

**GEOLOGICAL SURVEY OF CANADA  
OPEN FILE 1895**

**ANALYSIS OF IN SITU TDR DATA,  
NORMAN WELLS PIPELINE  
FINAL REPORT  
MARCH 31, 1988**

**for M. Burgess  
Geological Survey of Canada  
Energy Mines and Resources Canada  
1 Observatory Crescent  
Ottawa, Ontario  
K1A 0Y3**

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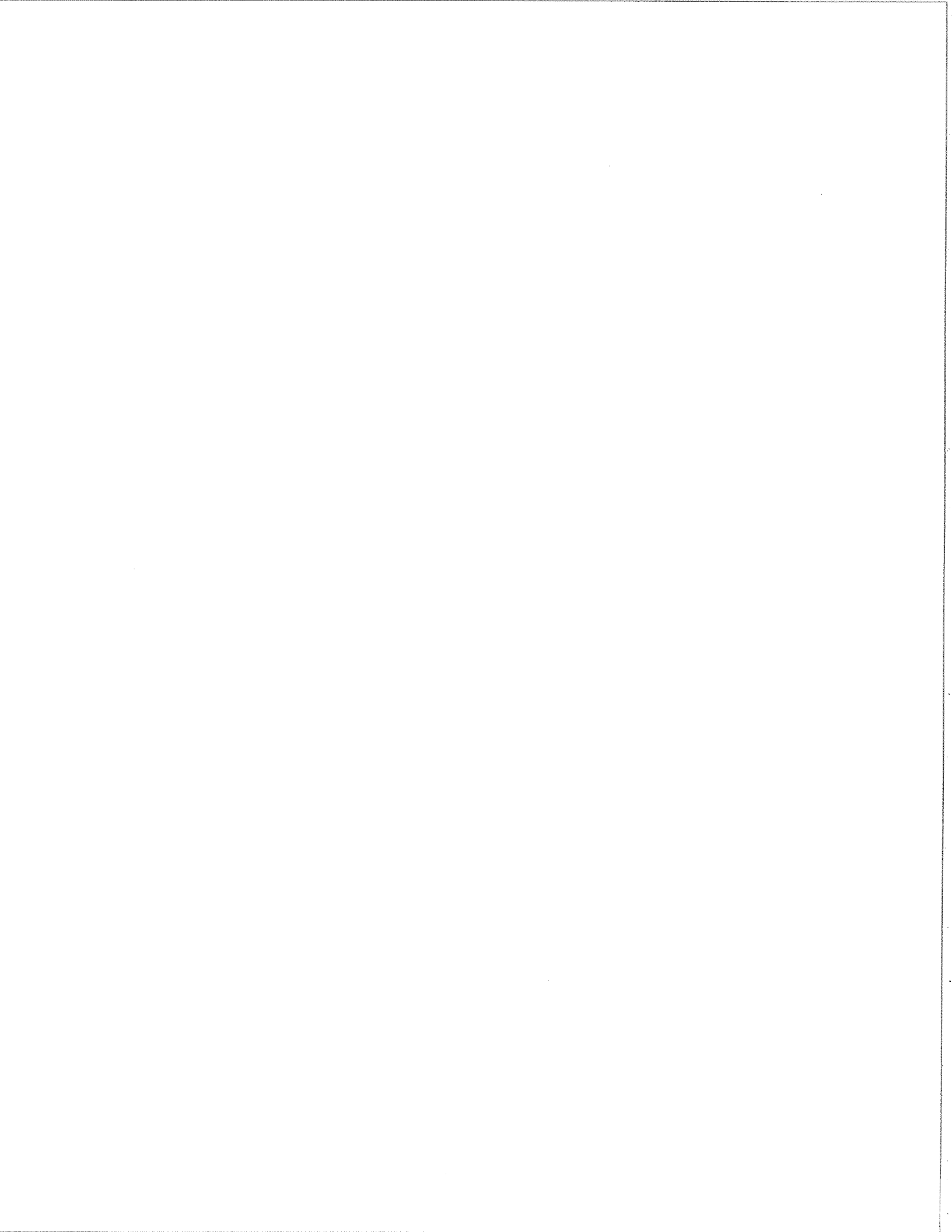
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## FOREWORD

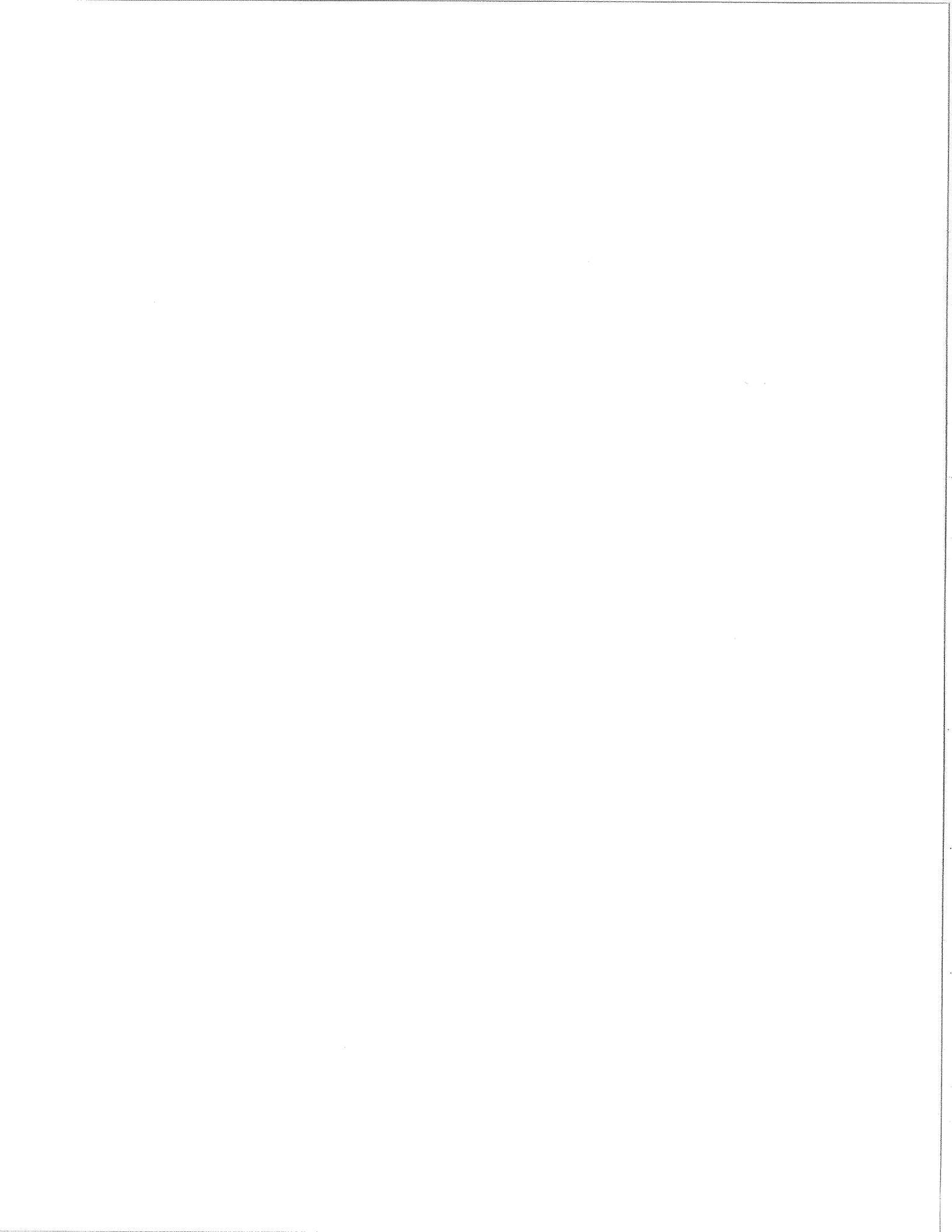
This report documents work undertaken as part of the federal government's Permafrost and Terrain Research and Monitoring Program along the 868 km Norman Wells to Zama oil pipeline. The 324 mm diameter, shallow burial (1 m) pipeline, traverses the discontinuous permafrost zone of northwestern Canada and began operation in April 1985. A joint monitoring program with Interprovincial Pipe Lines (NW) Ltd. was established following the signing of an environmental agreement between the pipeline company and the Department of Indian and Northern Affairs (INAC) in 1983. INAC coordinates the government's monitoring program in which Energy, Mines and Resources' Geological Survey of Canada, the National Research Council's Institute for Research in Construction, and Agriculture Canada's Land Resource Research Institute participate.

A major component of this research and monitoring program involves the detailed quantification of changes in the ground thermal regime and geomorphic conditions at thirteen instrumented sites along the route. This project was developed in cooperation with the Permafrost Research Section of the Geological Survey in order to examine and quantify the effects of pipeline construction, operation and maintenance in thaw sensitive terrain. Many components of this research are contracted out.

The work undertaken in this contract report describes but one aspect of these site investigations. Interpretations contained herein are often limited to the specific data base under analysis and may thus not present an integrated or comprehensive analysis of all site observations. The opinions and views expressed by the authors are their own and do not necessarily reflect those of the Geological Survey of Canada or Indian and Northern Affairs.

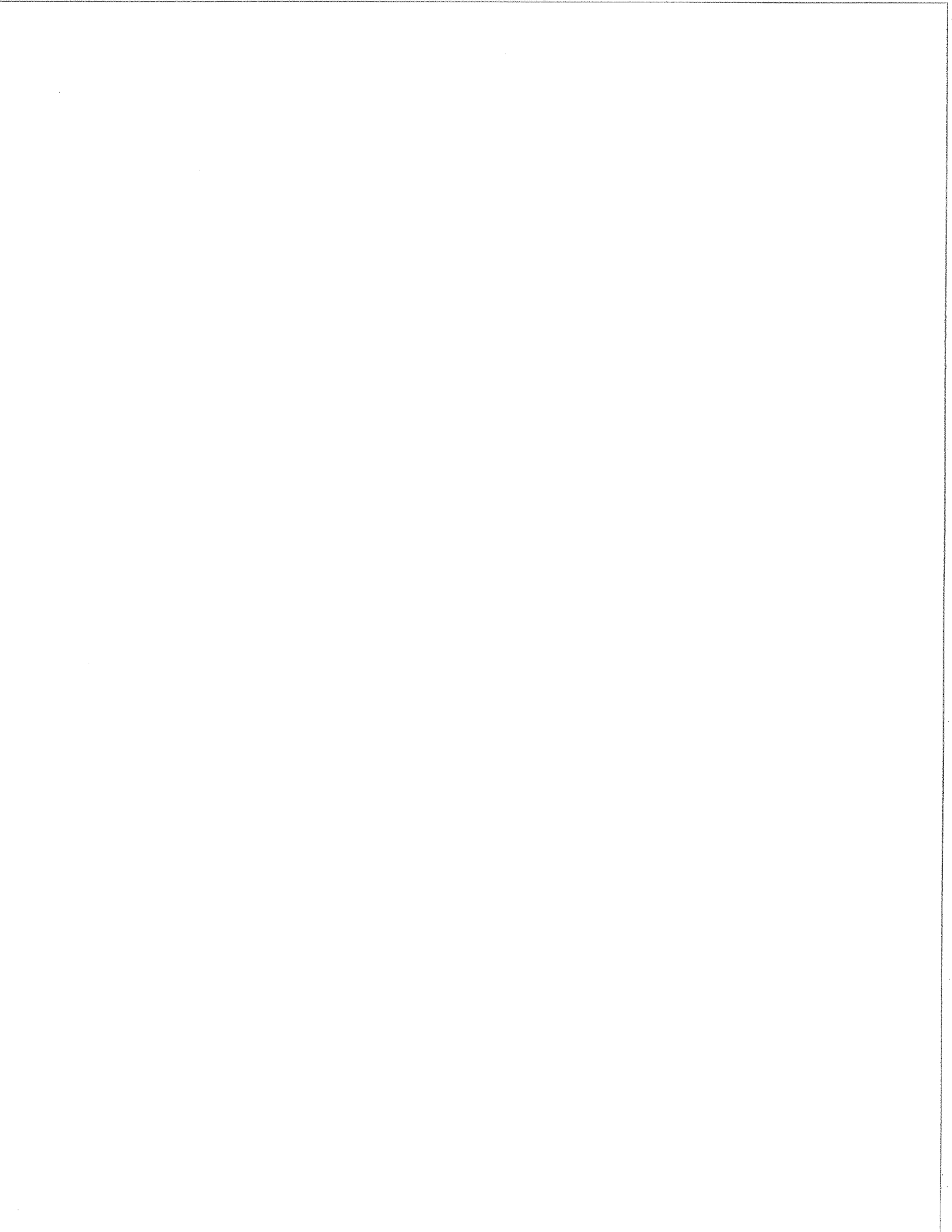
Funding for the research and analyses reported herein was largely provided by INAC's Northern Affairs Program, with contributions from the Northern Oil and Gas Action Program (NOGAP).

Margo Burgess  
Scientific Authority  
Permafrost Research Section  
Geological Survey of Canada



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## Analysis of In Situ TDR Data, Norman Wells Pipeline

### 1. Introduction

Information on the dielectric constant,  $K$ , obtained via Time-domain Reflectometry (TDR) has been collected at 13 monitoring sites along the 868 km long pipeline route from Norman Wells NWT to Zama Alta. These data were analysed to determine:

1. temporal variations in the soil moisture regime at each site
2. lateral variations in the soil moisture regime at each site (specifically, the existence of differences in observations between the TDR installations beside the pipeline, on the pipeline right-of-way (ROW) and off the right-of-way).
3. the existence and depth of thaw at each TDR installation at each site.

Based upon the analysis, recommendations have been made as to whether observations at a given site should be continued and, if so, at what frequency should they be made.

At each monitoring site there are 3 TDR installations each having up to 5 TDR probes. The TDR stations are coded as follows:

KB off right-of-way  
KC on right-of-way  
KP beside pipeline

The TDR probes have nominal lengths of 1, 2, 3, 4.5 and 6 feet. Each probe extends from the ground surface down to the depth determined by the probe length, giving an estimate of the dielectric constant over the total length. Initially, two inches of each TDR probe was exposed above the ground surface to allow connection to the TDR unit, however, the probes are subject to heave and settlement so the depth over which the dielectric constant is being measured could change. Beginning in October 1986, a detailed record was made of the length of rod exposed above the ground surface.

The actual number of TDR probes and their coverage depths are summarized in tables for each site.

### 2. Background on TDR Measurements of the Apparent Dielectric Constant

The apparent dielectric constant,  $K$ , of a soil is strongly influenced by its volumetric water content,  $\theta_v$ , hence variations in  $K$  can be used to monitor the change in water content of the soil. In brief, if  $K$  is found to increase, then the water content has increased (the  $K$ - $\theta_v$  relationship is known). The increase in water content can originate from the addition of water to an unsaturated soil and/or, in the case of freezing soils, the melting of ice due to increasing temperatures.

When TDR is used in freezing soils, the volumetric unfrozen water,  $\theta_u$ , is being measured since the volumetric ice content,  $\theta_i$ , has only a small influence on  $K_a$ . Total volumetric ice/water content,  $\theta_t$ , is comprised of ice and water such that:



$$\theta_t = \theta_u + \theta_i$$

and  $\theta_t$  is what could be determined by thawing a core specimen. It is possible that  $\theta_u$  can increase (eg. with increasing temperature) without an increase in  $\theta_t$  occurring.

If a TDR probe of 100 cm length is installed vertically from the ground surface, then the value of  $K$  determined is the average value for the soil over the 100 cm depth. The soil could, however, consist of a thawed layer over a frozen layer or a frozen layer over a thawed layer. Also, the water content within each layer could be variable.

$K$  is determined by measuring the one-way travel time ( $t_t$ , in nanoseconds, ns) of the TDR step pulse along a transmission line of known length,  $L$ :

$$K = [c * t_t / L]^2$$

where  $c$  is the free space velocity (30 cm/ns). The one-way travel time,  $t_t$ , represents the length of time the pulse needs to travel the length of the transmission line. The transmission lines used in the study are balanced parallel rod lines.

As indicated earlier, up to five TDR probes of different length have been installed, vertically from the ground surface. It is possible to obtain estimates of  $K$  in various layers from the  $K$  values measured for the individual probes. Figures 1 to 3 show three cases of an hypothetical soil in a permafrost region. These examples represent a two-layer soil model with a  $K$  of 10 in the 40 to 180 cm depth and varying values of  $K$  in the top 40 cm. These cases represent a surface thaw of the top 40 cm with each figure showing different total water contents (hence  $K$ ) in the thawed layer. The solid lines show what the  $K$  variations with depth should look like. The points numbered: 1, 2, 3, 4.5 and 6 on each figure denote the values of  $K$  which would have been measured using TDR probes with nominal lengths of 1, 2, 3, 4.5 and 6 feet respectively (actual lengths of 25, 57, 87, 133 and 178 cm respectively). In these examples, the 1 foot probe is contained completely within unfrozen material while the others traverse into frozen soil. The value of  $K$  for these probes has been plotted at the bottom of the appropriate depth range rather than at the mid-point.

The other numbered points (1-2, 1-3, 2-3 etc.) represent the value of  $K$  determined over the appropriate depth intervals. The value of  $K$  for these is plotted at the mid-point of the depth range. There are several things that these graphs indicate:

1. the value of  $K$  measured over the total length for all probes increase as the value of  $K$  value in the top 40 cm increases;
2. the increase in  $K$  for the longer probes (4.5 and 6 foot) is smaller than indicated by the shorter probes (2 and 3 foot) when  $K$  in the surface zone increases.
3.  $K$  within any layer can be estimated, and its value depends upon whether the probes bounding the layer terminate in the same material (ie. frozen or unfrozen).

With regard to this latter point, if two probes terminate within frozen soil, it is possible to obtain an estimate of  $K$  of the frozen layer. Figures 1 to 3 show that, the estimates of  $K$  between layers 2-3, 2-4.5, 2-6, 3-4.5, 3-6 and 4.5-6 give a value of  $K = 10$ , which is expected. The estimates for layers 1-2, 1-3, 1-4.5 and 1-6 show the influence of the differences in  $K$  between the unfrozen-frozen zones.

Figure 1

Top 40 cm, K=20

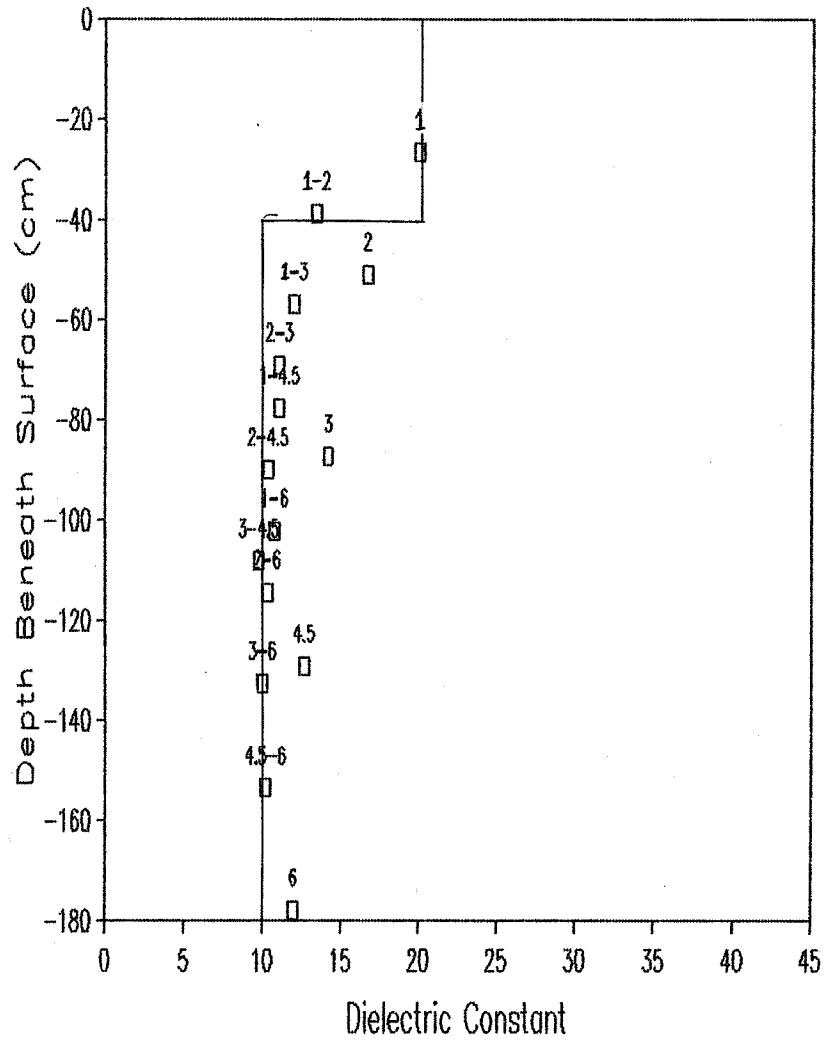


Figure 2

Top 40 cm, K=30

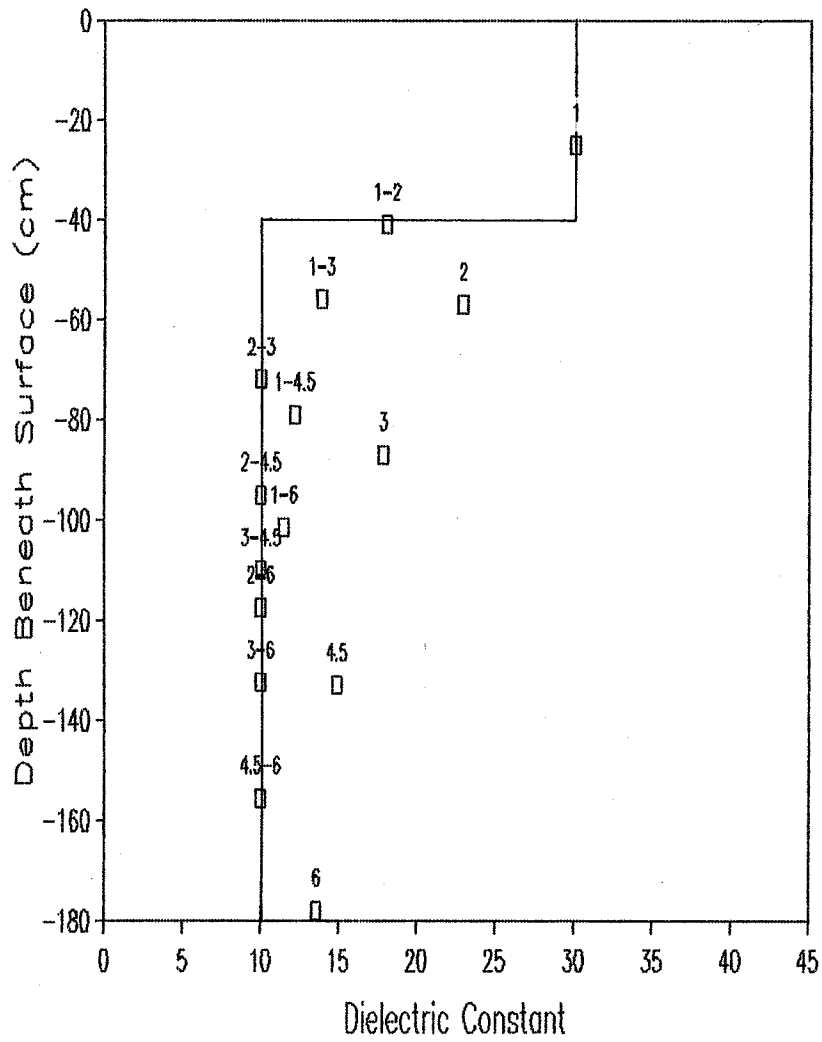
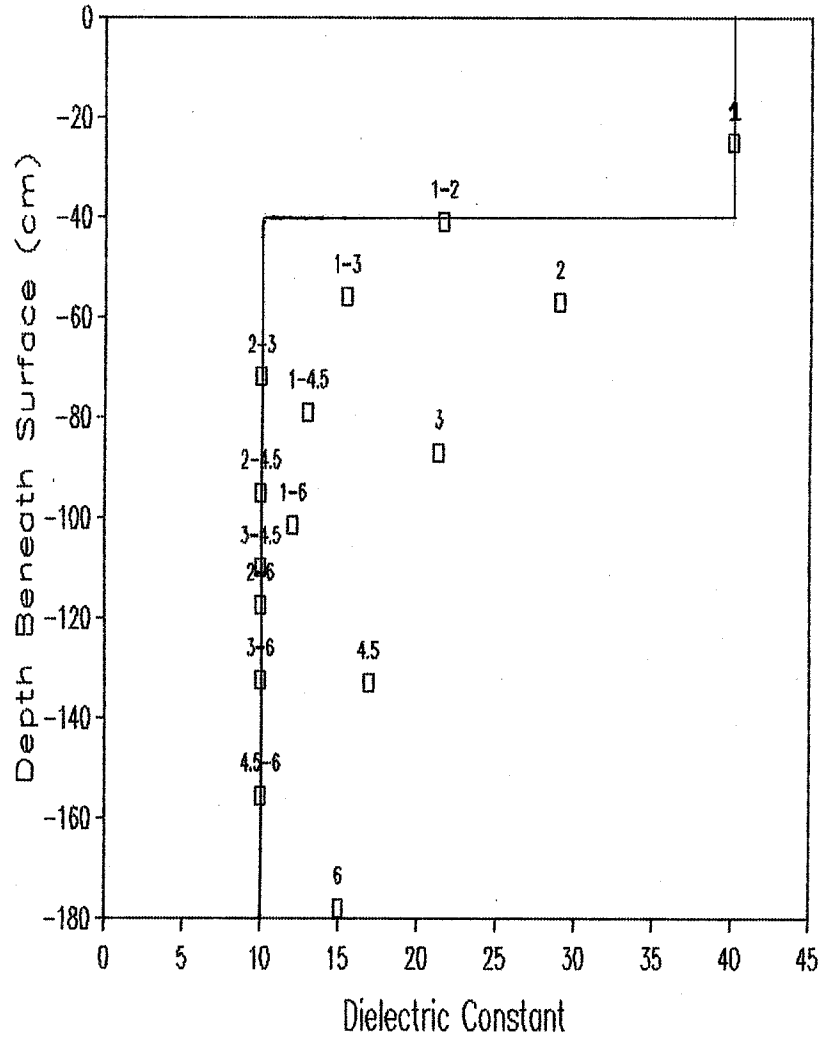
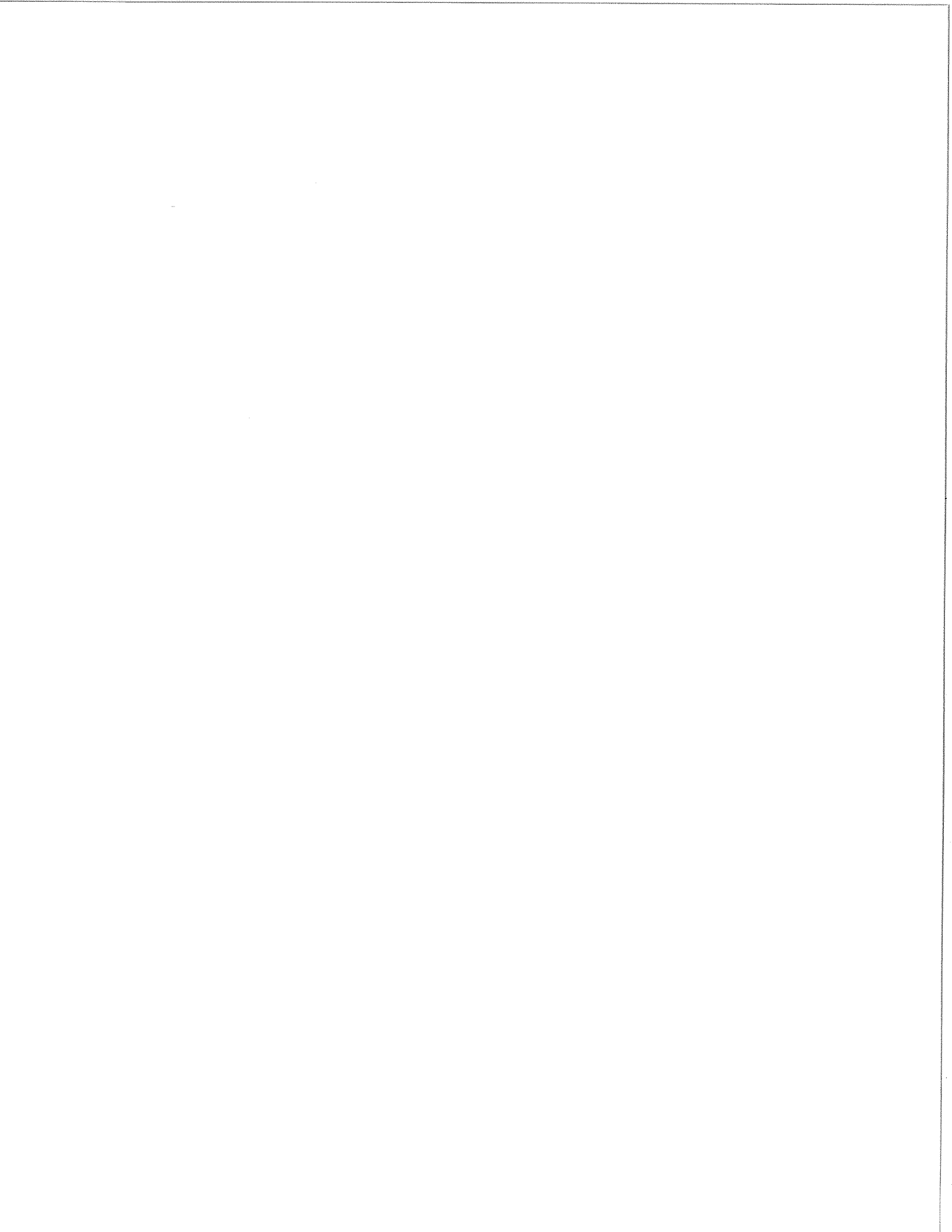


Figure 3

Top 40 cm, K=40





It should be noted that the real world rarely offers the chance to demonstrate theory exactly. There are complex variations within the soil profile which will, to some degree, make application of this idealized model difficult. Often there were more than two layers present within the soil or one layer (eg. frozen) possess a graded **K** profile. The data were used to identify trends within the profile.

By using the results from this layer analysis, estimates as to the possible depth of the active layer were made. These are recorded on the individual data sheets describing each site.

### 3. Analysis Undertaken

The dielectric constant data has been collected by the Scientific Authority twice a year since September 1984 for some sites and twice a year for all sites since October 1985. The data is in two forms: photographs of the TDR's crt display obtained during field measurement and processed dielectric constant data (originating from A-cubed Inc. of Mississauga who are involved in the TDR program as well as ground probing radar studies along the pipeline route). The analyses carried out to date include:

1. establishing a data base of the dielectric constant data
2. correcting any anomalous observations
3. estimating travel time,  $tt$ , to apparent frost or thaw fronts
4. devising methods of presenting the data in a form suitable to investigate temporal or site specific variations

The author has also corrected the data for the May 1987 and October 1987 data set since the probe lengths used in the analysis were not correct resulting in erroneous dielectric constant values.

An analysis of  $K$  variations by soil layer was carried out for each site at each monitoring station in order to obtain information on temporal or spatial variation in the thermal/hydrologic state of the ground. This information was also needed to aid in determining the position of thaw or freezing fronts evident on the photographs of the TDR's crt display. In general, when a distinct feature was noted on the display it usually represented a "wet" (unfrozen) layer over top of a "dry" (frozen) layer. The travel time to the feature was recorded and its position within the soil was determined using the results of the layer analysis. For example:

$$\text{Probe 1 } L = 50 \text{ cm } \quad tt = 8.33 \text{ ns } \quad K = 25.00$$

$$\text{Probe 2 } L = 100 \text{ cm } \quad tt = 13.60 \text{ ns } \quad K = 16.65$$

The results of the layer analysis would indicate that  $K = 10$  in the 50 to 100 cm layer.

$$K = [(30 * (13.6-8.33))/(100-50)]^2 = 10$$

If a discontinuity was noted on the 100 cm probe's trace at 12 ns, then its position can be determined assuming that  $K$  in the 50-100 cm layer is uniform:

$$L = [(30 * (tt-tt_f)) / \sqrt{K}]$$

$$L = [(30 * 1.6) / \sqrt{10}] = 15 \text{ cm}$$

where  $tt_f$  is the travel time to the feature;  $tt$  is the travel time to the end of the 100 cm probe; and  $K$  is the dielectric constant for the 50-100 cm layer. This means that the feature is 15 cm from the **end** of the 100 cm line, hence, it is located 85 cm from the ground surface. Without the value of  $K$  in the 50-100 cm layer the feature could only be located relative to the two probes (eg. somewhere between 50 and 100 cm).

#### 4. Observations

The intent of taking readings in May and October was to obtain estimates of **K** at the end of the winter (May) and the end of summer (October). Since it is impossible to time arrival at all sites before freeze or thaw begins, often a small thaw layer is evident in May and a small freeze-back is evident in October. The effect of these small freeze or thaw features must be accounted in order to obtain estimates of **K** representative of the summer and winter conditions. Once the database for each site is complete, the data is processed to determine **K** values in discrete soil layers as shown by the examples in Figures 1 to 3. The analysis serves several purposes:

1. the results help in determining the position of the seasonal frost or thaw front evident in most of the observations
2. estimates of **K** in the lower portions of the soil profile can be used to examine whether permafrost is degrading at the site (eg. persistently increasing values of **K** would indicate a continued warming trend (higher  $\theta_u$ ))
3. in light of (1) and (2) above, it should be possible to detect TDR probes which are not representative of conditions at a TDR station. These discrepancies may be due to lateral inhomogeneities in the soil, poor soil-probe contact, incorrect line length estimates (which are influenced by seasonal heave and subsidence) or a combination of these factors.

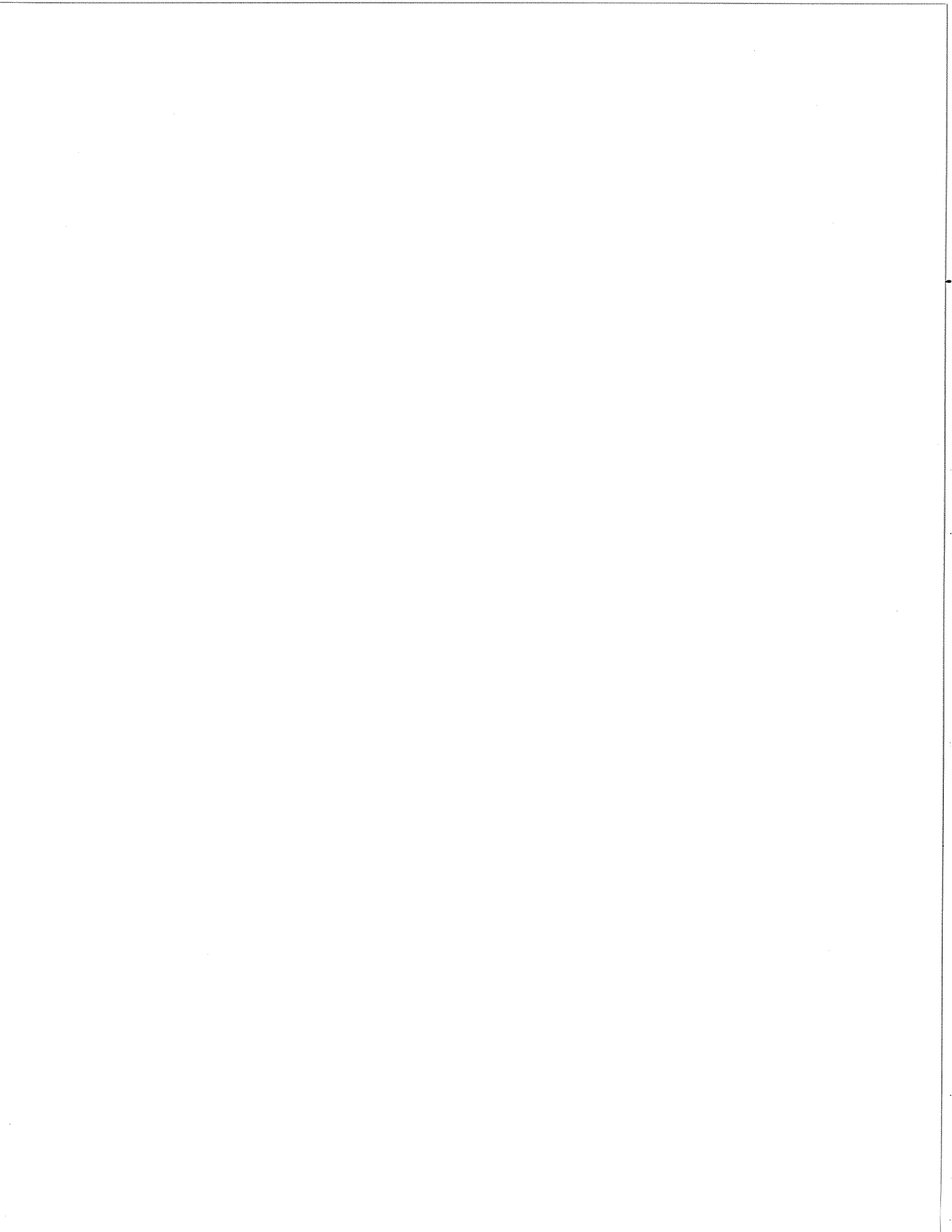
Graphs similar to those in Figures 1 to 3 are produced for each TDR station at each site for all times of observation. These have not been included here but accompany the report as an extra appendix. Similar observations were reported by A-cubed Inc, and one is referred to the Scientific Authority for more information.

A series of bar graphs follows which is a brief summary of the **K** values obtained for the longest probe (generally 178 cm) for all sites over the observation period. The **K** values are the average from the surface to the depth specified by the probe length. These will not be discussed individually but there were some quite clear observations which served to support findings for individual sites. It is possible to generalize the observation made:

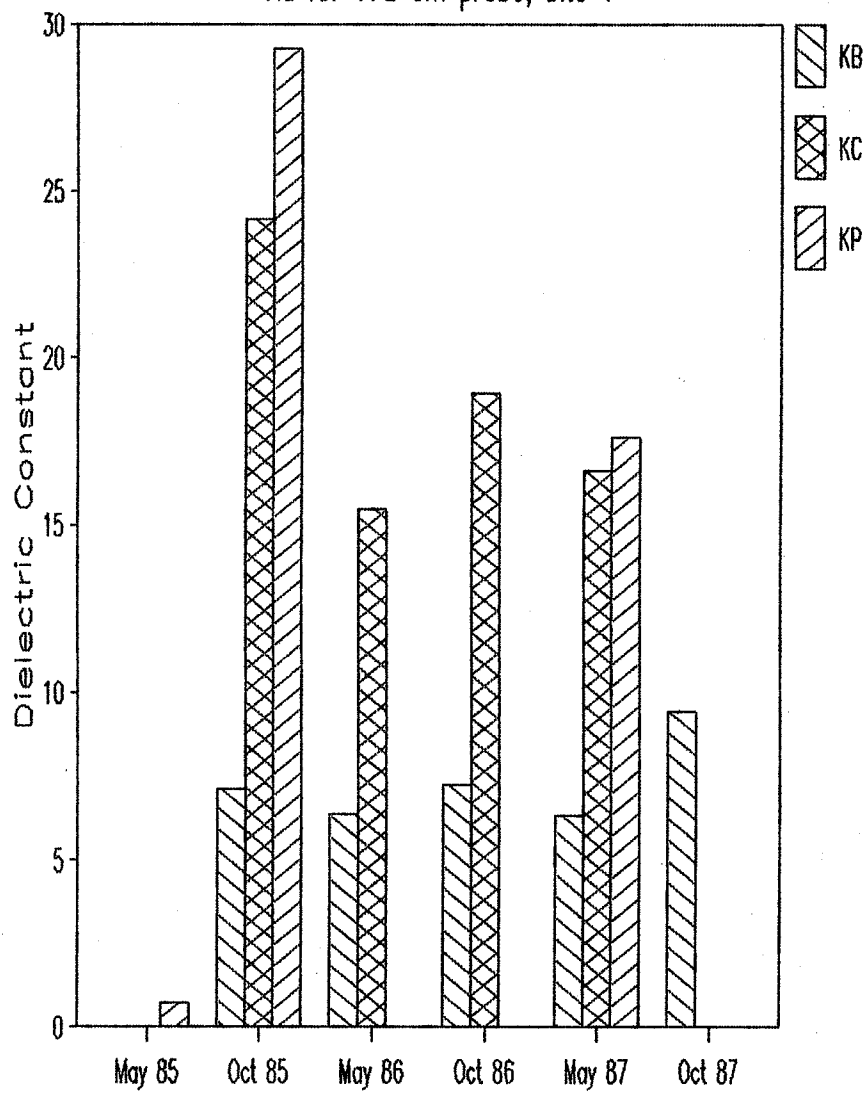
1. **KB** (off ROW) values of **K** over the top 6' tend to always be lower than those observed for either **KC** or **KP**.
2. **KP** and sometimes **KC** increased in wettness over the period of observation.

The summary diagrams (bar graphs) can be referred to when examining the author's recommendations as to whether a particular site should continue to be monitored. In general, any site which undergoes a complete thaw in the summer and a refreeze in the winter was deemed of little value to the monitoring program. Any site which had permafrost off-ROW and showed degradation on-ROW or beside the pipe should be monitored.

