→ EA03-008
→ Brief Proj. Desc. (Mar 22-04)

Brief Project Description

Updated January 2004

Introduction

The Deh Cho Bridge Corporation Ltd. (DCBC) of Fort Providence, NT has proposed to the GNWT to finance and construct a bridge across the Mackenzie River, at km 23, Yellowknife HWY #3. After construction, the bridge will be operated by the DCBC under an agreement with GNWT for a period of 35 years. On expiration of the agreement the ownership of the bridge will be transferred to the GNWT.

The proposed bridge will replace the existing ferry and ice bridge crossings, and will make the Yellowknife HWY an all-weather facility guaranteeing an uninterrupted link between the capital of the NT and the rest of Canada.

The proposed initiative, including the selected bridge site and bridge parameters were approved by the DOT, GNWT engineering personnel, and is fully supported by the local residents and the Municipal Authorities of Fort Providence. The proposed bridge site and bridge parameters have been agreed to by the Northern Transportation Company Limited (NTCL), which are the major operator on the Mackenzie River Water Way

Bridge Location

The proposed site is located at the crossing of the Yellowknife HWY #3, NT and the Mackenzie River. It is located on the existing highway right-of-way, at km 23 HWY #3, near Fort Providence, NT.

1:5,000,000 NT Geographic Map *(Attachment #1).*

1:50,000 Topographic Map 85F/5 *(Attachment #2).*

1:25,000 Hydrographical Chart #6453 *(Attachment #3).*

Latitude: **61° 15' 45" N** Longitude: **117° 31' 30" W**

Selection of Bridge Site

It is proposed to construct the bridge at the existing ferry crossing. At this site the natural riverbed is approximately 1,560 m wide. For the purpose of the ferry operation, partial causeways were extended on the north and on the south shore, more than 30 years ago. The north causeway projects into the river 430 m, while the south one projects 165 m. Presently, the constricted river is 965 m wide at the ferry crossing. The proposed bridge is 1,045 m long and would allow an increase of the waterway to 995 m.

The proposed site was recommended in a Study named Preliminary Hydraulic Design, Mackenzie River Bridge, Liard River Bridge, Great Bear River Bridge prepared for PWC by NORTHWEST HYDRAULIC CONSULTANTS LTD (NHCL) of Edmonton, AB in 1975. The Study establishes that the waterway could be constricted to 3,000 feet (915 m) or less without serious hydraulic effects, and concludes that a design value of less than 3,000 feet would be acceptable from a river engineering viewpoint. The Study evaluates three potential sites for a bridge crossing between Fort Providence Rapids and Beaver Lake *(Attachment#3),* and recommends the site at the existing ferry crossing for the following reasons:

- ✓ The bed of the river at the proposed site is highly stable and scour resistant with changes occurring only in geologic time scale.
- ✓ The direction of flow does not vary markedly from point to point across the section
- ✓ The structure is not located in a curve of the navigation channel

- ✓ The depth of the river at the proposed site is fairly uniform. The maximum depth is substantially less than the ones of the other locations.
- ✓ The bridge would use the existing highway approaches and would not interfere with lands along the shoreline that might be of interest to others.

The proposed site was confirmed by PWC and it was the basis for their Mackenzie River Bridge, Fort Providence, Yellowknife HWY #3, NT, Preliminary Design and Cost Estimate, dated December 1975.

Components & Parameters

.1 The proposed bridge, consisting of nine spans, is 1,045 m long, and is configured as steel girders-concrete deck composite construction. The static scheme is a simple main span supported on the cantilevered ends of two opposing continuous four span approaches. Enclosed in Appendix "A" are Preliminary Design Drawings prepared by the bridge designer J.R. Spronken & Associates of Calgary, AB.

The superstructure is supported on eight piers constructed in the watercourse and two abutments constructed on the approach berms. Under the main span there is a navigation channel used by large tug-barges configurations. The main span, including the cantilevers, is 190 m long with a vertical clearance of 22.56 m at H.W.L. The main span is flanked by three 112.5 m spans and one at 90.0 m end span. In order to reduce the depth of the girder on the main span the design contemplates a system of portal and stays installed on the piers on both sides of the main span. This allows for 9.0 m vertical clearance, and 10.5 m horizontal clearance for vehicle traffic travelling on the bridge deck. It is anticipated that such clearances will not present limitation for oversize loads travelling between Alberta and the NWT.

The roadway width on the bridge deck is 10.50 m, allowing for two 3.75 m wide traffic lanes and two at 1.50 m shoulders. On each side of the deck there are 0.82 m high safety rails consisting of 0.25 m high concrete curbs and 0.57 m high steel rail. The maximum longitudinal grade on the bridge is 3.5%.

