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PROVINCE OF MANITOBA

DEPARTMENT OF AGRICULTURE



AND CONSERVATION

WATER CONTROL AND CONSERVATION BRANCH

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GREATER WINNIPEG FLOODWAY
LOCATION STUDY

February 1960.
Winnipeg, Manitoba.

Prepared By:
Planning Division

Province of Manitoba
Department of Agriculture and Conservation
WATER CONTROL AND CONSERVATION BRANCH

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SYNOPSIS

The Royal Commission on Flood Cost-Benefit, in its report submitted to the Manitoba Government late in 1958, recommended that the intake of the Greater Winnipeg Floodway be relocated so as to have St. Norbert included in the protected area. However, this recommendation was not given detailed consideration by the Commission and hence such a study was undertaken by the Water Control and Conservation Branch. The purpose of this report is to outline the location studies undertaken, the results obtained and to present a recommendation as to the best route for the Floodway.

In addition to moving the Floodway intake upstream to provide protection for St. Norbert, it also was considered advisable to appraise the merits of including all of the Greater Winnipeg Perimeter Highway east of the Red River and the Canadian National Railway's Symington Yard within the protected area. Office studies were made of several Floodway routes which met both requirements. These were followed by field investigations and a detailed study of the two most favourable routes. The better of the two was then selected having regard to cost and other considerations.

To ensure that the most advantageous location of the Floodway was ultimately adopted, it was necessary to review the routes advocated previously by the Red River Basin Investigation and the Royal Commission on Flood Cost-Benefit. This review consisted primarily of modifying the routes by relocation of the Floodway intake upstream from St. Norbert and preparing cost

estimates of both modified locations.

The results of this location study indicate that the cost of constructing the Floodway along the Water Control and Conservation Branch route would be \$63,212,000 as compared to \$63,017,000 for the modified Red River Basin Investigation route and \$65,419,000 for the Commission's modified route. The slight cost advantage of the modified Red River Basin Investigation route over the Water Control and Conservation Branch route is not significant in cost estimates of this magnitude. Further, the former route has certain disadvantages over the latter route; one being the higher bridge maintenance costs resulting from a greater number of bridges and another being that the protected area is less by 4,700 acres. In the light of these and other factors, it has been concluded that the Water Control and Conservation Branch route would best serve the interests of the Greater Winnipeg area and the Province of Manitoba.

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INTRODUCTION

The flood problem in the Greater Winnipeg area has received attention and study since 1950. In 1953, the Red River Basin Investigation completed its study of various flood control measures. The results indicated that the most favourable means of providing flood protection for Greater Winnipeg would be by storage and diversion and further, that the most positive flood control measure for this area would be the diversion of flood flows of the Red River around Winnipeg. This was confirmed by the Royal Commission on Flood Cost-Benefit and was recommended by the Commission in its report submitted to the Government late in 1958. However, the Commission did recommend that protection for St. Norbert be incorporated into the flood diversion scheme and since the Commission did not investigate this suggestion in detail it was necessary for the Water Control and Conservation Branch to make such a study. This report presents the results of this study.

Since last spring an extensive program of field and office investigations has been undertaken with the object of establishing the best location for the Greater Winnipeg Floodway. The requirements to be met in selecting the location were as follows:

- (a) Protection for St. Norbert is to be provided in accordance with the Commission's recommendation by moving the Floodway intake from below St. Norbert (as in the Red River Basin Investigation and Royal Commission locations) to some point above St. Norbert.
- (b) In providing protection for St. Norbert, the relocation must recognize the existence of the section of the Greater Winnipeg

Perimeter Highway east of the Red River and the Canadian National Railways' Symington Yard. This is in accordance with the assumption made by the engineering consultant for the Commission, and accepted by the Commission, that both of these facilities should be entirely within the protected area.

Preliminary field investigations and office studies required in establishing the best location which would meet the above stated requirements have now been completed. Most attention has been focussed on the area south of the Trans-Canada Highway since only minor changes in location have been found necessary north of the Trans-Canada Highway.