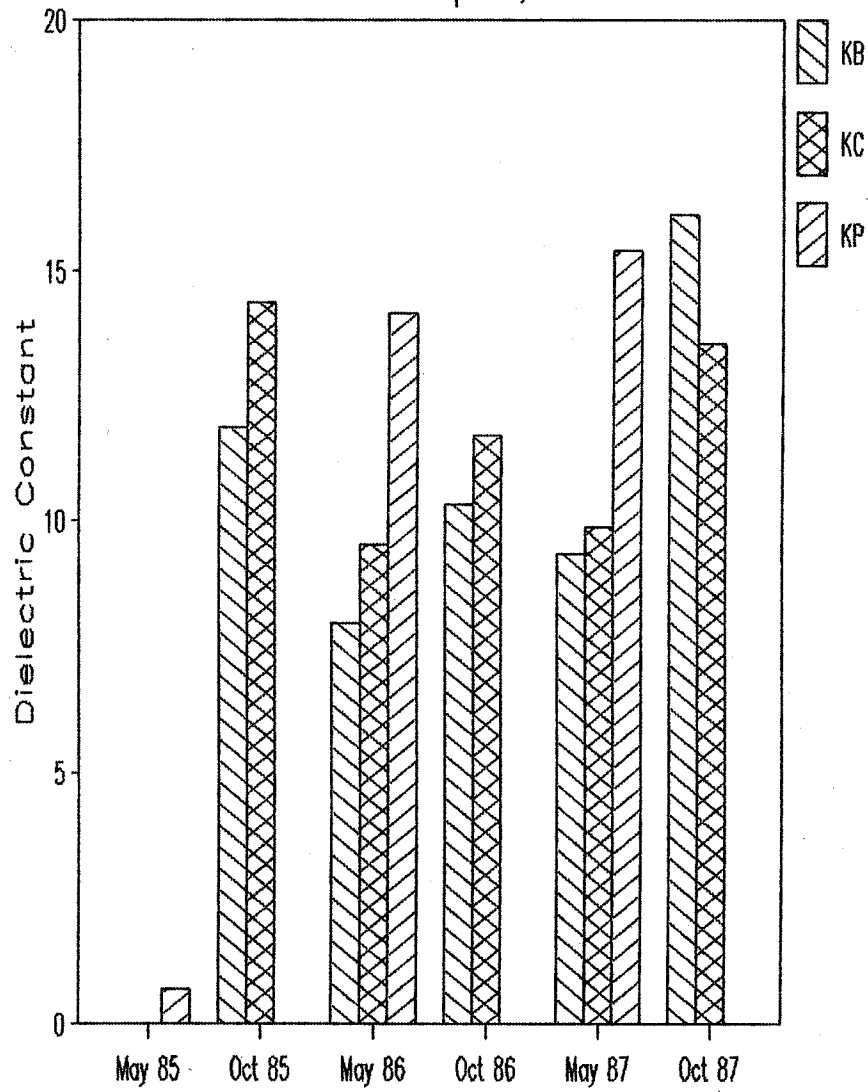




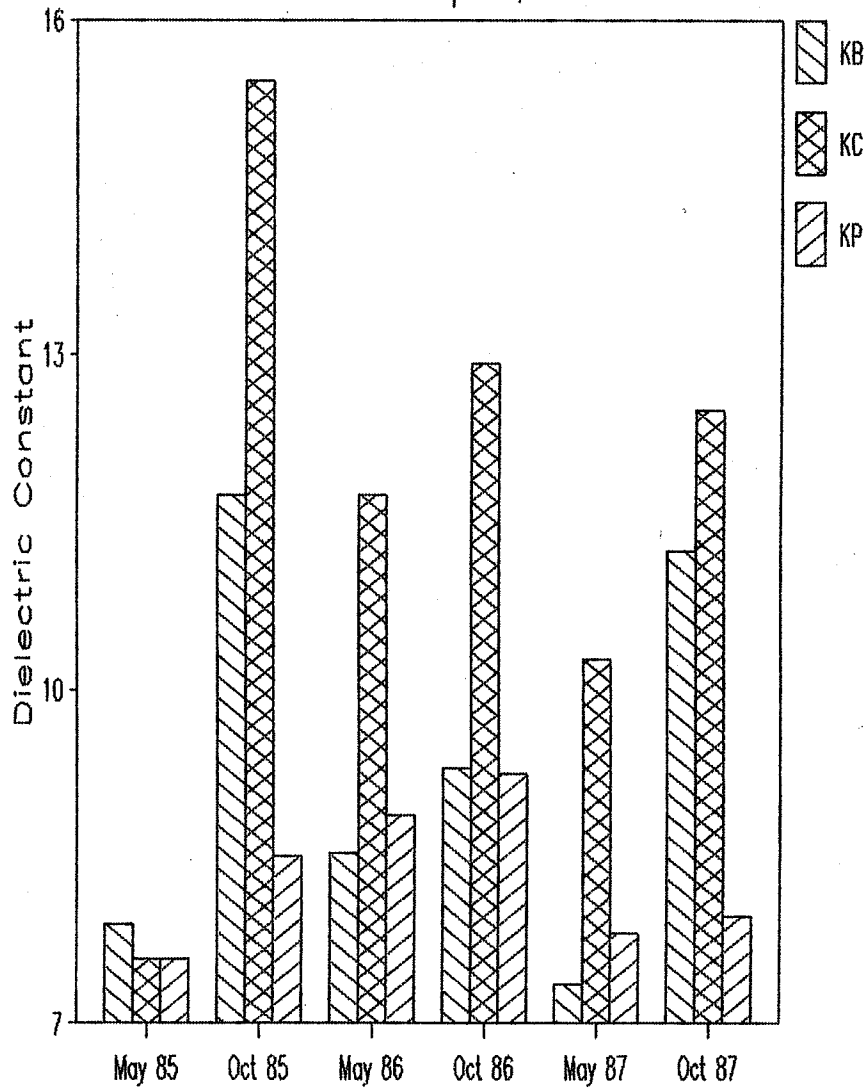
Ka for 178 cm probe, Site 1



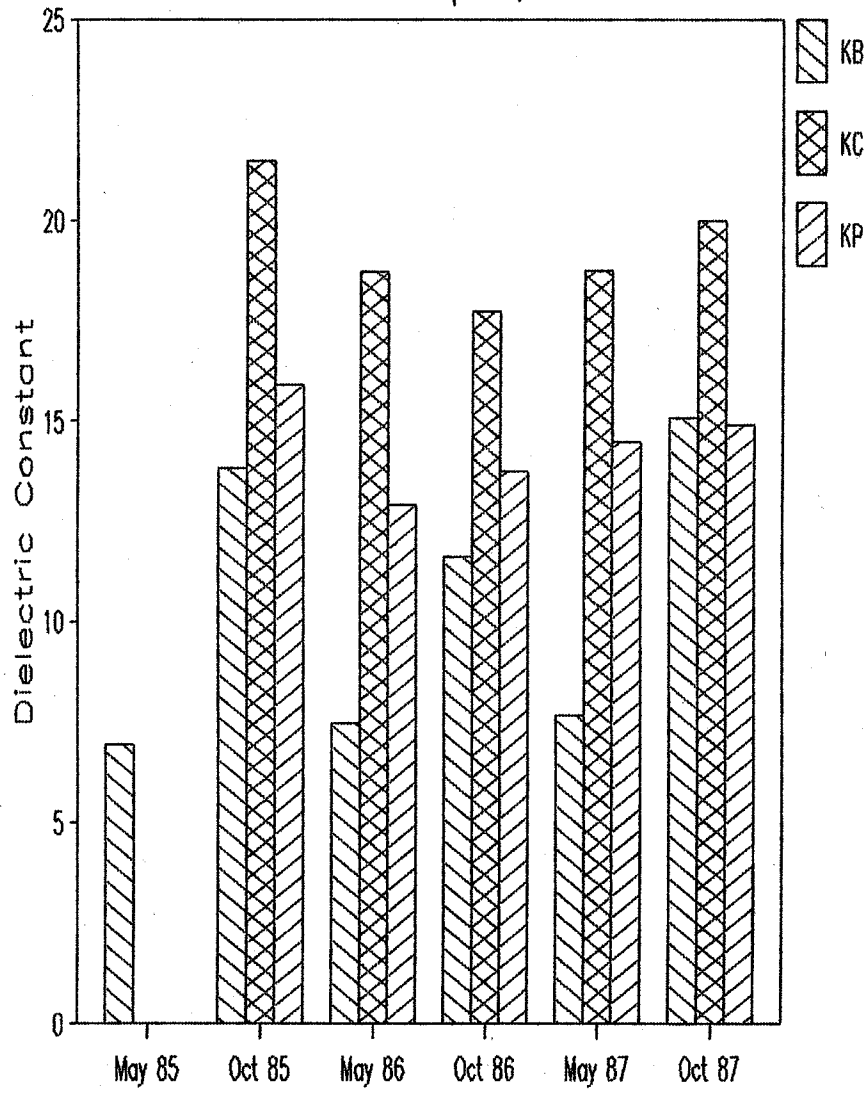
Ka for 178 cm probe, Site 2A



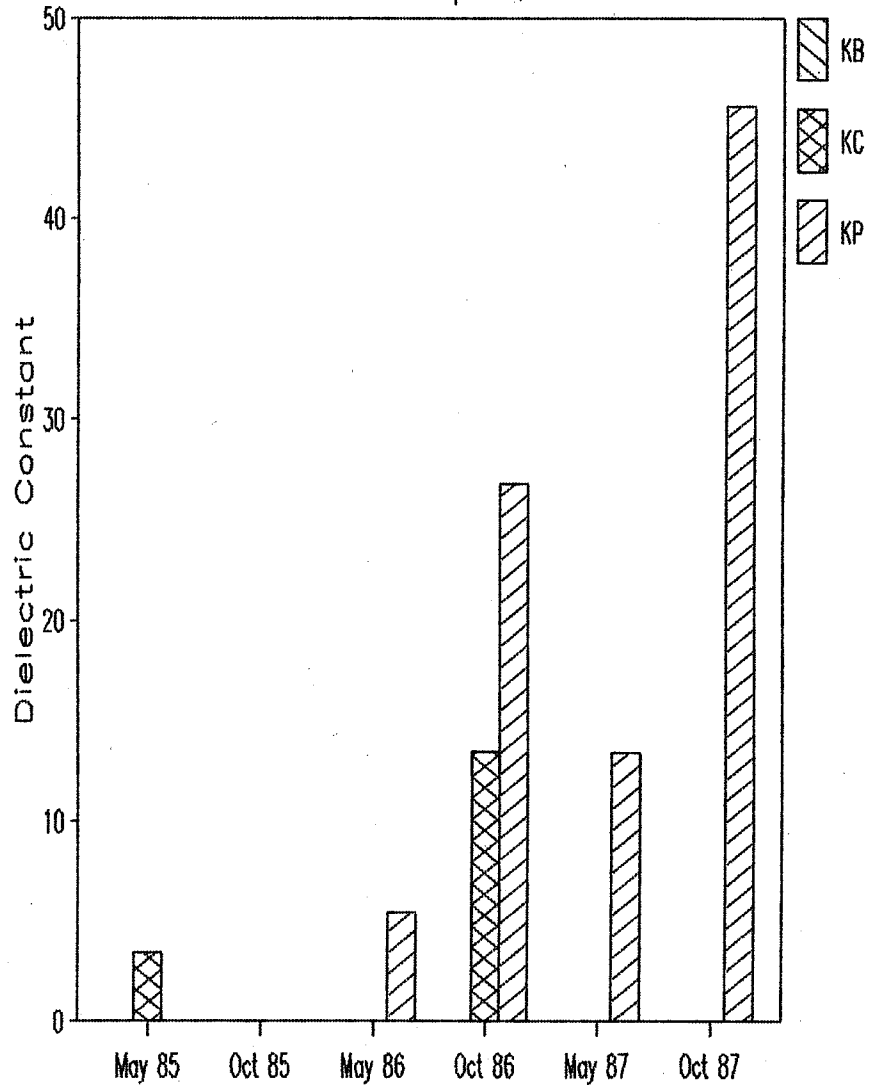
Ka for 178 cm probe, Site 2B



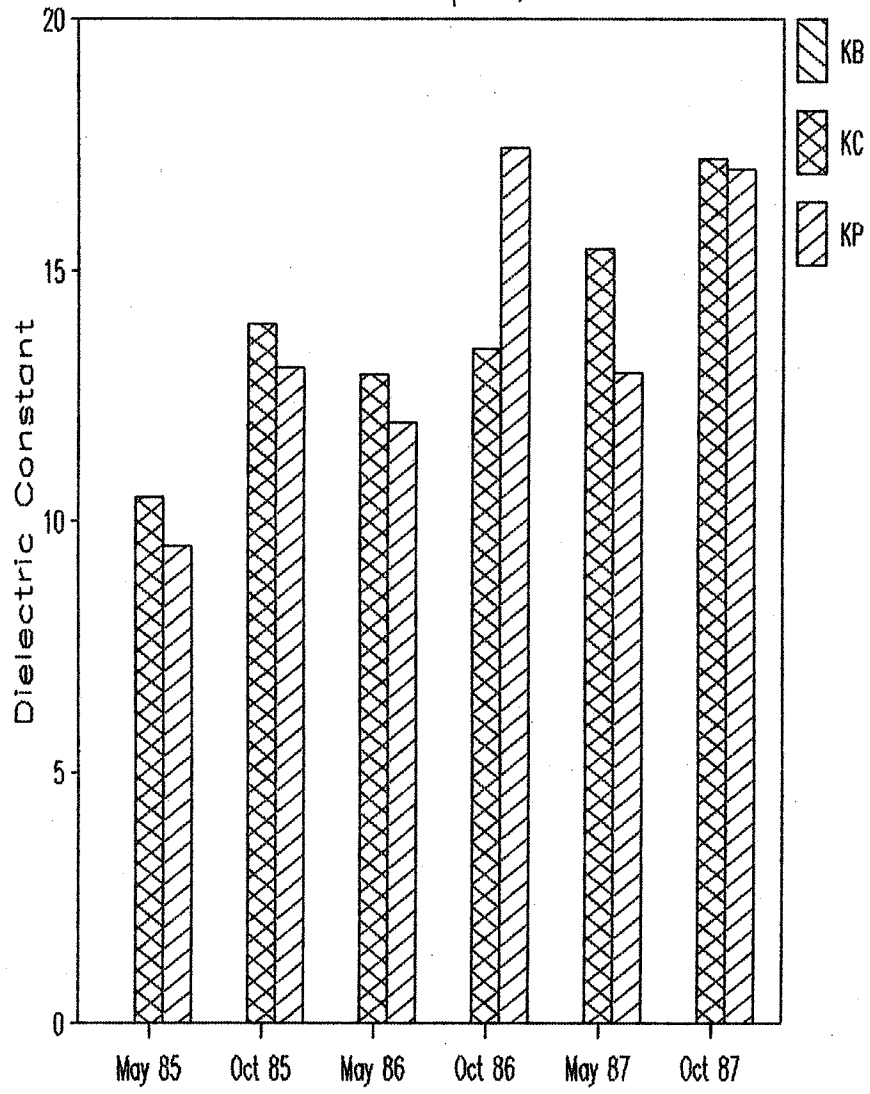
Ka for 178 cm probe, Site 2C



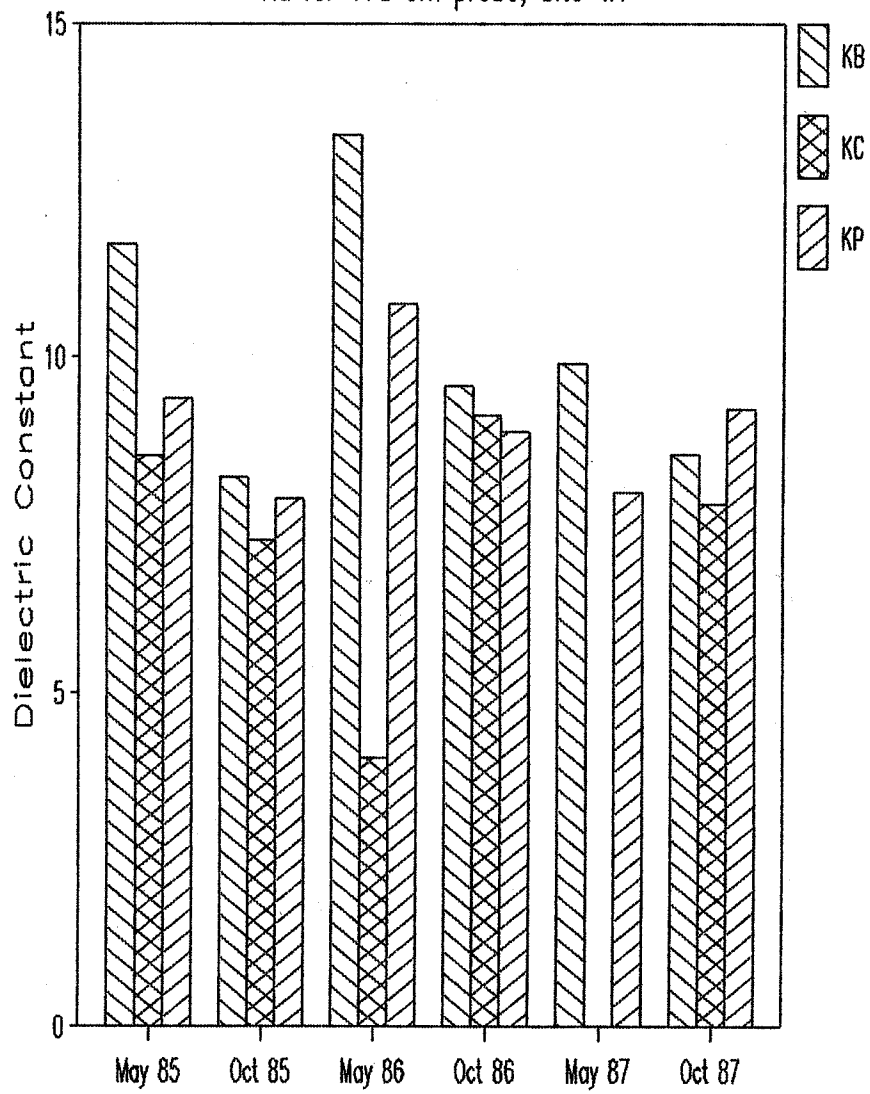
Ka for 178 cm probe, Site 3A



Ka for 178 cm probe, Site 3B

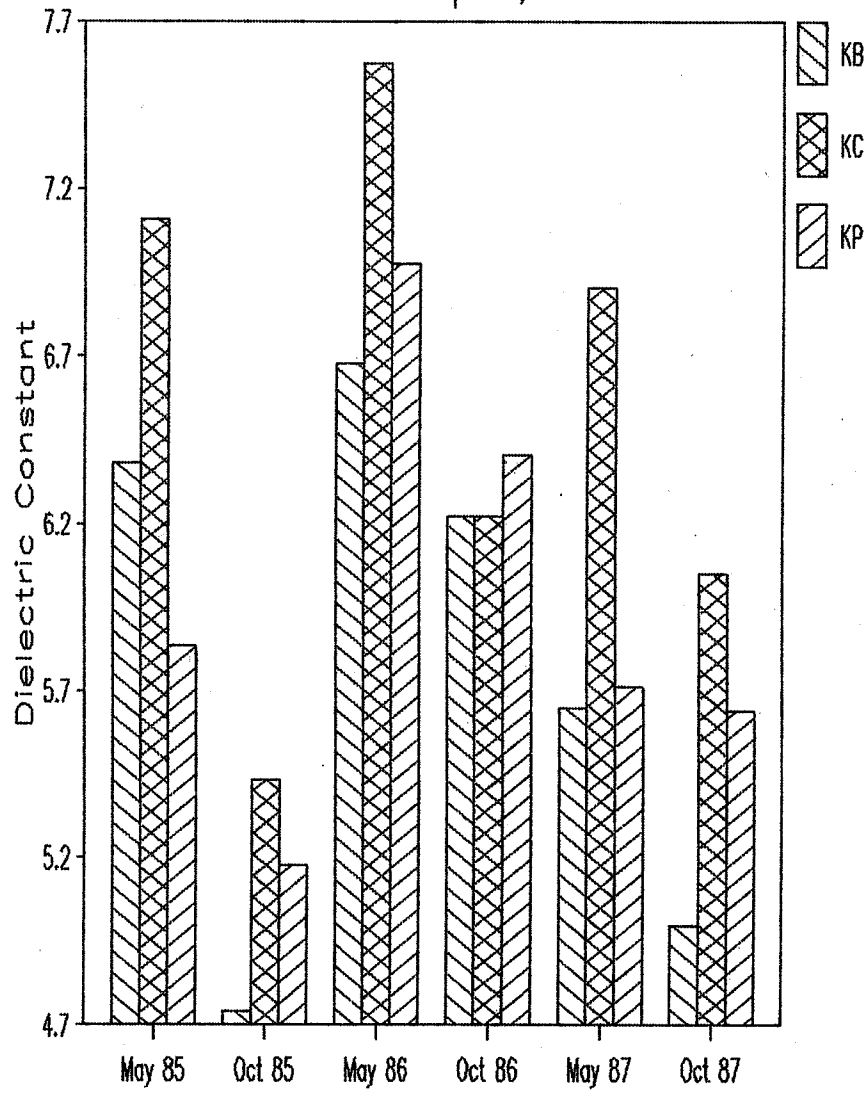


Ka for 178 cm probe, Site 4A

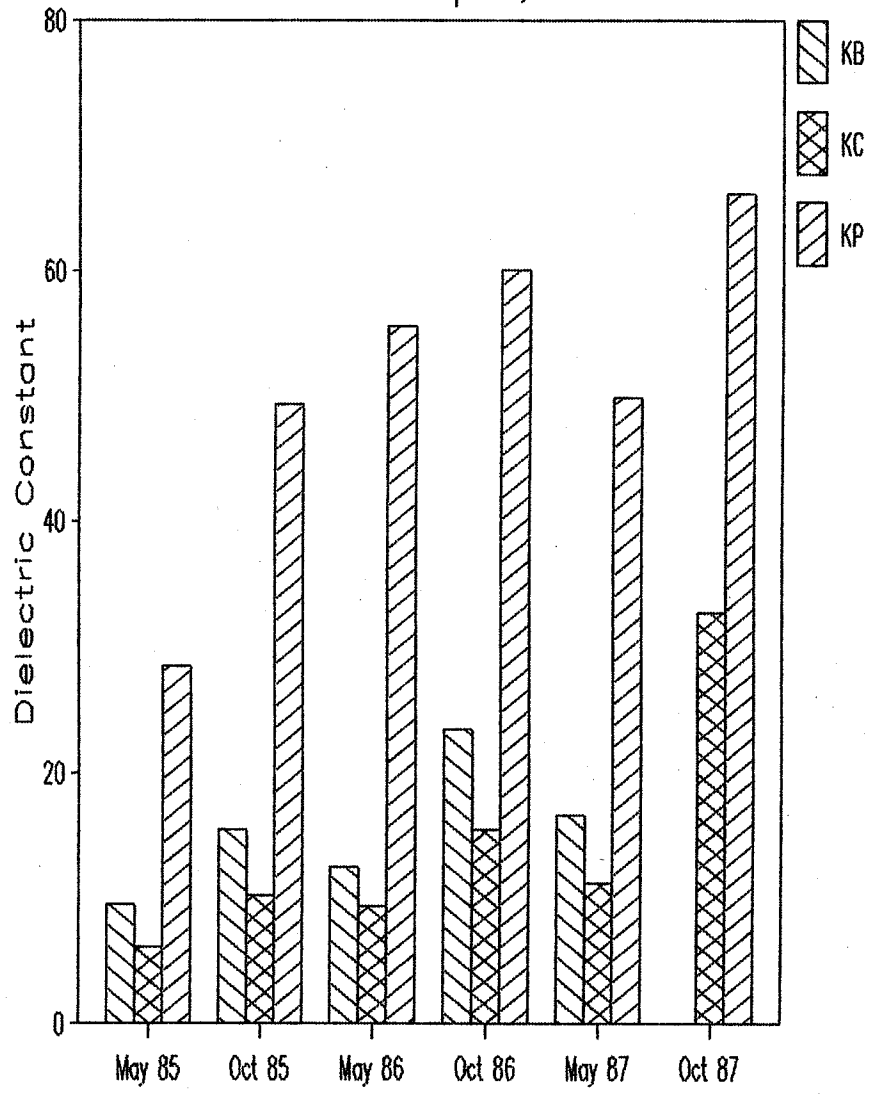




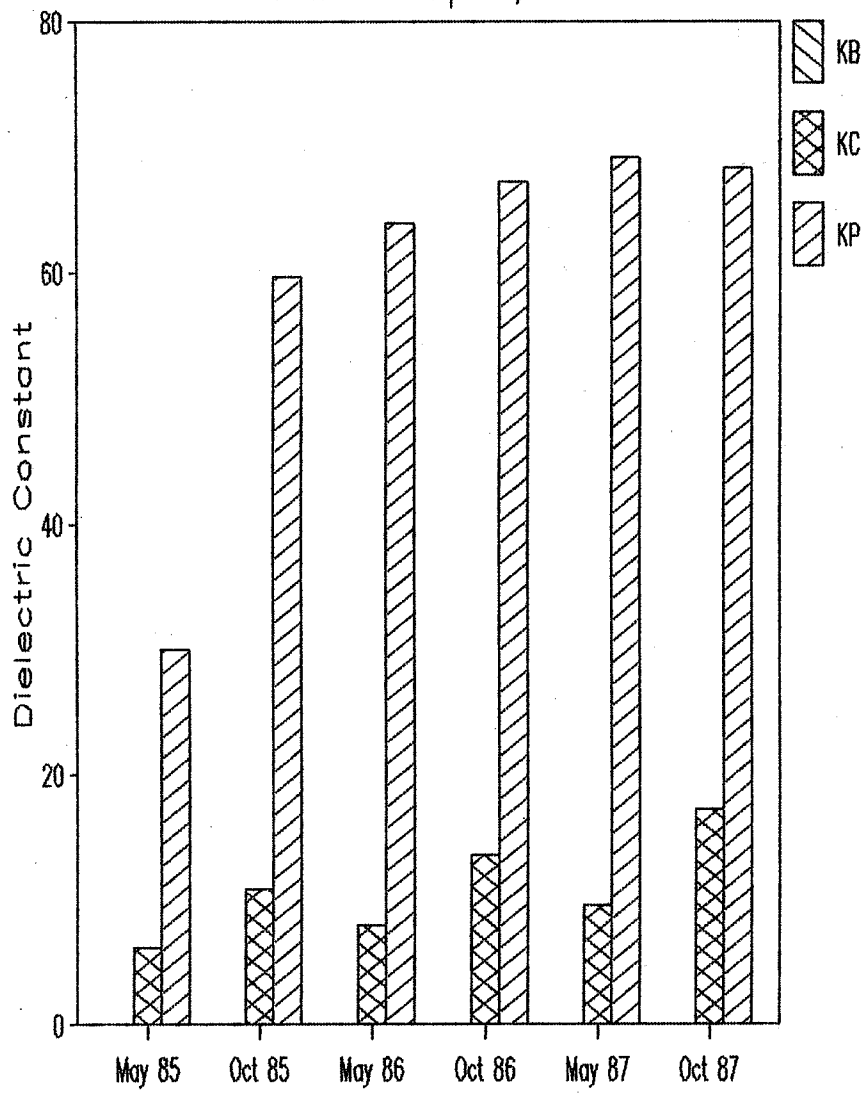
Ka for 178 cm probe, Site 4B



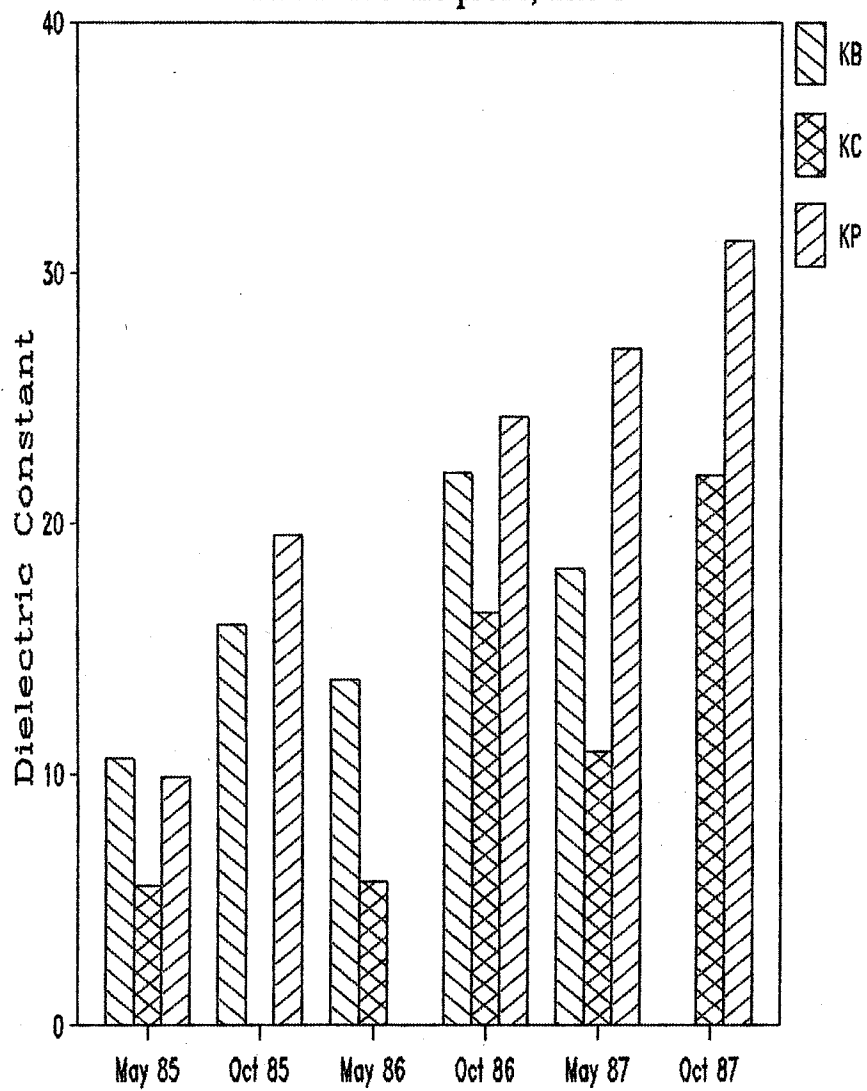
Ka for 178 cm probe, Site 5A



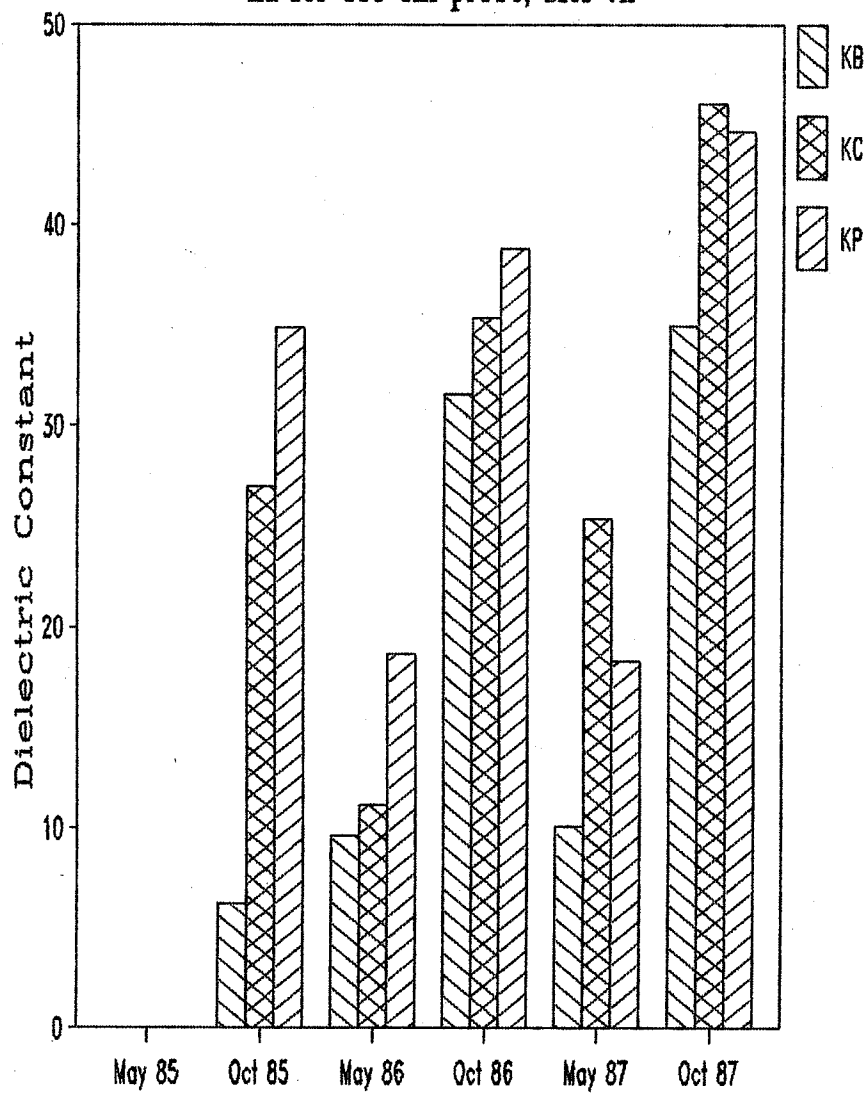
Ka for 178 cm probe, Site 5B



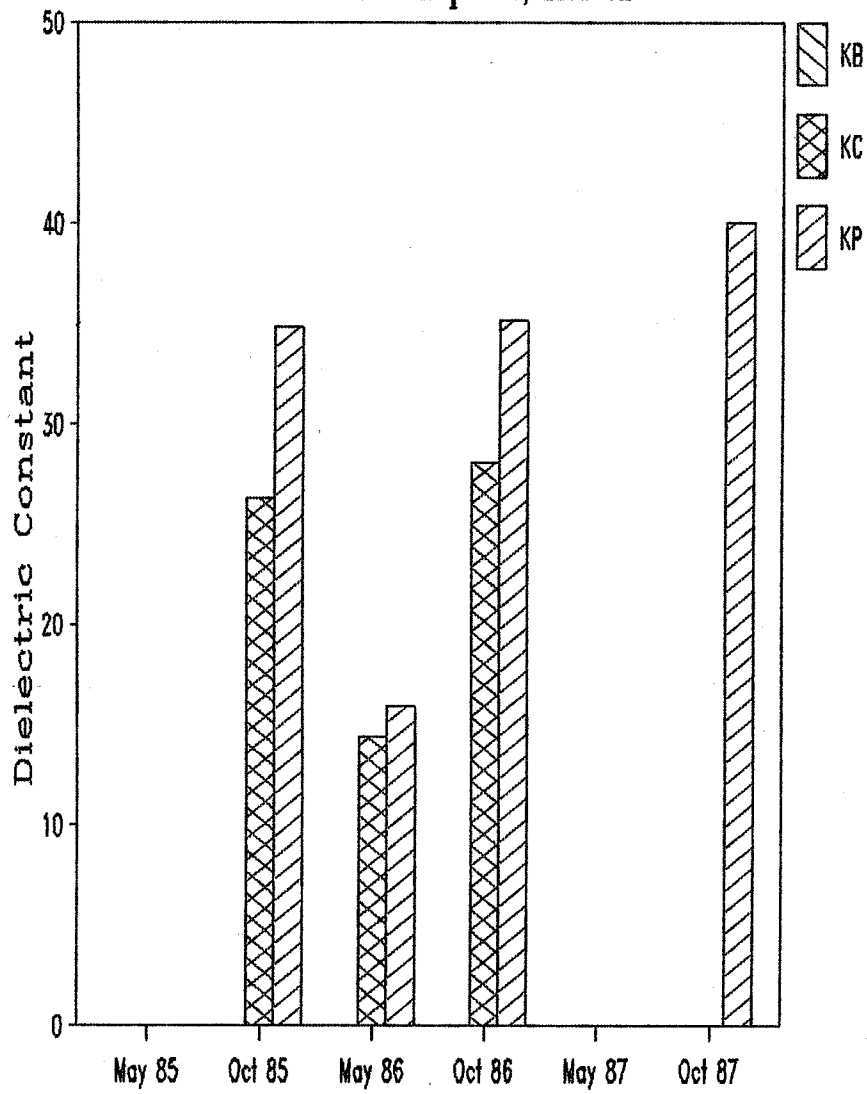
Ka for 178 cm probe, Site 6



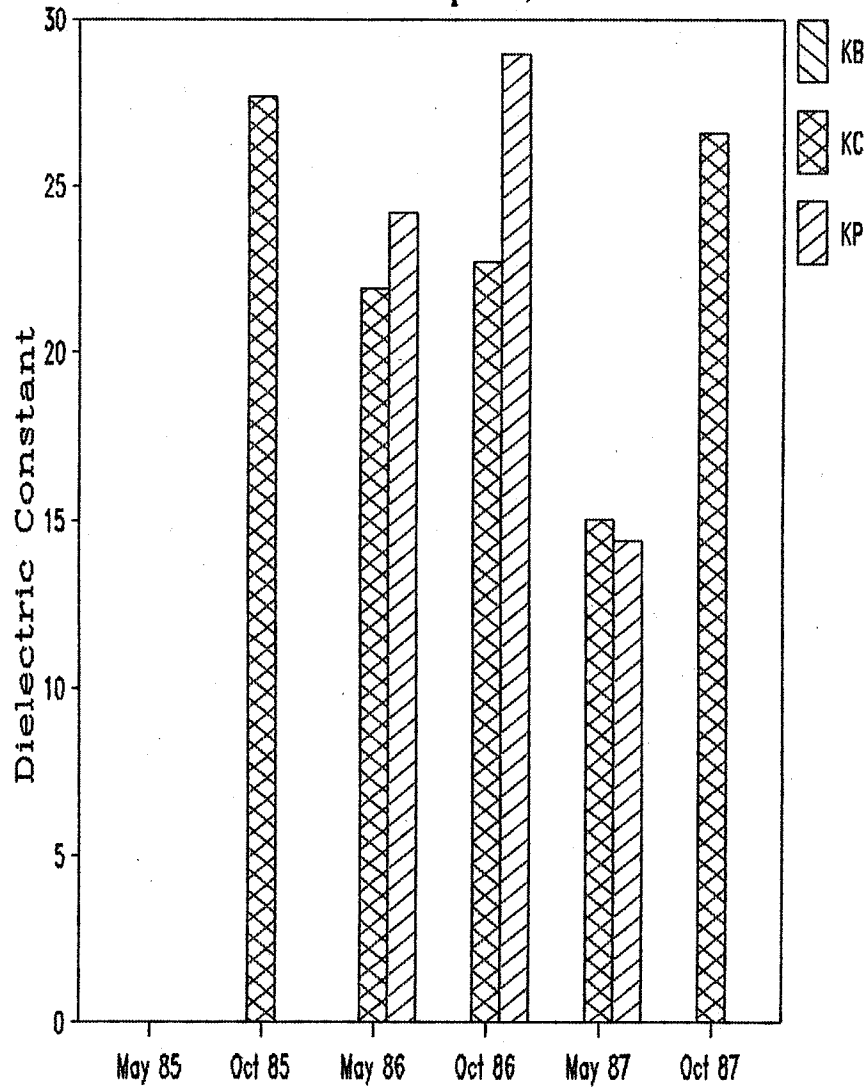
Ka for 133 cm probe, Site 7A



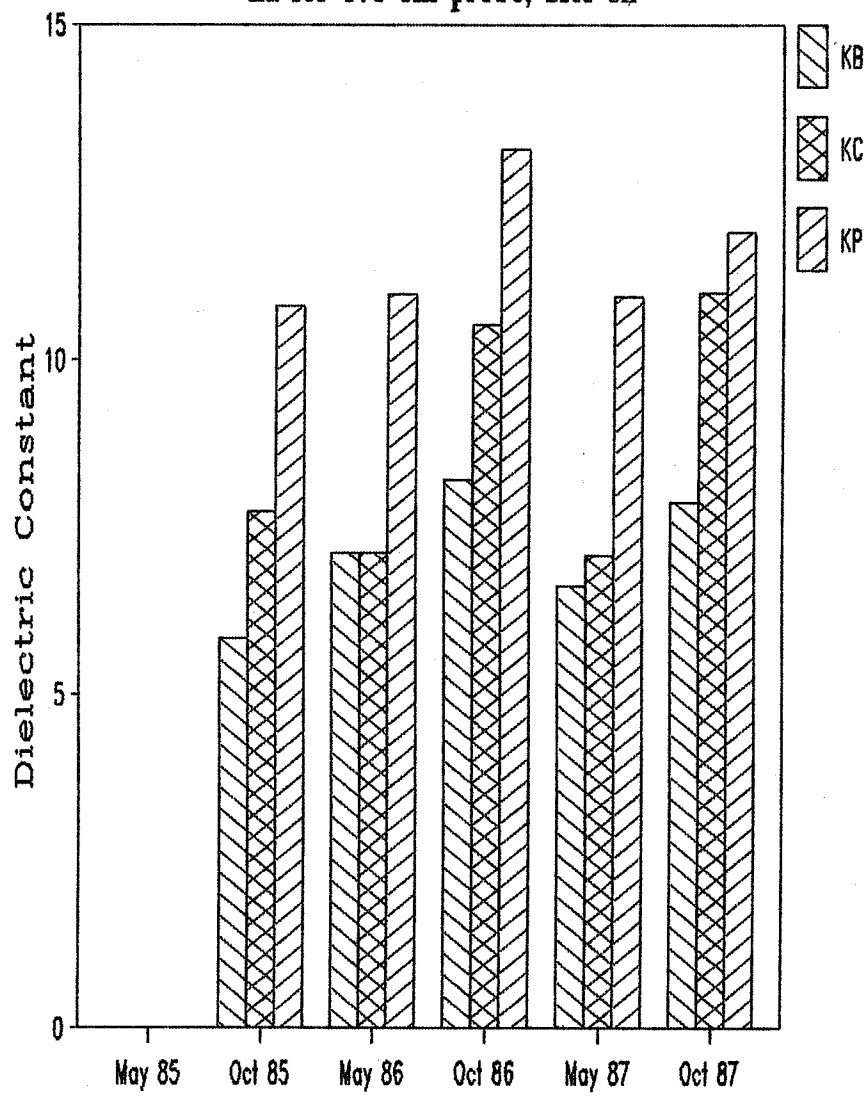
Ka for 178 cm probe, Site 7B



Ka for 178 cm probe, Site 7C

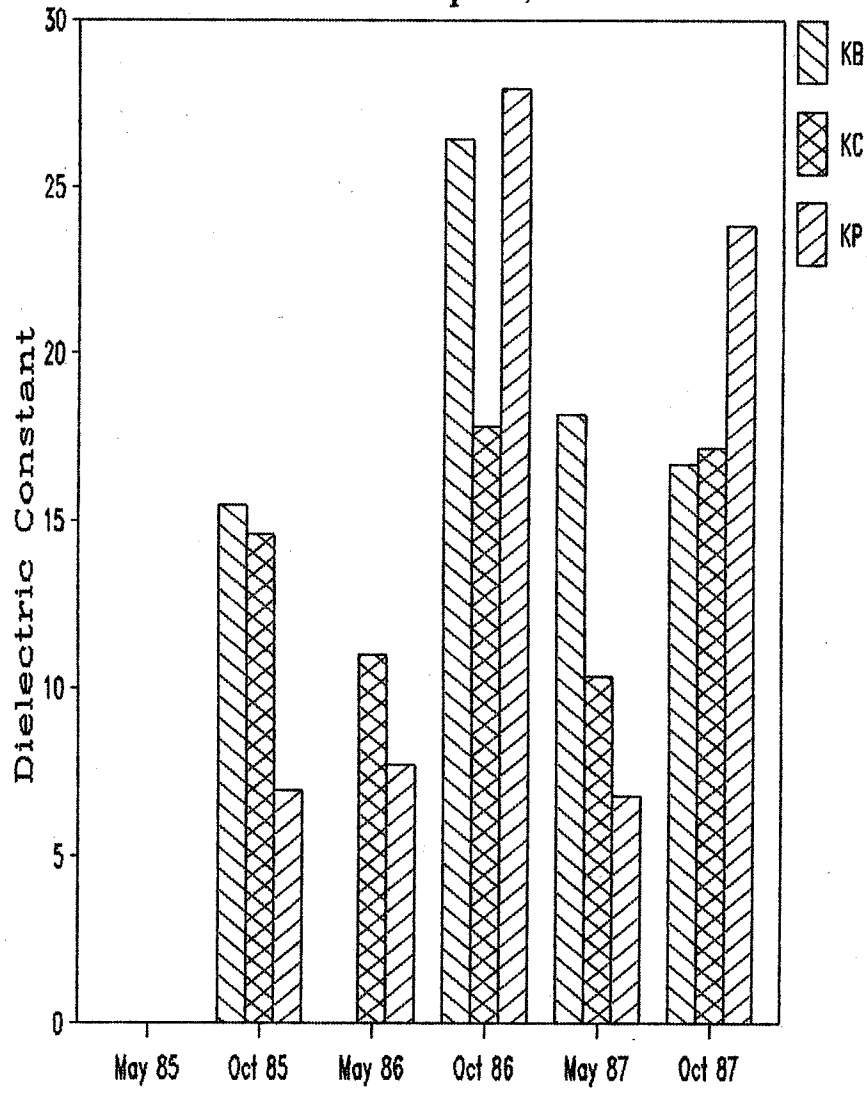


Ka for 178 cm probe, Site 8A

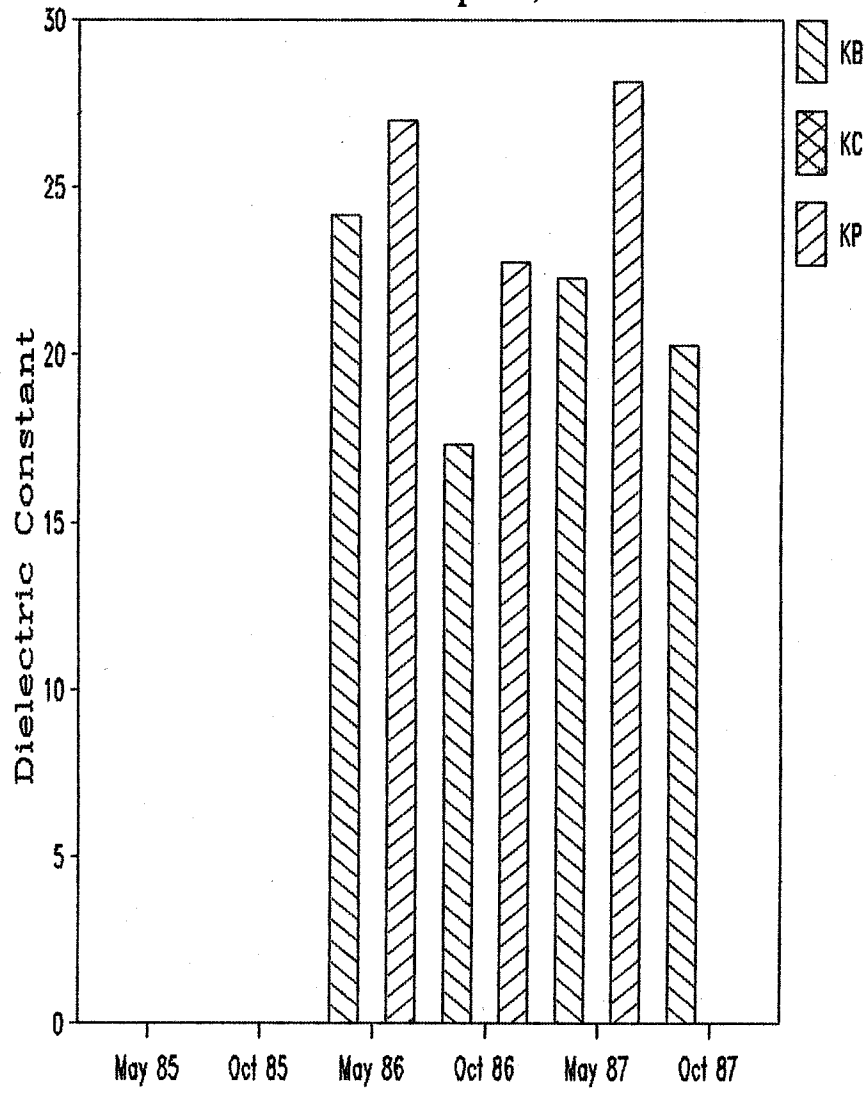




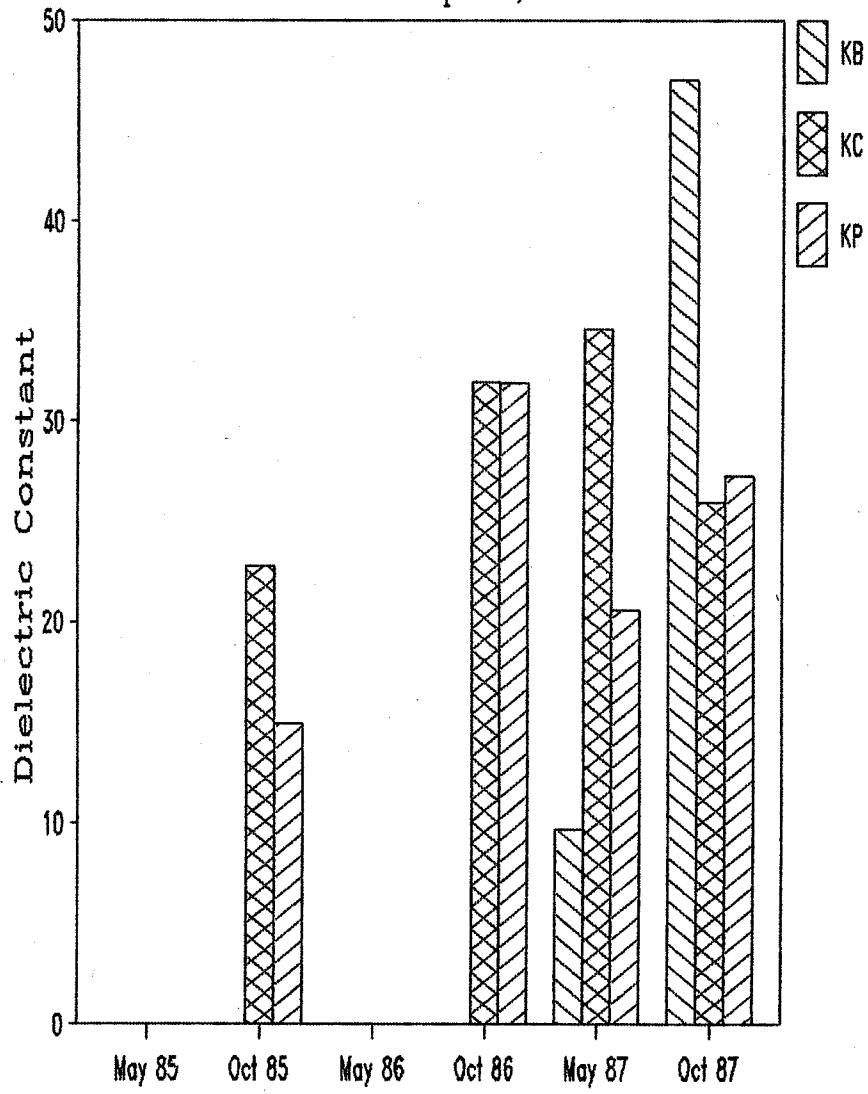
Ka for 178 cm probe, Site 8B



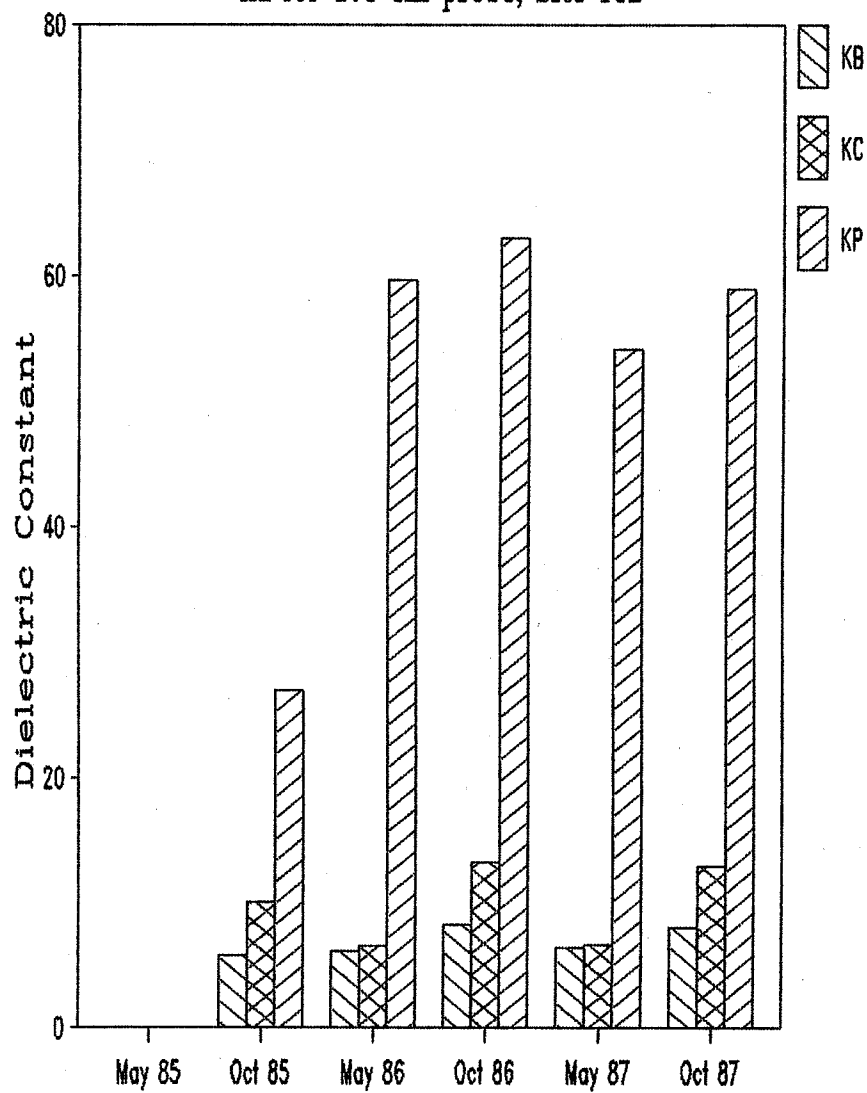
Ka for 178 cm probe, Site 9



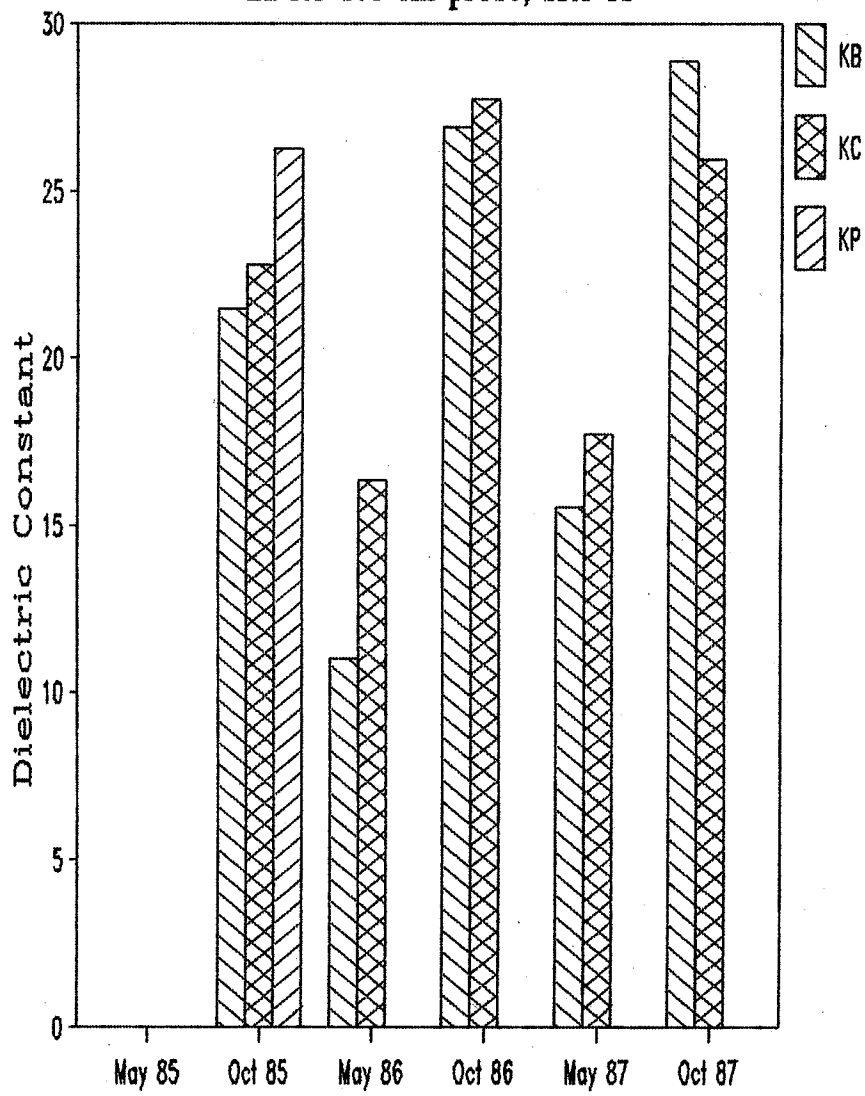
Ka for 178 cm probe, Site 10A



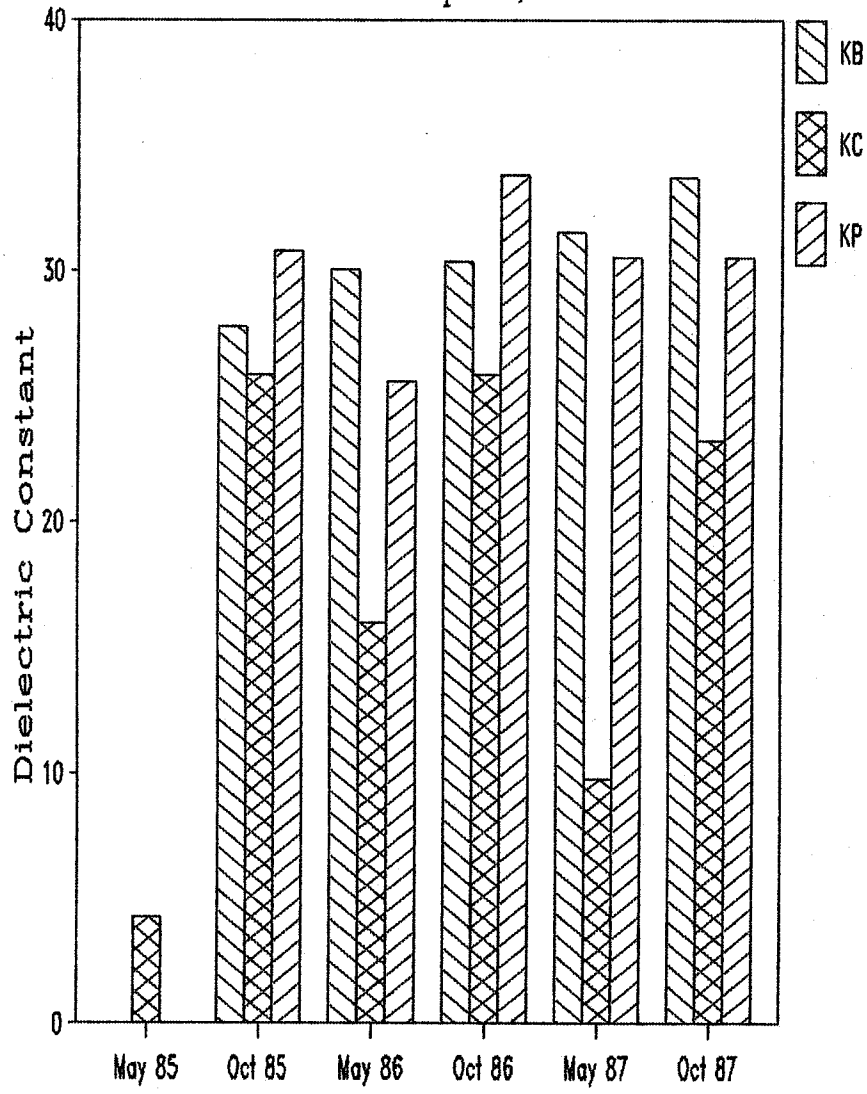
Ka for 178 cm probe, Site 10B



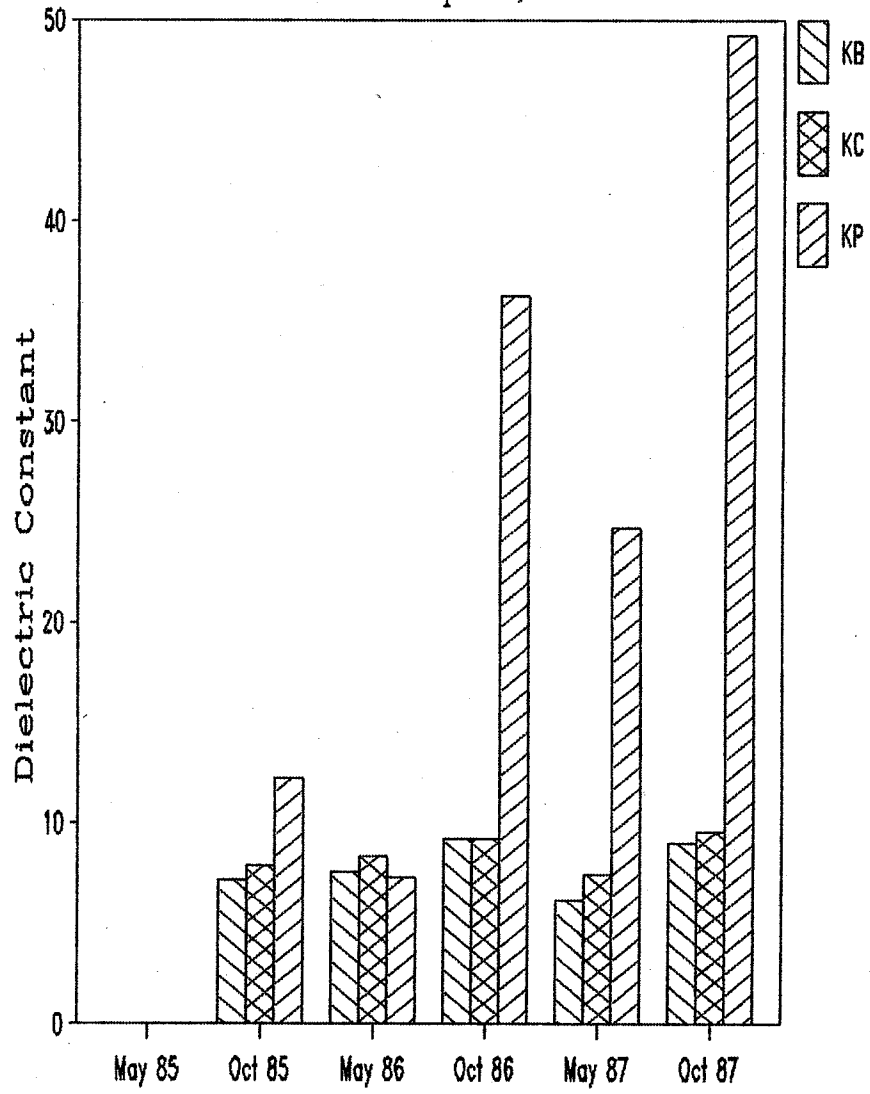
Ka for 178 cm probe, Site 11



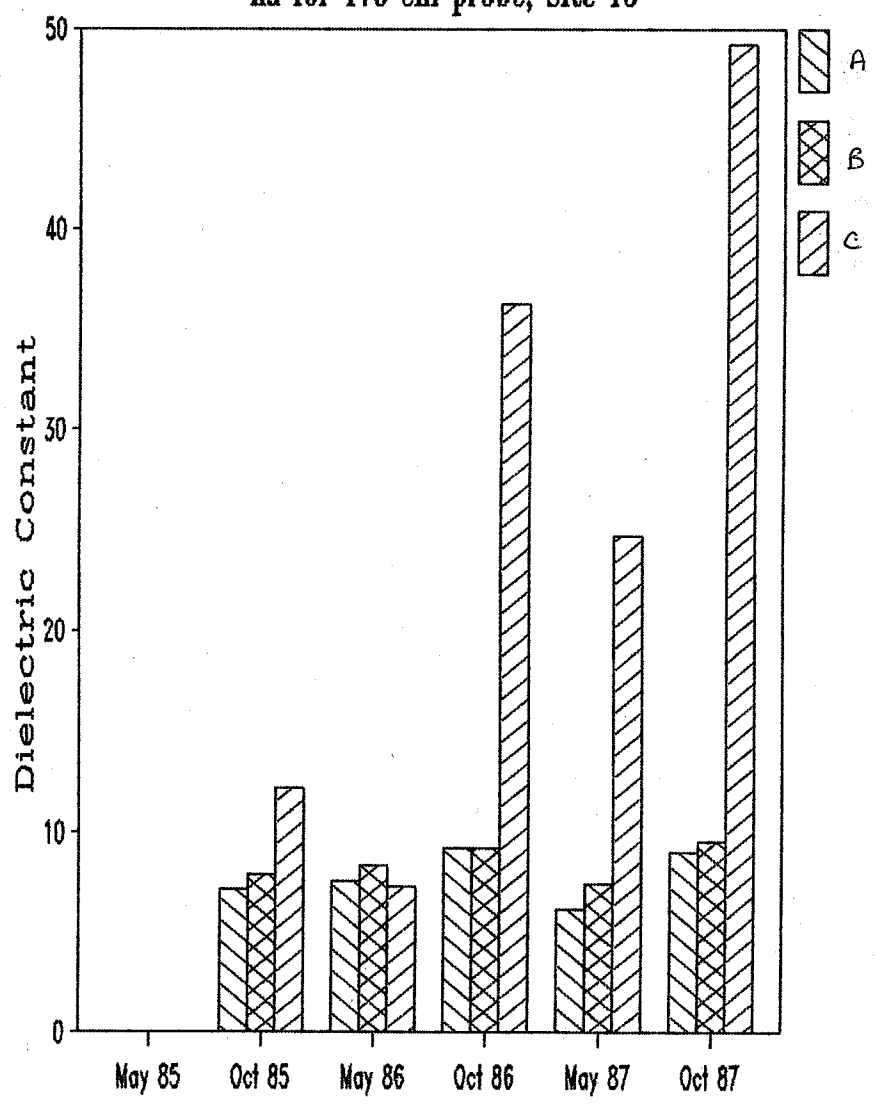
Ka for 178 cm probe, Site 12A



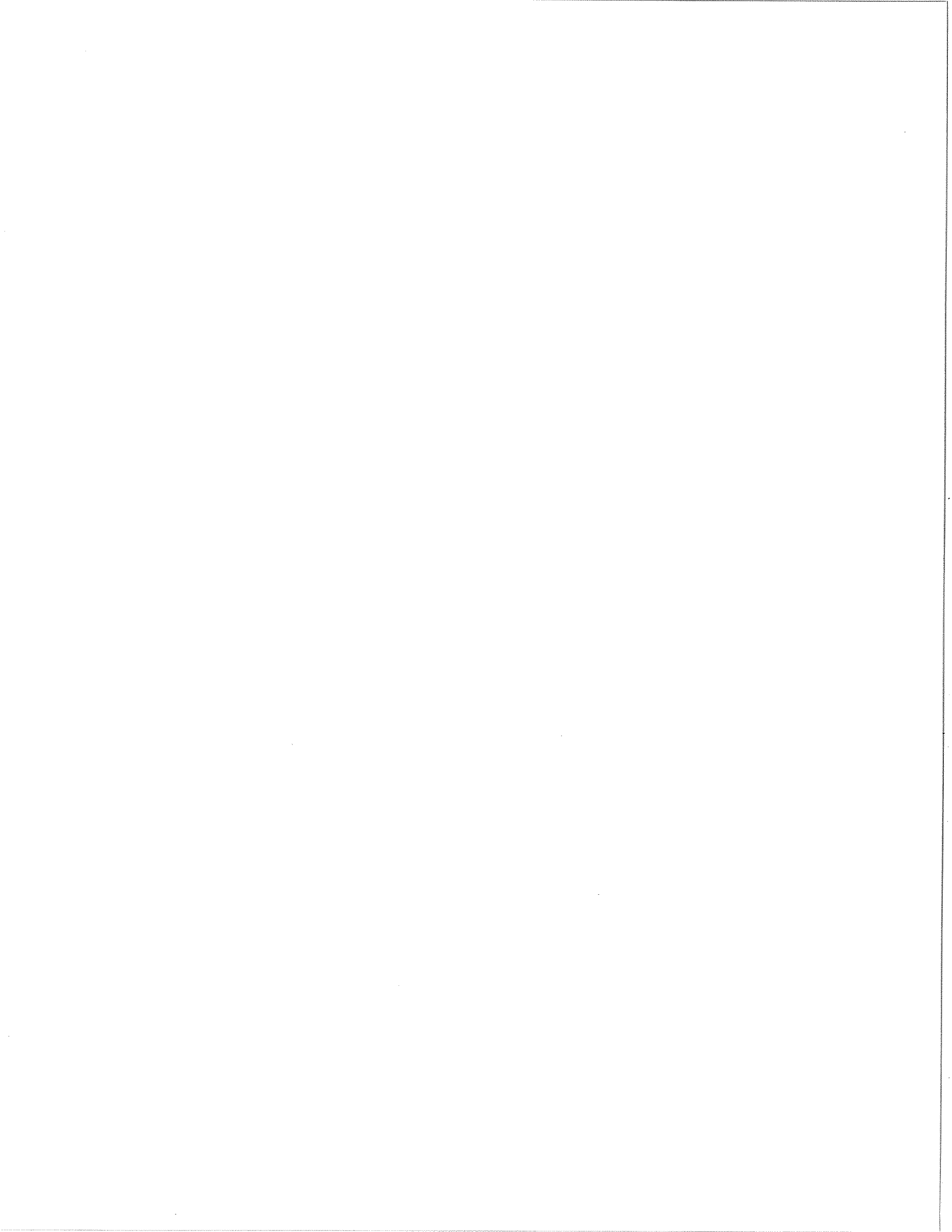
Ka for 178 cm probe, Site 12B



Ka for 178 cm probe, Site 13







### Summary for 2A KP

Lithologic record from the installation of thermistor cable T1 gives:

0 - 440 cm clayey silt

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
Oct 1984	0.3	0.3	0.2	0.0
May 1985	-0.5	-0.8	-1.1	-1.2
Oct 1985	0.5	0.6	0.4	0.1
May 1986	-0.3	-0.5	-0.6	-0.7
Oct 1986	-0.0	0.0	0.0	-0.0
May 1987	-0.1	-0.4	-0.4	-0.4
Oct 1987	2.8	2.2	1.8	1.1

Oct 1985

Profile is relatively uniform with an average **K** of 14 to 16. Temperatures suggest that it is unfrozen, so it is of low water content.

May 1986

Surface zone is wet (**K** = 29.2). A feature was detected on the 87 cm (11.67 ns) and the 133 cm (15.83 ns) probes between 8 and 8.7 ns. The position is between 48 and 62 cm and probably represents surface thaw.

Oct 1986

Surface zone appears drier than the rest of the profile (**K** = 4.9). Average at depth is about 15, similar to Oct 1985.

May 1987

Similar to May 1986. Feature noted between 8.33 and 8.83 ns which is near the end of the 53 cm (8.5 ns) probe.

Oct 1987

Similar to other Oct readings.

**Note** The crt display for the 6 foot probe on most dates suggests that it is picking up the pipe or the rods are nearly shorted. The results should be used with caution.

**Summary for 2B KB**

Lithologic record from the installation of thermistor cable T4 gives:

≈ 0 - 30 cm organic silt  
30 - 90 cm clay (till)  
90 - 175 cm silty clay  
175 > shale

	Cable T4	
	100 cm	200 cm
May 1985	-2.6	-3.8
Oct 1985	-0.1	-0.9
May 1986	-2.7	-3.8
Oct 1986	-0.1	-0.9
May 1987	-2.4	-3.4
Oct 1987	-0.3	-1.0

May 1985

Frozen material. Feature detected at 8.33 ns on the 178 cm (16.67 ns) probe. Average **K** is about 8. The feature is at about 89 cm suggesting that it represents the lithologic change between clay and silty clay.

Oct 1985

Scatter exists in the layer analysis; the best estimate of **K** is about 14.

May 1986

Material is well frozen.

Oct 1986

Material seems to be wetter in the top 54 cm (**K** = 12) and drier (more frozen) in the lower zone (**K** = 8)

May 1987

Almost completely uniform with depth (**K** = 7.5). Definitely frozen.

Oct 1987

Very near surface is drier; average **K** with depth is about 16.

**Summary for 2B KC**

Lithologic record from the installation of thermistor cable T3 gives:

0 - 90 cm woodchips  
90 - 150 cm clay (till)  
150 - 240 cm silty clay  
240 > shale

	Cable T3	
	100 cm	200 cm
Oct 1984	-0.3	-1.3
May 1985	-0.4	-0.7
Oct 1985	-0.3	-0.6
May 1986	-0.3	-0.5
Oct 1986	-0.2	-0.4
May 1987	-0.5	-0.6
Oct 1987	-0.3	-0.5

May 1985

**K** in the 87-178 cm zone is about 5.9. In the top 87 cm it is about 9.6, probably reflecting the differences in **K** between frozen woodchips and soil.

Oct 1985

Significant scatter in the layer analysis. **K** in the top 57 cm is 11.1; in the 57-87 cm layer it is 28.5 (base of woodchips) and in the 87-178 cm layer it is 14.8. The 133 cm probe trace is difficult to interpret and produces significant scatter in the layer analysis if included.

May 1986

**K** varies somewhat with depth but the material appears frozen. A feature was noted on the 87 cm (9.67 ns) probe at 2.5 ns and 8.5 ns perhaps showing differing water contents within the woodchips.

Oct 1986

A great deal of scatter in the layer analysis.

May 1987

Material appears to be frozen through with a wetter layer near the base of the woodchips.

Oct 1987

Scatter exists in the layer analysis, average **K** is about 12.

## Summary for 2B KP

Lithologic record from the installation of thermistor cable T1 gives:

0 - 100 cm woodchips  
100 - 170 cm clay (till)  
170 - 250 cm clayey silt  
250 > shale

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.1	-0.2	-0.5	-0.7
Oct 1985	0.7	-0.1	-0.2	-0.2
May 1986	-0.1	-0.1	-0.3	-0.4
Oct 1986	-0.4	-0.1	-0.2	-0.1
May 1987	-0.1	-0.3	-0.4	-0.4
Oct 1987	1.1	-0.2	-0.2	-0.2

May 1985

Generally frozen/dry. **K** in the woodchips is about 10; between 87-178 cm it is about 5.6.

Oct 1985

The 133 cm probes seems to be shorted (or near shorted) so it is not used. **K** is about 5 in the 87-178 cm layer; 11.7 in the top 57 cm and 16 in the 57-87 cm layer.

May 1986

Some scatter in the layer analysis exists. It appears that the 57-87 cm layer (near the base of the woodchips is warmer/wetter (**K** = 17.3) compared with the 0-57 cm layer (**K** = 9.4) and the 87-178 cm layer (**K** = 6.4).

Oct 1986

**K** relatively uniform with depth averaging about 9.5.

May 1987

**K** averages about 7.5 through the profile, with the surface zone being only slightly wetter. If the top 50 cm is thawed as suggested by the temperatures, then the material is relatively dry.

Oct 1987

Similar to Oct 1986.

**Summary for 2C KB**

Lithologic record from the installation of thermistor cable T4 gives:

≈ 0 - 40 cm organic silt  
40 - 110 cm clay (till)  
110 - 680 cm clayey silt  
680 > siltstone

	Cable T4	
	100 cm	200 cm
May 1985	-1.4	-2.0
Oct 1985	-0.1	-0.5
May 1986	-1.3	-1.8
Oct 1986	-0.1	-0.4
May 1987	-1.2	-1.8
Oct 1987	0.3	-0.4

May 1985

Feature detected on the 25 cm (2.99 ns) and the 87 cm (7.99 ns) probes between 1.5 and 1.6 ns. This reflects a thin thaw layer to about 7.5 cm. **K** in the frozen zone is about 6. It should be noted that it was difficult to determine the end of the 148 cm probe.

Oct 1985

A great deal of scatter exists in the layer analysis, either the probe lengths are not correct or there is poor agreement between them.

May 1986

Similar to May 1985.

Oct 1986

Similar to Oct 1986.

May 1987

Top 25 cm slightly wetter (**K** = 13.1) than the rest of the profile (**K** = 7.5)

Oct 1987

Similar to other October readings.

**Note** There is a great deal of scatter at this site suggesting that there are lateral inhomogenities which make the layer analysis difficult.

### Summary for 2C KC

Lithologic record from the installation of thermistor cable T3 gives:

