This movement is probably due to fear of delay at the Straits Ferry or the desire to stop at some point on the west shore of Lake Michigan. We believe that some portion of this traffic would be diverted to the proposed bridge but have made no allowance for the same in our estimates.

Our identification count of Michigan vehicles north of Menominee did not include those bound for the western part of the upper peninsula which would use Route U.S. 141 by-passing Menominee. We believe that there is traffic on this route which is subject to diversion to the proposed bridge but for which no specific allowance has been made in our estimate.

SUMMARY OF ESTIMATED TRAFFIC FOR THE PROPOSED BRIDGE

We have previously mentioned that the proposed bridge will take over the traffic from the existing ferry and divert traffic from the route around the Lake as well as induce additional traffic.

We have estimated the total traffic across the ferry in 1950 at 605 vehicular units or 562,000 vehicles. Our estimate of future growth to 1956, which we have assumed as the first full year of operation of the proposed

bridge, is based on an annual rate of 6 per cent which would make a total increase between 1950 and 1956 of approximately 42 per cent.

	<u>Vehicles</u>
Estimated 1950 traffic	562,000
Estimated growth to 1956 - 42 per cent	236,000
	798,000
Estimated traffic around Lake - 3 per cent	24,000
	822,000
Estimated induced traffic - 125 per cent	1,028,000
	1,850,000

Estimated Revenue

The average toll per vehicular unit in 1949 was \$1.89 and per vehicle \$2.04. We estimate the average toll per vehicular unit in 1950 at approximately \$1.88 or slightly less than in 1949 and have taken the estimated toll per vehicle in 1950 and thereafter at \$2.00. On this basis, the revenue for 1956 from the 1,850,000 vehicles would be \$3,700,000.

Future Traffic and Revenues

We have estimated the average growth after 1956 at a constant annual amount equivalent to 5 per cent of the traffic and revenue of 1956 or 92,000 vehicles and \$184,000. The estimated future traffic and revenues are shown in the tabulations at the beginning of the report.

Estimated Operating Expenses

Our estimate of operating expenses is based upon efficient operation of the bridge and does not include any allowance for salary or expenses of the Authority. Our allowance for maintenance and painting should more than cover the cost of such items in the early years and should create a reserve for increased expenses in later years.

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We show following the details of this estimate:

Administration	\$32,000
Toll collection	38,000
Tow service and snow removal	25,000
Fiscal agent, legal and auditing	15,000
Maintenance including painting	175,000
Insurance	90,000
Miscellaneous and contingents	<u>25,000</u>
Total	\$400,000

We have increased these expenses to \$425,000 in the sixth year of operation and \$450,000 in the sixteenth year of operation to take care of increased cost of toll collection and other expenses. If any or all of these expenses were to be paid for from funds other than bridge revenues, they should be omitted from the above estimate.

Conclusions

Our conclusions are shown in the first part of our report.

We wish to express our appreciation for the courtesies extended to us by the Michigan State Highway Department and their co-operation in furnishing us with records of past and present ferry traffic, revenue, operating expense and other data.

