Shore Gold Inc.

Design Basis Memorandum
Upgrade of Bridge Crossing over White Fox River
Star/Orion South Project

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Date:

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Revision Log

Revision #	Revised By	Date	Issue / Revision Description
A	Initial Issue	June 18, 2010	Issued for Review
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AECOM Signatures

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Appendix A: Saskatchewan Ministry of Highways and Infrastructure Standard Plan No. 20150

1. Introduction

1.1 Background

Shore Gold Inc. is planning on upgrading the existing bridge crossing over the White Fox River located southeast of Shipman, Saskatchewan. This upgrade is the result of this route becoming the main access into the proposed Star/Orion Mine site. The new bridge will be suitable for the anticipated traffic loadings over the twenty-five (25) year service of the mine.

Based on drawings supplied by Shore Gold Inc., the existing bridge was constructed in 2007 and consists of a "portable" steel bridge manufactured by Armtec/Rapid-Span Structures. The bridge abutments consist of galvanized steel bin walls designed by Armtec. Photographs of the existing bridge taken by AECOM in June 2010 are provided below. At the time of our inspection, water levels were above normal.

Photograph No. 1 – Centreline of Existing Bridge

Photograph No. 2 – Bridge Elevation

This Pre-design Report summarizes the existing conditions, examines various bridge upgrading options, and provides recommendations, a preliminary cost estimate and schedule.

Preliminary drawings (Figures 1 – 5) of the alternative structure types and recommended replacement structure are included in the body of this report.

1.2 Design Considerations

The following design considerations were evaluated to develop preliminary details for the proposed bridge structure:

- Roadway cross-section and alignment
- Hydraulic considerations
- Construction in remote area
- Regulatory Approvals
- Geotechnical Considerations
- Design Loading

2. Existing Conditions

2.1 Bridge Structure

The existing bridge was constructed in 2007 and consists of a 17.9 m clear span x 4.9 m wide “portable” steel bridge manufactured by Armtec/Rapid-Span Structures. The bridge design is based on a CS750 Truck (CSA S6-88) or British Columbia Forestry Truck (BCFS) L100 (90,580 GVW) Truck. The bridge superstructure is supported by a rubber bearing pads and a precast concrete sill placed on compacted, granular fill within the confines of galvanized steel bin walls designed by Armtec.

The current bridge is capable of accommodating one (1) lane of traffic.

2.2 Bridge Hydraulics

Information provided in the bridge hydraulic study completed by Water Resource Consultants Ltd. in March, 2006 indicates the 18 m span bridge meets the requirements for fish passage velocity. The elevation of the top of the bridge deck is 432.4 m based on Drawing No. S1549.1-001 prepared by Clifton Associates Ltd. This is above the 1:50 peak flow elevation of 432.0 m. Navigation clearance under the bridge varies between 1.5 m at the Q2 Water Level and 2.2 m under average summer water levels based on this same drawing. It is understood that the existing bridge structure has been approved by the Regulatory Agencies including Navigable Waters, Fisheries and Oceans Canada and Saskatchewan Environment.

3. Bridge Upgrade Options

3.1 Overview

A total of four options were developed for upgrading the bridge. The options focused on the following design considerations:

- Roadway cross-section and alignment
- Hydraulic considerations
- Construction time
- Regulatory approvals
- Geotechnical considerations
- Design Loading
- Winter Construction

3.2 Roadway Cross-Section and Alignment

The desired crossing will accommodate two (2) lanes of traffic. The recommended roadway width consists of 2-3.7 m wide lanes with 2.0 m wide shoulders and is classified as a paved secondary class highway. The location of the bridge structure is dependent on the final roadway alignment but it is anticipated that the roadway will generally follow the existing road alignment north of the White Fox River. This will require widening the existing one-lane bridge or constructing a new bridge at the existing location, or adjacent to the existing bridge.

Appendix A includes Saskatchewan Ministry of Highways and Infrastructure Standard Plan No. 20150 for recommended bridge widths on Provincial Highways and Roads. A bridge width of 11.0 m is required for the recommended roadway cross-section and bridge span of approximately 18 m.

3.3 Hydraulic Considerations

The existing hydraulic cross-section will be maintained as well as the existing navigational clearance box. The elevation of the new roadway will be based on the superstructure depth of the bridge and maintaining the existing hydraulic clearance box to minimize the height of the abutment walls.

3.4 Construction Time

Consideration has been given to the use of pre-fabricated bridge components to expedite the construction time and reduce costs, given the remoteness of the bridge site.

3.5 Regulatory Approvals

Upgrading the existing bridge structure will require approval from the following agencies:

- Fisheries and Oceans Canada
- Navigable Waters Protection Program
- Saskatchewan Environment

The existing one-lane bridge has been approved by the above agencies therefore widening the bridge may result in an expedited approval process in comparison to a new bridge structure.

3.6 Geotechnical Considerations

A geotechnical investigation was conducted by Clifton Associates Ltd. as part of the existing bridge design and foundation design recommendations are provided in the *"Geotechnical Report – Shipman Trail Bridge, Shipman, Saskatchewan – January 19, 2007"* prepared by Clifton Associates Ltd.. The bottoms of the existing bridge abutment bin walls appear to be founded approximately 800 to 1000 mm below existing ground based on Drawing No. S1549.1-001 prepared by Clifton Associates Ltd.. There is not adequate as-built information available to assess if the bin walls are founded on the upper silty clay or clayey silt or the underlying till.