.2 The Design Live Load for the bridge is CL-750 (GVW of 750 kN) in accordance with the CSA-S6-00. There is a 40% dynamic allowance and additional 60% safety factor incorporated in the design. Additionally, the design allows for special, overload truck configurations as shown on the drawings.

.3 The superstructure is a composite construction of two steel trusses with pre-cast concrete deck panels. The deck panels are pre-stressed transversely during fabrication, and post-tensioned longitudinally after installation.

.4 The abutments are cast in place concrete structure consisting of pile cap, back wall, and wing walls at 45 degree to the centre line of the bridge. The abutment construction involves production and placing of 650 cu m concrete.

The abutments are supported on heavy gage H piles, predrilled and driven to refusal into the underlying till.

.5 The substructure of the piers consists of flat footings and pedestals involving approx. 12,500 cu m cast-in place concrete. The pedestals are of conical shape. Aprons of granite Rip Rap will be paced around the pedestals for scour control (total of 5,000 cu m covering an area of appx. 6,000 sq m).

Prior to placing the footings the design contemplates construction of sheet pile cofferdams (appx 4,800 sq m), excavation of the riverbed to the design elevation (appx 6,100 cu m), placing of a tremie-concrete mud slabs (appx. 1,000 cu m) and dewatering of the cofferdams.

The substructure is designed to resist the impact of a colliding stray vessel. Friction and deformation of the colliding vessel will absorb the energy of the impact.

.6 The superstructure of the piers, or the pier bents are presented in concrete and steel options.

The concrete option consists of pre-cast and post-tensioned concrete sections involving 1,200 cu m pre-cast concrete and 1,100 cu m cast in place concrete.

The steel option consists of prefabricated steel elements assembled and bolted on site. The amount of steel required for the steel bents is 1,250 tonnes.

.7 The proposed road approaches are 12.0 m wide. Both approaches coincide with the existing causeways of the north and south ferry landings. The north approach projects into the river 350 m, and the south one 230 m. In order to avoid potential flooding and ice shove accumulations, the approaches are set at elevation not less than 2.0 m above the calculated ice jam. This elevation is the same as the one of the highway-winter road intersection on the north side of the bridge, which historically has never been flooded.

The footprints on the riverbed of the bridge approaches exceed the ones of the existing causeways. The required extension and widening of the footprints comprises placing of appx. 17,000 cu m clean limestone and appx. 5,000 cu m granite into the river. This rock will be placed to an elevation of 1.0 m above the Mean Water Level. The approach embankments above that elevation will be constructed of 90,000 cu m common backfill and will be dressed with 1 m thick layer of blasted rock rip rap.

The head-slopes of the approaches and their upstream shoulders exposed to ice action will be armoured with approx. 3,000 cu m large size granite rip-rap.

The roadway on the approaches will be paved. There is a standard highway guardrail installed on each side of the roadway.

.8 It is proposed to excavate and remove the backfill material from two areas within the limits of the watercourse. These areas are part of the Department of Transportation infrastructure associated with the existing ferryboat operation. It is possible that these areas are contaminated with hydrocarbons or other harmful to the fish habitat material. In order to establish if any contaminants are present in these areas the Department of Transportation has commissioned study with the environmental consultant Dillon. It is noted that it will be Department's liability should any contaminants are found.

The excavation and removal of backfill material will be completed to depths between 2.0 m and 4.0 m below the water level, to match the adjacent natural riverbed. These areas are depicted on *Attachment #4* and could be described as follows:

- ✓ Area "E" (4,300 sq. m) is part of the existing north ferry landing projected 80 m into the watercourse beyond the proposed bridge approach. The material to be removed from this area consists of 9,000 cu m granular backfill for embankment, 500 cu m blasted rock for rip rap, 80 cu m concrete for landing pad, and 30,000 kg structural steel for sheet-pile wall.
- ✓ Area "D" (9,500 sq. m) is part of the existing ferry haul-out on the south shore. It is located downstream, adjacent to the bridge approach. The material to be removed from this area consists of 11,000 cu m granular backfill and 90 cu m structural timber.

Most of the removed steel, concrete, and timber, will be disposed of in borrow pits that will be used for sources of common fill used for the construction of the bridge approaches. The disposed of material will be covered with a layer of pit run. Some of the steel and timber might be salvaged. The excavated gravel will be tested for contaminants, and if found suitable may be used for road embankment widening. Alternatively it will be appropriately disposed of in the borrow pit. The armour rock will be salvaged and will be incorporated in the erosion protection of the bridge approaches.

