Whitehorse Office
108 Gold Road
Whitehorse, Yukon Y1A 3W2
Phone (867) 668-7672
Fax: (867) 393-3577

www.aurorageosciences.com
aurora@klondiker.com

MEMORANDUM

To: Gerry Ferris, P.Eng.
BGC Engineering Inc.

Date: 26 Oct 04

From: Mike Power

Re: Faro Mine - Geophysical Survey - Preliminary results

Per your request, this memorandum is a preliminary report on the Faro Mine geophysical survey program conducted for BGC Engineering Inc. earlier this month. The survey program was conducted between October 7 - 18 and the data processing and interpretation are underway but not complete. This report summarizes the work to date.

a. Survey sites. Geophysical surveys were performed at the Faro Pit on the proposed west buttress to a plug dam and at a proposed diversion site on the west side of Rose Creek. At the Faro Pit, seismic refraction surveys were conducted on three lines, each approximately 200 m long running across the waste dump pile. The approximate location of these lines is sketched in Figure 1 below. At Rose Creek, ground penetrating radar (GPR) was conducted on three lines shown in Figure 2. In addition, seismic refraction surveys were conducted on two short segments of the main SE-NW GPR survey line labelled SL-1 and SL-2. Line locations in these two figures are approximate and for general reference only.

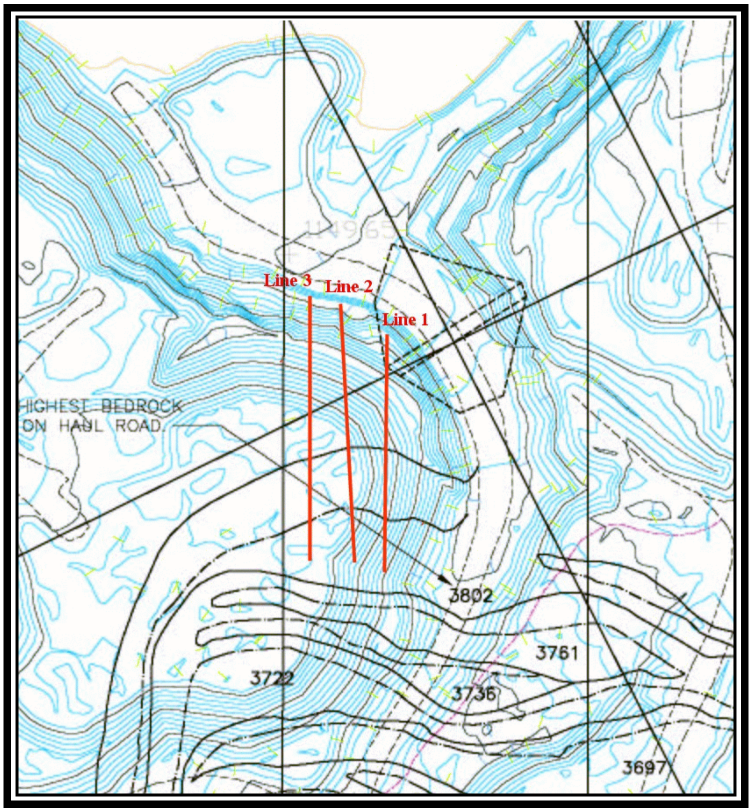

Figure 1. Approximate location of the Faro Pit seismic lines.

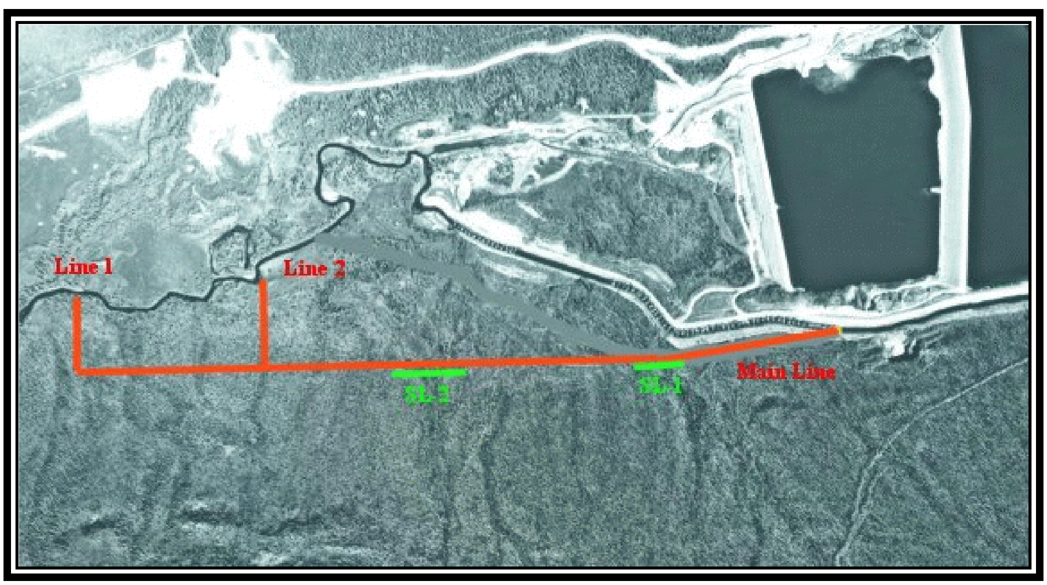

Figure 2. Approximate location of the Rose Creek seismic and GPR survey lines near the proposed PMF diversion.

b. Crew and equipment. The surveys were conducted by the following personnel:

Mike Power, P.Geoph.	Crew chief
Dave Hildes, Ph.D.	Geophysicist
Raanan Bodzin	Technician

The crew was equipped with the following instruments and ancillary equipment:

Seismograph:		Geometrics Strataview R-48 digital engineering seismograph (s/n 75162)
Seismic equipment:	1 -	24 channel cable w/ 10 m takeouts
	1 -	Bison HVB-1 high voltage seismic blaster / trigger
	29 -	Mark Products 40Hz vertical component geophones
	2 -	Type 6 explosives magazines
	1 -	Impulse laser range finder / digital clinometer & level
	1 -	Blasting wire, spool & winder
	4 -	VHF radios & chargers
GPR system:	1 -	RAMAC GPR (s/n 4679) w/ controller, Tx and Rx consoles
	1 -	50 MHz dipole antenna assembly
	1 -	25 MHz dipole antenna assembly
	1 -	50 MHz rough terrain antenna (s/n 12095)
	1 -	Hip chain trigger
	1 -	External monitor / computer controller
	6-	Li ion battery packs, chargers
	1-	Reflex processing and interpretation software package
Other:	2 -	1.8 Ghz laptop computers
	1-	Trimble Geoexplorer I differential GPS receiver
	1 -	1Ton 4x4 GMC truck
	1 -	Electronic and general repair tools

c. Seismic survey specifications. The seismic refraction surveys were conducted according to the following specifications:

Channels:	24
Receiver spacing:	5 m
Receivers:	single phone at each receiver station
Sampling:	0.250 ms
Record length:	256 ms
Pre-acquisition filters:	500 Hz high cut
Storage format:	SEG-Y digital file & paper shot record copy.
Shot spacing:	2 - 120 m off either end of the receiver array 2 - 5 m off either end of the receiver array 1 - mid-spread, offset 5 m left or right of line to clear the cable
Energy source:	High explosives (Dyno-Nobel Powerfrac™) initiated with StaticMaster seismic detonators. Single blast at each shot point.
Topography:	As provided by YES (Faro Pit lines) or surveyed with laser range finder, supplemented by DGPS receiver (Rose Creek seismic lines)

The survey lines at the Faro Pit were surveyed by Yukon Engineering Services prior to commencing the seismic survey. On each line, several pickets near Station 40 were placed for alignment and the remainder of the stations were spray painted on rock surfaces. Shots located off the seismic lines (ie. end of line shots) were surveyed with the laser range finder, recording the horizontal and vertical distances from a known station on the seismic line to the blast point.

The seismic survey lines at the Rose Creek site were surveyed in relative to the GPR line pickets which had also been surveyed by Yukon Engineering Services. Individual phone locations and all shot locations were surveyed with the laser range finder and compass and registered to UTM coordinates using the surveyed picket locations.

Source effort varied depending upon distance from the reading array and the difficulty encountered in producing clear records. Off-end shots typically required from 25 to 30 1"x8" sticks of powder while a 10 stick charge was used for the shots at the centres of the arrays. Charges were not covered because no fine material was present. At the north end of the lines, receiver stations were located on or immediately adjacent to bedrock outcropping in the southern wall of the Faro Pit and off-end shots were placed on bedrock near these phones with the assurance that head waves would be generated at short offsets.

d. Data processing & interpretation. A full description of the refraction seismic data processing and interpretation will follow with the final report. The data was interpreted using an automated delay time method incorporating surface topography and lateral phone and shot offsets, if applicable[1]. The Rimrock Geophysics SIP interpretation program takes as input the first breaks and all available shot and array geometry information. The interpreter determines the number of layers present in the data by inspection of the time - distance (T-X) curves and through velocity analysis of the T-X curves. The interpreter then assigns each arrival to a layer based on his analysis of the T-X curves. The output consists of scattergrams showing the subsurface reflection points along each of the layer boundaries and a best fit line through the point set. A good solution will show a minimum of scatter about the best fit line delineating the layer boundary. It is an inherent property of refraction solutions that 2 layer cases will produce much tighter scatter plots than 3 or more layer cases.

The following procedures were used to interpret the seismic refraction data. First, the first arrivals on the shot records were picked with Interpex Ltd.'s IXSeg2SegY semi-automated shot record analysis program. Picks were exported and formatted for entry into the SIP processing package. Topographic survey data was processed in spreadsheets, checked for accuracy using the fixed cable length constraint and the topography provided by YES, and then entered into the interpretation package. The data was fit to either a two layer or three layer case, depending upon the number of distinct segments visible in the T-X curves. After initial interpretation runs, layer assignments were adjusted to minimize the scatter of refraction points around the best fit solution for each layer boundary. This forward modelling is an iterative process where the interpreter may have to repeatedly adjust his picks and recheck the shot

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[1]Scott, J.H. (1973) Seismic refraction modeling by computer. Geophysics Vol. 38, No. 2.

records to improve the quality of the final solution. Final output including T-X plots and depth sections showing the location of the layer boundaries and the refraction point scatter are appended to this preliminary report. A more comprehensive summary of each inversion will follow with the final report.

e. Preliminary results - seismic refraction surveys. Appendix A contains the inversion results for the Faro Pit lines and Appendix B contains the results for the Rose Creek lines. For each spread (ie. each 115 m geophone array), a T-X plot and a model section is provided. The orientation of the local horizontal coordinate systems shown in the sections is constrained by the spread layout but the geographic orientation of the lines is also indicated on each section. The elevations shown in the model depth sections are elevations above mean sea level in metres referenced to the elevations provided by YES.

