Interim report on s-band propagation trials for C.N.R.-C.P.R.

National Research Council Canada. Radio Branch

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NATIONAL RESEARCH COUNCIL OF CANADA

RADIO BRANCH

INTERIM REPORT

ON

S-BAND PROPAGATION TRIALS FOR C.N.R. - C.P.R.

OTTAWA

FEBRUARY, 1946

main

NATIONAL RESEARCH COUNCIL OF CANADA

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INTERIM REPORT

S-BAND PROPAGATION TRIALS FOR CNR.-CPR.

1. Object: To study 10 cm. propagation over links that are encountered in the setting up of a radio relay system throughout Ontario. A typical course was that selected by the C.N.-C.P. Telegraphs. The plan was to establish contact and take continuous readings for short terms (3 days) to prove in the sites selected and get some indication of the behavior of the signals. A plan was also established to set up equipment for a long term study of propagation over a representative link when equipment was available. N.R.C. agreed to supply personnel and facilities.

2. Equipment: The equipment was to be mobile so as to allow point to point checking. It was decided to use four-foot parabolic reflectors with waveguide dipole feed. These radiators could be installed to give vertical or horizontal polarization. The reflectors could be mounted on short towers where necessary, or on 35 foot wind-charger towers where high structures do not exist. Provision was made for rotation in azimuth, and for varying elevation. The towers are readily portable, and can be easily erected by crews of linemen, providing quite a rigid structure.

The transmitter is a McNally-Pierce reflex Klystron. It is mounted directly on the waveguide feed behind the dish. It is completely enclosed and is heated by an element which is thermostatically controlled. The power output of the tube is 0.100 watts at 10.700 cms. The output power is continuously monitored by a thermistor bridge, and recorded. The power supply for the transmitter tube is mounted at ground level.

The receiver dipole feeds into waveguide, and then through a probe into low-loss 50 ohm cable. In the 50 feet of cable there is a loss of about 11 db. This figure can be checked in the field before and after each run. The signal is fed into a crystal mixer. There are six stages of I.F. at a frequency of 26.2 Mc/s. An A.F.C. circuit is used to keep the local oscillator tracking with any change of transmitter frequency. The characteristics of the A.V.C. circuit are so chosen and the design is such, that the A.V.C. meter on the front panel reads changes of signal directly in terms of db. This signal is continuously recorded.

A signal generator (10.700 cm) is supplied and is used to keep a check on the sensitivity of the receiver. A definite level of power is fed into a calibrated linear attenuator, and by means of a cable into the mixer. A thermistor bridge is provided to insure a check on the initial power level. By this means, the absolute value of signal at the receiver may be measured. The customary procedure is to monitor the receiver at intervals of one hour to check for sensitivity drift.

Communication between transmitting and receiving sites is provided by two 40 Mc/sec F.M. links. These have been borrowed, and to date have been the cause of more lost time on the survey than any other cause. It would be profitable to obtain some reliable commercial unit.

Living accommodation is provided in two living trailers which may be towed from site to site. The equipment is stored within these trailers, and the tower sections mount on the top. Everything is then completely mobile.

3. Progress to date.

The following links have been tested and recordings taken over the periods indicated:

Links	Tests Began	Tests Ended
Montreal - Rigaud	October 24/45 - 3 p.m.	October 28/45 - 7 a.m.
Rigaud - Montebello	October 31/45 - midnight November 12/45 - 2 p.m.	November 4/45 - 5 a.m.
Montebello - Chateau Laurier, Ottawa	November 8/45 - 5 p.m. November 12/45 - 2 p.m.	November 9/45 - 4:30 p.m. November 16/45 - 3 p.m.
Montebello - Blackburn Bldg., Ottawa.	November 21/45 - 3 p.m.	November 23/45 - 9 a.m.
Blackburn Bldg. Manion Corners.	December 7/45 - 2 p.m. December 10/45 - 11 a.m. December 13/45 - 6 p.m.	December 7/45 - 7 p.m. December 12/45 - 3 a.m. December 15/45 - 7 a.m.
Manion Corners - Smith's Falls	December 17/45 - 12:45 p.m.	December 20/45 - 7 a.m.

