Manitoba
CONSERVATION

RED RIVER FLOODWAY EXPANSION

PROJECT DESCRIPTION

JULY 2003

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1.0 General Information

1.1 General

The project is the expansion of the Red River Floodway (Floodway). The Floodway is an existing flood diversion channel that has been used more than 20 times to safely pass flood flows around Winnipeg and to avert flooding in the city. It was constructed between 1962 and 1968 and is located on the east side of Winnipeg. It is aligned in a generally northerly direction with a length of approximately 48 km (29.5 miles) from its inlet 1 km south of St. Norbert, to its outlet about 2 km north of Lockport.

The Floodway was designed 45 years ago to provide Winnipeg with protection up to an estimated flood magnitude that would be exceeded once in 160 years, based on statistical data on river floods that existed at the time. The estimated frequency of that selected design flood was revised by the year 2000 to represent only a 1 in 90 year flood. The change in the flood frequency results from the analysis of over 40 more years of flood data, and the occurrence of a series of relatively large floods (1966, 1974, 1979, 1996, and 1997) that influence the estimation of the flood potential.

The expansion of the Floodway will increase Winnipeg's security against floods up to the 1 in 700 year magnitude. That design level was established using current statistics of peak flood flows from over 90 years of data. It will reduce the exposure of the city to flood risks by a factor of almost 5.

1.2 Public Discussions

To date, there have been a series of consultations with the public regarding the project:

- Four meetings of the Clean Environment Commission in January of 2002 to receive input regarding the project and its comparison to the alternative that was being considered at the time (Ste. Agathe Detention Structure – see Section 2.1 for details).

The meetings were held in Selkirk, Winnipeg, Ste. Agathe, and Morris. Over 1,000 people attended these meetings and there were more than 100 submissions by stakeholders.

- Meetings in Selkirk in 2001 and 2002, and in Ste Adolphe in 2002 to discuss the operation of the Floodway and to announce the development of legislation for financial compensation to property owners that are adversely affected by river water levels that are controlled above the "state of nature".

- A Value Engineering process was carried out in August 2002, involving a group of 28 Canadian and international experts. The experts met for a week to examine and discuss the project concept. The group agreed that the expansion scheme was well developed and only minor improvements may be possible, but would require further planning to confirm.

1.3 Contacts

The proponent is the Floodway Expansion Authority (the Authority). The Authority is an entity established by the Province of Manitoba, and charged with the responsibility of executing the work required to complete the project.

Ernie Gilroy has been appointed as the Chairman of the Floodway Authority and will be the contact for further information that may be required (telephone no. 945-4900).

1.4 Federal Involvement

An announcement was made on April 3, 2003, that the Federal Government will provide financial support to the project. Details of that support are being discussed and developed by the Province and the Federal Government. Strategic Infrastructure Canada will represent the Federal Government in the implementation of the Floodway Expansion.

The Province already owns the majority of the lands required for the expansion of the Floodway. Much of the required property lies within the existing right-of-way of the Floodway and West Dike. An additional approximately 440 hectares (1100 acres) will have to be purchased from private owners. No federally owned land is required, or affected.

1.5 Authorizations Required

Under the Environment Act (Manitoba), all developments listed on the Classes of Development Regulation 164/88 require an environmental license before construction and/or operation. According to this regulation, the Floodway Expansion would be categorized as a Class 3 Development and will require a Manitoba Environment Act License. To satisfy the requirements of the assessment and licensing process for this class of project, an Environment Impact Assessment Report (EIAR) will be required to determine the type and significance of environmental effects of the project.

The Authority believes that the project will require a federal assessment under the Canadian Environmental Assessment Act (CEAA). Accordingly, a federal environmental screening will be required for the project to comply with the Act.

The Authority anticipates that one Co-operative Environmental Assessment (CEA) will be conducted under the Canada-Manitoba Agreement on Environmental Assessment Co-operation to satisfy both the federal and provincial environmental assessment processes. Conducting the federal and provincial process co-operatively will be the most efficient means of completing the assessment.

It is anticipated that authorization from the Canadian Transport Agency and Fisheries and Oceans Canada will be required.

The project does not impact on, or involve in any way, Indian Reserves or lands that are currently used by Aboriginal people. No requirements for authorizations of this type are foreseen.

2.0 Project Information

2.1 Development of Project Concept

The Floodway Expansion concept has been developed by a series of studies that began after the flood of 1997. A brief history of this process and the other options that were considered in the studies follows.

The flood of 1997 caused extensive damage in the Red River Valley, although the Floodway spared Winnipeg from major damages. Recognizing the devastating effects of the flood on both sides of the border, and the need for cross-border cooperation in addressing flood-related issues, President Bill Clinton, and Prime Minister Jean Chretien asked the International Joint Commission (IJC) to study the flood and its impacts. On June 12, 1997, the governments of Canada and the United States gave the IJC a reference under Article IX of the Boundary Waters Treaty of 1909 to examine and report on the causes and effects of damaging floods in the Red River, and to make recommendations on means to reduce, mitigate and prevent harm from future flooding in the basin. In September 1997, the IJC announced the appointment of the International Red River Basin Task Force to examine a range of alternatives to prevent or reduce future flood damage. The Task Force undertook and commissioned a series of studies and in 1999 commissioned a study of the flood risks in Winnipeg and possible means to reduce those risks. KGS Group was selected to do this work.

KGS Group submitted reports to the IJC Task Force in 1999, and in early 2000 (KGS Group, 1999, 2000) that summarized their findings. They included:

- Winnipeg is at risk to major floods of the magnitude of the 1997 event, or larger
- There are many vulnerabilities to floods that should be improved
- The potential damages in Winnipeg due to floods exceeding the 1997 magnitude would be as much as $17 billion for a 1 in 1000 year flood.
- The preferred options to provide a major increase in flood protection for Winnipeg were the Ste Agathe Detention Structure or the Floodway Expansion.

In the selection process that led to these two preferred options, KGS Group investigated a wide range of alternatives that included:

- Channel improvements in the Red River in Winnipeg and in the river reach north of Winnipeg to increase the discharge capability of the river.
- Diversion of the eastern tributaries of the Red River (including the Roseau River, Rat River, Joubert Creek, Cook's Creek, etc) around the city to re-enter the Red River north of the Floodway Outlet.
- A detention structure on the Red River upstream of Winnipeg near Ste Agathe where some of the the flood waters of the Red River would be detained temporarily during an extreme flood to reduce the outflow through the Winnipeg area, at the cost of additional incremental flooding upstream.
- Raising of the Primary Dikes in Winnipeg on a permanent basis to permit more flow to safely pass through the river during a flood.
- Installation of a massive pumping plant at the inlet to the Floodway to mobilize the large discharge capacity of the Floodway at high water levels, without actually having to raise the water level upstream of the Floodway Inlet above the "state-of-nature" level.
- Increase the freeboard on the West Dike and modify the operation rules to permit more frequent and higher water levels upstream of the Floodway Inlet.
- Remove a portion of the East Embankment of the Floodway to permit more efficient entrance of flood waters into the Floodway, thereby increasing its discharge capacity
- Removal of the Outlet Control Structure on the Floodway
- Removal of the entrance weir at the inlet to the Floodway.
- Raise the bridges along the Floodway Channel to increase the hydraulic capacity at high water levels.
- Construct a "twin Floodway" adjacent to the existing channel to increase the discharge capacity of the diversion. The possibility of extending this channel north of the current outlet location was also considered.
- Construct a separate new Floodway Channel to the west of Winnipeg
- Increase the capacity of the Portage Diversion, thereby reducing the potential for the Assiniboine River to exacerbate flood levels in Winnipeg
- Increase the height of the Shellmouth Dam to develop more storage capacity that could further reduce the contribution of flood from the Assiniboine River
- Expand the existing Floodway to increase its discharge capacity, and continue with the existing operation rules.

Not all the options listed above were analysed rigorously because cursory review was adequate to show that some were clearly uneconomic, had only minor hydraulic benefits, or had environmental impacts that would be unmanageable or almost certainly unacceptable.

At the request of the IJC, KGS Group did not investigate the option of developing storage reservoirs upstream in the Red River watershed, since the IJC Task Force was evaluating that separately. In their report of November 2000 the IJC stated that "it would be difficult if not impossible to develop enough economically and environmentally acceptable large reservoir

storage that alone would reduce substantially the flood peaks for major floods." On the subject of "micro-storage" development, they concluded that it "has some potential to reduce flood peaks, perhaps significantly for more frequent local floods, but reliance solely on micro-storage for major flood events would be impracticable and costly."

After KGS Group had submitted their report (March, 2000) and the IJC in turn issued their final report in November, 2000, the Province of Manitoba retained KGS Group to carry out further studies of the two preferred options that had emerged from the studies commissioned by the IJC.

That study was carried out by KGS Group in association with two other consulting firms, InterGroup Consultants (for socio-economic assessments) and North South Consultants (for aquatic and terrestrial environmental expertise). It culminated in a report in November 2001 that described the costs and impacts of both schemes, without selecting a preferred option. The selection was clearly of major social significance in Manitoba, and it was the opinion of KGS Group that once supplied with the facts, the provincial government should make the selection on behalf of the citizens of Manitoba.

KGS Group's studies of 2001 developed the concept of the Floodway Expansion further and the scheme presented in this Project Description is entirely based on that work.

2.2 Project Components

As described in Section 2.1, the concept for the Floodway Expansion was developed in preliminary studies by KGS Group in 2001. That concept is being refined by studies that are now underway to define the project in more detail, and to assess the environmental impacts. The Project Definition and Environmental Assessment (PDEA) will continue through 2004 and will culminate in a license application being submitted in early 2005.

The main components of the concept consist of the following:

- ***Enlargement of the Floodway Channel*** by varying amounts along its 46 km (29 miles) length, with width increases up to approximately 110 m (360 ft), and depth increases up to 2 m (6.5 ft), subject to final design optimization. The total volume of excavation is estimated to be 34 million cubic metres (45 million cubic yards). The new design

capacity will be 3960 m^3/s (140,000 cfs), compared to the original design capacity of 1700 m^3/s (60,000 cfs) used in the 1960's.

- ***Increase in the freeboard at the existing West Dike*** that extends over 70 km (44 miles) from the Floodway Inlet Control Structure in a generally south westerly direction to tie into high ground at the west side of the Red River Valley. The dike will be increased in height by varying amounts estimated to be up to 1.2 m (4 ft) and the west end will be extended beyond the current location. The dike is currently considered to provide acceptable safety against wind effects on the floodwaters of the Red River for water levels up to El 236 m (El 774 ft) at the Floodway Inlet Control Structure. In its improved condition, it is intended to be capable of safely protecting against water levels up to El 237 m (El 778 ft) at that location.

- ***Modification of the bridges*** over the Floodway Channel. This will consist of a combination of outright replacement of some of the bridges, and retrofitting of others to resist hydraulic loading due to overtopping. Considerable additional engineering will be required in the next planning phase to define the modifications in their final form.

- ***Enlargement of the Outlet Structure*** by extending the ogee crest and the stilling basin by an estimated 66 m (218 ft) towards the east, so that it will be capable of passing a flow of 1700 m^3/s (140,000 cfs). This will be accompanied by enlargement and re-shaping of the Outlet Channel to permit the increased Floodway flow to re-enter the Red River with minimum impact on the riverbanks. The Outlet Channel construction will be the only component of the Floodway Expansion that will require work on an existing riverbank and will require measures to minimize the release of excavated sediment into the river flow.

- ***Riverbank fortification and protection at and downstream of the Floodway Outlet,*** where appropriate and justifiable.

- ***Resumption of the dredging program*** in the lower Red River to reduce the risk of ice jamming and flooding, caused by sediment buildup.

- ***Replacement of drainage structures*** where necessary along the east bank of the Floodway to accommodate the enlarged channel cross section. Adjustment to the capacity of these drainage structures will be possible if analysis of their performance since their original construction warrants it.

- ***Replacement of the Inlet and Outlet structures at the Seine River Inverted Siphon*** that carry riparian flows under the Floodway and release them into the Seine River on the west side of the Floodway. The current plan is to retain the existing conduit under the channel and to extend it as required to reach the new locations of the Inlet and Outlet Structures.

- ***Replacement of the Aqueduct under the Floodway*** to permit the deepening and widening of the Floodway that is planned at that location.

- ***Extension of a number of transmission lines*** that cross the Floodway.

- ***Replacement of a number of miscellaneous crossings***, including gas pipelines, oil pipelines and underground pipelines.

- ***Improvements at the existing Floodway Inlet Control structure*** will be carried out. The full extent of the improvements that are required will be addressed in the planning phase, and may include:
    - Placement of additional riprap on the downstream slopes of the embankments adjacent to the concrete structure to protect it from erosive damage during the passage of large flows through the structure.
    - Possible improvement of the riprap on the upstream face of the embankments adjacent to the concrete structure to protect it from erosive damage during extreme events that require raising the upstream water level to as high as El 237 m (El 778 ft).
    - Possible installation of backup gates that could serve to control flow into the Red River in Winnipeg during flood events if the existing gates were to malfunction. The justification for this will be examined in detail in the planning phase.

- ***Incorporation of recreational facilities*** to the maximum extent practical. Options that are being considered include:
    - Enhancement of the existing ski-hill near Bird's Hill
    - Hang-gliding facility near Grande Pointe
    - White-water park near the outlet
    - Hiking/biking/ski trails along the channel
    - Interpretive centres to educational promotion of the environment
    - Use of the low flow channel for non-motorized sports such as kayaking and canoeing

- ***Use of Floodway to control summer river water levels*** in Winnipeg is being considered, and may become part of the Floodway Operation Rules.

The concept for the Floodway Expansion also includes a series of improvements to the flood protection infrastructure within Winnipeg. That work will be carried out by the City of Winnipeg and is not included in the current phase. The details of those improvements are not fully defined at this time. The current concept for these improvements includes the following main components, some of which have already been started by the City:

- Upgrading of the Primary Dikes in Winnipeg to provide a uniform level of protection to the so-called Flood Protection Level that is based on a river water level at James Avenue of 25.8 ft (JAPSD).

- Preparation of a manual to assist future flood fighting efforts.

- Locations of sewer cross connections and mitigation of these if necessary to improve the security of the sewer system during high river levels.

- Studies to improve the knowledge of the performance of the sewer system during flood conditions, as well as to identify desirable floodplain management steps and to acquire property to comply with those steps.

- Upgrading of the City's gate chambers on the combined sewer systems to ease the difficulties of isolating these systems during times of high river levels.

- Installation of means to isolate sewer systems in areas protected by secondary dikes. This will include installation of gate valves between secondary and primary dikes, or the installation of parallel sewer mains in streets adjoining premises protected by secondary dikes, and the installation of sump pits, pumps, and backwater valves at each house.

- Installation of land drainage outfall gate structures to provide positive cutoffs to protect areas vulnerable to high river levels.

- Upgrades to selected existing Flood Pump Stations that are now over 50 years old, to minimize the risk of equipment malfunction at critical times of high river levels.

- Upgrades to the Pollution Control Centres (South End and North End) to improve their ability to function during high river water levels.

- Studies of the requirements to stabilize critical segments of the riverbanks that support Primary Dikes, and critical City infrastructure.

- Upgrading of selected streets that can be overtopped during high river levels and prevent access to residential areas, thereby requiring evacuation of the residents prematurely.

- Acquisition and storage of an inventory of miscellaneous flood-fighting equipment that is difficult to obtain on short notice during emergencies, including submersible and skid-mounted pumps, portable generator sets, inflatable sewer plugs.

- Flood-proofing of critical civic buildings that could be inundated if flooding were to occur in Winnipeg. The intent would be to maintain these buildings in a functioning condition throughout the flood event.

The concept of Floodway Expansion has been developed in accordance with the intent of the current Operation Rules. Improvements in the design of the Floodway have been included to ensure that the Operation Rules can be used safely. These improvements include (as described above) the increase in freeboard of the West Dike, the improvement in erosion protection at the Floodway Inlet Control Structure, and the possible installation of backup control gates in that structure.

The proposed Floodway Expansion scheme incorporates the fact that the Floodway Inlet Control Structure is designed to control upstream water levels to El. 237.13 m (El. 778 ft.), while only releasing approximately 2265 m^3/s (80,000 cfs) into the city. The Operation Rules are therefore intended to control water levels both in the city and upstream of the floodway. Floodway Expansion has been planned for maximum safety and minimum risk of damages to the protection system and the city, with the water level at the "state-of-nature" at the Floodway entrance. Improvements to the floodway will provide increased flood capacity just upstream of the floodway entrance up to a 1:250 year flood, which is about 25% larger than the 1997 flood.

It is only under rare emergency conditions, when river water levels in Winnipeg threaten to overtop the Primary Dikes, that water levels can exceed the "state-of-nature" upstream of the Floodway Inlet. Legislation is being put in place for financial compensation for property owners in the event of such an extreme flooding situation.

The project will be undertaken after legislation is established that will provide for financial compensation to affected property owners that are adversely affected by water levels that may exceed the state of nature condition. The legislation is being composed at this time.

The entire concept and its individual components were reviewed in the Value Engineering process that was described in Section 1.2. All components have been deemed to be appropriate by this independent intensive review.

2.3 Project Activities

Project execution is planned to take place in three phases:

- Site investigations, project definition planning, and environmental assessments
- Final design and bid document preparation
- Selection of contractors and construction of the project. Construction will have to be phased so that the Floodway will be available to divert flood flows if necessary each spring. Control of summer floods as was carried out in 2002 would not be possible without significant cost and schedule delays.

The preliminary schedule of the project is shown in Figure 1. This schedule will be refined during the course of the Project Definition and Environmental Assessment.

The key features of the project are shown in the attached conceptual drawings as follows:

Plate B-1 – Location of Red River Floodway

Plate D-1 – West Dike location plan

Plate B-2 – Affected infrastructure

Plate B-3 – Stratigraphic profile along centre-line of Floodway channel

Plate B-4 – Sheets 1 to 9 – Plans and cross sections of the preliminary design of the Floodway Expansion

Plate B-5 – Sheets 1 to 4 – Typical cross sections of channel showing preliminary design of modifications at each location

Plate B-17 – Sheets 1 to 6 – Preliminary details of highway bridge modifications (these may change significantly as the planning studies progress further)

Plate B-18 – Sheets 1 to 6 – Preliminary details of railway bridge modifications (these may change significantly as the planning studies progress further)

Plate B-21 – Inlet Control structure – Backup control gates (not certain yet to be included in the project)

Plate B-22 – Plan of proposed Expansion of Outlet Structure

Plate B-23 – Cross section of proposed expansion of the Outlet Structure

Plate B-24 – Plan of expanded Outlet Structure and expanded Outlet Channel

Off-site Land Use

Off-site land use would consist of the following:

- Borrow areas for fill material to be used for construction of dikes, including the West Dike, and tie-in dikes at the Floodway Outlet Structure
- Quarries for riprap to be used as erosion protection at vulnerable locations along the West Dike, at the Floodway Inlet Control Structure, and possibly at other locations along the Floodway at Bridges, drainage structures, and at the Outlet Structure.

- Off-site sources of equipment and material such as cement and aggregate for concrete, reinforcing steel, miscellaneous steel parts for the Floodway Outlet and Inlet Structures, bridge structures and gates. The exact locations of these sources, and the routes used to transport them to the site are not known at this time.

- Transport of heavy construction equipment to the site for the duration of the construction. The location of the equipment and the routes used to transport them to the site will depend on the contractors selected to carry out the work.

2.4 Resource/Material Requirements

The construction of the channel will be carried out by excavation of soil using heavy excavating equipment. The enlargement will involve a combination of widening and deepening in varying amounts along the channel. Material excavated will be placed in spoil embankments adjacent to the channel, as shown on Plate B-4, and as was done during the original construction of the Floodway. Placement of topsoil and seeding of excavated slopes with selected species of grasses will be carried out to promote the rapid return of a vegetative cover that provides protection of the channel against erosion.

The construction of the increase in height of the West Dike will use locally available material obtained from adjacent lands. Exact locations of borrow areas must await the detailed studies of this component of the project that will be carried out in 2003 and 2004.

Material required for construction of the Outlet Structure, the bridges, the drainage structures, the Aqueduct, the Seine River Inverted Siphon, and for the improvements proposed for the Floodway Inlet Control Structure will include, but may not be limited to:

- Concrete
- Reinforcing steel
- Fabricated steel gates
- Steel and pre-cast components of bridges
- Riprap

Sources of these materials will be identified in the planning studies. These may be a variety of sources, and the final selection will depend on the contractor selected for each component of work.

Funding of the project is currently being discussed between the Province and the Federal Governments. According to the announcement made by Prime Minister Chretien on April 3, 2003, this shared funding agreement will be for $160,000,000, and will cover the cost of the initial components of the project. A summary of those components is provided in Table 1, and comprises what is termed the first phase of the project implementation. The intent is to obtain additional federal funding for the next phases of development after this initial construction is completed.

TABLE 1

Components of Phase 1 Floodway Expansion

Component	Estimated Increase in Reliable Flood Protection Capacity (cfs)	Est'd Reduction in Annual Flood Risk[1] ($ Millions per year)	Work Proposed	Est'd Cost[2] ($M)
PDEA	0	$0.0	Foreshortened PDEA based on current preliminary concept for Floodway	$7.4
Final Design and Preparation of Bid Documents	0	$0.0	Complete final design and preparation of bid documents for : channel expansion, bridges, transmission line modifications, other crossings, Outlet Structure and Outlet Channel, and retrofits of backup gates at Floodway Inlet Structure (if required)	$14.5
West Dike	17,000	$22.0	Increase freeboard on existing dike, by an average of 4 ft Placement of 4.4 million cubic yards of fill Placement of 700,000 cubic yards of rock armouring Purchase of right-of-way (about 200 acres[4])	$59.0
St. Mary's Road Bridge Retrofit	0	$0.0	Reinforcement of existing bridge to resist hydraulic loads during submerged condition, and drag forces due to debris lodgement. Includes upgraded pier foundation, and deck reinforcement (deck replacement not included in this cost).	$2.4
Low Flow Channel	1,000	$1.2	Excavate Low Flow Channel to permit gradual drawdown of groundwater levels to permit free drainage of lower soil layers to ease next phase of channel excavation Excavation of approximately 1.3 million cubic yards of material to allow deepening of up to as much as 6 ft.	$10.2
Outlet Structure Expansion	0	$0.0	Demolishing of east retaining wall of existing structure, and extension of weir crest some 220 ft m to the east, with replacement of tie-in earth structure to east channel bank Construction of approximately 18,000 cubic yards of reinforced concrete	$15.7
Outlet Channel Expansion	0	$0.0	Expansion of the Outlet Channel by excavation of approximately 800,000 cubic yards of soil, and placement on the east channel bank	$4.0
Land Acquisition for Floodway Expansion	0	$0.0	Acquire the necessary land adjacent to the West side of the Floodway that is required for placement of spoil from excavation of low flow channel and the west slope[4]	$4.0
Groundwater Mitigation	0	$0.0	Deepen affected wells in the zone of influence around the Floodway, due to deepened Low Flow Channel[3]	$8.0
Modification of Seine River Inverted Syphon	0	$0.0	Relocation of outlet structure of Seine River Syphon, and extension of pipe by approximately 150 feet	$3.1
Widen Channel along West Bank of Floodway Channel	14,000	$11.8	Excavation of approximately 11,000,000 cubic yards of soil along the west bank of the channel, except at locations of bridges, transmission line crossings that would eventually be extended, and other restrctions such as the Aqueduct. Width increase would	$31.7
Totals:	32,000	$35.0		**$160.0**

Note:

1. The reduced annual flood risks of individual components are approximate only. Some components of the scheme have not been assigned benefits, but contribute to the functionality of the scheme.
2. Costs for construction of works include contingency and construction management.
3. The only mitigation works considered in this work are deepening of a portion of the affected wells.
4. Land acquisition is uncertain at this time, and will require refined design of spoil embankments to define extent of land required.

2.5 Waste Disposal

There will be three main types of waste produced by the construction of this project:

- Soils excavated from the channel, the Outlet Structure area, and the Outlet Channel. This material will be placed in so-called “spoil embankments” adjacent to the existing spoil embankments that were formed at the time of the original channel construction. There is also a desire on both the part of the Province, as well as the public, to utilize the excavated material in ways that can promote the imaginative development of recreational facilities such as ski-hills, ski trails, hiking trails, etc.

- Material that is obtained from demolishing of existing structures that must be replaced or expanded. This material would consist mainly of broken reinforced concrete, embedded steel on the structures, and asphalt bridge deck material. It will be hauled to appropriate sites for disposal (exact locations will be identified in the next stages of planning). Structural steel from demolished bridges will be recycled.

- Construction waste that is accumulated during the construction process as would be expected for any work of this type. This waste will be carefully managed, and collected, and hauled to appropriate disposal sites.

After the construction is complete, waste material will not be produced by the project. One minor exception may be oil used in the Floodway Inlet Control Structure for the hoisting system for the control gates. Strict management of this oil to avoid spillage into the environment will continue as it has since the inception of the original Floodway Project.

2.6 Use of Red River Waterway

The use of the Red River will not be affected by the construction of this project. All work will be confined to areas located outside of the normal riverbanks, except at the Floodway Outlet. Excavation of the Outlet Channel will require limited excavation of the east riverbank as shown in Plate B-24. It may also require placement of riprap on the west riverbank to protect against adverse erosive effects of the re-entry of floodwaters from the Floodway into the Red River. This issue will be studied and defined during the next phase of planning.

3.0 Project Site Information

3.1 Project Location

The project is located in southern Manitoba and occupies a length of land over 110 km. Locations are shown on the attached Plates B-1, D-1 and B-2. The Floodway Inlet Control Structure is located south of St. Norbert at UTM coordinates 635 100 m E, 5 512 200 m N. The Floodway Outlet Structure is located near Lockport at 647 700 m E, 5 550 700 m N. The location of the project is shown on maps in Plates B-1 and D-1.