An inspection of the existing abutments was conducted by AECOM on June 10, 2010 to assess the existing performance of the bin walls and determine their suitability for use in the new bridge structure. Our inspection found localized bending of the upper cap plate of the bin wall at the south abutment. Generally, the bin walls appear to be in good condition and have been performing satisfactorily since 2007.

3.7 Design Loadings

The design of the new bridge would be in accordance with the Canadian Highway Bridge Design Code (CHBDC) - CAN/CSA-S6-06. The design vehicle would consist of a CHBDC CL-750 Truck plus, dynamic load allowance which is the current standard vehicle loading used on Saskatchewan Highways.

3.8 Winter Construction

The timing of the construction has not been confirmed but it is possible that the construction work may take place during the winter months. The advantages of winter construction include the reduction of the negative impacts on navigational, environmental and fish habitat regulations during construction. Disadvantages include increased construction costs due to the requirement for heating and hoarding during placement of concrete and granular backfill. Bridge options have been evaluated with the feasibility of winter construction.

3.9 Bridge Options

The following bridge options were considered as part of the pre-design work:

- Widen the existing bridge structure to accommodate the proposed roadway.
- Construct a new precast girder bridge.
- Construct a new steel girder bridge .
- Construct a new corrugated steel plate arch structure.

3.9.1 Option 1 - Widen Existing Bridge

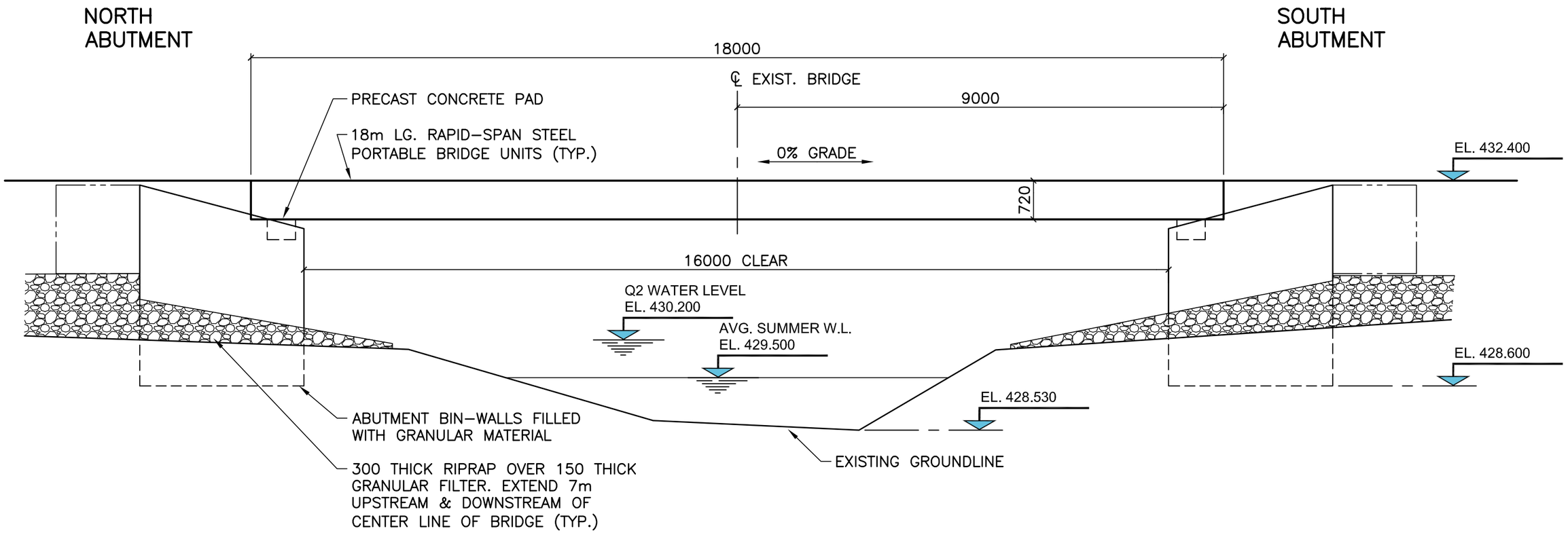
This option consists of the installation of one (1) additional bin wall cell adjacent to the each of the existing exterior bin walls at the abutments. The existing bin wall wingwalls would be removed and reconnected to the new exterior bin walls. The resulting width of the new abutments would be increased from 9.1 m to 15.2 m. The construction of the new abutment bin walls could proceed without disrupting traffic on the existing bridge.

Once the abutments have been widened, the bridge would be closed to traffic to permit the excavation and realignment of the bin walls for the new wingwalls. The existing bridge superstructure units would be unbolted and relocated to the exterior edges of the new bridge. New bridge superstructure units would then be placed and connected between the exterior units to result in a widened bridge structure.

Three (3) additional units would be installed to create a clear width of 11.98 m between the bridge rails to maintain the desired roadway width of 11.4 m (including 2.0 m shoulders). Estimated construction cost for this option is provided in Section 3.10 of this Report.