On all of the links tested, no difficulty has been experienced in establishing cm. communication. Variations in signal have been experienced and are indicated opposite each graph showing the profile of the link tested. Trouble was experienced at first with water in the guide. This was due to lack of adequate water-proofing. After precautions were taken, no further difficulty was experienced.

The Rigaud-Montreal curve provides some peculiarities which are difficult to interpret. At the beginning of the curve there was some difficulty due to moisture. However, from 5 p.m. October 25, 1945, a fairly reliable record was obtained.

Upon arrival at the Chateau Laurier in Ottawa, it was found that optical line of sight did not exist. The site was moved to the Blackburn Building with some increase in height and a corresponding increase in signal level. The profile in the two cases is the same.

The Blackburn Building to Montebello link has been selected for a long-term study. It is the longest link in the series and is not quite optical line of sight; therefore it was felt worthwhile to use this link for one of the long-term tests. These tests are to be carried out as soon as power is installed up

to the ski jump at Montebello. The antennae were left in position and all that is required is to install the receiver at the Blackburn Building and the transmitter at Montebello.

Considerable work was done on contour studies of the various links, and these are in the possession of Mr. Lang, who collaborated in making them. Copies are to be made for attachment to this report. Contour studies were also made with a view to by-passing the site at Blue Mountain. This was unsuccessful, and it is to be recommended that, from the point of view of propagation, Blue Mountain is better. Therefore, it is felt that it is of value to consider Blue Mountain more thoroughly from the other angles.

Calculations are being started to attempt predictions of signal versus atmospheric conditions over various links. The Rigaud-Montebello link has been considered and results appear to check with the observed results.

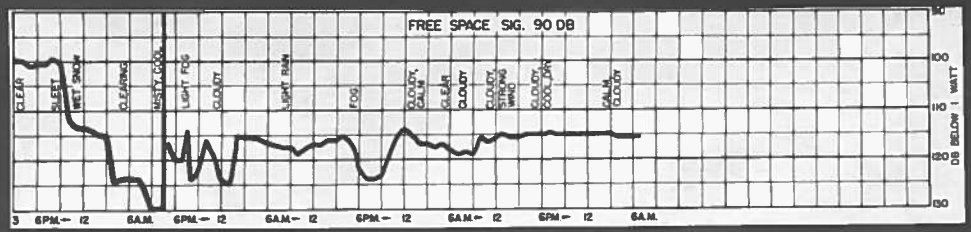
From the graphs, it is seen that the average received signal is well below the free space value. The single exception is the Montebello-Rigaud link. It is to be understood that these results are of a preliminary nature and future checks may change the db. levels quoted.

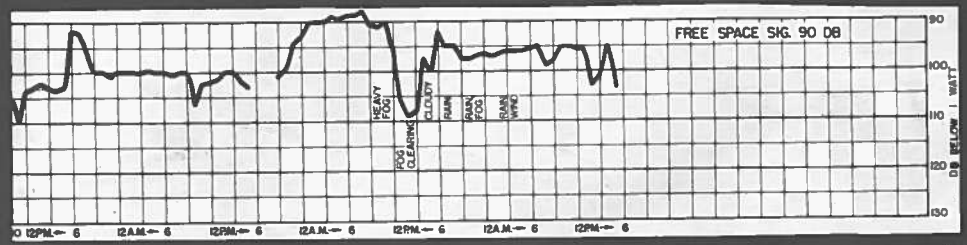
The Signal Strength vs. Time curves for the six links tested are shown on the left hand side of the next page. Opposite each graph is the profile of the link. The Montebello-Chateau profile is substantially the same as the Montebello-Blackburn profile below. The Chateau station is lower than the Blackburn station.