Each of the Faro Pit seismic lines were overlapped because the line available for survey was greater than a single 115 m spread but less than a 235 m (two spreads). The model sections for Lines 2 and 3 are oriented North to South while the model section for Line 1 is oriented South to North. The data in each case best fit a three layer model and the velocities used in the inversions are summarized below:

Line	V_1 (m/s)	V_2 (m/s)	V_3 (m/s)
1	548	1036	4281
2	492	923	4219
3	532	855	3923

The uppermost layer (V_1) has a velocity expected of dry, relatively unconsolidated material. The middle layer velocity is in the range expected for dry consolidated overburden including poorly compacted till. The velocity of the lower layer is in the range expected for bedrock in this area. The boundary between layers 2 and 3 (the lowermost boundary in each model) is thus interpreted to be bedrock.

The Rose Creek seismic survey was conducted on two lines centred on local drainages. Line SL-1 is centred on a creek nearest the eastern end of the GPR Main Line and consists of a single spread with a midpoint at the creek. Line SL-2 is centred on the next flowing drainage to the west and consists of two spreads with a common mid-point centred on the creek. The two spreads on line SL-2 are over lapped at a single station at local horizontal coordinate 115.5 m on the seismic sections.

The data from Line SL-1 is best modelled with a three layer case. The velocities used in the inversion were V_1=835 m/s, V_2=1550 m/s, and V_3=4182 m/s. The velocity of the middle layer was constrained to the value shown to improve the data fit; the estimated velocity was 1966 m/s. The lowermost layer boundary is interpreted to be bedrock and the middle layer appears to be water-saturated overburden.

The data from Line SL-2 is best modelled with a two layer case. The velocities used in the inversion were V_1=1560 m/s and V_2=3800 m/s. The velocity of the upper layer is that expected from water saturated overburden while the velocity of the lower layer is with the range of both bedrock and permafrost. Some refracted arrivals were in excess of 4100 m/s suggesting bedrock is the refractor for at least a portion of the layer boundary but other arrivals had velocities ranging from 2900 - 3700 m/s indicating that the refractor may be either permafrost or weathered bedrock (eg. phyllite). Permafrost was observed in a couple of shot holes on the eastern portion of the line (ie. from 0 to 115 m).

f. GPR survey specifications. The GPR survey at Rose Creek was conducted according to the following specifications:

Centre Frequency:	50 MHz
Station spacing:	20 cm
Time window:	700 ns after groundwave first arrival
Sampling interval:	1.25 ns per sample
Antenna separation:	2.0 m maintained using a rope between antenna pullers
Triggering:	Automated chainbox (Hipchain)
Line location:	The apparent horizontal distance at which each surveyed control line picket was encountered was recorded manually and used in the data processing to register the lines.

g. GPR data processing. A full description of the data processing procedures will follow in the final report. In brief, the following data processing steps and algorithms were applied to the raw data to produce the final radargrams:

1. Geometric registration of radar traces to topographic survey points.

2. Dewow

3. Drift correction and reset time zero to remove short wavelength static variations caused by variable antenna spacing.

4. Spherical & exponential gain.

5. Time varying gain to boost reflections in the region of interest.

6. Band-pass filtering

7. Spiking deconvolution

8. Velocity analysis of diffraction hyperbolas

9. Depth section production

Band pass filtering, spherical & exponential gain and spiking deconvolution were omitted in some cases where these steps were not considered useful in improving the quality of the final images.

h. GPR survey results. Raw radargrams (not interpreted) are appended to this report as JPEG files for the Rose Creek lines. The following notes describe the processing applied to each radargram:

1. Geometric registration - Warped GPR local coordinates onto fixed surveyed points P4 through P99.

2. Trace kills - Set bad traces to zero.

3. Drift removal - Flattened times of first maximum arrival

4. Reset time zero - Subtracted 10 ns from flattened data

5. Dewow - Used 20 ns time window

6. Gain - Applied time varying gain, then a scaled window gain using 70-100 ns time window

7. Depth conversion - Inserted static shift based on two way travel time

through overburden. Average overburden velocity of 0.14 m/ns used based on diffraction hyperbola analysis

Fully interpreted radargrams will be included in the final report.

Respectfully submitted,
AURORA GEOSCIENCES LTD.

Mike Power

Signature Not Verified

Digitally signed by Mike Power
DN: cn=Mike Power, c=US
Date: 2004.10.27 13:42:08 -07'00'

Mike Power, M.Sc., P.Geoph.
Geophysicist

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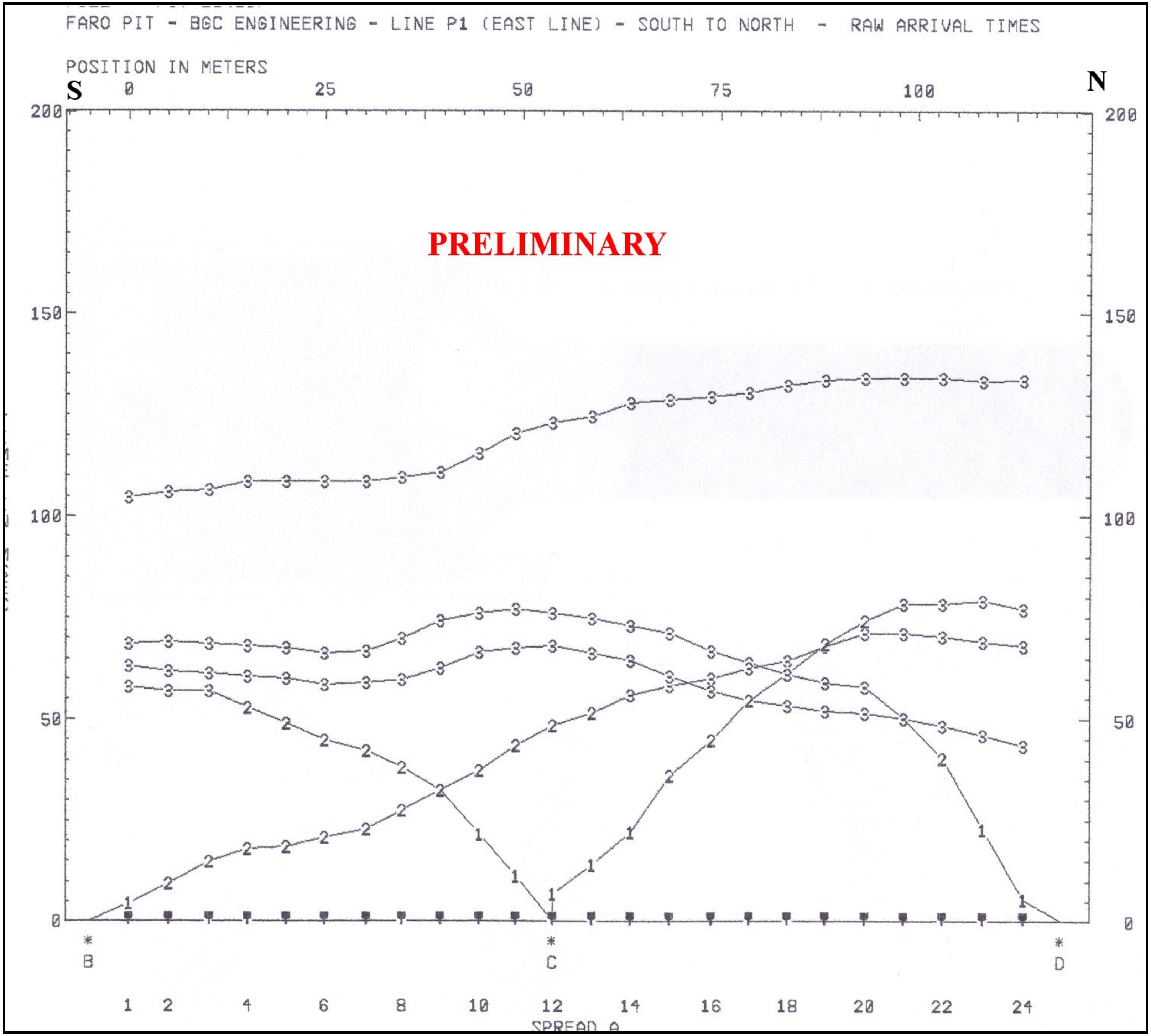
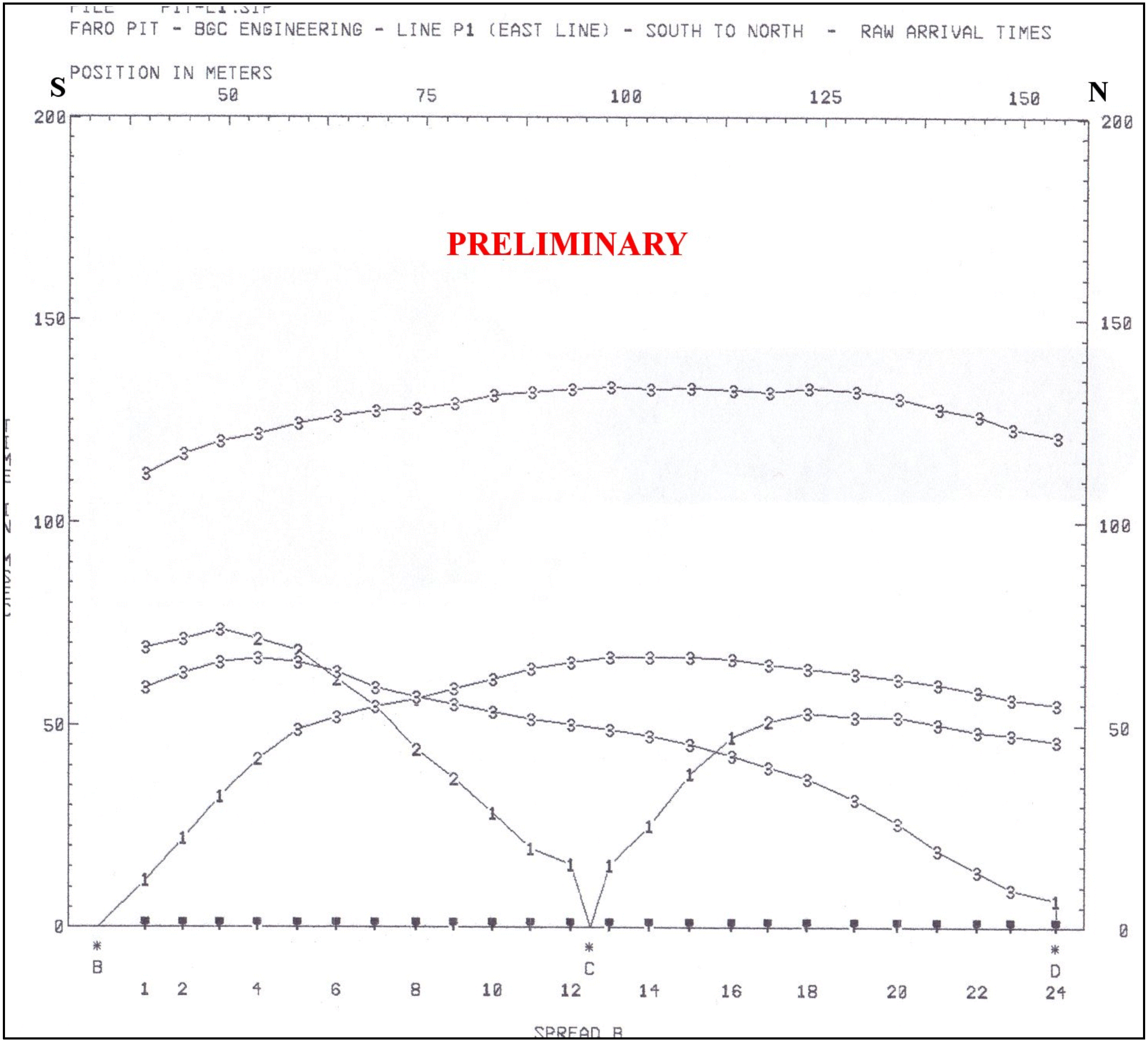
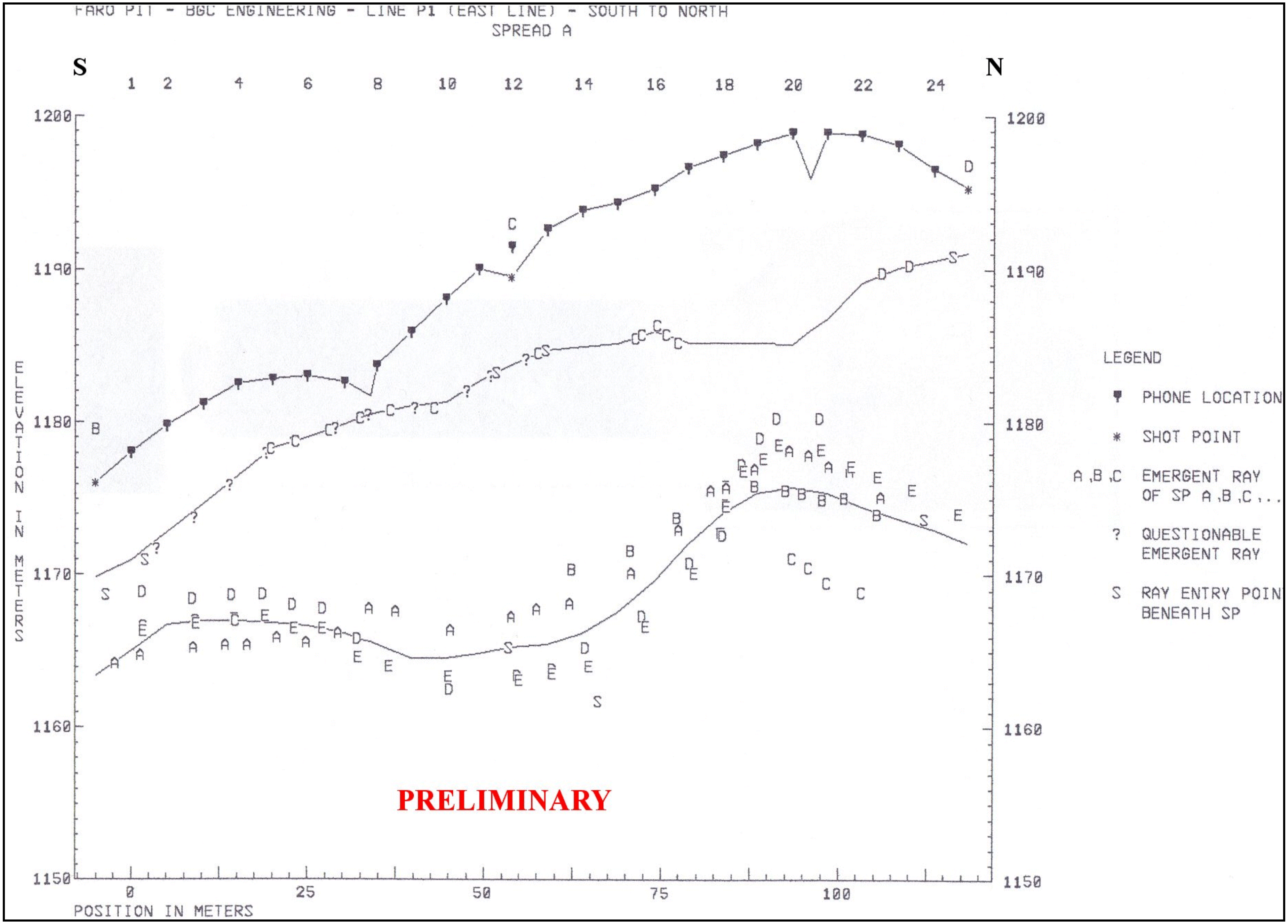
APPENDIX A. SEISMIC REFRACTION RESULTS - FARO PIT LINES