Respectfully submitted,

Coverdale + Colpitts

Consulting Engineers

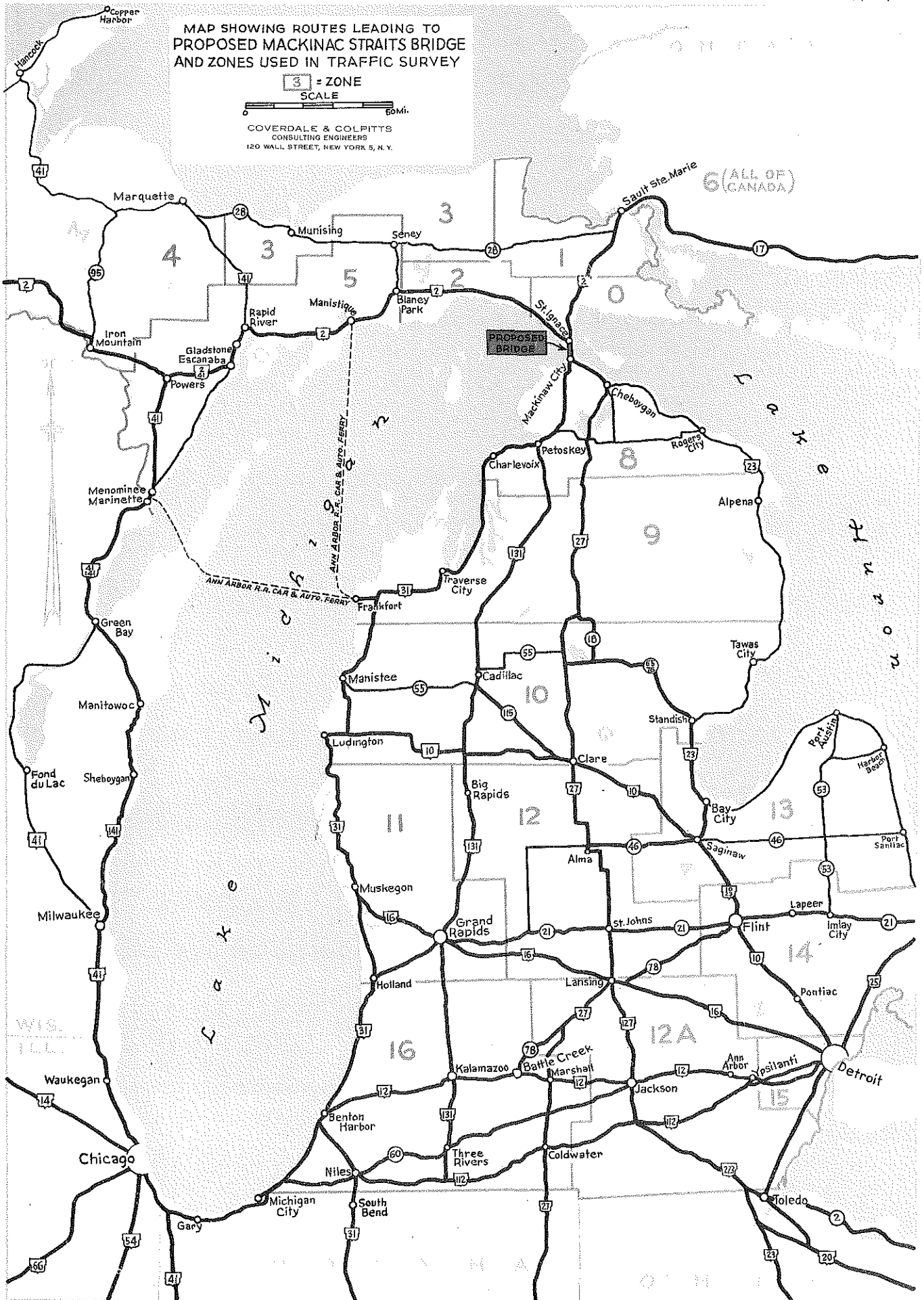
EXHIBITS

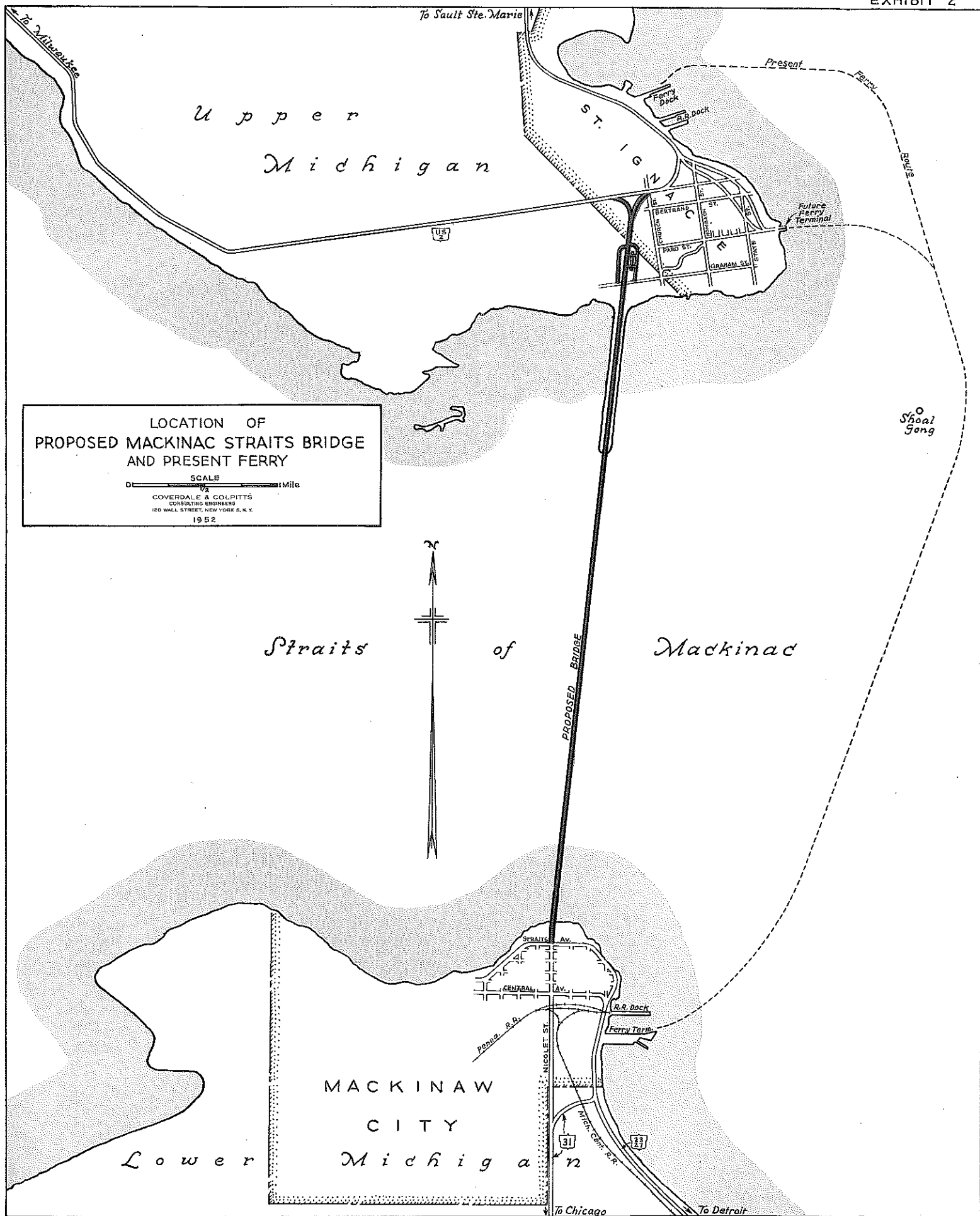
MAP SHOWING ROUTES LEADING TO
PROPOSED MACKINAC STRAITS BRIDGE
AND ZONES USED IN TRAFFIC SURVEY

3 = ZONE



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CONSULTING ENGINEERS
120 WALL STREET, NEW YORK 5, N.Y.





LOCATION OF
 PROPOSED MACKINAC STRAITS BRIDGE
 AND PRESENT FERRY

SCALE
 1/2 Mile

COVERDALE & COLPITTS
 CONSULTING ENGINEERS
 120 WALL STREET, NEW YORK 6, N. Y.
 1952

Straits of Mackinac

Upper Michigan

Lower Michigan

MACKINAW CITY



To Milwaukee

To Sault Ste. Marie

Shoal Gang

PROPOSED BRIDGE

Present

Ferry

Ferry Dock

R.R. Dock

Future Ferry Terminal

Bertrand St.

Hard St.

Graham St.

Straits Av.

Central Av.

R.R. Dock

Ferry Term.

Penab. R.R.

Nicolet St.