3.2 Environmental Features

Preliminary scoping was carried out in 2001 to identify potential adverse and/or positive environmental effects that may occur and to identify areas that will require further investigation at the next level of study. A more detailed and rigorous scoping exercise will be conducted at the next stage of study. Preliminary, simplified Project-Environment Interaction Matrices are provided in Table 2 and identify the most significant environmental issues that are foreseen based on studies to date.

The primary purpose of the project is to provide increased protection from the threat of floods in the Red River. This project will avert the major environmental damages that would occur if future major floods exceed the capacity of the existing Floodway. Flooding of the city could cause the release of a wide variety of toxic chemicals that in turn could cause extensive environmental damages in Winnipeg, the Red River north of Winnipeg, and in Lake Winnipeg. Such vulnerabilities are described in further detail in KGS Group's report to the IJC (KGS, 1999). Even at flood magnitudes that do not exceed the capacity of the existing Floodway, the increased Floodway capacity would result in lesser volumes of sewer overflows being spilled into the Red River from the sewage treatment plants. If operation of the Floodway in summer flood events becomes part of the Floodway operation rules, this will also result in reduced potential for sewage overflow into the Red River.

In addition, the Expanded Floodway would reduce the water levels upstream of the Floodway Inlet and reduce the upstream damages for flood events between approximately the 1 in 90 year and the 250 year frequency.

The Floodway Expansion will provide protection to more than 500,000 Manitobans living in Winnipeg and in the Red River Valley upstream of and near Winnipeg. It will avoid damages of more than $12 billion if the design flood were to occur. The benefit-cost ratio is estimated to be 2.5, which demonstrates a significant benefit to both Manitoba and Canada. Beyond the economic perspective, it will reduce the risk of the major catastrophe that would occur if Winnipeg were flooded, and over 300,000 citizens would be forced to evacuate. It is not clear how such a massive exodus could be undertaken, and the Floodway Expansion would reduce the risk of this happening, along with the associated potential for loss of human life.

The project will contribute significantly to the provincial economy and will result in significant spin-off benefits to business and rural municipalities. The positive impact will increase the GDP of the Province by more than $500 million, with an additional increase of over $300 million in the rest of Canada. The project will create an estimated 13,900 person-years of direct and indirect employment, with about 70% of that in Manitoba. An aboriginal training program is planned to be established as part of the expansion.

The development of the project will include the maximum practical extent of recreational facilities that can be incorporated as part of the expansion. This will provide economic spin-offs and enhanced recreational opportunity for Manitobans for decades to come. Furthermore, the use of Floodway to control summer water levels in Winnipeg would also enhance recreational opportunities along the riverbanks, as well as to significantly reduce the treat of basement flooding.

Any potential adverse socio-economic effects directly or indirectly resulting from the Floodway Expansion will be identified through the environmental assessment process and measures will be implemented to avoid, minimize or manage such effects.

TABLE 2
Preliminary Project-Environment Interaction Matrix
For Proposed Floodway Expansion

ENVIRONMENTAL COMPONENTS AND POTENTIAL EFFECTS	STAGE OF PROJECT	
	CONSTRUCTION	OPERATION
Social, Economic and Cultural Effects		
Loss of agricultural and commercial resource use	●	●
Alterations to domestic resource use	●	●
Disturbance to outdoor recreation/tourism	●	❍
Risk to community health and safety	●	❍
Creation of jobs in Manitoba	❍	
Opportunities for Aboriginals	❍	
Effect on GDP	❍	❍
Impact on Provincial and Federal Taxes Collected	❍	❍
Minimization of risk of major human suffering if a flood occurs than would exceed the existing flood capacity	❍	❍
Benefits to local economic well being in Winnipeg and upstream	❍	❍
Benefits to local social well being in Winnipeg and upstream	❍	❍
Alteration of aesthetics	●	❍
Disturbance to archaeological/historic resources	●	
Physical and Chemical Effects		
Water		
Aversion of environmental damage due to floods that overwhelm capacity of existing Floodway	❍	❍
Reduction of potential sewage outflows to river from sewage treatment plants (in spring floods and in summer, if summer use of the Expanded Floodway is included)		❍
Reduction of flood water levels in Winnipeg, and upstream of the Floodway for flood events between 1 in 90 and 1 in 250 year return period	❍	❍
Modified groundwater flows and watertable	●	●
Surface flow variation	●	●
Water quality changes	●	●
Streams (physical and chemical changes)	●	●
Modifications to ice regime		❍
Soil		
Decreased soil stability and increased erosion potential	● (Floodway) ● (West Dike)	● (Floodway) ❍ (West Dike)
Disturbance of unique physical features	●	
Changes to relief and topographic character	●	

ENVIRONMENTAL COMPONENTS AND POTENTIAL EFFECTS	STAGE OF PROJECT	
	CONSTRUCTION	OPERATION
Air		
Increased noise	●	
Increased air emissions	●	
Biological Effects		
Alteration of terrestrial habitats	●	❍
Disturbance to terrestrial wildlife	●	❍
Disturbance to riparian wildlife	●	
Loss of fish/aquatic habitats	●	
Disturbance to fish/aquatic wildlife	●	●
Disturbance to protected species (vegetation predominantly)	●	❍

Legend:

● potential adverse effect

❍ potential positive effect

Notes: 1. Socioeconomic effects will be considered either positive or negative depending upon where an individual lives along the Red River.

2. Planning/design effects will be associated with necessary geotechnical site investigaiton that will precede the construction.

3.3 Groundwater Considerations

A preliminary assessment of the hydrogeological considerations for the Floodway Expansion was completed by KGS Group in 2001. The following were considered:

Site Geology - The overburden along the Floodway Channel centreline consists primarily of high plasticity lacustrine clay overlying an un-cemented to cemented silt till and Paleozoic limestone bedrock as shown on Plate B-3. The bedrock forms the regional confined Upper Carbonate aquifer. The existing channel invert is primarily within the clays and cuts into glacial till intermittently for approximately 10% (3 miles) of the 47 km (29.5 mile) Floodway length. The channel also cuts through 800 m (0.5 miles) of sand and gravel outwash complex at Birds Hill.

Existing Channel - Construction of the Floodway in the 1960's established an effective 9.1 m (30 ft.) deep drainage channel. Discharge of groundwater from the bedrock resulted in lowering the pre-construction piezometric surface of the carbonate bedrock aquifer 4.6 to 6.1 m (15 to 20 ft.) near the Floodway, to 0.6 m (2 ft.) or less east and south of Winnipeg. Groundwater elevations stabilised to this channel invert within 4 years of construction in the early 1970s.

Proposed Channel - The proposed channel would include widening the existing channel and increasing the depth below the existing low flow channel invert. Deepening of the Floodway low flow channel will cause an increase in inflow of groundwater into the Floodway and result in a slight permanent lowering of the piezometric surface in the carbonate aquifer. The groundwater inflow will occur in areas of the Floodway directly connected to the till or underlying bedrock. These areas occur primarily north of the TransCanada highway, but some areas between the TransCanada and the Floodway Inlet may be affected as well.

To evaluate the potential impacts of enlargement of the Floodway channel, KGS Group performed preliminary groundwater modelling studies to quantify the estimated magnitude and significance of the proposed channel deepening. The studies addressed the following topics:

- ***Predicted Drawdown*** - Drawdown of the piezometric surface in the upper carbonate aquifer is predicted based on the proposed conceptual level of Floodway geometry.

- ***Potential Reductions in Water Quantity*** - The effects on groundwater supplies east of the floodway from St. Germaine to East Selkirk and to the east of Anola were evaluated and the number of water supply wells in the area of projected drawdown were estimated. The potential reduction in flow to industrial water supplies in the eastern Winnipeg Area (St. Boniface) was estimated.

- ***Water Quality Issues*** - The likelihood of saline water intrusion into wells between St. Anne's Road and the Red River was evaluated. The potential for groundwater supplies in Birds Hill, East St. Paul and along the river north to Lockport to become contaminated by Red River water was also evaluated.

The analyses to date show the following specific impacts that are anticipated from the proposed Floodway Expansion:

- ***Individual Water Wells*** - The projected additional drawdown cone is estimated to impact the following number of existing wells, based on the available database:

  200 wells with drawdown greater than 1.5 m (5 ft.)
  2000 wells with drawdown of 0.6 to 1.5 m (2 to 5 ft.)
  3000 wells with drawdown of 0.3 m to 0.6 m (1 to 2 ft.)

  The extent of well mitigation work will vary with the specific details of each installation, and could range from do nothing; lowering the pump; deepening the well; to total well replacement.

- ***Town of Birds Hill*** - Additional drawdown of 1.5 to .8 m (5 to 6 ft.) is estimated in the four existing wells in sands and gravels. Additional evaluation is necessary to establish the significance of this impact.

- ***Town of Oakbank*** – Additional drawdown of up to 2 to 3 ft. is estimated for this well field, with further assessment necessary to establish the significance relative to local recharge.

- ***Water Quantity*** – In the east Winnipeg St. Boniface area the bedrock aquifer piezometric levels are primarily influenced by the industrial and commercial well users with only secondary impacts anticipated from the Floodway channel lowering by 1.8 m (6 ft.)

- ***Water Quality*** – Saline groundwater in the area west of the Red River could intrude eastward into the Red River – St. Anne's Road area, although the additional drawdown is estimated to be less than 0.3 m (1 ft.) in this area, with limited influence. In the St. Boniface area, the history of high pumping has not drawn in saline waters and accordingly the limited floodway lowering for the proposed 1 in 700 year scheme is not anticipated to be a significant impact.

- ***Intrusion of Red River Water*** – There is potential for Red River water in the Floodway to recharge the aquifer in areas that the channel intersects till or bedrock, which will be increased by the channel expansion. The extent of this impact, in particular to the groundwater supplies at Birds Hill and north to Lockport requires further evaluation and will be the subject of the next level of studies now underway.

- ***Construction Dewatering*** – In areas of Floodway lowering resulting in a thin remaining cover of lacustrine clay overlying the till, the confined aquifer pressure may result in blowout failure or heave of the base of the channel. In such areas particularly from Birds Hill south to the TransCanada Highway No. 1, construction dewatering may be necessary in conjunction with excavation deepening.

These findings will be examined in more detail, and site investigations will be carried out to assist the further refinement of the predictions, and the mitigation works that will be required.

3.4 Land Use

The land use at the existing Floodway and the West Dike that ties into the Floodway Inlet Control Structure is largely agricultural in nature. There has been some limited use of the Floodway for recreational use such as snowmobiling, cross-country and downhill skiing in winter, and ATV use in summer.

There has been no contamination of the site from past land use.

The project is not located near any First Nation Reserves or near any lands that are currently used or have been traditionally used by Aboriginal people.

4.0 Additional Requirements Related to Fish, Fish Habitat, and Navigable Waters

The Red River originates near the North Dakota/South Dakota border, and flows north for 890 km (550 miles) into the south end of Lake Winnipeg. The drainage basin encompasses approximately 278 000 km^2 (107,000 square miles), including much of northern Minnesota, northern North Dakota, south-eastern Saskatchewan and southern Manitoba. The Assiniboine River, which converges with the Red River in downtown Winnipeg, accounts for approximately 153,500 km^2 (59,000 square miles) of the total drainage area (KGS Group, 2001). At Lockport, 45% of the flow originates from Manitoba, 46% from the United States and 9% from Saskatchewan (KGS Group, 2001).

The Red River flows through glaciolacustrine deposits that aggraded within glacial Lake Agassiz. It has a fairly uniform, continuous descent northward, averaging less than 10 cm/km (0.5 ft/mile). Consequently, water velocities are low. It is a typical lowland zone stream, consisting of oxbows and meanders, highly turbid waters, and substrates composed of sand/silt and/or gravel/cobble. In general, substrates from St. Adolphe to the north end of the City of Winnipeg are primarily composed of silt, clay, sand and/or gravel. From the north end of the city downstream to Selkirk, substrates are composed primarily of limestone boulders and cobble. Substrates return to silt, mud and clay as the river approaches Netley Marsh at the south end of Lake Winnipeg. River bathymetry from the City of Winnipeg to Lake Winnipeg is relatively well understood, but there is little recent detailed information from south of the City.

4.1 Water Chemistry

Red River water quality is relatively well understood. The City of Winnipeg, Province of Manitoba and Environment Canada all test water quality in the Red River on a regular basis and have long-term Red River water quality databases. Red River water is characterised by high levels of turbidity, total suspended solids (TSS), and nutrients. Turbidity and TSS levels are related to discharge and are generally highest during April and lowest during the winter. Red River water often exceeds Manitoba Water Quality Objectives for TSS, phosphorus, ammonia, and fecal coliform. Many of the exceedences are related to low flow periods (i.e., in winter and during drought).

4.2 Biota

Lower Trophic Levels

With the exception of a couple of studies conducted during the early 1980's, there is very little information on the phytoplankton community in the Red River. Macrophyte growth in the Red River is relatively sparse because of low light penetration (as a result of high turbidity and suspended solids), water velocity, and ice scour. Site-specific occurrences of macrophytes have not been documented.

The distribution of benthic invertebrates in the Red River is spatially heterogeneous. Studies conducted for the City of Winnipeg identified twenty-five taxa from between St. Adolphe and Lockport. The greatest number of taxa was found within the City of Winnipeg, and Insecta (primarily Trichoptera) were the most abundant group.

Freshwater bivalves (clams) are of special concern because:

1) the Red River has the most diverse assemblages of freshwater clam species of any river in Canada;
2) general aquatic habitat degradation and destruction within the Red River, over the last 20-30 years, has resulted in a considerable decline in abundance of all clam species within the river; and
3) most mussel species present are at the limit of their range, and any degradation of habitat would be difficult to rebound from (KGS Group, 2001). Because of specialized habitat requirements, the occurrence of clams along riverbeds is usually patchy and discontinuous. Recent studies have examined clam distribution in the Red River, but site-specific information is rare.

Fish

At least 57 species of fish are known to occur in the Red River and its tributaries, in Manitoba. The most abundant species include: channel catfish, sauger, goldeye, white sucker, freshwater drum, emerald shiner, and river shiner. There are no endangered species occurring in the river, however, bigmouth buffalo, silver chub, and chestnut lamprey have been designated "Of Special

Concern" by the Committee on the Status of Endangered Wildlife in Canada (http://www.cosewic.gc.ca/ updated 15 August 2000). Four species, the channel catfish, flathead chub, brassy minnow and spotfin shiner, are on the Manitoba Endangered Species Act "Watch List" due to concern for declining populations or the paucity of information on their current status within the province.

The majority of Red River fish species spawn during spring, when discharges are high and water temperatures are rising. A few species such as channel catfish, freshwater drum, carp and Goldeye and a number of cyprinid species, spawn during late spring and into early summer. Burbot are the only species that spawn under the ice during late winter. None of the species found in the Red River upstream of Lockport spawn in the Red River or its tributaries during fall. Specific spawning locations within the Red River are unknown, however, tributaries and tributary mouths are known to provide important spawning habitat for many Red River fish. Lake Whitefish spawn in the fall off rock/gravel shoreline areas of Lake Winnipeg. The dates of dredging in Lake Winnipeg and in the mouth of the Red River have been established in relation to whitefish spawning.

Red River fish populations are highly mobile during open-water periods. Fish tagged in Winnipeg have been recaptured as far south as Halstad, Minnesota (approximate distance of 413 km (256 miles), and as far north as Dogwood Point on Lake Winnipeg (approximate distance of 247 (153 miles). Fish in the river have been shown to travel up to 55 km (34 miles) in two days and 403 km (250 miles) within 14 days. A large proportion of fish within the City of Winnipeg during summer move out of the city during fall. Fish that remain within the city limits during winter remain relatively stationary within the deeper reaches.

Manitoba Conservation Fisheries Branch considers most Red River fish safe for human consumption. However, there is an advisory in the Manitoba Anglers Guide each year warning anglers that some fish from the Red River (i.e., large walleye and northern pike) may have elevated mercury levels. The Environmental Protection Agency (EPA) in the United States has issued thirty-three advisories with regard to elevated mercury levels in a number of fish species in the Red River (EPA 2000). The EPA has also issued one advisory of elevated PCB levels in white sucker between five and fifteen inches. A recent paper provided an overview of concentrations of trace elements and organochlorine compounds in fish from the upper Red River.

4.3 Potential Environmental Effects

A preliminary Project-Environment Interaction Matrix is given in Table 2. The purpose of the matrix is to allow for early identification of potential environmental effects associated with the option, and to assist in the identification of data/information requirements. Potential aquatic and groundwater effects identified as warranting further discussion at this early stage of development are described below.

A number of aquatic issues and concerns have been identified as a part of the ongoing assessment, and will be evaluated further in the PDEA.

Erosion Control During Construction – Construction associated with Floodway expansion will result in a minor disturbance and destabilisation of the Floodway channel banks and Red River banks in the downstream portion of the channel and outlet control structure that may result in erosion and introductions of sediment to the Red River. This activity could lead to increased levels of turbidity and TSS in the river during construction and to deposition of sediments in downstream areas possibly resulting in direct effects on aquatic life or a harmful alteration to fish habitat. The vulnerability of the Floodway to erosion would be increased substantially if it were required to carry flood flows during the construction period.

Decreased Groundwater Levels – Lowering groundwater levels in the vicinity of the Floodway may affect small local streams near the Floodway that rely on groundwater discharge as a major component of the overall flow within the streams.

Fish Stranding - Although fish stranding would likely occur at a number of locations within the flood plain if the Floodway did not exist, stranding within the Floodway could be viewed as an incremental effect of the project. The extent that fish become “stranded” in the Floodway after cessation of spring flows is currently unknown and is being investigated during the PDEA.

Barrier to Fish Passage - Operation of the existing Floodway Inlet Control Structure and its effect on fish passage has never been evaluated. The Inlet Control Structure may presently be a barrier to fish passage when the gates are raised during a flood event and possibly under high flows when the gates are down. Effects are likely greatest during spring (April through May) when flows are highest and fish spawning migrations occur. Effects on fish passage during summer flood conditions are less of a concern, but have the potential to affect fish foraging activity. Changes to the Floodway operation, which may accompany an enlarged Floodway, could affect the level of attention that this issue receives.

Loss of Fish Habitat – A relatively small amount of fish habitat may be lost associated with the construction and operation of the expanded Red River Floodway. The nature and extent of potential losses will be identified and assessed in the PDEA that is currently underway.

4.4 Site Photos

Photographs of a variety of the components of the existing Floodway are shown on the following pages.

PHOTO NO. 1 **FLOODWAY INLET CONTROL STRUCTURE (DOWNSTREAM SIDE)**

PHOTO NO. 2 **SEINE RIVER INVERTED SIPHON OUTLET – RIPARIAN FLOW PASSES INTO SEINE RIVER IN BACKGROUND**

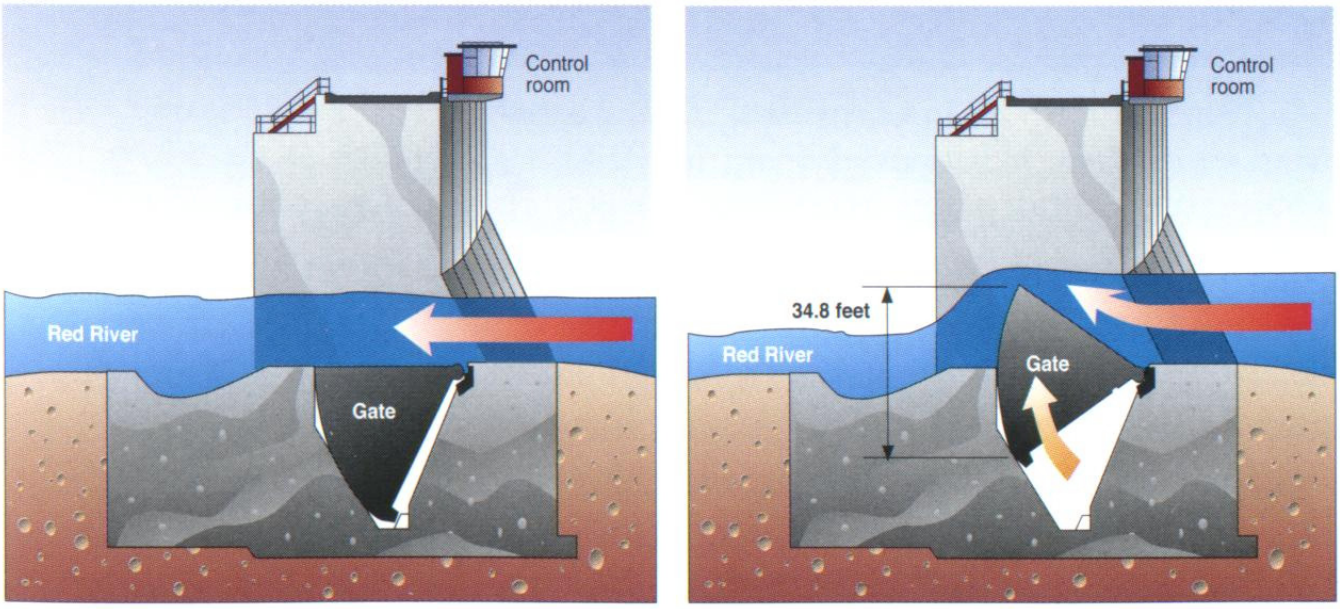


PHOTO NO. 3 **CROSS SECTION OF FLOODWAY INLET CONTROL STRUCTURE – SHOWS OPERATION OF GATES**

PHOTO NO. 4 **FLOODWAY OUTLET STRUCTURE**

PHOTO NO. 5 WEST DIKE – SHOWS TYPICAL HEIGHT AND SIDE SLOPES

PHOTO NO. 6 FLOODWAY AT PTH 59 NORTH; SKI HILL IN BACKGROUND

PHOTO NO. 7 **TYPICAL DRAINAGE STRUCTURE ON EAST BANK OF FLOODWAY (LOW FLOW CHANNEL FLOWS FROM RIGHT TO LEFT)**

PHOTO NO. 8 **FLOODWAY INLET IN 1997 FLOOD EVENT**

- **INLET CONTROL STRUCTURE IN FOREGROUND**
- **WINNIPEG TO LEFT (NORTH)**
- **FLOODWAY FLOWS TOWARDS TOP OF PHOTO**

PHOTO NO. 9 **TYPICAL RAILWAY BRIDGE OVER FLOODWAY**

PHOTO NO. 10 **FLOODWAY – TYPICAL VIEW OF CHANNEL NORTH OF TRANSCANADA HIGHWAY**

5.0 References

“Flood Protection for Winnipeg”, Parts I and II, December, 1999, KGS Group

“The Next Flood - Getting Prepared”, April, 2000, IJC Red River Basin Task Force

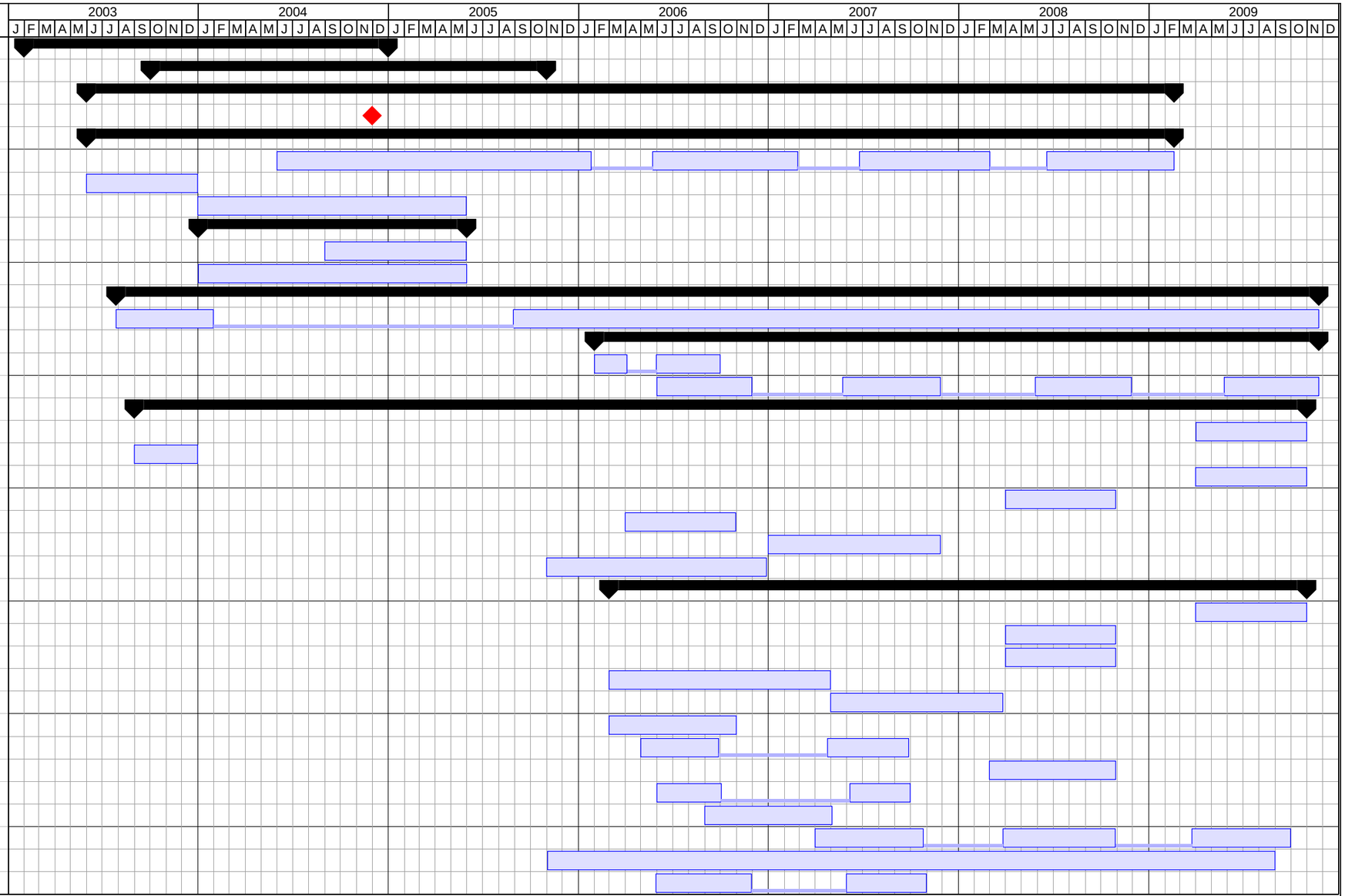
“Living with the Red”, November 2000, International Joint Commission