This option will require temporary closure of the bridge for an estimated three (3) weeks during construction of the wingwall bin walls and erection of the new bridge units. The existing bridge deck surface consists of steel plate overlaid with gravel. The new bridge deck would be an exposed steel plate coated with an epoxy-bonded anti-skid deck wearing surface by the bridge manufacturer. The new bridge units would be designed and fabricated by Armtec/Rapid Span Structures Ltd. W-beam approach guardrails would be installed in accordance with Saskatchewan Ministry of Highways and Infrastructure Standards.

A preliminary plan and cross-section of this alternative is provided in Figures 1 and 2.



SECTION A (XX-T-F02)

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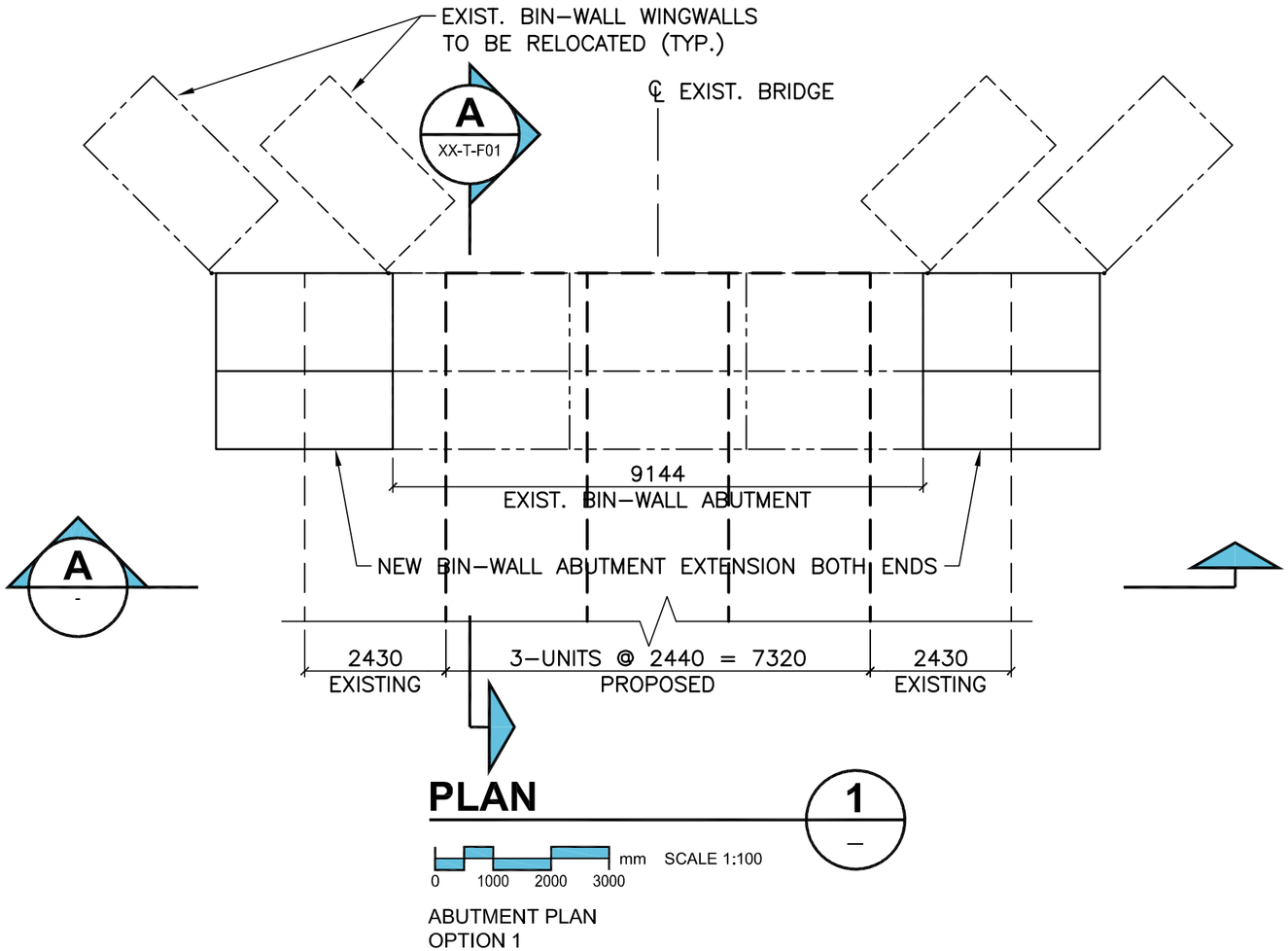
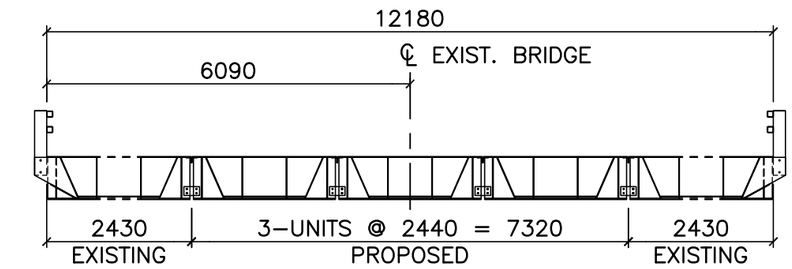
0 750 1500 2250