≈ 0 - 100 cm clay (till)  
100 - 670 cm clayey silt

	Cable T3	
	100 cm	200 cm
May 1985	-0.7	-1.4
Oct 1985	2.1	2.8
May 1986	-0.5	-0.8
Oct 1986	1.1	2.1
May 1987	-0.5	-0.8
Oct 1987	5.1	4.9

May 1985

The end point on the crt display for the 178 cm probe was missed. A feature was detected on the 87 cm (11.99 ns) probe and on the 178 cm probe between 8 and 8.33 ns. The top 25 cm is very wet ( $K = 40.9$ ) and is drier (frozen) at depth ( $K = 10.4$ ). The feature (thaw layer) appears at about 50 cm.

Oct 1985

A great deal of scatter exists in the layer analysis. The profile appears unfrozen (see temperatures also) with water content increasing with depth.

May 1986

The profile exhibits a wet-dry-wet sequence.  $K$  in the top 25 cm is 41; in the 25-133 layer it is about 12.6 and in the 133-178 cm layer it is 26.2.

Oct 1986

$K$  increases with depth. Material is unfrozen and  $K$  profile shows increasing water content with depth.

May 1987

Surface thaw evident.  $K$  in the top 25.5 cm is 35.7. Thaw front evident at about 1.3 to 2 ns (approximately 15 cm).

Oct 1987

Very similar to Oct 1986

**Summary for 2C KP**

Lithologic record from the installation of thermistor cable T1 gives:

≈ 0 - 100 cm clay (till)  
100 - 550 cm clayey silt

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
Oct 1984	1.0	1.6	2.2	2.7
May 1985	-0.2	-1.0	-1.4	-1.4
Oct 1985	1.1	1.7	2.1	2.3
May 1986	-0.3	-0.8	-1.0	-0.8
Oct 1986	0.5	0.9	1.4	1.8
May 1987	-0.3	-0.8	-0.9	-0.7
Oct 1987	3.8	4.0	4.0	3.6

Temperature record shows that this site thaws to 4.5 m by September of any given year.

May 1985

Frozen material, **K** is about 12.6 in the 25-87 cm layer. The end point for the 178 cm probe was not detected.

Oct 1985

**K** increases with depth (7.8 in the 0-25 cm layer; to about 20 in the 87-178 cm layer).

May 1986

Feature noted between 8.7 and 10 ns (approximately 57 cm) and represents a thaw layer. **K** at depth is about 10.

Oct 1986

Similar to Oct 1985

May 1987

Similar to May 1986. Feature noted between 9.2 and 10.3 ns. **K** in frozen zone is about 12.5.

Oct 1987

Similar to other Oct observations.



## Summary for 3A KB

### Notes

Lithologic record from the installation of thermistor cable T4 gives:

≈ 0 - 35 cm organic silt  
35 - 80 cm ice + silt  
80 - 200 cm silt

Temperature data shows that the material is continuously frozen from the 50 cm to at least 8 m depth with the warmest temperature at the 50 cm being ≈ -0.4 (from cable T4). The base of the active layer is < 50 cm.

May 1985 generally frozen,  $K \approx 4.2$  in lower portion of the profile. A feature appears at about 1.3 to 1.4 (3 - 5 cm) ns on the TDR crt displays suggesting the beginning of a thin thaw layer.

Oct 1985 wet in surface zone.  $K$  in frozen layer is ≈ 8.5. Feature appears between the 25 cm (3.53 ns) and 87 cm (9.55 ns) probes at 6 ns (50 cm) and could be a combination of lithologic features and high water content.

May 1986 wet in surface zone.  $K \approx 4.7$  in frozen zone. Feature appears between 1.4 and 2.8 ns and is evident on the 25, 57 and 87 cm probes, suggesting a thin thawed layer.

Oct 1986  $K$  is 7.5 in frozen zone. No distinct features in the trace; generally frozen.

May 1987  $K$  is 5.7 in frozen zone. Feature appears on the 26.5 cm (4.25 ns), the 45 cm (5.92 ns) and 72.4 cm (7.91 ns) probes at different times (2.9, 5, 2.8 ns respectively). The feature is probably a thin thaw layer in the 8 - 20 cm region.

Oct 1987  $K$  is about 16 and the profile seems to have warmed. Since it is a silty material and the temperatures are below freezing, this value is not unreasonable.

## Summary for 3A KC

### Notes

Lithologic record from the installation of thermistor cable T3 (4.5 m from pipeline) gives:

0 - 30 cm organic silt  
30 - 150 cm ice + silt  
150 - 530 cm silt

Temperature data for cable T3 shows that the material is frozen below the 100 cm depth on all observation dates except Oct 1987.

May 1985 generally frozen,  $K \approx 3.4$ . A feature appears at about 6.7 ns (107 cm) between the 87 cm (5.44 ns) and the 178 cm (11.01 ns) TDR probes. This feature may be lithologic.

Oct 1985 wet in surface zone.  $K$  in frozen layer is  $\approx 7.3$ . Impossible to discern features.

May 1986 wet in surface zone.  $K \approx 12.0$  in frozen zone. Feature appears at 5.8 to 6.2 ns on the 47 to 91.4 cm probes (between 20 and 33 cm from the surface) and is probably a thaw zone.

Oct 1986  $K$  is 14.0 in frozen zone. No readings for the 25 cm probe. A feature appears 6.7 ns on the 84.5 cm probe; 7.5 ns on the 125 cm probe and 7 ns on the 178 cm probe. This feature is probably in the region of 60 to 63 cm beneath the surface and may be lithologic.

May 1987  $K$  is 10.0 in frozen zone. Scatter is evident in the measurements. A feature appears around the 3.8 to 4.7 ns region on the 39, 62 and 72 cm TDR probes. This would correspond to a possible depth of about 21 to 23 cm and is probably a thaw zone.

Oct 1987 The profile is very wet and is probably thawed, possessing a graded water content profile. The temperature of recorded at 1 m on cable T3 was 0.54 C and -0.52 at 2 m.

## Summary for 3A KP

### Notes

Lithologic record from the installation of thermistor cable T1 (1.4 m from pipeline) gives:

0 - 35 cm organic silt  
35 - 155 cm ice + silt  
150 - 520 cm silt

	T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.9	-2.0	-2.7	-3.1
Oct 1985	0.6	-0.1	-0.5	-0.9
May 1986	-0.3	-1.3	-1.9	-2.2
Oct 1986	-0.2	0.0	-0.3	-0.6
May 1987	0.3	-0.8	-1.1	-1.3
Oct 1987	-	0.8	-0.3	-0.5

May 1985 generally frozen,  $K \approx 4.9$ . A feature appears at about 3.67 ns ( $\approx 25$  cm) on the 87 cm (8.50 ns) probe. It does not appear on the 139 cm (13.17 ns) TDR probes. This feature may be lithologic or represents a thawing zone.

Oct 1985 the pattern is complex, see trace also. The data suggests that thaw occurred at this site to a depth of about 94 cm as evidenced by a feature at 15.33 ns on the 133 cm probe (assuming  $K$  is 7.8 in frozen section). At the time of observation, the surface began to freeze back since a feature appears at 4.75, 4.67 and 3.83 ns on the 57 cm (9.17 ns), 87 cm (14.99 ns) and 133 cm (19.29 ns) probes respectively. The shape of the TDR trace suggests a freeze back of the top 32 to 51 cm of the profile (range 32, 34, 51 cm using a  $K$  of 32 in the thawed zone)

May 1986 Generally frozen, with some surface thaw. There is scatter in the layer analysis but  $K$  is generally 7.4 in the frozen portion. A feature occurs at about 3.49 to 3.99 ns (29 to 30 cm from surface) on all the TDR probes except the 25 cm probe. This feature could be a combination of lithology and surface wetness.

Oct 1986 Surface layer (unknown thickness) has started to freeze back. It overlies a wet unfrozen layer which probably extends to the a depth of 130-150 cm (see temperatures also).

May 1987  $K$  is 12.0 in frozen zone. Scatter is evident in the measurements. A feature appears between 4.7 and 6.2 ns on the 50cm (6.58 ns), 105 cm (13.83) and 112 cm (13.67 ns) TDR probes lying somewhere between the 24.5 and 50 cm probes (estimates of 33, 39 and 44 cm respectively assuming a  $K$  of 12 in the frozen zone.

Oct 1987 The profile is very wet and is probably thawed, with either a drier surface or more probably a thin frozen surface layer. The temperature of recorded at 1 m on cable T1 was 0.8 C and -0.3 at 2 m.