“Flood Protection for Winnipeg”, Part III, March, 2001

“Flood Protection Studies for Winnipeg”, (3 Volumes), November, 2001, KGS Group

FIGURES

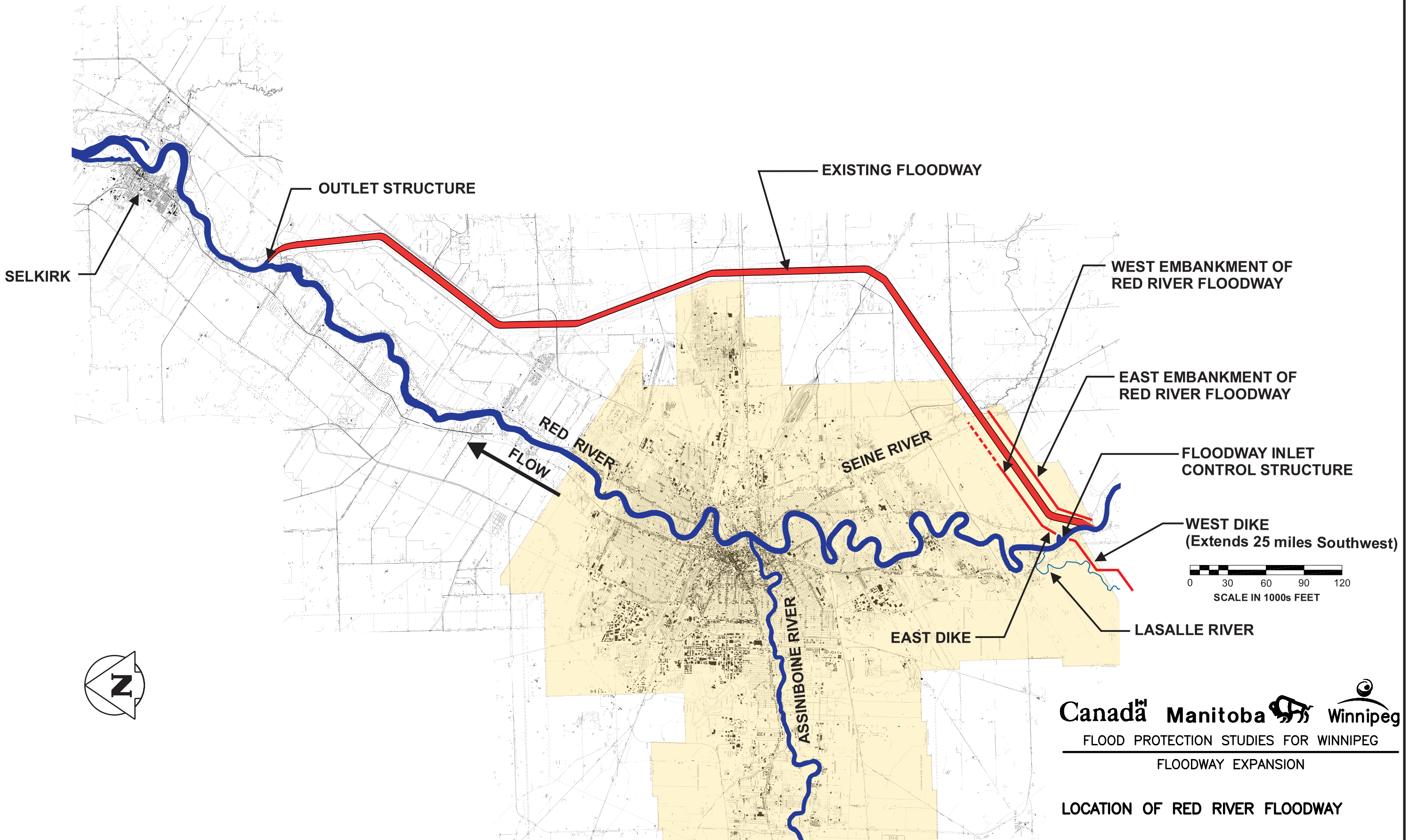
ID	Task Name
1	**Project Definition and Environmental Assessment (Part 1)**
8	**Project Definition and Environmental Assessment (Part 2)**
104	**Phase 2 - Final Design / Tendering / Preparation for Construction**
105	**Environmental License (Target Date)**
106	**Floodway Expansion**
107	Final Design
108	Surveys
109	Land Acquisition
110	**West Dike**
111	Design / Bid Documents
112	Land Acquisitions
113	**Phase 3 - Construction**
114	**Construction Management**
115	**Excavation**
116	Low Flow Channel
117	Remainder of Channel
118	**Rail Bridges**
119	CNR - Pine Falls Bridge
120	Removal of Lac Du Bonnet Bridge
121	CPR - Keewatin Bridge
122	CNR - Redditt Bridge
123	Greater Winnipeg Water District Bridge
124	CNR - Sprague Bridge
125	CPR - Emerson Bridge
126	**Highway Bridges**
127	PTH 44 Bridge
128	PTH 59 North Bridge
129	PTH 15 Bridge
130	Trans Canada Bridge
131	PTH 59 South Bridge
132	St. Mary's Road Bridge
133	**Transmission Lines**
134	**Outlet Structure**
135	**West Dike**
136	**Aqueduct Modifications**
137	**Miscellaneous Structures**
138	**City Infrastructure**
139	**Floodway Inlet Structure**



NOTE: ***This schedule is preliminary and will be refined during the Project Definition and Environmental Assessment***

FIGURE 1
FLOODWAY EXPANSION PHASE 1, 2 & 3 (PLANNING, DESIGN/BID, CONSTRUCTION)
SCHEDULE TO 2009

PLATES



Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

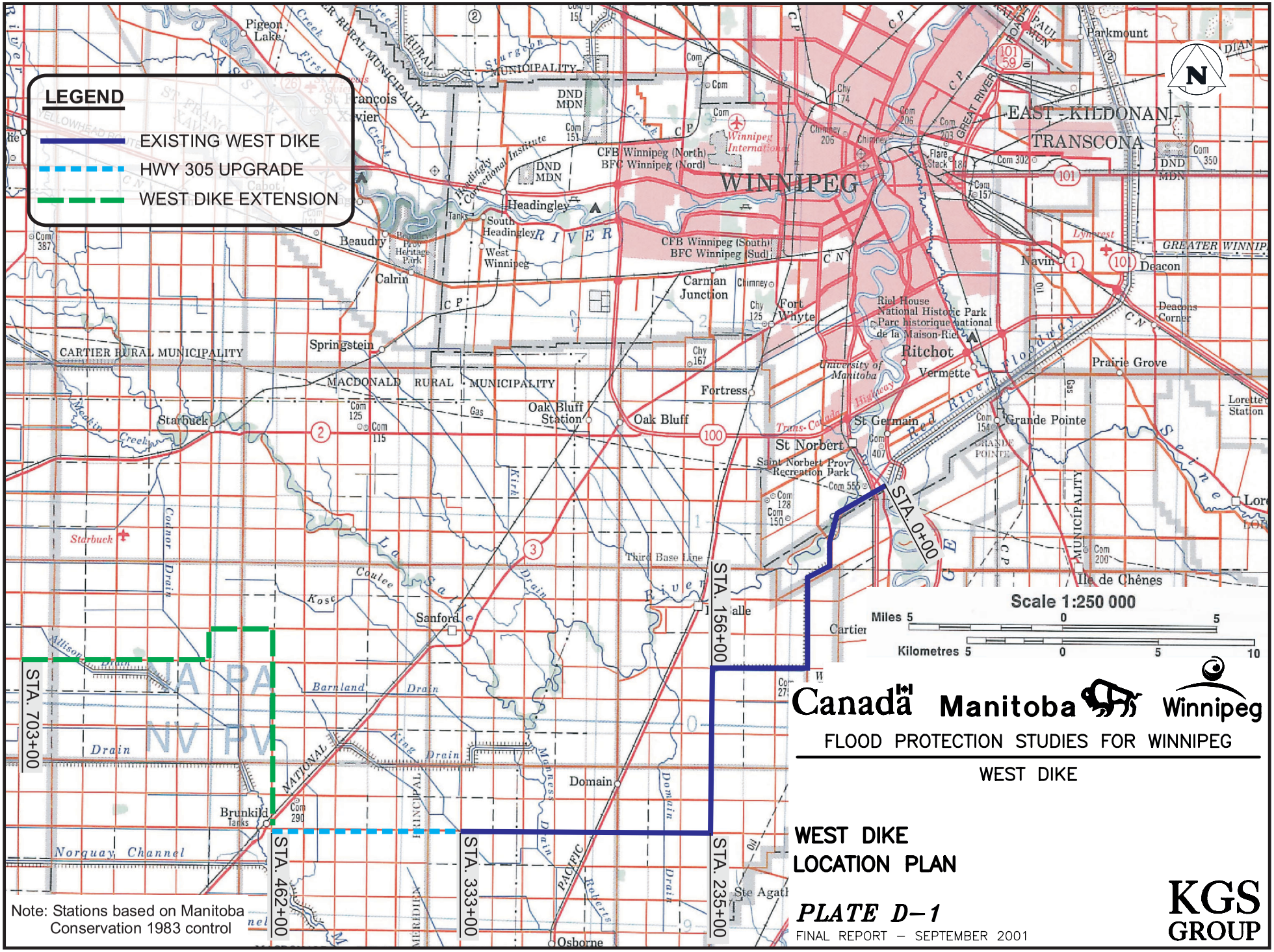
LOCATION OF RED RIVER FLOODWAY

PLATE B–1

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P-00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/Pplte B-1.cdr



Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

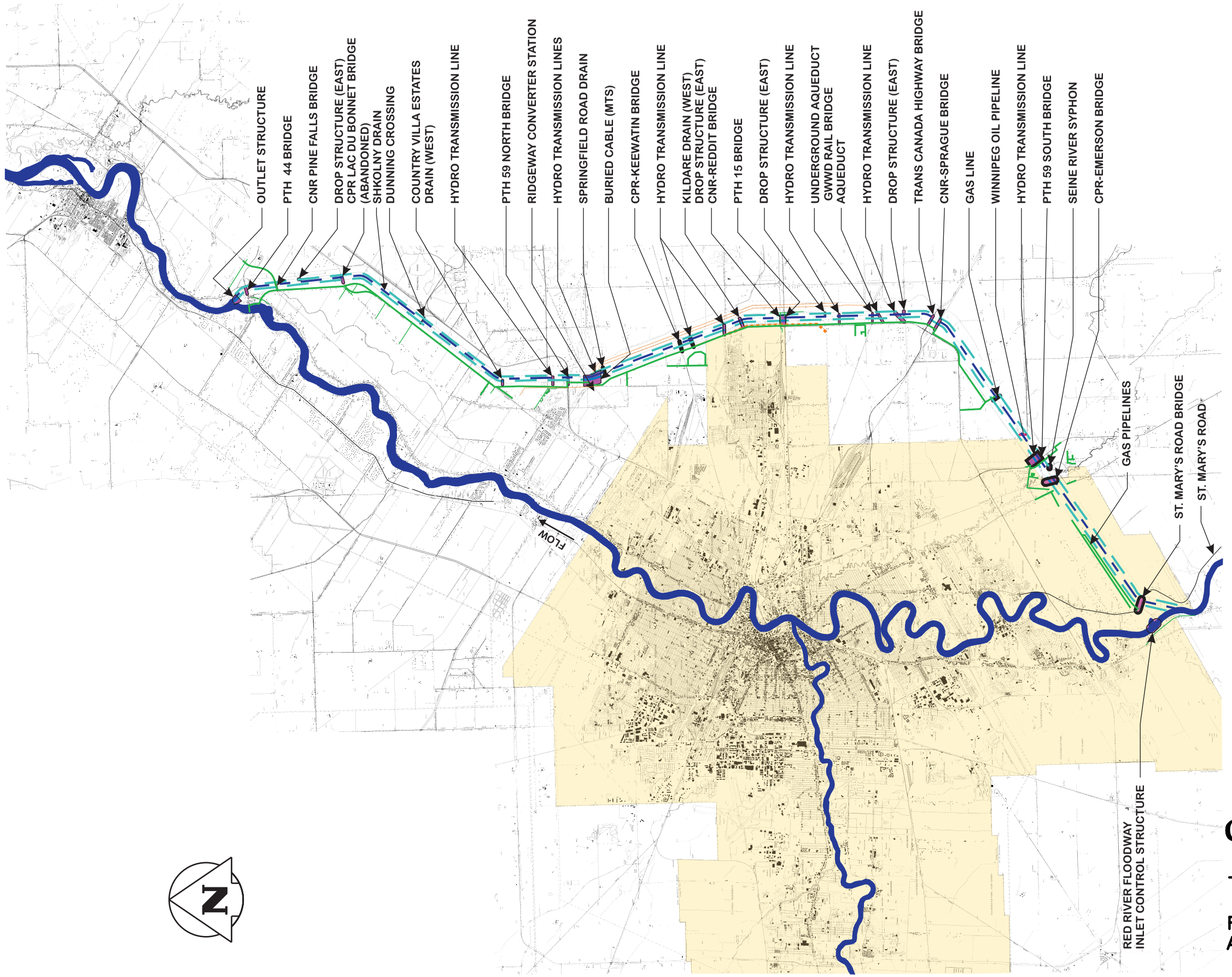
WEST DIKE

WEST DIKE LOCATION PLAN

PLATE D–1

FINAL REPORT – SEPTEMBER 2001

KGS GROUP



LEGEND

- EXISTING FLOODWAY
- CENTERLINE FLOODWAY
- AFFECTED AREAS
- GAS LINES
- HYDRO LINES

0 30 60 90 120

SCALE IN 1000s FEET

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOOD EXPANSION

RED RIVER FLOODWAY AFFECTED INFRASTRUCTURE

PLATE B–2

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P-00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/Plate B-2.cdr

LEGEND

- GROUND SURFACE
- EXISTING BOTTOM OF SLOPE
- EXISTING TOP OF LOW FLOW CHANNEL
- EXISTING LOW FLOW CHANNEL INVERT
- OBSERVED MAXIMUM GROUNDWATER LEVEL PRE CONSTRUCTION (1964–65)
- OBSERVED MAXIMUM GROUNDWATER LEVEL POST CONSTRUCTION (2000)
- APPROXIMATE AREAS WHERE GROUNDWATER DISCHARGE (100 GPM OR GREATER) WAS NOTED DURING FLOODWAY CONSTRUCTION (RENDER,1970)
- VARIABLY TEXTURED FINE SEDIMENTS (SILTY AND SANDY CLAY, SANDY SILT, ORGANIC SILTS AND CLAY)
- BROWN CLAY
- GREY CLAY
- GLACIAL OUTWASH SAND AND GRAVEL
- UNCEMENTED GLACIAL TILL
- CEMENTED GLACIAL TILL
- CARBONATE BEDROCK

NOTES:

1. DATA USED TO COMPILE SECTION INCLUDES:
   - HOBSON (1964) HAMMER SEISMIC SURVEY
   - GWDRILL DATABASE
   - MANITOBA WATER RESOURCES WELL DATABASE
   - MANITOBA DEPARTMENT OF AGRICULTURE AND CONSERVATION WATER CONTROL AND CONSERVATION BRANCH DRAWING FILE NUMBERS 11–5–1067,11–5–1137,11–5–1516,11–5–1267.
2. BOREHOLES USED TO PRODUCE SECTION ARE LOCATED WITHIN 300ft OF FLOODWAY CENTERLINE, WITH EXCEPTION OF CNR–1 (354ft W), 21 (472ft W) AND 13 (590ft W)
3. CURRENT BEDROCK PIEZOMETRIC LEVELS NEAR THE FLOODWAY CENTERLINE VARY FROM ELEVATIONS NEAR THE TOP OF THE EXISTING LOW FLOW CHANNEL TO ELEVATIONS NEAR THE EXISTING BOTTOM OF SLOPE.

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

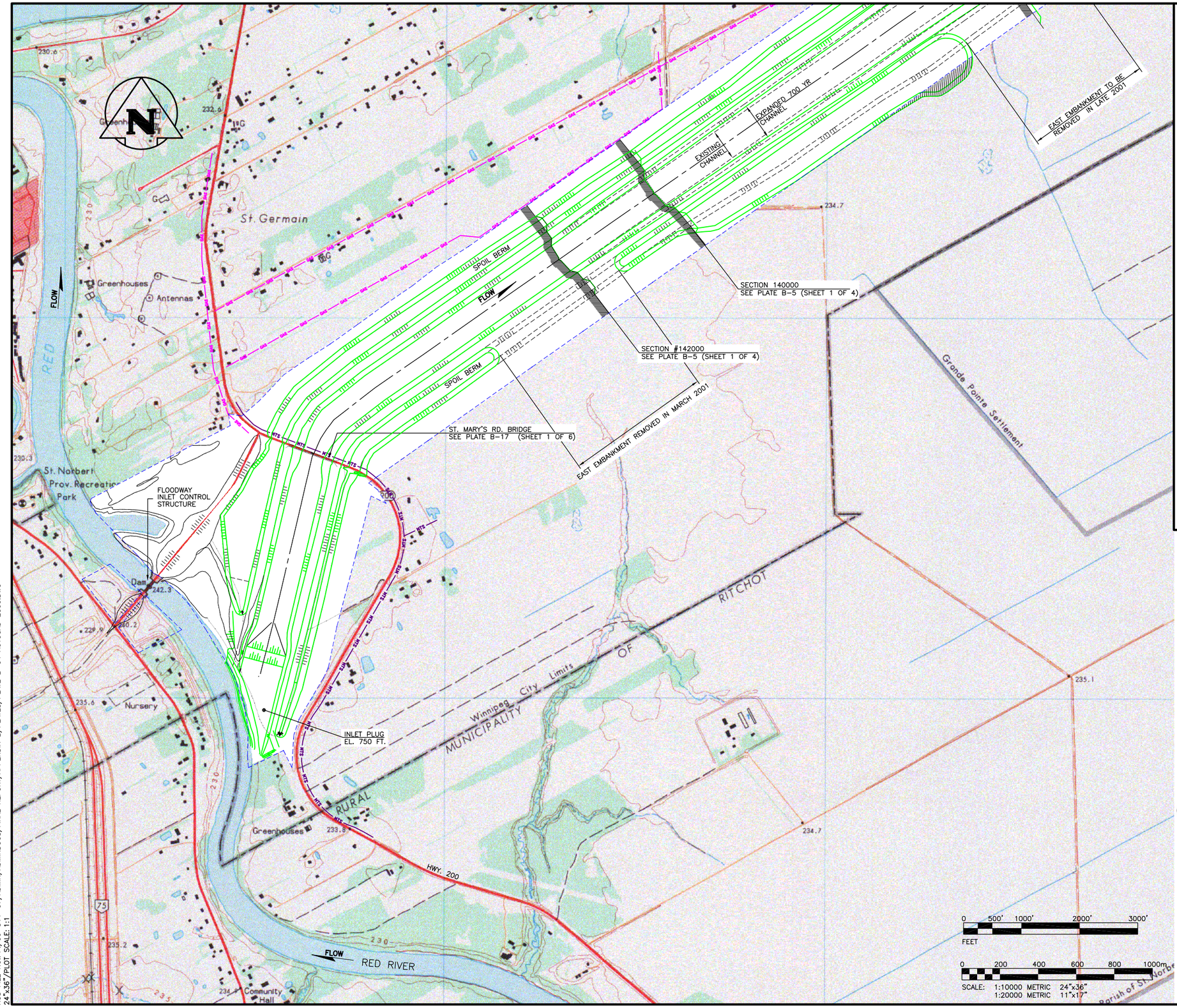
FLOODWAY EXPANSION

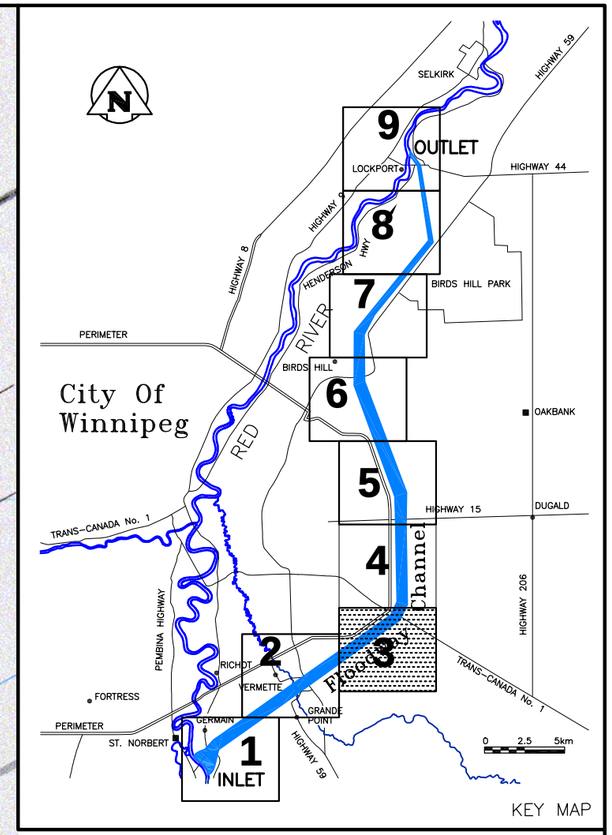
STRATIGRAPHIC PROFILE ALONG CENTER OF FLOODWAY CHANNEL

PLATE B–3

FINAL REPORT – SEPTEMBER 2001

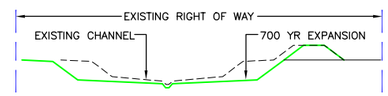
KGS GROUP





LEGEND

- EXISTING SLOPE
- PROPOSED SLOPE
- BURIED HYDRO LINES (EXISTING)
- TRANSMISSION LINES (EXISTING)
- CENTRA GAS – BURIED PIPELINES (EXISTING)
- MTS – BURIED FIBER LINES (EXISTING)
- WPG OIL PIPELINE CO. – BURIED PIPELINES (EXISTING)
- LAND TO BE ACQUIRED OUTSIDE OF EXISTING RIGHT OF WAY



0 500' 1000' 2000' 3000'
FEET

0 200 400 600 800 1000m
SCALE: 1:10000 METRIC 24"x36"
1:20000 METRIC 11"x17"

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

1 IN 700 YEAR EXPANDED FLOODWAY PLAN

PLATE B-4 (SHEET 1 OF 9)

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-04 AUTOCAD 2000.DWG
24"x36"/PLOT SCALE: 1:1

N

ST.
Dakota Crossing
VITAL
Vermette
Seine River
Auto Wrecker
Campground
Greenhouse
CANADIAN PACIFIC
ST BONIFACE-
ST VITAL
City Limits
Winnipeg
PTH 59 SOUTH BRIDGE
SEE PLATE B-17 (SHEET 2 OF 6)
TRANSMISSION TOWERS
SPOIL BERM
EXISTING CHANNEL
EXPANDED 700 YR CHANNEL
SECTION #127150
SEE PLATE B-5 (SHEET 1 OF 4)
SECTION #120000
SEE PLATE B-5 (SHEET 2 OF 4)
CPR EMERSON BRIDGE
PLATE B-18 (SHEET 1 OF 6)
MB HYDRO
115 KV
SECTION #123700
SEE PLATE B-5 (SHEET 2 OF 4)
MB HYDRO
66 KV
SEINE RIVER INVERTED SIPHON
SEE PLATES B-27 & B-28
RELOCATED HWY 300
SECTION #133000
SEE PLATE B-5 (SHEET 1 OF 4)
FLOW
0 500' 1000' 2000' 3000'
FEET
0 200 400 600 800 1000m
SCALE: 1:10000 METRIC 24"x36"
1:20000 METRIC 11"x17"

N

SELKIRK
HIGHWAY 59
9 OUTLET
LOCKPORT
HIGHWAY 44
HIGHWAY 9
HIGHWAY 8
8
HENDERSON HWY
7 BIRDS HILL PARK
PERIMETER
BIRDS HILL
RED RIVER
City Of Winnipeg
6
OAKBANK
5
HIGHWAY 15
DUGALD
TRANS-CANADA No. 1
4
Floodway Channel
PEMBINA HIGHWAY
HIGHWAY 206
2
3
RICHOT
VERMETTE
FORTRESS
GRANDE POINT
TRANS-CANADA No. 1
PERIMETER
GERMAIN
ST. NORBERT
1 INLET
HIGHWAY 59
0 2.5 5km
KEY MAP

LEGEND

- EXISTING SLOPE
- PROPOSED SLOPE
- BURIED HYDRO LINES (EXISTING)
- TRANSMISSION LINES (EXISTING)
- CENTRA GAS – BURIED PIPELINES (EXISTING)
- MTS – BURIED FIBER LINES (EXISTING)
- WPG OIL PIPELINE CO. – BURIED PIPELINES (EXISTING)
- LAND TO BE ACQUIRED OUTSIDE OF EXISTING RIGHT OF WAY