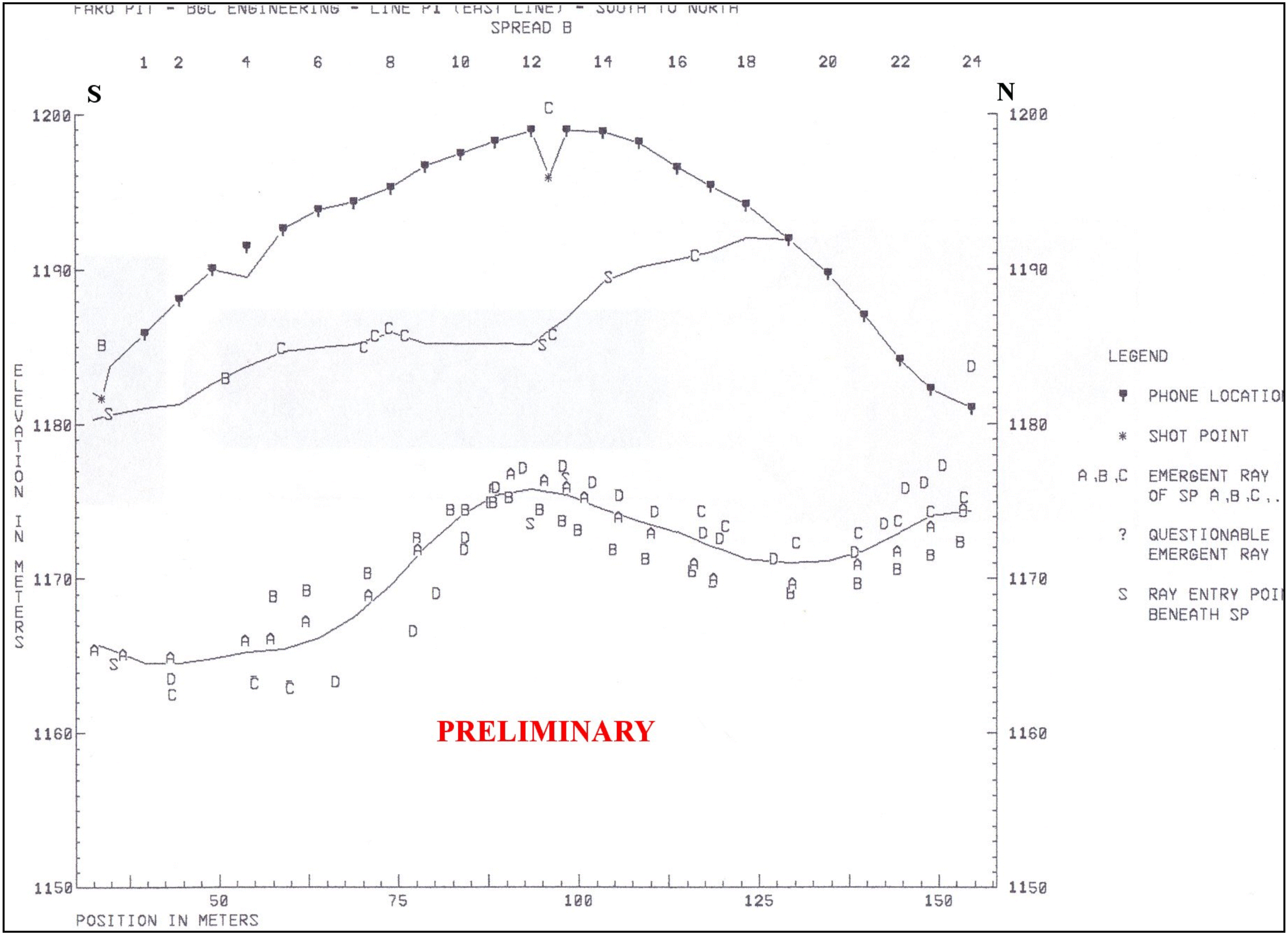
Pit Line 1 - Spread 1 - T-X curves



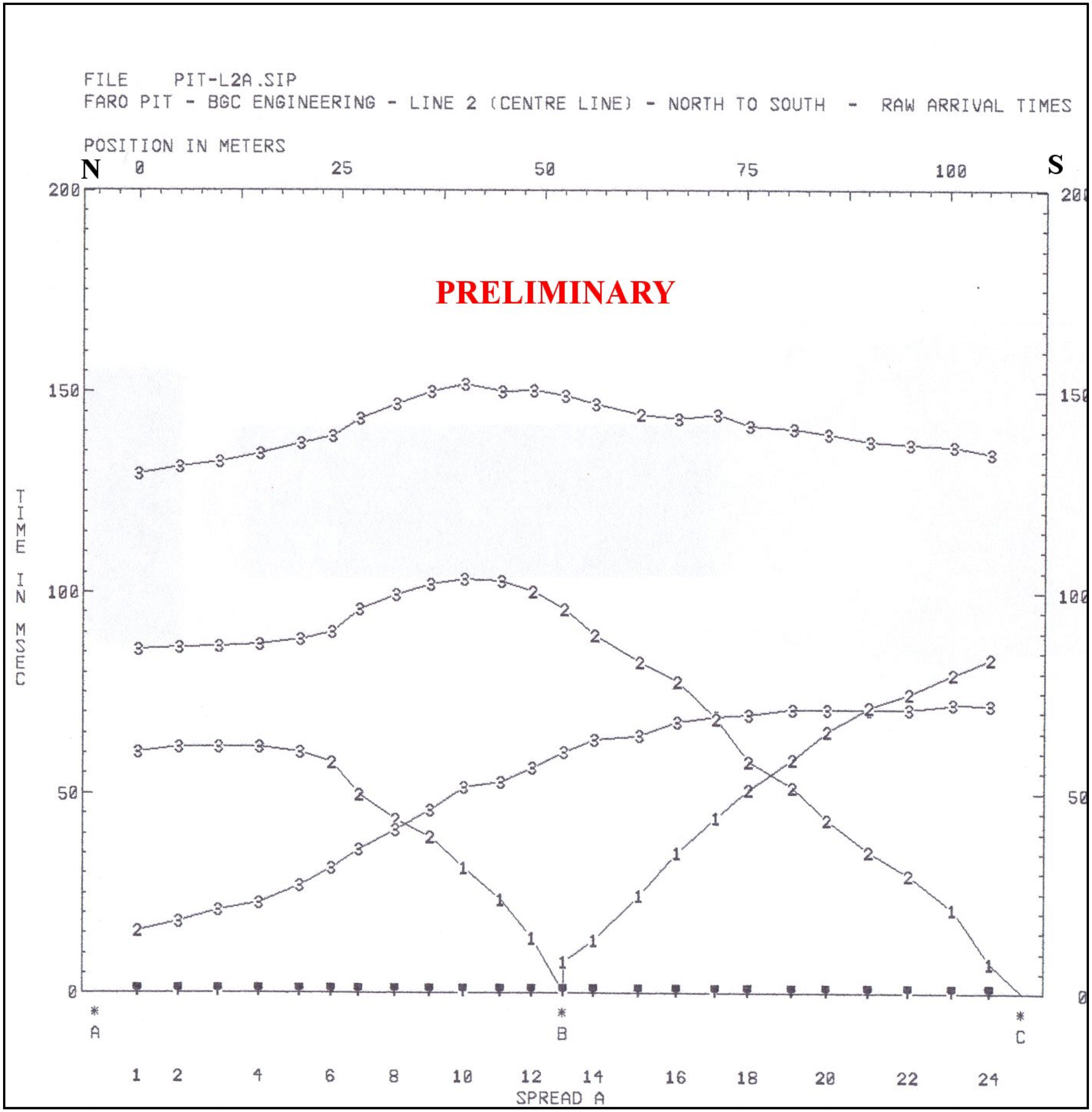
Pit Line 2 - Spread 2 - T-X curves



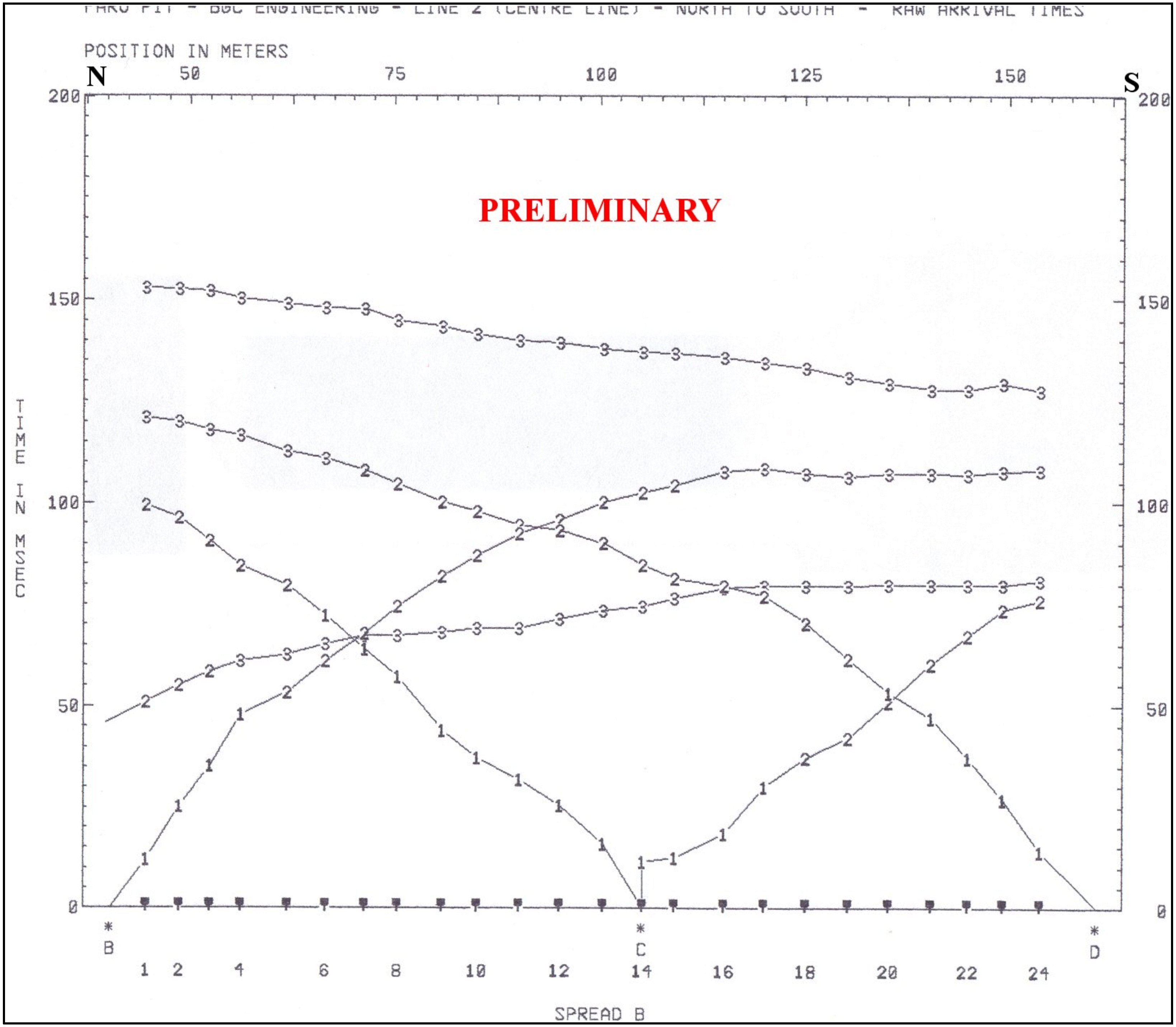
Pit Line 1 - Spread 1 (south end of line) - Inversion model



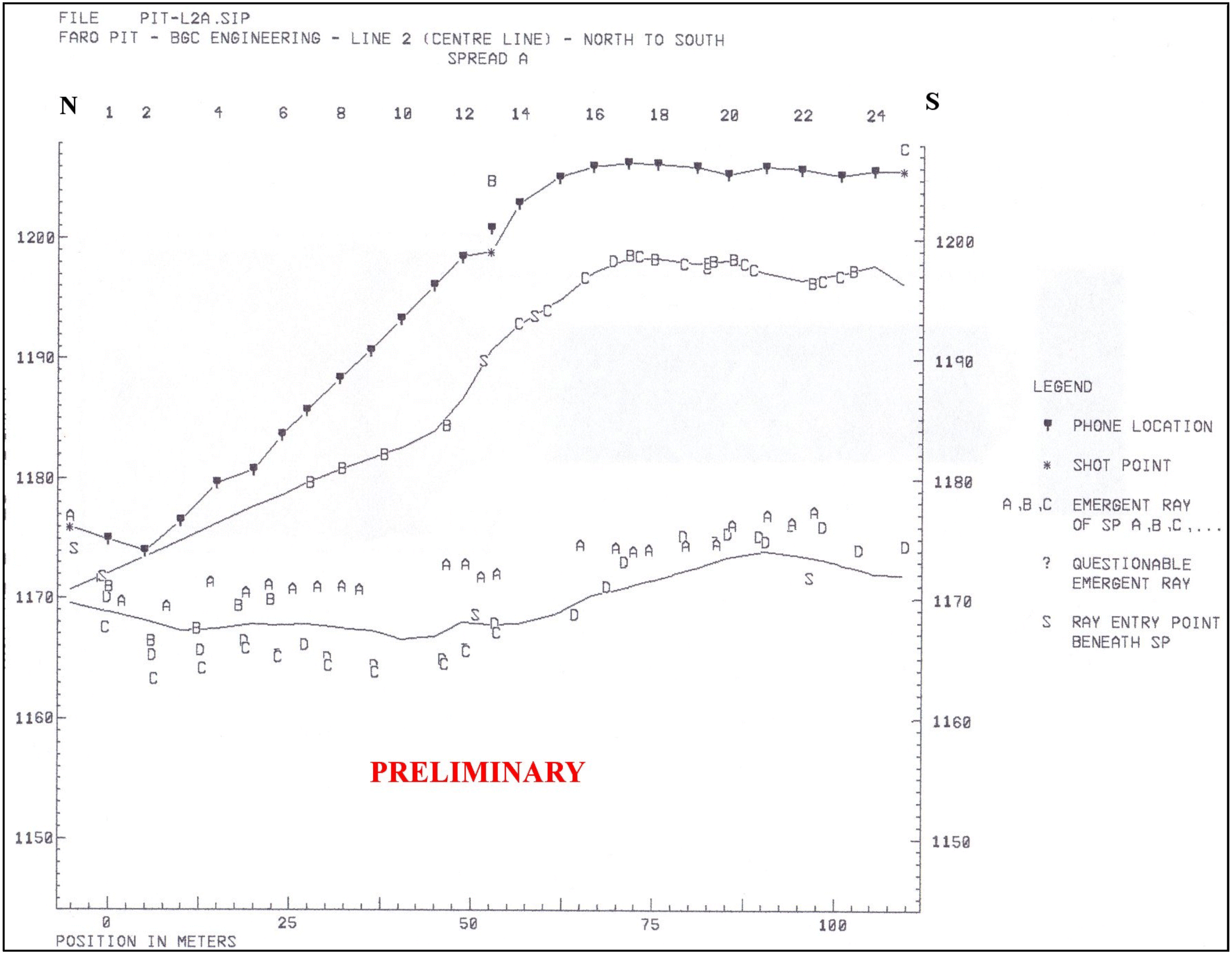
Pit Line 1 - Spread 2 (north end of line) - Inversion model