It was also considered advisable to examine the Red River Basin Investigation and Royal Commission on Flood Cost-Benefit locations to ascertain the most economical way in which these routes might be modified so that they would comply with requirement (a). Costs of both modified routes were estimated to assist in assessing their relative merits along with those of the most favourable location which meets requirement (b) as well as requirement (a).

HISTORY AND SCOPE OF PREVIOUS INVESTIGATIONS

Red River Basin Investigation.

In 1953, the Red River Basin Investigation completed an extensive study of flood control measures and presented, in its report, floodway designs covering capacities ranging from 20,000 to 100,000 c.f.s. The route in the case of each design was the same and is shown on the accompanying map. Variations in size and depth were made in accordance with capacity requirements. Although cost estimates of the various floodway designs were given in the report, no recommendation as to the capacity of Floodway was made since the scope of the investigation did not include a benefit-cost analysis.

Royal Commission on Flood Cost-Benefit.

The Royal Commission on Flood Cost-Benefit made benefit-cost analyses of the measures dealt with in the report of the Red River Basin Investigation and recommended the following major projects in its report submitted to the Government late in 1958:

- (1) A Greater Winnipeg Floodway with a capacity of 60,000 c.f.s.
- (2) A diversion of the Assiniboine River to Lake Manitoba.
- (3) A storage reservoir near Russell, Manitoba.

However, the Commission makes this further recommendation:

"The Commission recommends that the intake of the Greater Winnipeg Floodway, which, in the plan proposed by the Red River Basin Investigation, would leave the main channel of the Red River just north of St. Norbert at Mile 62.7, be moved upstream to about Mile 68providing this proves feasible from an engineering point of view. The cost of this extension to the Floodway will be about \$3,000,000.

While this addition to the cost of the Floodway will not have an economic justification at this time, the Commission recognizes that it will have other benefits now and in the foreseeable future and recommends it for the following reasons:

- (a) It will bring St. Norbert, now recognized as an integral part of the Greater Winnipeg Metropolitan area, and some of the area contiguous to St. Norbert within the area to be protected;
- (b) The increased cost of some \$3.0 millions is not material in view of the fact that the Greater Winnipeg area inevitably will face a major growth in the next twenty-five years;
- (c) Even with the cost increase due to this extension, the overall benefit-cost ratio is still very favourable."

FLOODWAY LOCATION PROBLEM

In accordance with the recommendation of the Royal Commission on Flood Cost-Benefit set forth in the preceding section, the first requirement of the Floodway relocation is to provide protection for St. Norbert. The second requirement is to locate the Floodway so that the Perimeter Highway and the Canadian National Railways' Symington Yard are both within the protected area. This is in agreement with the assumption made by the Commission's engineering consultant and accepted by the Commission. Since both of these requirements affect the location south of the Trans-Canada Highway, most attention was focussed on this reach.

In addition to the above requirements, local opinion during the last few months suggested that the outlet site at Lockport, selected by the Red River Basin Investigation and the Commission, should be relocated. The details of the investigation of this relocation are discussed later in a separate section.

Location South of the Trans-Canada Highway.

Office studies of several trial locations in this area were undertaken following which the two most favourable alternatives were selected. Field investigations along these routes were then made to more accurately assess their relative merits. These routes are shown on the accompanying map and are designated as Alternative A and Alternative B.

The problem of location in this reach consists mainly of securing satisfactory alignment of the Floodway intake with the Red River

and the establishment of a suitable crossing of the Trans-Canada Highway. These requirements were met in the case of both Alternative A and Alternative B. A further complication of the location problem is caused by the nature of the topography immediately north of the Trans-Canada Highway where the land rises to the east. The channel was therefore located in this reach, as close as possible to the Perimeter Highway to keep excavation quantities to a minimum.

The relocation of the Floodway to provide protection for St. Norbert necessitated finding a suitable control structure site for each of the alternatives. Several potential sites were selected for further investigation. Borings to determine foundation conditions at these sites were undertaken along with detailed topographic surveys. The best of these sites was then chosen. The most favourable site for Alternative A appears to be near the inter-municipal boundary between Ritchot and St. Vital and that for Alternative B, about one mile upstream from the confluence of the Sale and Red Rivers. These sites are shown on the accompanying map.