EXISTING RIGHT OF WAY
EXISTING CHANNEL
700 YR EXPANSION

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

1 IN 700 YEAR EXPANDED FLOODWAY PLAN

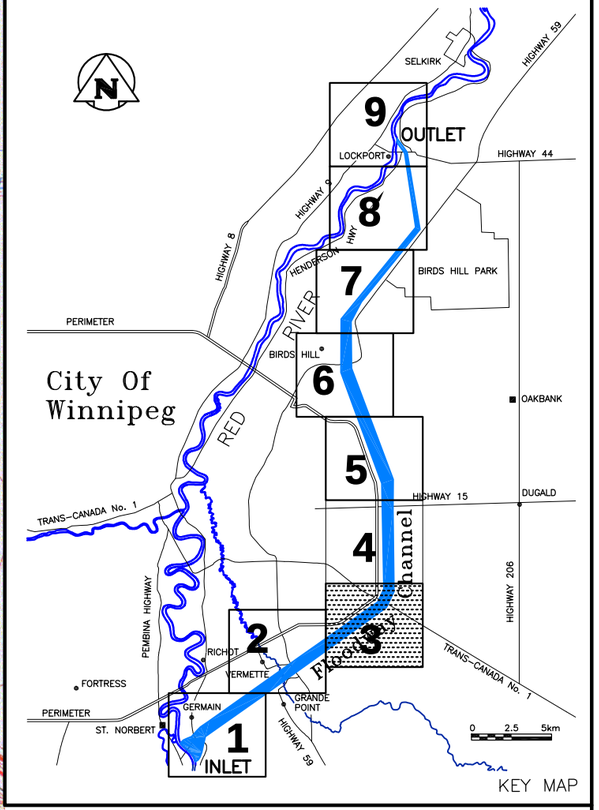
PLATE B–4 (SHEET 2 OF 9)

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-04 AUTOCAD 2000.DWG
24"x36"/PLOT SCALE: 1:1

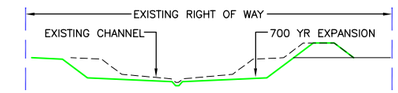
Campground
CANADIAN
NATIONAL
Airstrip
Amusement Park
Sewage Disposal Beds
Campground
SECTION 99500
SEE PLATE B-5 (SHEET 2 OF 4)
SECTION 100000
SEE PLATE B-5 (SHEET 2 OF 4)
TRANS CANADA HWY BRIDGE
SEE PLATE B-17 (SHEET 2 OF 6)
CNR SPRAGUE BRIDGE
SEE PLATE B-18 (SHEET 2 OF 6)
EXPANDED 700 YR CHANNEL
EXISTING CHANNEL
FLOW
SPOIL BERM
SPOIL BERM
SECTION #110000
SEE PLATE B-5 (SHEET 2 OF 4)
Sewage Disposal Beds
Service Center
Deacons Corner
Airstrip
Airstrip
Prairie Grove
Prairie Grove Cem
RURAL MUNICIPALITY OF SPRINGFIELD
Drain
100
235
236.9
235.2
236.1
235.8
244.2
237.9
238.1
238.4
238.3
237.4
239.2
236.3
13
12
11
15
9
4
3
2
1



KEY MAP

LEGEND

- EXISTING SLOPE
- PROPOSED SLOPE
- BURIED HYDRO LINES (EXISTING)
- TRANSMISSION LINES (EXISTING)
- CENTRA GAS – BURIED PIPELINES (EXISTING)
- MTS – BURIED FIBER LINES (EXISTING)
- WPG OIL PIPELINE CO. – BURIED PIPELINES (EXISTING)
- LAND TO BE ACQUIRED OUTSIDE OF EXISTING RIGHT OF WAY



0 500' 1000' 2000' 3000'
FEET

0 200 400 600 800 1000m

SCALE: 1:10000 METRIC 24"x36"
1:20000 METRIC 11"x17"

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

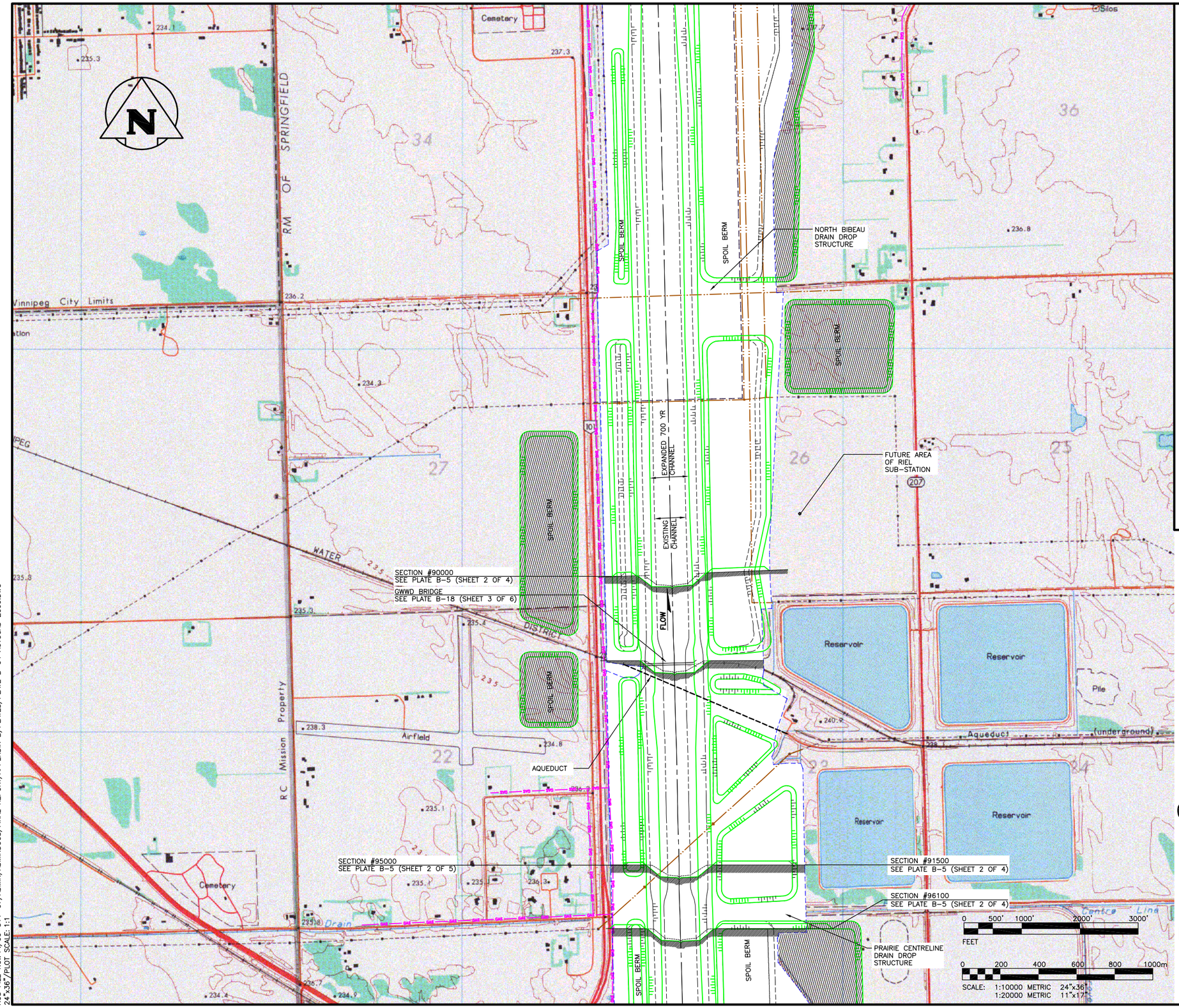
1 IN 700 YEAR EXPANDED FLOODWAY PLAN

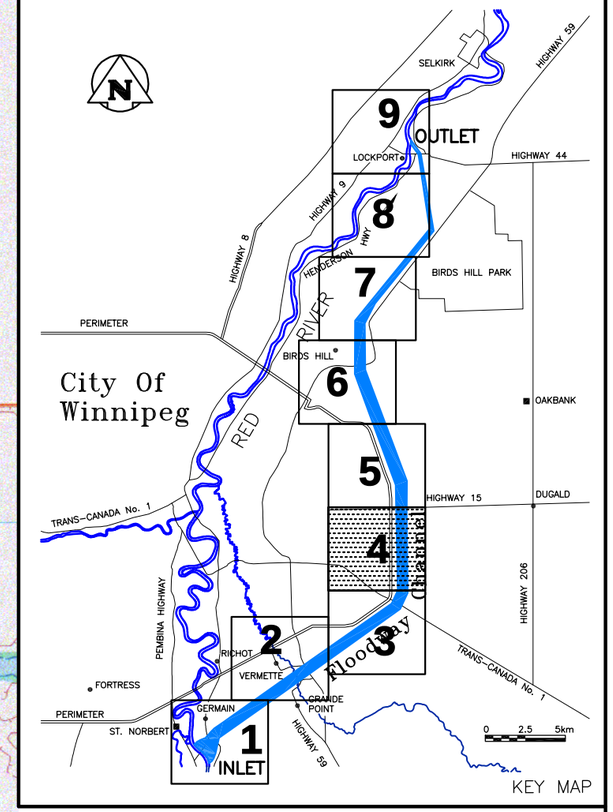
PLATE B-4 (SHEET 3 OF 9)

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-04 AUTOCAD 2000.DWG
24"x36"/PLOT SCALE: 1:1





LEGEND

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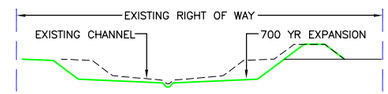


Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

1 IN 700 YEAR EXPANDED FLOODWAY PLAN

PLATE B–4 (SHEET 4 OF 9)

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-04 AUTOCAD 2000.DWG
24"x36" PLOT SCALE: 1:1

SECTION # 64700
SEE PLATE B-5 (SHEET 3 OF 4)

CPR KEEWATIN BRIDGE
SEE PLATE B-18 (SHEET 5 OF 6)

SECTION #70000
SEE PLATE B-5 (SHEET 3 OF 4)

TRANSMISSION TOWERS TYP.

SECTION #73000
SEE PLATE B-5 (SHEET 3 OF 4)

COOKS' CREEK DIVERSION
DROP STRUCTURE
SEE PLATES B-25 & B-28

CNR REDDITT BRIDGE
SEE PLATE B-18 (SHEET 4 OF 6)

PTH 15 BRIDGE
SEE PLATE B-17 (SHEET 4 OF 6)

SECTION #79500
SEE PLATE B-5 (SHEET 3 OF 6)

FLOW

SPOIL BERM

EXPANDED 700 YR CHANNEL

EXISTING CHANNEL

Winnipeg City Limits

North Transcona

Canterbury Park

Kern Park

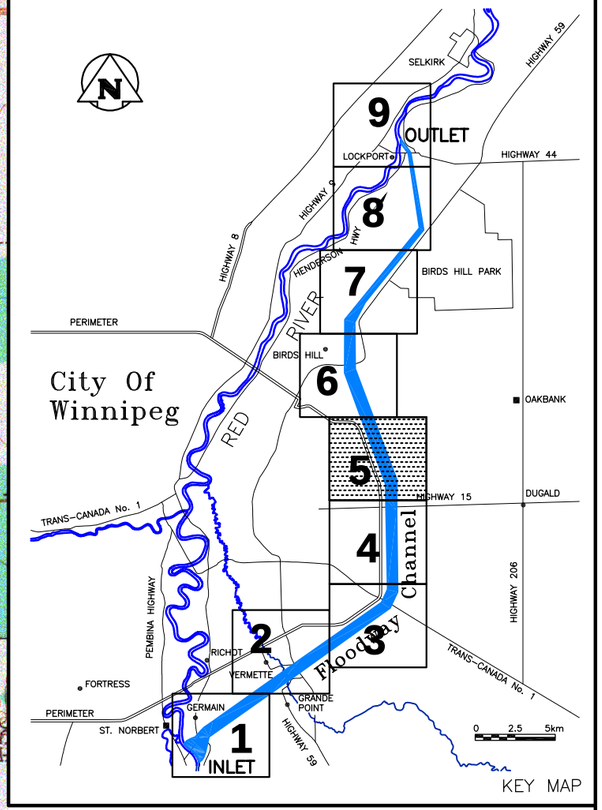
Cooks Creek Diversion

Dam

Pit

0 500' 1000' 2000' 3000'
FEET

0 200 400 600 800 1000m
SCALE: 1:10000 METRIC 24"x36"
1:20000 METRIC 11"x17"



KEY MAP

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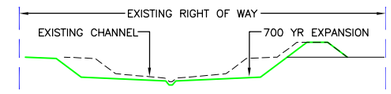


Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

1 IN 700 YEAR EXPANDED FLOODWAY PLAN

PLATE B-4 (SHEET 5 OF 9)

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-04 AUTOCAD 2000.DWG
24"x36"/PLOT SCALE: 1:1

COUNTRY VILLA ESTATES DRAIN

EXISTING 700 YR EXPANDED CHANNEL

PTH 59 NORTH BRIDGE
SEE PLATE B-17 (SHEET 5 OF 6)

SECTION #48900
SEE PLATE B-5 (SHEET 3 OF 4)

SECTION #50000
SEE PLATE B-5 (SHEET 3 OF 4)

SECTION #51000
SEE PLATE B-5 (SHEET 3 OF 4)

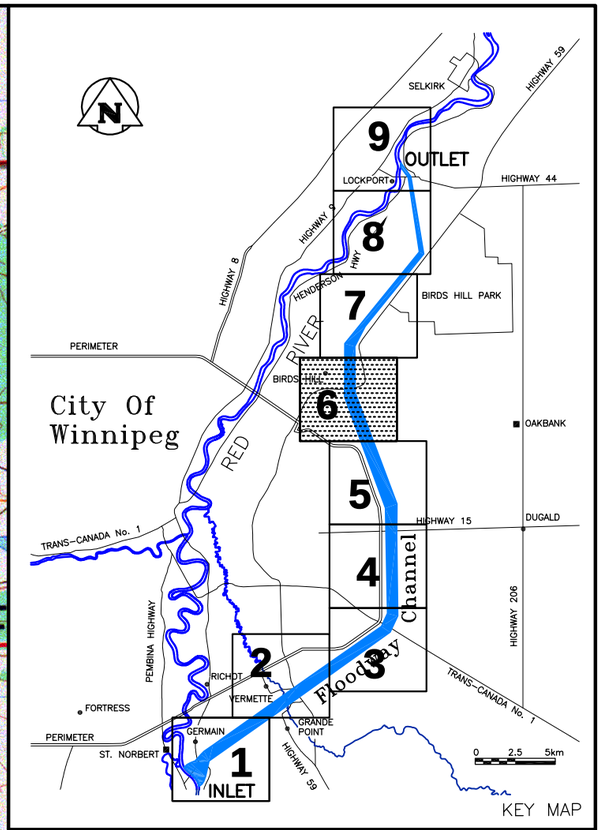
WINNIPEG HYDRO LINE

SPRINGFIELD ROAD DRAIN
DROP STRUCTURE

SECTION #57000
SEE PLATE B-5 (SHEET 3 OF 4)

SECTION #60000
SEE PLATE B-5 (SHEET 3 OF 4)

Birds Hill
Municipal Hall
Fire Hall
Sewage Disposal
Tower
Substation
Greenhouses
CANADIAN NATIONAL
Weigh Station
Yard
RM OF SPRINGFIELD
RM OF EAST ST PAUL
Parkmount
Campground
Pit
FLOW
Parish of St Pauls
Winnipeg City Limits
Golf Course
Wharf
Cem
DB



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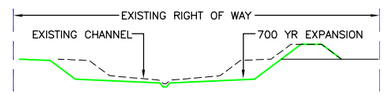


0 500' 1000' 2000' 3000'
FEET

0 200 400 600 800 1000m
SCALE: 1:10000 METRIC 24"x36"
1:20000 METRIC 11"x17"

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

1-700 YEAR EXPANDED FLOODWAY PLAN

PLATE B-4 (SHEET 6 OF 9)

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-04 AUTOCAD 2000.DWG
24"x36"/PLOT SCALE: 1:1

DUNNING ROAD LOW LEVEL CROSSING

SKHOLNY DRAIN DROP STRUCTURE

SECTION #30000
SEE PLATE B-5 (SHEET 4 OF 4)

SECTION #40000
SEE PLATE B-5 (SHEET 4 OF 4)

PTH 59

BIRDS HILL PROVINCIAL PARK

Boundary

Park Gate

Dump

Dump

Sewage

Trailer Park

Airstrip

Pit

Pit

Pit

R/M OF

SPOIL BERM

FLOW

SPOIL BERM

EXPANDED 700 YR CHANNEL

EXISTING CHANNEL

(abandoned)

232.4

233.6

231.7

234.8

232.3

239.2

234.8

232.4

234.1

232.7

233.8

231.1

235.5

234.7

14

11

12

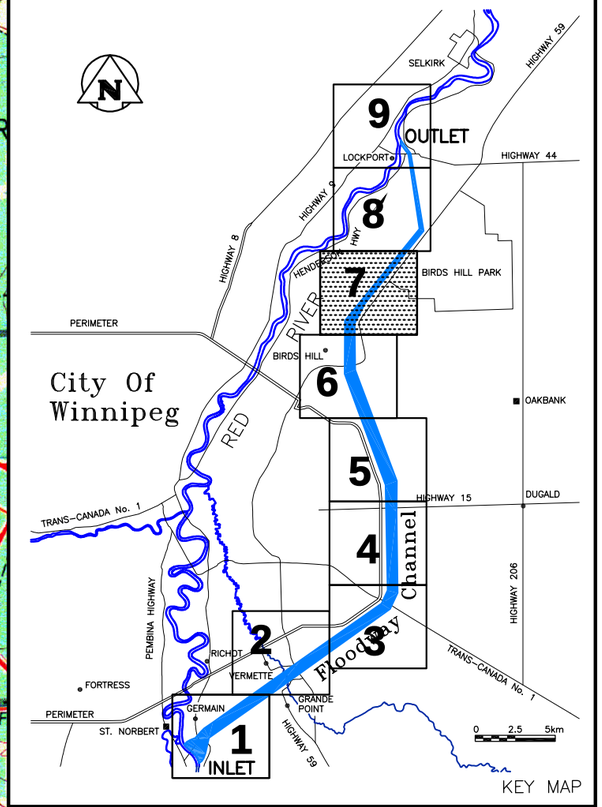
2

3

1

202

59



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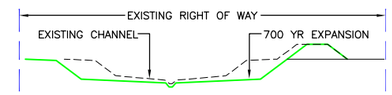


Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

1 IN 700 YEAR EXPANDED FLOODWAY PLAN

PLATE B-4 (SHEET 7 OF 9)

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

0 500' 1000' 2000' 3000'
FEET
0 200 400 600 800 1000m
SCALE: 1:10000 METRIC 24"x36"
1:20000 METRIC 11"x17"

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-04 AUTOCAD 2000.DWG
24"x36"/PLOT SCALE: 1:1

ASHFIELD DRAIN DROP STRUCTURE

SECTION #10000
SEE PLATE B-5 (SHEET 4 OF 4)

CPR-LAC DU BONNET BRIDGE (ABANDONED)

EXPANDED 700 YR CHANNEL

EXISTING CHANNEL

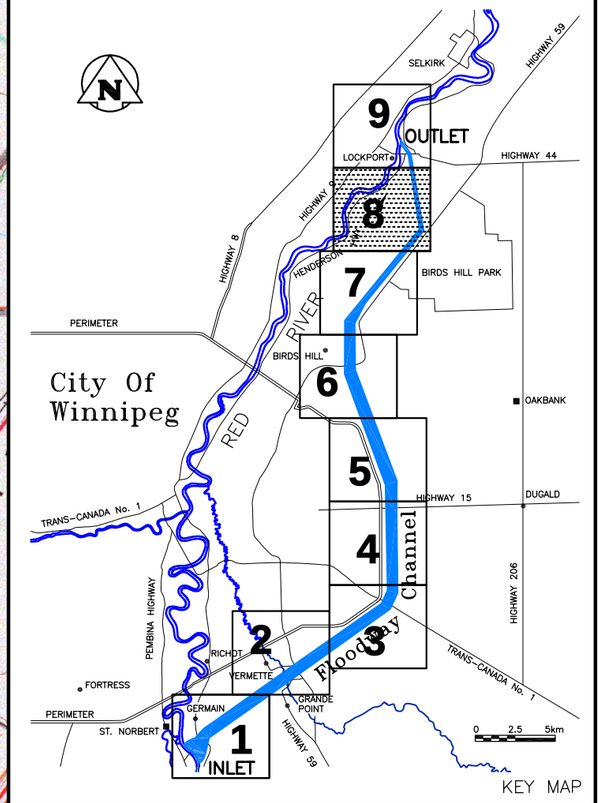
SECTION #20000
SEE PLATE B-5 (SHEET 4 OF 4)

SPOIL BERM

FLOW

0 500' 1000' 2000' 3000'
FEET

0 200 400 600 800 1000m
SCALE: 1:10000 METRIC 24"x36"
1:20000 METRIC 11"x17"



LEGEND

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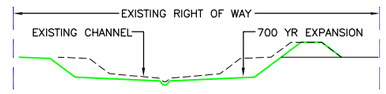

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

1 IN 700 YEAR EXPANDED FLOODWAY PLAN

PLATE B-4 (SHEET 8 OF 9)

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-04 AUTOCAD 2000.DWG
24"x36"/PLOT SCALE: 1:1

OUTLET CHANNEL
SEE PLATES B-24

OUTLET STRUCTURE
SEE PLATES B-22 & B-23

SECTION #-1000
SEE PLATE B-5 (SHEET 4 OF 4)

RELOCATE EXISTING ROAD

SECTION #500
SEE PLATE B-5 (SHEET 4 OF 4)

ST. ANDREWS
LOCK AND DAM

PTH 44 BRIDGE
SEE PLATE B-17 (SHEET 6 OF 6)

SECTION #3000
SEE PLATE B-5 (SHEET 4 OF 4)

SECTION #4550
SEE PLATE B-5 (SHEET 4 OF 4)

CNR PINE FALLS BRIDGE
SEE PLATE B-18 (SHEET 6 OF 6)

0 500' 1000' 2000' 3000'
FEET

0 200 400 600 800 1000m

SCALE: 1:10000 METRIC 24"x36"
1:20000 METRIC 11"x17"

KEY MAP

LEGEND

- EXISTING SLOPE
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- WPG OIL PIPELINE CO. – BURIED PIPELINES (EXISTING)
- LAND TO BE ACQUIRED OUTSIDE OF EXISTING RIGHT OF WAY

EXISTING RIGHT OF WAY
EXISTING CHANNEL
700 YR EXPANSION

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

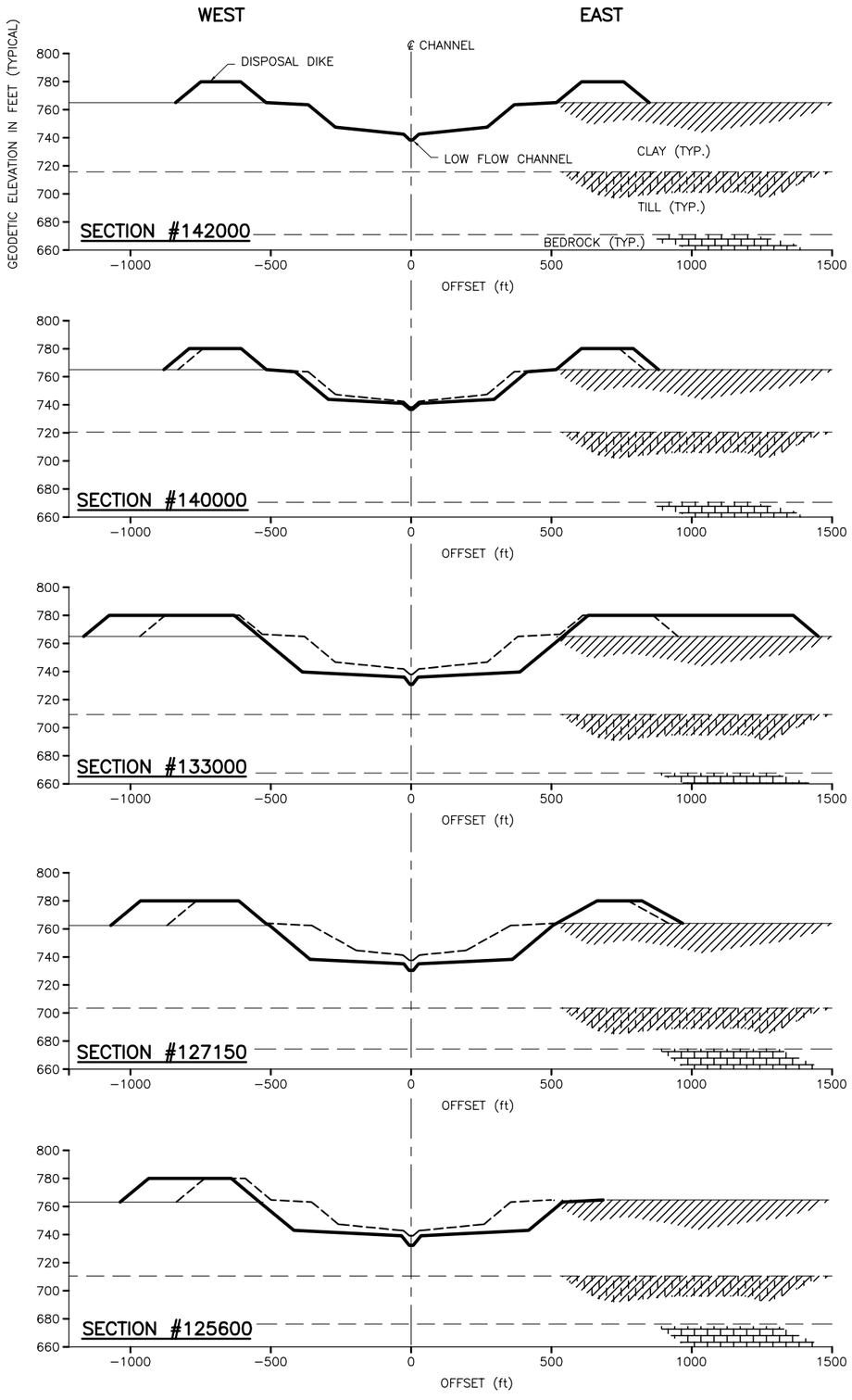
1 IN 700 YEAR EXPANDED FLOODWAY PLAN

PLATE B-4 (SHEET 9 OF 9)