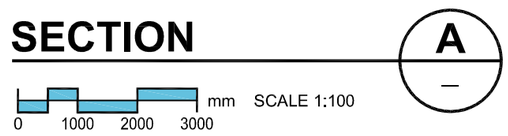
OPTION 1 - LONGITUDINAL

FIGURE 1
WIDEN EXISTING STRUCTURE
OPTION 1



ABUTMENT PLAN
OPTION 1





OPTION 1

FIGURE 2
WIDEN EXISTING STRUCTURE
OPTION 1

3.9.2 Option 2 - New Precast Girder Bridge

This option consists of the construction of a new bridge located either at the existing bridge location or adjacent to the existing bridge. If desired, the existing crossing would be maintained as construction access until the new bridge is completed. The existing portable bridge would be dismantled and removed/salvaged. The existing bin walls would also be removed and salvaged.

The precast girder bridge would be similar to a current standard Saskatchewan Ministry of Highways and Infrastructure structure. The precast boxes would be 710 mm deep, clear spanning the river (18 m span) and would be supported by precast concrete abutment caps and driven steel pipe piles. The abutment backwalls would consist of pressure treated timber planks. Precast concrete bridge barriers would be constructed monolithically with the precast box girders.

The bridge wearing surface would consist of asphalt concrete pavement placed directly onto the precast box girders. The use of waterproofing membrane is not considered due to the twenty-five (25) year service life.

W-beam approach guardrails would be installed in accordance with Saskatchewan Ministry of Highways and Infrastructure Standards.

A preliminary plan and cross-section of this alternative is provided in Figure 3.0.

The estimated construction cost for this option is provided in Section 3.9 of this Report.

3.9.3 Option 3 - New Steel Girder Bridge

This option consists of the construction of a new bridge located either at the existing bridge location or adjacent to the existing bridge crossing. If desired, the existing crossing would be maintained as construction access until the new bridge is completed. The existing portable bridge would be dismantled and removed/salvaged. The existing bin walls would also be removed and salvaged.

The steel girder bridge would consist of five (5) girder lines clear spanning the river (18 m span) and would act compositely with the concrete bridge deck. The steel girders would be approximately 645 mm deep. The bridge deck would consist of full depth precast concrete panels due to the remoteness of the proposed bridge site. Cast-in place concrete barriers or steel railing would be considered for the bridge. The substructure would consist of a precast concrete abutment cap and driven steel pipe piles similar to the precast girder bridge previously described in Section 3.7.2. The abutment backwalls would consist of pressure treated timber planks.

The bridge wearing surface would consist of asphalt concrete pavement placed directly onto the precast deck panels. The use of a waterproofing membrane is not considered due to the twenty-five (25) year service life.

W-beam approach guardrails would be installed in accordance with Saskatchewan Ministry of Highways and Infrastructure Standards.

A preliminary plan and cross-section of this alternative is provided in Figure 4.

The estimated construction cost for this option is provided in Section 3.9 of this Report.