Relocation of the Floodway inlet also necessitated selecting a new route for the dyke west of the Red River. The office studies and field surveys which have been made for this purpose indicate that several suitable routes are available.

Comparison of Alternatives A and B: Evaluation of the relative merits of Alternatives A and B is based on the following considerations.

(a) Cost. The estimate of cost of each of the routes was based on the same unit prices as the Commission used with the exception of the

unit price of right-of-way which was revised to \$600 per acre from the \$350 unit price used by the Commission. A comparison of the costs is made in Table 1 which follows.

TABLE 1
COST COMPARISON OF ALTERNATIVES A AND B
FROM THE TRANS-CANADA HIGHWAY SOUTH TO THE RED RIVER
(thousands of dollars)

| Alternative | Channel Excavation | Dykes | Right of Way | Bridges | Control Structure | Total |
|-------------|--------------------|-------|--------------|---------|-------------------|--------|
| A | 10,816 | 2077 | 2,093 | 3,881 * | 4,400 | 23,267 |
| B | 10,163 | 1904 | 2,473 | 3,339 | 4,700 | 22,579 |

* Includes the cost of the Trans-Canada Gas Pipeline crossing estimated at \$250,000.

(b) Protected Area. Alternative A provides protection for an additional 4,300 acres of land. A benefit-cost study, however, does not indicate that protection of this additional land, which is largely agricultural, can be justified by the expenditure of \$688,000, the difference in the estimated cost of these alternatives.

It should be noted that approximately one quarter of the Grande Pointe Settlement would benefit from Alternative A since it would be included in the additional protected area referred to above, but on the other hand, one third of the Settlement would be occupied by the right-of-way required for the Floodway.

(c) Channel Alignment. Alignment of the Red River in the case of Alternative B is superior to Alternative A both at the control structure

and at the Floodway intake.

(d) Control Structure Site. Test borings taken at both sites indicate that at the Alternative A site hardpan is closer to the surface with the result that costs would be lower than for Alternative B. On the other hand, however, the riverbanks are less stable, containing river deposit material which could cause certain construction problems not likely to occur at the Alternative B site. This undesirable characteristic would seem to more than offset the advantages of the higher hardpan elevation. The Alternative B site is therefore considered to be the more favourable location.

Discussion: Alternative B is lower in cost than Alternative A, has more favourable alignment at the control structure and the intake, and has more stable riverbanks at the control structure site. Protection of the additional area by Alternative A cannot be justified on a benefit-cost basis. For these reasons Alternative B is the preferable location for the Floodway. All further reference, in this report, to the Floodway location as adopted by the Water Control and Conservation Branch, will assume that the location between the Trans-Canada Highway and the Red River is that of Alternative B.

Location North of the Trans-Canada Highway.

In the area north of the Trans-Canada Highway it was noted that the routes of the Red River Basin Investigation and the Royal Commission on Flood Cost-Benefit were either coincident or adjacent to one another. For this reason it was concluded that only minor improvement along this section of the Floodway would be anticipated. However, local opinion

during the last few months suggested that the outlet site at Lockport, selected by the Red River Basin Investigation and the Commission, should be relocated.

Office studies of several outlet locations were made. In the case of an outlet upstream of Lockport it was found that increased backwater effects would offset the decreased excavation required on the shortened route. On the other hand, extending the Floodway below Lockport would increase excavation costs which would not be commensurate with savings resulting from the reduced backwater effect. These findings agree with the Red River Basin Investigation conclusion that the most economical location for the Floodway outlet would be approximately one half mile below St. Andrews Dam.

MODIFIED LOCATIONS OF PREVIOUS ROUTES

The requirements of the Floodway relocation as stated earlier in this report are:

- (a) to provide protection for St. Norbert.
- (b) to have both the Perimeter Highway and Symington Yard entirely within the protected area.