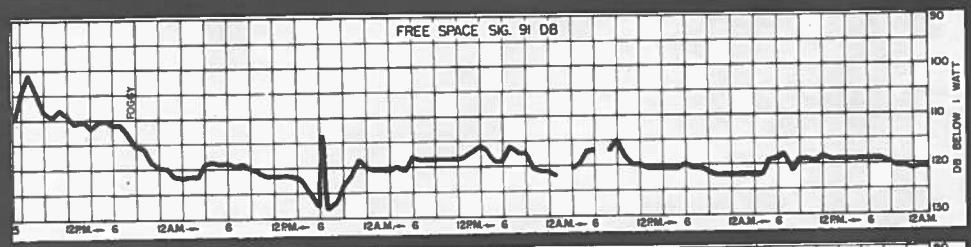
The following drawings are forwarded separately:

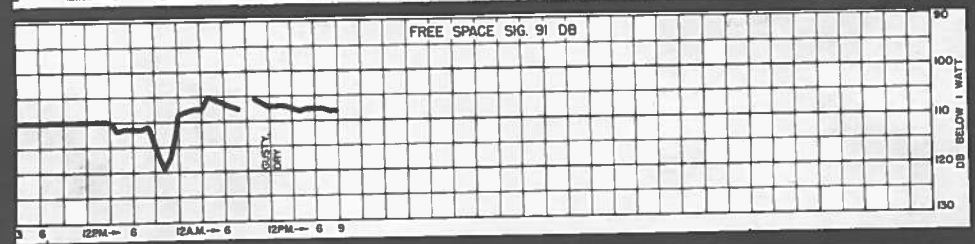
X125	-- Profile map	--	Toronto to Oak Hill
X126	-- "	" --	Oak Hill to Ottawa
X127	-- "	" --	Ottawa to Montreal