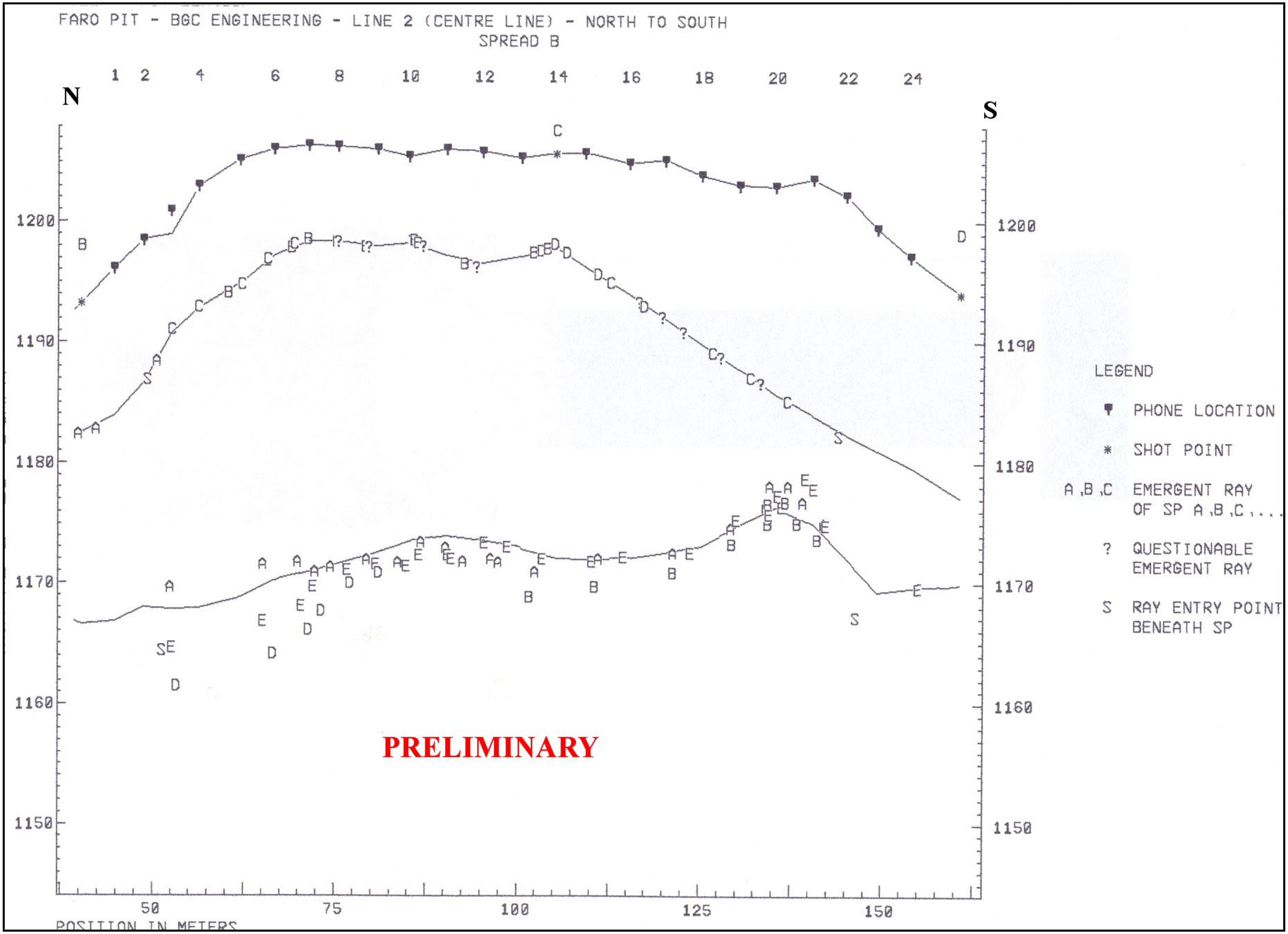
Pit Line 2 - Spread 1 - T-X curves



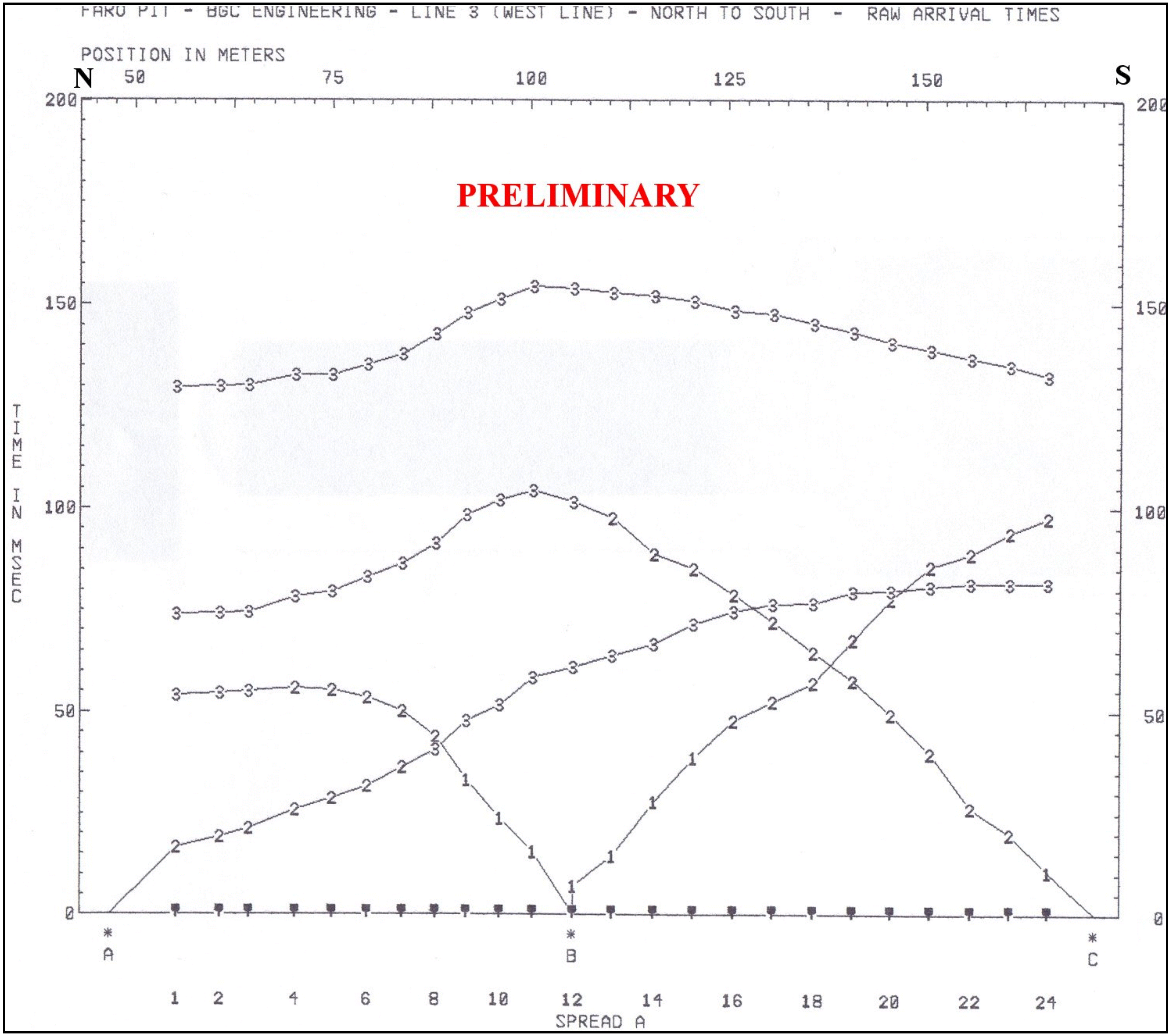
Pit Line 2 - Spread 2 - T-X curves



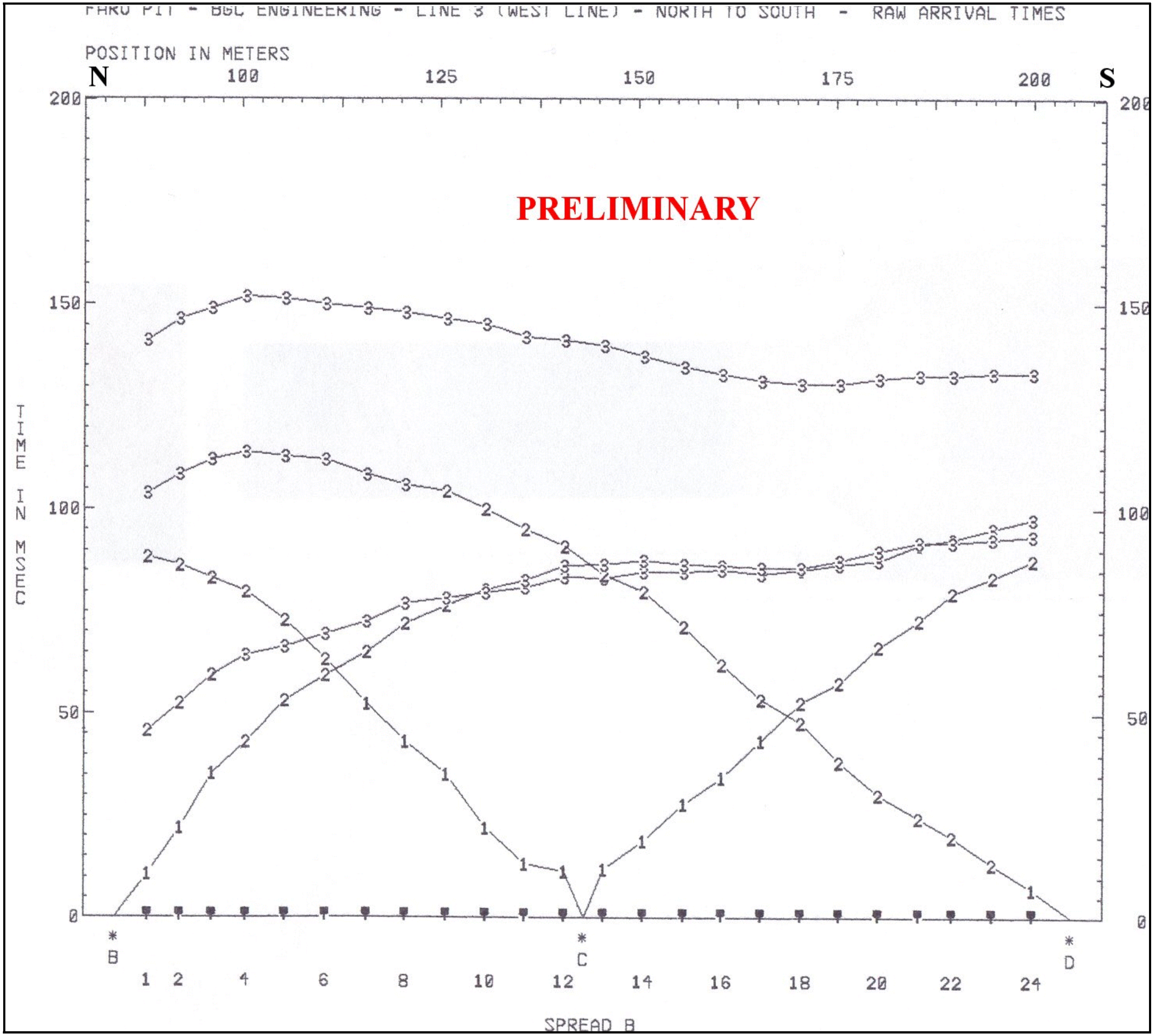
Pit Line 2 - Spread 1 (north end of line) - Inversion model