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-04 AUTOCAD 2000.DWG
24"x36" PLOT SCALE: 1:1

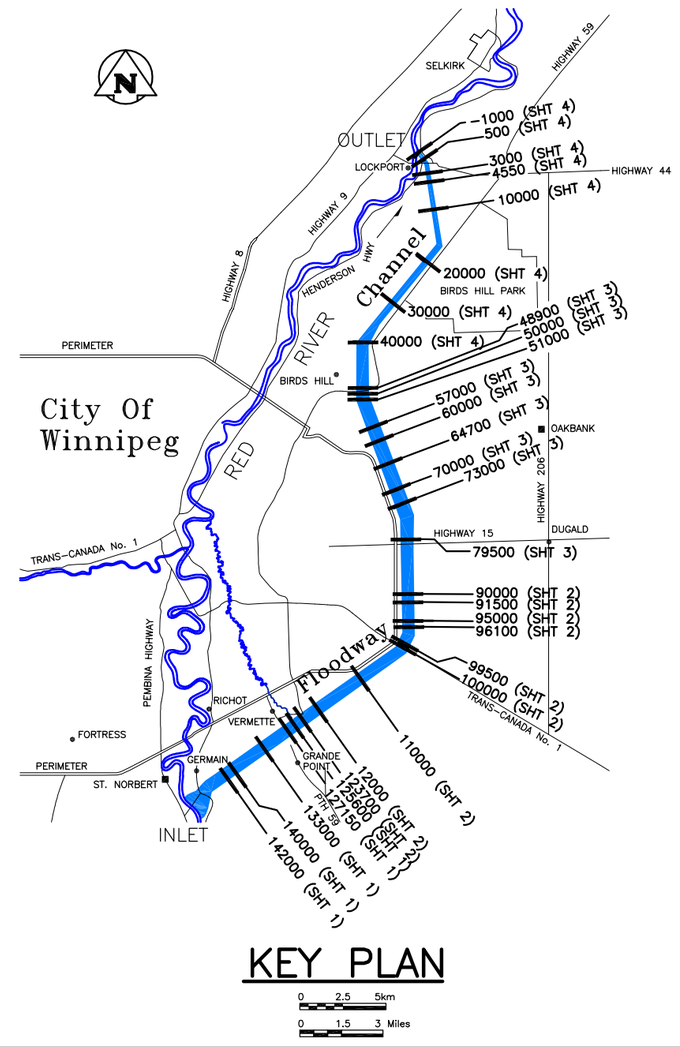


LEGEND

- EXISTING FLOODWAY
- EXPANDED FLOODWAY
- ORIGINAL GROUND SURFACE
- ASSUMED STRATIGRAPHIC CONTACT
- **96100** SECTION NUMBER (DISTANCE ALONG CHANNEL IN FEET)

NOTE:

1. CROSS SECTIONS ALL LOOKING DOWNSTREAM (NORTH).



Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

1 IN 700 YEAR EXPANDED FLOODWAY SECTIONS

PLATE B-5 ***(SHEET 1 OF 4)***

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

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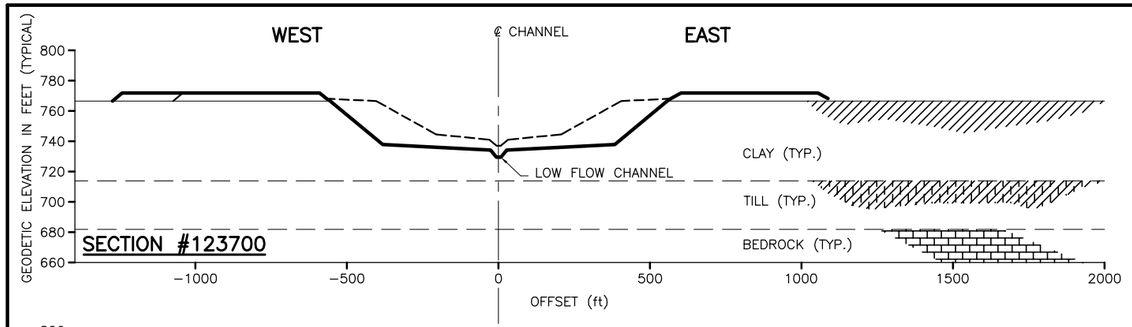
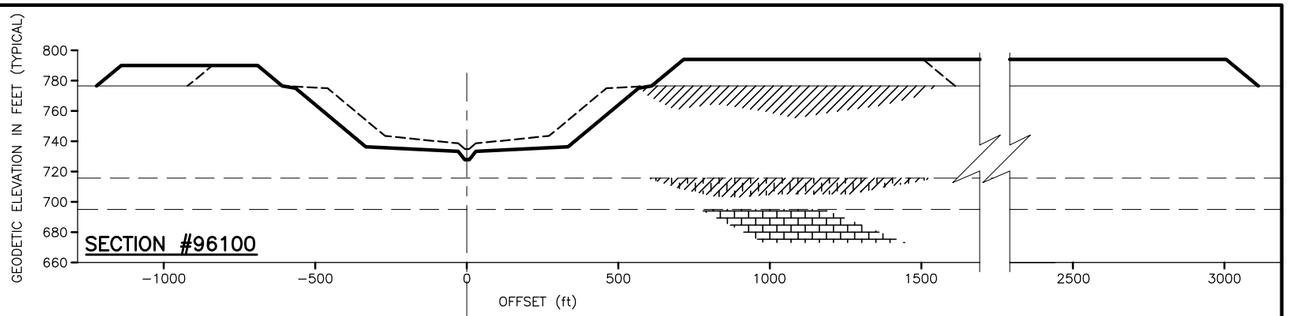
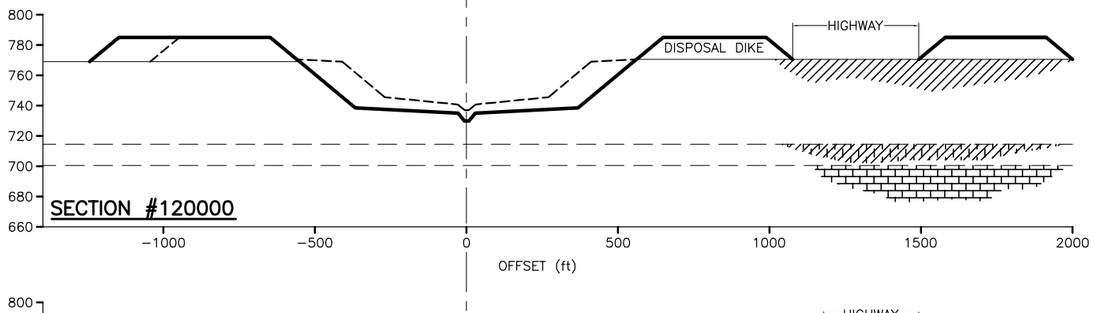
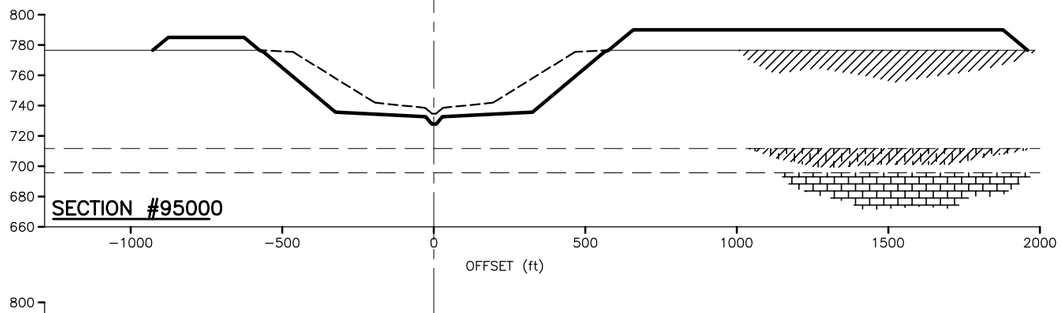
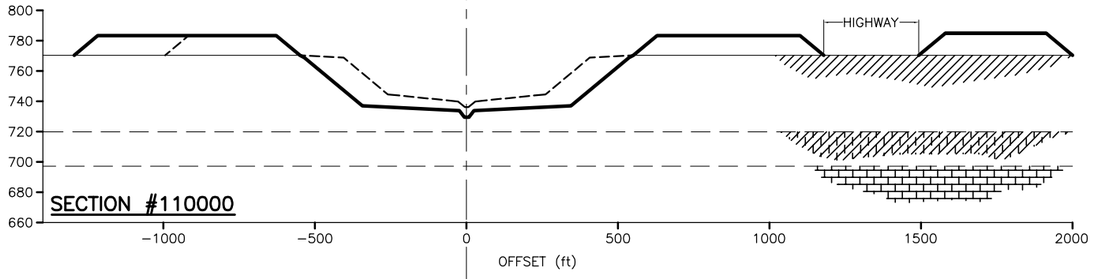
24"x36"/PLOT SCALE: 3000

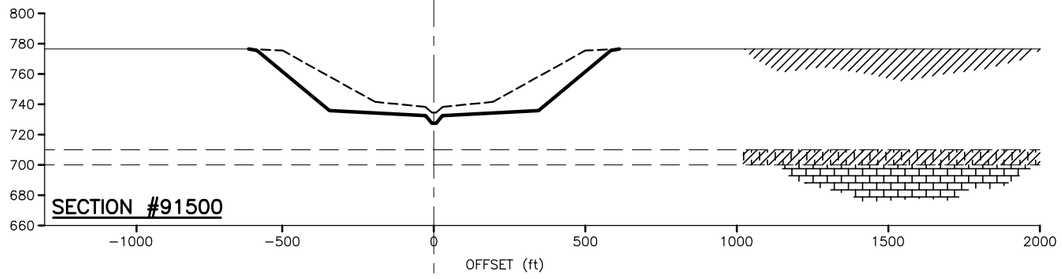


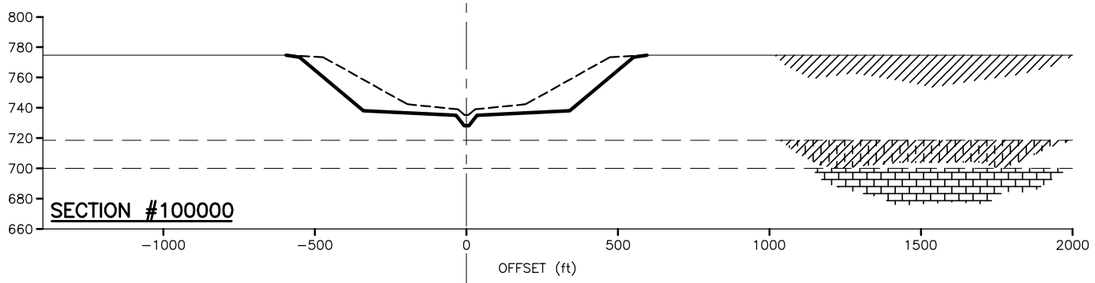


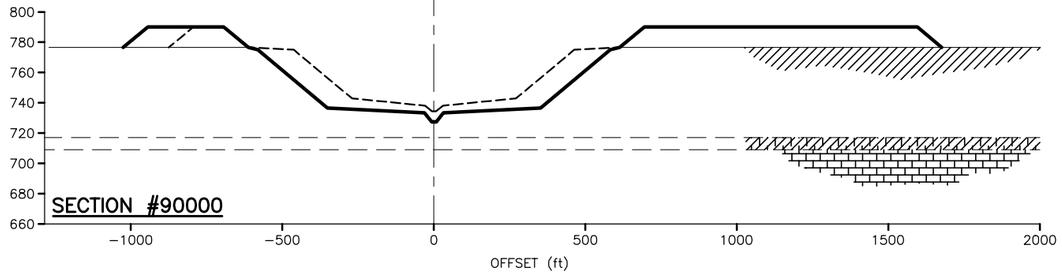


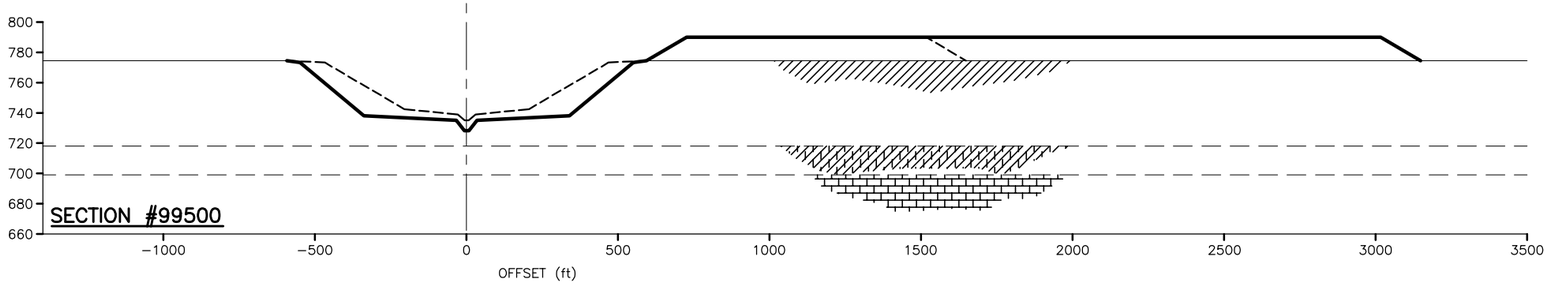












Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

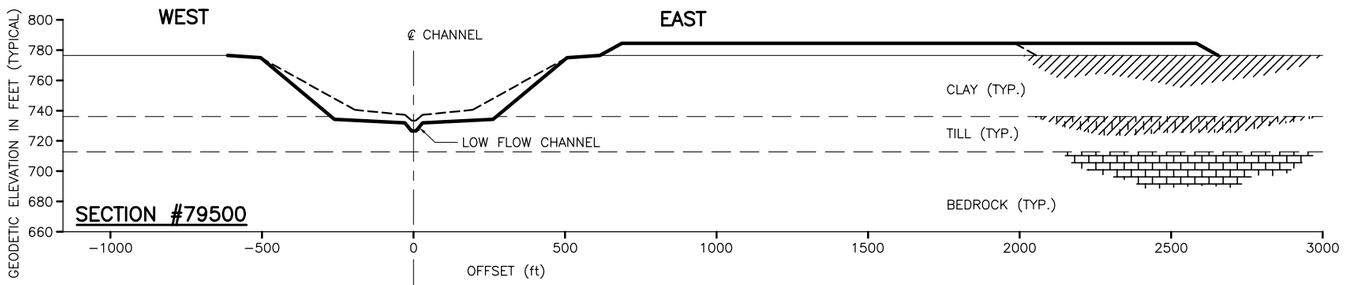
1 IN 700 YEAR EXPANDED FLOODWAY SECTIONS

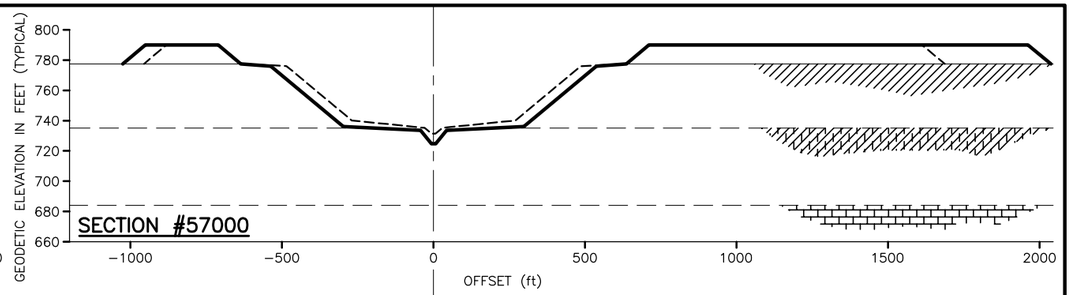
PLATE B–5 ***(SHEET 2 OF 4)***

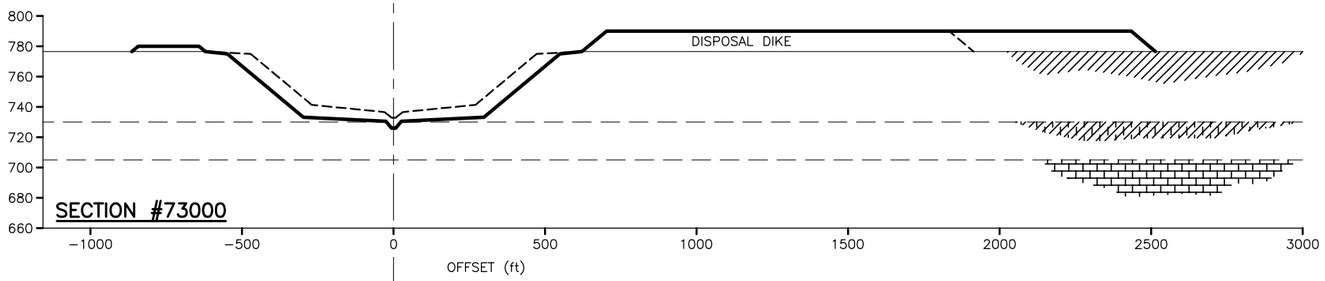
FINAL REPORT – SEPTEMBER 2001

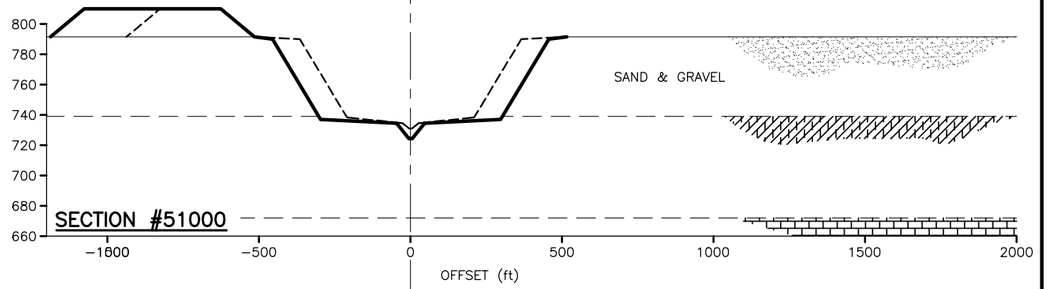
KGS GROUP

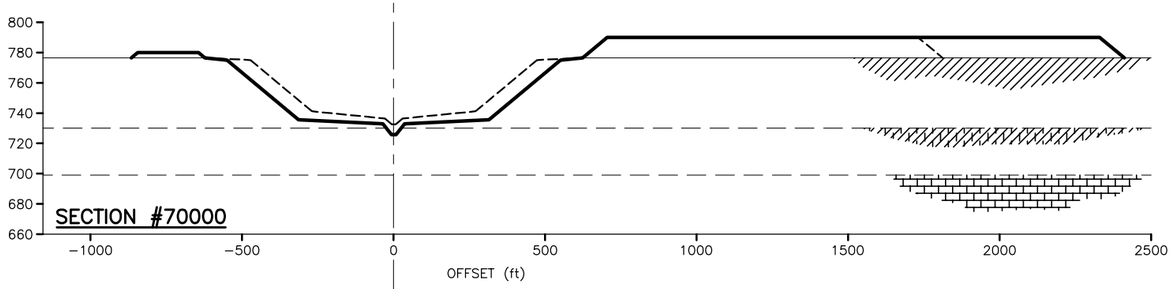
KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-05.DWG
24"x36" PLOT SCALE: 3000

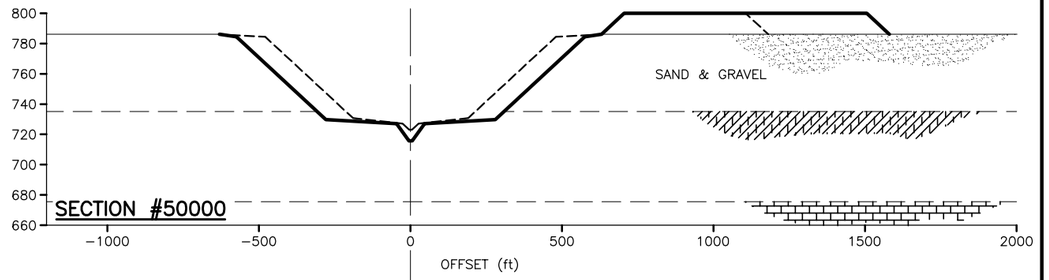


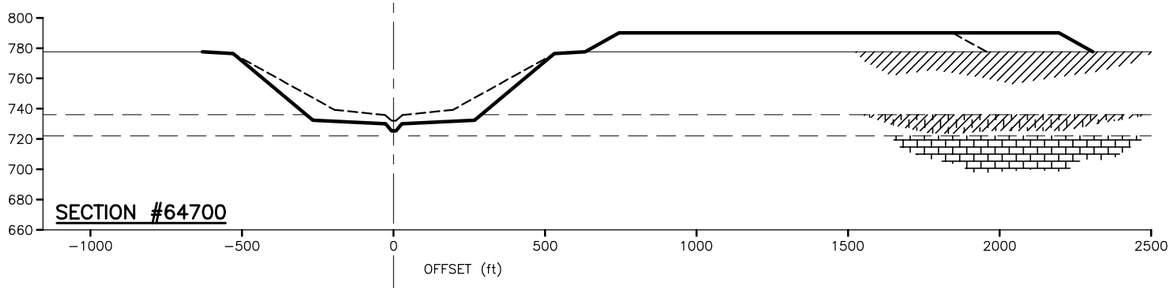


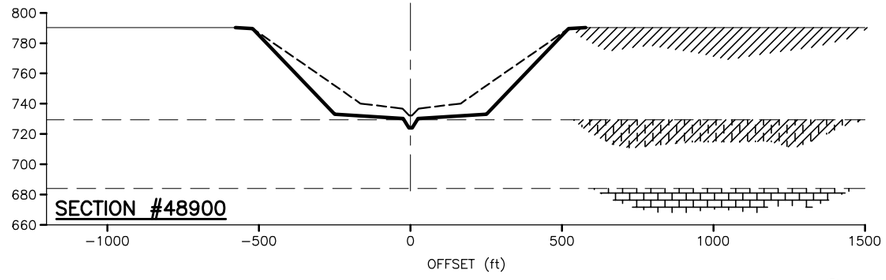


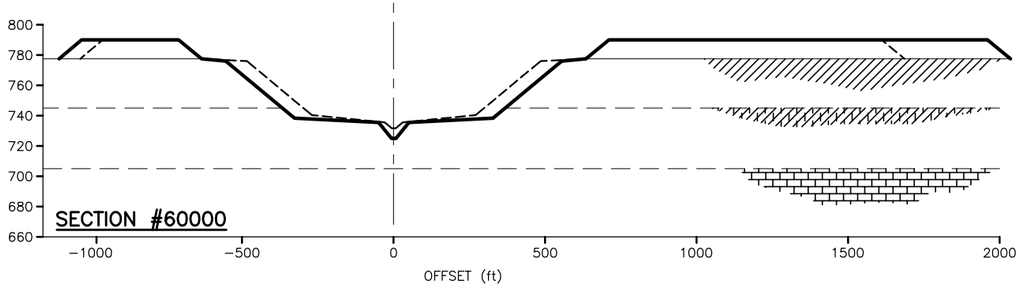












Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

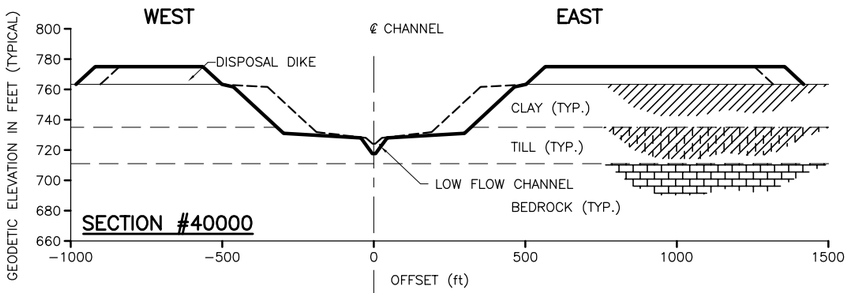
1 IN 700 YEAR EXPANDED FLOODWAY SECTIONS

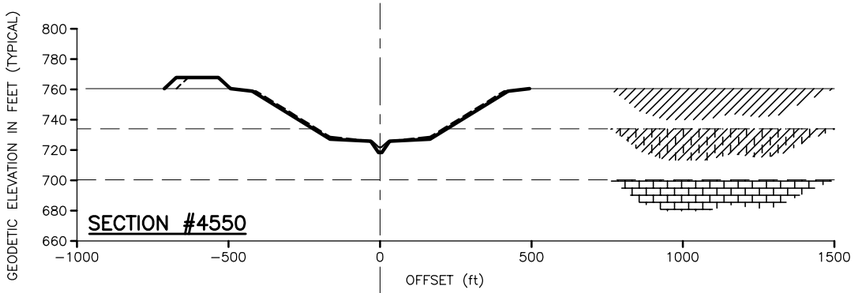
PLATE B–5 (SHEET 3 OF 4)