## Summary for 3B KB

### Notes

Lithologic record from the installation of thermistor cable T4 gives:

0 - 40 cm organic silt  
40 - 400 cm sand

Temperature data shows that the material is continuously frozen from the 1 m to 20.9 m depth with the warmest temperature at the 1 m mark being  $\approx -0.35$  (from cable T4). The base of the active layer is  $< 1$  m.

May 1985 generally frozen,  $K \approx 5.5$

Oct 1985 thin freeze-back at time of reading. Active layer feature at 8.5 ns between the 57 (7.93 ns) and 87 cm (10.55 ns) probe ( $\approx 61$  cm). Frozen layer,  $K \approx 5.5$ .

May 1986 thaw front at time of reading between 0 cm and 25 cm probes (3.15 ns) at 2.3 - 2.8 ns. Dominantly frozen,  $K \approx 5.5$

Oct 1986 similar to Oct 1985

May 1987 similar to other May observations

Oct 1987 top 25 or so cm frozen back, wet (unfrozen) between 25 cm (1.92 ns) and 83 cm (12.17 ns) probes. Unfrozen-frozen boundary at 11.5 ns ( $\approx 75$  cm),  $K \approx 5.5$  in frozen layer.

## Summary for 3B KC

### Notes

Lithologic record from the installation of thermistor cables T2 and T3 gives:

≈ 0 - 40cm organic silt  
40 - 550 cm sand

Temperatures data from thermistor cables T3 (4.2 m from pipeline) and T2 (2.3 m from pipeline)

	T3		T2	
	100 cm	200 cm	50 cm	100 cm
May 1985	-1.1	-2.3	-0.7	-1.6
Oct 1985	0.6	-0.2	0.3	0.6
May 1986	-0.6	-1.4	2.7	-0.4
Oct 1986	-0.1	-0.1	-1.3	-0.1
May 1987	-0.1	-0.2	3.5	-0.2
Oct 1987	1.6	-0.1	2.7	2.0

May 1985 thawed between 25 cm (5.1 ns) and 87 cm (11.0 ns) probes. Unfrozen-frozen boundary between 7.6-8.3 ns (≈ 54 cm) with  $K \approx 7.3$  in frozen layer.

Oct 1985 some lack of congruity between probes. Boundary appears between 6.7-7.7 ns (≈ 65 cm) between 57 cm (6.0 ns) and 87 cm (9.99 ns) probes.  $K \approx 15$  in lower zone.

May 1986 very wet in top 25 cm ( $K = 45.4$ ). Thaw front appears between 13.1-13.7 ns (≈ 50 cm) between the 57 cm (14.1 ns) and 87 cm (17.72 ns) probes with  $K \approx 11$  in frozen layer.

Oct 1986 generally frozen. feature appears between 6.7 and 7.5 ns (≈ 60-67 cm) with  $K \approx 14$  in lower portion of profile.

May 1987 Frozen-unfrozen boundary appears between 13.3-13.8 ns (70-75 cm) between the 56 cm (10.7 ns) and 86.4 cm (14.9 ns) depth.  $K \approx 9$  in frozen zone.

Oct 1987 Frozen-unfrozen boundary appears between 7.2-7.9 ns between the 57 cm (6.2 ns) and the 87.4 cm (10.3 ns) probes. Quite a bit of scatter in depth interpretation due to a variable water content gradient or errors in readings.

### Cautionary Note

From the temperature data and the lithologic record it appears that the differences in lithology show up on the trace somewhere between 50 and 65 cm. The  $K$  values and the temperature data for Oct 1985, 1986 and 1987 suggest that the whole profile is unfrozen, hence, the feature is not a freeze-thaw boundary but due to differences in materials.  $K$  is ≈ 15 which would correspond to a volumetric water content of about 27.5 % which is reasonable for a dense saturated sand.

## Summary for 3B KP

### Notes

Lithologic record from the installation of thermistor cables T1 gives:

≈ 0 - 30cm organic silt  
40 - 500 cm sand

Temperatures data from thermistor cables T1 (1.3 m from pipeline) shows:

	T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.9	-1.7	-2.0	-2.3
Oct 1985	0.4	0.6	0.2	-0.2
May 1986	2.7	-0.4	-0.7	-0.9
Oct 1986	-1.1	-0.1	-0.2	-0.3
May 1987	2.5	-0.2	-0.3	-
Oct 1987	2.8	2.0	1.0	-

May 1985 wet in upper zone. Thaw feature at 8.0 ns (65 cm) between the 25 cm (5.4 ns) and 87 cm (11.2 ns) probes.  $K \approx 9$  in frozen zone. (temperatures suggest that this may be a lithologic feature)

Oct 1985 some scatter in analysis due to probe error or variable water content profile.  $K$  between 12 and 15 in lower zone suggesting that it is unfrozen (see temperatures also).

May 1986 thaw feature(?) at 9.0 - 9.7 ns (55 - 60 cm) near the end of the 57 cm probe (9.2 ns). The surface is very wet and  $K$  in the lower zone is in the order of 6 - 8.

Oct 1986 No data for upper two probes (25 and 57 cm). Difficult to interpret.

May 1987 Feature appears between 7.3 - 8.5 ns (33 - 46 cm) within the top 59 cm (9.75 ns).  $K$  within the lower (frozen) soil is between 7 - 9. No readings for the 25 cm probe.

Oct 1987 Profile is thawed with an average  $K$  of about 16 - 17. A feature appears at 12.67 ns on the 120 cm probe and at 8 ns on the 160 cm probe. The feature is probably lithologic in nature

### Cautionary Note

The consistence appearance of a feature in the 30 - 60 cm region suggests that it is lithologic in nature. It may be coincidence that the thawed layer agrees at times within this range.

### Summary for 4A KB

Lithologic record from the installation of thermistor cable T2 gives:

0 - 35 cm organic silt  
35 - 90 cm silt and sand  
90 - 520 cm sand  
520 > silty clay

	Cable T2	
	100 cm	200 cm
May 1985	-0.1	0.5
Oct 1985	2.2	1.9
May 1986	0.1	0.6
Oct 1986	3.5	3.4
May 1987	0.1	0.6
Oct 1987	3.3	2.4

This site varies little in its **K** values from season to season or with depth. There is nothing significant to report.

### Summary for 4A KC

Lithologic record from the installation of thermistor cable T4 gives:

0 - 530 cm sand

	Cable T4			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.1	-0.3	0.0	0.5
Oct 1985	3.1	3.9	4.1	3.6
May 1986	-0.1	-0.0	0.2	0.6
Oct 1986	3.0	3.7	4.1	4.4
May 1987	-0.1	-0.1	0.2	0.6
Oct 1987	5.7	5.8	5.6	5.1

Similar to site 4A KB. There is something wrong with the 178 cm probe. It looks like the rods may be shorting at depth.

**Summary for 4A KP**

Lithologic record from the installation of thermistor cable T4 gives:

0 - 530 cm sand

	Cable T4			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.1	-0.3	0.0	0.5
Oct 1985	3.1	3.9	4.1	3.6
May 1986	-0.1	-0.0	0.2	0.6
Oct 1986	3.0	3.7	4.1	4.4
May 1987	-0.1	-0.1	0.2	0.6
Oct 1987	5.7	5.8	5.6	5.1

Similar to the other 4A sites.



**Summary for 4B KB**

Lithologic record from the installation of thermistor cable T4 gives:

0 - 35 cm organic silt  
35 > sand

	Cable T4	
	100 cm	200 cm
May 1985	-0.2	-0.5
Oct 1985	3.3	3.3
May 1986	-0.1	-0.9
Oct 1986	3.2	2.9
May 1987	-0.1	-2.3
Oct 1987	5.8	5.2

This site varies little in its **K** values from season to season or with depth. There is nothing significant to report.

**Summary for 4B KC**

Lithologic record from the installation of thermistor cable T2 gives:

0 - 530 cm sand

	50 cm	Cable T4		
		100 cm	150 cm	200 cm
May 1985	6.0	0.5	-0.1	-0.2
Oct 1985	2.0	2.7	3.4	4.2
May 1986	7.6	2.4	-0.1	-0.0
Oct 1986	1.7	2.8	3.7	4.5
May 1987	3.0	2.9	-0.0	0.1
Oct 1987	5.9	6.1	6.4	6.4

Similar to site 4B KB.

**Summary for 4B KP**

Lithologic record from the installation of thermistor cable T2 gives:

0 - 530 cm sand

	Cable T4			
	50 cm	100 cm	150 cm	200 cm
May 1985	6.0	0.5	-0.1	-0.2
Oct 1985	2.0	2.7	3.4	4.2
May 1986	7.6	2.4	-0.1	-0.0
Oct 1986	1.7	2.8	3.7	4.5
May 1987	3.0	2.9	-0.0	0.1
Oct 1987	5.9	6.1	6.4	6.4

Similar to other 4B sites.

## Summary for 5A KB

Lithologic record from the installation of thermistor cable T4 gives:

0 - 380 cm peat  
380 - 400 cm clayey silt  
400 > clay till

	Cable T4	
	100 cm	200 cm
May 1985	-0.1	-0.2
Oct 1985	-0.0	-0.1
May 1986	-0.0	-0.2
Oct 1986	0.1	-0.2
May 1987	0.0	-0.2
Oct 1987	1.0	-0.2

May 1985 Feature noted at 7.67 to 7.99 ns on the 133 cm (14.67 ns) and 178 cm (18.33 ns) probes respectively. This represents the thaw depth. **K** is about 5.75 in the frozen zone suggesting that the front is around 45 to 49 cm.

Oct 1985 Top 25 cm has started to freeze back or had dried during the summer months. The 25 to 87 cm zone is very wet (**K** = 40) but not saturated given that this is peat. The feature detected at 15 ns on the 87 cm (16.67 ns) probe; at 15 ns on the 133 cm (20.33 ns) probe and at 15.33 ns on the 178 cm (11.67 ns) probe is the freeze-back/dry layer feature. The base of the thawed layer from the layer analysis appears to be around 100 cm.

May 1986 Feature noted between 8.83 and 12 ns on the 57, 87, 133 and 178 cm probes. **K** in frozen zone is about 6 and the unfrozen/frozen boundary is 60 to 70 cm from the surface.

Oct 1986 **K** is higher in frozen layer (about 8.5 in the 127 to 170 cm layer) and the unfrozen/frozen boundary appears to be at about 120 cm depth. **K** in the top 28 cm was relatively dry or had recently frozen (**K** = 16). in the 28 to 56 cm zone **K** was 72.5 suggesting saturated peat.

May 1987 Very complicated layer analysis. Thaw feature detected at 14 ns on the 130.7 cm (18.83 ns) probe and at 16 ns on the 174 cm (23.67 ns) probe. **K** in the frozen zone is about 8 putting the thaw boundary at 85 - 92 cm.

Oct 1987 Appears very wet in general. The 127 and 170 cm probes are difficult to interpret.

## Summary for 5A KC

Lithologic record from the installation of thermistor cable T3 gives:

0 - 320 cm peat  
320 - 400 cm clayey silt  
400 > clay till

	Cable T3	
	100 cm	200 cm
May 1985	-0.1	-0.0
Oct 1985	0.1	-0.0
May 1986	-0.0	-0.0
Oct 1986	0.5	-0.0
May 1987	0.0	0.0
Oct 1987	2.6	0.0

May 1985 Profile generally frozen (given temperatures and **K** values). **K** averages about 6 in the profile with a feature being detected between 2.33 and 2.83 ns (about 25 cm).

Oct 1985 Top 25 cm dry or recently frozen. Thaw depth is about 60 cm with **K** about 5 in the frozen zone and grading up to 46 in the 25-57 cm zone.

May 1986 The layer analysis indicates that there is a lot of incongruity between the probes. The profile has been generally frozen but an estimate as to the position of thaw features or an average **K** would be inappropriate.

Oct 1986 Top 25 cm dry or recently frozen. Thaw front detected on the 127 cm (20.33 ns) and 170 cm (22.67 ns) probes at 15.33 ns and 14 ns respectively. **K** is about 8 in the frozen zone and the unfrozen-frozen boundary appears to be around 74 to 80 cm. The temperature record would put this feature at a much greater depth.

May 1987 Layer analysis fairly complicated. The ends of the 130 and 179 cm probes were difficult to detect with any certainty. The profile is essentially frozen.

Oct 1987 Layer analysis fairly complicated. The profile is wet (**K** between 45 to 65 in various layers). The profile appears to be thawed (given temperatures) but the layer analysis indicates a frozen layer (**K** = 8) in the 126 - 175 cm zone. This may be in error but needs to be confirmed.

## Summary for 5A KP

Lithologic record from the installation of thermistor cable T1 gives:

0 - 330 cm peat  
330 - 520 cm clayey silt

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.0	-0.1	-0.1	-0.2
Oct 1985	0.9	0.2	-0.2	-0.2
May 1986	6.8	0.0	-0.1	-0.1
Oct 1986	6.9	0.6	-0.1	-0.1
May 1987	12.5	0.1	-0.1	-0.1
Oct 1987	4.3	3.4	0.5	-0.1

May 1985 Profile appears to have a dry/frozen layer over a wet layer over a frozen layer. There is no data for the 25 cm probe. The 57 cm probe gives  $K$  of 8.9. A feature is detected at 2.5 ns and 3.83 ns on the 57 cm (5.67 ns) and 87 cm (8.75 ns) probes respectively; this is the dry/frozen layer (also noted on the 133 cm and 178 cm probes at 3.33 ns). Another feature being the unfrozen/frozen boundary is noted at 8.67 ns on the 133 cm (23.66 ns) and the 178 cm (31.67 ns).  $K$  in the 87 to 178 cm zone is about 57 from the layer analysis.

Oct 1985 The profile is extremely wet throughout the profile.  $K$  is 82 in the 57 to 87 cm zone and 53 in the 87 to 52 cm zone suggesting that a frozen veneer may exist at some depth.

May 1986 Profile is very wet and assumed to be completely thawed ( $K = 88$  in the 57 to 163 cm zone).

Oct 1986 Profile is very wet and assumed to be completely thawed.

May 1987 Profile is very wet and assumed to be completely thawed.

Oct 1987 Profile is very wet and assumed to be completely thawed.

## Summary for 5B KB

Lithologic record from the temperature record indicates very thick icy peat.

	Cable T1	
	100 cm	200 cm
May 1985	-0.2	-0.3
Oct 1985	-0.1	-0.2
May 1986	-0.1	-0.2
Oct 1986	-0.1	-0.2
May 1987	-0.1	-0.1
Oct 1987	0.1	-0.1

May 1985 Start of thaw layer in top 25 cm. **K** averages 4.5 over profile, hence, frozen.

Oct 1985 Top 25 cm is either drier or has started to freeze back. Feature noted on the 87 cm (11.83 ns) and the 133 cm (13.99 ns) probes at 8.99 ns and 7.33 ns respectively. **K** in the frozen layer is still about 4.5 putting the feature at about 39-46 cm. The top 25 cm is 9.3; between 25 to 57, **K** is 33.4 and below the feature about 4.5.

May 1986 Similar to May 1985. Feature (thaw boundary) appears at 4.17 ns on the 57 cm probe (8.00 ns); 3.67 ns on the 87 cm probe (9.67ns) and 2.67 ns on the 133 cm probe (11.83); essentially placing it around the 20 to 30 depth.

Oct 1986 Dry/frozen layer on top of wet zone. Feature noted at 10.5 ns on the 83.8 cm (13 ns) probe and 9.33 ns on the 130 cm (15.33 ns) probe. Layer analysis indicates incongruity between probes. The best estimate of the unfrozen/frozen boundary would be between 60 and 70 cm.

May 1987 Several features appear on the TDR crt displays indicating a wet-dry-wet-dry sequence. Profile is generally frozen with a small thaw layer appearing in the top 25 to 35 cm (between 2.0 and 4.5 ns). Another feature appears on the 85.4 cm (11.5 ns) probe at 8.67 ns and on the 130.4 cm (13.33 ns) at about 6.67 ns. The feature is somewhere around 50 to 60 cm depth and may represent thermal conditions or differences in the materials.

Oct 1987 Top 27.5 cm is dry/frozen (**K** = 8.5) over top a wetter (but not saturated) layer with **K** being about 36. A feature was noted on the 129 cm probe (16.67) at 10.8 ns but not on the shorter probes. This feature is at about 60-70 cm and probably represents the base of the summer thaw. **K** is 3.9 in the 83-129 cm layer (frozen).

## Summary for 5B KC

Lithologic record from the temperature record indicates very thick icy peat.

	Cable T3	
	100 cm	200 cm
May 1985	-0.3	-0.4
Oct 1985	-0.1	-0.2
May 1986	-0.1	-0.2
Oct 1986	-0.0	-0.1
May 1987	0.0	-0.2
Oct 1987	1.2	-0.2

- May 1985 Generally frozen with **K** averaging about 5 throughout the profile. The surface 25 cm has **K** at about 16 and the feature detected between 2.5 and 3.2 ns on the crt displays reflect the unfrozen/frozen interface.
- Oct 1985 Top 25 cm dry/frozen over top of a wet/thawed layer; **K** is about 19.6. A feature was detected at about 12 ns on the 87, 133 and 178 cm probes (14.5, 18, 19.5 ns respectively) suggesting an unfrozen/frozen boundary at about 50-60 cm with **K** = 52 in the thawed zone and 5.5 below.
- May 1986 Profile analysis is fairly complicated and subject to error. The profile is generally frozen with a feature being detected at about 2.5 to 3.33 ns. This is essentially in the vicinity of the end of the 25 cm probe. No real evidence of much surface thaw as yet.
- Oct 1986 Top 30.5 cm dry/frozen (**K** = 15.8) over a wet layer (**K** = 77 in the 30.5 to 56 cm zone). A feature was detected at about 12.3 ns on the 175.3 cm probe putting it in the vicinity of 60-70 cm. The end of the 127 cm probe was not detected on the crt display but rather the feature was erroneously assumed to be the end of the line.
- May 1987 Layer analysis very complicated. The profile appears to be generally frozen with varying **K**'s in different layers giving a complex series of bumps on the crt display. The first notable feature appears on all TDR probes at about 3-3.33 ns (approximately 27.5 cm) and another was noted on the 127 and 175 cm probes at 11.3 and 9.33 respectively. This is in the vicinity of the end of the 80 cm probe and probably reflects differing wetness. If the profile is thawed as the temperatures suggest, then the peat is fairly dry but this is unlikely.
- Oct 1987 Rather complex layer analysis. Top 28.5 cm is dry/frozen (**K** = 16.3). The 28.5 to 76.4 cm zone is wet (**K** = 61) and the material appears to be frozen at depth (with **K** being 5.2 in the 76.4 to 169 cm region. The feature detected at 14.3 to 17 ns on the 122.2 cm (21 ns) and 169 cm (23.3 ns) probe puts the unfrozen/frozen boundary between 70 and 80 cm.

**Summary for 5B KP**

Lithologic record from the temperature record indicates very thick icy peat.

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	4.3	-0.0	-0.1	-0.1
Oct 1985	0.9	0.2	-0.2	-0.2
May 1986	6.8	0.0	-0.1	-0.1
Oct 1986	6.7	0.6	-0.1	-0.1
May 1987	12.5	0.0	-0.1	-0.1
Oct 1987	4.3	0.5	-0.1	-0.1

May 1985 Layer analysis suggests incongruity between probes.

Oct 1985 Profile is essentially thawed. A feature was noted at 25.8 ns on the 133 cm (35.8 ns) probe and at 33.3 ns on the 178 cm (45.83 ns) probe placing it around 120 - 140 cm. The average **K** in the 57 - 133 cm zone is about 75.

May 1986 Profile is essentially thawed with a dry/frozen layer within the top 57 cm (9.58 ns) at around 3.6 ns.

Oct 1986 Same as above. Profile is wet and thawed.

May 1987 Same as above.

Oct 1987 Same as above.



## Summary for 6 KB

Lithologic record from the temperature record indicates very thick icy peat.

	Cable T4	
	100 cm	200 cm
May 1985	-0.0	-0.1
Oct 1985	-0.0	-0.1
May 1986	-0.0	-0.1
Oct 1986	0.0	-0.1
May 1987	0.0	-0.1
Oct 1987	0.0	-0.1

- May 1985 **K** in the top 25 cm is 17.6. Feature noted between 4.5 and 5.3 ns on the 57 cm (9.67), 87 cm (12 ns), 133 cm (16.83 ns) and the 178 cm (19.3 ns) probes. This represents the base of the unfrozen/frozen zone which is about 30 - 50 cm from the surface. **K** in the frozen zone is about 4.5.
- Oct 1985 Fairly complex profile. **K** in the top 25 cm is 12.5 (either dry or frozen). **K** is about 60.3 in the 25 - 57 cm zone and grades to smaller values with depth. The feature is noted at 17 ns on the 133 cm probe (21.33 ns) and at 16.3 ns on the 178 cm probe (23.67 ns). This places the feature past the end of the 87 cm (15.83 ns probe) in the vicinity of 90 - 100 cm.
- May 1986 Several features noted on this trace. The first occurs between 4.5 and 6.3 ns on all but the 25 cm probe. The second appears at 133.3 and 15.7 on the 178 and 133 cm probes respectively. The layer analysis indicates a dry/frozen layer in the top 25 cm followed by a warmer wetter layer to about 90 cm then frozen beneath.
- Oct 1986 Dry surface layer (**K** = 16.3) followed by a wet layer between 25.4 and 86.3 (**K** = 56) grading to frozen material below. The feature noted at 21 ns on the 130 cm (24.3 ns) probe and at 20 ns on the 172.7 cm (27 ns) probe denotes the unfrozen/frozen boundary. Using a **K** of 8.0 for this layer, the boundary occurs around 100 - 110 cm depth.
- May 1987 Good example of the effect of multiple layers on the TDR's crt display. The first feature is noted at 4.7 to 6.3 ns on all the probes except the shortest. The second, denoting the end of the feature is at around 7.3 to 9 ns. The unfrozen/frozen boundary appears at about 17.3 to 18 ns on the 132.2 cm (21.7 ns) and the 174 cm (24.7 ns) probes placing around 95 to 110 cm.
- Oct 1987 Surface zone is dry/frozen with **K** = 13.5 for the top 24.5 cm. **K** in the 25-85 cm zone is very wet at 63.5. The unfrozen/frozen boundary appears to around 110 to 120 cm and was detected on the 129 cm (26.2 ns) and the 166 cm (end point missed) probe at 23.7 and 22.3 ns respectively.

## Summary for 6 KC

Lithologic record from the temperature record indicates very thick icy peat.

	Cable T3	
	100 cm	200 cm
May 1985	-0.3	-0.4
Oct 1985	-0.1	-0.2
May 1986	-0.3	-0.4
Oct 1986	0.0	-0.1
May 1987	-0.1	-0.1
Oct 1987	-0.1	-0.2

May 1985 Essentially frozen with  $K = 5.0$  on average.

Oct 1985 Complicated layer analysis suggesting probe incongruity. Unfrozen/frozen boundary detected at 11.2 ns on the 87 cm probe (12.99 ns) and at 12.3 ns on the 133 cm probe (18.0 ns). This places at around 55 to 65 cm with  $K = 6.2$  in the frozen zone.

May 1986 Similar to May 1985. Feature noted at 2.99 - 3.2 ns may be lithologic since it does not seem to be due to significant water content differences.  $K$  averages 5.5 throughout the profile.

Oct 1986  $K$  is 16 in the top 28 cm (3.42 ns). The feature noted on the 84 cm (15 ns), 130 cm (19.7 ns) and the 173 cm (23.3 ns) probe denote the unfrozen/frozen boundary. These appear at 11.5, 14.7, and 13.3 ns respectively placing the boundary somewhere between 55 and 70 cm.  $K$  is about 7 in the frozen zone.

May 1987 Very complex profiles with many features denoted. The layer analysis also suggests poor agreement between the probes. Features were noted at 3 to 4 ns (between 26.5 and 36 cm); at 10 - 11 ns (between 57 cm (7.8 ns) probe and 87.4 cm (132 ns) probe) and at 14 ns on the 176 cm probe (19.33). The end point of the 132 cm probe was also missed.

Oct 1987 The surface 27.5 cm is dry/frozen ( $K = 13.2$ ). It is very wet between the 27.5 (3.3 ns) and the 84.4 cm (19 ns) probes. A feature was noted on the 126 cm (23 ns) probe at 19 ns and at 21.3 ns on the 169 cm (26.3 ns) probes. This denotes the unfrozen/frozen boundary with  $K = 7$  in the 84.4 to 169 cm zone.

### Summary for 6 KP

Lithologic record from the temperature record indicates very thick icy peat.

	50 cm	100 cm	150 cm	200 cm
May 1985	-0.0	-0.2	-0.3	-0.3
Oct 1985	0.1	-0.1	-0.1	-0.1
May 1986	-0.0	-0.1	-0.1	-0.1
Oct 1986	0.3	-0.1	-0.1	-0.1
May 1987	0.0	-0.1	-0.0	-0.1
Oct 1987	2.2	0.0	0.0	-0.1

May 1985 Material generally frozen. Feature noted around 10 ns on the 87 cm (11.83 ns), 133 cm (18.33 ns) and the 178 cm (18.66 ns) probes.

Oct 1985 Material generally frozen but warm since **K** averages 20. Features detected at 15 ns on the 133 cm (18 ns) probe and at 16.5 ns on the 147 cm (21.7 ns) probe. The layer analysis suggests that this is just a layer of differing water content.

May 1986 No attempt was made to interpret the 157.5 cm probe. The material still appears to be frozen generally.

Oct 1986 Profile has begun to develop a very wet layer between 58.5 and 112 cm. The feature at 21.7 ns on the 152 cm (25 ns) probe seems to denote an unfrozen/frozen boundary.

May 1987 **K** is 28.4 in the top 57 cm a surface drying has occurred. The feature detected at 5.3 to 7 ns on the probes seems to denote the boundary. The position of the unfrozen/frozen boundary is quite uncertain but may lie between 100 and 120 cm.

Oct 1987 Between 55 cm and 108 cm **K** is 66.6. Below 108 the layer analysis suggests a **K** of 8 but the scatter is great and the thermal properties suggest that the unfrozen/frozen boundary may be at a greater depth.

### Summary for 7A KB

Lithologic record from the temperature record indicates ice rich lacustrine material with thick permafrost (>20 m).

	Cable T4	
	100 cm	200 cm
May 1985	-0.9	-1.6
Oct 1985	-0.4	-0.9
May 1986	-	-0.9
Oct 1986	-0.3	-0.6
May 1987	-0.7	-0.8
Oct 1987	-0.1	-0.6

Oct 1985 **K** = 36 in the top 56 cm with **K** = 8.2 below

May 1986 Completely frozen **K** averages about 7.

Oct 1986 Material appears to be completely thawed or near thawed. Feature appears on the 81.2 cm (15.5 ns) probe at 12.33 ns (approximately 56 cm) and on the 122 cm (18.33 ns) probe at 11.7 ns (approximately 50 cm). It could be lithologic.

May 1987 Essentially frozen except for the the top 24.5 cm. The feature detected at 3.33 to 3.83 ns on the remaining probes is in the vicinity of 25 cm. **K** averages about 7.5 in the frozen zone.

Oct 1987 The profile is extremely wet with **K** averaging 59 in te 25 to 69.4 cm zone. The feature detected on the 103.2 cm (20.33 ns) probe at 19 ns would suggest the boundary between unfrozen/frozen material at a depth of 80-90 cm.

### Summary for 7A KC

Lithologic record from the temperature record indicates ice rich lacustrine material with thick permafrost (>20 m).

	Cable T3	
	100 cm	200 cm
Oct 1985	-0.2	-0.7
May 1986	-0.8	-0.7
Oct 1986	0.0	-0.4
May 1987	-0.1	-0.3
Oct 1987	0.2	-0.3

Oct 1985 **K** is very high (wet) in the top 86 cm being 42.5 in the 25.4 - 55.9 cm zone and 31.1 in the 55.9 - 86.4 cm zone. **K** is about 5.9 below this.

May 1986 The profile is essentially frozen (**K** = 6.5) with exception of the top 25 cm which is very wet (**K** = 68.4). The unfrozen/frozen boundary is between 7.0 and 7.5 ns which is almost in perfect agreement with the end of the 25.4 cm probe (7.0 ns).

Oct 1986 On average, the profile is extremely wet (**K** = 42).

May 1987 Probe agreement is poor as noted by the layer analysis. The profile is essentially frozen but warm (**K** = 20) with the surface zone very wet as in May 1986.

Oct 1987 Same as Oct 1986.

### Summary for 7A KP

Lithologic record from the temperature record indicates ice rich lacustrine material with thick permafrost (>20 m).

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	2.1	-0.9	-1.5	-1.8
Oct 1985	0.3	0.2	0.0	-0.5
May 1986	11.7	-0.2	-0.2	-0.4
Oct 1986	-1.9	-0.1	-0.0	-0.2
May 1987	15.9	0.7	-0.3	-0.4
Oct 1987	5.0	1.8	0.9	-0.1

Oct 1985 Profile is fairly warm and wet. **K** is 35 in the top 25.4 cm; **K** is 47.4 in the 25.4-55.9 cm zone and decreases gradually. In the 86.4-157.5 cm zone **K** is about 15.8 suggesting that it is ice-bonded.

May 1986 Material is largely frozen with **K** of about 15. The surface 25.4 cm is thawed with **K** = 40.9.

Oct 1986 Profile is completely thawed and very wet with **K** = 44.8 between 25.4 and 152.4 cm.

May 1987 **K** = 38.1 in the top layer. It is thawed and wet. The position of the thaw front was noted on the 55.9 cm (9.67 ns), the 86.4 cm (12.2 ns) and the 117 cm (13 ns) probes at around 5.8 ns. **K** in the frozen zone is about 16 putting the feature at around 35-45 cm.

Oct 1987 Profile is completely thawed and very wet with **K** = 45 over the profile.

**Table 1 Site Descriptions**

<b>Site</b>	<b>Station</b>	<b>Km along Pipeline</b>	<b>Description (at time of establishment)</b>
84-1	Pump Station 1	0.1	Ice-rich silty clay in widespread permafrost
84-2	Canyon Creek		
	A	19.0	Level location, frozen till with low ice content in widespread permafrost
	B	19.3	East-facing slope in widespread permafrost with a 1 m insulating woodchip cover
	C	19.6	West-facing slope in widespread permafrost with erosion control berms
84-3	Great Bear River		(Joint IPL site)
	A	79.2	Statigraphically complex ice-rich alluvial terrace deposits in widespread permafrost; cliff base
	B	79.4	Cliff-top lacustrine deposits with veneer of aeolian deposits
85-7	Table Mountain		(Joint IPL site)
	A	271.2	Ice-rich lacustrine plain (old seismic line, 1960's)
	B	272.0	Helipad clearing at bend on top of north facing slope, ice-rich lacustrine plain
	C	272.3	New clearing on ice-rich lacustrine plain
84-4	Trail River		(pipeline previously traversed frozen ground)
	A	478.0	Unfrozen saturated sands and silts in dune hollow
	B	478.1	Dry sands and silts in dune crest
85-8	Manner's Creek		(rapidly changing permafrost conditions)
	A	557.8	thin peat with thick (10 m) permafrost
	B	558.2	Thick (2.7 m) peat with thin (4 m) permafrost
	C	558.3	thin peat (1 m) with thin (1 m) permafrost
85-9	Pump Station 3	583.3	Frost free granular soils after long frozen section
85-10	Mackenzie Highway South		
	A	588.3	Transition from a helipad clearing in unfrozen terrain to
	B	588.7	Thin (3 m) permafrost with 2 m peat cover
85-11	Moraine South	597.4	Thin (<4 m) permafrost in helipad clearing
85-12	Jean Marie Creek		
	A	608.6	Thin unfrozen peat plateau
	B	608.7	Thick ice-rich peat plateau; 4 m permafrost
85-13	Redknife Hills		
	A	682.2	Frozen (6 m) terrain surrounding large fen
	B	682.4	Frozen (6 m) terrain at fen border
	C	682.6	Unfrozen terrain in fen
84-5	Petitot River North		
	A	783.0	Ice-rich peat (3.5 m); (15-18 m) permafrost
	B	783.3	Very thick icy peat (7 m); 12 m permafrost
84-6	Petitot River South	819.5	Thick (5 m) ice-rich peat; 7 m permafrost

## 5. Recommendations Regarding Continuation of Readings at the Various Sites

	Recommendation	Reason
84-1	Yes	Off-ROW relatively stable, on-ROW may be exhibiting increased active layer thickness, beside pipe should be continued, however, the 4.5 and 6 foot probes seem to be picking up the pipe.
84-2A	No	Appears to a low water content material. Only features evident are the seasonal freeze/thaw boundaries.
84-2B	Yes	Woodchip site. Nothing major to note but it should be monitored.
84-2C	Yes	Off-ROW has remained generally frozen. On-ROW and near pipe experience significant thaw but remain relatively dry throughout the year.
84-3A	Yes	On-ROW and beside pipe may be showing increased active layer thickness. Off-ROW is similar and needs another year of observations before conclusions can be drawn.
84-3B	No	On-ROW and beside pipe just experience seasonal freeze-thaw. The material is dense sand.
84-4A	No	Unfrozen sands, little seasonal or site specific change
84-4B	No	Unfrozen sands, little seasonal or site specific change
84-5A	Yes	Material beside pipe is essentially thawed. On-ROW is gradually increasing in <b>K</b> .
84-5B	Yes	Similar to 5A
84-6	Yes	Maybe for another year. The site has been gradually increasing in <b>K</b> at all sites.
85-7A	No	This site is now just experiencing seasonal freeze/thaw.
85-7B	Yes	Should monitor to see if the wettness in KB and KP persists.
85-7C	Yes	Same reasons as for 7B
85-8A	No	On-ROW and near pipe experience complete freeze/thaw, off-ROW doesn't.
85-8B	Yes	On-ROW still seems to have frozen ground, pipe doesn't other than seasonal freezing
85-8C	Yes	On-ROW still seems to have frozen ground, pipe area appears to be thawing
85-9	No	Only experiences seasonal freeze-thaw. KP probes are suspect.
85-10A	No	Same as above.
85-10B	Yes	Frozen ground still evident on-ROW but not by pipe.
85-11	No	Lack of agreement between probes at all sites suggesting within site variations are great. Also the pipe probes have been buried.
85-12A	No	Only experiences seasonal freezing-thawing.
85-12B	Yes	Monitor to see if thaw at KP persists. KC and KB are relatively stable at present.
85-13	Yes	Continue for one season.



## 6. Site Summaries

### K Values Recorded at the Sites

As indicated earlier, one of the difficulties in analysing the TDR data is that **K** profile with depth is generally not uniform. For example, some of the sites in October have shown a freeze-back layer over top of thawed material which in turn lies over frozen material. When one measures **K** on a 6 foot probe, these three layers may occupy a certain portion of the total probe length. The resultant **K** will reflect the sum of the various layers. To facilitate the analysis, **K** for various soil layers was determined using the data obtained from each probe as discussed earlier.

The values of **K** reported here represent the average excluding any freeze-back or thaw evident in the record on the day of observation. If the base of the active layer or the position of the freeze-back layer is evident in the trace, then the travel time (in nanoseconds, ns) to the feature is given and the approximate depth at which occurs is noted. This is referenced to the travel times for the TDR probes. For example:

3B KB on Oct 1985 feature at 8.5 ns ( $\approx$  61 cm)  
between 57 and 87 cm (7.93 and 10.55 ns respectively)  
**K**  $\approx$  5.5 in frozen layer

The temperatures at this site suggest an area of permafrost; hence, this indicates that a "wet" (unfrozen) layer over top of a "dry" (frozen) and the feature appears at 8.5 ns on the TDR crt records. The layer is between the 57 and 87 cm TDR probes and the travel time to the end of the probes is noted for reference (eg. 7.93 and 10.55 ns). The position of the feature is determined by assuming that **K** is 5.5 in the frozen portion (a complete discussion will follow at a later date)

## Summary for 1 KB

### Notes

Lithologic record from the installation of thermistor cable T4 gives:

≈ 0 - 30 cm organic silt  
30 - 300 cm clay till  
300 - 650 cm silty clay

Temperature data shows that the material is continuously frozen at depths greater than 50 cm to at least 13.6 m depth with the warmest temperature at the 50 cm being ≈ 0.0 (from cable T4).

	Cable T4			
	50 cm	100 cm	150 cm	200 cm
May 1985	-1.2	-2.1	-2.5	-2.5
Oct 1985	-0.2	-0.8	-1.2	-1.4
May 1986	-1.1	-2.0	-2.3	-2.3
Oct 1986	-1.6	-1.1	-1.0	-1.3
May 1987	-1.0	-1.9	-2.3	-2.3
Oct 1987	0.0	-0.7	-1.1	-1.3

Oct 1985

Freeze-back of the active layer evident. **K** in frozen layer is ≈ 5.0. A feature (base of active layer) appears between the 25 cm (2.17 ns) and 57 cm (7.92 ns) depths between 5.33 and 6.5 ns (38 to 49 cm) and appears to reflect the base of the active layer.

May 1986

**K** ≈ 6.0 to 7.0 throughout profile (10.3 in top 25 cm). A feature appears between 1.8 and 2.1 ns (about 14 to 21 cm) and is evident on all probes, suggesting a thin thawed layer.

Oct 1986

Top 25 cm frozen (**K** is 4.3). Thaw evident down to about 50 cm (**K** 28 in the 25 to 53 cm layer). **K** is about 7.5 in frozen zone. No distinct features in the trace.

May 1987

Profile is essentially frozen; **K** is 6.0.

Oct 1987

Top 25 cm frozen back (**K** = 5.02). The 25 to 49 cm zone appears to be very wet (**K** = 54). **K** is about 7.5 below about 70 cm. A feature is evident between between the 49 cm (7.83 ns) and 71.4 cm (8.67 ns) probes between 6 to 6.7 ns (45 to 53 cm). This feature seems to correspond with the base of the active layer.

### Summary for 1 KC

Lithologic record from the installation of thermistor cable T2 gives:

≈ 0 - 250 cm clay till  
250 - 520 cm silt

Temperature data shows that the base of the permafrost is greater than 5 m (end of thermistor cable). The readings for Oct 1987 suggest complete thaw to 100 cm at least, this is substantiated by the TDR record.

	Cable T2			
	50 cm	100 cm	150 cm	200 cm
Oct 1984	-0.3	-0.6	-1.0	-1.4
May 1985	-0.7	-1.1	-1.5	-1.8
Oct 1985	0.2	-0.1	-0.4	-0.7
May 1986	-0.2	-0.4	-0.7	-0.8
Oct 1986	-0.1	-0.0	-0.2	-0.4
May 1987	-0.1	-0.4	-0.7	-0.7
Oct 1987	2.2	1.2	-0.0	-0.3

Oct 1985

Surface very wet (**K** about 42). Feature detected on the 133 cm (25 ns) and 178 cm (29.2 ns) probes at 21.2 ns and 19.2 ns respectively. This feature is probably the base of the active layer (between 87 and 133 cm) yet the **K** profile doesn't show a distinct boundary.

May 1986

Top 25 cm very wet (**K** is 64). Some scatter in data. A feature was detected on the 57, 87, 133 and 178 cm probes (10, 14.3, 18.3, 23.3 ns respectively) at about 7.83 ns. The average **K** in the frozen zone is about 11 putting the feature between 28 to 38 cm. It appears to be a thin thaw zone.

Oct 1986

Overlays of the Oct 1985 and Oct 1986 data show much the same thing.

May 1987

Essentially a duplicate of May 1986, however, there is no scatter in the data. Average **K** in frozen zone is about 14. Top 30 or so cm very wet, **K** of about 66.

Oct 1987

Top 25 cm or so freezing back. It was very wet to at least 111 cm. An estimate of **K** for the longest probe (146 cm) could not be made since the end point was missed. It is difficult to say whether the increased wetness at this site is due to seasonal conditions or represents a degradation of the permafrost.

### Summary for 1 KP

Lithologic record from the installation of thermistor cable T1 gives:

≈ 0 - 250 cm clay till  
250 - 520 cm silt

Temperature data shows that the base of the permafrost is greater than 5 m (end of thermistor cable). The readings for Oct 1987 suggest complete thaw to 100 cm at least, this is substantiated by the TDR record.

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
Oct 1984	-0.0	-0.3	-0.8	-1.3
May 1985	-0.3	-0.8	-1.2	-1.6
Oct 1985	0.9	0.5	-0.1	-0.5
May 1986	0.1	-0.1	-0.4	-0.7
Oct 1986	-1.3	-0.1	-0.1	-0.3
May 1987	2.3	-0.2	-0.6	-0.8
Oct 1987	4.0	1.4	0.4	-0.2

Oct 1985

The profile is generally wet down to about 80 or so cm (**K** is 42 in the 0-87 cm zone). The 133 and 178 cm probes produced strange crt traces, suggesting either the probes are shorted, crossed or are encountering a "feature" along their length.

May 1986

The surface layer has begun to thaw (**K** = 44.8) but appears to have frozen completely through during winter. The 133 and 178 cm probes still exhibit the "feature" along their length. The thaw front can be detected on the 57 cm (10.25 ns) and the 87 cm (14.5 ns) probes at 7.75 and 8.42 ns respectively. **K** in the frozen portion is about 19, suggesting the thaw front is at about 39 to 45 cm from the surface.

Oct 1986

The surface is experiencing freeze-back. The 127 and 170.2 cm probes still exhibit the strange feature. **K** in the frozen zone is about 22.

May 1987

Surface zone very wet (**K** about 60). **K** decreases from about 20 in the 21.5 to 51 cm layer to about 8 in the 119.2 to 164.9 cm layer. A feature was detected on the 21.5 cm (5.58 ns) 51 cm (10 ns), 76.4 cm (13.41 ns), and 164.9 cm (26 ns) probes. Since the **K** profile is highly graded, it can only be estimated that the thaw layer is within the top 21.5 cm of the profile.

Oct 1987

The top layer of the profile is experiencing freeze-back (**K** is 14.2 in the top 30.5 cm). The 111.2 and 152.9 cm probes exhibit strange crt displays and should not be considered reliable.

Summary for 2A KB

Lithologic record from the installation of thermistor cable T4 gives:

≈ 0 - 40 cm organic silt  
40 - 440 cm clayey silt

	Cable T4	
	100 cm	200 cm
Oct 1984	-0.3	-0.4
May 1985	-1.3	-1.6
Oct 1985	-0.1	-0.4
May 1986	-1.1	-1.3
Oct 1986	-0.7	-0.3
May 1987	-1.0	-1.3
Oct 1987	0.3	-0.3

Oct 1985

Appears to be well frozen throughout profile. **K** varies from 7.8 in the top 25 cm to about 20 in the 133-152 cm zone.