A route which meets both of these requirements is shown on the accompanying map as a solid black line. Before this location can be recommended, however, it is necessary that the previous routes advocated, namely, those of the Red River Basin Investigation and the Royal Commission on Flood Cost-Benefit, be carefully reviewed to ensure that the most advantageous location is finally adopted.

In reviewing these two routes it was first necessary to ascertain whether they could be altered to meet the two requirements stated above. Both the Red River Basin Investigation and Commission routes can be modified by relocating only the southerly three or four miles to meet the first requirement of providing protection for St. Norbert. However, neither can be changed so as to avoid two crossings of the Perimeter Highway and in the case of the Red River Basin Investigation route, a crossing of the four track approach to the Symington Yard.

Having established the most satisfactory relocation of the inlet, it was then necessary to prepare cost estimates for each of the modified routes. It was decided to adopt the 1958 unit prices (except that for right-of-way) assumed by the Commission in their studies as being representative of current conditions. It was also necessary to make due allowance for increases in cost for expanded facilities already built or under construction since the original reports were prepared.

Modified Red River Basin Investigation Route.

Modified Inlet: Several possible routes for the relocation of the intake to a point south of St. Norbert were studied. Three major considerations borne in mind in establishing this relocation were:

1. Satisfactory intake channel alignment.
2. Minimum excavation.
3. An intersection angle with the Perimeter Highway of at least 38° since a flatter angle would unduly increase the cost of the bridge or alternatively would necessitate the reconstruction of a section of the Perimeter Highway.

The most satisfactory relocation studied was found to be the one shown as a broken red line on the accompanying map.

Estimate of Cost: In the report of the Red River Basin Investigation, the estimated cost of a 60,000 c.f.s. Floodway was given as \$46,834,000. However, since that report was prepared, conditions and unit prices have changed making it necessary to revise the estimated cost. The Commission revised the unit prices used by the Red River Basin Investigation to conform with 1958 conditions and these prices, with the exception of that for right-of-way, have been used during the present investigation in preparing all revised costs. Recent acquisition of land adjacent to the Floodway indicated that the average unit price for right-of-way should be increased to \$600 per acre from the \$350 price used by the Commission. This price with an additional allowance for the approximate number of buildings in the right-of-way was therefore used in all of the revised estimates. In Table 2 which follows are shown the costs as given in the Red River Basin Investigation

report and revised costs of the original and modified locations. An explanation of Table 2 follows.

Column 1. This column lists all of the major items considered in preparing cost estimates.

Column 2. This column lists the estimated costs contained in the 1953 report of the Red River Basin Investigation.

Column 3. This column lists the costs of the original route as revised by applying the 1958 unit prices used by the Commission.

Column 4. This column lists the costs of the original route based on 1958 prices with the exception of the revised right-of-way price and includes the cost of adapting the location to the public facilities recently constructed in the area (P.T.H. 59, the Perimeter Highway, the Greater Winnipeg Water District Second Branch Aqueduct and the Symington Yard) which necessitate the following structures:

1. Two P.T.H. 59 Highway bridges.
2. Two Perimeter Highway bridges.
3. A crossing of the Greater Winnipeg Water District Second Branch Aqueduct.
4. A four track bridge at the east end of the Symington Yard.

Column 5. This column is the same as column 4 except that the inlet water elevation has been raised from elevation 768 to 769 to correspond to the natural water level obtaining at the original point of diversion for a design flood of 140,000 c.f.s. This change has resulted in decreased excavation and right-of-way costs. An inlet water elevation corresponding to the natural level of the design flood of 140,000 c.f.s. was used for the modified location also

(Column 6), thus enabling the original and modified routes to be compared on the same basis.

Column 6. This column lists the costs for the Red River Basin Investigation route as modified to provide protection for St. Norbert and includes the cost of providing for the expanded public facilities as provided for in Column 4. Therefore, the difference in cost between Column 5 and Column 6 of \$3,848,000 represents the total cost of providing protection for St. Norbert.