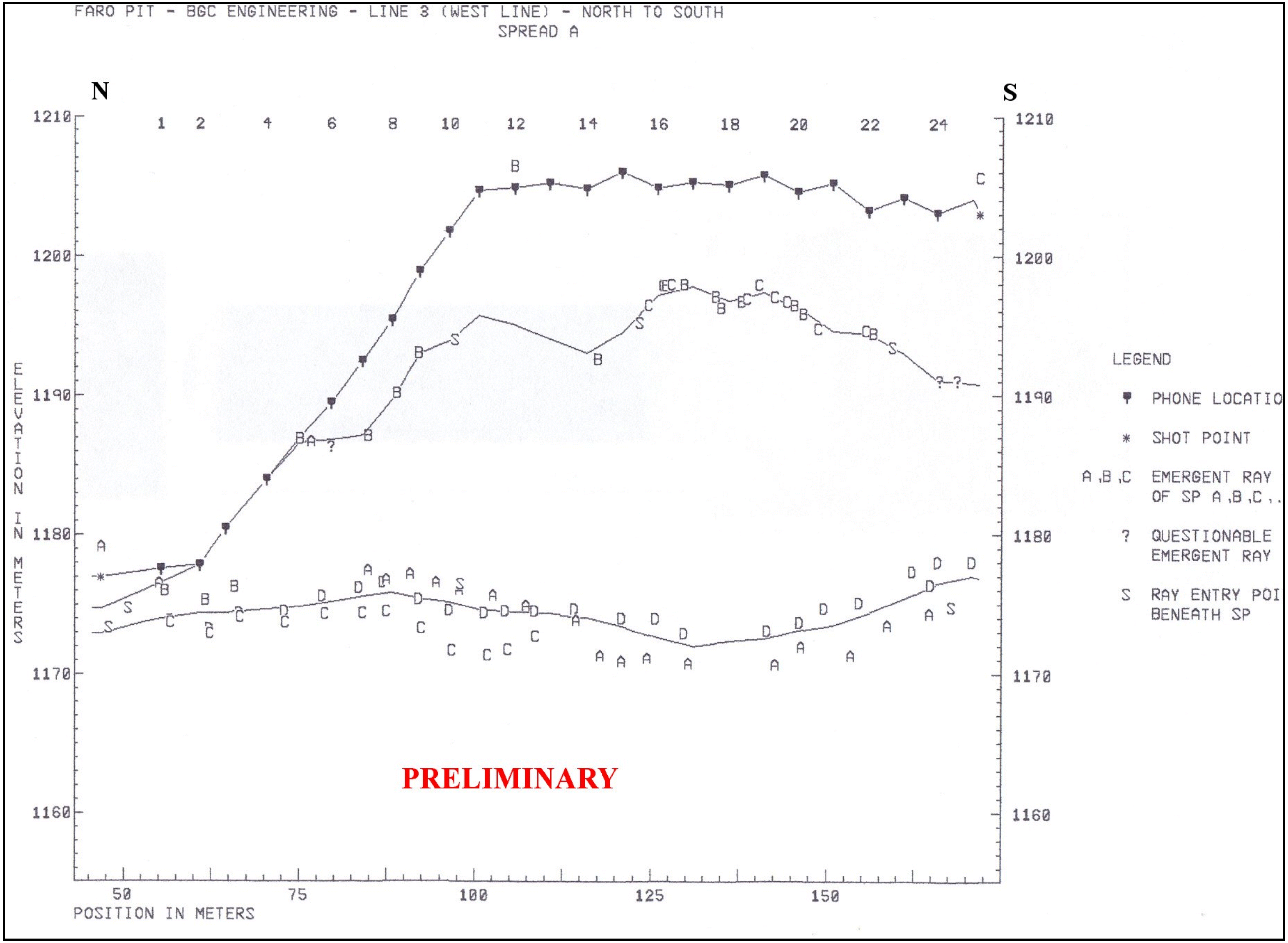
Pit Line 2 - Spread 2 (south end of line) - Inversion model