May 1986

Frozen throughout with **K** of about 8.5. Feature noted on all probes between 0.9 and 1.7 ns (about 10 cm) suggesting the start of a thaw zone.

Oct 1986

similar to Oct 1985

May 1987

Similar to May 1986. Feature noted at 1.83 to 3 ns on all probes (about 23 cm) perhaps showing the lower **K** in surface zone. There is some lack of congruity between the probes.

Oct 1987

Similar to other Oct readings. Average **K** is about 18.5 below 60 cm.

### Summary for 2A KC

Lithologic record from the installation of thermistor cable T3 gives:

0 - 440 cm clayey silt

	Cable T3	
	100 cm	200 cm
Oct 1984	0.0	-0.3
May 1985	-1.8	-2.4
Oct 1985	0.4	-0.3
May 1986	-1.2	-1.6
Oct 1986	-0.0	-0.1
May 1987	-0.5	-0.8
Oct 1987	2.0	0.5

May 1985

Surface zone slightly wetter than the rest of the profile. **K** is about 7.5 in lower portion of the profile. Feature noted between 2.83 and 3.17 ns on the 57 cm (6.99 ns) and 87 cm (8.83 ns) probes but not on the 25 cm (3.17 ns) probe suggesting the start of surface thaw/warming to about 25 cm.

Oct 1985

Generally low water content and thawed to at least 1 m with **K** increasing from about 10 in the 25-57 cm zone to 15 in the 133-178 cm zone.

May 1986

Surface thaw evident. Feature noted on all probes at between 3.6 to 4 ns. **K** in frozen portion is about 7 suggesting a thin thaw layer of 10 to 20 cm.

Oct 1986

Generally low water content. Average **K** is about 12.

May 1987

Surface thaw evident. Feature noted between 2.8 and 2.9 ns on the 25.5 cm (4.17 ns), 53 cm (4.41 ns) and 83.4 cm (9.17 ns) probes.

Oct 1987

Profile appears frozen through although the temperatures suggest otherwise. **K** increases from 7.5 in the 0-25 cm zone to about 18 in the 128-174 cm zone. The material is probably of low water content.

**Summary for 7B KB**

Lithologic record from the temperature record indicates ice rich lacustrine material with thick permafrost (>20 m).

	Cable T4	
	100 cm	200 cm
May 1985	-0.8	-1.6
Oct 1985	-0.1	-0.8
May 1986	-0.6	-1.1
Oct 1986	-0.0	-0.6
May 1987	-0.7	-1.3
Oct 1987	0.5	-0.6

Oct 1985 Profile appears to be essentially frozen with a dry/frozen layer in the top 25.4 cm ( $K = 16.6$ ) and a slightly warmer but still frozen layer beneath. A feature is detected at 14.0 ns on the 132 ns (18.2 ns) probe placing it between 86.4 and 132 cm. This feature may be lithologic or represents an area of higher ice content.

May 1986 The profile is frozen.  $K$  averages about 10.

Oct 1986 Top 25 cm is frozen/dry with  $K = 5.1$ . Between 25 and 127 cm,  $K$  averages about 28.5 making it essentially behave as an unfrozen material.

May 1987 Similar to May 1986.

Oct 1987 Similar to Oct 1986.

**Summary for 7B KC**

Lithologic record from the temperature record indicates ice rich lacustrine material with thick permafrost (>20 m).

	Cable T3	
	100 cm	200 cm
Oct 1985	0.3	-0.2
May 1986	-0.1	-0.4
Oct 1986	0.0	-0.0
May 1987	0.6	-0.2
Oct 1987	1.9	0.8

Oct 1985 **K** averages 28 over the 28 to 132 cm region. Essentially warm material.

May 1986 Essentially frozen with **K** averaging about 15.

Oct 1986 Very wet and thawed throughout.

May 1987 Similar to May 1986. **K** averages about 12.

Oct 1987 Similar to Oct 1986. **K** averages about 34.



### Summary for 7B KP

Lithologic record from the temperature record indicates ice rich lacustrine material with thick permafrost (> 20 m).

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
Oct 1985	-0.0	0.2	-0.2	-0.6
May 1986	4.0	-0.3	-0.4	-0.5
Oct 1986	-0.7	-0.0	-0.1	-0.2
May 1987	13.2	-0.3	-0.5	-0.4
Oct 1987	3.6	1.7	1.0	0.1

Oct 1985 Material is essentially unfrozen **K** averages about 30.

May 1986 Profile essentially frozen with **K** of about 15 in frozen zone and **K** = 29.3 in the top 25.4 cm (4.6 ns). Thaw feature appears at about 6.2-6.3 ns on all traces placing it between 30 and 35 cm.

Oct 1986 Material is thawed with **K** = 38.6 in the 27-172.7 cm zone. The surface 27 cm is either freezing or dry with **K** = 20.1.

May 1987 Profile is essentially frozen similar to May 1986. **K** averages 11.5.

Oct 1987 Similar to Oct 1986. No surface thaw evident.

**Summary for 7C KB**

Lithologic record from the temperature record indicates ice rich lacustrine material with thick permafrost (>20 m).

	Cable T4	
	100 cm	200 cm
May 1985	-1.4	-2.0
Oct 1985	-0.3	-0.8
May 1986	-1.2	-1.6
Oct 1986	-0.1	-0.7
May 1987	-1.2	-1.7
Oct 1987	-0.1	-0.7

Oct 1985 Top 25.4 cm freezing back or drier, **K** = 9.3. **K** in the 25.4 - 55.9 cm zone is about 21.1; in the 55.9-86.4 cm zone, **K** = 10.3. Profile is generally frozen except for the 25.4-55.9 cm layer which may have experienced summer thaw.

May 1986 Profile is completely frozen with **K** averaging 9.5.

Oct 1986 **K** averages 15.3 in the 25.4-127 cm zone. **K** is 8.2 in the top 25.4 cm layer. Essentially frozen.

May 1987 Same as May 1986.

Oct 1987 Similar to Oct 1986 except the profile is warmer with **K** averaging 20.

### Summary for 7C KC

Lithologic record from the temperature record indicates ice rich lacustrine material with thick permafrost (>20 m).

	Cable T3	
	100 cm	200 cm
Oct 1985	-0.1	-0.9
May 1986	-1.0	-1.8
Oct 1986	-0.3	-0.6
May 1987	-0.8	-1.4
Oct 1987	0.8	-0.4

Oct 1985 Profile fairly wet with **K** averaging 28.5. Layer analysis is complicated and suggests poor correlation between probes.

May 1986 Poor correlation between probes. Thaw feature appears between 5.2 and 6.8 ns which would place past the end of the 25.4 cm (5.0 ns) probe near 30 cm. **K** in the top layer is 34.8, and averages 13 in the frozen zone.

Oct 1986 Profile is essentially unfrozen.

May 1987 Thaw feature appears at 3.6 to 3.8 ns on the probes which would situate it at the base of the 22.5 cm (3.99 ns) probe. **K** in the thawed layer is 28.4 with **K** averaging about 14 in the frozen zone.

Oct 1987 Profile is essentially thawed.

### Summary for 7C KP

Lithologic record from the temperature record indicates ice rich lacustrine material with thick permafrost (>20 m).

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
Oct 1985	0.2	0.1	-0.5	-0.9
May 1986	1.9	-0.8	-1.2	-1.3
Oct 1986	-4.3	-0.6	-0.0	-0.3
May 1987	2.7	-0.6	-0.8	-0.9
Oct 1987	4.0	2.4	1.3	0.0

Oct 1985 The profile appears to be frozen beneath 55-60 cm although no distinct features appear on the TDR traces. **K** in the frozen layer is about 15. In the surface zone it is about 21.

May 1986 Fairly wet (**K** = 34) in the top 25.4 cm (5.1 ns) layer. A thaw front is evident on the 3 longest probes between 7.4 - 8.2 ns which would place it between 25.4 cm (5.1 ns) and 55.9 cm (9.7 ns).

Oct 1986 There is poor agreement between the probes in the layer analysis. The profile appears to be very warm (thawed) with **K** averaging 31.5

May 1987 A classic profile. **K** is 31.2 in the top 30 or cm of the profile. (feature noted at about 5 ns) with **K** averaging about 12.5 in the frozen zone.

Oct 1987 Wet and thawed. **K** averages about 33.8 in the profile.

### Summary for 8A KB

Lithologic record from the temperature record indicates thin peat layer with thick permafrost (> 10 m).

	Cable T4	
	100 cm	200 cm
May 1985	-0.2	-0.6
Oct 1985	-0.1	-0.3
May 1986	-0.2	-0.5
Oct 1986	-0.1	-0.3
May 1987	-0.2	-0.4
Oct 1987	-0.1	-0.3

Oct 1985 Material is completely frozen; average  $K = 6.5$ . Feature noted at 1.3 to 1.62 ns on all probes which corresponds to end of the 25.4 cm line. This may be frozen dry peat since  $K$  in this layer was 2.5.

May 1986 Surface zone has thawed at some point. The top 25 cm has a  $K = 9$ , while the 25-57 cm layer has a  $K = 22$ ; below this  $K$  averages 6.8. A feature was noted on the traces between 4.7 and 5.7 ns. This is in the vicinity of 45 to 50 cm and probably represents a small thawed layer or just wetter material.

Oct 1986 Top 28.3 cm is very dry  $K = 1.31$  (either dry peat or dry frozen peat).  $K = 8.4$  in the frozen zone. The feature at 10.33 ns noted on the 172.7 cm (16.5 ns) probe appears at about 100-110 cm and may represent the extent of summer thaw. The feature was not clear on the 127 cm probe.

May 1987 Similar to May 1986,  $K = 6$  in the frozen zone. The top 25.5 cm has a  $K = 4.2$ ; the 25-56 cm zone has a  $K = 17.5$  and may reflect thaw or a higher water content material. A feature was noted on the 175 cm probe (15 ns) at 9.33 ns but not on the other probes. In light of the observation for Oct 1986, this may be a lithologic feature unique to that particular probe placement.

Oct 1987 Similar to other October observations. Surface 25.5 cm is very dry ( $K = 2.2$ ) overlying a wetter layer (25.5-56.0 cm,  $K = 14.2$ ) overtop of frozen ground ( $K = 9$ )

### Summary for 8A KC

Lithologic record from the temperature record indicates thin peat layer with thick permafrost (>10 m).

	Cable T3	
	100 cm	200 cm
May 1985	-0.7	-1.0
Oct 1985	-0.0	-0.2
May 1986	-0.1	-0.3
Oct 1986	0.0	-0.1
May 1987	-0.1	-0.2
Oct 1987	0.5	-0.1

Oct 1985 Top 25.4 cm frozen back or dry ( $K = 7.1$ ). The 25.4-57 cm layer is unfrozen ( $K = 22.5$ ) and  $K$  averages about 8 in the frozen layer. A feature was detected on the 133 cm (14.83 ns) probe at 12.99 ns and on the 178 cm (16.5 ns) probe at 10.83 ns. This feature is in the 114-118 cm and seems to be lithologic in nature.

May 1985 Top 25 cm unfrozen with  $K = 21.1$ .  $K$  decreases gradually to about 5 near 60 cm. A feature was noted on the four longest probes between 4.2 - 4.9 ns which is in the 22-30 cm zone denoting the base of the thaw layer.

Oct 1986 Material seems to be unfrozen of low water content. Nothing distinguishing.

May 1987 Material is largely frozen.  $K$  averages 8 in the frozen zone. The feature noted at 3.3-3.83 ns on the four longest probes is in the order of 40 to 45 cm and may represent a start of ground thaw.

Oct 1987 Similar to Oct 1986 but seems drier with  $K$  averaging 13 throughout the profile.

### Summary for 8A KP

Lithologic record from the temperature record indicates thin peat layer with thick permafrost (>10 m).

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	0.0	-0.6	-1.0	-1.2
Oct 1985	0.4	0.2	-0.1	-0.1
May 1986	-0.0	-0.1	-0.1	-0.1
Oct 1986	1.0	1.0	0.6	0.1
May 1987	-0.0	-0.1	-0.0	0.0
Oct 1987	2.8	2.2	1.5	0.7

All dates No distinguishing features. The material appears to be low in water content grading to higher values with depth. Some seasonal variations exist. Wettest layer appears to be towards the end or the 133 and 178 cm zone.

### Summary for 8B KB

Lithologic record from the temperature record indicates thick peat layer with thick permafrost (<4 m).

	Cable T4	
	100 cm	200 cm
May 1985	-0.1	-0.0
Oct 1985	0.1	-0.1
May 1986	-0.2	-0.1
Oct 1986	0.1	-0.1
May 1987	-0.2	-
Oct 1987	0.4	-0.1

Oct 1985 Top 25 cm dry and/or frozen,  $K = 5.6$ . The 25.4-87 cm layer is unfrozen and wet (but not saturated if it is peat) with  $K = 36$ .  $K$  in the 87-178 cm layer averages 8.8. A feature was noted at 13 ns on the 133 cm (19 ns) probe and at 13.7 ns on the 178 cm (23.33 ns) probe. This feature is the unfrozen/frozen boundary and appears between 72 to 80 cm.

May 1986 The layer analysis indicates disagreement between the probes. The top 25 cm is dry/frozen with  $K = 16$  overlying a wet ( $K = 31$ ) layer between 25 and 87 cm and a drier (probably frozen) layer below ( $K = 14.5$ ).

Oct 1986 Top 28 cm is dry or has recently frozen back ( $K = 5.8$ ). The 28-83.8 cm layer is very wet with  $K = 63$ .  $K$  is about 18 in the 83.8-172.7 cm layer. A feature was noted at 17.3 ns on the 130 cm (22.33 ns) probe and at 20.8 ns on the 172.7 cm (29.6 ns) probe. This represents the unfrozen/frozen boundary between 94 and 110 cm depth.

May 1987 The top 24.5 cm is dry/frozen ( $K = 7.1$ ) over a wet layer between 24.5 and 87.4 cm ( $K = 31.8$ ). The material appears to be frozen between 87.4 and 175.9 with a  $K = 13.9$ .

Oct 1987 Top 22.5 cm dry or has recently frozen back ( $K = 5.4$ ). The material is wetter beneath and seems to be frozen or dry at depth. A feature was noted on the 127.2 cm (19.67 ns) probe at 14.2 ns and at 14.3 ns on the 174.9 cm (23.83 ns) probe. This is just past the end of the 86.4 cm probe in the vicinity of 90 and 100 cm. This may reflect the unfrozen/frozen boundary.



### Summary for 8B KC

Lithologic record from the temperature record indicates thick peat layer with thick permafrost (<4 m).

	Cable T3	
	100 cm	200 cm
May 1985	-0.3	-0.1
Oct 1985	-0.2	-0.2
May 1986	-0.3	-0.2
Oct 1986	-0.1	-0.2
May 1987	-0.3	-0.2
Oct 1987	-0.1	-0.2

Oct 1985 Feature noted on the 133 cm (18.67 ns) probe at 12.5 ns and at 13 ns on the 178 cm (22.67 ns) probes. **K** is about 7.1 between 133 and 178 cm. The feature is between 63 and 69 cm and represents the unfrozen/frozen boundary.

May 1986 Surface 25 cm is wet (**K** = 30.2). A feature was noted between 6 - 7 ns on the four longest probes. This feature is the unfrozen/frozen boundary which is between 30 and 40 cm.

Oct 1986 The top 25.4 cm is drier (**K** = 27.3) than 25.4-86.3 cm layer (**K** = 42). **K** is about 6.1 in the 86-175.3 cm layer. The feature noted at 15.5 ns on the 127 cm (22.3 ns) and the 175.3 cm (24.67 ns) places the unfrozen/frozen boundary between 75-80 cm.

May 1987 Profile is frozen (**K** = 6.8) below 24.5 cm. The feature detected on the four longest probes is in the vicinity of 25-30 cm. **K** in the surface zone is 48.2 (wet).

Oct 1987 Material still appears frozen (**K** = 8.5) in the 76.4 to 168.9 cm layer. The feature noted on the 121.2 cm (18.5 ns) and the 168.9 cm (23.3) ns places the unfrozen/frozen boundary between 66-73 cm.

### Summary for 8B KP

Lithologic record from the temperature record indicates thick peat layer with thick permafrost (<4 m).

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.6	-0.5	-0.5	-0.2
Oct 1985	-0.2	-0.2	-0.2	-0.1
May 1986	-0.2	-0.2	-0.3	-0.1
Oct 1986	-0.1	-0.1	-0.3	-0.1
May 1987	-0.2	-0.2	-0.3	-0.1
Oct 1987	-0.1	-0.1	-0.2	-0.1

Oct 1985 Material essentially frozen with an average  $K = 7$ .

May 1986 Little change from Oct.

Oct 1986 Seems to get wetter with depth. If the traces are correct, there appears to be a very wet ( $K$  approx. equal to water) layer between 124.5 and 170.2 cm.

May 1987 Similar to May 1986. Frozen.

Oct 1987 Similar to Oct 1986. Very wet layer at depth (124.2-167.9 cm)

## Summary for 8C KB

Lithologic record from the temperature record indicates thin peat layer with thin permafrost (<4 m).

	Cable T4	
	100 cm	200 cm
May 1985	-0.1	-0.2
Oct 1985	-0.1	-0.2
May 1986	-0.2	-0.3
Oct 1986	-0.1	-0.3
May 1987	-0.2	-0.2
Oct 1987	-0.1	-0.2

Oct 1985 Dry/frozen in top 25.4 cm ( $K = 2.2$ ). Warmer (wetter) in the 25.4-87 cm layer ( $K = 15.5$  and frozen beneath ( $K = 7$  in the 87-178 cm layer. A feature was detected on the 133 cm (14.83 ns) probe at 7.83 ns and at 9 ns on the 178 cm (17.33 ns) probe but not on the 87 cm (9.33 ns) probe. This feature is in the 53-83 cm zone and may be lithologic.

May 1986 Top 25 cm is frozen/dry ( $K = 5.3$ ) with a wetter layer between ( $K = 23$ ) between 25 and 87 cm. The feature detected at 11.5 ns on the 133 cm (16.99 ns) and the 178 cm (19.67 ns) probes correspond to the end of the 87 cm line and represents the base of this thaw (?) layer.

Oct 1986  $K$  in the 88.9 - 175.3 cm layer is 7.7. A wet layer exists between 58.5-88.9 cm ( $K = 31.3$ ) and the surface 28 cm is very dry/frozen ( $K = 2.6$ ). The feature detected between 12.3 and 13.3 ns on the 132 cm (14.67 ns) and the 175.3 cm (18.67 ns) puts the unfrozen/frozen boundary between 106 and 116 cm.

May 1987 Profile seems warmer with  $K$  averaging 16.8 over the 24.5-169.9 cm layer. The surface is dry/frozen ( $K = 4.8$ ).

Oct 1987 Similar to Oct 1986.

### Summary for 8C KC

Lithologic record from the temperature record indicates thin peat layer with thin permafrost (<4 m).

	Cable T3	
	100 cm	200 cm
May 1985	-0.3	-0.2
Oct 1985	-0.1	-0.2
May 1986	-0.2	-0.2
Oct 1986	-0.0	-0.1
May 1987	-0.1	-0.1
Oct 1987	0.1	-0.1

- Oct 1985 Top 25 cm is drier ( $K = 15.5$ ) than the 25.4-57 cm layer ( $K = 44.2$ ).  $K$  in the frozen zone is about 7.4. The feature detected between 9.8 and 11 ns on the 3 longest probes correspond to the end of the 57 cm probe and signifies the unfrozen/frozen boundary.
- May 1986 The material is frozen ( $K = 5$ ) below about 25 cm.  $K = 22.9$  in the top 25 cm. All the features detected on the 4 longest probes correspond to the 25 cm boundary which signifies the unfrozen/frozen boundary.
- Oct 1986  $K = 21.3$  in the top 25.4 cm layer; between 25.4-55.9,  $K = 62$  (very wet). The feature detected on the 3 longest probes between 13-13.7 ns corresponds to about 60-70 cm and represents the unfrozen/frozen boundary.  $K$  in the frozen zone is about 4.5.
- May 1987 Similar to May 1986. The features detected on the 4 longest probes denote the unfrozen/frozen boundary which is around 24-30 cm.
- Oct 1987 Similar to Oct 1986. The feature detected on the 3 longest probes between 13 and 13.8 ns corresponds to the unfrozen/frozen boundary.  $K$  is about 9 in the frozen zone, hence, the boundary is between 60 and 68 cm similar to the Oct 1986 position.

### Summary for 8B KP

Lithologic record from the temperature record indicates thin peat layer with thin permafrost (<4 m).

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.3	-0.6	-0.5	-0.5
Oct 1985	-0.0	-0.3	-0.2	-0.3
May 1986	-0.2	-0.4	-0.4	-0.4
Oct 1986	0.0	-0.2	-0.2	-0.3
May 1987	-0.2	-0.3	-0.2	-0.2
Oct 1987	1.4	-0.2	-0.2	-0.2

Oct 1985 **K** in the 57-178 cm layer is about 7.7 (frozen). A wet zone appears between 25-57 cm. The features detected on the longest three probes between 10.7-12.8 ns corresponds to the unfrozen/frozen boundary between 62-73 cm.

May 1986 Material is completely frozen (**K** = 6.2), except for the top 25-30 cm (**K** = 30.2). All features detected on the longest 4 probes correspond to this boundary.

Oct 1986 **K** in the frozen zone is about 6.2. The feature at 13.83 ns on the 134.7 cm (19.33 ns) probe and at 14.7 ns on the 175.3 cm (23.33 ns) probe suggest an unfrozen/frozen boundary between 68 and 71 cm similar to the Oct 1986 boundary.

May 1987 Less agreement between probes, essentially similar to May 1986.

Oct 1987 A lot of scatter in the layer analysis. The position of the unfrozen/frozen boundary appears at two distinctly different places on the two longest probes. No guess possible.

### Summary for 9

The temperature record for this site generally shows that it is unfrozen during the May and October observation periods. The lithologic record from the temperature record indicates frost granular soils. There is nothing distinctive about any of the sites. It should be noted that it was difficult to determine the end of the longer TDR probes at all sites even though the **K** rarely exceeds 25-30 (eg. not an exceptionally high water content). This may be due to salinity effects or the probes are splayed apart during installation. The 133 and 178 cm **KP** probe in particular is "detecting" something and appear to be almost shorted. This is a prime candidate for exclusion.

**Summary for 10A**

Lithologic record from the temperature record indicates thin peat layer over unfrozen till and shallow bedrock.

Unfortunately the two longest probes (133 and 178 cm) for **KB** are not reliable. They appear to be almost shorted either due to probe contact or exceptional (and unlikely) high pore water salinity. There doesn't appear to be any use in continuing observations at this site since other probes (particularly the 133 and 178 cm ones) at the **KC** and **KP** sites. All sites exhibit some freeze back and thaw features but generally profiles are unfrozen during the May and October observations.

### Summary for 10B KB

Lithologic record from the temperature record indicates very thin permafrost (frozen peat) over unfrozen till.

	Cable T4			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.0	-0.3	-0.2	-0.1
Oct 1985	-0.0	-0.2	-0.2	-0.1
May 1986	0.4	-0.3	-0.2	-0.1
Oct 1986	0.0	-0.1	-0.1	-0.0
May 1987	0.9	-0.2	-0.1	-0.0
Oct 1987	0.6	-0.1	-0.1	-0.0

Oct 1985 Generally frozen. A feature appears between 5.7 and 6.5 ns (near 50-60 cm) which may be lithologic.

May 1986 Frozen below 25 cm ( $K = 4.2$ );  $K = 25.0$  in the top 25 cm layer. Feature appears at about 2.5 ns on all probes and represents an unfrozen/frozen boundary between 10 and 15 cm.

Oct 1986 Dry/frozen in the top 22.9 cm ( $K = 15.5$ ) and wet/unfrozen between 22.9 and 50.8 ( $K = 36$ ) and frozen beneath ( $K = 6$ ). The unfrozen/frozen boundary appears between 5.7 and 7.7 on the 3 longest probes and occurs between 40-45 cm.

May 1987 Essentially completely frozen although temperatures suggest otherwise. The surface material may be dry if the temperatures are correct. Feature appearing at 2.5 ns may be lithologic (eg peat).

Oct 1987 Similar to Oct 1986 but the unfrozen/frozen boundary occurs at different places on the 3 deepest probes but is probably in the order of 45-55 cm.



## Summary for 10B KC

Lithologic record from the temperature record indicates very thin permafrost (frozen peat) over unfrozen till.

	Cable T3			
	50 cm	100 cm	150 cm	200 cm
May 1985	1.7	-0.1	-0.1	0.1
Oct 1985	0.2	0.2	0.0	0.0
May 1986	7.3	-0.0	0.0	0.0
Oct 1986	0.0	0.2	0.0	0.0
May 1987	10.8	-0.0	0.0	-0.2
Oct 1987	0.8	2.4	1.2	0.2

Oct 1985 **K** in frozen zone is about 7.5. Features appear at 7.5 to 8.75 ns on the 3 longest probes. These are in the 50-65 cm zone and may be lithologic.

May 1986 Profile is essentially frozen (**K** = 5.4) except for a thin surface veneer (**K** = 16 in the top 25 cm).

Oct 1986 Top 25.4 cm dry (**K** = 14.0) followed by a wet layer (**K** = 48.5) between 25.4 and 53.4 cm. **K** is about 7 in the frozen portion of the soil. The features which appear on the 3 longest probes between 10.3 and 10.7 correspond to the 53 - 58 cm depth and this represents the base of the unfrozen layer.

May 1987 Similar to May 1986.

Oct 1987 Similar to Oct 1986. **K** in the top 23 cm is 18, followed by a wetter layer between 23 and 49 cm (**K** = 34.4) with **K** being about 8 in the frozen layer. A feature appearing at about 10.6 ns corresponds to the end of the 74.4 cm probe and may be the unfrozen/frozen boundary.

**NOTE** The temperature record does not seem to agree with the **K** record. Either the temperatures are wrong or this material has a very low water content in the unfrozen state. If the peat veneer is thin and contains water (but not saturated) then the apparent unfrozen/frozen boundaries may indeed be lithologic. This should be confirmed in the field.

### Summary for 10B KP

Lithologic record from the temperature record indicates very thin permafrost (frozen peat) over unfrozen till.

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.1	-0.2	0.0	0.0
Oct 1985	0.4	-0.0	0.3	0.5
May 1986	3.4	-0.1	0.2	0.4
Oct 1986	1.2	3.1	3.1	2.4
May 1987	1.7	0.0	0.5	0.6
Oct 1987	3.9	5.8	5.2	3.5

Oct 1985  $K = 25.0$  in the top 25 cm followed by a very wet layer ( $K = 64$ ) in the 25-87 cm layer; below 87 cm  $K = 10.5$ .

May 1986 Ground is completely thawed and very wet with  $K$  averaging 60 in the top 178 cm.

Oct 1986 Same as May 1986. Very wet and unfrozen.

May 1987 Very wet.

Oct 1987 Very wet.

### Summary for 11 KB

Temperature record indicates thin permafrost.

	Cable T4			
	50 cm	100 cm	150 cm	200 cm
May 1985	0.6	-0.4	-0.4	-0.4
Oct 1985	0.0	0.1	-0.1	-0.2
May 1986	2.0	-0.2	-0.1	-0.2
Oct 1986	0.1	0.2	0.1	-0.1
May 1987	4.6	-0.3	-0.1	-0.1
Oct 1987	1.5	2.2	1.5	1.0

Oct 1985 No distinct unfrozen/frozen boundaries but the **K** values decrease from 38 in the 0-25.4 cm zone to about 14 in the 133-178 cm zone. Thaw seems to have extended to somewhere between 60-80 cm.

May 1986 Profile is frozen (**K** = 8) except for the top 25 cm (**K** = 38.5). The feature noted on the longest 4 probes between 5.4 and 6 ns corresponds to a depth of 25-30 cm and reflects an unfrozen/frozen boundary.

Oct 1986 Layer analysis is complex and suggests incongruity between probes. The surface zone is wet (**K** = 37.3 and decreases to 19.6 at the 127-167 cm depth.

May 1987 Similar to May 1986.

Oct 1987 Profile appears to be completely thawed with **K** averaging about 28.9.

### Summary for 11 KC

Lithologic record from the temperature record indicates very thin permafrost (frozen peat) over unfrozen till.

	Cable T3			
	50 cm	100 cm	150 cm	200 cm
May 1985	2.7	-0.2	-0.2	-0.1
Oct 1985	0.9	2.0	2.2	2.0
May 1986	11.5	-0.0	0.1	0.1
Oct 1986	1.1	3.6	4.5	4.7
May 1987	10.4	-0.1	-0.0	0.1
Oct 1987	1.7	4.6	5.0	4.6

Oct 1985 Profile is very wet near the surface and grades to drier (frozen) values with depth. **K** in the top 25 cm is 37.3, decreasing to 9.7 in the 133-178 cm zone.

May 1986 Very wet in the top 25 cm (**K** = 43.7) and averaging 16 below. The features showing on the 4 longest probes correspond to the unfrozen/frozen boundary which is between 25-30 cm.

Oct 1986 The results are similar to Oct 1985, except it appears warmer/wetter.

May 1987 Similar to May 1986. **K** averages 14 in the frozen zone and the surface 25 cm is unfrozen with **K** = 44.5.

Oct 1987 Lack of agreement between probes giving scatter to the layer analysis. In general the same as all other October readings.

### Summary for 11 KP

The October 1985 reading showed that the profile was unfrozen. After this date the probes were buried while refilling the trench so no data is available.

**Summary for 12A KB**

The site is identified as a low ice content peat plateau. Peat thickness was not identified at all sites. The temperatures are generally unfrozen with periods of seasonal freezing. There is nothing distinguishing about this site. There is nothing other than seasonal wetting and drying to report.

**Summary for 12A KC**

Similar to 12A KB. Nothing significant to report other than the occasional wet/dry interface. There is seasonal freezing.

**Summary for 12A KP**

Similar to all the 12A sites.

### Summary for 12B KB

	Cable T3			
	50 cm	100 cm	150 cm	200 cm
May 1985	0.9	-0.1	-0.4	-0.3
Oct 1985	0.3	-0.1	-0.2	-0.1
May 1986	2.6	-0.3	-0.3	-0.2
Oct 1986	0.1	-0.1	-0.2	-0.2
May 1987	3.1	-0.3	-0.3	-0.2
Oct 1987	3.1	0.0	-0.2	-0.1

May 1985 Profile essentially frozen. Evidence of a thaw front at 2.8 ns on the 57 cm (5.83 ns) probe and at 3.33 ns on the 133 cm (11.17 ns) probe. No estimate possible.

Oct 1985 Top 25 cm dry/frozen ( $K = 6.8$ ) over a wetter layer between 25.4 and 57 cm ( $K = 25.2$ ). Below the material is frozen with  $K = 7.2$  on average. The feature which shows up on the 3 longest probes between 7 and 8 ns corresponds to a depth of about 50-65 cm and may reflect the unfrozen/frozen boundary.

May 1986 Similar to May 1985. The feature indicated on the longest probes is in the vicinity of 55-65 cm.  $K$  is about 7.8 in the frozen zone.

Oct 1986 Top 28 cm is dry/frozen ( $K = 6.7$ ) overlying a wet layer ( $K = 32$ ) between 28-58.5 cm).  $K$  averages about 6.5 below 58.5 cm. The feature which appears on the 3 longest probes corresponds to a depth of about 55-68 cm and represents the unfrozen/frozen boundary.

May 1987 Frozen  $K$  averages 5.7.

Oct 1987 Similar to other October readings. The feature which appears on the longest three probes between 9.17 and 9.42 ns is the unfrozen/frozen boundary with occurs near 60-65 cm depth.

### Summary for 12B KC

	Cable T3	
	100 cm	200 cm
May 1985	-1.2	-1.5
Oct 1985	-0.0	-0.1
May 1986	-0.6	-0.7
Oct 1986	-0.1	-0.2
May 1987	-0.7	-0.8
Oct 1987	-0.1	-0.2

May 1985 Frozen  $\mathbf{K} = 6$  on average.

Oct 1985  $\mathbf{K}$  averages about 7 in the frozen zone. The 3 longest probes show a feature at between 7-8 ns which is about 55-65 cm from the surface. Since the surface isn't remarkably wet, this may represent a change in lithography.

May 1986 Top 25 cm wetter than beneath ( $\mathbf{K} = 22.9$ ).  $\mathbf{K}$  tends to gradually decrease with depth averaging 7 in the top 25 cm to 6.7 between 25-178 cm.

Oct 1986 Similar to Oct 1985.

May 1987 Similar to May 1986

Oct 1987 Similar to other October readings.

### Summary for 12B KP

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.2	-0.8	-1.0	-1.3
Oct 1985	0.2	-0.1	-0.2	-0.2
May 1986	0.9	-0.2	-0.3	-0.4
Oct 1986	0.1	0.0	-0.0	-0.1
May 1987	3.1	-0.1	-0.1	-0.2
Oct 1987	4.2	2.3	0.6	-0.1

May 1985 Frozen **K** averages 4.8

Oct 1985 Frozen in the 122-167.7 cm layer **K** = 7.6. The 57 and 122 cm probes don't seem right.

May 1986 Profile essentially frozen, **K** averaging about 6.5. Some surface thaw in the top 25 cm evident **K** = 16.

Oct 1986 Profile seems to have completely thawed with **K** averaging 44.3 in the 25.4-170.2 cm layer. Freeze back/dry layer in the top 25 cm with **K** = 10.6.

May 1987 Very complex layer analysis. Either the probes lack congruity or there is a sequence of differing degrees of wetness. The profile seems to be generally unfrozen with dry/frozen pockets.

Oct 1987 Thawed and wet with a surface dry/frozen layer extending to about 24.5 cm.



### Summary for 13A

Thin frozen terrain surrounding fen.

	Cable T1	
	100 cm	200 cm
May 1985	-0.3	-0.3
Oct 1985	-0.1	-0.2
May 1986	-0.2	-0.2
Oct 1986	0.1	-0.2
May 1987	-0.2	-0.2
Oct 1987	0.6	-0.2

### Summary for 13B

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.2	-0.8	-1.0	-1.3
Oct 1985	0.2	-0.1	-0.2	-0.2
May 1986	0.9	-0.2	-0.3	-0.4
Oct 1986	0.1	0.0	-0.0	-0.1
May 1987	3.1	-0.1	-0.1	-0.2
Oct 1987	4.2	2.3	0.6	-0.1

### Summary for 13C

	Cable T1			
	50 cm	100 cm	150 cm	200 cm
May 1985	-0.2	-0.8	-1.0	-1.3
Oct 1985	0.2	-0.1	-0.2	-0.2
May 1986	0.9	-0.2	-0.3	-0.4
Oct 1986	0.1	0.0	-0.0	-0.1
May 1987	3.1	-0.1	-0.1	-0.2
Oct 1987	4.2	2.3	0.6	-0.1

K Data for Norman Wells to Zama Pipeline Route Site 84-1

Depth Range (cm)	Oct 85			May 86			Oct 86			May 87			Oct 87		
	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)	Ka	tt	
.00	25.00	6.78	2.17	.00	25.00	10.27	2.67	.00	25.40	4.27	1.75	.00	24.50	6.00	
.00	57.00	17.38	7.92	.00	57.00	6.90	4.99	.00	53.40	14.04	6.67	.00	51.00	6.02	
.00	87.00	9.63	9.00	.00	87.00	5.81	6.99	.00	81.20	7.84	7.58	.00	78.40	5.13	
.00	133.00	7.74	12.33	.00	133.00	6.15	10.99	.00	127.00	7.93	11.92	.00	128.20	6.04	
.00	178.00	7.12	15.83	.00	178.00	6.38	14.99	.00	172.70	7.25	15.50	.00	170.90	6.33	
25.00	57.00	29.06		25.00	57.00	4.73		25.40	53.40	27.79		24.50	51.00	6.03	
25.00	87.00	10.92		25.00	87.00	4.37		25.40	81.20	9.82		24.50	78.40	4.76	
25.00	133.00	7.96		25.00	133.00	5.34		25.40	127.00	9.02		24.50	128.20	6.05	
25.00	178.00	7.17		25.00	178.00	5.84		25.40	172.70	7.84		24.50	170.90	6.38	
57.00	87.00	1.17		57.00	87.00	4.00		53.40	81.20	.96		51.00	78.40	3.67	
57.00	133.00	3.03		57.00	133.00	5.61		53.40	127.00	4.58		51.00	128.20	6.05	
57.00	178.00	3.85		57.00	178.00	6.15		53.40	172.70	4.93		51.00	170.90	6.46	
87.00	133.00	4.72		87.00	133.00	6.81		81.20	127.00	8.08		78.40	128.20	7.61	
87.00	178.00	5.07		87.00	178.00	6.96		81.20	172.70	6.74		78.40	170.90	7.44	
133.00	178.00	5.44		133.00	178.00	7.11		127.00	172.70	5.52		128.20	170.90	7.24	

Depth Range (cm)	Oct 85			May 86			Oct 86			May 87			Oct 87		
	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)	Ka	tt	
.00	25.00	41.53	5.37	.00	25.00	64.06	6.67	.00	25.40	8.17	2.42	.00	21.50	66.18	
.00	57.00	46.74	12.99	.00	57.00	27.70	10.00	.00	53.40	28.01	9.42	.00	53.00	30.96	
.00	87.00	42.16	18.83	.00	87.00	24.42	14.33	.00	81.20	28.70	14.50	.00	76.40	25.38	
.00	133.00	31.77	24.99	.00	133.00	17.09	18.33	.00	124.50	25.19	20.83	.00	124.20	20.34	
.00	178.00	24.17	29.17	.00	178.00	15.46	23.33	.00	167.70	18.94	24.33	.00	166.90	16.60	
25.00	57.00	51.03		25.00	57.00	9.75		25.40	53.40	56.25		21.50	53.00	14.51	
25.00	87.00	42.42		25.00	87.00	13.74		25.40	81.20	42.18		21.50	76.40	14.63	
25.00	133.00	29.70		25.00	133.00	10.49		25.40	124.50	31.06		21.50	124.20	14.07	
25.00	178.00	21.78		25.00	178.00	10.67		25.40	167.70	21.34		21.50	166.90	12.07	
57.00	87.00	34.11		57.00	87.00	18.75		53.40	81.20	30.05		53.00	76.40	14.79	
57.00	133.00	22.44		57.00	133.00	10.81		53.40	124.50	23.18		53.00	124.20	13.87	
57.00	178.00	16.09		57.00	178.00	10.92		53.40	167.70	15.31		53.00	166.90	11.44	
87.00	133.00	16.14		87.00	133.00	6.81		81.20	124.50	19.23		76.40	124.20	13.43	
87.00	178.00	11.62		87.00	178.00	8.80		81.20	167.70	11.62		76.40	166.90	10.64	
133.00	178.00	7.77		133.00	178.00	11.11		124.50	167.70	5.91		124.20	166.90	7.90	

Depth Range (cm)	May 86			Oct 86			May 87			Oct 87									
	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)							
.00	25.00	40.91	5.33	.00	25.00	44.84	5.58	.00	25.40	6.04	2.08	.00	21.50	60.62	5.58	.00	30.50	14.19	3.83
.00	57.00	46.24	12.92	.00	57.00	29.10	10.25	.00	55.90	22.46	8.83	.00	51.00	34.60	10.00	.00	53.00	33.14	10.17
.00	87.00	42.16	18.83	.00	87.00	25.00	14.50	.00	78.70	23.92	12.83	.00	76.40	27.73	13.41	.00	85.40	30.30	15.67
.00	133.00	29.28	23.99	.00	133.00	.00	.00	.00	127.00	.00	.00	.00	119.20	17.60	16.67	.00	111.20	.00	.00
.00	178.00	25.55	29.99	.00	178.00	8.87	17.67	.00	170.20	22.10	26.67	.00	164.90	14.60	21.00	.00	152.90	.00	.00
25.00	57.00	50.53		25.00	57.00	19.17		25.40	55.90	44.08		21.50	51.00	20.20	30.50	53.00	71.46		
25.00	87.00	42.67		25.00	87.00	18.63		25.40	78.70	36.61		21.50	76.40	18.31	30.50	85.40	41.86		
25.00	133.00	26.87		25.00	133.00	.00		25.40	127.00	.00		21.50	119.20	11.60	30.50	111.20	.00		
25.00	178.00	23.38		25.00	178.00	5.62		25.40	170.20	25.96		21.50	164.90	10.41	30.50	152.90	.00		
57.00	87.00	34.93		57.00	87.00	18.06		55.90	78.70	27.70		51.00	76.40	16.22	53.00	85.40	25.93		
57.00	133.00	19.09		57.00	133.00	.00		55.90	127.00	.00		51.00	119.20	8.61	53.00	111.20	.00		
57.00	178.00	17.91		57.00	178.00	3.38		55.90	170.20	21.93		51.00	164.90	8.39	53.00	152.90	.00		
87.00	133.00	11.32		87.00	133.00	.00		78.70	127.00	.00		76.40	119.20	5.22	85.40	111.20	.00		
87.00	178.00	13.54		87.00	178.00	1.09		78.70	170.20	20.59		76.40	164.90	6.62	85.40	152.90	.00		
133.00	178.00	16.00		133.00	178.00	.00		127.00	170.20	.00		119.20	164.90	8.08	111.20	152.90	.00		