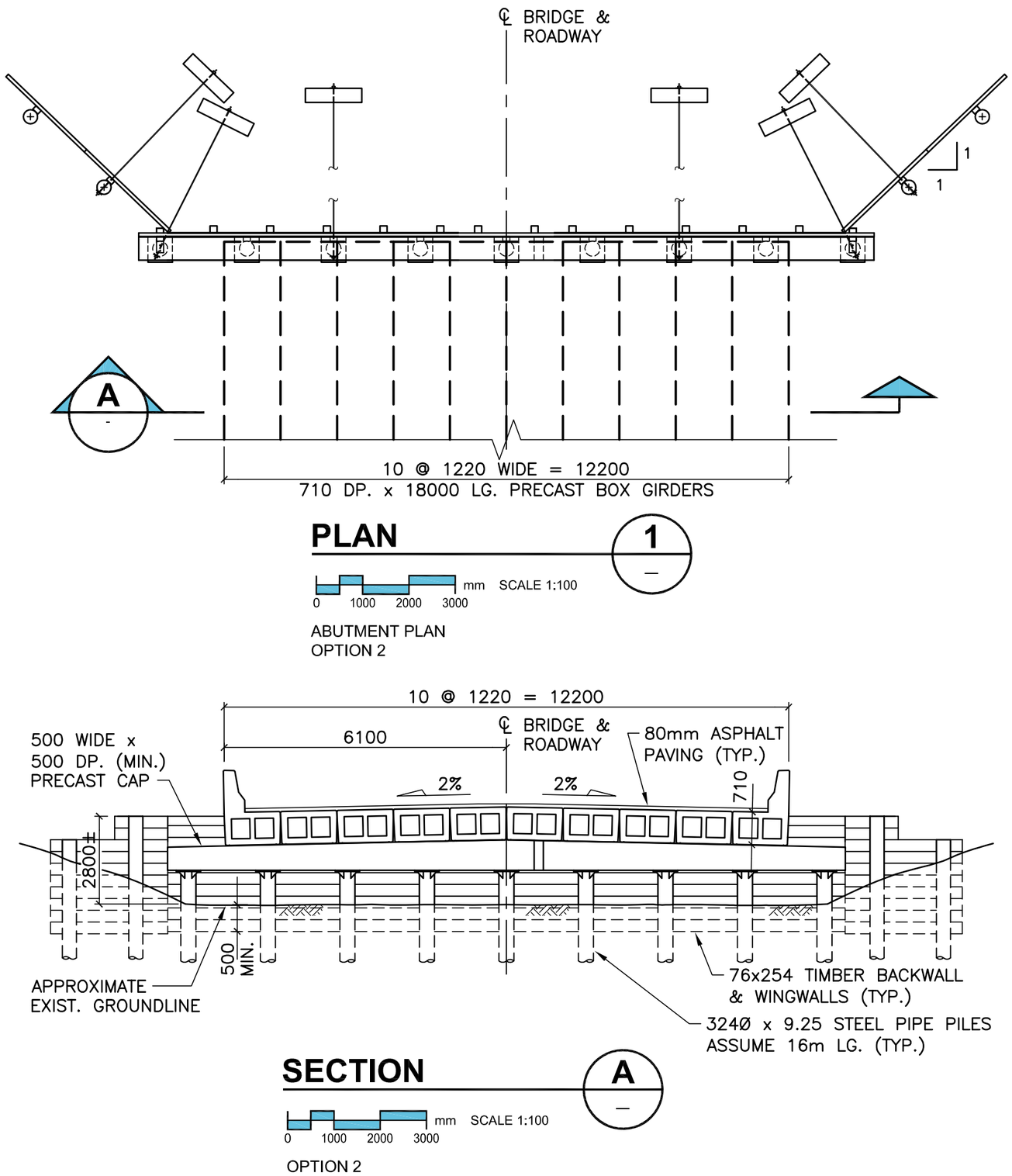
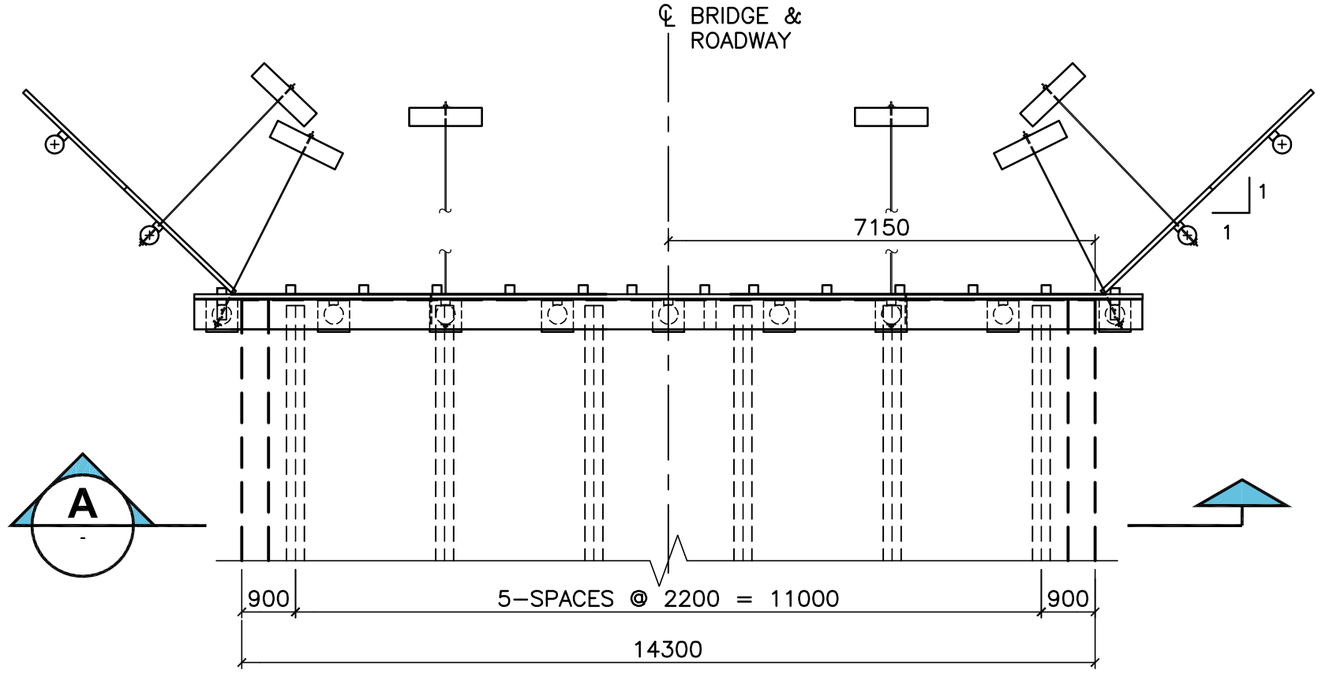