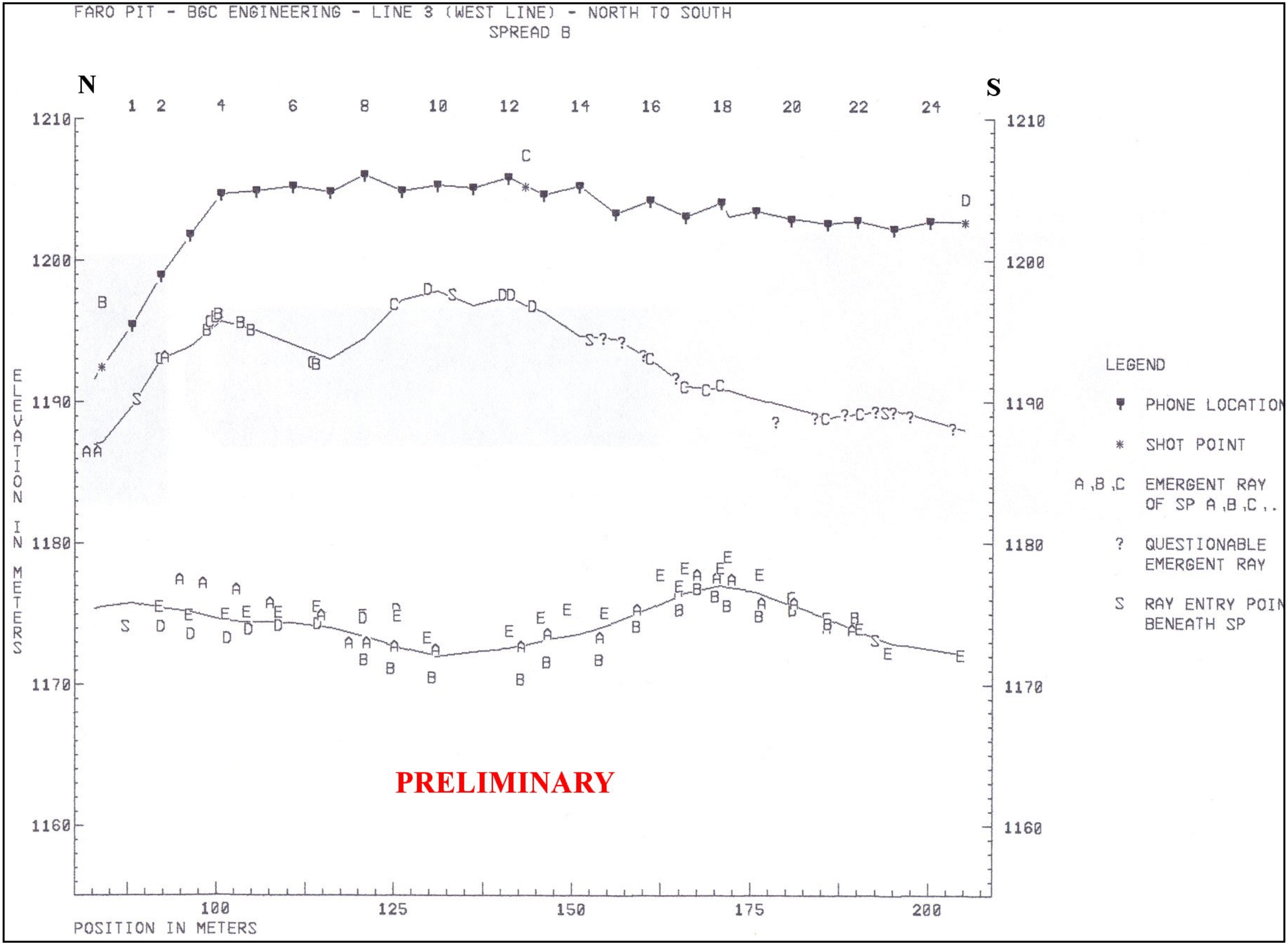
Pit Line 3 - Spread 1 - T-X curves



Pit Line 3 - Spread 2 - T-X curves

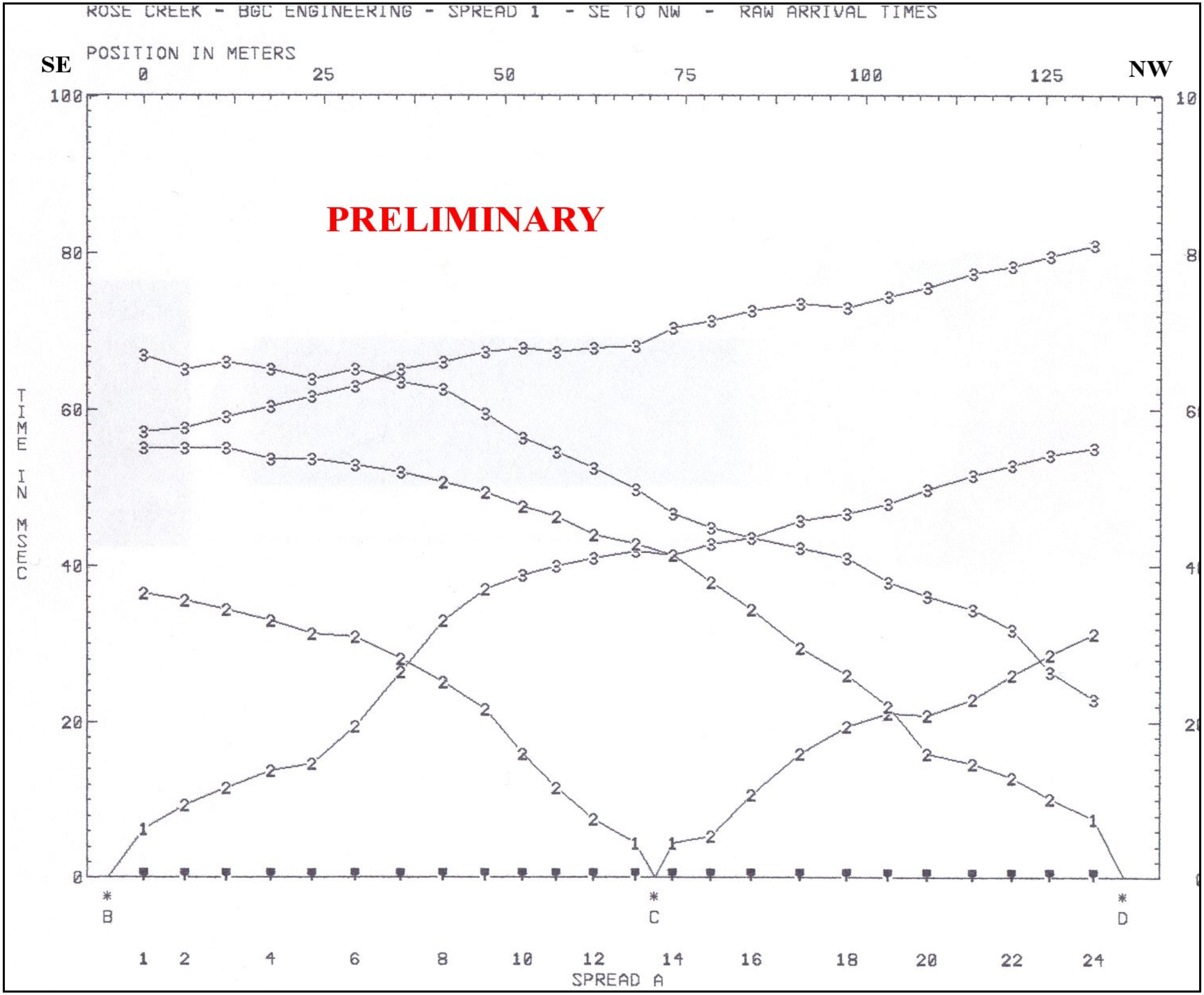


Pit Line 3 - Spread 1 (north end of line) - Inversion model

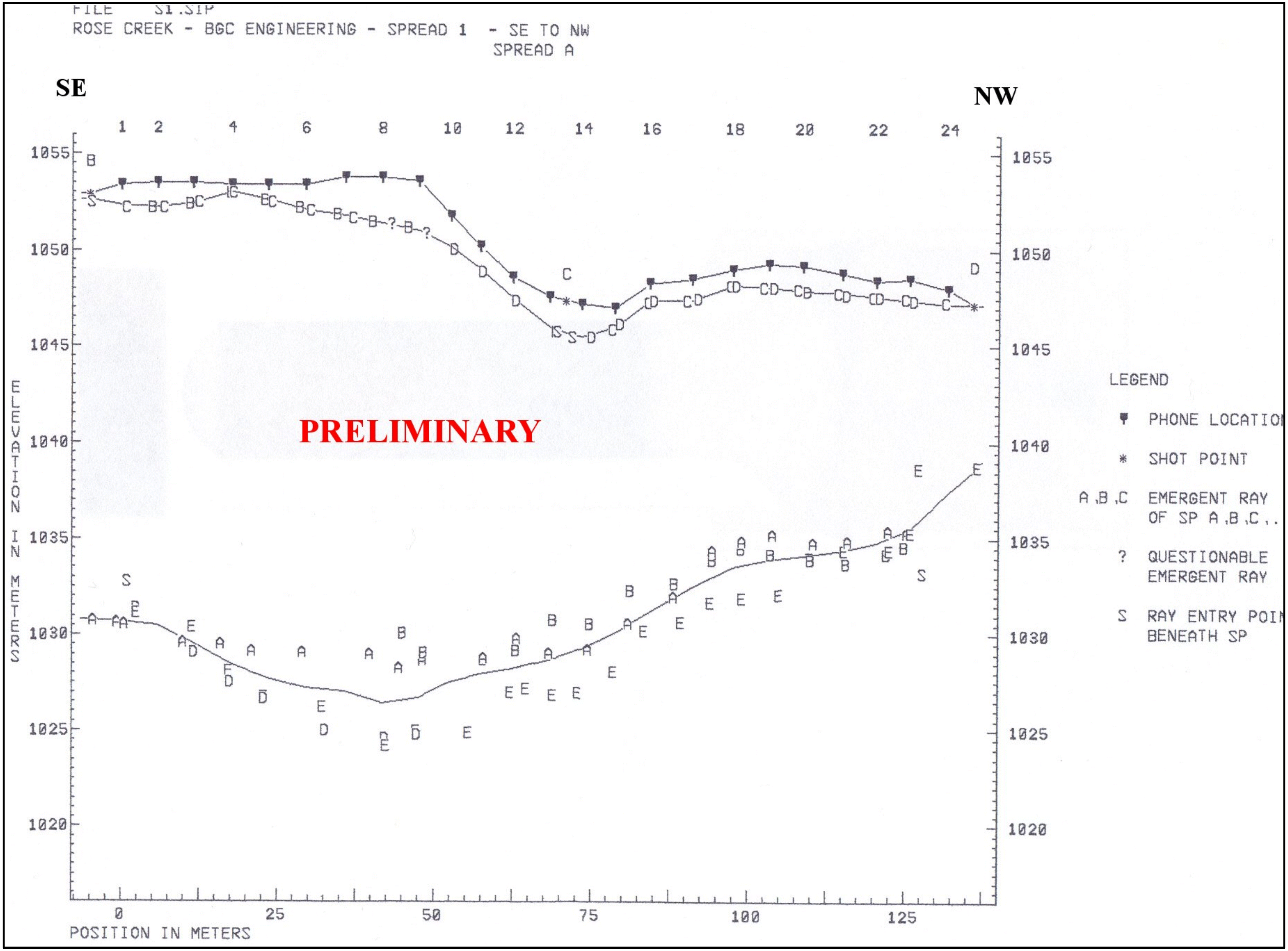


Pit Line 3 - Spread 2 (south end of line) - Inversion model