.9 Accesses for public and commercial vehicles to both ferry landings and clear route for the ferryboat will be maintained, without interruption, for the duration of the bridge construction. Since sections of the existing access roads to the ferry landings and the bridge approaches overlap *(Attachment #7, Attachment #8)*, it is proposed to construct detours as follows:

- ✓ South Approach: Construct approx. 250 m detour road and arrange for temporary south ferry landing 10 m downstream of the existing one. This involves minor road improvement works with no in-stream construction activities.
- ✓ North Approach: Construct approx. 450 m detour road 25 m downstream of the existing access. This involves placing approx. 6,000 cu m blasted rock into the watercourse, with corresponding 5800 sq m footprint on the riverbed. The road embankment above the water level will be built of gravel. After completion of the bridge construction the gravel and the blasted rock will be thoroughly recovered from the river, and will be incorporated in the bridge approach widening, and armouring correspondingly.

Construction Schedule

On-site construction of the bridge is scheduled to commence in spring 2005. Some preparatory work may start in fall 2004. The bridge will be opened for traffic in fall 2006.

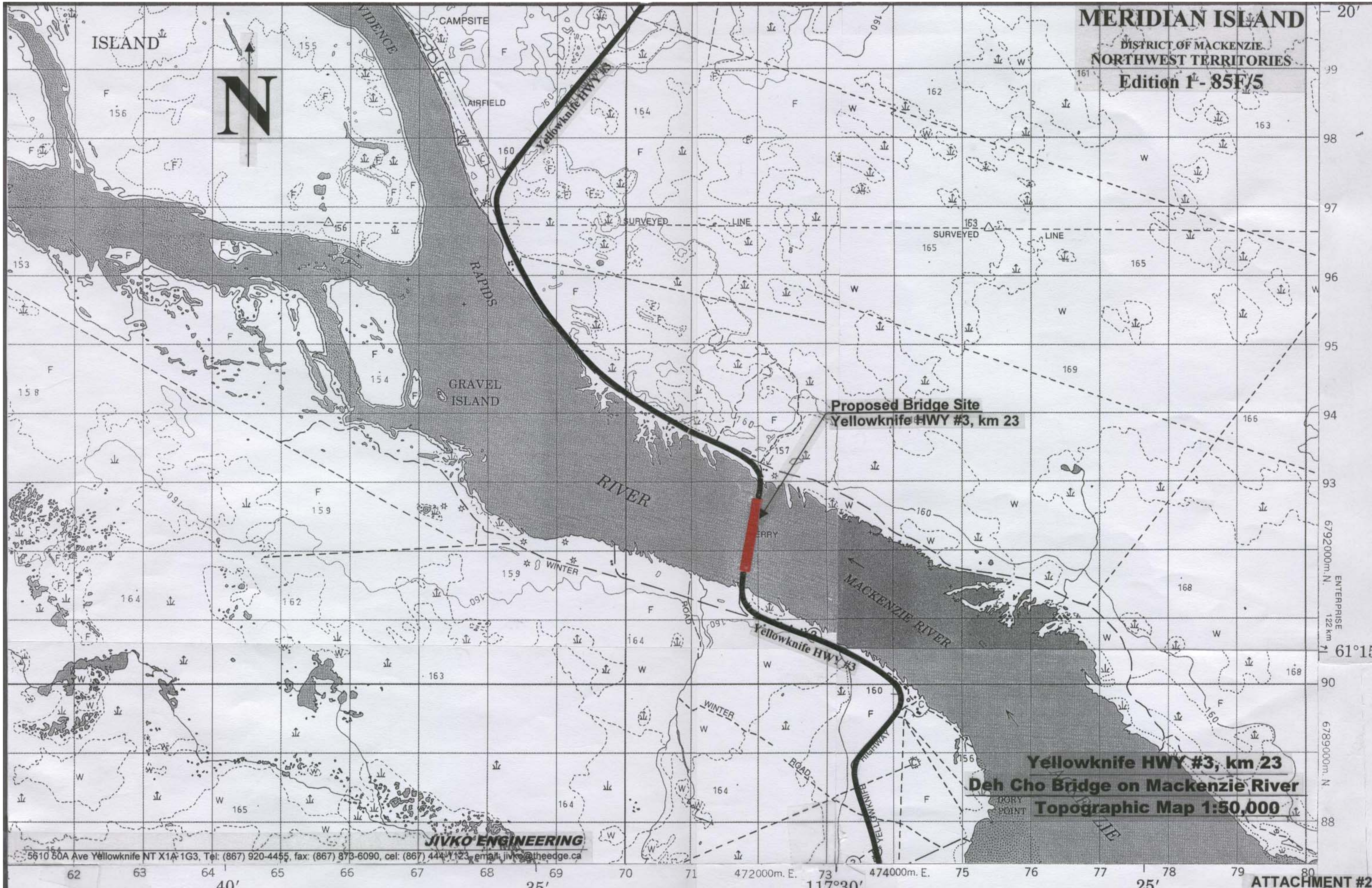
Prepared by:
Jivko Engineering
Jivko Jivkov, P. Eng.