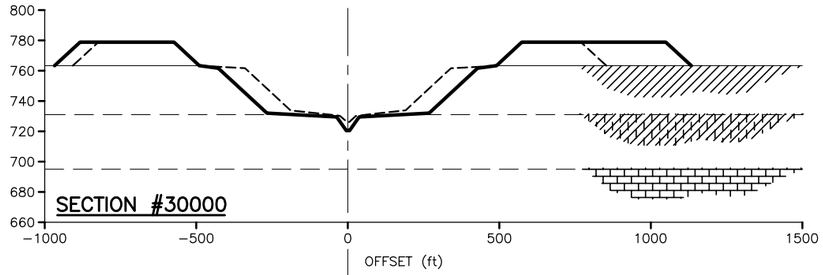
FINAL REPORT – SEPTEMBER 2001

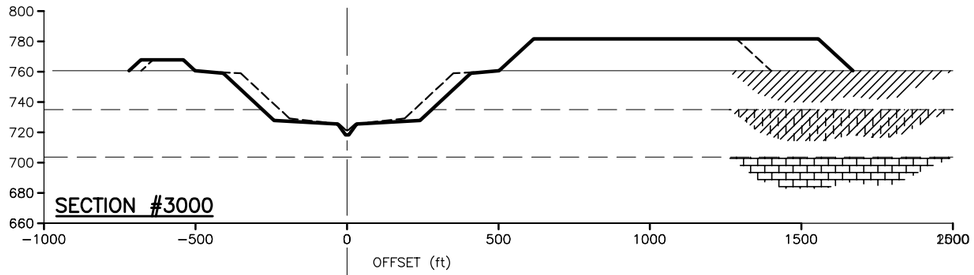
KGS GROUP

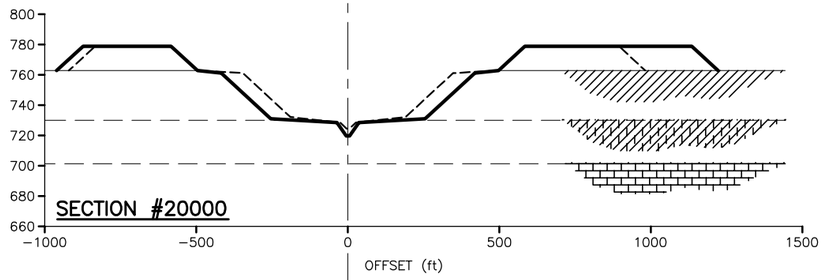
KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-05.DWG
24"x36"/PLOT SCALE: 3000

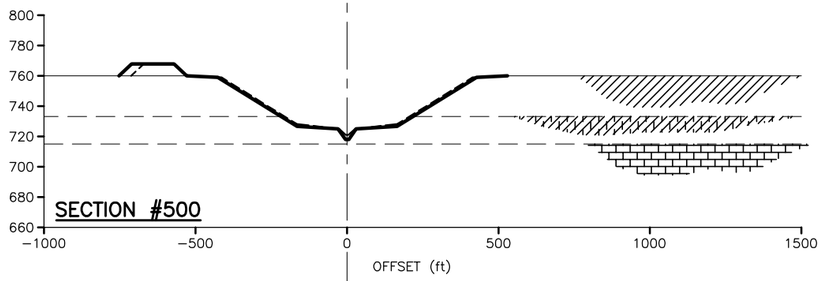


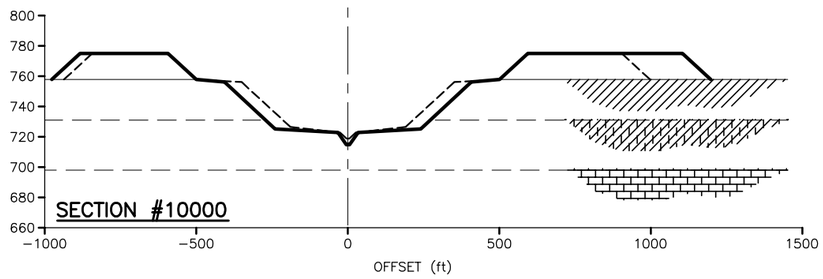


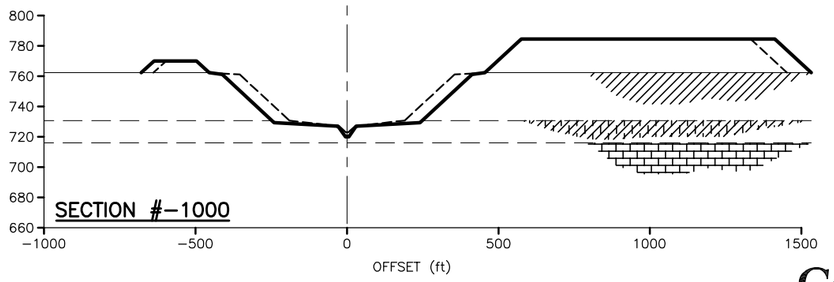












Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

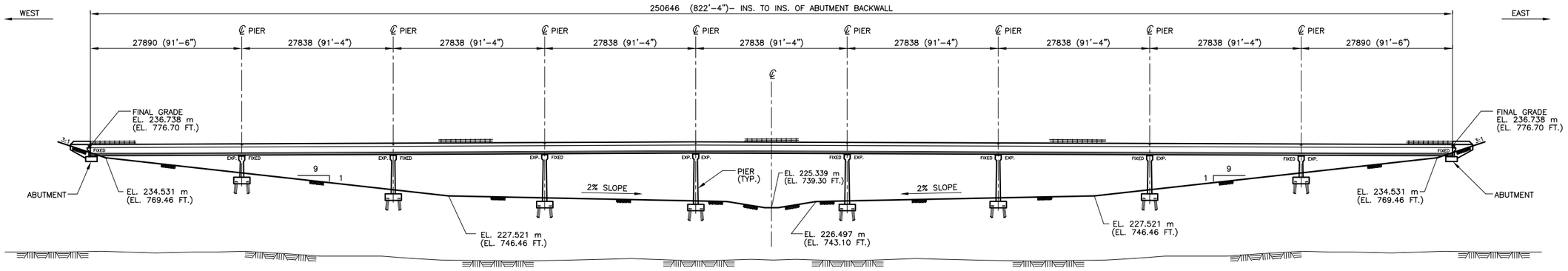
1 IN 700 YEAR EXPANDED FLOODWAY SECTIONS

PLATE B–5 ***(SHEET 4 OF 4)***

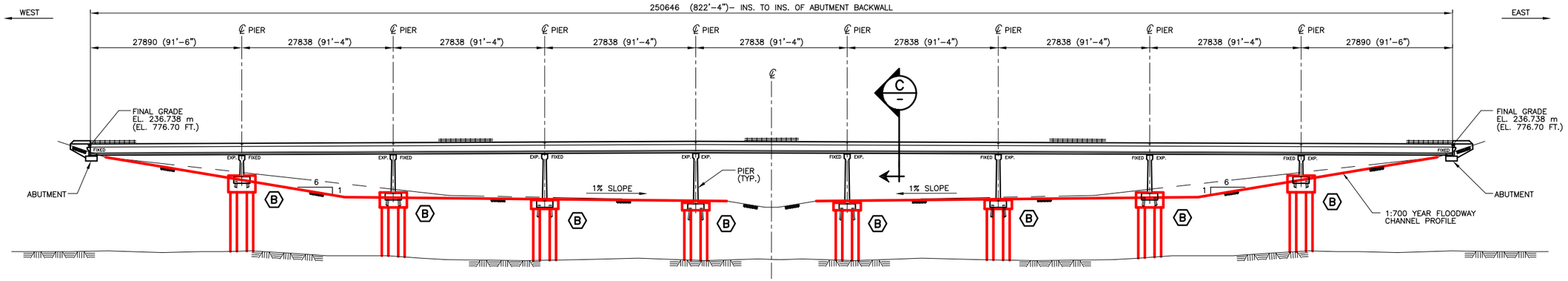
FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-05.DWG
24"x36"/PLOT SCALE: 3000



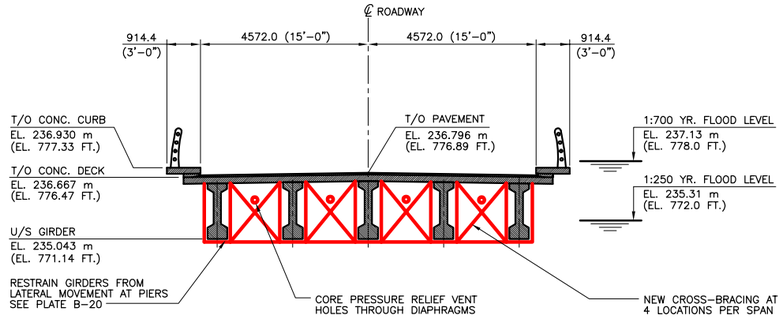
(A) ELEVATION – EXISTING



(B) ELEVATION – MODIFIED

RETROFIT EXISTING BRIDGE

TYPE-(-) – DENOTES TYPE OF PIER REINFORCEMENT
FOR TYPICAL DETAILS SEE PLATE 'B-19'



(C) SECTION THROUGH MODIFIED BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

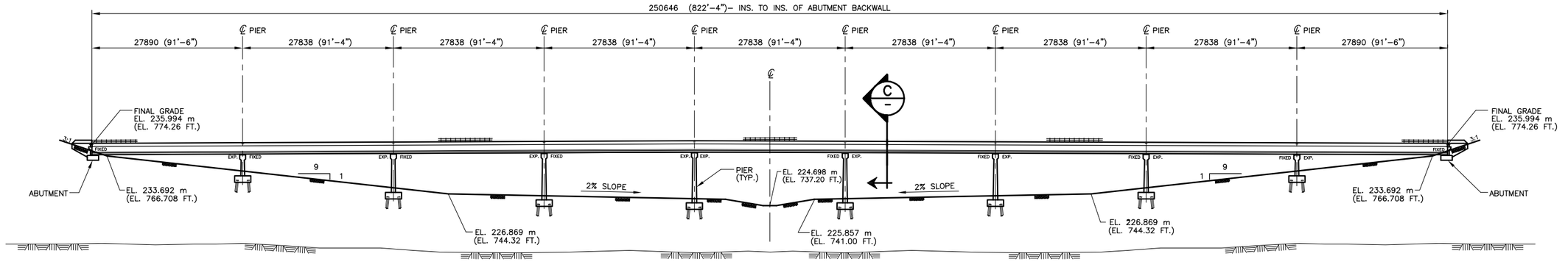
1 IN 700 YEAR EXPANDED FLOODWAY HIGHWAY BRIDGE MODIFICATIONS ST. MARY'S ROAD

PLATE B-17 (SHEET 1 OF 6)

FINAL REPORT – SEPTEMBER 2001

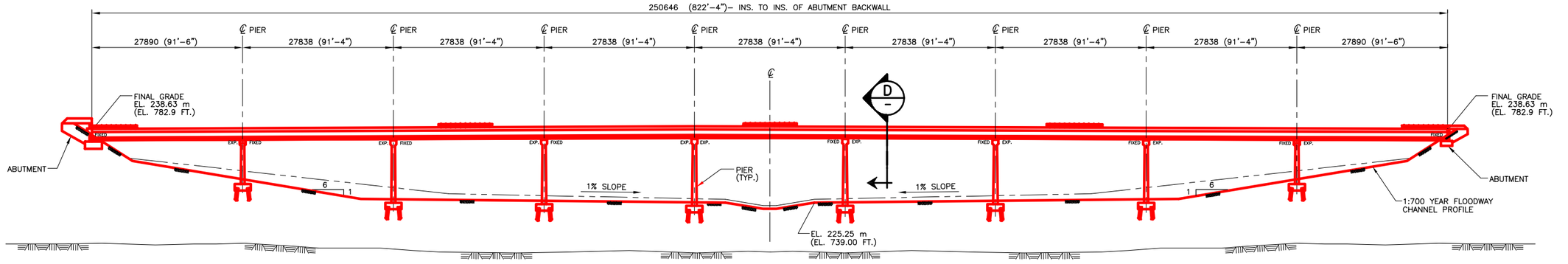
KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-17-1.DWG
24"x36" PLOT SCALE: 100



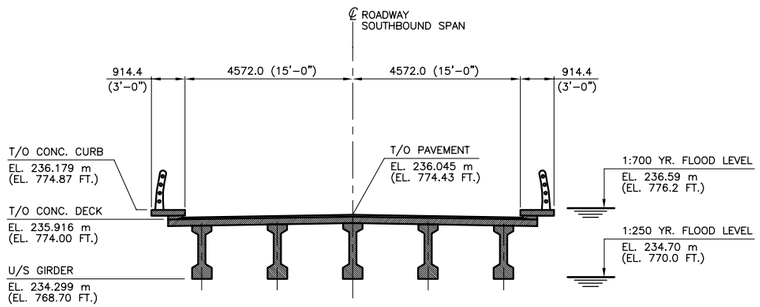
(A) ELEVATION – EXISTING

SOUTHBOUND BRIDGE SHOWN
NORTHBOUND SIMILAR – UNDERSIDE OF FOOTINGS TYPICALLY LOWER THAN SOUTHBOUND
ie LESS UNDERMINING



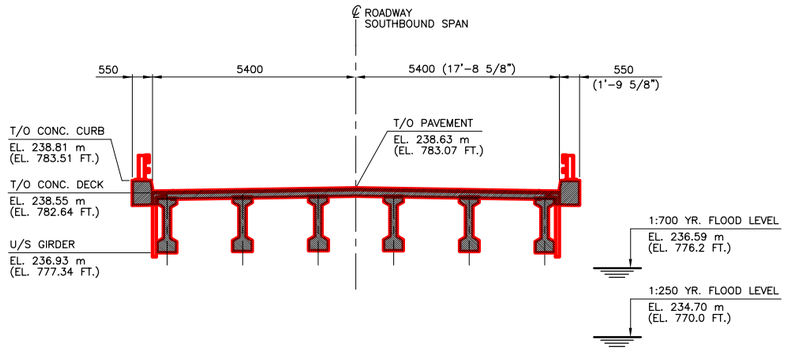
(B) ELEVATION – NEW BRIDGE

SOUTHBOUND BRIDGE SHOWN
NEW RAISED BRIDGE, MAINTAIN EXISTING ALIGNMENT



(C) SECTION THROUGH EXISTING BRIDGE

(NORTHBOUND SPAN SIMILAR)



(D) SECTION THROUGH NEW BRIDGE

(NORTHBOUND SPAN SIMILAR)

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

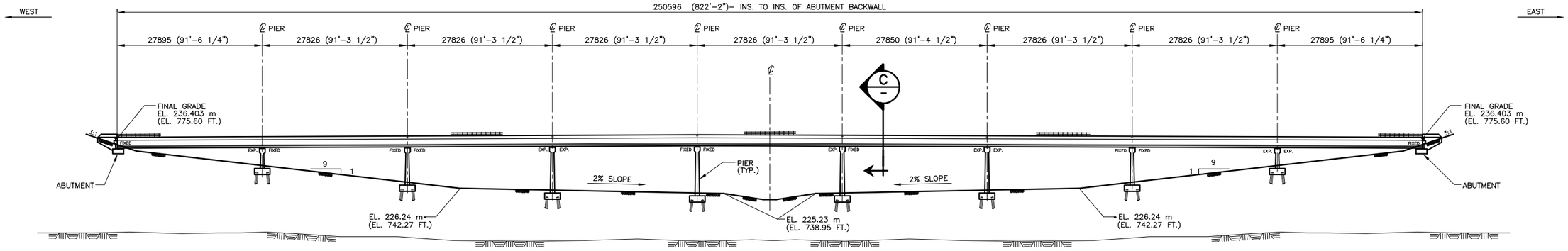
1 IN 700 YEAR EXPANDED FLOODWAY HIGHWAY BRIDGE MODIFICATIONS PTH 59 SOUTH

PLATE B–17 (SHEET 2 OF 6)

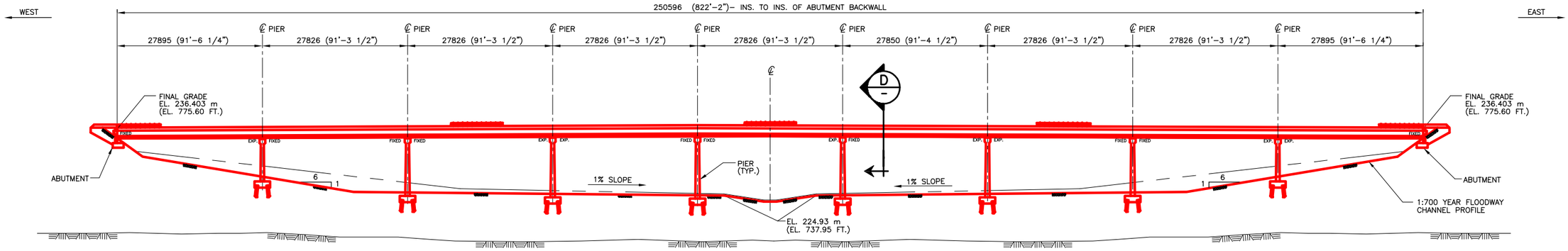
FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-17-2.DWG
24"x36"/PLOT SCALE: 100

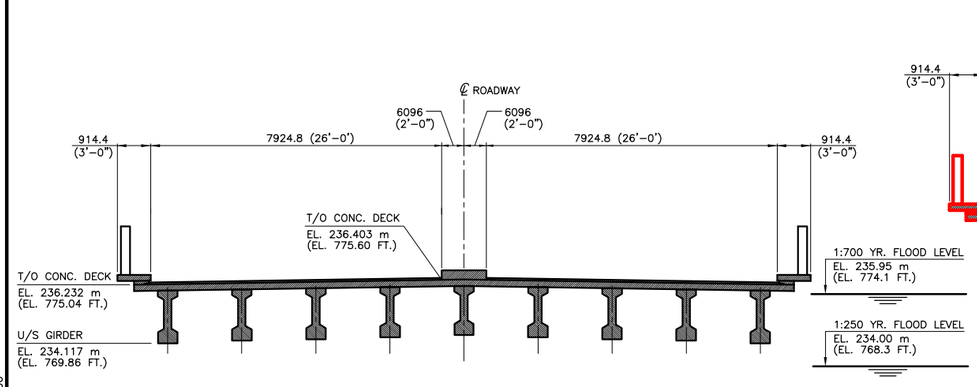


A ELEVATION – EXISTING

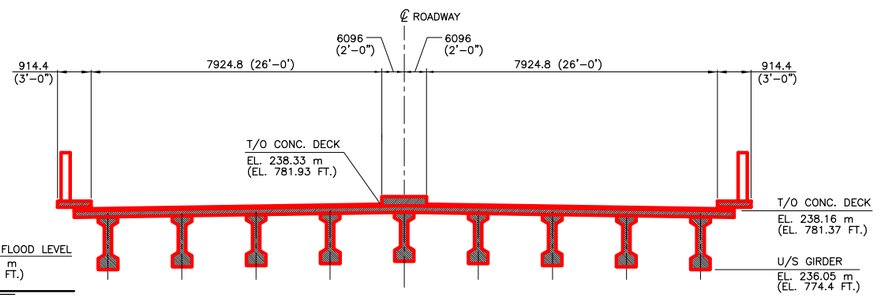


B ELEVATION – NEW BRIDGE

NEW RAISED BRIDGE, MAINTAIN EXISTING ALIGNMENT



C SECTION THROUGH EXISTING BRIDGE



D SECTION THROUGH NEW BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

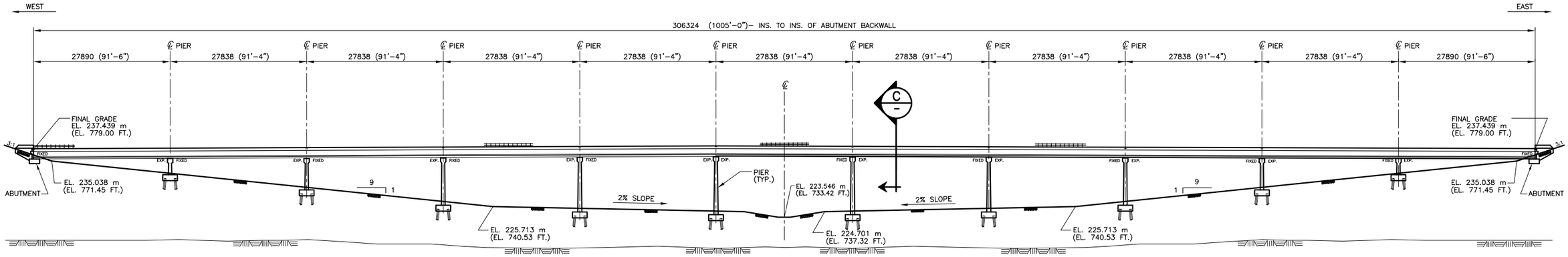
1 IN 700 YEAR EXPANDED FLOODWAY
HIGHWAY BRIDGE MODIFICATIONS
TRANS CANADA 1 EAST

PLATE B-17 ***(SHEET 3 OF 6)***

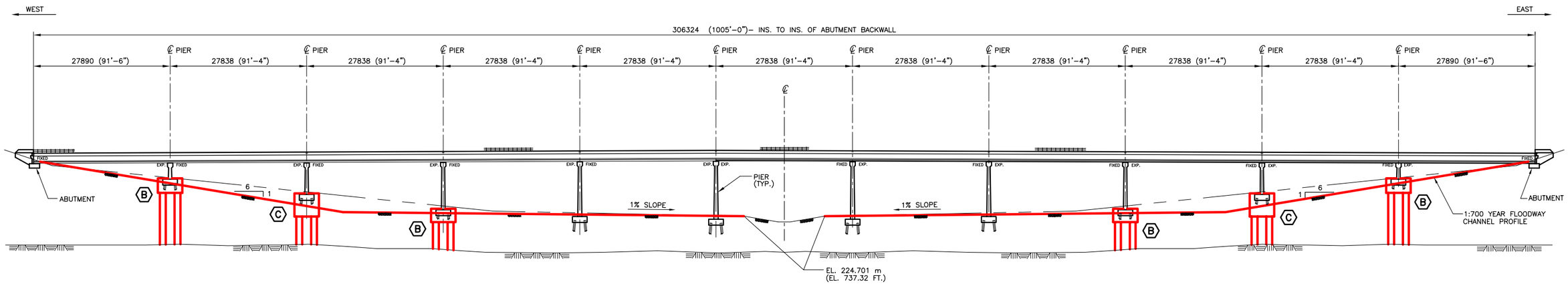
FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-17-3.DWG
24"x36"/PLOT SCALE: 100



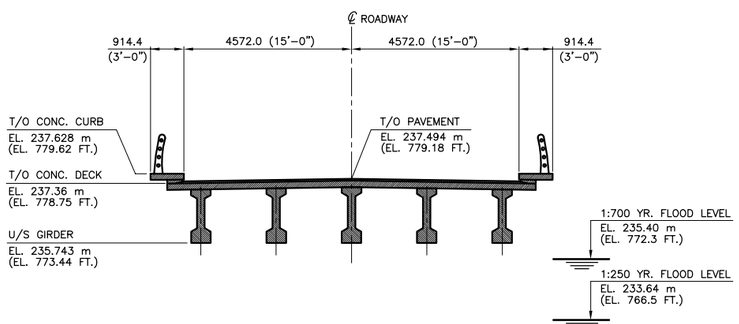
A — ELEVATION — EXISTING



B — ELEVATION — MODIFIED

RETROFIT EXISTING BRIDGE

TYPE—⬡— – DENOTES TYPE OF PIER REINFORCEMENT
FOR TYPICAL DETAILS SEE PLATE 'B-19'



C — SECTION THROUGH EXISTING BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

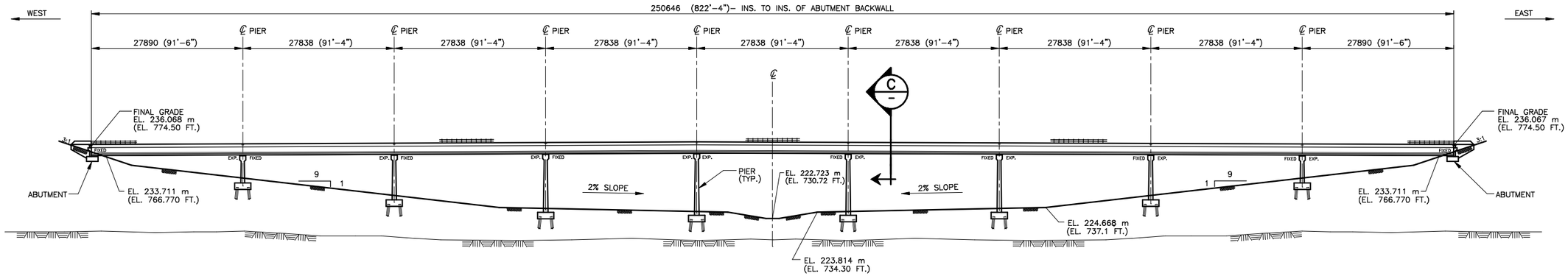
1 IN 700 YEAR EXPANDED FLOODWAY
HIGHWAY BRIDGE MODIFICATIONS
PTH 15

PLATE B-17 (SHEET 4 OF 6)