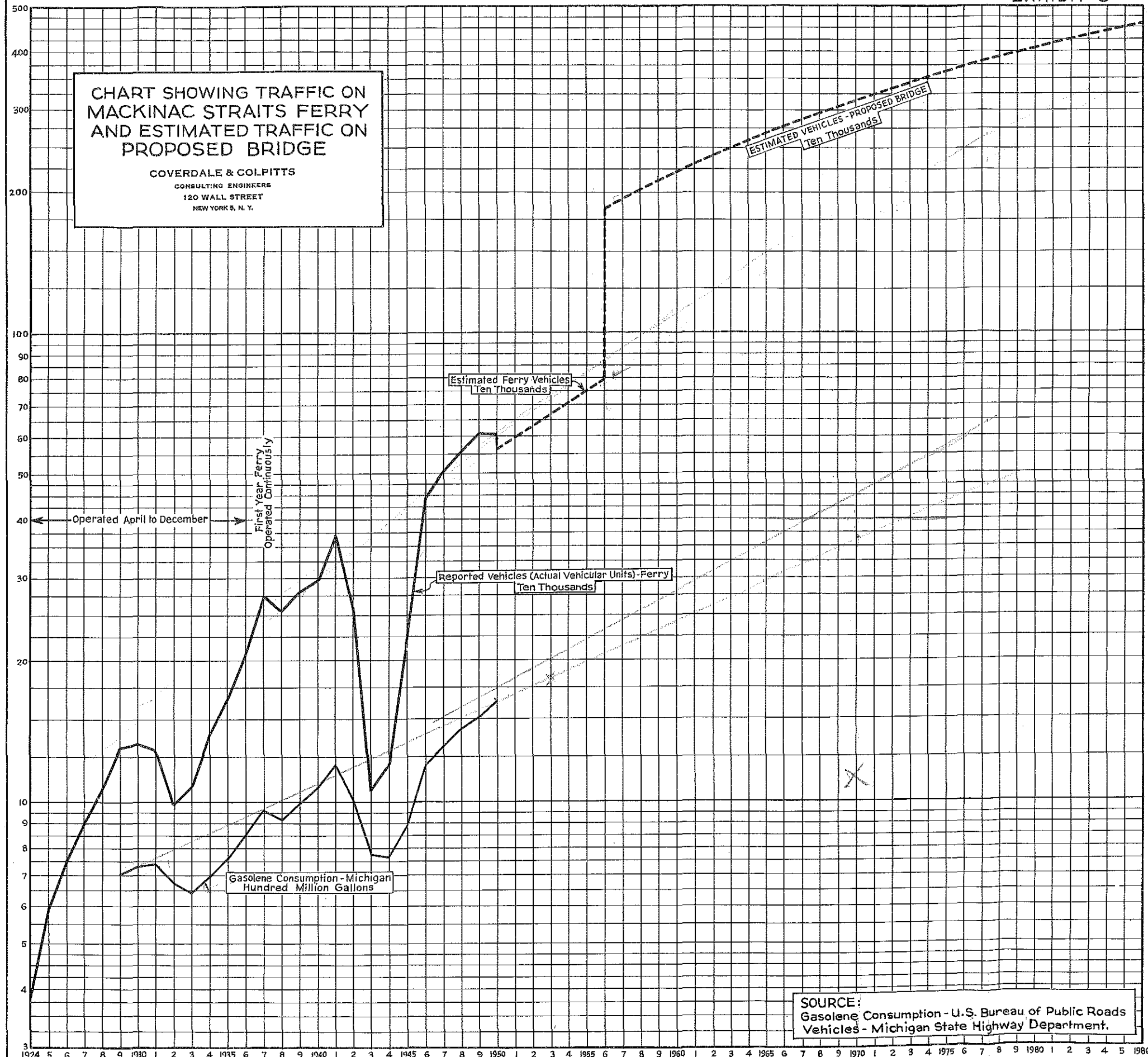
West Cent. R.R.

To Chicago

To Detroit

CHART SHOWING TRAFFIC ON
MACKINAC STRAITS FERRY
AND ESTIMATED TRAFFIC ON
PROPOSED BRIDGE

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120 WALL STREET
NEW YORK 5, N. Y.



SOURCE:
Gasolene Consumption - U.S. Bureau of Public Roads
Vehicles - Michigan State Highway Department.

APPENDICES

MACKINAC STRAITS FERRY

ORIGIN AND DESTINATION SURVEY

TRAFFIC PATTERN FOR FIVE DAYS FROM 8 A.M. FRIDAY, AUGUST 18, 1950
TO 8 A.M. WEDNESDAY, AUGUST 23, 1950 EXPANDED TO A FULL WEEK