March 22, 2004

ATTACHMENT #1

JIVKO ENGINEERING

5610 50A Ave Yellowknife NT X1A 1G3, Tel: (867) 920-4455, fax: (867) 873-6090, cel: (867) 444-1123, email: jivko@theedge.ca


MERIDIAN ISLAND
DISTRICT OF MACKENZIE
NORTHWEST TERRITORIES
Edition 1 - 85F/5
N
ISLAND
CAMPSITE
AIRFIELD
Yellowknife HWY #3
SURVEYED LINE
RAPIDS
GRAVEL ISLAND
RIVER
Proposed Bridge Site
Yellowknife HWY #3, km 23
FERRY
MACKENZIE RIVER
WINTER ROAD
DORY POINT
6792000m. N.
6789000m. N
ENTERPRISE 122 km
61°15′
20′
40′
35′
117°30′
25′
472000m. E.
474000m. E.
Yellowknife HWY #3, km 23
Deh Cho Bridge on Mackenzie River
Topographic Map 1:50,000
JIVKO ENGINEERING
5610 50A Ave Yellowknife NT X1A 1G3, Tel: (867) 920-4455, fax: (867) 873-6090, cel: (867) 444-1123, email: jivko@theedge.ca
ATTACHMENT #2

JIVKO ENGINEERING
5610 50A Ave Yellowknife NT X1A 1G3, Tel: (867) 920-4455, fax: (867) 873-6090, cel: (867) 444-1123, email: jivko@theedge.ca

MONTHLY MEAN WATER LEVEL / NIVEAU MOYEN MENSUEL DE L'EAU
Highest — Le plus élevé
Average ⌒ Moyen
Lowest --- Le plus bas

Mètres / Mètres	Jan. / Janv.	Feb. / Fév.	Mar. / Mars	April / Avril	May / Mai	June / Juin	July / Juil.	Aug. / Août	Sept. / Sept.	Oct. / Oct.	Nov. / Nov.	Dec. / Déc.	Mètres / Mètres
1.8													1.8
1.4													1.4
1.2													1.2
1.0													1.0
0.8													0.8
0.6													0.6
0.4													0.4
0.2													0.2
0.0													0.0

Chart Datum / Zéro des cartes
151.09m GD

PIDS
YELLOWKNIFE HIGHWAY
Proposed Bridge
9 spans, L=1045 m
EXISTING FERRY SITE
ROCKY POINT SITE
DORY POINT SITE
Dory Point
To Hay River
BEAVE
LAKE
80km
37.3Sm

HORIZONTAL DATUM: This chart is drawn on an unknown datum. Positions on NAD 83 or WGS 84 may be in error by 0.3 miles.

SYSTÈME GÉODÉSIQUE: Le système de référence de cette carte est inconnu. Les positions rapportées au NAD 83 ou au WGS 84 peuvent être erronées de 0.3 milles.