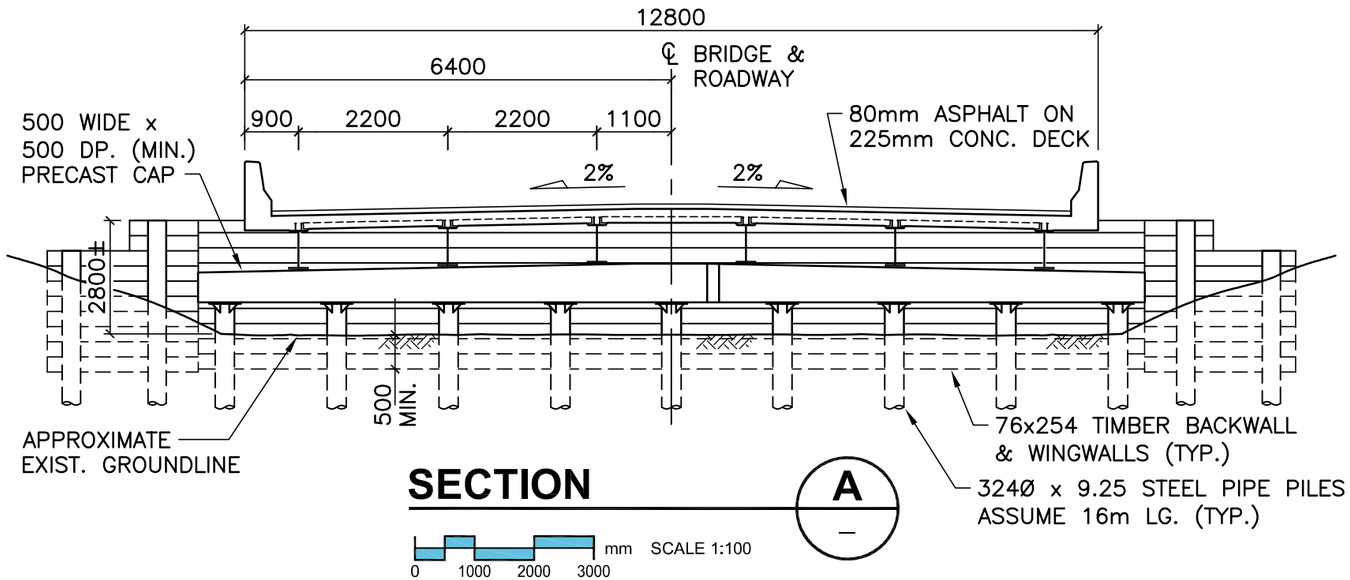
FIGURE 3
PRECAST BOX GIRDER STRUCTURE
OPTION 2



PLAN 1

0 1000 2000 3000 mm SCALE 1:100

ABUTMENT PLAN
OPTION 3



SECTION A

0 1000 2000 3000 mm SCALE 1:100

OPTION 3

FIGURE 4
STEEL DECK & CONC. DECK STRUCTURE
OPTION 3

3.9.4 Option 4 - New Steel Plate Arch Structure

This option consists of the construction of a new bridge located either at the existing bridge location or adjacent to the existing bridge crossing. If desired, the existing crossing would be maintained as construction access until the new bridge is completed. The existing portable bridge would be dismantled and removed/salvaged. The existing bin walls would also be removed and salvaged.

The steel plate arch structure would consist of clear span corrugated steel arch (16 m span). The arch would be founded on cast-in-place concrete footings. Headwalls consisting of corrugated steel or pre-cast concrete would be considered.

This option will require the raising of the existing roadway approximately 1 m in order to accommodate the minimum depth of fill required for the arch structure. This type of structure relies on soil/corrugated steel plate interaction for structural integrity. Proper placement and compaction of the granular backfill required making this option much more dependent on above freezing temperatures unless special precautions such as heating and hoarding are taken to prevent the backfill from freezing during storage and placement. These precautions result in added costs and risk.

W-beam approach guardrails would be installed in accordance with Saskatchewan Ministry of Highways and Infrastructure Standards.

A preliminary cross-section of this alternative is provided in Figure 5.

3.10 Preliminary Cost Estimates

Preliminary cost estimates for the alternative bridge options described n Section 3.8 are summarized below in Table 1.0. These costs are based on construction during the summer/fall where heating and hoarding is not required during the placement of concrete and granular backfill.

Table 1. Preliminary Cost Estimates for Alternative Bridge Structures

Option No.	Description	Estimated Construction Cost
1	Widen Existing Bridge	$ 510,000
2	Clear Span Precast Girder Bridge	$ 692,000
3	Clear Span Steel Girder Bridge	$ 761,200
4	Clear Span Corrugated Steel Plate Arch	$ 654,500

GST has not been included in these costs. Costs for the removal and salvage of the existing bridge and construction of the bridge approaches are not included in the costs presented in Table 1.0.

Should winter construction be considered there will be cost premiums associated with heating and hoarding to prevent any concrete from freezing during placement and curing. Placement of granular backfill will also require heating and hoarding in order to achieve the required compaction. The cost premiums for winter construction are estimated in Table 2 on the following page.

Table 2. Estimated Additional Costs for Winter Construction

Option No.	Description	Estimated Additional Construction Cost
1	Widen Existing Bridge	$ 30,000
2	Clear Span Precast Girder Bridge	$ 15,000
3	Clear Span Steel Girder Bridge	$ 15,000
4	Clear Span Corrugated Steel Plate Arch	$ 100,000

It is evident that the lowest cost option for winter construction will be Option No. 1. If access over the existing bridge must be maintained during construction, then Option No 2 is the lower cost option during winter construction.