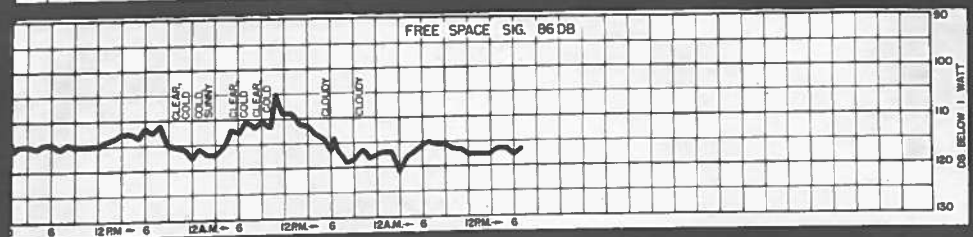
SIGNAL STRENGTH VS TIME

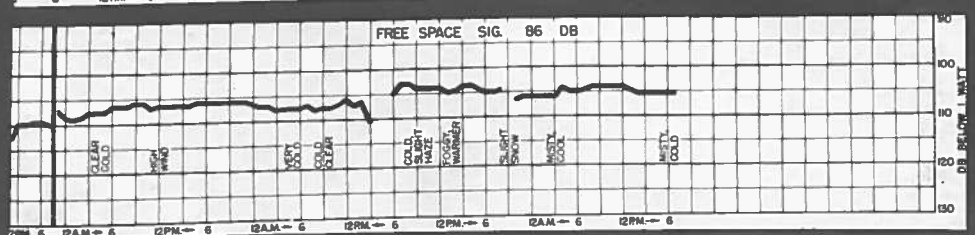




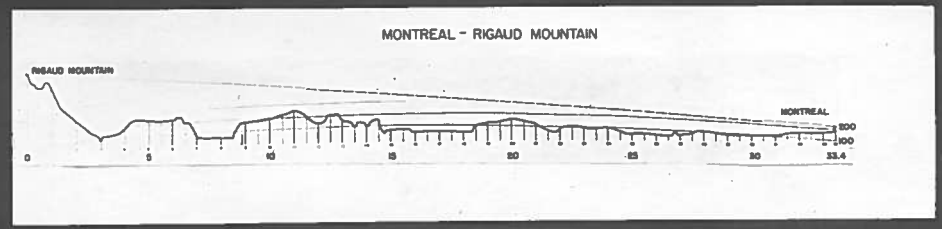


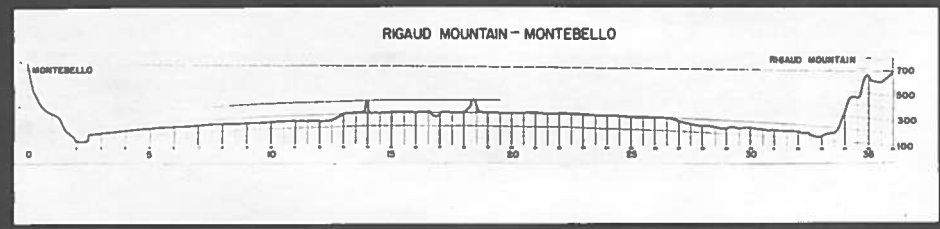