TABLE 2

COST COMPARISON
ORIGINAL AND MODIFIED LOCATIONS OF RED RIVER BASIN INVESTIGATION ROUTE
(thousands of dollars)

| Item | Original Location | | | Modified Location (St. Norbert Protection) |
|--------------------------------|---------------------------------|---------------------------------|--|---|
| | 1953 Cost; Inlet W.L. 768 | 1958 Cost; Inlet W.L. 768 | 1958 Cost; Expanded Facilities; Inlet W.L. 769 | |
| (1) | (2) | (3) | (4) | (5) |
| Control Structure | 3,000 | 3,417 | 3,417 | 4,700 |
| Dykes (including right-of-way) | 950 | 1,120 ¹ | 1,076 ¹ | 1,904 |
| Right-of-Way (Floodway) | 1,200 | 3,360 | 7,457 | 7,840 |
| Excavation | 30,910 | 30,910 | 30,910 | 29,639 |
| Highway Bridges | (7) 3,384 | (7) 3,574 | (12) 8,002 ² | (12) 8,002 |
| Railway Bridges | (7) 5,880 | (7) 6,977 | (7) 8,956 ³ | (7) 8,956 |
| Aqueduct Crossings | 230 | 260 | 529 | 529 |
| Seine River Diversion | 120 | 136 | 120 ⁴ | 120 |
| Outlet Structure | 660 | 762 | 762 | 762 |
| Miscellaneous | 500 | 565 | 565 | 565 |
| Total | \$46,834 | \$51,081 | \$61,794 | \$63,017 |

1. Commission's price of \$800/acre for dyke right-of-way reduced to \$600/acre.

2. Includes the cost of Dawson Road bridge (not included in original estimate).

3. Includes increased cost of east Transcona Yard approach bridge due to addition of two tracks since 1953.

4. Design discharge reduced due to the Seine River diversion at Ste. Anne.

NOTE: The number of bridges is shown in brackets to the left of the estimated bridge costs.

Modified Royal Commission on Flood Cost-Benefit Route.

Modified Inlet: In extending the Commission's route to a point south of St. Norbert the main objectives were:

1. Satisfactory intake channel alignment.
2. Minimum excavation.

Following a study of the features of the area a location for the extension was ultimately determined which met these objectives. This location is indicated as a broken blue line on the accompanying map.

Estimate of Cost: The report of the Royal Commission on Flood Cost-Benefit gave the estimated cost of the 60,000 c.f.s. capacity Floodway, following the route shown as a solid blue line on the accompanying map, as \$57,361,000. A review of the unit prices upon which this estimate of cost was based indicated that only the unit price of \$350 per acre for right-of-way required revision. As in the case of the modified Red River Basin Investigation cost estimate, a unit price of \$600 per acre plus an additional allowance for buildings has been used in preparing all revised costs costs.

Table 3 which follows shows the costs as given in the Commission's report and the revised costs of the original and modified location. An explanation of Table 3 follows.

Column 1. This column lists all of the major items considered in preparing cost estimates.

Column 2. This column lists the estimated costs contained in the 1958 report of the Royal Commission on Flood Cost-Benefit.

Column 3. This column lists the costs of the original route based on 1958 prices with the exception of the revised right-of-way price, and includes the cost of adapting the location to the public facilities recently constructed in the area (the Perimeter Highway and the Greater Winnipeg Water District Second Branch Aqueduct) which necessitate the following structures:

1. Two Perimeter Highway bridges.
2. A crossing of the Greater Winnipeg Water District Second Branch Aqueduct.

Column 4. This column is the same as column 3 except that the inlet water elevation has been raised from elevation 768 to 769 to correspond to the natural water level obtaining at the original point of diversion for a design flood of 140,000 c.f.s. This change has resulted in decreased excavation and right-of-way costs. An inlet water elevation corresponding to the natural level of the design flood of 140,000 c.f.s. was used for the modified location also (column 5), thus enabling the original and modified routes to be compared on the same basis.

Column 5. This column lists the costs for the Commission's route as modified to provide protection for St. Norbert and includes the cost of providing for the expanded public facilities as provided for in column 3. Therefore, the difference in cost between column 4 and column 5 of \$4,531,000 represents the total cost of providing protection for St. Norbert.