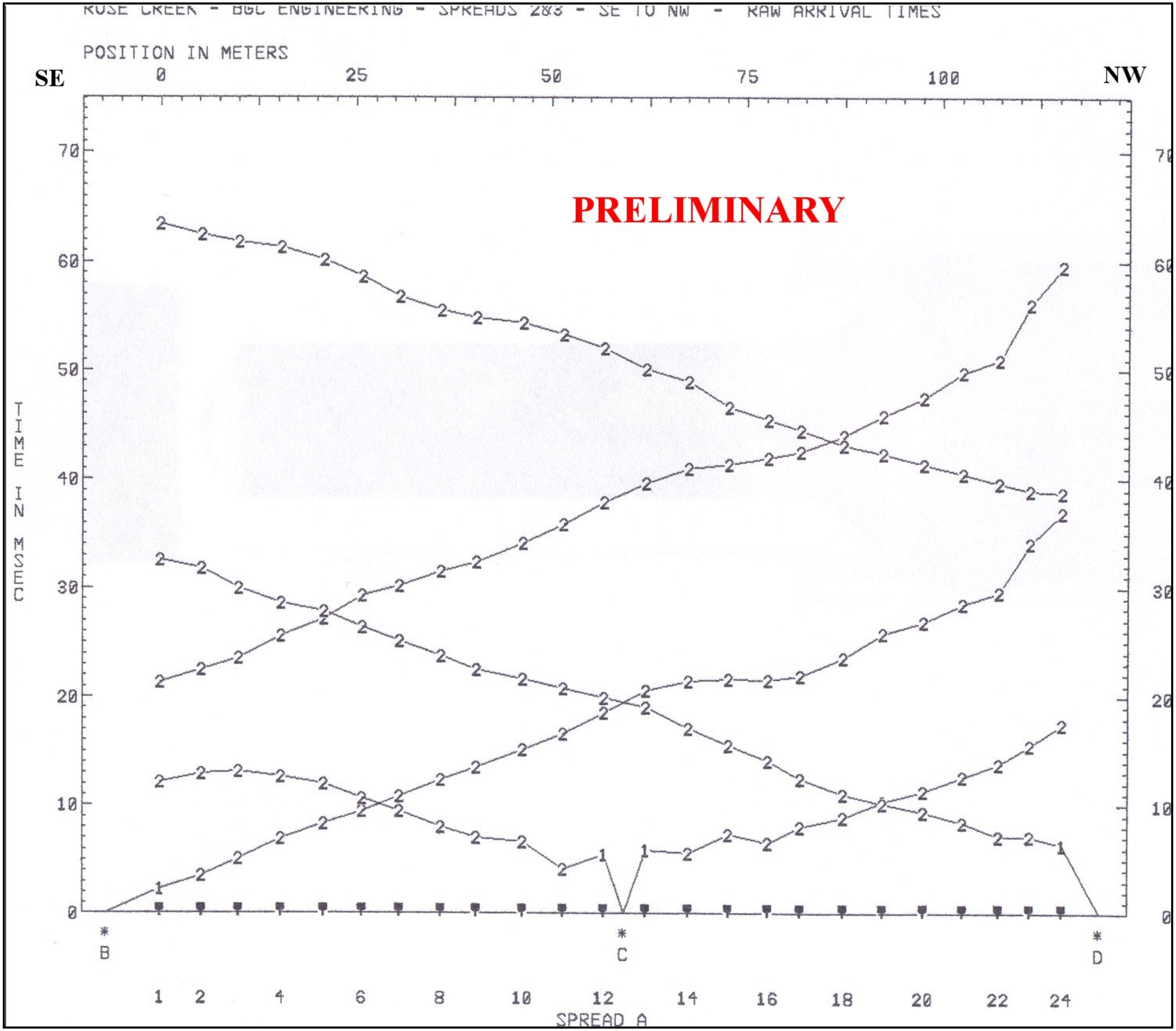
APPENDIX B. SEISMIC REFRACTION RESULTS - ROSE CREEK LINES



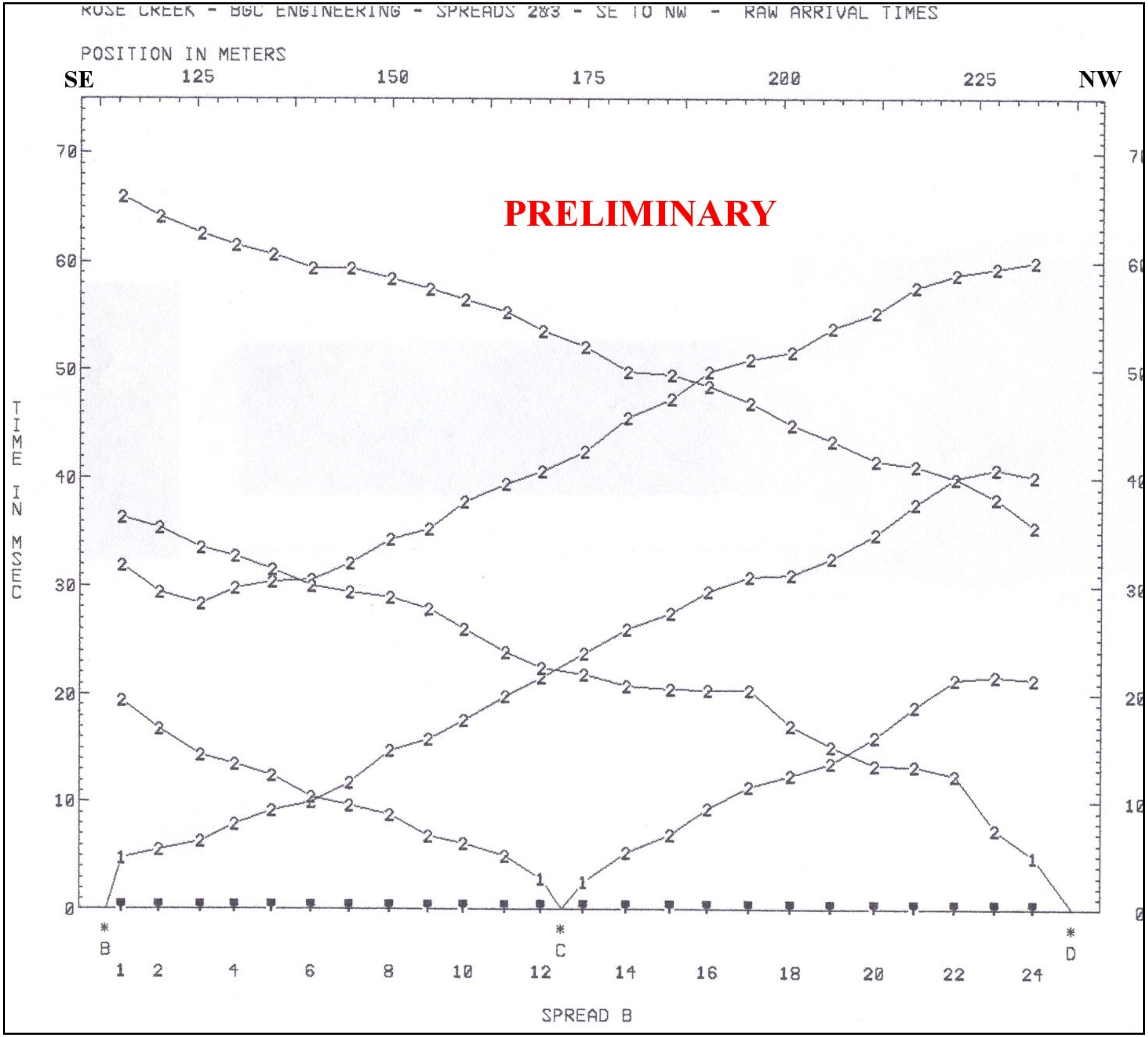
Rose Creek - Line SL-1 - Spread 1 - T-X curves



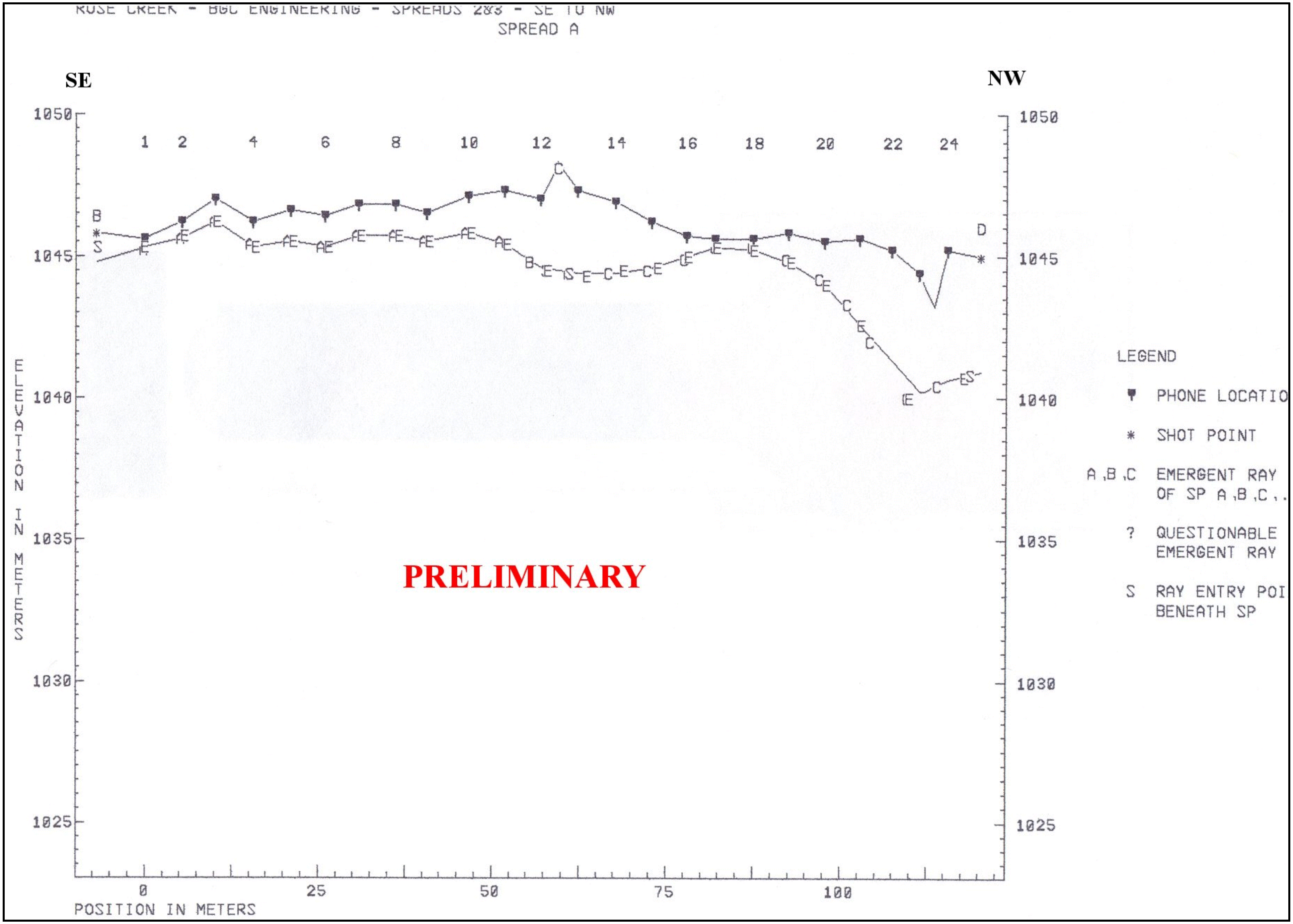
Rose Creek - Line SL-1 - Spread 1 - Inversion model