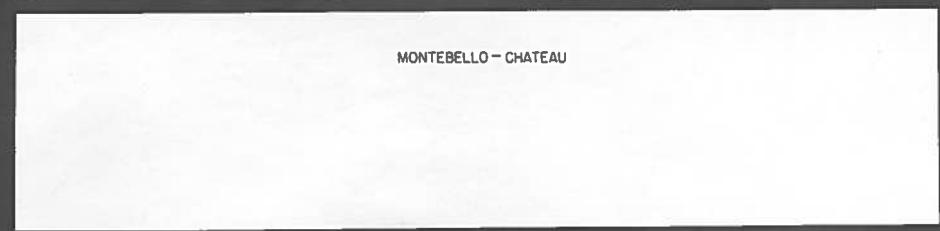


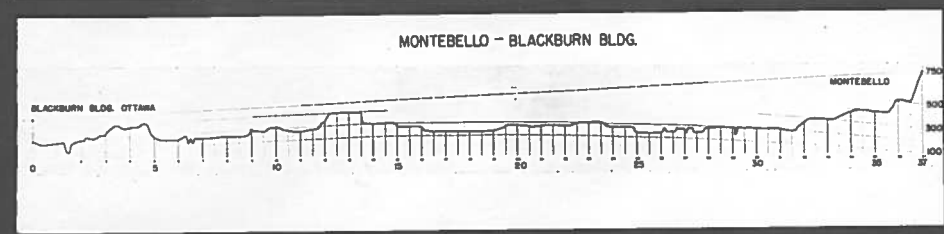


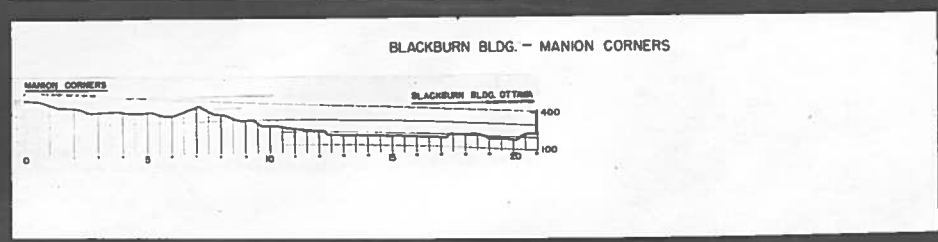
PROFILE OF LINK