Yellowknife Highway #3, km 23
Deh Cho Bridge at Mackenzie River

Hydrographic Chart 1:25,000

Statute Miles 1 — 0 — 1 Milles terrestres

Metres 1000 — 0 — 2000 Mètres

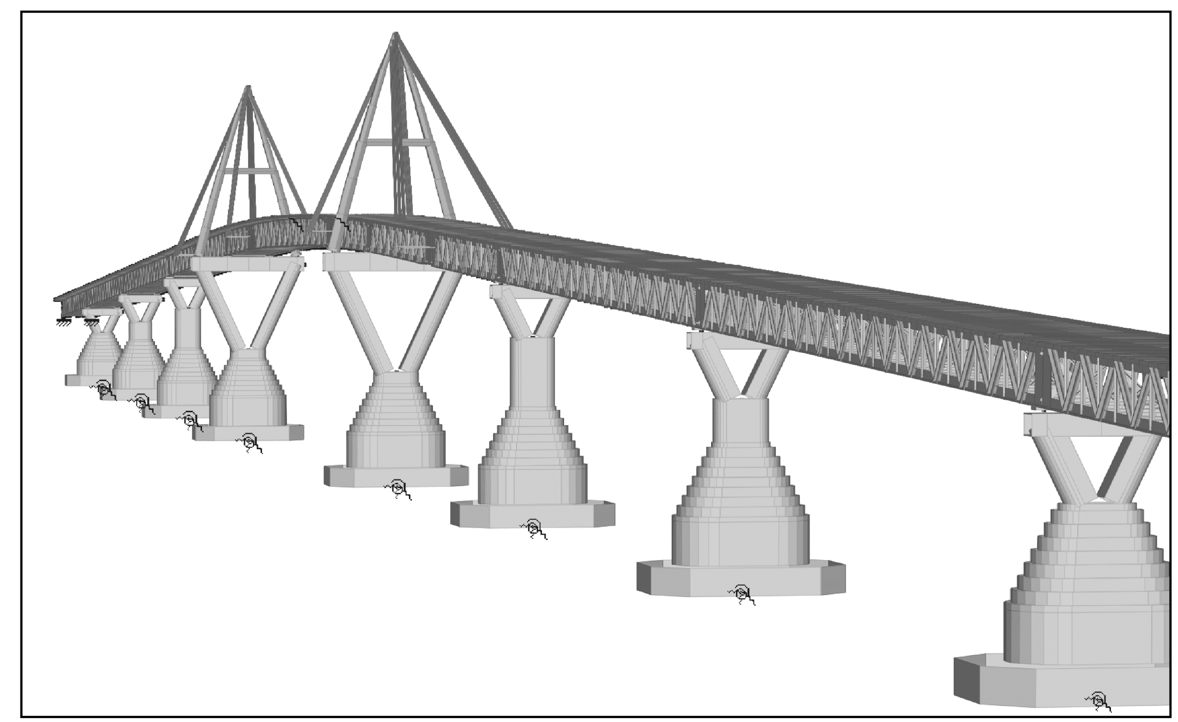
Canadian Hydrographics Service
Chart # 6453, Edition 1999

ATTACHMENT #3

DEH CHO BRIDGE

YELLOWKNIFE HWY#3 Km 23
ON MACKENZIE RIVER

Deh Cho Bridge Corporation

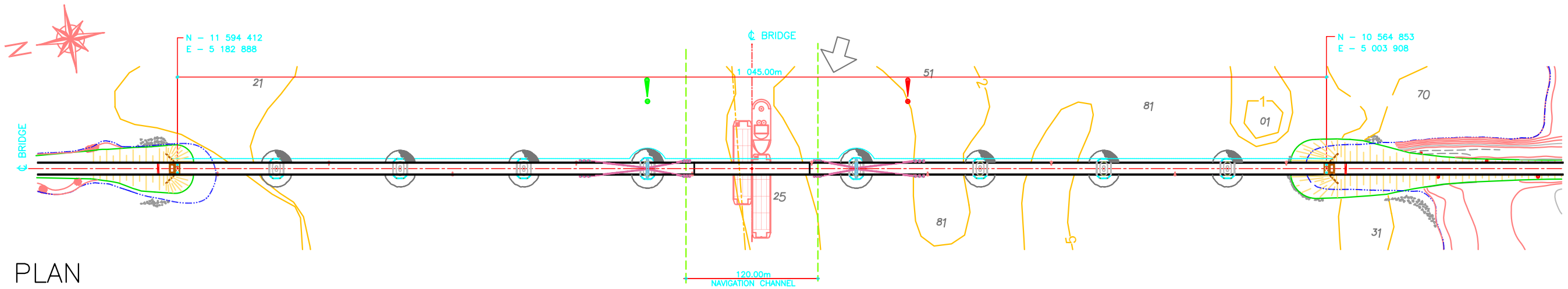


Andrew Gamble & Associates

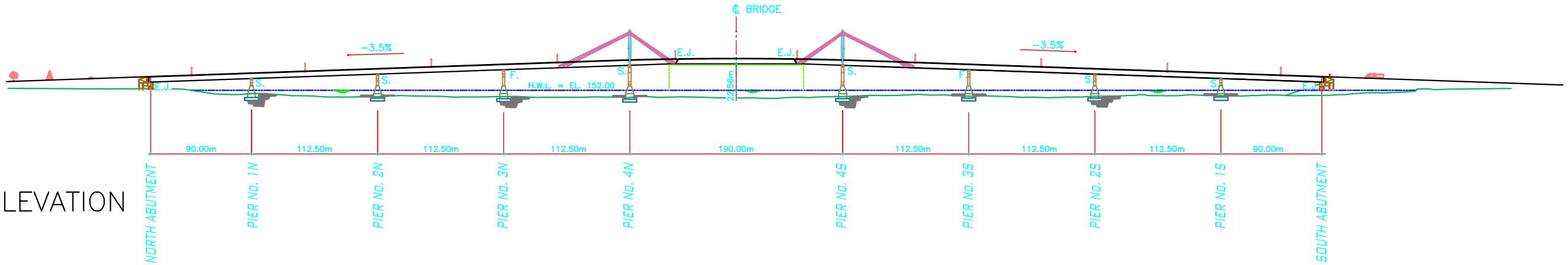
JIVKO ENGINEERING
5610, 50 "A" Avenue, Yellowknife, NT, X1A-1G3
Phone (867) 920-4455, Fax (867) 873-6090