Southern Michigan Peninsular and Other States	Upper Michigan Peninsular						Canada		Wisconsin		Northwest United States		Other States		Total	
	Eastern Zones 0 - 1 - 2		Central Zones 3 - 5		Western Zone 4		6 - 7		17		24					
	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent	Number	Per Cent
<u>Northern Zones</u>																
8	1,301	5.1	462	1.8	220	0.9	157	0.6	175	0.7	45	0.2	39	0.2	2,399	9.5
9	755	3.0	438	1.7	230	0.9	162	0.6	85	0.3	38	0.1	10	0.1	1,718	6.6
10	473	1.8	307	1.2	130	0.5	91	0.4	63	0.3	30	0.1	16	0.1	1,110	4.4
Total	2,529	9.9	1,207	4.7	580	2.3	410	1.6	323	1.3	113	0.4	65	0.3	5,227	20.5
<u>Central Zones</u>																
11 (Grand Rapids) (Muskegon)	858	3.3	465	1.8	330	1.3	123	0.5	80	0.3	44	0.2	1	0.1	1,901	7.4
12	424	1.7	245	1.0	137	0.5	78	0.3	41	0.2	39	0.2	9	0.1	973	4.0
13 (Bay City) (Saginaw)	568	2.2	326	1.3	163	0.7	87	0.3	41	0.1	33	0.1	5		1,223	4.7
Total	1,850	7.2	1,036	4.1	630	2.5	288	1.1	162	0.6	116	0.5	15	0.1	4,097	16.1
<u>Southern Zones</u>																
12A (Lansing) (Jackson)	1,095	4.3	512	2.0	459	1.8	168	0.7	51	0.2	53	0.2			2,338	9.2
14 (Flint) (Pontiac)	1,007	3.9	575	2.3	510	2.0	245	1.0	101	0.4	103	0.4	2		2,543	10.0
15 (Detroit)	2,077	8.1	1,206	4.7	1,769	6.9	479	1.8	244	1.0	247	1.0	14	0.1	6,036	23.6
16 (Kalamazoo) (Battle Creek)	570	2.3	267	1.0	179	0.7	105	0.4	35	0.1	19	0.1			1,175	4.6
Total	4,749	18.6	2,560	10.0	2,917	11.4	997	3.9	431	1.7	422	1.7	16	0.1	12,092	47.4
<u>Other States</u>																
West and South 17, 18, 23, 24	346	1.4	210	0.8	74	0.3	127	0.5	70	0.3	59	0.2	67	0.2	953	3.7
East and South 19, 20, 21, 22	1,456	5.7	498	1.9	236	0.9	634	2.5	168	0.7	139	0.5	23	0.1	3,154	12.3
Total	1,802	7.1	708	2.7	310	1.2	761	3.0	238	1.0	198	0.7	90	0.3	4,107	16.0
Grand Total	10,930		5,511		4,437		2,456		1,154		849		186		25,523	
Per Cent		42.8		21.5		17.4		9.6		4.6		3.3		0.8		100.0

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CONSULTING ENGINEERS

120 WALL STREET

NEW YORK 5, N. Y.

January 8, 1951

Mr. Prentiss M. Brown
Chairman of Mackinac Bridge Authority
2000 Second Avenue
Detroit 6, Michigan

Dear Sir:

In accordance with your instructions we have made a study of the probable gross and net revenues of the proposed bridge across the Straits of Mackinac between Mackinaw City on the south and St. Ignace on the north. This estimate is made on the assumption that the State-owned and operated ferry in this location will cease to operate on the completion of the proposed bridge. For the purposes of our estimate, we have assumed the bridge will open for operation on January 1, 1956.

The results of our study are shown in the following tabulations, the first of which shows the estimated traffic, gross and net revenues by years, and the rate at which a 3-1/2 per cent bond issue in the amount of \$87,000,000 could be paid off assuming that all of the net earnings were available for debt service. The second tabulation gives similar information assuming that the operating expenses are not charged against bridge revenues, but are paid from other funds.

PROPOSED MACKINAC BRIDGE

TENTATIVE ESTIMATE OF TRAFFIC AND GROSS AND NET REVENUES
AND TABULATION SHOWING RATE AT WHICH A 3-1/2 PER CENT
BOND ISSUE IN THE AMOUNT OF \$87,000,000 COULD BE RETIRED
ASSUMING ALL NET REVENUES WERE AVAILABLE FOR DEBT SER-
VICE AND THE BONDS WERE RETIRED AT PAR