TABLE 3
 COST COMPARISON
 ORIGINAL AND MODIFIED LOCATIONS OF ROYAL COMMISSION ON FLOOD COST-BENEFIT ROUTE
 (Thousands of dollars)

| Item | Original Location | | Modified Location (St. Norbert Protection) |
|--------------------------------|---------------------------------|--|---|
| | 1958 Cost; Inlet W.L. 768 | 1958 Cost; Expanded Facilities; Inlet W.L. 769 | |
| (1) | (2) | (3) | (4) (5) |
| Control Structure | 3,417 | 3,417 | 4,700 |
| Dykes (including right-of-way) | 1,120 | 1,076 ^{1.} | 1,904 |
| Right-of-Way (Floodway) | 3,520 | 6,980 | 7,650 |
| Excavation | 35,246 | 35,246 | 34,015 |
| Highway Bridges | (10) 5,639 | (12) 8,859 | (12) 8,859 |
| Railway Bridges | (7) 6,762 | (7) 6,315 ^{2.} | (7) 6,315 |
| Aqueduct Crossings | 260 | 529 | 529 |
| Seine River Diversion | 70 | 120 ^{3.} | 120 |
| Outlet Structure | 762 | 762 | 762 |
| Miscellaneous | 565 | 565 | 565 |
| Total | \$57,361 | \$63,869 | \$65,419 |

1. Commission's price of \$800/acre for dyke right-of-way reduced to \$600/acre.
 2. Two track bridge at C.N.R. crossing east of Transcona reduced to a single track bridge.
 3. Design discharge increased due to peak flow experienced in 1959.

NOTE: The number of bridges is shown in brackets to the left of the estimated bridge costs.

RECOMMENDED FLOODWAY LOCATION

The purpose of this study has been to determine the best location for the Greater Winnipeg Floodway in accordance with the recommendation of the Royal Commission on Flood Cost-Benefit that protection be provided for St. Norbert. The three locations which satisfy this requirement and which have been investigated in detail are:

1. The route selected by the Water Control and Conservation Branch.
2. The modified Red River Basin Investigation route.
3. The modified Royal Commission on Flood Cost-Benefit route.

The cost estimates for each of the above routes are summarized in Table 4. This table shows the estimated cost of constructing the Floodway along the Water Control and Conservation Branch route to be \$63,212,000 as compared to \$63,017,000 for the modified Red River Basin Investigation route and \$65,419,000 for the Commission's modified route.

The modified Red River Basin Investigation route has a slight advantage of \$195,000 in cost over the Water Control and Conservation Branch route, which is the next lowest in cost. This small cost advantage is insignificant in cost estimates of this magnitude and in any case is outweighed by the following disadvantages of the modified Red River Basin Investigation route:

1. It would require two additional bridges where the floodway crosses the Perimeter Highway resulting in higher bridge maintenance costs.
2. It would require a four track bridge at the Symington Yard approach and a four track bridge at the Transcona Yard approach. These, as in the case of item 1 above, would result in higher bridge maintenance costs.
3. It would leave a 2.5 mile portion of the Perimeter Highway east of the Red River unprotected from flooding.
4. It would provide protection for 4,700 acres less than the Water Control and Conservation Branch route and since the Floodway would probably form an artificial outer boundary of the Greater Winnipeg Metropolitan area, it would be more limiting in this respect.
5. Right-of-way acquisition would cause more disruption of property holdings due to the existence of more urban type development along this route.

Having regard to the above disadvantages of the Red River Basin Investigation route, it is recommended that in the best interests of the Greater Winnipeg area and the Province of Manitoba, the Water Control and Conservation Branch location for the Greater Winnipeg Floodway be adopted.