J. R. Spronken & Associates Ltd.
Consulting Professional Engineers
Calgary, Alberta
Phone: 265-1123 E-Mail : jrsa@spronken.net Fax. 265-1784

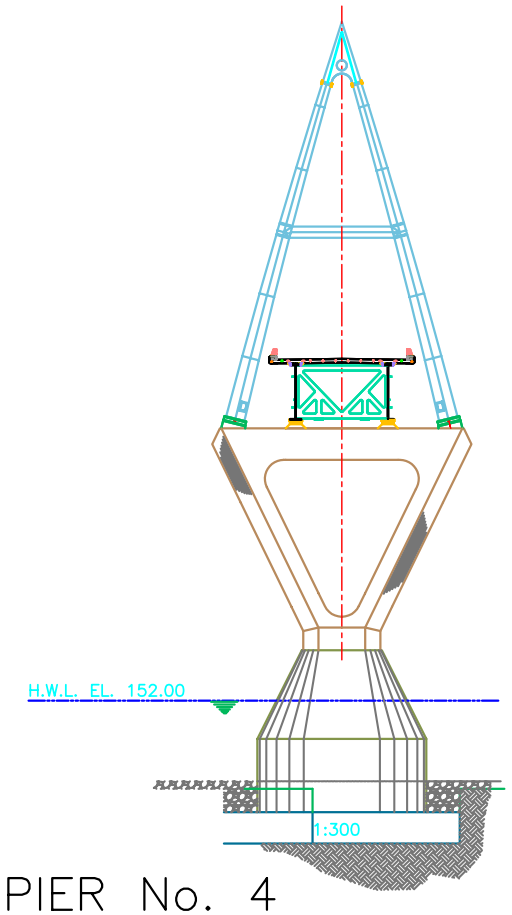
Drawing No. 02 152-001



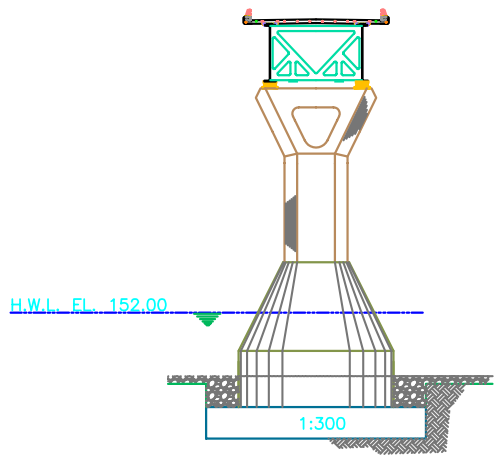
PLAN



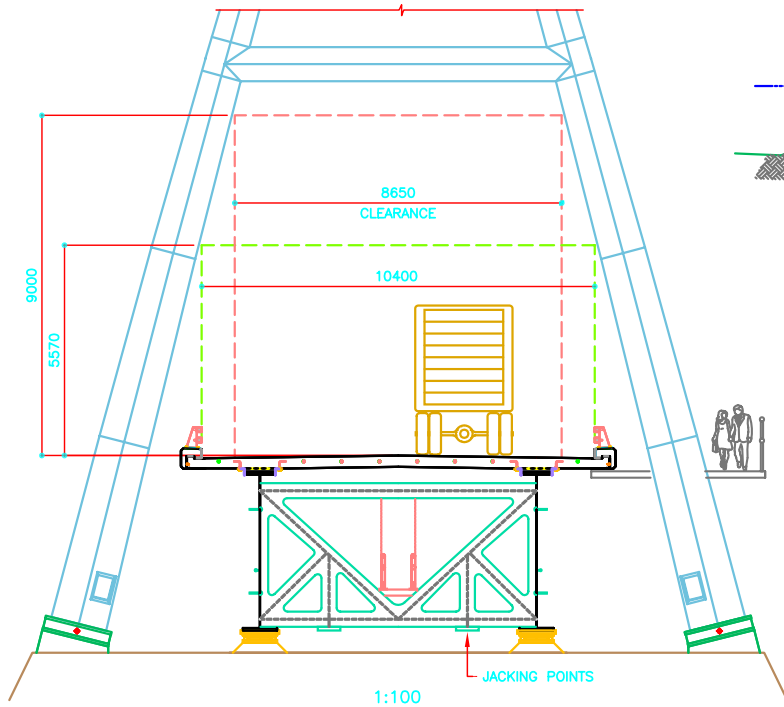
ELEVATION



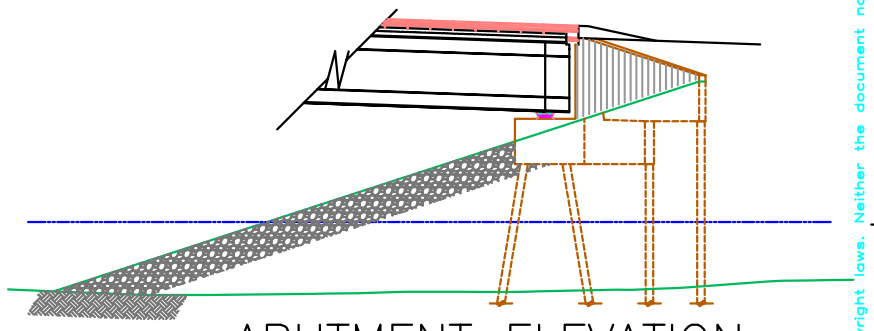
PIER No. 4



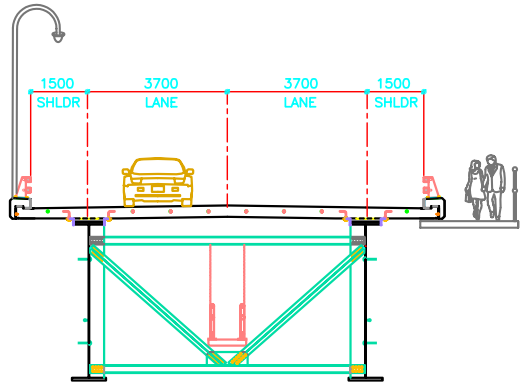
PIER's 1, 2 & 3



PIER SECTION



ABUTMENT ELEVATION



TYPICAL SECTION

Deh Cho Bridge Corporation

ALL DIMENSIONS & ELEVATIONS ARE APPROXIMATE & ARE SHOWN FOR REPRESENTATION ONLY

REV	DATE	DESCRIPTION

Andrew Gamble & Associates

J. R. Spronken & Associates Ltd.
Consulting Professional Engineers
Calgary, Alberta

JIVKO ENGINEERING
5610, 50 "A" Avenue, Yellowknife, NT, X1A-1G3
Phone (867) 920-4455, Fax (867) 873-6090