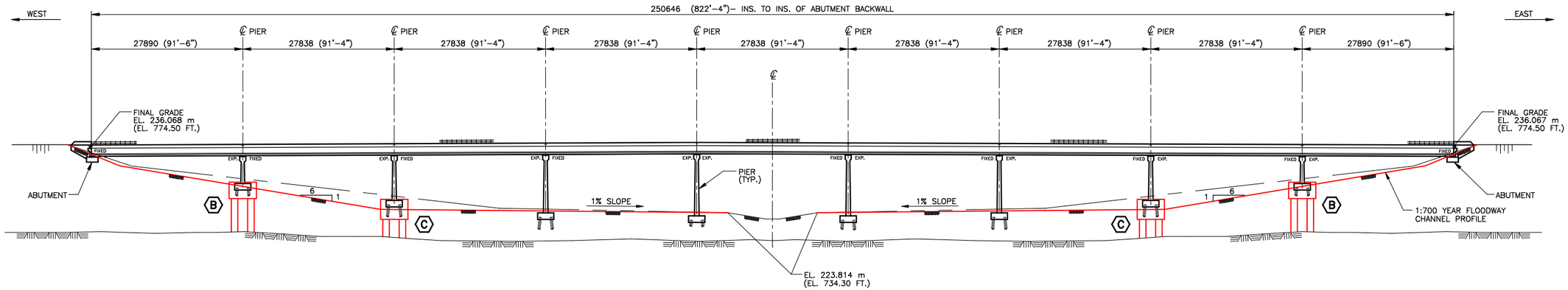
FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-17-4.DWG
24"x36" PLOT SCALE: 100



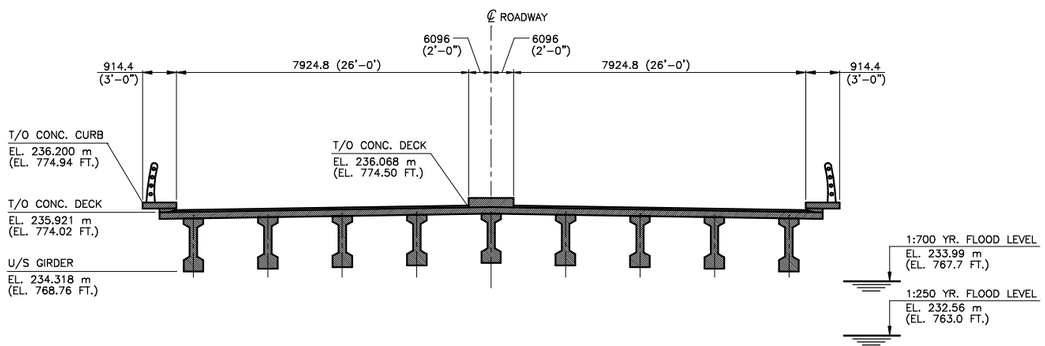
A — ELEVATION — EXISTING



B — ELEVATION — MODIFIED

RETROFIT EXISTING BRIDGE

TYPE—⬡— – DENOTES TYPE OF PIER REINFORCEMENT
FOR TYPICAL DETAILS SEE PLATE 'B-19'



C — SECTION THROUGH EXISTING BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

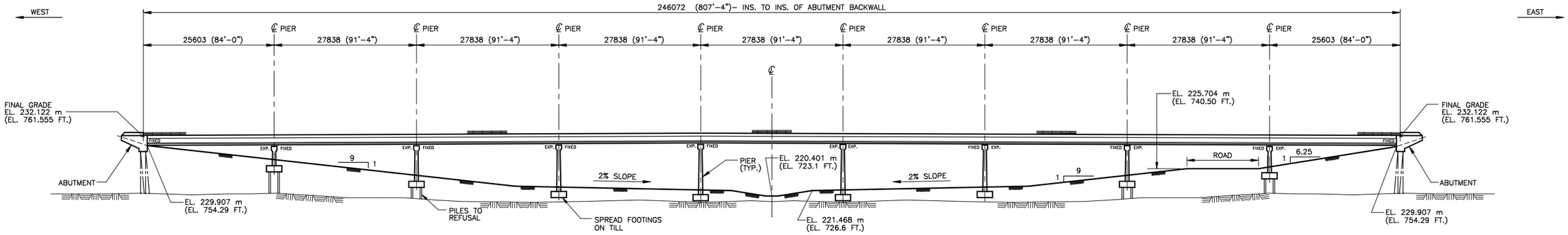
1 IN 700 YEAR EXPANDED FLOODWAY
HIGHWAY BRIDGE MODIFICATIONS
HIGHWAY 59 NORTH

PLATE B-17 (SHEET 5 OF 6)

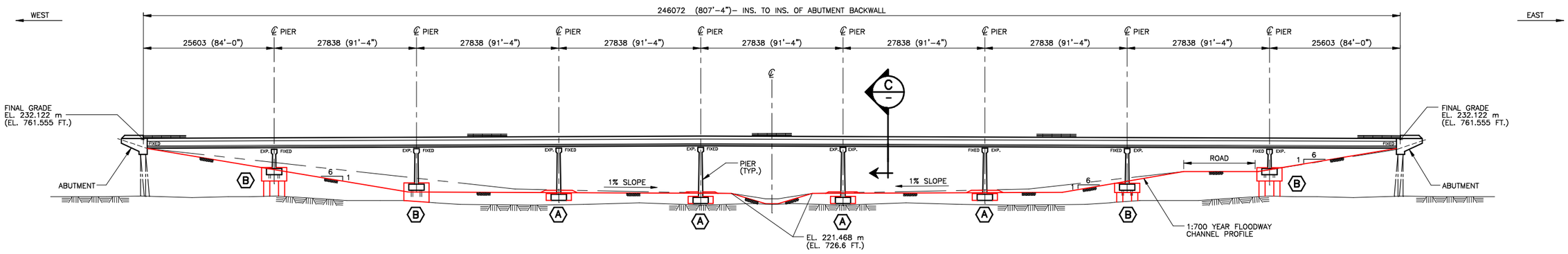
FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-17-5.DWG
24"x36"/PLOT SCALE: 100



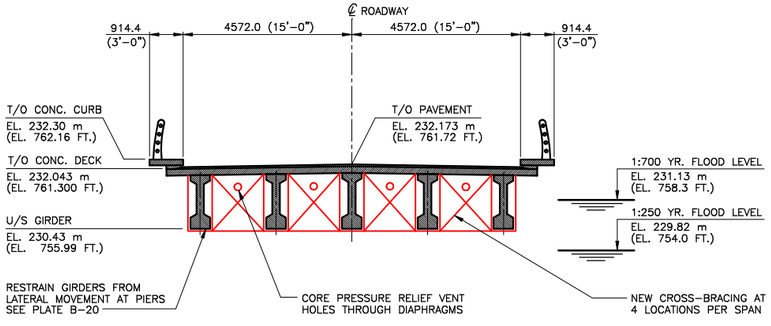
(A) ELEVATION – EXISTING



(B) ELEVATION – MODIFIED

RETROFIT EXISTING BRIDGE

TYPE –⟨-⟩– DENOTES TYPE OF PIER REINFORCEMENT
FOR TYPICAL DETAILS SEE PLATE 'B-19'



(C) SECTION THROUGH MODIFIED BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

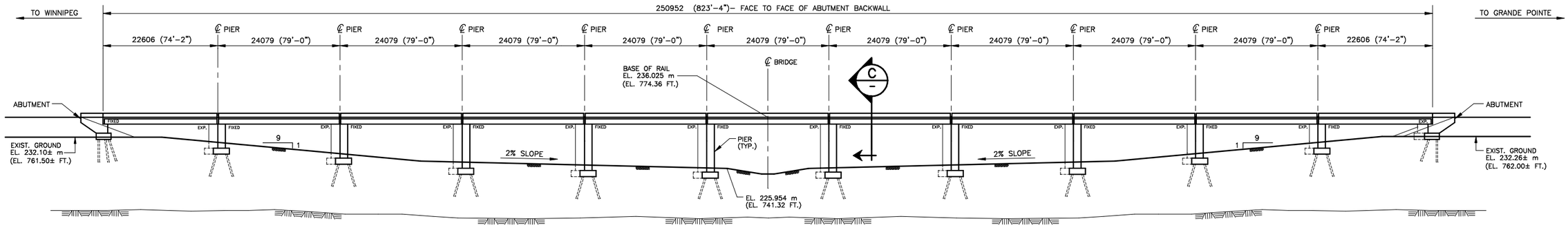
1 IN 700 YEAR EXPANDED FLOODWAY
HIGHWAY BRIDGE MODIFICATIONS
PTH 44

PLATE B-17 (SHEET 6 OF 6)

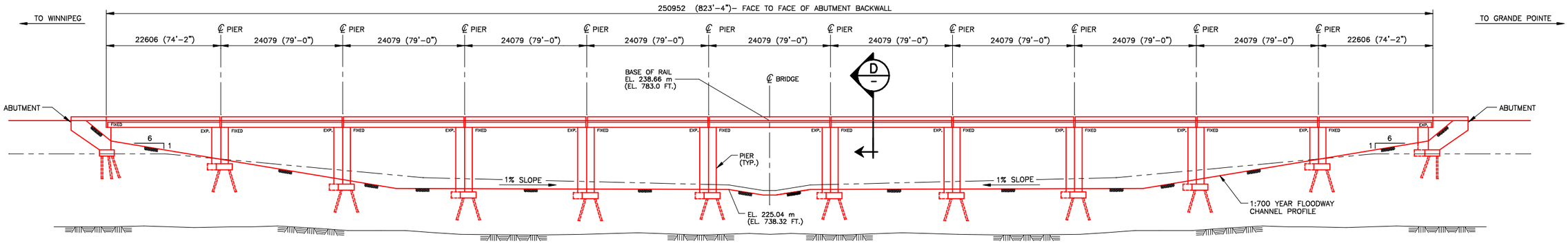
FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-17-6.DWG
24"x36"/PLOT SCALE: 100

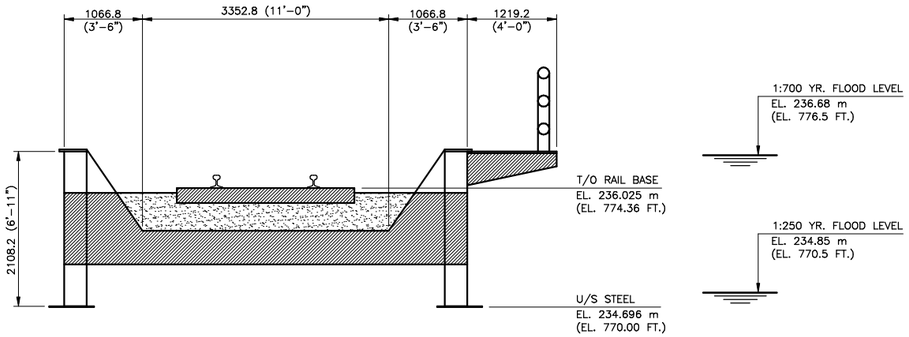


A ELEVATION – EXISTING

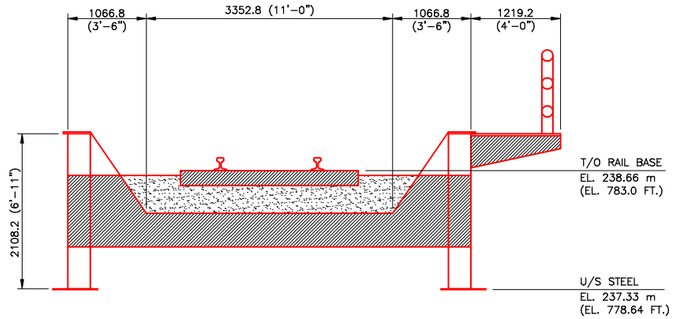


B ELEVATION – NEW BRIDGE

NEW RAISED BRIDGE ON NEW ALIGNMENT



C SECTION THROUGH EXISTING BRIDGE



D SECTION THROUGH NEW BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

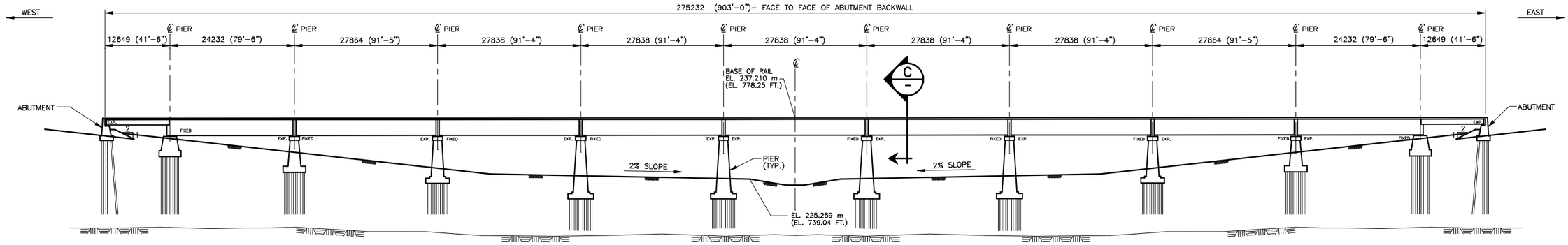
1 IN 700 YEAR EXPANDED FLOODWAY RAILWAY BRIDGE MODIFICATIONS CPR – EMERSON SUBDIVISION

PLATE B–18 (SHEET 1 OF 6)

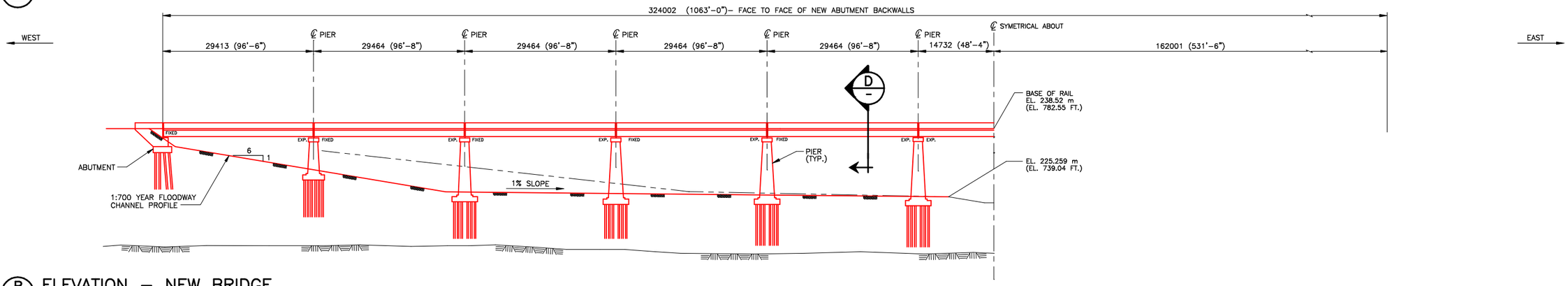
FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-18-1.DWG
24"x36"/PLOT SCALE: 100

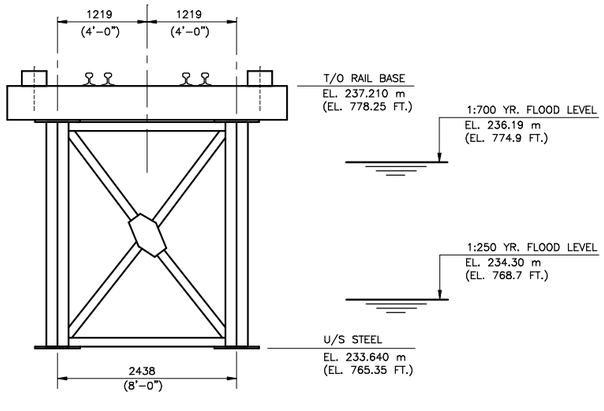


A ELEVATION – EXISTING

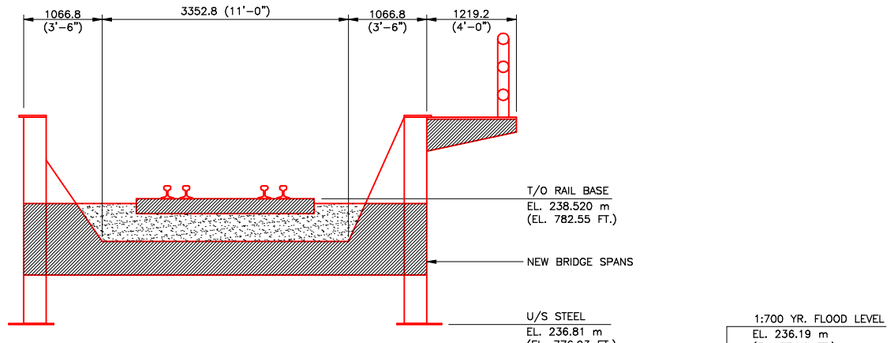


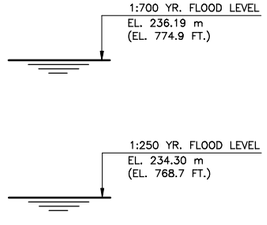
B ELEVATION – NEW BRIDGE

NEW RAISED AND LENGTHENED BRIDGE ON NEW ALIGNMENT



C SECTION THROUGH EXISTING BRIDGE





D SECTION THROUGH NEW BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

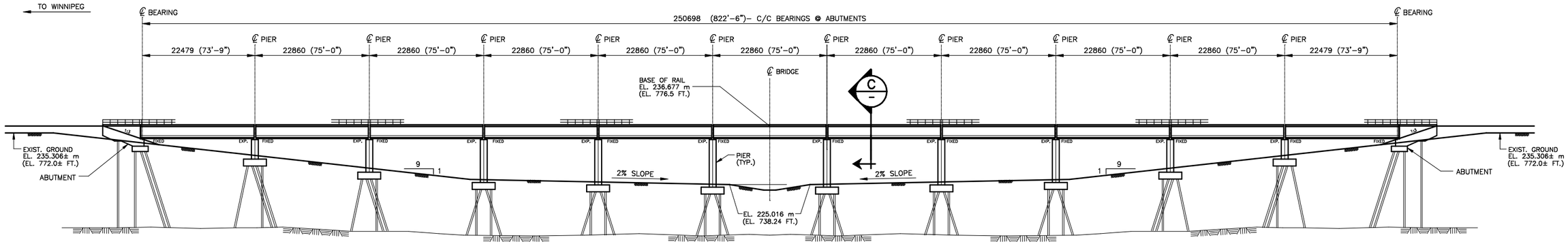
1 IN 700 YEAR EXPANDED FLOODWAY RAILWAY BRIDGE MODIFICATIONS CNR – SPRAGUE DIVISION

PLATE B–18 (SHEET 2 OF 6)

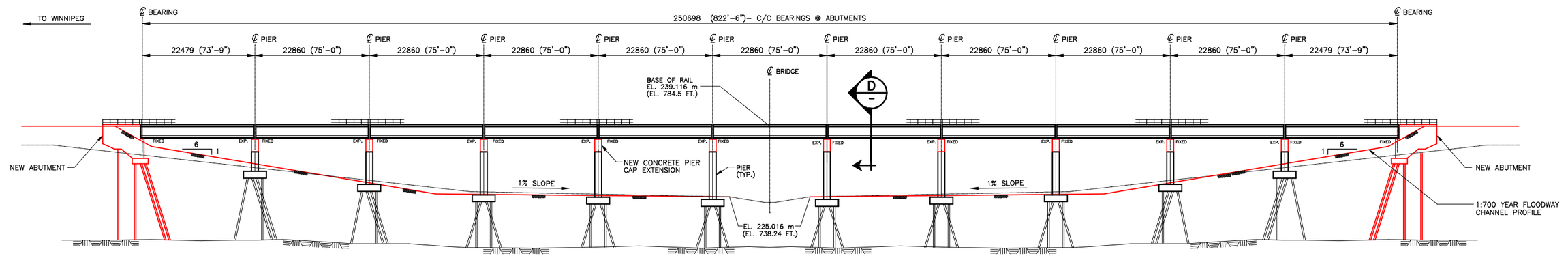
FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-18-2.DWG
24"x36"/PLOT SCALE: 100



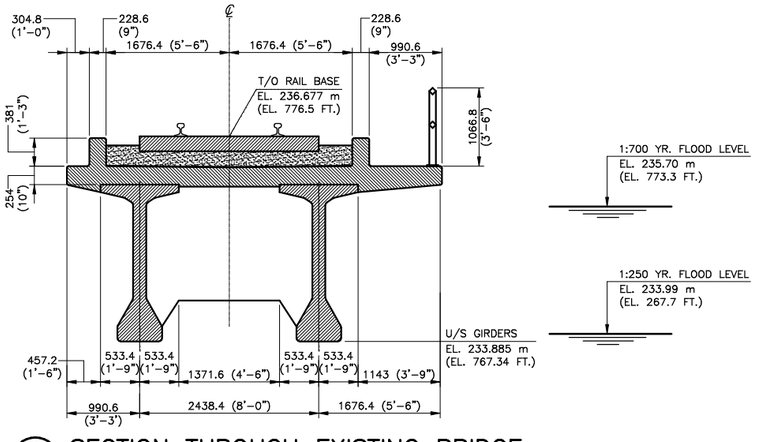
A ELEVATION – EXISTING



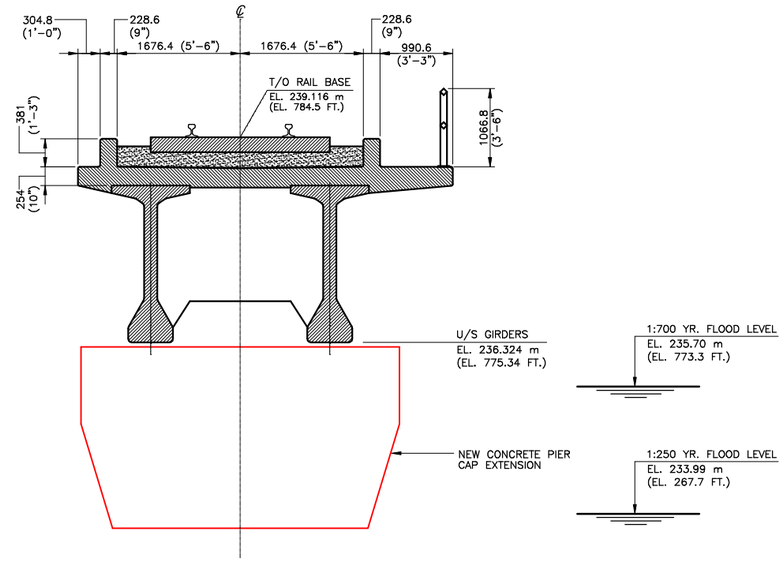
B ELEVATION – MODIFIED

RETROFIT, RAISE EXISTING BRIDGE

TYPE – ⬡ – DENOTES TYPE OF PIER REINFORCEMENT FOR TYPICAL DETAILS SEE PLATE 'B-19'



C SECTION THROUGH EXISTING BRIDGE



D SECTION THROUGH ELEVATED BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

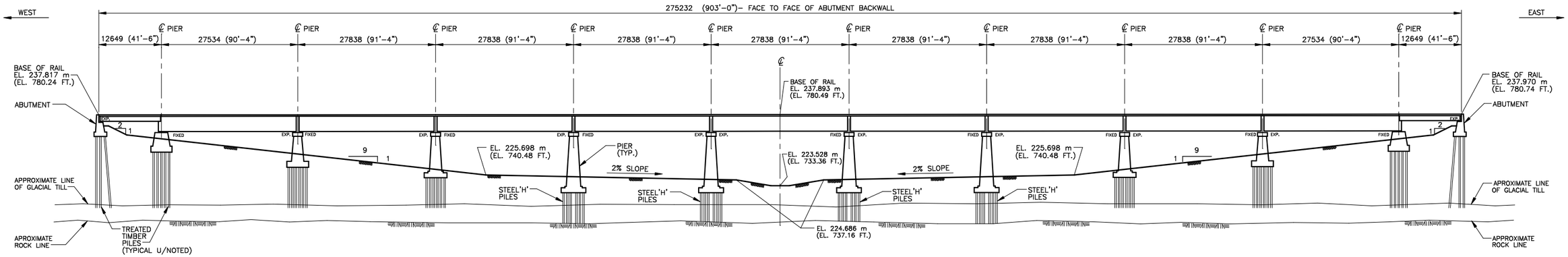
1 IN 700 YEAR EXPANDED FLOODWAY RAILWAY BRIDGE MODIFICATIONS GREATER WINNIPEG WATER DISTRICT

PLATE B-18 (SHEET 3 OF 6)

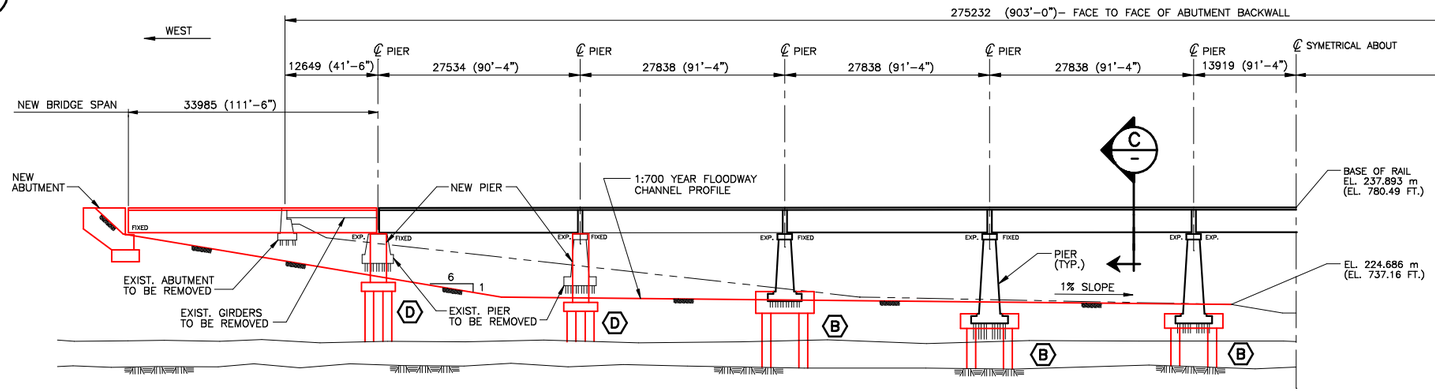
FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-18-3.DWG
24"x36"/PLOT SCALE: 100