K Data for Norman Wells to Zama Pipeline Route Site 84-2A

Depth Range (cm)	May 86			Oct 86			May 87			Oct 87									
	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)	Ka	tt	Depth Range (cm)							
.00	25.00	7.82	2.33	.00	25.00	9.88	2.62	.00	20.30	6.69	1.75	.00	20.50	8.57	2.00	.00	20.50	8.57	2.00
.00	57.00	9.71	5.92	.00	57.00	6.93	5.00	.00	48.30	9.64	5.00	.00	47.00	12.32	5.50	.00	46.00	11.72	5.25
.00	87.00	11.89	10.00	.00	87.00	8.25	8.33	.00	78.70	12.22	9.17	.00	78.40	9.97	8.25	.00	76.40	14.15	9.58
.00	133.00	14.70	17.00	.00	133.00	8.17	12.67	.00	124.50	14.26	15.67	.00	127.20	5.20	9.67	.00	125.20	15.96	16.67
.00	152.40	11.87	17.50	.00	152.40	7.96	14.33	.00	152.40	10.33	16.33	.00	143.90	9.35	14.67	.00	141.90	16.14	19.00
25.00	57.00	11.33		25.00	57.00	4.98		20.30	48.30	12.13		20.50	47.00	15.70	20.50	46.00	14.62		
25.00	87.00	13.77		25.00	87.00	7.63		20.30	78.70	14.53		20.50	78.40	10.49	20.50	76.40	16.55		
25.00	133.00	16.61		25.00	133.00	7.79		20.30	124.50	16.06		20.50	127.20	4.65	20.50	125.20	17.67		
25.00	152.40	12.76		25.00	152.40	7.60		20.30	152.40	10.96		20.50	143.90	9.49	20.50	141.90	17.65		
57.00	87.00	16.65		57.00	87.00	11.09		48.30	78.70	16.93		47.00	78.40	6.90	46.00	76.40	18.26		
57.00	133.00	19.13		57.00	133.00	9.17		48.30	124.50	17.65		47.00	127.20	2.43	46.00	125.20	18.71		
57.00	152.40	13.26		57.00	152.40	8.61		48.30	152.40	10.66		47.00	143.90	8.06	46.00	141.90	18.50		
87.00	133.00	20.84		87.00	133.00	8.01		78.70	124.50	18.13		76.40	127.20	.76	76.40	125.20	19.00		
87.00	152.40	11.84		87.00	152.40	7.58		78.70	152.40	8.49		76.40	143.90	8.65	76.40	141.90	18.61		
133.00	152.40	.60		133.00	152.40	6.59		124.50	152.40	.50		127.20	143.90	80.68	125.20	141.90	17.52		

Oct 85				May 86				Oct 86				May 87				Oct 87			
Depth	Range	Ka	tt	Depth	Range	Ka	tt	Depth	Range	Ka	tt	Depth	Range	Ka	tt	Depth	Range	Ka	tt
(cm)				(cm)				(cm)				(cm)				(cm)			
.00	25.00	10.27	2.67	.00	25.00	30.21	4.58	.00	28.00	4.97	2.08	.00	25.50	24.07	4.17	.00	25.50	7.51	2.33
.00	57.00	10.24	6.08	.00	57.00	15.58	7.50	.00	53.40	7.89	5.00	.00	53.00	6.23	4.41	.00	54.00	9.92	5.67
.00	87.00	11.49	9.83	.00	87.00	11.12	9.67	.00	83.40	9.35	8.50	.00	83.40	10.88	9.17	.00	81.40	10.59	8.83
.00	133.00	14.14	16.67	.00	133.00	10.70	14.50	.00	127.00	.00	.00	.00	129.20	10.83	14.17	.00	128.20	12.04	14.83
.00	178.00	14.38	22.50	.00	178.00	9.54	16.33	.00	175.30	11.70	19.99	.00	174.90	9.89	18.33	.00	173.90	13.54	21.33
25.00	57.00	10.22		25.00	57.00	7.49		28.00	53.40	11.89		25.50	53.00	.07		25.50	54.00	12.36	
25.00	87.00	12.00		25.00	87.00	6.07		28.00	83.40	12.09		25.50	83.40	6.71		25.50	81.40	12.17	
25.00	133.00	15.12		25.00	133.00	7.59		28.00	127.00	.40		25.50	129.20	8.37		25.50	128.20	13.33	
25.00	178.00	15.12		25.00	178.00	7.27		28.00	175.30	13.31		25.50	174.90	8.08		25.50	173.90	14.75	
57.00	87.00	14.06		57.00	87.00	4.71		53.40	83.40	12.25		53.00	83.40	22.07		54.00	81.40	11.97	
57.00	133.00	17.47		57.00	133.00	7.64		53.40	127.00	4.15		53.00	129.20	14.76		54.00	128.20	13.72	
57.00	178.00	16.57		57.00	178.00	7.21		53.40	175.30	13.61		53.00	174.90	11.74		54.00	173.90	15.35	
87.00	133.00	19.90		87.00	133.00	9.92		83.40	127.00	34.21		83.40	129.20	10.73		81.40	128.20	14.79	
87.00	178.00	17.45		87.00	178.00	8.15		83.40	175.30	14.07		83.40	174.90	9.02		81.40	173.90	16.44	
133.00	178.00	15.11		133.00	178.00	6.52		127.00	175.30	154.16		129.20	174.90	7.46		128.20	173.90	18.21	

Oct 85				May 86				Oct 86				May 87				Oct 87			
Depth	Range	Ka	tt	Depth	Range	Ka	tt	Depth	Range	Ka	tt	Depth	Range	Ka	tt	Depth	Range	Ka	tt
(cm)				(cm)				(cm)				(cm)				(cm)			
.00	25.00	12.28	2.92	.00	25.00	29.16	4.50	.00	25.40	4.88	1.87	.00	24.50	23.04	3.92	.00	23.40	9.63	2.42
.00	57.00	10.24	6.08	.00	57.00	21.21	8.75	.00	55.90	6.04	4.58	.00	53.00	23.15	8.50	.00	52.00	10.36	5.58
.00	87.00	12.69	10.33	.00	87.00	16.19	11.67	.00	83.80	8.89	8.33	.00	77.40	20.74	11.75	.00	77.40	13.79	9.58
.00	133.00	13.01	15.99	.00	133.00	12.75	15.83	.00	129.60	10.50	14.00	.00	132.20	14.88	17.00	.00	128.20	11.78	14.67
.00	178.00	.00	.00	.00	178.00	14.16	22.33	.00	175.30	.00	.00	.00	171.90	15.42	22.50	.00	169.90	.00	.00
25.00	57.00	8.78		25.00	57.00	15.88		25.40	55.90	7.11		24.50	53.00	23.24		23.40	52.00	10.99	
25.00	87.00	12.86		25.00	87.00	12.04		25.40	83.80	11.01		24.50	77.40	19.72		23.40	77.40	15.82	
25.00	133.00	13.18		25.00	133.00	9.91		25.40	129.60	12.20		24.50	132.20	13.27		23.40	128.20	12.30	
25.00	178.00	.00		25.00	178.00	12.22		25.40	175.30	.00		24.50	171.90	14.30		23.40	169.90	.00	
57.00	87.00	18.06		57.00	87.00	8.53		55.90	83.80	16.26		53.00	77.40	15.97		52.00	77.40	22.32	
57.00	133.00	15.30		57.00	133.00	7.81		55.90	129.60	14.70		53.00	132.20	10.37		52.00	128.20	12.81	
57.00	178.00	.00		57.00	178.00	11.34		57.00	175.30	.00		53.00	171.90	12.48		52.00	169.90	.00	
87.00	133.00	13.63		87.00	133.00	7.36		83.80	129.60	13.79		77.40	132.20	8.26		77.40	128.20	9.04	
87.00	178.00	.00		87.00	178.00	12.35		83.80	175.30	.00		77.40	171.90	11.65		77.40	169.90	.00	
133.00	178.00	.00		133.00	178.00	18.78		129.60	175.30	.00		132.20	171.90	17.27		128.20	169.90	.00	

K Data for Morosan Wells to Zama Pipeline Route Site 84-2B

	May 85			Oct 85			May 86			Oct 86						
	Depth Range CM	Ka	tt (ns)	Depth Range CM	Ka		Depth Range CM	Ka		Depth Range CM	Ka					
<b>KB</b>	.00	25.00	8.93	2.49	.00	25.00	9.00	2.50	.00	25.00	6.78	2.17	.00	28.00	5.81	2.25
	.00	57.00	.00	.00	.00	57.00	8.14	5.42	.00	57.00	6.46	4.83	.00	53.90	7.74	5.00
	.00	87.00	7.76	8.08	.00	13.95	10.83	10.83	.00	87.00	8.25	8.33	.00	88.90	11.00	9.83
	.00	133.00	.00	.00	.00	133.00	10.95	14.67	.00	133.00	7.31	11.99	.00	127.00	9.92	13.33
	.00	178.00	7.89	16.67	.00	178.00	11.74	20.33	.00	178.00	8.53	17.33	.00	180.40	9.29	18.33
	25.00	57.00	.00	25.00	57.00	7.49			25.00	57.00	6.22		28.00	53.90	10.15	
	25.00	87.00	7.32	25.00	87.00	16.25			25.00	87.00	8.88		28.00	88.90	13.94	
	25.00	133.00	.00	25.00	133.00	11.43			25.00	133.00	7.44		28.00	127.00	11.27	
	25.00	178.00	7.73	25.00	178.00	12.22			25.00	178.00	8.84		28.00	180.40	10.02	
	57.00	87.00	.00	57.00	87.00	29.27			57.00	87.00	12.25		53.90	88.90	17.14	
	57.00	133.00	.00	57.00	133.00	13.33			57.00	133.00	7.99		53.90	127.00	11.69	
	57.00	178.00	.00	57.00	178.00	13.67			57.00	178.00	9.60		53.90	180.40	9.99	
	87.00	133.00	.00	87.00	133.00	6.27			87.00	133.00	5.70		88.90	127.00	7.60	
	87.00	178.00	8.02	87.00	178.00	9.81			87.00	178.00	8.80		88.90	180.40	7.77	
	133.00	178.00	.00	133.00	178.00	14.24			133.00	178.00	12.67		127.00	180.40	7.89	
<b>MC</b>	.00	25.00	.00	.00	.00	25.00	.00	.00	.00	25.00	.00	.00	.00	25.00	.00	.00
	.00	57.00	.00	.00	.00	57.00	11.10	6.33	.00	57.00	8.91	5.67	.00	48.30	12.18	5.62
	.00	87.00	9.61	8.99	.00	87.00	16.19	11.67	.00	87.00	11.12	9.67	.00	88.90	11.66	10.12
	.00	132.10	.00	.00	.00	133.00	9.04	13.33	.00	133.00	10.45	14.33	.00	124.50	18.13	17.67
	.00	178.00	7.57	16.33	.00	178.00	15.46	23.33	.00	178.00	11.74	20.33	.00	178.00	12.92	21.33
	25.00	57.00	.00	25.00	57.00	.00			25.00	57.00	.00		25.00	48.30	.00	
	25.00	87.00	.00	25.00	87.00	.00			25.00	87.00	.00		25.00	88.90	22.57	
	25.00	132.10	.00	25.00	133.00	.00			25.00	133.00	.00		25.00	124.50	28.38	
	25.00	178.00	.00	25.00	178.00	.00			25.00	178.00	.00		25.00	178.00	17.49	
	57.00	87.00	.00	57.00	87.00	28.52			57.00	87.00	16.00		48.30	88.90	11.06	
	57.00	132.10	.00	57.00	133.00	7.64			57.00	133.00	11.69		48.30	124.50	22.51	
	57.00	178.00	.00	57.00	178.00	17.77			57.00	178.00	13.21		48.30	178.00	13.20	
	87.00	132.10	.00	87.00	133.00	1.17			87.00	133.00	9.24		88.90	124.50	40.48	
	87.00	178.00	5.86	87.00	178.00	14.78			87.00	178.00	12.35		88.90	178.00	14.25	
	132.10	178.00	.00	133.00	178.00	44.44			133.00	178.00	16.00		124.50	178.00	4.21	

Ka	May 87		Oct 87		May 87		Oct 87		May 87		Oct 87	
	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
	cm		cm		cm		cm		cm		cm	
.00	25.00	.00	.00	25.00	.00	.00	25.40	.00	25.40	.00	.00	.00
.00	57.00	.00	.00	57.00	11.70	5.83	57.00	9.42	55.90	8.46	5.42	.00
.00	87.00	10.00	9.17	87.00	13.11	10.50	87.00	11.87	88.90	10.28	9.50	.00
.00	139.00	.00	.00	133.00	.00	.00	133.00	8.59	124.50	10.07	13.17	.00
.00	178.00	7.57	16.33	178.00	8.50	17.30	178.00	8.87	167.70	9.25	17.00	.00
25.00	57.00	.00	25.00	57.00	.00	25.00	57.00	.00	55.90	.00	.00	.00
25.00	87.00	.00	25.00	87.00	.00	25.00	87.00	.00	88.90	.00	.00	.00
25.00	139.00	.00	25.00	133.00	.00	25.00	133.00	.00	124.50	.00	.00	.00
25.00	178.00	.00	25.00	178.00	.00	25.00	178.00	.00	167.70	.00	.00	.00
57.00	87.00	.00	57.00	87.00	16.00	17.31	87.00	17.31	88.90	13.76	.00	.00
57.00	139.00	.00	57.00	133.00	.00	57.00	133.00	7.99	124.50	11.49	.00	.00
57.00	178.00	.00	57.00	178.00	7.17	8.62	178.00	8.62	167.70	9.66	.00	.00
87.00	139.00	.00	87.00	133.00	.00	87.00	133.00	3.83	124.50	9.56	.00	.00
87.00	178.00	5.57	87.00	178.00	5.03	6.41	178.00	6.41	167.70	8.15	.00	.00
139.00	178.00	.00	133.00	178.00	.00	133.00	178.00	9.73	167.70	7.07	.00	.00

Ka	May 87		Oct 87		May 87		Oct 87		May 87		Oct 87	
	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
	cm		cm		cm		cm		cm		cm	
.00	26.50	8.53	2.58	26.50	6.72	2.29	26.50	.00	25.50	.00	.00	.00
.00	51.00	7.81	4.75	52.00	10.36	5.58	51.00	4.83	48.00	12.92	5.75	.00
.00	88.40	7.69	8.17	87.40	12.99	10.50	88.40	9.17	85.40	13.81	10.58	.00
.00	127.20	7.58	11.67	127.20	13.66	15.67	127.20	12.83	121.20	9.57	12.50	.00
.00	178.90	7.35	16.17	178.90	11.25	20.00	178.90	19.33	179.90	12.50	21.20	.00
26.50	51.00	7.06	26.50	52.00	14.98	.00	51.00	25.50	48.00	.00	24.50	51.00
26.50	88.40	7.34	26.50	87.40	16.36	.00	88.40	25.50	85.40	.00	24.50	88.40
26.50	127.20	7.33	26.50	127.20	15.89	.00	127.20	25.50	121.20	.00	24.50	125.20
26.50	178.90	7.16	26.50	178.90	12.15	.00	178.90	25.50	179.90	.00	24.50	169.90
51.00	88.40	7.53	52.00	87.40	17.38	.00	88.40	48.00	85.40	15.01	6.43	.00
51.00	127.20	7.42	52.00	127.20	16.20	9.42	127.20	48.00	121.20	7.65	51.00	125.20
51.00	178.90	7.18	52.00	178.90	11.62	10.71	178.90	48.00	179.90	12.35	51.00	169.90
88.40	127.20	7.32	87.40	127.20	15.19	7.61	127.20	85.40	121.20	2.59	88.40	125.20
88.40	178.90	7.03	87.40	178.90	9.70	10.40	178.90	85.40	179.90	11.37	88.40	169.90
127.20	178.90	6.82	127.20	178.90	6.31	12.71	178.90	121.20	179.90	19.77	125.20	169.90

RP

KC

KB

K Data for Korman Wells to Zama Pipeline Route Site 84-2C

	May 85			Oct 85			May 86			Oct 86						
	Depth	Ka	tt (ns)	Depth	Ka		Depth	Ka		Depth	Ka					
	CM			CM			CM			CM						
K8	.00	25.00	12.96	3.00	.00	25.00	17.64	3.50	.00	25.00	11.53	2.83	.00	28.00	7.64	2.58
	.00	57.00	.00	.00	.00	57.00	8.38	5.50	.00	57.00	5.81	4.58	.00	53.40	6.88	4.67
	.00	87.00	7.59	7.99	.00	87.00	15.26	11.33	.00	87.00	7.94	8.17	.00	88.90	11.00	9.83
	.00	133.00	.00	.00	.00	133.00	9.27	13.50	.00	133.00	6.15	10.99	.00	129.60	7.94	12.17
	.00	148.00	6.93	12.99	.00	148.00	13.81	16.33	.00	148.00	7.48	13.49	.00	137.90	11.61	15.66
	25.00	57.00	.00	25.00	57.00	3.52			25.00	57.00	2.69		28.00	53.40	6.09	
	25.00	87.00	5.83	25.00	87.00	14.35			25.00	87.00	6.68		28.00	88.90	12.76	
	25.00	133.00	.00	25.00	133.00	7.72			25.00	133.00	5.14		28.00	129.60	8.02	
	25.00	148.00	5.94	25.00	148.00	13.08			25.00	148.00	6.76		28.00	137.90	12.75	
	57.00	87.00	.00	57.00	87.00	33.99			57.00	87.00	12.89		53.40	88.90	19.01	
	57.00	133.00	.00	57.00	133.00	9.97			57.00	133.00	6.40		53.40	129.60	8.72	
	57.00	148.00	.00	57.00	148.00	17.89			57.00	148.00	8.63		53.40	137.90	15.22	
	87.00	133.00	.00	87.00	133.00	2.00			87.00	133.00	3.38		88.90	129.60	2.97	
	87.00	148.00	6.05	87.00	148.00	11.85			87.00	148.00	6.85		88.90	137.90	12.74	
	133.00	148.00	.00	133.00	148.00	93.32			133.00	148.00	25.00		129.60	137.90	159.12	
KC	.00	25.00	40.91	5.33	.00	25.00	16.84	3.42	.00	25.00	40.91	5.33	.00	28.00	8.18	2.67
	.00	57.00	.00	.00	.00	57.00	10.11	6.04	.00	57.00	22.39	8.99	.00	53.40	8.44	5.17
	.00	87.00	17.09	11.99	.00	87.00	13.11	10.50	.00	87.00	19.09	12.67	.00	88.90	9.91	9.33
	.00	132.10	.00	.00	.00	133.00	11.91	15.30	.00	133.00	16.47	17.99	.00	127.00	11.46	14.33
	.00	178.00	.00	.00	.00	178.00	21.48	27.50	.00	178.00	18.72	25.67	.00	180.40	17.74	25.33
	25.00	57.00	.00	25.00	57.00	6.03			25.00	57.00	11.77		28.00	53.40	8.72	
	25.00	87.00	10.39	25.00	87.00	11.74			25.00	87.00	12.61		28.00	88.90	10.76	
	25.00	132.10	.00	25.00	133.00	10.89			25.00	133.00	12.37		28.00	127.00	12.48	
	25.00	178.00	.00	25.00	178.00	22.29			25.00	178.00	15.91		28.00	180.40	19.90	
	57.00	87.00	.00	57.00	87.00	19.89			57.00	87.00	13.54		53.40	88.90	12.36	
	57.00	132.10	.00	57.00	133.00	13.36			57.00	133.00	12.62		53.40	127.00	13.94	
	57.00	178.00	.00	57.00	178.00	28.31			57.00	178.00	17.10		53.40	180.40	22.68	
	87.00	132.10	.00	87.00	133.00	9.80			87.00	133.00	12.04		88.90	127.00	15.50	
	87.00	178.00	.00	87.00	178.00	31.41			87.00	178.00	18.37		88.90	180.40	27.52	
	132.10	178.00	.00	133.00	178.00	66.15			133.00	178.00	26.21		127.00	180.40	36.19	

MP	May 87			Oct 87			May 87			Oct 87					
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka			
.00	25.00	17.64	3.50	.00	25.00	7.82	2.33	.00	25.00	17.54	3.49	.00	28.00	4.97	2.08
.00	57.00	.00	.00	.00	57.00	10.55	6.17	.00	57.00	18.49	8.17	.00	53.40	8.97	5.33
.00	87.00	13.95	10.83	.00	87.00	12.30	10.17	.00	87.00	14.84	11.17	.00	83.80	9.63	8.67
.00	139.00	.00	.00	.00	133.00	10.45	14.33	.00	133.00	12.49	15.67	.00	127.00	10.94	14.00
.00	178.00	.00	.00	.00	178.00	15.91	23.67	.00	178.00	12.92	21.33	.00	175.30	13.75	21.67
25.00	57.00	.00	.00	25.00	57.00	12.96		25.00	57.00	19.25		28.00	53.40	14.73	
25.00	87.00	12.58		25.00	87.00	14.39		25.00	87.00	13.81		28.00	83.80	12.55	
25.00	139.00	.00	.00	25.00	133.00	11.11		25.00	133.00	11.45		28.00	127.00	13.05	
25.00	178.00	.00	.00	25.00	178.00	17.51		25.00	178.00	12.24		28.00	175.30	15.92	
57.00	87.00	.00	.00	57.00	87.00	16.00		57.00	87.00	9.00		53.40	83.80	10.86	
57.00	139.00	.00	.00	57.00	133.00	10.38		57.00	133.00	8.76		53.40	127.00	12.49	
57.00	178.00	.00	.00	57.00	178.00	18.83		57.00	178.00	10.65		53.40	175.30	16.17	
87.00	139.00	.00	.00	87.00	133.00	7.36		87.00	133.00	8.61		83.80	127.00	13.70	
87.00	178.00	.00	.00	87.00	178.00	19.81		87.00	178.00	11.22		83.80	175.30	18.17	
139.00	178.00	.00	.00	133.00	178.00	38.77		133.00	178.00	14.24		127.00	175.30	22.70	

MB	May 87			Oct 87			May 87			Oct 87					
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka			
.00	25.50	13.13	3.08	.00	25.50	12.46	3.00	.00	25.50	35.72	5.08	.00	25.50	11.40	2.87
.00	49.00	8.00	4.62	.00	48.00	9.46	4.92	.00	52.00	27.44	9.08	.00	52.00	10.07	5.50
.00	87.40	8.18	8.33	.00	86.40	13.50	10.58	.00	88.40	17.77	12.42	.00	87.40	10.81	9.58
.00	124.20	6.64	10.67	.00	120.20	10.53	13.00	.00	127.20	17.37	17.67	.00	127.20	13.36	15.50
.00	144.40	7.67	13.33	.00	141.40	15.07	18.30	.00	178.90	18.76	25.83	.00	178.90	14.47	21.67
25.50	49.00	3.86		25.50	48.00	6.55		25.50	52.00	20.51		25.50	52.00	8.86	
25.50	87.40	6.47		25.50	86.40	13.94		25.50	88.40	12.26		25.50	87.40	17.56	
25.50	124.20	5.32		25.50	120.20	10.04		25.50	127.20	13.79		25.50	127.20	13.88	
25.50	144.40	6.69		25.50	141.40	15.68		25.50	178.90	16.47		25.50	178.90	14.25	
49.00	87.40	8.40		48.00	86.40	19.55		52.00	88.40	7.58		52.00	87.40	11.37	
49.00	124.20	5.83		48.00	120.20	11.27		52.00	127.20	11.74		52.00	127.20	11.36	
49.00	144.40	7.50		48.00	141.40	18.47		52.00	178.90	15.68		52.00	178.90	25.05	
87.40	124.20	3.64		86.40	120.20	4.61		88.40	127.20	16.48		87.40	127.20	11.36	
87.40	144.40	6.93		86.40	141.40	17.73		88.40	178.90	19.76		87.40	178.90	31.40	
124.20	144.40	15.61		120.20	141.40	56.25		127.20	178.90	22.42		127.20	178.90	42.01	

MP	May 87			Oct 87			May 87			Oct 87					
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka			
.00	26.50	6.49	2.25	.00	26.50	6.49	2.25	.00	26.50	15.70	3.50	.00	26.50	6.49	2.25
.00	51.00	11.44	5.75	.00	51.00	11.44	5.75	.00	51.00	20.36	7.67	.00	51.00	11.44	5.75
.00	79.40	12.00	9.17	.00	79.40	12.00	9.17	.00	78.40	16.32	10.75	.00	79.40	12.00	9.17
.00	122.20	12.81	14.58	.00	122.20	12.81	14.58	.00	122.20	14.80	15.67	.00	122.20	12.81	14.58
.00	170.90	14.91	22.00	.00	170.90	14.91	22.00	.00	170.90	14.47	21.67	.00	170.90	14.91	22.00
26.50	51.00	18.37		26.50	51.00	26.07		26.50	51.00	26.07		26.50	51.00	18.37	
26.50	79.40	15.40		26.50	78.40	17.56		26.50	78.40	17.56		26.50	79.40	15.40	
26.50	122.20	14.94		26.50	122.20	14.55		26.50	122.20	14.55		26.50	122.20	14.94	
26.50	170.90	16.84		26.50	170.90	14.25		26.50	170.90	14.25		26.50	170.90	16.84	
51.00	79.40	13.05		51.00	78.40	11.37		51.00	78.40	11.37		51.00	79.40	13.05	
51.00	122.20	13.84		51.00	122.20	11.36		51.00	122.20	11.36		51.00	122.20	13.84	
51.00	170.90	16.53		51.00	170.90	12.27		51.00	170.90	12.27		51.00	170.90	16.53	
79.40	122.20	14.38		78.40	122.20	11.36		78.40	122.20	11.36		79.40	122.20	14.38	
79.40	170.90	17.70		79.40	170.90	12.54		79.40	170.90	12.54		79.40	170.90	17.70	
122.20	170.90	20.89		122.20	170.90	13.66		122.20	170.90	13.66		122.20	170.90	20.89	



K Data for Mounsa Wells to Zama Pipeline Route Site 84-3A

May 85				Oct 85				May 86				Oct 86			
Depth	Range	Ka	tt (ns)	Depth	Range	Ka		Depth	Range	Ka		Depth	Range	Ka	
CM				CM				CM				CM			
.00	25.00	11.54	2.83	.00	25.00	17.93	3.53	.00	25.00	14.31	3.15	.00	22.50	12.64	2.67
.00	57.00	.00	.00	.00	57.00	.00	.00	.00	57.00	7.62	5.24	.00	44.30	7.96	4.17
.00	87.00	5.93	7.06	.00	87.00	10.85	9.55	.00	87.00	6.74	7.53	.00	71.80	8.96	7.16
.00	133.00	.00	.00	.00	133.00	.00	.00	.00	133.00	.00	.00	.00	133.00	.00	.00
.00	178.00	.00	.00	.00	178.00	.00	.00	.00	178.00	.00	.00	.00	178.00	.00	.00
25.00	57.00	.00	.00	25.00	57.00	.00	.00	25.00	57.00	3.85	22.50	44.30	4.26	.00	.00
25.00	87.00	4.19	.00	25.00	87.00	8.50	.00	25.00	87.00	4.48	22.50	71.80	7.49	.00	.00
25.00	133.00	.00	.00	25.00	133.00	.00	.00	25.00	133.00	.00	22.50	133.00	.00	.00	.00
25.00	178.00	.00	.00	25.00	178.00	.00	.00	25.00	178.00	.00	22.50	178.00	.00	.00	.00
57.00	87.00	.00	.00	57.00	87.00	.00	.00	57.00	87.00	5.22	44.30	71.80	10.70	.00	.00
57.00	133.00	.00	.00	57.00	133.00	.00	.00	57.00	133.00	.00	44.30	133.00	.00	.00	.00
57.00	178.00	.00	.00	57.00	178.00	.00	.00	57.00	178.00	.00	44.30	178.00	.00	.00	.00
87.00	133.00	.00	.00	87.00	133.00	.00	.00	87.00	133.00	.00	71.80	133.00	.00	.00	.00
87.00	178.00	.00	.00	87.00	178.00	.00	.00	87.00	178.00	.00	71.80	178.00	.00	.00	.00
133.00	178.00	.00	.00	133.00	178.00	.00	.00	133.00	178.00	.00	133.00	178.00	.00	.00	.00
.00	25.00	.00	.00	.00	25.00	51.83	6.00	.00	25.00	34.80	4.92	.00	25.00	.00	.00
.00	57.00	.00	.00	.00	57.00	.78	.00	.00	47.00	18.33	6.71	.00	49.40	11.25	5.52
.00	87.00	3.52	5.44	.00	87.00	7.29	7.83	.00	73.70	19.01	10.71	.00	84.50	11.93	9.73
.00	133.00	.00	.00	.00	133.00	.00	.00	.00	91.40	17.24	12.65	.00	125.00	13.30	15.20
.00	178.00	3.45	11.02	.00	178.00	.00	.00	.00	178.00	.00	.00	.00	178.00	13.44	21.75
25.00	57.00	.00	.00	25.00	57.00	.00	.00	25.00	47.00	5.97	25.00	49.40	.00	.00	.00
25.00	87.00	1.00	.00	25.00	87.00	.78	.00	25.00	73.70	12.74	25.00	84.50	1.00	.00	.00
25.00	133.00	.00	.00	25.00	133.00	.00	.00	25.00	91.40	12.21	25.00	125.00	.00	.00	.00
25.00	178.00	.00	.00	25.00	178.00	.00	.00	25.00	178.00	.00	25.00	178.00	.00	.00	.00
57.00	87.00	.00	.00	57.00	87.00	.00	.00	47.00	73.70	20.24	49.40	84.50	12.92	.00	.00
57.00	133.00	.00	.00	57.00	133.00	.00	.00	47.00	91.40	16.12	49.40	125.00	14.73	.00	.00
57.00	178.00	.00	.00	57.00	178.00	.00	.00	47.00	178.00	.00	49.40	178.00	14.33	.00	.00
87.00	133.00	.00	.00	87.00	133.00	.00	.00	73.70	91.40	10.80	84.50	125.00	16.40	.00	.00
87.00	178.00	3.38	.00	87.00	178.00	.00	.00	73.70	178.00	.00	84.50	178.00	14.88	.00	.00
133.00	178.00	.00	.00	133.00	178.00	.00	.00	91.40	178.00	.00	125.00	178.00	13.77	.00	.00

May 87			Oct 87			May 87			Oct 87		
Depth Range	Ka	CM	Depth Range	Ka	CM	Depth Range	Ka	CM	Depth Range	Ka	CM
.00 25.00	19.36	3.67	.00 25.00	13.41	3.05	.00 25.00	20.82	3.80	.00 22.50	8.78	2.22
.00 57.00		.00	.00 57.00	23.28	9.17	.00 57.00	9.97	6.00	.00 49.40	22.09	7.74
.00 87.00	8.59	8.50	.00 87.00	26.75	15.00	.00 76.20	10.76	8.33	.00 87.00	.00	.00
.00 139.00	4.92	10.28	.00 133.00	18.93	19.29	.00 119.40	9.60	12.33	.00 108.00	26.85	18.65
.00 178.00		.00	.00 178.00		.00	.00 130.80	5.41	10.14	.00 115.60	26.75	19.93
25.00 57.00		25.00	57.00 32.87		25.00	57.00	4.24		22.50 49.40	37.86	
25.00 87.00	5.47	25.00	87.00 33.42		25.00	76.20	7.04		22.50 87.00	1.00	
25.00 139.00	3.03	25.00	133.00 20.34		25.00	119.40	7.35		22.50 108.00	33.24	
25.00 178.00		25.00	178.00 .00		25.00	130.80	3.23		22.50 115.60	32.56	
57.00 87.00		57.00	87.00 34.01		57.00	76.20	13.28		49.40 87.00	.00	
57.00 139.00		57.00	133.00 15.96		57.00	119.40	9.27		49.40 108.00	31.22	
57.00 178.00		57.00	178.00 .00		57.00	130.80	2.83		49.40 115.60	30.52	
87.00 139.00	1.05	87.00	133.00 7.83		87.00	119.40	7.72		87.00 108.00	.00	
87.00 178.00		87.00	178.00 .00		87.00	130.80	.99		87.00 115.60	.00	
139.00 178.00		133.00	178.00 .00		119.40	130.80	33.23		108.00 115.60	25.35	

May 87			Oct 87			May 87			Oct 87		
Depth Range	Ka	CM	Depth Range	Ka	CM	Depth Range	Ka	CM	Depth Range	Ka	CM
.00 26.50	23.15	4.25	.00 27.50	14.58	3.50	.00 24.50	36.24	4.92	.00 24.50	38.74	5.08
.00 45.00	15.56	5.92	.00 45.00	15.78	5.96	.00 38.96	22.50	6.16	.00 38.00	52.40	9.17
.00 72.40	10.74	7.91	.00 69.40	15.42	9.08	.00 62.00	18.27	8.83	.00 49.40	38.11	10.17
.00 133.00		.00	.00 133.00		.00	.00 72.20	21.54	11.17	.00 72.20	33.84	14.00
.00 178.00		.00	.00 178.00		.00	.00 178.00		.00	.00		.00
26.50 45.00	7.31	27.50	45.00 17.76		24.50	38.96	6.66		24.50 50.00	5.99	
26.50 72.40	5.72	27.50	69.40 15.98		24.50	62.00	9.82		24.50 87.00	1.00	
26.50 133.00		27.50	133.00 .00		24.50	72.20	15.47		24.50 105.20	12.04	
26.50 178.00		27.50	178.00 .00		24.50	178.00	.00		24.50 112.10	9.86	
45.00 72.40	4.76	45.00	69.40 14.77		38.96	62.00	12.12		50.00 87.00	.00	
45.00 133.00		45.00	133.00 .00		38.96	72.20	20.44		50.00 105.20	15.53	
45.00 178.00		45.00	178.00 .00		38.96	178.00	.00		50.00 112.10	11.72	
72.40 133.00		69.40	133.00 .00		62.00	72.20	47.20		87.00 105.20	.00	
72.40 178.00		69.40	178.00 .00		62.00	178.00	.00		87.00 112.10	.00	
133.00 178.00		133.00	178.00 .00		72.20	178.00	.00		105.20 112.10	.51	

MB

K Data for Norman Wells to Zama Pipeline Route Site 84-3B

	May 85			Oct 85			May 86			Oct 86		
	Depth Range CM	Ka	tt (ms)	Depth Range CM	Ka		Depth Range CM	Ka		Depth Range CM	Ka	
KB	.00 25.00	8.99	2.50	.00 25.00	8.44	2.42	.00 25.00	11.39	2.81	.00 25.00	6.31	2.09
	.00 57.00	.00	.00	.00 57.00	17.41	7.93	.00 57.00	8.02	5.38	.00 51.90	17.20	7.17
	.00 87.00	6.39	7.33	.00 87.00	13.24	10.55	.00 87.00	7.26	7.81	.00 81.90	15.85	10.87
	.00 133.00	.00	.00	.00 133.00	9.06	13.34	.00 133.00	6.49	11.29	.00 125.00	11.04	13.84
	.00 178.00	.00	.00	.00 178.00	.00	.00	.00 178.00	.00	.00	.00 178.00	.00	.00
	25.00 57.00	.00	.00	25.00 57.00	26.65	.00	25.00 57.00	5.80	.00	25.00 51.90	32.12	.00
	25.00 87.00	5.47		25.00 87.00	15.48		25.00 87.00	5.86		25.00 81.90	21.41	
	25.00 133.00	.00		25.00 133.00	9.21		25.00 133.00	5.55		25.00 125.00	12.43	
	25.00 178.00	.00		25.00 178.00	.00		25.00 178.00	.00		25.00 178.00	.00	
	57.00 87.00	.00		57.00 87.00	6.89		57.00 87.00	5.92		51.90 81.90	13.64	
	57.00 133.00	.00		57.00 133.00	4.57		57.00 133.00	5.45		51.90 125.00	7.49	
	57.00 178.00	.00		57.00 178.00	.00		57.00 178.00	.00		51.90 178.00	.00	
	87.00 133.00	.00		87.00 133.00	3.32		87.00 133.00	5.15		81.90 125.00	4.29	
	87.00 178.00	.00		87.00 178.00	.00		87.00 178.00	.00		81.90 178.00	.00	
	133.00 178.00	.00		133.00 178.00	.00		133.00 178.00	.00		125.00 178.00	.00	
KB	.00 25.00	38.04	5.14	.00 25.00	20.70	3.79	.00 25.00	45.36	5.61	.00 22.50	.00	.00
	.00 57.00	.00	.00	.00 57.00	9.97	6.00	.00 57.00	28.88	8.42	.00 4.94	11.25	.55
	.00 87.00	14.42	11.01	.00 87.00	11.89	10.00	.00 87.00	23.61	11.94	.00 84.50	11.93	9.73
	.00 133.00	.00	.00	.00 133.00	15.58	17.50	.00 133.00	15.98	12.18	.00 125.00	13.30	15.20
	.00 178.00	10.48	19.21	.00 178.00	13.96	22.17	.00 178.00	12.94	21.34	.00 178.00	13.44	21.75
	25.00 57.00	.00	.00	25.00 57.00	4.28		25.00 57.00	14.65		22.50 4.94	.00	.00
	25.00 87.00	8.07		25.00 87.00	9.02		25.00 87.00	15.18		22.50 84.50	.00	.00
	25.00 133.00	.00		25.00 133.00	14.50		25.00 133.00	8.80		22.50 125.00	.00	.00
	25.00 178.00	7.61		25.00 178.00	12.98		25.00 178.00	9.51		22.50 178.00	.00	.00
	57.00 87.00	.00		57.00 87.00	16.00		57.00 87.00	15.62		4.94 84.50	11.97	
	57.00 133.00	.00		57.00 133.00	20.61		57.00 133.00	6.45		4.94 125.00	13.39	
	57.00 178.00	.00		57.00 178.00	16.07		57.00 178.00	8.76		4.94 178.00	13.51	
	87.00 133.00	.00		87.00 133.00	23.92		87.00 133.00	.17		84.50 125.00	16.40	
	87.00 178.00	7.30		87.00 178.00	16.09		87.00 178.00	7.32		84.50 178.00	14.88	
	133.00 178.00	.00		133.00 178.00	9.69		133.00 178.00	10.08		125.00 178.00	13.77	

KP	May 87				Oct 87				May 87				Oct 87			
	Depth Range CM	Ka	tt	Depth Range CM	Ka	tt	Depth Range CM	Ka	tt	Depth Range CM	Ka	tt	Depth Range CM	Ka	tt	
.00	25.00	5.37	1.93	.00	25.00	16.00	3.33	.00	25.00	44.42	5.55	.00	22.50	.00	.00	
.00	57.00	.00	.00	.00	57.00	12.87	6.82	.00	57.00	23.29	9.17	.00	57.00	.00	.00	
.00	87.00	11.15	9.68	.00	87.00	11.76	9.94	.00	76.20	18.59	10.95	.00	81.90	10.33	9.03	
.00	139.00	.00	.00	.00	133.00	14.53	16.90	.00	119.40	13.75	14.76	.00	120.00	16.51	16.25	
.00	178.00	18.31	25.39	.00	178.00	13.08	21.46	.00	130.80	11.99	15.10	.00	163.00	17.43	22.68	
25.00	57.00	.00	25.00	57.00	10.66	25.00	25.00	57.00	11.49	22.50	57.00	.00	57.00	.00	.00	
25.00	87.00	14.07	25.00	87.00	10.23	25.00	25.00	76.20	10.00	22.50	81.90	.00	81.90	.00	.00	
25.00	139.00	.00	25.00	133.00	14.20	25.00	25.00	119.40	8.56	22.50	120.00	.00	120.00	.00	.00	
25.00	178.00	21.16	25.00	178.00	12.63	25.00	25.00	130.80	7.32	22.50	163.00	.00	163.00	.00	.00	
57.00	87.00	.00	57.00	87.00	9.79	57.00	57.00	76.20	7.75	57.00	81.90	.00	81.90	.00	.00	
57.00	139.00	.00	57.00	133.00	15.84	57.00	57.00	119.40	7.22	57.00	120.00	.00	120.00	.00	.00	
57.00	178.00	.00	57.00	178.00	13.18	57.00	57.00	130.80	5.81	57.00	163.00	.00	163.00	.00	.00	
87.00	139.00	.00	87.00	133.00	20.57	87.00	87.00	119.40	6.99	81.90	120.00	32.39	120.00	32.39	32.39	
87.00	178.00	26.81	87.00	178.00	14.41	87.00	87.00	130.80	5.19	81.90	163.00	25.53	163.00	25.53	25.53	
139.00	178.00	.00	133.00	178.00	9.24	133.00	133.00	130.80	.80	120.00	163.00	20.13	163.00	20.13	20.13	

KB	May 87				Oct 87				May 87				Oct 87			
	Depth Range CM	Ka	tt	Depth Range CM	Ka	tt	Depth Range CM	Ka	tt	Depth Range CM	Ka	tt	Depth Range CM	Ka	tt	
.00	26.50	7.48	2.42	.00	24.50	5.51	1.92	.00	29.50	37.23	6.00	.00	30.50	15.16	3.96	
.00	51.00	11.11	5.67	.00	48.00	22.96	7.67	.00	56.00	32.65	10.67	.00	57.00	10.53	6.17	
.00	87.40	6.77	7.58	.00	83.40	19.15	12.17	.00	86.40	27.13	15.00	.00	87.40	12.58	10.33	
.00	129.20	6.72	11.16	.00	126.20	13.14	15.25	.00	126.20	18.31	18.00	.00	125.20	16.27	16.83	
.00	178.00	.00	.00	.00	178.00	.00	.00	.00	167.90	15.45	22.00	.00	163.90	17.21	22.66	
26.50	51.00	15.84	24.50	48.00	53.88	29.50	56.00	27.90	29.50	57.00	6.24	24.50	59.00	.00	.00	
26.50	87.40	6.47	24.50	83.40	27.25	24.50	29.50	86.40	22.52	30.50	87.40	11.30	24.50	82.40	.00	
26.50	129.20	6.53	24.50	126.20	15.47	29.50	29.50	126.20	13.86	30.50	125.20	16.64	24.50	124.20	.00	
26.50	178.00	.00	24.50	178.00	.00	24.50	29.50	167.90	12.03	30.50	163.90	17.70	24.50	163.90	.00	
51.00	87.40	2.49	48.00	83.40	14.54	48.00	56.00	86.40	18.30	57.00	87.40	16.91	59.00	82.40	8.32	
51.00	129.20	4.45	48.00	126.20	8.46	56.00	56.00	126.20	9.82	57.00	125.20	22.02	59.00	124.20	6.59	
51.00	178.00	.00	48.00	178.00	.00	56.00	56.00	167.90	9.23	57.00	163.90	21.44	59.00	163.90	8.04	
87.40	129.20	6.62	83.40	126.20	4.67	86.40	86.40	126.20	5.11	87.40	125.20	26.62	82.40	124.20	5.71	
87.40	178.00	.00	83.40	178.00	.00	86.40	86.40	167.90	6.63	87.40	163.90	23.39	83.40	159.90	34.93	
129.20	178.00	.00	126.20	178.00	.00	126.20	126.20	167.90	8.27	125.20	163.90	20.43	120.20	159.90	16.11	