Year	Vehicles	Revenue	Operating Expenses	Available for Debt Service	Interest at 3-1/2%	Available for Amortization	Bonds Outstanding \$87,000,000
1956	1,770,000	\$3,700,000	\$400,000	\$3,300,000	\$3,045,000	\$ 255,000	\$86,745,000
1957	1,858,000	3,884,000	400,000	3,484,000	3,036,000	448,000	86,297,000
1958	1,946,000	4,068,000	400,000	3,668,000	3,020,000	648,000	85,649,000
1959	2,034,000	4,252,000	400,000	3,852,000	2,998,000	854,000	84,795,000
1960	2,122,000	4,436,000	400,000	4,036,000	2,968,000	1,068,000	83,727,000
1961	2,210,000	4,620,000	425,000	4,195,000	2,930,000	1,265,000	82,462,000
1962	2,298,000	4,804,000	425,000	4,379,000	2,886,000	1,493,000	80,969,000
1963	2,386,000	4,988,000	425,000	4,563,000	2,834,000	1,729,000	79,240,000
1964	2,474,000	5,172,000	425,000	4,747,000	2,773,000	1,974,000	77,266,000
1965	2,562,000	5,356,000	425,000	4,931,000	2,704,000	2,227,000	75,039,000
1966	2,650,000	5,540,000	425,000	5,115,000	2,626,000	2,489,000	72,550,000
1967	2,738,000	5,724,000	425,000	5,299,000	2,539,000	2,760,000	69,790,000
1968	2,826,000	5,908,000	425,000	5,483,000	2,443,000	3,040,000	66,750,000
1969	2,914,000	6,092,000	425,000	5,667,000	2,336,000	3,331,000	63,419,000
1970	3,002,000	6,276,000	425,000	5,851,000	2,220,000	3,631,000	59,788,000
1971	3,090,000	6,460,000	450,000	6,010,000	2,093,000	3,917,000	55,871,000
1972	3,178,000	6,644,000	450,000	6,194,000	1,955,000	4,239,000	51,632,000
1973	3,266,000	6,828,000	450,000	6,378,000	1,807,000	4,571,000	47,061,000
1974	3,354,000	7,012,000	450,000	6,562,000	1,647,000	4,915,000	42,146,000
1975	3,442,000	7,196,000	450,000	6,746,000	1,475,000	5,271,000	36,875,000
1976	3,530,000	7,380,000	450,000	6,930,000	1,291,000	5,639,000	31,236,000
1977	3,618,000	7,564,000	450,000	7,114,000	1,093,000	6,021,000	25,215,000
1978	3,706,000	7,748,000	450,000	7,298,000	883,000	6,415,000	18,800,000
1979	3,794,000	7,932,000	450,000	7,482,000	658,000	6,824,000	11,976,000
1980	3,882,000	8,116,000	450,000	7,666,000	419,000	7,247,000	4,729,000
1981	3,970,000	8,300,000	450,000	7,850,000	166,000	7,684,000	
1982	4,058,000	8,484,000	450,000	8,034,000			
1983	4,146,000	8,668,000	450,000	8,218,000			
1984	4,234,000	8,852,000	450,000	8,402,000			
1985	4,322,000	9,036,000	450,000	8,586,000			
1986	4,410,000	9,220,000	450,000	8,770,000			

Bonds issued, say, 1952 (beginning)

Date of last maturity, 1981 (end)

Time to amortize - 30 years

Total bonds issued \$ 87,000,000

Total interest paid 54,845,000

Total debt service 141,845,000 100.0%

Total revenues collected 200,260,000 41.2%

Coverage over 35-year period 141.2%

PROPOSED MACKINAC BRIDGE

TENTATIVE ESTIMATE OF TRAFFIC AND REVENUES AND TABULATION SHOWING
RATE AT WHICH A 3-1/2 PER CENT BOND ISSUE IN THE AMOUNT OF
\$87,000,000 COULD BE RETIRED ASSUMING ALL GROSS REVENUES WERE
AVAILABLE FOR DEBT SERVICE AND THE BONDS WERE RETIRED AT PAR