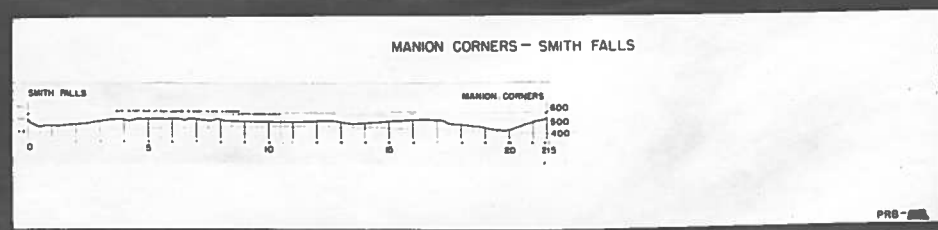












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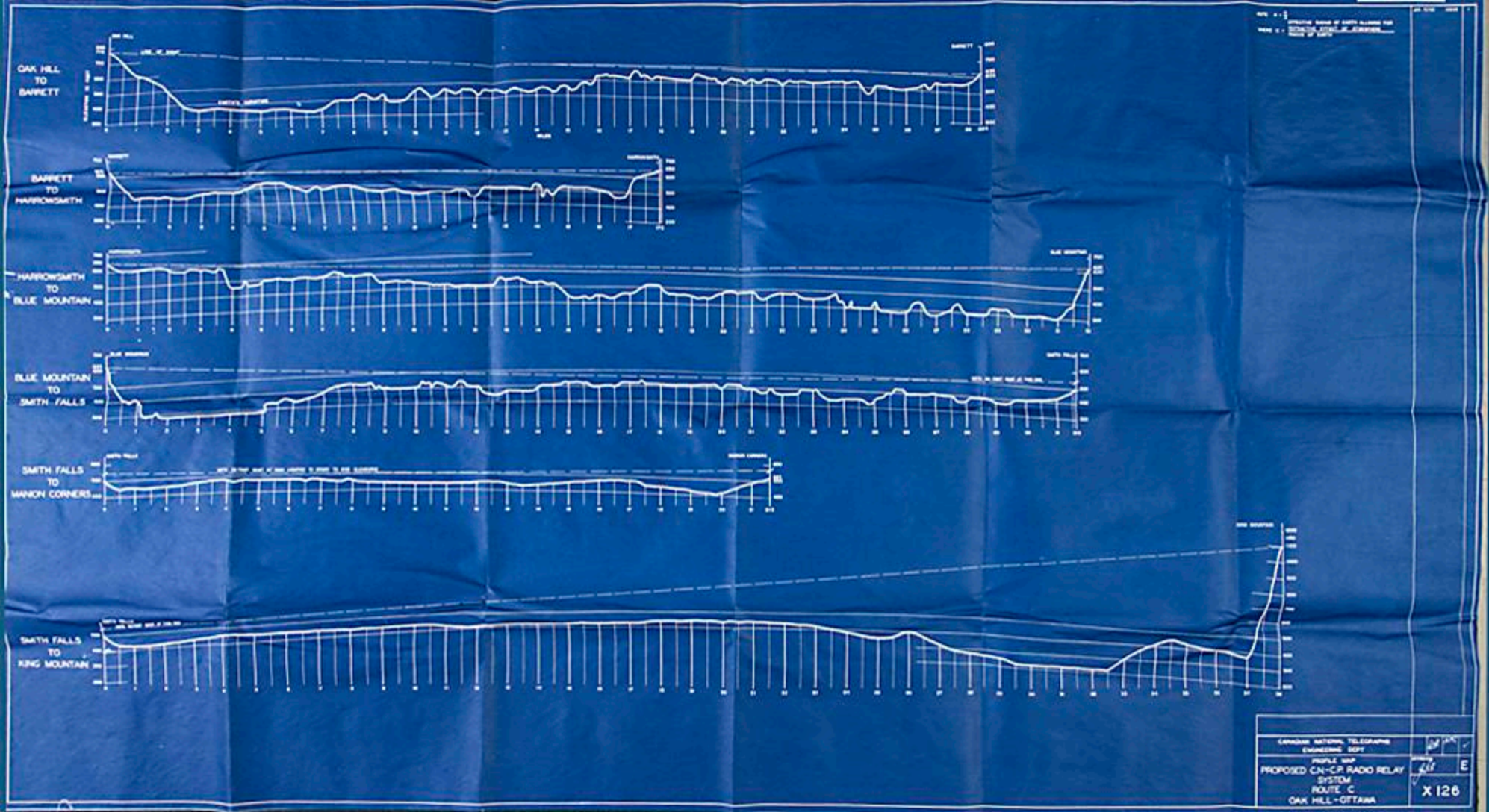
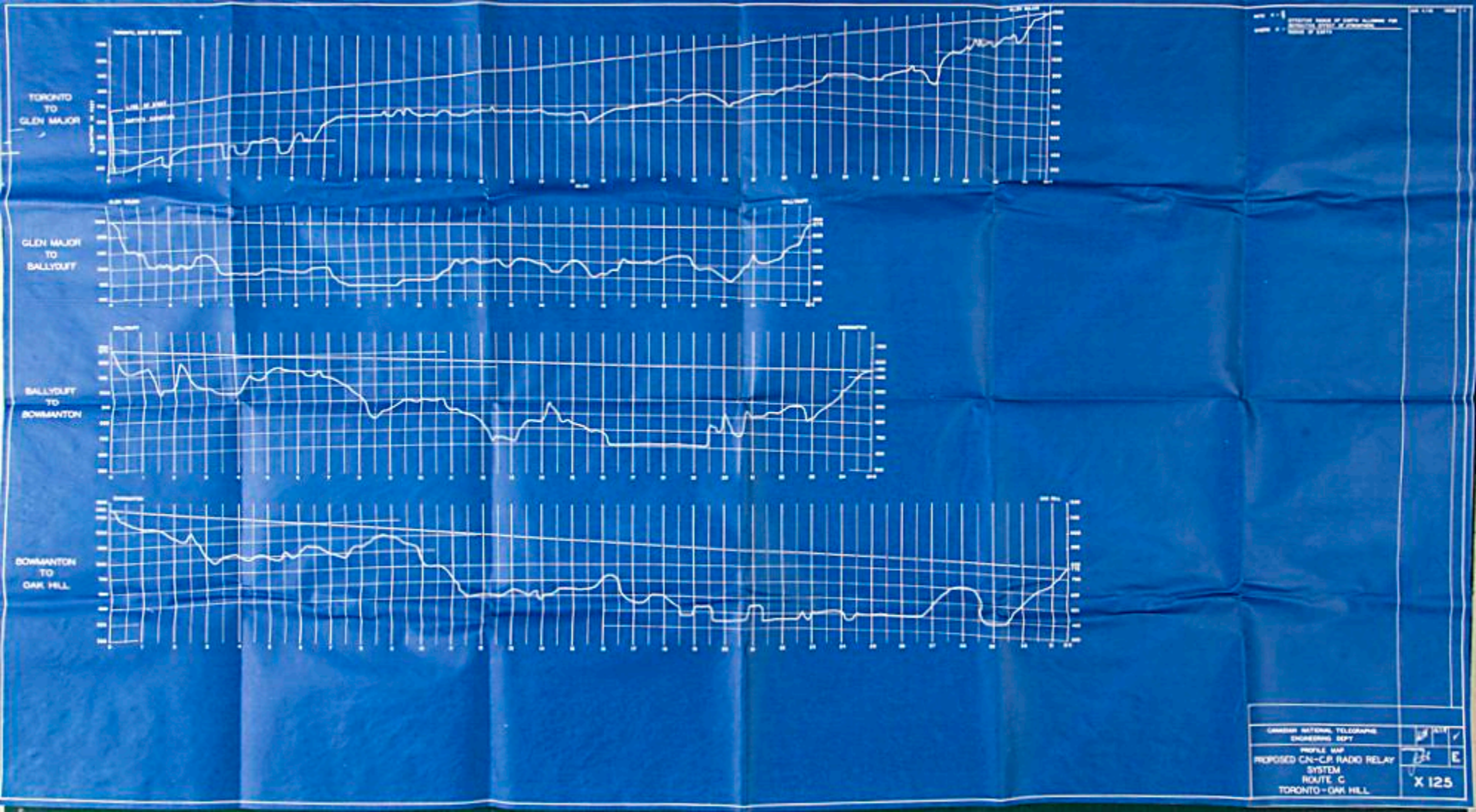