X Data for Morwan Wells to Zama Pipeline Route Site 84-4A

	May 85				Oct 85				May 86				Oct 86			
	Depth Range CM	Ra	tt (ms)	Depth Range CM	Ra	Depth Range CM	Ra	Depth Range CM	Ra	Depth Range CM	Ra	Depth Range CM	Ra	Depth Range CM	Ra	
MB	.00	25.00	.00	.00	25.00	5.99	2.04	.00	25.00	7.82	2.33	.00	28.00	5.61	2.21	
	.00	57.00	9.00	5.70	57.00	4.82	4.17	.00	57.00	9.71	5.92	.00	58.50	5.61	4.62	
	.00	87.00	12.03	10.06	87.00	7.14	7.75	.00	87.00	13.95	10.83	.00	88.90	7.90	8.33	
	.00	133.00	9.97	14.00	133.00	6.73	11.50	.00	133.00	10.70	14.50	.00	134.70	6.94	11.83	
	.00	178.00	11.71	20.30	178.00	8.21	17.00	.00	178.00	13.34	21.67	.00	177.80	9.57	18.33	
	25.00	57.00	.00	25.00	57.00	3.99		25.00	57.00	11.33		28.00	58.50	5.62		
	25.00	87.00	.00	25.00	87.00	7.63		25.00	87.00	16.92		28.00	88.90	9.09		
	25.00	133.00	.00	25.00	133.00	6.91		25.00	133.00	11.43		28.00	134.70	7.32		
	25.00	178.00	.00	25.00	178.00	8.60		25.00	178.00	14.38		28.00	177.80	10.42		
	57.00	87.00	19.01	57.00	87.00	12.82		57.00	87.00	24.11		58.50	88.90	13.40		
	57.00	133.00	10.73	57.00	133.00	8.37		57.00	133.00	11.47		58.50	134.70	8.06		
	87.00	178.00	13.10	87.00	178.00	10.12		87.00	178.00	15.25		88.90	177.80	11.89		
	87.00	133.00	6.60	87.00	133.00	5.98		87.00	133.00	5.73		88.90	134.70	5.26		
	87.00	178.00	11.40	87.00	178.00	9.30		87.00	178.00	12.77		88.90	177.80	11.39		
	133.00	178.00	17.64	133.00	178.00	13.44		133.00	178.00	22.85		134.70	177.80	20.47		

	May 85				Oct 85				May 86				Oct 86			
	Depth Range CM	Ra	tt (ms)	Depth Range CM	Ra	Depth Range CM	Ra	Depth Range CM	Ra	Depth Range CM	Ra	Depth Range CM	Ra	Depth Range CM	Ra	
MC	.00	25.00	10.27	2.67	25.00	7.55	2.29	.00	25.00	12.19	2.91	.00	30.50	6.90	2.67	
	.00	57.00	8.14	5.42	57.00	6.36	4.79	.00	57.00	9.16	5.75	.00	58.50	6.79	5.08	
	.00	87.00	9.27	8.83	87.00	5.42	6.75	.00	87.00	8.59	8.50	.00	86.30	7.11	7.67	
	.00	133.00	7.33	12.00	133.00	6.25	11.08	.00	133.00	7.47	12.12	.00	132.10	7.53	12.08	
	.00	178.00	8.53	17.33	178.00	7.27	16.00	.00	178.00	4.03	11.91	.00	180.40	9.13	18.17	
	25.00	57.00	6.65	25.00	57.00	5.49		25.00	57.00	7.09		30.50	58.50	6.67		
	25.00	87.00	8.88	25.00	87.00	4.66		25.00	87.00	7.32		30.50	86.30	7.23		
	25.00	133.00	6.72	25.00	133.00	5.96		25.00	133.00	6.55		30.50	132.10	7.72		
	25.00	178.00	8.26	25.00	178.00	7.23		25.00	178.00	3.11		30.50	180.40	9.62		
	57.00	87.00	11.63	57.00	87.00	3.84		57.00	87.00	7.56		58.50	86.30	7.81		
	57.00	133.00	6.75	57.00	133.00	6.16		57.00	133.00	6.32		58.50	132.10	8.14		
	57.00	178.00	8.72	57.00	178.00	7.72		57.00	178.00	2.33		58.50	180.40	10.38		
	87.00	133.00	4.27	87.00	133.00	7.97		87.00	133.00	5.57		86.30	132.10	8.34		
	87.00	178.00	7.85	87.00	178.00	9.30		87.00	178.00	1.26		86.30	180.40	11.21		
	133.00	178.00	12.63	133.00	178.00	10.76		133.00	178.00	.02		132.10	180.40	14.31		

MP

May 87				Oct 87				May 87				Oct 87			
Depth Range	Ka	tt	cm	Depth Range	Ka	tt	cm	Depth Range	Ka	tt	cm	Depth Range	Ka	tt	cm
.00 25.00	10.27	2.67	.00	25.40	7.32	2.29	.00	25.00	9.59	2.58	.00	28.00	6.02	2.29	
.00 57.00	14.24	7.17	.00	57.00	8.75	5.62	.00	57.00	13.53	6.99	.00	61.00	8.22	5.83	
.00 87.00	8.59	8.50	.00	87.00	5.69	6.92	.00	87.00	9.27	8.83	.00	88.90	9.22	9.00	
.00 133.00	9.73	13.83	.00	133.00	6.44	11.25	.00	133.00	9.97	14.00	.00	134.70	7.29	12.12	
.00 178.00	9.38	18.17	.00	178.00	7.89	16.67	.00	178.00	10.80	19.50	.00	177.80	8.88	17.66	
25.00 57.00	17.80		25.40	57.00	9.99		25.00	57.00	17.09		28.00	61.00	10.36		
25.00 87.00	7.96		25.40	87.00	5.08		25.00	87.00	9.15		28.00	88.90	10.93		
25.00 133.00	9.61		25.40	133.00	6.24		25.00	133.00	10.06		28.00	134.70	7.64		
25.00 178.00	9.24		25.40	178.00	7.99		25.00	178.00	11.01		28.00	177.80	9.47		
57.00 87.00	1.77		57.00	87.00	1.69		57.00	87.00	3.39		61.00	88.90	11.62		
57.00 133.00	6.91		57.00	133.00	4.94		57.00	133.00	7.66		61.00	134.70	6.56		
57.00 178.00	7.44		57.00	178.00	7.51		57.00	178.00	9.62		61.00	177.80	9.23		
87.00 133.00	12.08		87.00	133.00	7.97		87.00	133.00	11.37		88.90	134.70	4.18		
87.00 178.00	10.16		87.00	178.00	10.33		87.00	178.00	12.37		88.90	177.80	8.54		
133.00 178.00	8.37		133.00	178.00	13.06		133.00	178.00	13.44		134.70	177.80	14.87		

May 87				Oct 87				May 87				Oct 87			
Depth Range	Ka	tt	cm	Depth Range	Ka	tt	cm	Depth Range	Ka	tt	cm	Depth Range	Ka	tt	cm
.00 26.50	4.72	1.92	.00	26.50	5.13	2.00	.00	25.50	.00	.00	.00	25.50	9.87	2.67	
.00 56.00	7.41	5.08	.00	57.00	5.71	4.54	.00	58.00	.00	.00	.00	58.00	6.24	4.83	
.00 87.40	9.91	9.17	.00	87.40	5.91	7.08	.00	86.40	.00	.00	.00	87.40	5.37	6.75	
.00 132.20	7.63	12.17	.00	132.20	6.81	11.50	.00	134.20	.00	.00	.00	133.20	6.51	11.33	
.00 177.90	9.91	18.67	.00	177.90	8.54	17.33	.00	177.90	.00	.00	.00	178.90	7.81	16.67	
26.50 56.00	10.33		26.50	57.00	6.24		25.50	58.00	.00		25.50	58.00	3.98		
26.50 87.40	12.76		26.50	87.40	6.26		25.50	86.40	.00		25.50	87.40	3.91		
26.50 132.20	8.46		26.50	132.20	7.27		25.50	134.20	.00		25.50	133.20	5.82		
26.50 177.90	11.02		26.50	177.90	9.23		25.50	177.90	.00		25.50	178.90	7.50		
56.00 87.40	15.27		57.00	87.40	6.28		58.00	86.40	.00		58.00	87.40	3.84		
56.00 132.20	7.79		57.00	132.20	7.71		58.00	134.20	.00		58.00	133.20	6.72		
56.00 177.90	11.19		57.00	177.90	10.07		58.00	177.90	.00		58.00	178.90	8.63		
87.40 132.20	4.04		87.40	132.20	8.76		86.40	134.20	.00		87.40	133.20	9.00		
87.40 177.90	9.92		87.40	177.90	11.54		86.40	177.90	.00		87.40	178.90	10.58		
132.20 177.90	18.21		132.20	177.90	14.65		134.20	177.90	.00		133.20	178.90	12.29		

May 87				Oct 87				May 87				Oct 87			
Depth Range	Ka	tt	cm	Depth Range	Ka	tt	cm	Depth Range	Ka	tt	cm	Depth Range	Ka	tt	cm
.00 26.50	7.51	2.42	.00	26.50	8.85	5.75	.00	26.50	6.49	2.25	.00	26.50	7.51	2.42	
.00 58.00	8.85	5.75	.00	58.00	7.72	7.08	.00	58.00	11.30	6.50	.00	58.00	8.85	5.75	
.00 88.40	5.77	7.08	.00	88.40	9.15	11.83	.00	88.40	9.15	13.33	.00	88.40	7.21	11.83	
.00 132.20	7.21	11.83	.00	132.20	16.67	17.00	.00	132.20	16.67	16.67	.00	132.20	9.23	17.00	
26.50 58.00	10.06		26.50	58.00	10.06		26.50	58.00	16.38		26.50	58.00	10.06		
26.50 86.40	5.10		26.50	86.40	8.29		26.50	86.40	8.29		26.50	86.40	5.10		
26.50 132.20	7.13		26.50	132.20	9.89		26.50	132.20	9.89		26.50	132.20	7.13		
26.50 176.90	9.57		26.50	176.90	8.27		26.50	176.90	8.27		26.50	176.90	9.57		
58.00 88.40	1.72		58.00	88.40	2.51		58.00	86.40	2.51		58.00	88.40	1.72		
58.00 132.20	6.04		58.00	132.20	7.63		58.00	132.20	7.63		58.00	132.20	6.04		
58.00 167.90	9.43		58.00	167.90	6.58		58.00	176.90	6.58		58.00	167.90	9.43		
88.40 132.20	10.58		88.40	132.20	12.19		86.40	132.20	12.19		88.40	132.20	10.58		
88.40 167.90	14.01		88.40	167.90	8.26		86.40	176.90	8.26		88.40	167.90	14.01		
132.20 167.90	18.88		132.20	167.90	5.02		132.20	176.90	5.02		132.20	167.90	18.88		

K Data for Monsoon Wells to Zama Pipeline Route Site 84-4B

May 85				Oct 85				May 86				Oct 86			
Depth	Range	Ka	tt (ns)	Depth	Range	Ka		Depth	Range	Ka		Depth	Range	Ka	
CM				CM				CM				CM			
.00	25.00	10.65	2.72	.00	25.40	4.67	1.83	.00	25.00	7.55	2.29	.00	28.00	6.02	2.29
.00	57.00	6.93	5.00	.00	57.00	4.61	4.08	.00	57.00	7.26	5.12	.00	58.50	6.24	4.87
.00	87.00	7.94	8.17	.00	87.00	5.02	6.50	.00	87.00	8.25	8.33	.00	86.30	7.58	7.92
.00	133.00	7.12	11.83	.00	133.00	4.59	9.50	.00	133.00	7.54	12.17	.00	134.70	5.82	10.83
.00	178.00	6.38	14.99	.00	178.00	4.74	12.92	.00	178.00	6.68	15.33	.00	180.40	6.22	15.00
25.00	57.00	4.57		25.40	57.00	4.56		25.00	57.00	7.04		28.00	58.50	6.44	
25.00	87.00	6.95		25.40	87.00	5.17		25.00	87.00	8.54		28.00	86.30	8.39	
25.00	133.00	6.40		25.40	133.00	4.57		25.00	133.00	7.53		28.00	134.70	5.77	
25.00	178.00	5.79		25.40	178.00	4.75		25.00	178.00	6.54		28.00	180.40	6.26	
57.00	87.00	10.05		57.00	87.00	5.86		57.00	87.00	10.30		58.50	86.30	10.83	
57.00	133.00	7.27		57.00	133.00	4.58		57.00	133.00	7.74		58.50	134.70	5.51	
57.00	178.00	6.13		57.00	178.00	4.80		57.00	178.00	6.41		58.50	180.40	6.22	
87.00	133.00	5.70		87.00	133.00	3.83		87.00	133.00	6.27		86.30	134.70	3.25	
87.00	178.00	5.06		87.00	178.00	4.48		87.00	178.00	5.33		86.30	180.40	5.09	
133.00	178.00	4.44		133.00	178.00	5.20		133.00	178.00	4.44		134.70	180.40	7.49	

May 85				Oct 85				May 86				Oct 86			
Depth	Range	Ka	tt (ns)	Depth	Range	Ka		Depth	Range	Ka		Depth	Range	Ka	
CM				CM				CM				CM			
.00	25.00	9.14	2.52	.00	25.40	6.57	2.17	.00	25.00	6.78	2.17	.00	25.40	5.52	1.99
.00	57.00	5.44	4.43	.00	57.00	5.19	4.33	.00	57.00	5.81	4.58	.00	58.50	5.23	4.46
.00	87.00	6.11	7.17	.00	87.00	5.55	6.83	.00	87.00	6.55	7.42	.00	86.30	6.35	7.25
.00	133.00	6.15	10.99	.00	133.00	4.92	9.83	.00	133.00	6.35	11.17	.00	134.70	5.73	10.75
.00	178.00	7.11	15.82	.00	178.00	5.43	13.83	.00	178.00	7.57	16.33	.00	180.40	6.22	15.00
25.00	57.00	3.21		25.40	57.00	4.21		25.00	57.00	5.10		25.40	58.50	5.01	
25.00	87.00	5.06		25.40	87.00	5.15		25.00	87.00	6.45		25.40	86.30	6.71	
25.00	133.00	5.54		25.40	133.00	4.56		25.00	133.00	6.25		25.40	134.70	5.78	
25.00	178.00	6.80		25.40	178.00	5.25		25.00	178.00	7.71		25.40	180.40	6.34	
57.00	87.00	7.51		57.00	87.00	6.25		57.00	87.00	8.07		58.50	86.30	9.06	
57.00	133.00	6.71		57.00	133.00	4.71		57.00	133.00	6.77		58.50	134.70	6.13	
57.00	178.00	7.97		57.00	178.00	5.55		57.00	178.00	8.49		58.50	180.40	6.73	
87.00	133.00	6.21		87.00	133.00	3.83		87.00	133.00	5.98		86.30	134.70	4.71	
87.00	178.00	8.13		87.00	178.00	5.33		87.00	178.00	8.63		86.30	180.40	6.10	
133.00	178.00	10.37		133.00	178.00	7.11		133.00	178.00	11.83		134.70	180.40	7.78	

May 85		Oct 85		May 86		Oct 86	
Depth Range	Ka	tt (ms)	Depth Range	Ka	Depth Range	Ka	Depth Range
CM			CM		CM		CM
.00	25.00	7.88	2.34	.00	25.40	3.89	1.67
.00	57.00	5.07	4.28	.00	57.00	4.82	4.17
.00	87.00	6.39	7.33	.00	87.00	5.15	6.58
.00	133.00	6.35	11.17	.00	133.00	5.26	10.17
.00	178.00	5.83	14.33	.00	178.00	5.18	13.50
25.00	57.00	3.31	25.40	57.00	5.63	25.00	57.00
25.00	87.00	5.83	25.40	87.00	5.72	25.00	87.00
25.00	133.00	6.02	25.40	133.00	5.62	25.00	133.00
25.00	178.00	5.93	25.40	178.00	5.41	25.00	178.00
57.00	87.00	9.30	57.00	87.00	5.81	57.00	87.00
57.00	133.00	7.40	57.00	133.00	5.61	57.00	133.00
57.00	178.00	6.21	57.00	178.00	5.35	57.00	178.00
87.00	133.00	6.27	87.00	133.00	5.48	87.00	133.00
87.00	178.00	5.33	87.00	178.00	5.20	87.00	178.00
133.00	178.00	4.44	133.00	178.00	4.93	133.00	178.00

May 87		Oct 87		May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM		CM		CM		CM	
.00	28.50	4.26	1.96	.00	28.50	4.98	2.12
.00	58.00	6.24	4.83	.00	57.00	4.61	4.08
.00	86.40	7.39	7.83	.00	87.40	5.71	6.96
.00	133.20	6.33	11.17	.00	133.20	4.82	9.75
.00	178.90	5.65	14.17	.00	178.90	5.00	13.33
28.50	58.00	8.52	28.50	57.00	4.26	26.50	58.00
28.50	86.40	9.25	28.50	87.40	6.08	26.50	86.40
28.50	133.20	6.96	28.50	133.20	4.78	26.50	133.20
28.50	178.90	5.93	28.50	178.90	5.00	26.50	178.90
58.00	86.40	10.04	57.00	87.40	8.08	58.00	86.40
58.00	133.20	6.40	57.00	133.20	4.98	58.00	133.20
58.00	178.90	5.37	57.00	178.90	5.18	58.00	178.90
86.40	133.20	4.58	87.40	133.20	3.34	86.40	133.20
86.40	178.90	4.23	87.40	178.90	4.36	86.40	178.90
133.20	178.90	3.88	133.20	178.90	5.52	133.20	178.90

May 87		Oct 87		May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM		CM		CM		CM	
.00	28.50	4.26	1.96	.00	26.50	6.49	2.25
.00	58.00	6.24	4.83	.00	59.00	5.83	4.75
.00	86.40	7.39	7.83	.00	88.40	6.26	7.37
.00	133.20	6.33	11.17	.00	134.20	5.69	10.67
.00	178.90	5.65	14.17	.00	178.90	6.05	14.67
28.50	58.00	8.52	26.50	59.00	5.33	23.50	57.00
28.50	86.40	9.25	26.50	88.40	6.16	23.50	87.40
28.50	133.20	6.96	26.50	134.20	5.50	23.50	134.20
28.50	178.90	5.93	26.50	178.90	5.98	23.50	177.90
58.00	86.40	10.04	59.00	88.40	7.15	57.00	87.40
58.00	133.20	6.40	58.00	134.20	5.58	57.00	134.20
58.00	178.90	5.37	58.00	178.90	6.16	57.00	177.90
86.40	133.20	4.58	88.40	134.20	4.67	87.40	134.20
86.40	178.90	4.23	88.40	178.90	5.86	87.40	177.90
133.20	178.90	3.88	134.20	178.90	7.21	134.20	177.90

May 87		Oct 87		May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM		CM		CM		CM	
.00	28.50	4.26	1.96	.00	23.50	3.67	1.50
.00	58.00	6.24	4.83	.00	57.00	4.43	4.00
.00	86.40	7.39	7.83	.00	87.40	5.24	6.67
.00	133.20	6.33	11.17	.00	134.20	6.24	11.17
.00	178.90	5.65	14.17	.00	177.90	5.71	14.17
28.50	58.00	8.52	23.50	57.00	5.01	24.50	56.00
28.50	86.40	9.25	23.50	87.40	5.89	24.50	86.40
28.50	133.20	6.96	23.50	134.20	6.87	24.50	133.20
28.50	178.90	5.93	23.50	177.90	6.06	24.50	177.90
58.00	86.40	10.04	57.00	87.40	6.94	56.00	86.40
58.00	133.20	6.40	57.00	134.20	7.76	56.00	133.20
58.00	178.90	5.37	57.00	177.90	6.37	56.00	177.90
86.40	133.20	4.58	87.40	134.20	8.32	86.40	133.20
86.40	178.90	4.23	87.40	177.90	6.18	86.40	177.90
133.20	178.90	3.88	134.20	177.90	4.24	133.20	177.90



K Data for Korman Wells to Zama Pipeline Route Site 84-5a

	May 85			Oct 85			May 86			Oct 86						
	Depth	Ka	tt (ns)	Depth	Ka		Depth	Ka		Depth	Ka					
	CM			CM			CM			CM						
<b>KB</b>																
	.00	25.00	12.87	2.99	.00	25.40	20.04	3.79	.00	25.00	20.25	3.75	.00	28.00	16.14	3.75
	.00	57.00	20.82	8.67	.00	57.00	34.01	11.08	.00	57.00	33.52	11.00	.00	55.90	39.22	11.67
	.00	87.00	15.73	11.50	.00	87.00	33.04	16.67	.00	87.00	22.74	13.83	.00	86.30	42.12	18.67
	.00	133.00	10.95	14.67	.00	133.00	21.03	20.33	.00	133.00	14.70	17.00	.00	127.00	30.37	23.33
	.00	178.00	9.54	18.33	.00	178.00	15.46	23.33	.00	178.00	12.53	21.00	.00	170.20	23.50	27.50
	25.00	57.00	28.36		25.40	57.00	47.90		25.00	57.00	46.20		28.00	55.90	72.52	
	25.00	87.00	16.96		25.40	87.00	39.35		25.00	87.00	23.79		28.00	86.30	58.94	
	25.00	133.00	10.53		25.40	133.00	21.27		25.00	133.00	13.55		28.00	127.00	35.20	
	25.00	178.00	9.05		25.40	178.00	14.76		25.00	178.00	11.44		28.00	170.20	25.11	
	57.00	87.00	8.01		57.00	87.00	31.25		57.00	87.00	8.01		55.90	86.30	47.72	
	57.00	133.00	5.61		57.00	133.00	13.33		57.00	133.00	5.61		55.90	127.00	24.20	
	57.00	178.00	5.74		57.00	178.00	9.22		57.00	178.00	6.15		55.90	170.20	17.26	
	87.00	133.00	4.27		87.00	133.00	5.70		87.00	133.00	4.27		86.30	127.00	11.80	
	87.00	178.00	5.07		87.00	178.00	4.82		87.00	178.00	5.59		86.30	170.20	9.97	
	133.00	178.00	5.95		133.00	178.00	4.00		133.00	178.00	7.11		127.00	170.20	8.39	
<b>MC</b>																
	.00	25.00	9.59	2.58	.00	25.40	24.26	4.17	.00	25.00	13.31	3.04	.00	25.40	21.44	3.92
	.00	57.00	12.32	6.67	.00	57.00	35.56	11.33	.00	57.00	20.82	8.67	.00	53.40	40.52	11.33
	.00	87.00	8.25	8.33	.00	87.00	24.72	14.42	.00	87.00	3.93	5.75	.00	81.20	40.99	17.33
	.00	133.00	6.93	11.67	.00	133.00	15.00	17.17	.00	133.00	10.95	14.67	.00	127.00	23.06	20.33
	.00	178.00	6.11	14.67	.00	178.00	10.24	18.99	.00	178.00	9.38	18.17	.00	172.70	15.51	22.67
	25.00	57.00	14.70		25.40	57.00	46.21		25.00	57.00	27.86		25.40	53.40	63.03	
	25.00	87.00	7.74		25.40	87.00	24.92		25.00	87.00	1.72		25.40	81.20	51.98	
	25.00	133.00	6.38		25.40	133.00	13.14		25.00	133.00	10.44		25.40	127.00	23.48	
	25.00	178.00	5.62		25.40	178.00	8.49		25.00	178.00	8.80		25.40	172.70	14.58	
	57.00	87.00	2.76		57.00	87.00	9.55		57.00	87.00	8.53		53.40	81.20	41.92	
	57.00	133.00	3.90		57.00	133.00	5.31		57.00	133.00	5.61		53.40	127.00	13.46	
	57.00	178.00	3.93		57.00	178.00	3.61		57.00	178.00	5.55		53.40	172.70	8.13	
	87.00	133.00	4.74		87.00	133.00	3.22		87.00	133.00	33.84		81.20	127.00	3.86	
	87.00	178.00	4.37		87.00	178.00	2.27		87.00	178.00	16.76		81.20	172.70	3.07	
	133.00	178.00	4.00		133.00	178.00	1.47		133.00	178.00	5.44		127.00	172.70	2.36	

May 85		Oct 85		May 86		Oct 86		May 87		Oct 87		
Depth Range	Ka	tt (ms)	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM			CM		CM		CM		CM		CM	
0.00	25.50	0.00	0.00	25.40	0.00	25.00	0.00	28.00	0.00	28.00	0.00	28.00
0.00	57.00	8.91	5.67	57.00	31.01	57.00	14.76	57.00	33.84	55.90	33.84	10.84
0.00	87.00	9.10	8.75	87.00	46.01	87.00	36.41	87.00	52.43	86.30	52.43	20.83
0.00	133.00	28.51	23.67	133.00	0.00	134.70	63.57	134.70	64.50	124.50	64.50	33.33
0.00	178.00	28.49	31.67	178.00	49.32	178.00	55.62	178.00	60.08	167.70	60.08	43.33
25.00	57.00	0.00	25.40	57.00	0.00	57.00	0.00	57.00	0.00	55.90	0.00	0.00
25.00	87.00	0.00	25.40	87.00	0.00	87.00	0.00	87.00	0.00	86.30	0.00	0.00
25.00	133.00	0.00	25.40	133.00	0.00	134.70	0.00	134.70	0.00	124.50	0.00	0.00
25.00	178.00	0.00	25.40	178.00	0.00	162.60	0.00	162.60	0.00	167.70	0.00	0.00
57.00	87.00	9.49	57.00	87.00	82.63	87.00	104.04	87.00	97.19	86.30	97.19	0.00
57.00	133.00	50.48	57.00	133.00	0.00	134.70	121.08	134.70	96.73	124.50	124.50	96.73
57.00	178.00	41.55	57.00	178.00	59.42	178.00	88.53	178.00	76.01	167.70	167.70	76.01
87.00	133.00	94.68	87.00	133.00	0.00	134.70	132.47	134.70	96.37	124.50	124.50	96.37
87.00	178.00	57.09	87.00	178.00	52.60	178.00	82.72	178.00	68.76	167.70	167.70	68.76
133.00	178.00	28.44	133.00	178.00	0.00	162.60	24.68	162.60	48.23	167.70	167.70	48.23

May 85		Oct 87		May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM		CM		CM		CM	
0.00	26.50	16.43	3.58	0.00	26.50	18.02	3.75
0.00	55.00	18.62	7.91	0.00	53.00	38.14	10.91
0.00	88.40	25.91	15.00	0.00	83.40	60.76	21.67
0.00	130.70	18.68	18.83	0.00	127.20	0.00	0.00
0.00	173.90	16.67	23.67	0.00	169.90	0.00	0.00
26.50	55.00	20.77	26.50	53.00	65.70	53.00	65.70
26.50	88.40	30.63	26.50	83.40	89.27	83.40	89.27
26.50	130.70	19.28	26.50	127.20	0.00	127.20	0.00
26.50	173.90	16.72	26.50	169.90	0.00	169.90	0.00
55.00	88.40	40.55	53.00	83.40	112.75	83.40	112.75
55.00	130.70	18.73	53.00	127.20	0.00	127.20	0.00
55.00	173.90	15.81	53.00	169.90	0.00	169.90	0.00
88.40	130.70	7.38	83.40	127.20	0.00	127.20	0.00
88.40	173.90	9.25	83.40	169.90	0.00	169.90	0.00
130.70	173.90	11.30	127.20	169.90	0.00	169.90	0.00

May 87		Oct 87		May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM		CM		CM		CM	
0.00	21.50	0.00	21.50	0.00	21.50	0.00	21.50
0.00	53.00	21.39	53.00	31.76	9.58	53.00	21.39
0.00	87.40	38.90	87.40	44.56	17.00	87.40	38.90
0.00	133.20	65.12	133.20	46.71	28.75	133.20	65.12
0.00	155.90	49.79	155.90	32.68	33.33	155.90	49.79
21.50	53.00	0.00	53.00	45.76	0.00	53.00	0.00
21.50	87.40	0.00	87.40	60.25	0.00	87.40	0.00
21.50	133.20	0.00	133.20	55.12	0.00	133.20	0.00
21.50	155.90	0.00	155.90	35.09	0.00	155.90	0.00
53.00	87.40	76.05	87.40	76.80	58.49	87.40	76.05
53.00	133.20	107.05	133.20	33.07	69.04	133.20	107.05
53.00	155.90	83.05	155.90	30.70	58.49	155.90	83.05
83.40	134.20	93.59	134.20	50.10	76.40	134.20	93.59
83.40	159.90	86.09	159.90	24.74	65.65	159.90	86.09
134.20	159.90	53.23	159.90	7.96	1.23	159.90	53.23

**X Data for Moxness Wells to Zama Pipeline Route Site 84-58**

	May 85			Oct 85			May 86			Oct 86						
	Depth Range CM	Ka	tt (ns)	Depth Range CM	Ka		Depth Range CM	Ka		Depth Range CM	Ka					
<b>MB</b>	.00	25.00	15.97	3.33	.00	25.40	9.29	2.58	.00	25.00	20.25	3.75	.00	28.00	7.17	2.50
	.00	57.00	11.99	6.58	.00	57.00	20.82	8.67	.00	57.00	17.73	8.00	.00	61.00	21.05	9.33
	.00	87.00	7.94	8.17	.00	87.00	16.64	11.83	.00	87.00	11.12	9.67	.00	83.80	21.66	13.00
	.00	133.00	6.15	10.99	.00	133.00	9.96	13.99	.00	133.00	7.12	11.83	.00	129.60	12.59	15.33
	.00	178.00	.00	.00	.00	178.00	.00	.00	.00	178.00	.00	.00	.00	170.20	.00	.00
	25.00	57.00	9.28		25.40	57.00	33.43		25.00	57.00	15.88		28.00	61.00	38.55	
	25.00	87.00	5.48		25.40	87.00	20.29		25.00	87.00	8.21		28.00	83.80	31.87	
	25.00	133.00	4.53		25.40	133.00	10.12		25.00	133.00	5.04		28.00	129.60	14.35	
	25.00	178.00	.00		25.40	178.00	.00		25.00	178.00	.00		28.00	170.20	.00	
	57.00	87.00	2.53		57.00	87.00	9.99		57.00	87.00	2.79		61.00	83.80	23.32	
	57.00	133.00	3.03		57.00	133.00	4.41		57.00	133.00	2.29		61.00	129.60	6.88	
	57.00	178.00	.00		57.00	178.00	.00		57.00	178.00	.00		61.00	170.20	.00	
	87.00	133.00	3.38		87.00	133.00	1.98		87.00	133.00	1.98		83.80	129.60	2.33	
	87.00	178.00	.00		87.00	178.00	.00		87.00	178.00	.00		83.80	170.20	.00	
	133.00	178.00	.00		133.00	178.00	.00		133.00	178.00	.00		129.60	170.20	.00	
<b>MC</b>	.00	25.00	15.97	3.33	.00	25.40	19.62	3.75	.00	25.00	12.96	3.00	.00	30.50	15.79	4.04
	.00	57.00	10.11	6.04	.00	57.00	35.56	11.33	.00	57.00	10.55	6.17	.00	55.90	38.09	11.50
	.00	87.00	9.61	8.99	.00	87.00	25.00	14.50	.00	87.00	13.95	10.83	.00	81.20	30.71	15.00
	.00	133.00	7.74	12.33	.00	133.00	16.47	17.99	.00	133.00	11.19	14.83	.00	127.00	.00	.00
	.00	178.00	6.11	14.67	.00	178.00	10.80	19.50	.00	178.00	7.89	16.67	.00	175.30	13.54	21.50
	25.00	57.00	6.45		25.40	57.00	51.79		25.00	57.00	8.83		30.50	55.90	77.63	
	25.00	87.00	7.50		25.40	87.00	27.41		25.00	87.00	14.35		30.50	81.20	42.06	
	25.00	133.00	6.25		25.40	133.00	15.76		25.00	133.00	10.80		30.50	127.00	1.58	
	25.00	178.00	4.94		25.40	178.00	9.59		25.00	178.00	7.18		30.50	175.30	13.09	
	57.00	87.00	8.70		57.00	87.00	10.05		57.00	87.00	21.72		55.90	81.20	17.22	
	57.00	133.00	6.16		57.00	133.00	6.91		57.00	133.00	11.69		55.90	127.00	23.55	
	57.00	178.00	4.58		57.00	178.00	4.10		57.00	178.00	6.78		55.90	175.30	6.31	
	87.00	133.00	4.74		87.00	133.00	5.18		87.00	133.00	6.81		81.20	127.00	96.54	
	87.00	178.00	3.51		87.00	178.00	2.72		87.00	178.00	3.71		81.20	175.30	4.29	
	133.00	178.00	2.43		133.00	178.00	1.01		133.00	178.00	1.50		127.00	175.30	178.33	

May 85		Oct 85		May 86		Oct 86	
Depth Range	Ka	tt (ms)	Depth Range	Depth Range	Ka	Depth Range	Ka
CM			CM	CM		CM	
.00	25.00	.00	.00	.00	.00	.00	.00
.00	57.00	11.10	6.33	.00	13.83	.00	55.90
.00	87.00	.00	.00	.00	22.99	.00	86.30
.00	133.00	4.11	8.99	.00	35.83	.00	124.50
.00	178.00	29.98	32.49	.00	45.83	.00	167.70
25.00	57.00	.00	25.40	57.00	.00	28.00	55.90
25.00	87.00	.00	25.40	87.00	.00	28.00	86.30
25.00	133.00	.00	25.40	133.00	.00	28.00	124.50
25.00	178.00	.00	25.40	178.00	.00	28.00	167.70
57.00	87.00	.00	57.00	87.00	83.91	55.90	86.30
57.00	133.00	1.10	57.00	133.00	75.42	55.90	124.50
57.00	178.00	42.07	57.00	178.00	62.95	55.90	167.70
87.00	133.00	.00	87.00	133.00	70.12	86.30	124.50
87.00	178.00	.00	87.00	178.00	56.70	86.30	167.70
133.00	178.00	245.44	133.00	178.00	44.44	124.50	167.70

May 87		Oct 87		May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM		CM		CM		CM	
.00	27.50	16.74	3.75	.00	27.50	14.58	3.50
.00	60.00	19.49	8.83	.00	61.00	21.83	6.25
.00	85.40	16.32	11.50	.00	83.40	24.18	10.83
.00	130.40	9.40	13.33	.00	129.20	14.98	17.00
.00	173.90	.00	.00	.00	178.90	.00	18.00
27.50	60.00	21.99	27.50	61.00	37.41	27.50	56.00
27.50	85.40	16.12	27.50	83.40	34.85	27.50	84.40
27.50	130.40	7.80	27.50	129.20	17.06	27.50	122.20
27.50	173.90	.00	27.50	178.90	.00	27.50	168.90
60.00	85.40	9.94	61.00	83.40	31.19	55.00	84.40
60.00	130.40	3.68	61.00	129.20	9.95	55.00	122.20
60.00	173.90	.00	61.00	178.90	.00	55.00	168.90
85.40	130.40	1.45	83.40	129.20	3.86	76.40	122.20
85.40	173.90	.00	83.40	178.90	.00	76.40	168.90
130.40	173.90	.00	129.20	178.90	.40	122.20	168.90

May 87		Oct 87		May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM		CM		CM		CM	
.00	27.50	16.74	3.75	.00	27.50	14.58	3.50
.00	60.00	19.49	8.83	.00	61.00	21.83	6.25
.00	85.40	16.32	11.50	.00	83.40	24.18	10.83
.00	130.40	9.40	13.33	.00	129.20	14.98	17.00
.00	173.90	.00	.00	.00	178.90	.00	18.00
27.50	60.00	21.99	27.50	61.00	37.41	27.50	56.00
27.50	85.40	16.12	27.50	83.40	34.85	27.50	84.40
27.50	130.40	7.80	27.50	129.20	17.06	27.50	122.20
27.50	173.90	.00	27.50	178.90	.00	27.50	168.90
60.00	85.40	9.94	61.00	83.40	31.19	55.00	84.40
60.00	130.40	3.68	61.00	129.20	9.95	55.00	122.20
60.00	173.90	.00	61.00	178.90	.00	55.00	168.90
85.40	130.40	1.45	83.40	129.20	3.86	76.40	122.20
85.40	173.90	.00	83.40	178.90	.00	76.40	168.90
130.40	173.90	.00	129.20	178.90	.40	122.20	168.90

May 87		Oct 87		May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM		CM		CM		CM	
.00	27.50	16.74	3.75	.00	27.50	14.58	3.50
.00	60.00	19.49	8.83	.00	61.00	21.83	6.25
.00	85.40	16.32	11.50	.00	83.40	24.18	10.83
.00	130.40	9.40	13.33	.00	129.20	14.98	17.00
.00	173.90	.00	.00	.00	178.90	.00	18.00
27.50	60.00	21.99	27.50	61.00	37.41	27.50	56.00
27.50	85.40	16.12	27.50	83.40	34.85	27.50	84.40
27.50	130.40	7.80	27.50	129.20	17.06	27.50	122.20
27.50	173.90	.00	27.50	178.90	.00	27.50	168.90
60.00	85.40	9.94	61.00	83.40	31.19	55.00	84.40
60.00	130.40	3.68	61.00	129.20	9.95	55.00	122.20
60.00	173.90	.00	61.00	178.90	.00	55.00	168.90
85.40	130.40	1.45	83.40	129.20	3.86	76.40	122.20
85.40	173.90	.00	83.40	178.90	.00	76.40	168.90
130.40	173.90	.00	129.20	178.90	.40	122.20	168.90

K Data for Moxness Wells to Zama Pipeline Route Site 84-6

	May 85			Oct 85			May 86			Oct 86						
	Depth Range CM	Ka	tt (ns)	Depth Range CM	Ka		Depth Range CM	Ka		Depth Range CM	Ka					
<b>KB</b>	.00	25.00	17.64	3.50	.00	25.40	12.47	2.99	.00	25.00	15.97	3.33	.00	25.40	16.32	3.42
	.00	57.00	25.90	9.67	.00	57.00	34.56	11.17	.00	57.00	25.90	9.67	.00	58.50	36.80	11.83
	.00	87.00	17.09	11.99	.00	87.00	29.80	15.83	.00	87.00	23.88	14.17	.00	86.30	42.12	18.67
	.00	133.00	14.41	16.83	.00	133.00	23.15	21.33	.00	133.00	19.01	19.33	.00	129.60	31.72	24.33
	.00	178.00	10.61	19.33	.00	178.00	15.91	23.67	.00	178.00	13.75	22.00	.00	172.70	22.00	27.00
	25.00	57.00	33.46		25.40	57.00	60.31		25.00	57.00	35.33		25.40	58.50	58.10	
	25.00	87.00	16.88		25.40	87.00	39.10		25.00	87.00	27.51		25.40	86.30	56.43	
	25.00	133.00	13.71		25.40	133.00	26.15		25.00	133.00	19.75		25.40	129.60	36.24	
	25.00	178.00	9.63		25.40	178.00	16.53		25.00	178.00	13.40		25.40	172.70	23.06	
	57.00	87.00	5.38		57.00	87.00	21.72		57.00	87.00	20.25		58.50	86.30	54.48	
	57.00	133.00	7.99		57.00	133.00	16.08		57.00	133.00	14.54		58.50	129.60	27.82	
	57.00	178.00	5.74		57.00	178.00	9.60		57.00	178.00	9.35		58.50	172.70	15.88	
	87.00	133.00	9.96		87.00	133.00	12.87		87.00	133.00	11.32		86.30	129.60	15.38	
	87.00	178.00	5.86		87.00	178.00	6.68		87.00	178.00	6.66		86.30	172.70	8.37	
	133.00	178.00	2.78		133.00	178.00	2.43		133.00	178.00	3.17		129.60	172.70	3.45	
<b>MC</b>	.00	25.00	10.89	2.75	.00	25.40	18.79	3.67	.00	25.00	7.82	2.33	.00	28.00	16.14	3.75
	.00	57.00	9.42	5.83	.00	57.00	37.73	11.67	.00	57.00	10.11	6.04	.00	55.90	41.47	12.00
	.00	87.00	8.59	8.50	.00	87.00	20.06	12.99	.00	87.00	8.94	8.67	.00	83.80	28.84	15.00
	.00	133.00	5.97	10.83	.00	133.00	16.47	17.99	.00	133.00	6.73	11.50	.00	129.60	20.73	19.67
	.00	178.00	5.56	13.99	.00	178.00	.00	.00	.00	178.00	5.70	14.17	.00	172.70	16.42	23.33
	25.00	57.00	8.34		25.40	57.00	57.68		25.00	57.00	12.10		28.00	55.90	78.69	
	25.00	87.00	7.74		25.40	87.00	20.60		25.00	87.00	9.41		28.00	83.80	36.58	
	25.00	133.00	5.04		25.40	133.00	15.94		25.00	133.00	6.49		28.00	129.60	22.10	
	25.00	178.00	4.86		25.40	178.00	.00		25.00	178.00	5.39		28.00	172.70	16.48	
	57.00	87.00	7.13		57.00	87.00	1.74		57.00	87.00	6.92		55.90	83.80	10.41	
	57.00	133.00	3.90		57.00	133.00	6.22		57.00	133.00	4.65		55.90	129.60	9.75	
	57.00	178.00	4.09		57.00	178.00	.00		57.00	178.00	4.06		55.90	172.70	8.47	
	87.00	133.00	2.31		87.00	133.00	10.63		87.00	133.00	3.41		83.80	129.60	9.36	
	87.00	178.00	3.28		87.00	178.00	.00		87.00	178.00	3.29		83.80	172.70	7.90	
	133.00	178.00	4.44		133.00	178.00	.00		133.00	178.00	3.17		129.60	172.70	6.49	