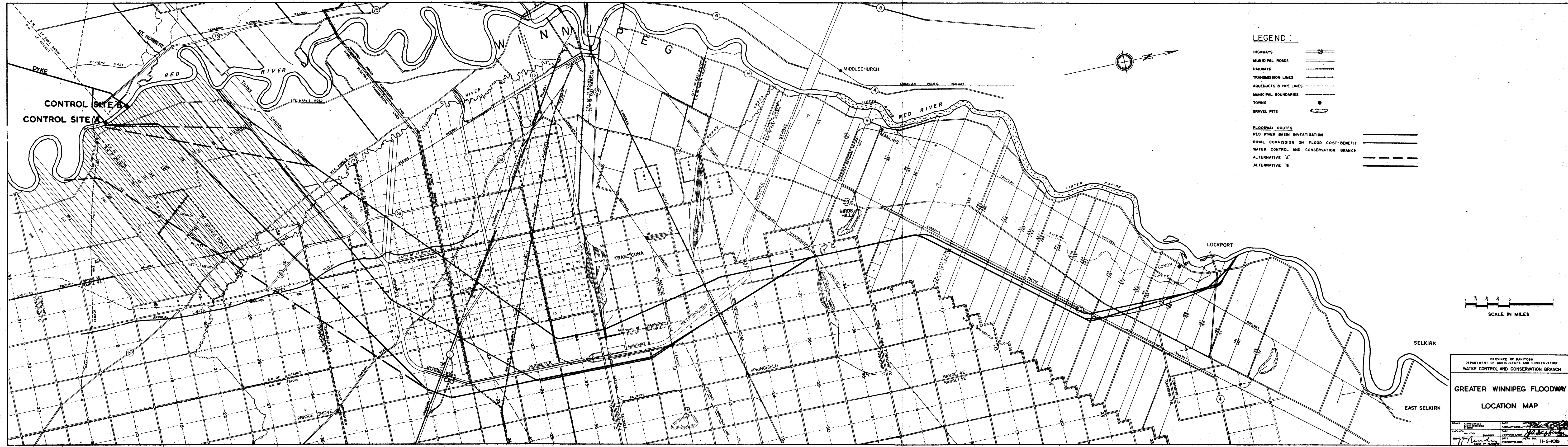
TABLE 4

COST COMPARISON

ALTERNATIVE GREATER WINNIPEG FLOODWAY ROUTES
(thousands of dollars)

| Item | Modified Red River Basin Investigation Route (27.6 miles) | Modified Royal Commission on Flood Cost- Benefit Route (29.0 miles) | Water Control and Conserva- tion Branch Route (29.2 miles) |
|-----------------------|--|---|--|
| Control Structure | 4,700 | 4,700 | 2,700 |
| Dykes | 1,904 | 1,904 | 1,904 |
| Right-of-Way | 7,840 | 7,650 | 7,483 |
| Excavation | 29,639 | 34,015 | 35,387 |
| Highway Bridges | (12) 8,002 | (12) 8,859 | (10) 5,412 |
| Railway Bridges | (7) 8,956 | (7) 6,315 | (7) 6,350 |
| Aqueduct Crossings | 529 | 529 | 529 |
| Seine River Diversion | 120 | 120 | 120 |
| Outlet Structure | 762 | 762 | 762 |
| Miscellaneous | <u>565</u> | <u>565</u> | <u>565</u> |
| Total | \$63,017 | \$65,419 | \$63,212 |

NOTE: The number of bridges is shown in brackets to the left of the estimated bridge costs.



PROVINCE OF MANITOBA
DEPARTMENT OF AGRICULTURE AND CONSERVATION
WATER CONTROL AND CONSERVATION BRANCH

**GREATER WINNIPEG FLOODWAY
LOCATION MAP**

| | | |
|-----------------------------|------------------------|-----------------------------------|
| DRAWN BY S. H. COOPER | DATE FEBRUARY 1950 | APPROVED BY <i>[Signature]</i> |
| CHECKED BY H. A. COOK | DATE FEBRUARY 1950 | DATE FEBRUARY 1950 |
| DESIGNED BY S. H. COOPER | DATE FEBRUARY 1950 | DATE FEBRUARY 1950 |
| SCALE 1" = 1 MILE | SCALE NO. 11-5-1015 | |