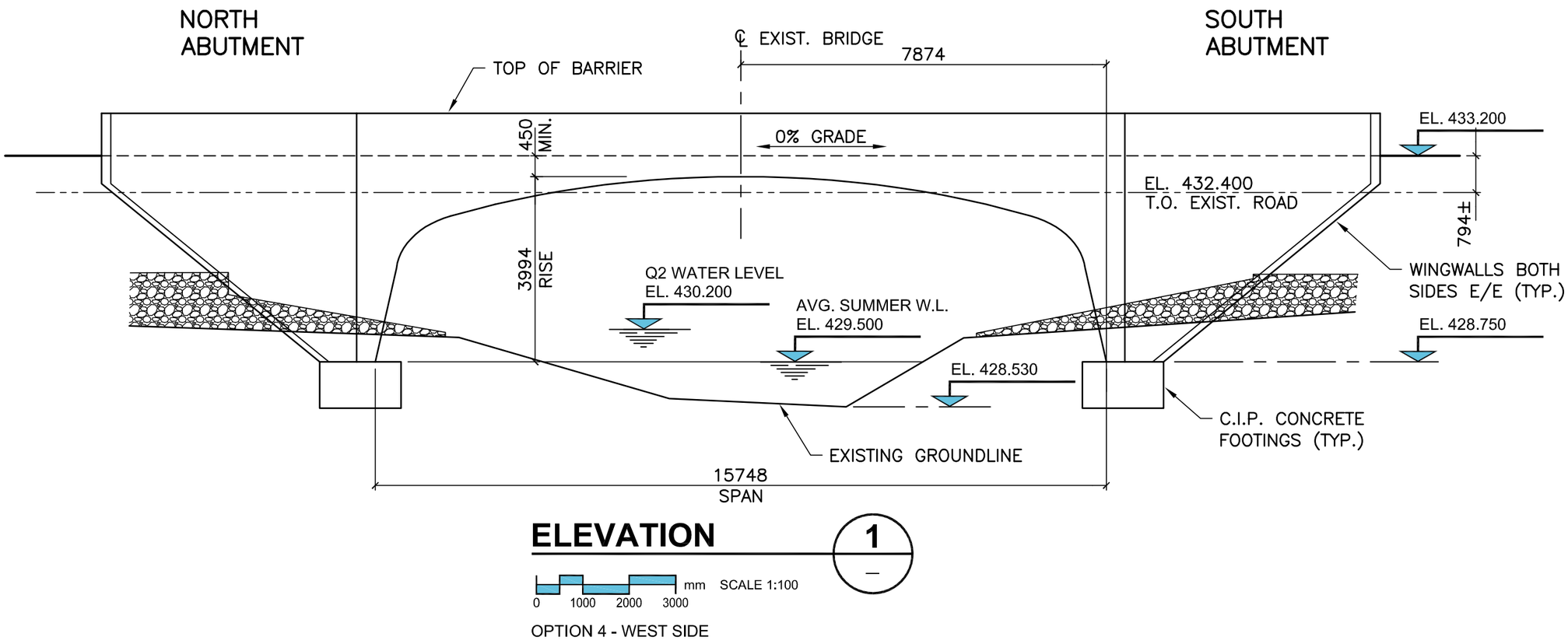


FIGURE 5
SUPER–COR BOX CULVERT STRUCTURE
OPTION 4

3.11 Recommended Bridge Upgrade

The recommended bridge upgrade on the basis of lowest estimated cost and maintaining the desired roadway width at the bridge is Option 1 – widening the existing bridge. This upgrade will require temporary closure of the existing bridge. The duration for this closure is estimated at three (3) weeks. This option is also the lowest cost should winter construction be required.

3.12 Detailed Cost Estimate

The preliminary detailed cost estimate for Option 1 is summarized in the following table:

Table 3: Preliminary Cost Estimate – Option 1

Item		Estimated Cost
Division 1 – General Requirements	$	57,800
Division 2 – Site Work		
Riprap & Filter Fabric	$	2,200
Supply & Install Abutment Bin Walls	$	173,000
Division 5 – Metals		
Supply & Install three (3) additional bridge panels.	$	200,000
Supply & Install W-Beam Guardrail at approaches	$	10,500
Subtotal	**$**	**443,500**
Contingency @ 15%	$	66,500
Estimated Total	**$**	**510,000**

Notes:

1. Costs are in 2010 dollars.
2. GST must be added.
3. Cost of engineering is not included.
4. Cost estimates have been prepared on the basis of information from similar projects and knowledgeable contractors. Actual costs may vary, however, due to market conditions, inflation and construction risk.

4. Schedule

The construction schedule for the bridge upgrade will depend on receiving approvals from the Regulatory Agencies including: The Navigable Waters Protection Act, Fisheries and Oceans and Saskatchewan Environment.

Applications should be sent to these agencies for approval immediately once the pre-design recommendations have been approved by Shore Gold. A minimum of six (6) months can be expected can be expected for the approval process.