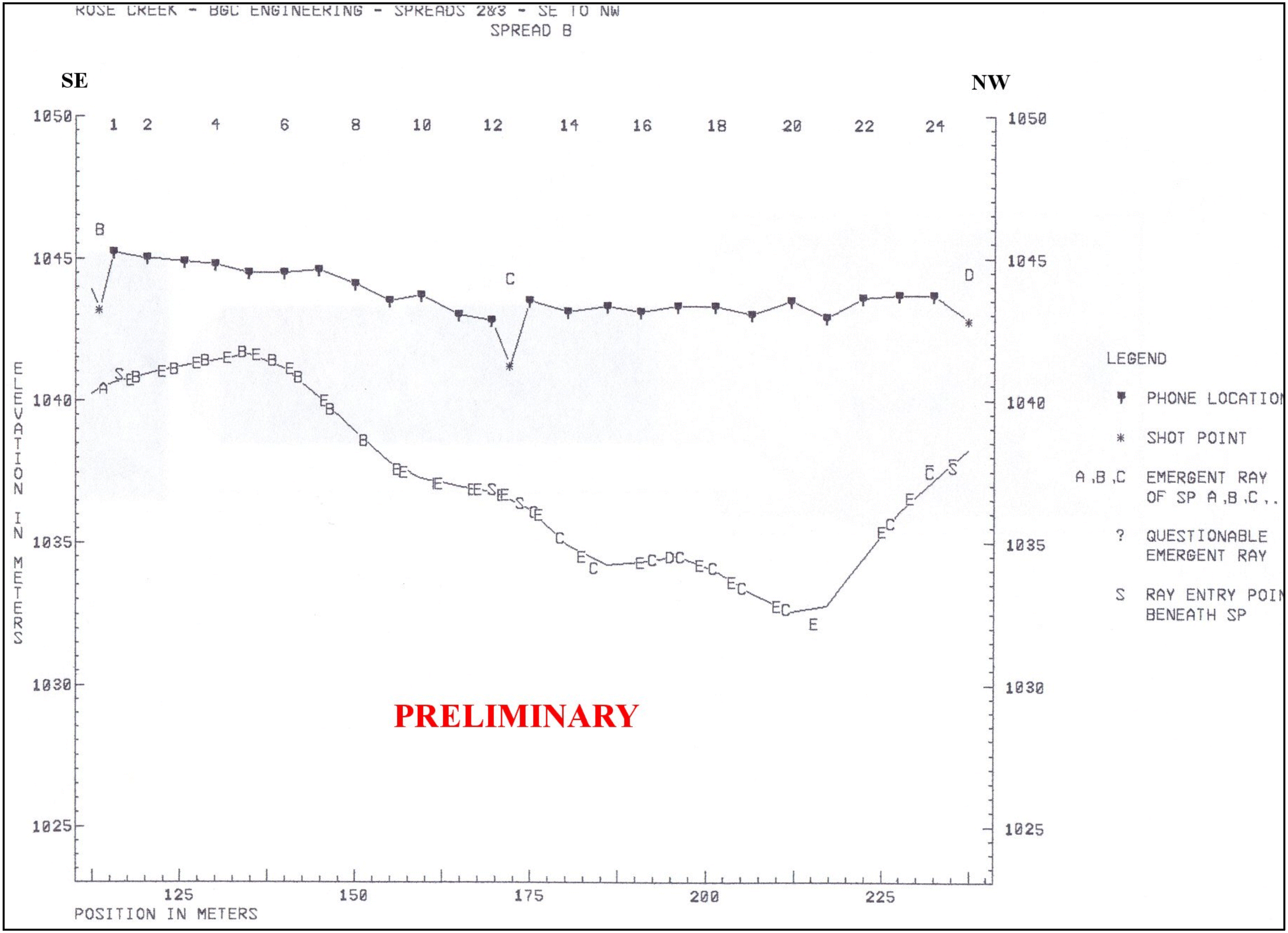
Rose Creek - Line SL-2 - Spread 1 (East end of line) - T-X curves



Rose Creek - Line SL-2 - Spread 2 (West end of line) - T-X curves



Rose Creek - Line SL-2 - Spread 1 (East end of line) - Inversion model



Rose Creek - Line SL-2 - Spread 2 (West end of line) - Inversion model