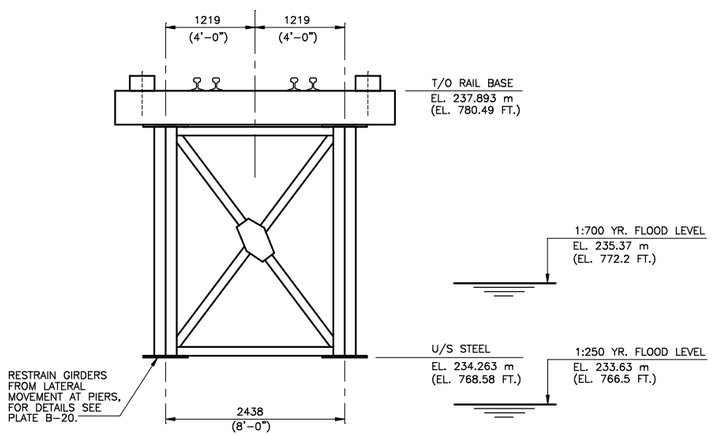
A — ELEVATION — EXISTING



B — ELEVATION — MODIFIED

RETROFIT AND LENGTHEN EXISTING BRIDGE

TYPE ⬡ - DENOTES TYPE OF PIER REINFORCEMENT
FOR TYPICAL DETAILS SEE PLATE 'B-19'



C — SECTION THROUGH MODIFIED BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

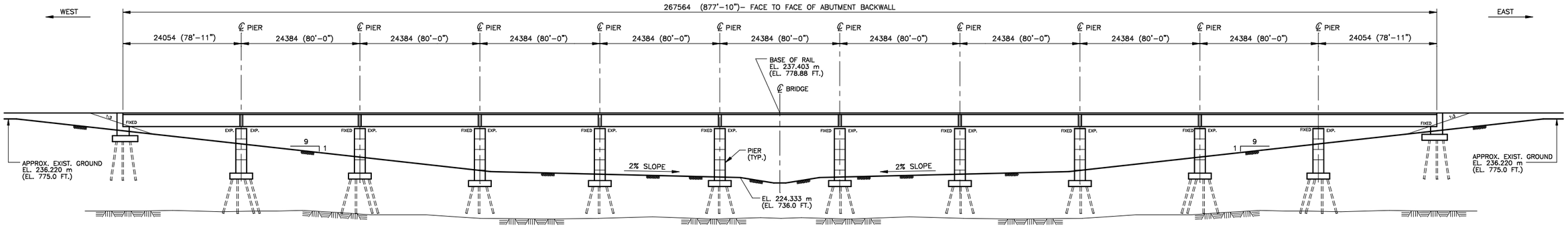
1 IN 700 YEAR EXPANDED FLOODWAY
RAILWAY BRIDGE MODIFICATIONS
CNR — REDDITT SUBDIVISION

PLATE B-18 (SHEET 4 OF 6)

FINAL REPORT — SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-18-4.DWG
24"x36"/PLOT SCALE: 100



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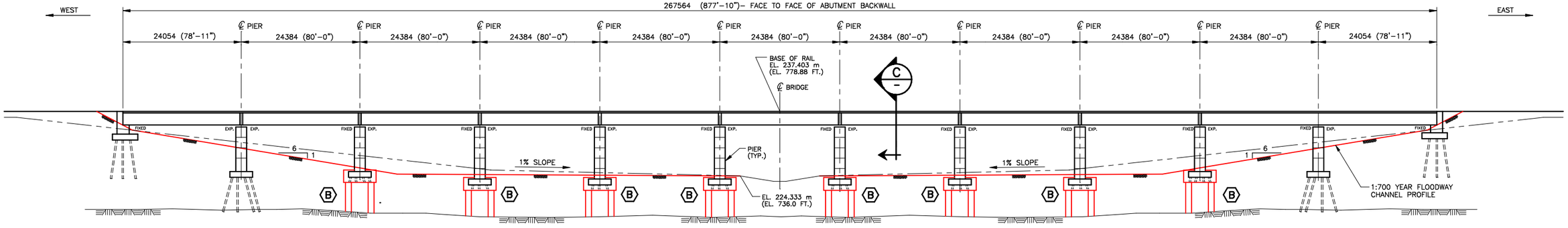
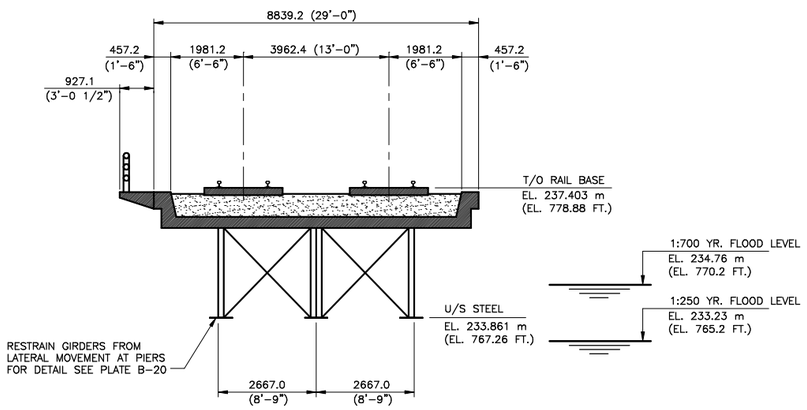


B — ELEVATION — MODIFIED

RETROFIT EXISTING BRIDGE

TYPE-⟨-⟩ – DENOTES TYPE OF PIER REINFORCEMENT
FOR TYPICAL DETAILS SEE PLATE 'B-19'



C — SECTION THROUGH MODIFIED BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

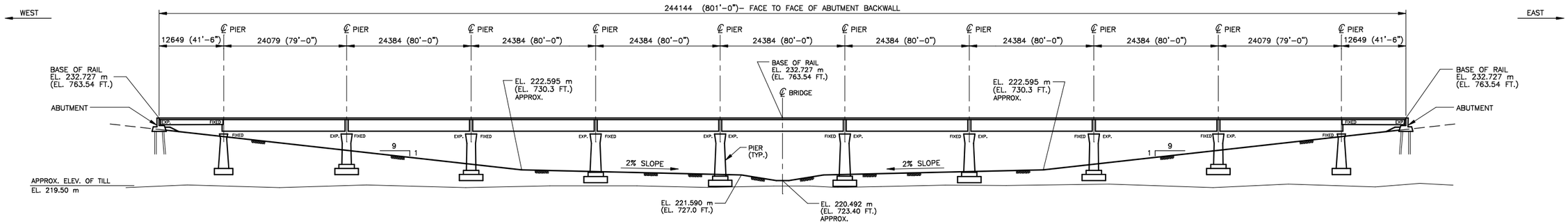
1 IN 700 YEAR EXPANDED FLOODWAY
RAILWAY BRIDGE MODIFICATIONS
CPR – KEEWATIN SUBDIVISION

PLATE B-18 (SHEET 5 OF 6)

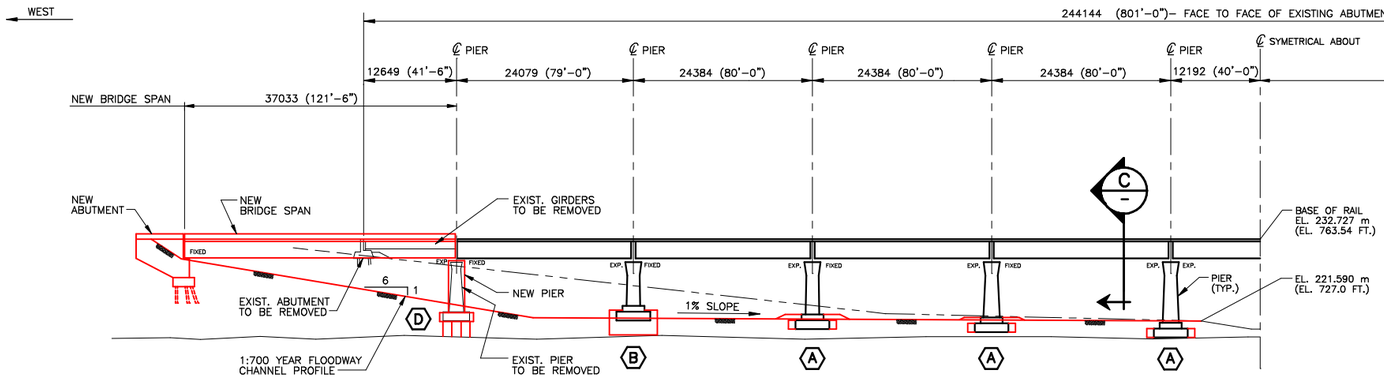
FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-18-5.DWG
24"x36"/PLOT SCALE: 100



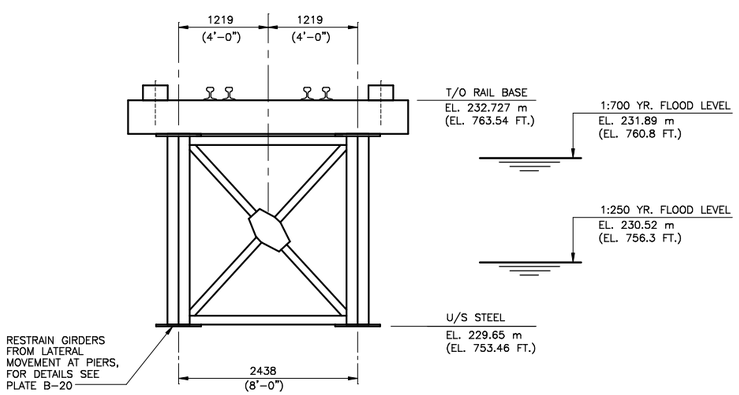
A — ELEVATION — EXISTING



B — ELEVATION — MODIFIED

RETROFIT AND LENGTHEN EXISTING BRIDGE

TYPE — ⬡ — DENOTES TYPE OF PIER REINFORCEMENT FOR TYPICAL DETAILS SEE PLATE 'B-19'



C — SECTION THROUGH MODIFIED BRIDGE

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

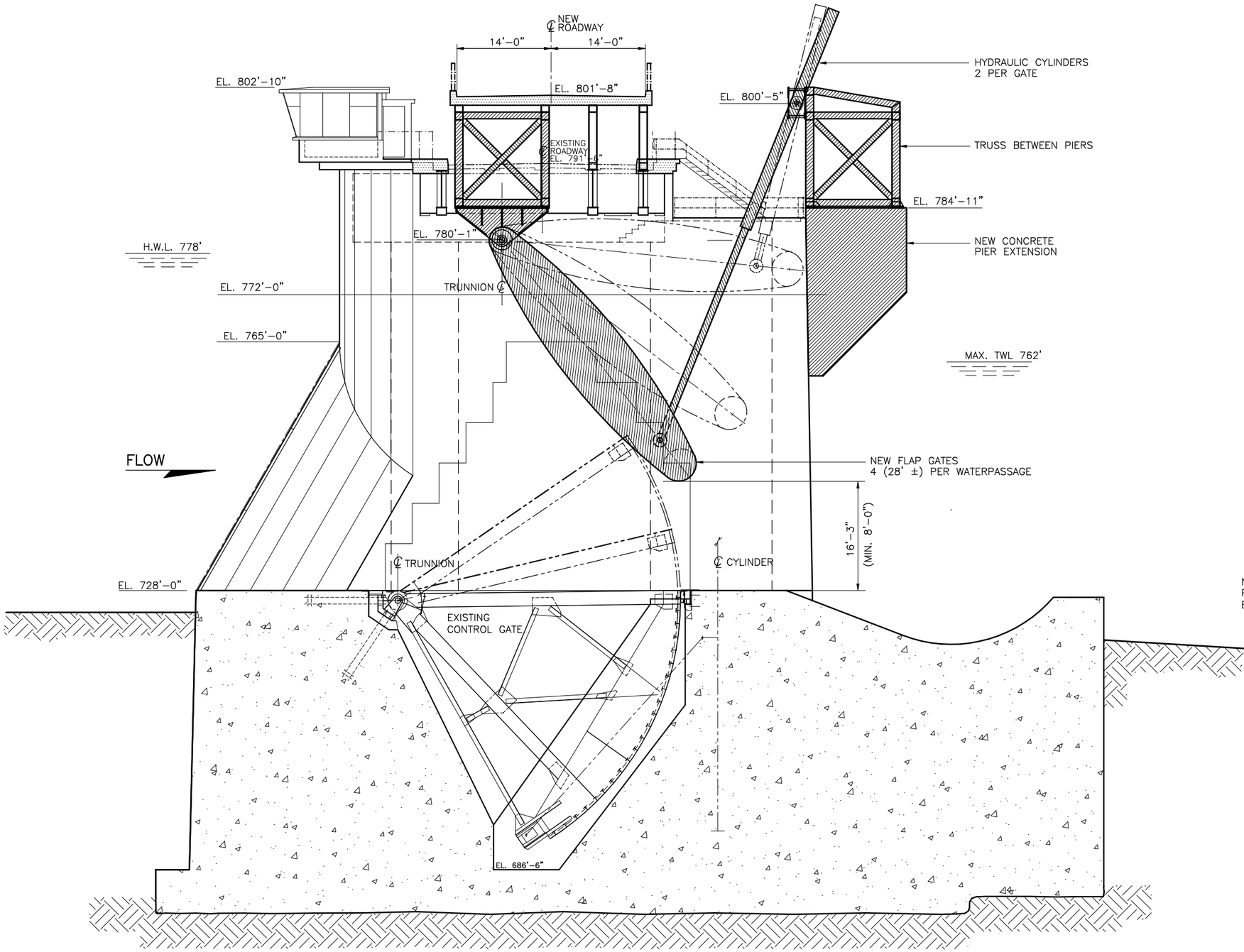
1 IN 700 YEAR EXPANDED FLOODWAY
RAILWAY BRIDGE MODIFICATIONS
CNR — PINE FALLS SUBDIVISION

PLATE B-18 (SHEET 6 OF 6)

FINAL REPORT — SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-18-6.DWG
24"x36"/PLOT SCALE: 100



NOTE:
POSSIBLE REQUIREMENTS FOR
ENERGY DISSIPATION NOT SHOWN.

SECTION (CENTER PIER)

0 2 4 8 12 16 20 24 28 32ft.

SCALE: 1/16"=1'–0" (11x17)

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

INLET CONTROL STRUCTURE
PROPOSED BACKUP GATES

PLATE B–21

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-21.DWG
24"x36"/PLOT SCALE:96

EL. VARIES (BEDROCK SURFACE)

EXISTING CHANNEL WIDTH 162'

OUTLET CHANNEL EL. 707'–6"

NEW CHANNEL WIDTH 380'

BERM EL. 738'–0"

BERM EL. 738'–0"

1:6

1:6

1:6

℄ FLOODWAY (EXISTING)

81'–0"

81'–0"

DEMOLISH EXISTING OUTLET WALL

NEW OUTLET WALL

EXISTING ROLLWAY

218'–0"

NEW ROLLWAY EXTENSION

(EXISTING) STEEL PIPES 2–42" DIA. EMBEDDED

EXISTING CREST EL. 730'–0" REWORK CREST TO EL. 734'–0"

NEW CREST EL. 734'–0"

157'–4"

77'–4"

EL. 761'–0"

EL. 761'–0"

RAMP

RAMP

6'–0"

8'–1"

LOW FLOW CHANNEL INVERT EL. 722'–7"

52'–0"

NEW OUTLET WALL

EL. 728'–4"

F G2

G G2

FLOW

1:6

EL. 728'–4"

1:3

1:3

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FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

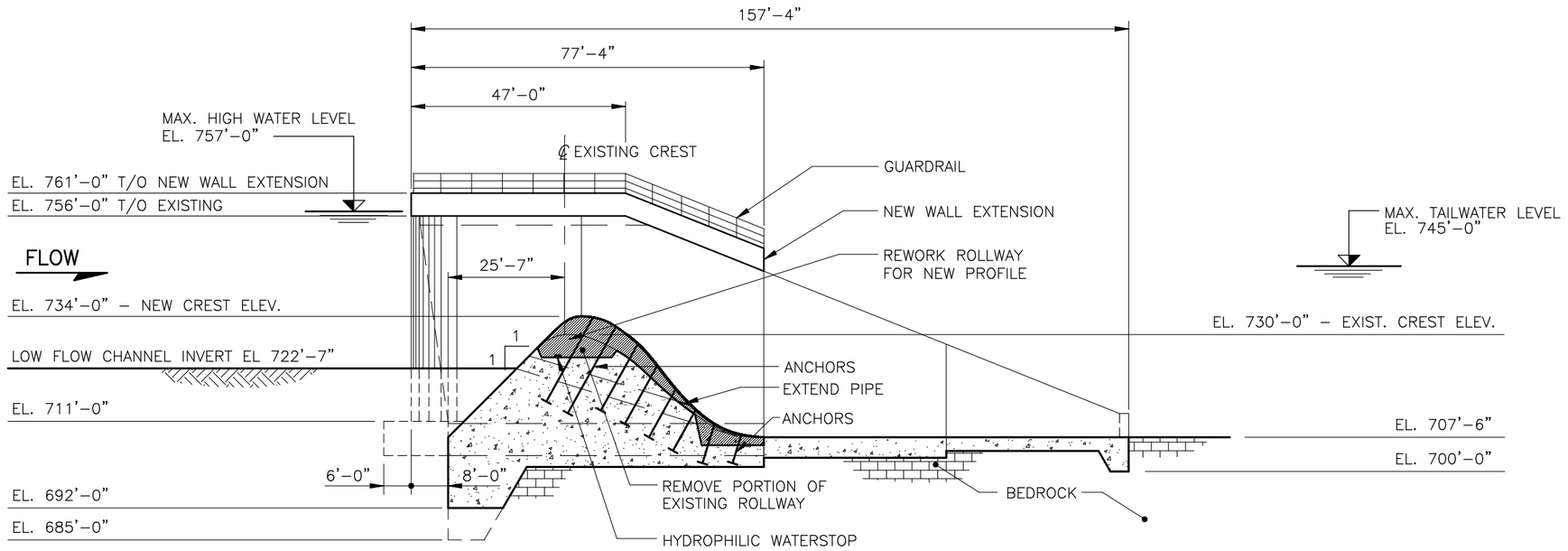
1 IN 700 YEAR EXPANDED FLOODWAY OUTLET STRUCTURE PLAN

PLATE B–22

FINAL REPORT – SEPTEMBER 2001

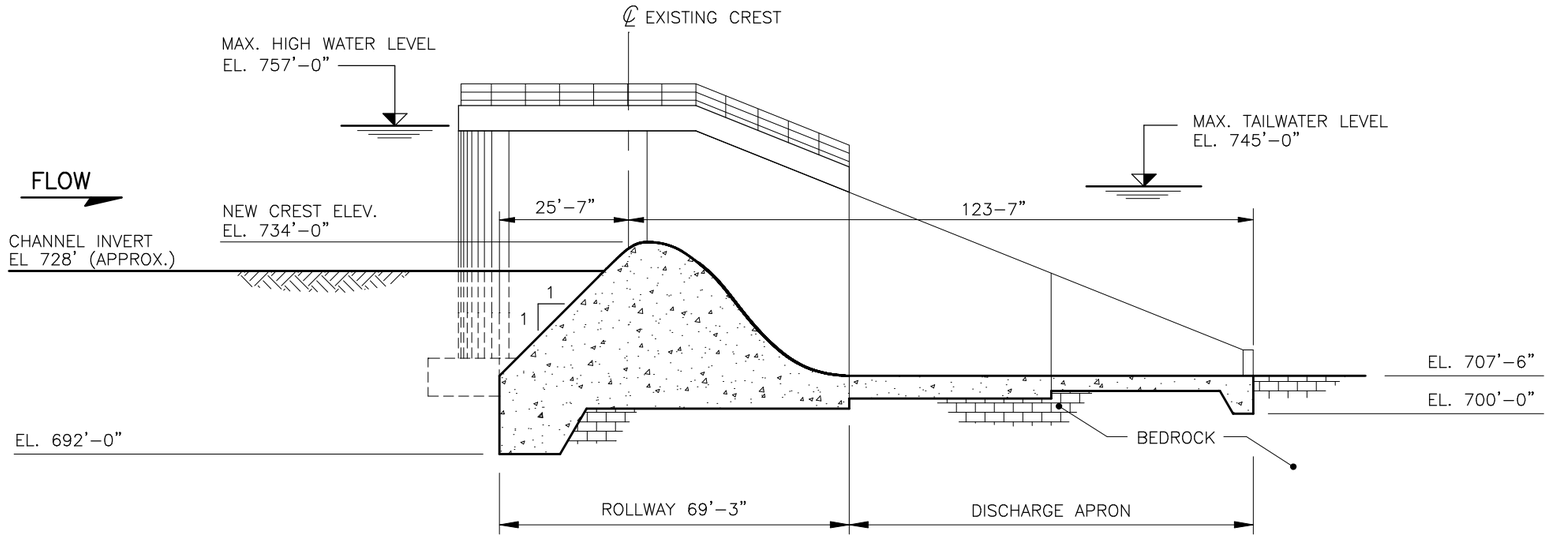
KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-22.DWG
24"x36"/PLOT SCALE: 360



F
G1

SECTION – REVISED EXISTING ROLLWAY



G
G1

SECTION – NEW ROLLWAY

Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

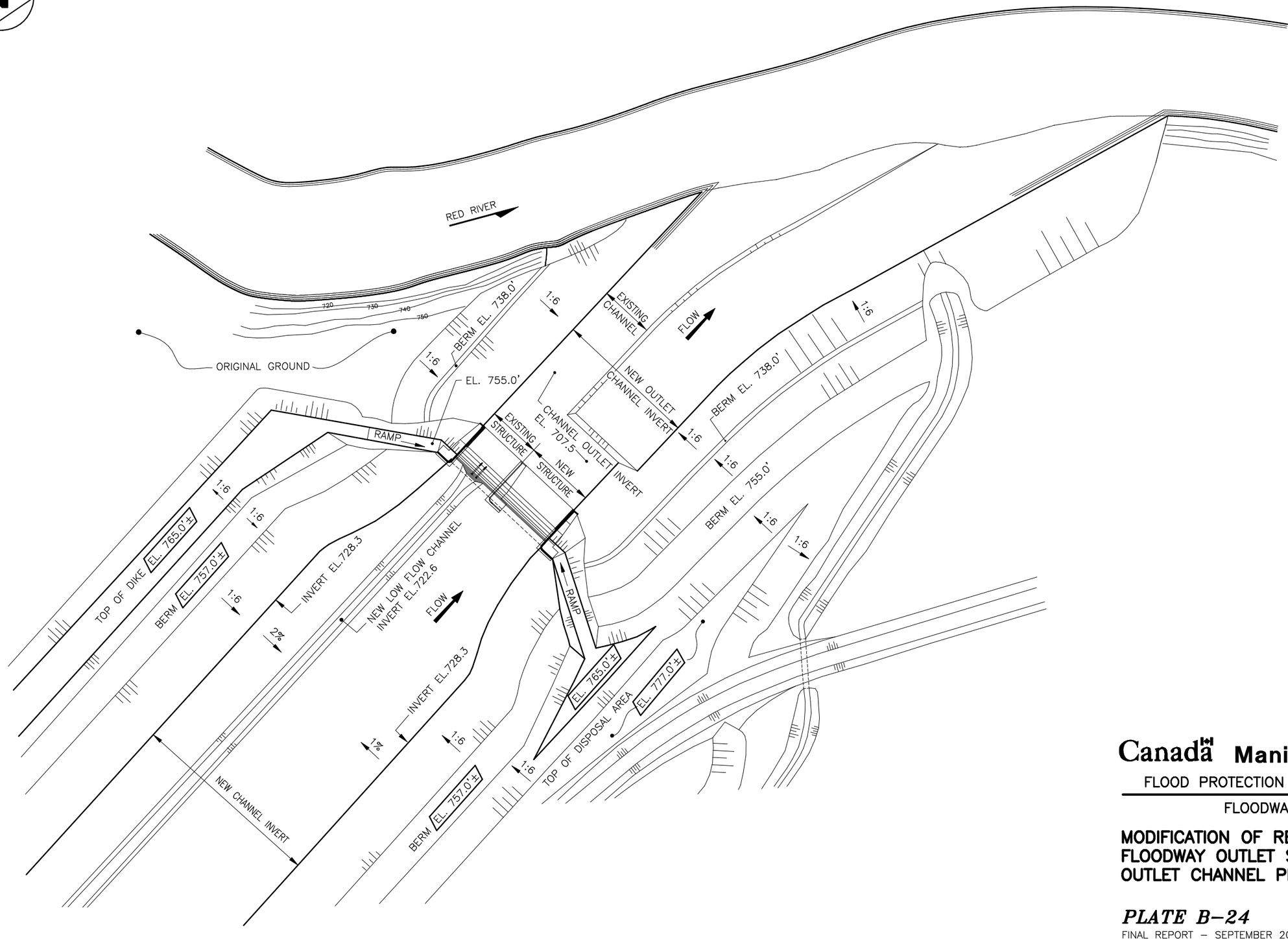
1 IN 700 YEAR EXPANDED FLOODWAY OUTLET STRUCTURE SECTIONS

PLATE B–23

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-23.DWG
24"x36"/PLOT SCALE: 1:80



Canada Manitoba Winnipeg

FLOOD PROTECTION STUDIES FOR WINNIPEG

FLOODWAY EXPANSION

MODIFICATION OF RED RIVER FLOODWAY OUTLET STRUCTURE AND OUTLET CHANNEL PLAN

PLATE B–24

FINAL REPORT – SEPTEMBER 2001

KGS GROUP

KGS FILE NO.: P:/00-311-07/ADMIN/ADMINDOCS/FINAL REPORT/APPENDIX B/PLATES/PLATE B-24.DWG
24"x36"/PLOT SCALE: 2400