Year	Vehicles	Revenue	Interest at 3-1/2%	Available for Amortization	Bonds Outstanding \$87,000,000
1956	1,770,000	\$3,700,000	\$3,045,000	\$ 655,000	\$86,345,000
1957	1,858,000	3,884,000	3,022,000	862,000	85,483,000
1958	1,946,000	4,068,000	2,992,000	1,076,000	84,407,000
1959	2,034,000	4,252,000	2,954,000	1,298,000	83,109,000
1960	2,122,000	4,436,000	2,909,000	1,527,000	81,582,000
1961	2,210,000	4,620,000	2,855,000	1,765,000	79,817,000
1962	2,298,000	4,804,000	2,794,000	2,010,000	77,807,000
1963	2,386,000	4,988,000	2,723,000	2,265,000	75,542,000
1964	2,474,000	5,172,000	2,644,000	2,528,000	73,014,000
1965	2,562,000	5,356,000	2,555,000	2,801,000	70,213,000
1966	2,650,000	5,540,000	2,457,000	3,083,000	67,130,000
1967	2,738,000	5,724,000	2,350,000	3,374,000	63,756,000
1968	2,826,000	5,908,000	2,231,000	3,677,000	60,079,000
1969	2,914,000	6,092,000	2,103,000	3,989,000	56,090,000
1970	3,002,000	6,276,000	1,963,000	4,313,000	51,777,000
1971	3,090,000	6,460,000	1,812,000	4,648,000	47,129,000
1972	3,178,000	6,644,000	1,650,000	4,994,000	42,135,000
1973	3,266,000	6,828,000	1,475,000	5,353,000	36,782,000
1974	3,354,000	7,012,000	1,287,000	5,725,000	31,057,000
1975	3,442,000	7,196,000	1,087,000	6,109,000	24,948,000
1976	3,530,000	7,380,000	873,000	6,507,000	18,441,000
1977	3,618,000	7,564,000	645,000	6,919,000	11,522,000
1978	3,706,000	7,748,000	403,000	7,345,000	4,177,000
1979	3,794,000	7,932,000	146,000	7,786,000	
1980	3,882,000	8,116,000			
1981	3,970,000	8,300,000			
1982	4,058,000	8,484,000			
1983	4,146,000	8,668,000			
1984	4,234,000	8,852,000			
1985	4,322,000	9,036,000			
1986	4,410,000	9,220,000			

Bonds issued, say, 1952 (beginning)
Date of last maturity, 1979 (end)
Time to amortize - 28 years
Total bonds issued \$ 87,000,000
Total interest paid 48,975,000
Total debt service 135,975,000 100.0%
Total revenues collected 200,260,000 47.3%
Covers over 35-year period 147.3%

A bond issue in the amount of \$87,000,000 has been assumed on the advice of the Consulting Engineers, who have given us this figure as a tentative estimate of the over-all cost of the project.

It is to be noted that a bond issue of the above amount can be retired from the net earnings of the bridge in 30 years and that if the bonds cover a term of 35 years the total debt service would be covered during this period 1.41 times.

The second tabulation indicates that if the bridge is relieved from the burden of operating expenses, the bond issue can be retired in 28 years with a coverage of 1.47 times.

Our estimate of bridge traffic for 1956 is arrived at as follows:

	<u>Vehicles</u>
Estimated ferry traffic - 1950 (Not counting trailers as separate vehicles)	538,600
6 Years growth @ 6% (41.85%)	225,400
Total ferry traffic - 1956	<u>764,000</u>
Diverted from west side of Lake Michigan - 3%	22,900
Total ferry and diverted traffic	<u>786,900</u>
Induced traffic @ 125%	983,600
Total bridge traffic - 1956	<u>1,770,500</u>
Say	1,770,000

Our estimate of bridge revenue has been derived by dividing the total revenue received in 1950 by the number of vehicles carried in that year as shown above and applying this average toll to the estimated number of vehicles carried in 1956. On this basis the average toll is approximately \$2.09 per vehicle.

We believe that our estimate of traffic is liberal, but considering the territory, the character of the present traffic and service rendered by the ferry, we believe it is reasonable to expect the traffic volumes and revenues shown.

As it may not be possible to finance the project from the net revenues of the bridge alone, we have assumed in our second tabulation that the State would pay the operating expenses which we have estimated at \$400,000 for the first five years, \$425,000 for the next ten years, and \$450,000 thereafter. As the deficit from ferry operations alone, excluding any capital improvements necessary, was approximately \$474,000 in 1948, \$360,000 in 1949, and will be greater than the latter amount in 1950, the payment of the operating expenses by the State should not be considered a contribution as such payments would be less than the present deficits resulting from ferry operation.

In cases where it has been difficult to finance projects solely from revenues available from the project itself, States have contributed to the project in certain cases by assuming part of the construction costs; for instance, of the bridge approaches. The guaranty of the debt service by the State would, of course, result in a substantially lower interest rate, making the total overall cost less and insuring the success of the project.

We wish to express our appreciation for the courtesies extended to us by the Michigan State Highway Department and their co-operation in furnishing us with past and present ferry traffic, revenue, operating expense and other data.

Respectfully submitted,

Coverdale & Colpitts
Consulting Engineers