Project

YELLOWKNIFE HWY#3 Km 23
DEH CHO BRIDGE
ON MACKENZIE RIVER

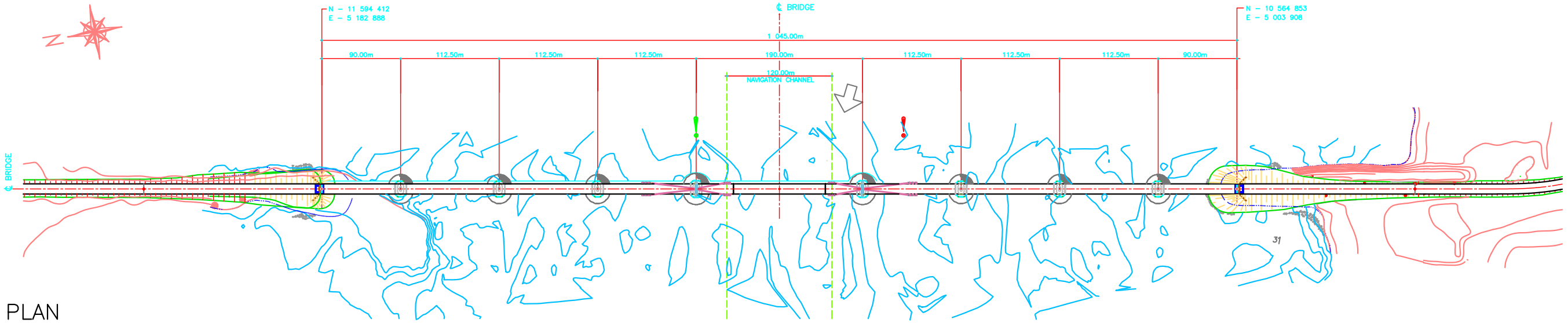
Title

PROPOSED
BRIDGE
PLAN & PROFILE

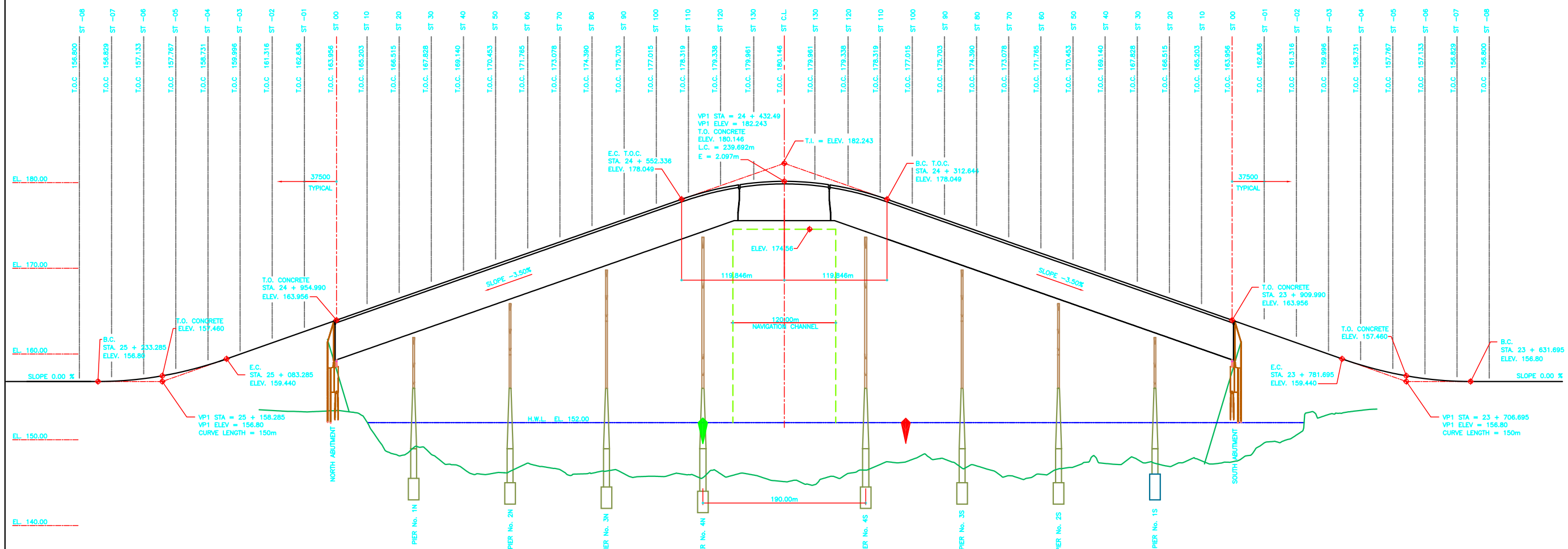
Scale 2000
Surveyed by
Drawn by R.Loeppky date : 04.01.29
Designed by | Checked by
SEAL: | SEAL:
Signature | Signature
Date | Date
Approved by
Project No. 02 152 | Page of
Drawing No. 02 152

22x34 METRIC FILE NAME : DEH CHO – 000-a

PLOT DATE : 04.02.09



PLAN



ELEVATION

HORIZ. SCALE 1:2500

VERT. SCALE 1:250

NOTE: ALL DIMENSIONS ARE BASED ON HORIZONTAL PROJECTIONS

Deh Cho Bridge Corporation

ALL DIMENSIONS & ELEVATIONS ARE APPROXIMATE & ARE SHOWN FOR REPRESENTATION ONLY

REV	DATE	DESCRIPTION

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Consulting Professional Engineers
Calgary, Alberta

JIVKO ENGINEERING
5610, 50 "A" Avenue, Yellowknife, NT, X1A-1G3
Phone (867) 920-4455, Fax (867) 873-6090

Project

YELLOWKNIFE HWY#3 Km 23
DEH CHO BRIDGE
ON MACKENZIE RIVER

Title

PROPOSED
BRIDGE
PLAN & PROFILE

Scale 2500
Surveyed by
Drawn by R.Loeppky date : 04.01.29
Designed by | Checked by
SEAL: | SEAL:
Signature | Signature
Date | Date
Approved by
Project No. 02 152 | Page of
Drawing No. 02 152

22x34 METRIC FILE NAME : DEH CHO – 000–b

PLOT DATE : 04.02.09