OAK HILL TO BARRETT
BARRETT TO HARROWSMITH
HARROWSMITH TO BLUE MOUNTAIN
BLUE MOUNTAIN TO SMITH FALLS
SMITH FALLS TO MANON CORNERS
SMITH FALLS TO KING MOUNTAIN
CANADIAN NATIONAL TELEGRAPHS
ENGINEERING DEPT
PROFILE MAP
PROPOSED CN-CP RADIO RELAY SYSTEM
ROUTE C
OAK HILL - OTTAWA
E
X 126

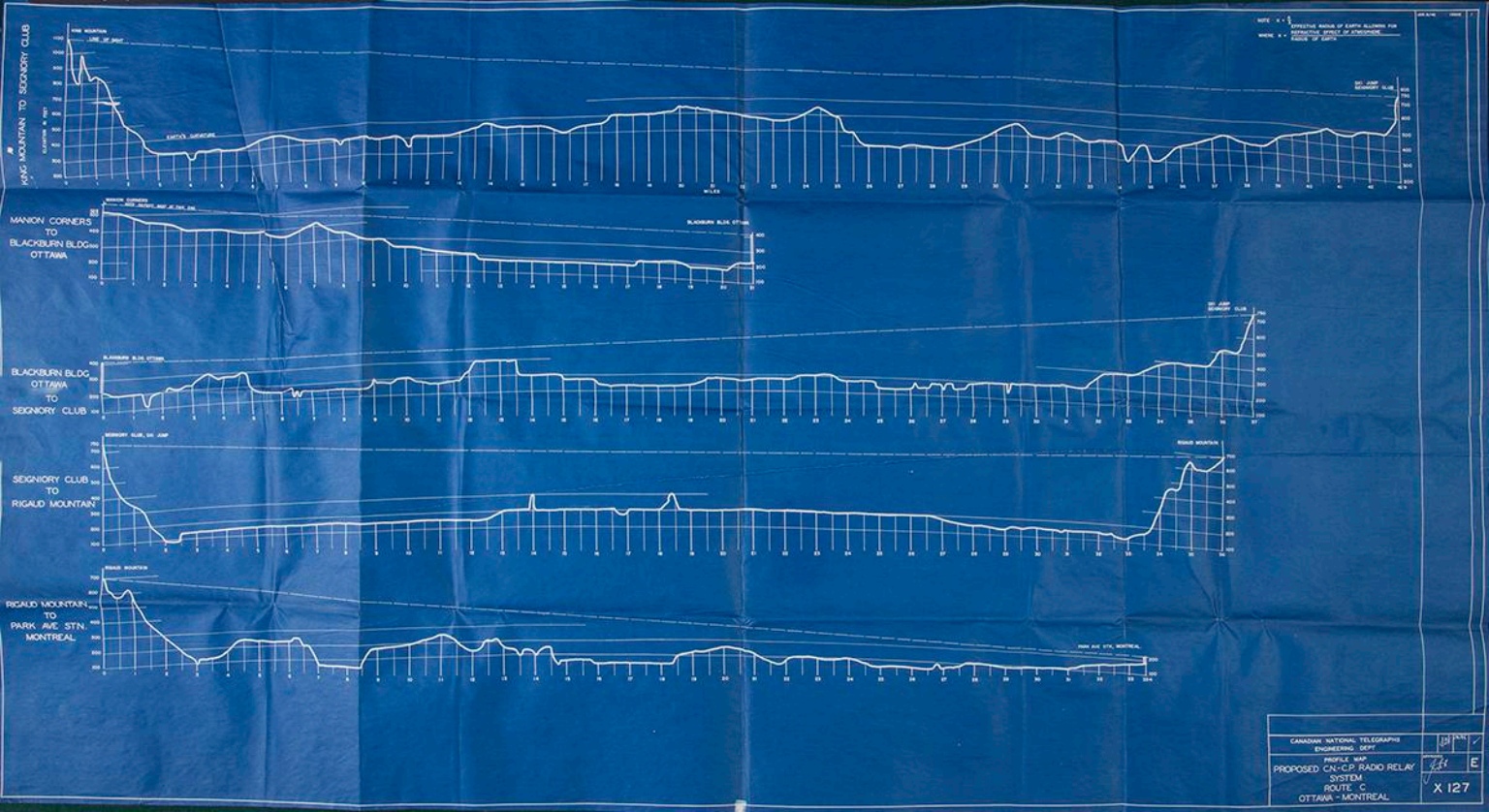


CANADIAN NATIONAL TELEGRAPHS
ENGINEERING DEPT

PROFILE MAP
PROPOSED CN-CP RADIO RELAY
SYSTEM
ROUTE C
TORONTO - OAK HILL

E

X 125


KING MOUNTAIN TO SEIGNIORY CLUB
MANION CORNERS TO BLACKBURN BLDG OTTAWA
BLACKBURN BLDG OTTAWA TO SEIGNIORY CLUB
SEIGNIORY CLUB TO RIGAUD MOUNTAIN
RIGAUD MOUNTAIN TO PARK AVE. STN. MONTREAL
NOTE K = 1 EFFECTIVE RADIUS OF EARTH ALLOWING FOR REFRACTIVE EFFECT OF ATMOSPHERE
WHERE K = EFFECTIVE RADIUS OF EARTH / ACTUAL RADIUS OF EARTH
CANADIAN NATIONAL TELEGRAPHS
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ROUTE C
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PROPOSED C.N. - C.P. RADIO RELAY SYSTEM
TORONTO - OTTAWA - MONTREAL
L A Y O U T