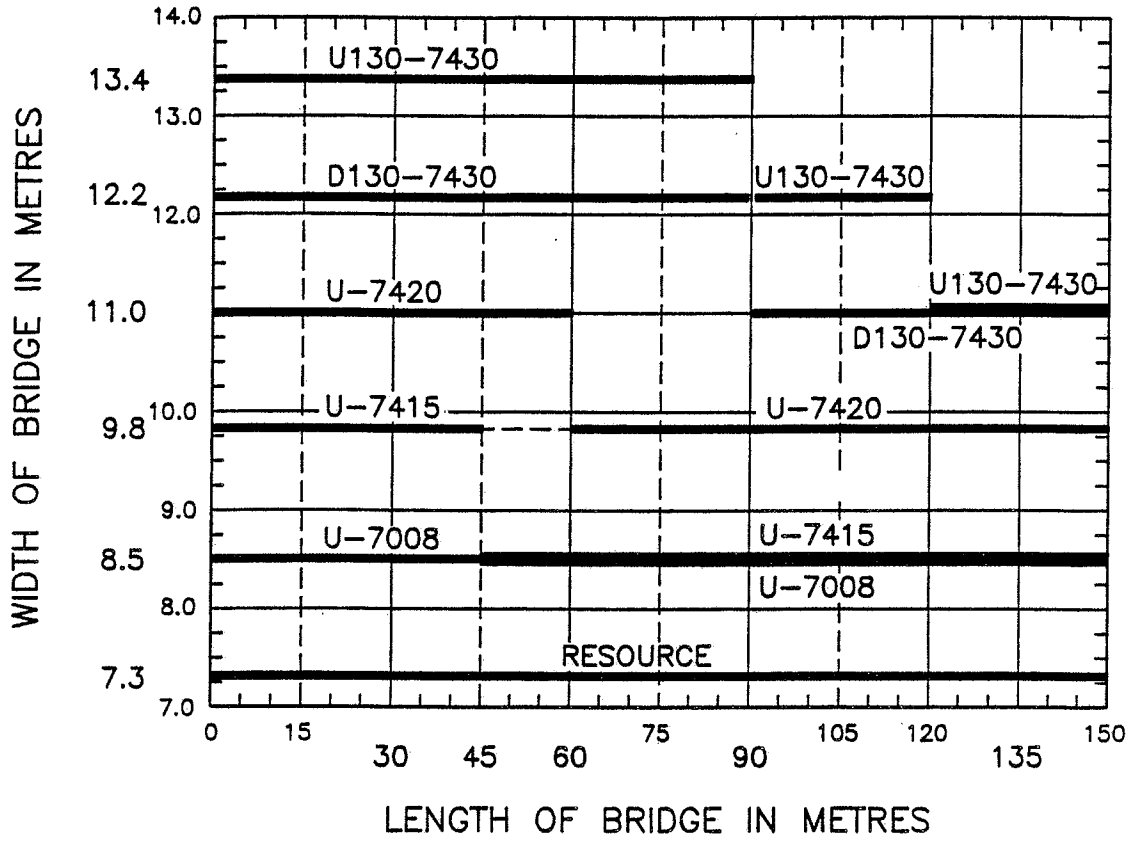
The construction period for the bridge widening is estimated between six (6) to eight (8) weeks.

5. Construction

Construction will require temporary closure of the existing bridge for a period of approximately three (3) weeks and cannot commence until approval from the Regulatory Agencies has been obtained. Placement of the backfill within the bin walls is recommended during the summer months as backfilling under winter conditions will require heating and hoarding of the bin walls and granular backfill. Environmental regulations will likely prevent any work adjacent to the river during the spring or fall.

Appendix A

- **Saskatchewan Ministry of Highways and Infrastructure Standard Plan No. 20150**



Notes:

1. This standard does not apply to interchange structures.
2. The width shall be the lesser of the measurement of:
   i) curb face to curb face;
   ii) from toe to toe of Type 1 bridge barrier;
   iii) from the face of the bridge barrier to the face of the bridge barrier for Type 3 bridge barriers.
3. On divided highways the right edge of curb shall be 6.7 metres from the roadway centreline.
4. Bridge widths on timber access roads shall be constructed to the width:
   i) specified in the agreement or;
   ii) the bridge width will conform to the standard having the same width as the haul road.
5. A plan and report will be required for Head Office approval when:
   i) the bridge is longer than shown above;
   ii) the bridge is on or within 100 metres of a horizontal curve;
   iii) the vertical or horizontal alignment needed to meet the structure is more than 10 km/h below the design speed;
   iv) when the timber haul road does not conform to one of our existing standards.

Saskatchewan Highways and Transportation

BRIDGE WIDTHS
ON PROVINCIAL HIGHWAYS AND PROVINCIAL ROADS

RECOMMENDED BY:	C.J. Rybyt	DIRECTOR DESIGN & TRAFFIC SAFETY	DATE	92-2-11	STANDARD PLAN NO	20150
APPROVED BY:		EXECUTIVE DIRECTOR ENGINEERING DIVISION	DATE	92-02-17	SHEET	1 of 1

ACAD DWG: SP20150.DWG LAST REV DATE: 1992 01 23