May 85		Oct 85		May 86		Oct 86		May 87		Oct 87		May 87		Oct 87		
Depth	Ka	tt (ns)	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka
CM			CM		CM		CM		CM		CM		CM		CM	
0.00	25.00	.00	.00	.00	.00	25.00	.00	.00	.00	28.00	.00	.00	.00	.00	.00	.00
0.00	57.00	13.53	6.99	.00	8.33	.00	8.33	19.22	8.33	.00	58.50	16.12	7.83	.00	58.00	16.12
0.00	87.00	16.64	11.83	.00	.00	.00	.00	21.67	13.50	.00	83.80	25.12	14.00	.00	83.80	25.12
0.00	133.00	17.09	18.33	.00	16.47	.00	17.99	19.03	17.00	.00	111.80	26.90	19.33	.00	111.80	26.90
0.00	178.00	9.89	18.66	.00	19.48	.00	21.67	.00	.00	.00	152.40	24.22	25.00	.00	152.40	24.22
25.00	57.00	.00	25.00	.00	.00	25.00	57.00	.00	.00	28.00	58.50	.00	.00	.00	58.50	.00
25.00	87.00	.00	25.00	56.00	.00	25.00	87.00	.00	.00	28.00	83.80	.00	.00	28.00	83.80	.00
25.00	133.00	.00	25.00	133.00	.00	25.00	116.90	.00	.00	28.00	111.80	.00	.00	28.00	111.80	.00
25.00	178.00	.00	25.00	147.30	.00	25.00	157.50	.00	.00	28.00	152.40	.00	.00	28.00	152.40	.00
57.00	87.00	23.43	57.00	56.00	.00	57.00	87.00	26.73	58.50	83.80	53.53	58.50	30.09	58.50	83.80	53.53
57.00	133.00	20.04	57.00	133.00	14.54	57.00	116.90	18.86	58.50	111.80	41.90	58.50	30.09	58.50	111.80	41.90
57.00	178.00	8.37	57.00	147.30	19.64	57.00	157.50	.00	58.50	152.40	30.09	58.50	30.09	58.50	152.40	30.09
87.00	133.00	17.97	87.00	133.00	.00	87.00	116.90	12.33	83.80	111.80	32.61	83.80	32.61	83.80	111.80	32.61
87.00	178.00	5.07	87.00	147.30	.00	87.00	157.50	.00	83.80	152.40	23.14	83.80	23.14	83.80	152.40	23.14
133.00	178.00	.05	133.00	147.30	59.60	116.90	157.50	.00	111.80	152.40	17.55	111.80	17.55	111.80	152.40	17.55

May 87		Oct 87		May 87		Oct 87		May 87		Oct 87		May 87		Oct 87	
Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka
CM		CM		CM		CM		CM		CM		CM		CM	
0.00	24.50	16.63	3.33	.00	24.50	13.49	3.00	.00	26.50	12.16	3.08	.00	27.50	13.20	3.33
0.00	57.00	27.70	10.00	.00	57.00	31.54	10.67	.00	57.00	16.98	7.83	.00	56.00	41.33	12.00
0.00	86.40	30.83	15.99	.00	85.40	45.35	19.17	.00	87.40	20.94	13.33	.00	84.40	45.56	18.99
0.00	132.20	24.18	21.67	.00	129.20	36.93	26.17	.00	132.20	.00	.00	.00	126.20	29.89	23.00
0.00	173.90	18.16	24.70	.00	165.90	.00	.00	.00	175.90	10.87	19.33	.00	168.90	21.87	26.33
24.50	57.00	37.91	24.50	57.00	50.13	26.50	57.00	21.83	27.50	56.00	83.29	21.50	57.00	.00	57.00
24.50	86.40	37.65	24.50	85.40	63.45	26.50	87.40	25.50	27.50	84.40	68.17	21.50	79.40	.00	79.40
24.50	132.20	26.10	24.50	129.20	44.08	26.50	132.20	.76	27.50	126.20	35.75	21.50	105.20	.00	105.20
24.50	173.90	18.41	24.50	165.90	.00	26.50	175.90	10.65	27.50	168.90	23.81	21.50	146.90	.00	146.90
57.00	86.40	37.36	57.00	85.40	80.62	57.00	87.40	29.46	56.00	84.40	54.52	57.00	79.40	62.02	79.40
57.00	132.20	21.67	57.00	129.20	41.48	57.00	132.20	9.76	56.00	126.20	22.10	57.00	105.20	53.12	105.20
57.00	173.90	14.23	57.00	165.90	.00	87.40	132.20	79.68	84.40	126.20	8.28	79.40	105.20	66.64	105.20
86.40	132.20	13.84	85.40	129.20	22.99	87.40	175.90	8.42	84.40	168.90	6.79	79.40	146.90	26.07	146.90
86.40	173.90	8.92	85.40	165.90	.00	87.40	175.90	4.14	84.40	168.90	6.79	79.40	146.90	26.18	146.90
132.20	173.90	4.75	129.20	165.90	.00	132.20	175.90	176.09	126.20	168.90	5.47	105.20	146.90	9.00	146.90

**K Data for Morris Wells to Zama Pipeline Route Site 84-7A**

	Oct 85		May 86		Oct 86		May 87		Oct 87											
	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka										
	CM		CM		CM		CM		CM											
<b>KB</b>																				
	.00	25.40	37.24	5.17	.00	25.40	7.60	2.33	.00	28.00	30.64	5.17	.00	24.50	22.03	3.83	.00	24.50	51.02	5.83
	.00	55.90	35.38	11.08	.00	55.90	7.81	5.21	.00	55.90	41.47	12.00	.00	53.00	14.96	6.83	.00	51.00	54.79	12.58
	.00	86.40	14.59	11.00	.00	86.40	7.88	8.08	.00	81.20	32.79	15.50	.00	76.40	11.58	8.67	.00	69.40	56.14	17.33
	.00	122.00	6.25	10.17	.00	116.90	9.61	12.08	.00	122.00	31.55	22.84	.00	110.20	10.09	11.67	.00	103.20	34.94	20.33
	.00	178.00	.00	.00	.00	177.80	6.62	15.25	.00	178.00	.00	.00	.00	178.00	.00	.00	.00	178.00	.00	.00
	25.40	55.90	33.87		25.40	55.90	7.99		28.00	55.90	53.98		24.50	53.00	9.97		24.50	51.00	58.40	
	25.40	86.40	8.23		25.40	86.40	8.00		28.00	81.20	33.95		24.50	76.40	7.80		24.50	69.40	59.04	
	25.40	122.00	2.41		25.40	116.90	10.21		28.00	122.00	31.82		24.50	110.20	7.52		24.50	103.20	30.55	
	25.40	178.00	.00		25.40	177.80	6.46		28.00	178.00	.00		24.50	178.00	.00		24.50	178.00	.00	
	55.90	86.40	.01		55.90	86.40	8.01		55.90	81.20	17.22		53.00	76.40	5.52		51.00	69.40	59.97	
	55.90	122.00	.17		55.90	116.90	11.42		55.90	122.00	24.22		53.00	110.20	6.43		51.00	103.20	19.84	
	86.40	122.00	.49		86.40	116.90	15.44		81.20	122.00	29.15		76.40	110.20	7.10		69.40	103.20	7.09	
	86.40	178.00	.00		86.40	177.80	5.53		81.20	178.00	.00		76.40	178.00	.00		69.40	178.00	.00	
	122.00	178.00	.00		116.90	177.80	2.44		122.00	178.00	.00		110.20	178.00	.00		103.20	178.00	.00	
<b>KC</b>																				
	.00	25.40	45.46	5.71	.00	25.40	68.35	7.00	.00	28.00	24.12	4.62	.00	24.50	66.63	6.67	.00	24.50	45.36	5.50
	.00	55.90	43.81	12.33	.00	55.90	26.91	9.67	.00	55.90	40.33	13.31	.00	51.00	35.76	10.17	.00	51.00	46.43	11.58
	.00	86.40	39.07	18.00	.00	86.40	17.85	12.17	.00	78.70	41.99	23.23	.00	78.40	22.27	12.33	.00	71.40	51.02	17.00
	.00	119.40	26.96	20.67	.00	116.90	11.13	13.00	.00	119.40	35.36	41.59	.00	109.20	25.37	18.33	.00	100.20	46.06	22.67
	.00	177.80	.00	.00	.00	177.80	.00	.00	.00	178.00	.00	.00	.00	177.80	.00	.00	.00	177.80	46.11	40.24
	25.40	55.90	42.46		25.40	55.90	6.88		28.00	55.90	87.25		24.50	51.00	15.70		24.50	51.00	47.43	
	25.40	86.40	36.55		25.40	86.40	6.46		28.00	78.70	121.24		24.50	78.40	9.95		24.50	71.40	54.11	
	25.40	119.40	22.79		25.40	116.90	3.87		28.00	119.40	147.25		24.50	109.20	17.08		24.50	100.20	46.29	
	25.40	177.80	.00		25.40	177.80	.00		28.00	178.00	.00		24.50	177.80	.00		24.50	177.80	46.23	
	55.90	86.40	31.09		55.90	86.40	6.06		55.90	78.70	170.41		51.00	78.40	5.63		51.00	71.40	63.44	
	55.90	119.40	15.50		55.90	116.90	2.69		55.90	119.40	178.55		51.00	109.20	17.73		51.00	100.20	45.68	
	55.90	177.80	.00		55.90	177.80	.00		55.90	178.00	.00		51.00	177.80	.00		51.00	177.80	45.98	
	86.40	119.40	5.86		86.40	116.90	.67		78.70	119.40	183.20		78.40	109.20	34.17		71.40	100.20	34.86	
	86.40	177.80	.00		86.40	177.80	.00		78.70	178.00	.00		78.40	177.80	.00		71.40	177.80	42.95	
	119.40	177.80	.00		116.90	177.80	.00		119.40	178.00	.00		109.20	177.80	.00		100.20	177.80	46.17	

MP	Oct 85		May 86		Oct 86		May 87		Oct 87		
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	
	.00	25.40	34.87	40.93	5.42	24.22	4.17	23.50	4.83	20.50	41.78
	.00	55.90	41.47	25.09	9.33	35.91	10.67	52.00	8.00	49.00	46.05
	.00	86.40	37.63	18.84	12.50	37.04	17.00	72.40	9.67	68.40	53.44
	.00	132.10	34.86	18.62	19.00	38.81	25.33	119.20	17.00	112.20	44.68
	.00	157.50	26.60	21.09	23.33	40.93	32.50	145.90	.00	148.90	25.00
	25.40	55.90	47.40	14.84	25.40	48.50	23.50	52.00	.00	49.00	49.25
	25.40	86.40	38.81	12.14	25.40	43.46	23.50	72.40	8.79	68.40	58.87
	25.40	132.10	34.86	14.59	25.40	43.21	23.50	119.20	14.55	112.20	45.34
	25.40	157.50	25.14	17.90	25.40	44.80	23.50	145.90	.00	148.90	.00
	55.90	86.40	31.08	9.71	53.40	39.07	52.00	72.40	6.00	68.40	74.55
	55.90	132.10	30.38	14.49	53.40	41.15	52.00	119.20	16.15	112.20	43.63
	86.40	132.10	29.91	18.93	53.40	43.77	52.00	145.90	.00	148.90	.00
	86.40	157.50	15.76	18.21	83.80	42.84	72.40	119.20	22.12	112.20	32.57
	132.10	157.50	1.62	40.92	122.00	45.95	72.40	145.90	.00	148.90	.00
					122.00	50.00	119.20	145.90	.00	148.90	.00

K Data for Moxam Wells to Zama Pipeline Route Site 84-7B

MB	Oct 85		May 86		Oct 86		May 87		Oct 87		
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	
	.00	25.40	10.94	6.55	2.17	5.12	1.92	23.50	1.75	21.50	12.17
	.00	55.90	17.52	7.44	5.08	16.93	7.67	55.00	4.75	42.00	19.40
	.00	86.40	21.17	10.13	9.17	20.39	13.00	83.40	8.34	70.40	30.69
	.00	132.10	17.01	10.35	14.17	22.32	20.00	134.20	14.00	119.20	27.05
	.00	177.80	.00	17.80	.00	.00	.00	178.00	.00	178.00	.00
	25.40	55.90	24.18	8.22	25.40	32.00	23.50	55.00	8.16	42.00	28.79
	25.40	86.40	26.42	11.85	25.40	29.74	23.50	83.40	10.88	70.40	41.50
	25.40	132.10	18.65	11.38	25.40	28.51	23.50	134.20	11.02	119.20	31.11
	25.40	177.80	.00	17.80	25.40	.00	23.50	178.00	.00	178.00	.00
	55.90	86.40	28.76	16.14	55.90	27.56	55.00	83.40	14.35	70.40	52.11
	55.90	132.10	16.64	12.79	55.90	27.08	55.00	134.20	12.27	119.20	31.74
	86.40	132.10	10.39	10.77	86.40	26.72	83.40	134.20	11.18	119.20	22.20
	86.40	177.80	.00	17.80	86.40	.00	83.40	178.00	.00	178.00	.00
	132.10	177.80	.00	17.80	127.00	.00	134.20	178.00	.00	178.00	.00



	Oct 85			May 86			Oct 86			May 87			Oct 87		
	Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka
	CM			CM			CM			CM			CM		
<b>MC</b>															
	.00	25.40	16.60	3.45	.00	25.40	12.21	2.96	.00	27.90	8.74	4.41	.00	22.50	15.99
	.00	55.50	18.20	7.89	.00	55.90	9.26	5.67	.00	48.30	18.01	10.31	.00	41.00	15.71
	.00	86.40	21.40	13.32	.00	86.40	11.46	9.75	.00	86.40	23.07	26.30	.00	83.40	11.68
	.00	132.10	15.79	17.50	.00	132.10	13.76	16.33	.00	121.90	29.31	43.99	.00	117.20	12.24
	.00	177.80	26.30	30.39	.00	177.80	14.41	22.50	.00	165.10	28.09	29.17	.00	177.80	.00
	25.40	55.50	19.61		25.40	55.90	7.11		27.90	48.30	75.22		22.50	41.00	15.37
	25.40	86.40	23.58		25.40	86.40	11.15		27.90	86.40	126.01		22.50	83.40	10.26
	25.40	132.10	15.60		25.40	132.10	14.14		27.90	121.90	159.55		22.50	117.20	11.42
	55.50	177.80	28.13		25.40	177.80	14.79		27.90	165.10	29.30		22.50	177.80	.00
	55.50	86.40	27.80		55.90	86.40	16.10		48.30	86.40	158.56		41.00	83.40	8.35
	55.50	132.10	14.15		55.90	132.10	17.63		48.30	121.90	188.47		41.00	117.20	10.55
	55.50	177.80	30.47		55.90	177.80	17.15		48.30	165.10	23.46		41.00	177.80	.00
	86.40	132.10	7.51		86.40	132.10	18.68		86.40	121.90	223.43		83.40	117.20	13.68
	86.40	177.80	31.40		86.40	177.80	17.51		86.40	165.10	1.19		83.40	177.80	.00
	132.10	177.80	71.67		132.10	177.80	16.37		121.90	165.10	105.94		117.20	177.80	.00
<b>MP</b>															
	.00	25.40	27.20	4.42	.00	25.40	29.30	4.58	.00	27.90	20.07	4.17	.00	26.50	8.56
	.00	55.50	33.80	10.76	.00	55.90	20.81	8.50	.00	61.00	34.35	11.92	.00	59.00	13.58
	.00	86.40	33.49	16.67	.00	86.40	17.85	12.17	.00	78.70	36.43	15.83	.00	76.40	13.92
	.00	132.10	28.89	23.67	.00	132.10	24.96	22.00	.00	127.00	34.88	25.00	.00	129.20	16.19
	.00	177.80	34.87	35.00	.00	177.80	15.95	23.67	.00	172.70	35.23	34.17	.00	178.00	.00
	25.40	55.50	39.93		25.40	55.90	14.85		27.90	61.00	49.35		26.50	59.00	18.53
	25.40	86.40	36.30		25.40	86.40	13.91		27.90	78.70	47.47		26.50	76.40	17.29
	25.40	132.10	29.30		25.40	132.10	23.98		27.90	127.00	39.78		26.50	129.20	18.55
	25.40	177.80	36.24		25.40	177.80	14.12		27.90	172.70	38.64		26.50	178.00	.00
	55.50	86.40	32.94		55.90	86.40	13.01		61.00	78.70	44.07		59.00	76.40	15.10
	55.50	132.10	25.57		55.90	132.10	28.24		61.00	127.00	35.37		59.00	129.20	18.56
	55.50	177.80	35.36		55.90	177.80	13.94		61.00	172.70	35.72		59.00	178.00	.00
	86.40	132.10	21.12		86.40	132.10	41.65		78.70	127.00	19.78		76.40	129.20	19.78
	86.40	177.80	36.20		86.40	177.80	14.25		78.70	172.70	34.24		76.40	178.00	.00
	132.10	177.80	55.32		132.10	177.80	1.20		127.00	172.70	36.21		129.20	178.00	.00

K Data for Morass Wells to Zama Pipeline Route Site 84-7C

KB	Oct 85		May 86		Oct 86		May 87		Oct 87	
	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka
	CM		CM		CM		CM		CM	
.00	25.40	9.31	2.58	.00	25.40	10.55	2.75	.00	25.40	8.15
.00	55.90	15.14	7.25	.00	55.90	9.52	5.75	.00	55.90	13.45
.00	86.40	14.15	10.83	.00	86.40	8.71	8.50	.00	86.40	13.62
.00	132.10	10.10	13.99	.00	132.10	9.63	13.66	.00	127.00	13.69
.00	177.80	.00	.00	.00	177.80	.00	.00	.00	178.00	.00
25.40	55.90	21.07	25.40	55.90	8.70	8.70	25.40	55.90	18.87	
25.40	86.40	16.46	25.40	86.40	8.00	8.00	25.40	86.40	16.31	
25.40	132.10	10.29	25.40	132.10	9.42	9.42	25.40	127.00	15.30	
25.40	177.80	.00	25.40	177.80	.00	.00	25.40	178.00	.00	
55.90	86.40	12.42	55.90	86.40	7.32	7.32	55.90	86.40	13.93	
55.90	132.10	7.05	55.90	132.10	9.71	9.71	55.90	127.00	13.88	
55.90	177.80	.00	55.90	177.80	.00	.00	55.90	178.00	.00	
86.40	132.10	4.30	86.40	132.10	11.50	11.50	86.40	127.00	13.84	
86.40	177.80	.00	86.40	177.80	.00	.00	86.40	178.00	.00	
132.10	177.80	.00	132.10	177.80	.00	.00	127.00	178.00	.00	
MC	.00	25.40	4.17	.00	25.40	34.80	4.99	.00	24.50	18.76
.00	55.90	26.91	9.67	.00	55.90	16.93	7.67	.00	53.30	21.13
.00	86.40	29.59	15.67	.00	86.40	16.88	11.83	.00	83.80	26.33
.00	132.10	21.32	20.33	.00	116.90	14.33	14.75	.00	121.90	26.71
.00	147.30	27.68	25.83	.00	147.30	21.94	23.00	.00	162.60	22.72
25.40	55.90	29.26	25.40	55.90	6.91	6.91	25.40	53.30	81.92	
25.40	86.40	31.98	25.40	86.40	11.31	11.31	25.40	83.80	111.36	
25.40	132.10	20.66	25.40	116.90	10.23	10.23	25.40	121.90	149.81	
25.40	147.30	28.43	25.40	147.30	19.63	19.63	25.40	162.60	22.76	
55.90	86.40	34.83	55.90	86.40	16.79	16.79	53.30	83.80	143.30	
55.90	132.10	17.63	55.90	116.90	12.14	12.14	53.30	121.90	184.37	
55.90	147.30	28.16	55.90	147.30	25.32	25.32	53.30	162.60	13.27	
86.40	132.10	9.38	86.40	116.90	8.24	8.24	83.80	121.90	220.98	
86.40	147.30	25.08	86.40	147.30	30.26	30.26	83.80	162.60	.18	
132.10	147.30	117.86	116.90	147.30	66.25	66.25	121.90	162.60	171.71	

KB	Oct 85		May 86		Oct 86		May 87		Oct 87	
	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka
	CM		CM		CM		CM		CM	
.00	25.40	9.31	2.58	.00	25.40	10.55	2.75	.00	25.40	8.15
.00	55.90	15.14	7.25	.00	55.90	9.52	5.75	.00	55.90	13.45
.00	86.40	14.15	10.83	.00	86.40	8.71	8.50	.00	86.40	13.62
.00	132.10	10.10	13.99	.00	132.10	9.63	13.66	.00	127.00	13.69
.00	177.80	.00	.00	.00	177.80	.00	.00	.00	178.00	.00
25.40	55.90	21.07	25.40	55.90	8.70	8.70	25.40	55.90	18.87	
25.40	86.40	16.46	25.40	86.40	8.00	8.00	25.40	86.40	16.31	
25.40	132.10	10.29	25.40	132.10	9.42	9.42	25.40	127.00	15.30	
25.40	177.80	.00	25.40	177.80	.00	.00	25.40	178.00	.00	
55.90	86.40	12.42	55.90	86.40	7.32	7.32	55.90	86.40	13.93	
55.90	132.10	7.05	55.90	132.10	9.71	9.71	55.90	127.00	13.88	
55.90	177.80	.00	55.90	177.80	.00	.00	55.90	178.00	.00	
86.40	132.10	4.30	86.40	132.10	11.50	11.50	86.40	127.00	13.84	
86.40	177.80	.00	86.40	177.80	.00	.00	86.40	178.00	.00	
132.10	177.80	.00	132.10	177.80	.00	.00	127.00	178.00	.00	
MC	.00	25.40	4.17	.00	25.40	34.80	4.99	.00	24.50	18.76
.00	55.90	26.91	9.67	.00	55.90	16.93	7.67	.00	53.30	21.13
.00	86.40	29.59	15.67	.00	86.40	16.88	11.83	.00	83.80	26.33
.00	132.10	21.32	20.33	.00	116.90	14.33	14.75	.00	121.90	26.71
.00	147.30	27.68	25.83	.00	147.30	21.94	23.00	.00	162.60	22.72
25.40	55.90	29.26	25.40	55.90	6.91	6.91	25.40	53.30	81.92	
25.40	86.40	31.98	25.40	86.40	11.31	11.31	25.40	83.80	111.36	
25.40	132.10	20.66	25.40	116.90	10.23	10.23	25.40	121.90	149.81	
25.40	147.30	28.43	25.40	147.30	19.63	19.63	25.40	162.60	22.76	
55.90	86.40	34.83	55.90	86.40	16.79	16.79	53.30	83.80	143.30	
55.90	132.10	17.63	55.90	116.90	12.14	12.14	53.30	121.90	184.37	
55.90	147.30	28.16	55.90	147.30	25.32	25.32	53.30	162.60	13.27	
86.40	132.10	9.38	86.40	116.90	8.24	8.24	83.80	121.90	220.98	
86.40	147.30	25.08	86.40	147.30	30.26	30.26	83.80	162.60	.18	
132.10	147.30	117.86	116.90	147.30	66.25	66.25	121.90	162.60	171.71	

	Oct 85		May 86		Oct 86		May 87		Oct 87						
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka					
MP	.00 25.40	21.40	3.92	.00 25.40	36.04	5.08	.00 25.40	17.09	3.50	.00 21.50	31.15	4.00	.00 22.50	44.40	5.00
	.00 55.90	27.85	9.83	.00 55.90	26.91	9.67	.00 53.30	23.79	8.67	.00 48.00	21.97	7.50	.00 45.00	40.10	9.50
	.00 86.40	27.13	15.00	.00 86.40	17.85	12.17	.00 83.80	24.52	13.83	.00 78.40	18.26	11.17	.00 74.40	32.60	14.16
	.00 132.10	19.94	19.66	.00 132.10	14.04	16.50	.00 106.70	40.00	22.49	.00 113.20	16.51	15.33	.00 110.20	35.87	22.00
	.00 162.60	.00	.00	.00 162.60	24.20	26.66	.00 162.60	28.95	29.16	.00 160.90	14.37	20.33	.00 152.90	.00	.00
	.25.40 55.90	33.87		25.40 55.90	20.32		25.40 53.30	30.85		21.50 48.00	15.70		22.50 45.00	36.02	
	25.40 86.40	29.72		25.40 86.40	12.14		25.40 83.80	28.17		21.50 78.40	14.28		22.50 74.40	28.05	
	25.40 132.10	19.60		25.40 132.10	10.30		25.40 106.70	49.13		21.50 113.20	13.74		22.50 110.20	33.83	
	25.40 162.60	.00		25.40 162.60	22.27		25.40 162.60	31.49		21.50 160.90	12.35		22.50 152.90	.00	
	55.90 86.40	25.83		55.90 86.40	6.06		53.30 83.80	25.82		48.00 78.40	13.10		45.00 74.40	22.62	
	55.90 132.10	14.98		55.90 132.10	7.24		53.30 106.70	60.36		48.00 113.20	12.99		45.00 110.20	33.09	
	55.90 162.60	.00		55.90 162.60	22.84		53.30 162.60	31.65		48.00 160.90	11.63		45.00 152.90	.00	
	86.40 132.10	9.37		86.40 132.10	8.09		83.80 106.70	128.78		78.40 113.20	12.89		74.40 110.20	43.17	
	86.40 162.60	.00		86.40 162.60	32.57		83.80 162.60	34.06		78.40 160.90	11.10		74.40 152.90	.00	
	132.10 162.60	.00		132.10 162.60	99.94		106.70 162.60	12.81		113.20 160.90	9.89		110.20 152.90	.00	

K Data for Norman Wells to Zama Pipeline Route Site 84-8A

	Oct 85		May 86		Oct 86		May 87		Oct 87						
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka					
MS	.00 25.40	2.47	1.33	.00 25.00	9.00	2.50	.00 28.30	1.31	1.08	.00 25.50	4.24	1.75	.00 25.50	2.16	1.25
	.00 57.00	6.46	4.83	.00 57.00	15.58	7.50	.00 55.90	7.94	5.25	.00 56.00	10.33	6.00	.00 56.00	7.41	5.08
	.00 87.00	5.55	6.83	.00 87.00	9.10	8.75	.00 86.30	7.71	7.99	.00 80.40	7.83	7.50	.00 81.40	7.80	7.58
	.00 133.00	6.35	11.17	.00 133.00	7.42	12.08	.00 127.00	8.72	12.50	.00 128.20	7.24	11.50	.00 127.20	8.58	12.42
	.00 178.00	5.83	14.33	.00 178.00	7.12	15.83	.00 172.70	8.22	16.50	.00 174.90	6.62	15.00	.00 172.90	7.87	16.17
	25.40 57.00	11.04		25.00 57.00	21.97		28.30 55.90	20.54		25.50 56.00	17.48		25.50 56.00	14.19	
	25.40 87.00	7.17		25.00 87.00	9.15		28.30 86.30	12.77		25.50 80.40	9.87		25.50 81.40	11.54	
	25.40 133.00	7.53		25.00 133.00	7.08		28.30 127.00	12.05		25.50 128.20	8.11		25.50 127.20	10.86	
	25.40 178.00	6.53		25.00 178.00	6.83		28.30 172.70	10.26		25.50 174.90	7.08		25.50 172.90	9.22	
	57.00 87.00	4.00		57.00 87.00	1.56		55.90 86.30	7.31		56.00 80.40	3.40		56.00 81.40	8.72	
	57.00 133.00	6.26		57.00 133.00	3.27		55.90 127.00	9.36		56.00 128.20	5.22		56.00 127.20	9.56	
	57.00 178.00	5.55		57.00 178.00	4.27		55.90 172.70	8.35		56.00 174.90	5.16		56.00 172.90	8.10	
	87.00 133.00	8.01		87.00 133.00	4.72		86.30 127.00	11.05		80.40 128.20	6.30		81.40 127.20	10.05	
	87.00 178.00	6.11		87.00 178.00	5.45		86.30 172.70	8.73		80.40 174.90	5.67		81.40 172.90	7.93	
	133.00 178.00	4.44		133.00 178.00	6.25		127.00 172.70	6.89		128.20 174.90	5.06		127.20 172.90	6.06	

	Oct 85			May 86			Oct 86			May 87			Oct 87			
	Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka	
	CM			CM			CM			CM			CM			
MC	.00	25.40	7.06	2.25	.00	25.00	21.12	3.83	.00	28.00	8.68	2.75	.00	24.50	11.34	
	.00	57.00	14.56	7.25	.00	57.00	14.56	7.25	.00	55.90	14.81	7.17	.00	54.00	13.04	
	.00	87.00	12.91	10.42	.00	87.00	10.73	9.50	.00	83.80	15.99	11.17	.00	84.40	8.77	
	.00	133.00	11.19	14.83	.00	133.00	8.38	12.83	.00	127.00	15.51	16.67	.00	125.20	8.62	
	.00	178.00	7.73	16.50	.00	178.00	7.12	15.83	.00	172.70	10.52	18.67	.00	173.90	7.08	
	25.40	57.00	22.53		25.00	57.00	10.28		28.00	55.90	22.59	24.50	54.00	14.54	25.50	53.00
	25.40	87.00	15.83		25.00	87.00	7.53		28.00	83.80	20.49	24.50	84.40	14.94	25.50	82.40
	25.40	133.00	12.30		25.00	133.00	6.25		28.00	127.00	17.79	24.50	125.20	8.01	25.50	127.20
	57.00	178.00	7.85		57.00	178.00	5.54		55.90	83.80	18.50	54.00	84.40	3.26	53.00	82.40
	57.00	133.00	8.95		57.00	133.00	4.85		55.90	127.00	16.07	54.00	125.20	5.87	53.00	127.20
	57.00	178.00	5.26		57.00	178.00	4.53		55.90	172.70	8.72	54.00	173.90	4.98	53.00	171.90
	87.00	178.00	8.27		87.00	178.00	4.72		83.80	127.00	14.59	84.40	125.20	8.31	82.40	127.20
	87.00	178.00	4.02		87.00	178.00	4.35		83.80	172.70	6.41	84.40	173.90	5.65	82.40	171.90
	133.00	178.00	1.24		133.00	178.00	4.00		127.00	172.70	1.72	125.20	173.90	3.81	127.20	171.90
MP	.00	25.00	6.78	2.17	.00	25.00	9.59	2.58	.00	28.00	7.64	2.58	.00	26.50	8.53	
	.00	57.00	5.61	4.50	.00	57.00	8.63	5.58	.00	58.50	7.47	5.33	.00	56.00	9.49	
	.00	87.00	6.83	7.58	.00	87.00	12.30	10.17	.00	86.30	8.39	8.33	.00	84.40	12.94	
	.00	133.00	8.70	13.08	.00	133.00	8.38	12.83	.00	127.00	9.92	13.33	.00	128.20	9.37	
	.00	178.00	10.80	19.50	.00	178.00	10.99	19.67	.00	175.30	13.13	21.17	.00	173.90	10.94	
	25.00	57.00	4.77		25.00	57.00	7.91		28.00	58.50	7.32	26.50	56.00	10.39	26.50	56.00
	25.00	87.00	6.85		25.00	87.00	13.49		28.00	86.30	8.75	26.50	84.40	15.26	26.50	84.40
	25.00	133.00	9.18		25.00	133.00	8.11		28.00	127.00	10.61	26.50	128.20	9.59	26.50	128.20
	25.00	178.00	11.55		25.00	178.00	11.23		28.00	175.30	14.33	26.50	173.90	11.40	26.50	173.90
	57.00	87.00	9.49		57.00	87.00	21.07		58.50	86.30	10.48	56.00	84.40	21.31	56.00	84.40
	57.00	133.00	11.47		57.00	133.00	8.19		58.50	127.00	12.28	56.00	128.20	9.28	56.00	128.20
	57.00	178.00	13.83		57.00	178.00	12.20		58.50	175.30	16.55	56.00	173.90	11.66	56.00	173.90
	87.00	133.00	12.87		87.00	133.00	3.01		86.30	127.00	13.58	84.40	128.20	4.11	84.40	128.20
	87.00	178.00	15.44		87.00	178.00	9.81		86.30	175.30	18.73	84.40	173.90	9.20	84.40	173.90
	133.00	178.00	18.32		133.00	178.00	20.79		127.00	175.30	23.71	128.20	173.90	15.98	128.20	173.90

K Data for Mounson Wells to Zama Pipeline Route Site 84-8B

	Oct 85		May 86		Oct 86		May 87		Oct 87	
	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka
	CM		CM		CM		CM		CM	
<b>KB</b>										
	.00	25.40	2.00	.00	25.00	15.97	3.33	.00	28.00	5.81
	.00	57.00	.00	.00	57.00	24.95	9.49	.00	55.90	23.96
	.00	87.00	24.42	.00	87.00	26.15	14.83	.00	83.80	37.04
	.00	133.00	18.35	.00	133.00	21.74	20.67	.00	129.20	26.65
	.00	178.00	15.46	.00	178.00	.00	.00	.00	172.70	26.44
	25.40	57.00	.00	25.00	57.00	33.35	.00	24.50	55.00	25.76
	25.40	87.00	36.06	25.00	87.00	30.96	28.00	24.50	87.40	31.84
	25.40	133.00	22.44	25.00	133.00	23.20	28.00	24.50	129.20	26.10
	25.40	178.00	17.58	25.00	178.00	.00	28.00	24.50	175.90	20.46
	57.00	87.00	.00	57.00	87.00	28.52	55.90	55.00	87.40	38.14
	57.00	133.00	.00	57.00	133.00	19.48	55.90	55.00	129.20	26.24
	87.00	178.00	.00	87.00	178.00	.00	55.90	55.00	175.90	19.22
	87.00	133.00	9.24	87.00	133.00	14.51	83.80	87.40	129.20	18.54
	87.00	178.00	8.80	87.00	178.00	.00	83.80	87.40	174.90	18.44
	133.00	178.00	8.37	133.00	178.00	.00	129.20	129.20	174.90	11.49
<b>KC</b>										
	.00	25.40	17.48	.00	25.00	30.21	4.58	.00	25.40	27.25
	.00	57.00	28.59	.00	57.00	20.01	8.50	.00	55.90	35.94
	.00	87.00	25.00	.00	87.00	17.09	11.99	.00	86.30	36.29
	.00	133.00	17.73	.00	133.00	11.83	15.25	.00	127.00	27.82
	.00	178.00	14.60	.00	178.00	10.99	19.67	.00	175.30	17.82
	25.40	57.00	39.50	25.00	57.00	13.51	25.40	24.50	54.00	6.46
	25.40	87.00	28.49	25.00	87.00	12.86	25.40	24.50	82.40	8.12
	25.40	133.00	17.79	25.00	133.00	8.78	25.40	24.50	127.20	6.40
	25.40	178.00	14.14	25.00	178.00	8.75	25.40	24.50	170.90	6.73
	57.00	87.00	18.84	57.00	87.00	12.18	55.90	54.00	82.40	10.04
	57.00	133.00	11.28	57.00	133.00	7.10	55.90	54.00	127.20	6.37
	57.00	178.00	9.62	57.00	178.00	7.67	55.90	54.00	170.90	6.80
	87.00	133.00	7.40	87.00	133.00	4.52	86.30	82.40	127.20	4.48
	87.00	178.00	7.25	87.00	178.00	6.41	86.30	82.40	170.90	5.89
	133.00	178.00	7.11	133.00	178.00	8.68	127.00	127.20	170.90	7.54

Depth Range CM	May 86		Oct 86		May 87		Oct 87	
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka
.00	25.00	6.23	2.08	10.89	2.75	7.17	2.50	12.88
.00	57.00	9.94	5.99	12.32	6.67	9.52	5.75	9.16
.00	87.00	6.32	7.29	8.25	8.33	12.22	9.17	7.50
.00	133.00	9.51	13.67	9.96	13.99	13.06	15.00	9.48
.00	178.00	6.97	15.67	7.73	16.50	13.06	30.00	12.75
25.00	57.00	13.44	25.00	13.51	28.00	12.21	26.50	6.44
25.00	87.00	6.36	25.00	7.29	28.00	15.58	26.50	6.51
25.00	133.00	10.36	25.00	9.75	28.00	15.10	26.50	8.65
25.00	178.00	7.10	25.00	7.27	28.00	33.66	26.50	5.87
57.00	87.00	1.69	57.00	2.76	55.90	20.25	57.00	6.62
57.00	133.00	9.19	57.00	8.35	55.90	40.51	57.00	5.72
57.00	178.00	5.76	57.00	5.94	55.90	16.36	77.40	9.77
87.00	133.00	17.31	87.00	13.63	55.90	14.58	77.40	11.33
87.00	178.00	7.63	87.00	7.25	78.70	46.64	77.40	5.53
133.00	178.00	1.78	133.00	2.80	124.50	96.96	124.20	1.66

X Data for Norman Wells to Zama Pipeline Route Site 84-9

Depth Range CM	May 86		Oct 86		May 87		Oct 87	
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka
.00	25.40	13.23	3.08	44.84	5.58	21.44	3.92	43.10
.00	57.00	13.89	7.08	27.65	9.99	21.20	8.58	30.96
.00	87.00	18.08	12.33	22.74	13.83	21.63	12.99	23.56
.00	133.00	.00	.00	23.89	21.67	18.75	18.33	22.28
.00	178.00	.00	.00	24.17	29.17	17.34	24.33	22.28
25.40	57.00	14.42	25.00	17.09	25.40	21.01	25.50	21.50
25.40	87.00	20.29	25.00	15.94	25.40	21.71	25.50	16.59
25.40	133.00	.00	25.00	19.98	25.40	18.10	25.50	18.21
25.40	178.00	.00	25.00	21.40	25.40	16.68	25.50	19.46
57.00	87.00	27.56	57.00	14.75	55.90	22.49	53.00	12.45
57.00	133.00	.00	57.00	21.26	55.90	16.92	53.00	17.09
57.00	178.00	.00	57.00	22.61	55.90	15.66	53.00	19.03
87.00	133.00	.00	87.00	26.14	83.80	13.75	81.40	20.19
87.00	178.00	.00	87.00	25.57	83.80	13.82	81.40	21.23
133.00	178.00	.00	133.00	25.00	127.00	13.89	129.20	22.27

	Oct 85		May 86		Oct 86		May 87		Oct 87	
	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka
	CM		CM		CM		CM		CM	
<b>KC</b>										
	.00	25.40	3.83	.00	25.00	44.84	5.58	.00	25.40	31.47
	.00	57.00	8.33	.00	57.00	25.42	9.58	.00	55.90	27.38
	.00	87.00	12.33	.00	87.00	22.22	13.67	.00	83.80	23.63
	.00	133.00	18.35	.00	133.00	20.33	19.99	.00	127.00	23.06
	.00	178.00	.00	.00	178.00	.00	.00	.00	178.00	.00
	25.40	57.00	18.25	25.00	57.00	14.06	25.40	55.90	24.19	24.19
	25.40	87.00	17.14	25.00	87.00	15.32	25.40	83.80	20.57	20.57
	25.40	133.00	17.87	25.00	133.00	16.02	25.40	127.00	21.16	21.16
	25.40	178.00	.00	25.00	178.00	.00	25.40	178.00	.00	.00
	57.00	87.00	16.00	57.00	87.00	16.73	55.90	83.80	16.96	16.96
	57.00	133.00	17.71	57.00	133.00	16.89	55.90	127.00	19.93	19.93
	57.00	178.00	.00	57.00	178.00	.00	55.90	178.00	.00	.00
	87.00	133.00	18.87	87.00	133.00	16.99	83.80	127.00	21.97	21.97
	87.00	178.00	.00	87.00	178.00	.00	83.80	178.00	.00	.00
	133.00	178.00	.00	133.00	178.00	.00	127.00	178.00	.00	.00
<b>KP</b>										
	.00	25.00	3.96	.00	25.00	36.00	5.00	.00	28.00	26.78
	.00	57.00	8.41	.00	57.00	25.90	9.67	.00	55.90	25.50
	.00	87.00	12.08	.00	87.00	23.88	14.17	.00	83.80	21.93
	.00	133.00	.00	.00	133.00	.00	.00	.00	124.50	29.84
	.00	178.00	.00	.00	178.00	27.00	30.83	.00	167.70	22.76
	25.00	57.00	17.40	25.00	57.00	19.17	28.00	55.90	24.25	24.25
	25.00	87.00	15.44	25.00	87.00	19.69	28.00	83.80	19.67	19.67
	25.00	133.00	.00	25.00	133.00	.00	28.00	124.50	30.76	30.76
	25.00	178.00	.00	25.00	178.00	25.65	28.00	167.70	22.00	22.00
	57.00	87.00	13.47	57.00	87.00	20.25	55.90	83.80	15.57	15.57
	57.00	133.00	.00	57.00	133.00	.00	55.90	124.50	33.63	33.63
	57.00	178.00	.00	57.00	178.00	27.52	55.90	164.90	26.89	26.89
	87.00	133.00	.00	87.00	133.00	.00	83.80	124.50	49.97	49.97
	87.00	178.00	.00	87.00	178.00	30.17	83.80	167.70	23.61	23.61
	133.00	178.00	.00	133.00	178.00	.00	124.50	167.70	7.72	7.72

K Data for Korman Wells to Zama Pipeline Route Site 84-18A

	Oct 85		May 86		Oct 86		May 87		Oct 87										
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka									
KB	.00	25.40	3.29	.00	25.00	28.13	4.42	.00	28.00	12.73	3.33	.00	25.50	25.00	4.25	.00	25.50	12.79	3.04
	.00	57.00	7.67	.00	57.00	49.22	13.33	.00	55.90	21.20	8.58	.00	51.00	20.36	7.67	.00	51.00	18.79	7.37
	.00	87.00	12.33	.00	87.00	20.10	13.00	.00	83.80	20.28	12.58	.00	83.40	17.62	11.67	.00	82.40	19.89	12.25
	.00	133.00	.00	.00	133.00	.00	.00	.00	129.60	.00	.00	.00	129.20	.00	.00	.00	130.20	24.93	21.67
	.00	178.00	.00	.00	178.00	.00	.00	.00	175.30	.00	.00	.00	176.90	9.66	18.33	.00	174.90	47.05	39.99
	25.40	57.00	17.29	25.00	57.00	69.77	.00	28.00	55.90	31.87	25.50	51.00	16.19	25.50	51.00	25.50	51.00	25.95	
	25.40	87.00	19.38	25.00	87.00	17.24	.00	28.00	83.80	24.73	25.50	83.40	14.78	25.50	82.40	23.58	25.50	130.20	23.58
	25.40	133.00	.00	25.00	133.00	.00	.00	28.00	129.60	.00	25.50	129.20	.00	25.50	130.20	28.50	25.50	174.90	55.05
	25.40	178.00	.00	25.00	178.00	.00	.00	28.00	175.30	.00	25.50	176.90	7.78	25.50	174.90	55.05	51.00	82.40	21.74
	57.00	87.00	21.72	57.00	87.00	.11	.00	55.90	83.80	18.50	51.00	83.40	13.72	51.00	82.40	21.74	51.00	130.20	29.34
	57.00	133.00	.00	57.00	133.00	.00	.00	55.90	129.60	.00	51.00	129.20	.00	51.00	130.20	29.34	51.00	174.90	62.38
	57.00	178.00	.00	57.00	178.00	.00	.00	51.00	175.30	.00	51.00	176.90	6.45	51.00	174.90	62.38	82.40	130.20	34.95
	87.00	133.00	.00	87.00	133.00	.00	.00	83.80	129.60	.00	83.40	129.20	.00	82.40	130.20	34.95	82.40	174.90	80.94
	87.00	178.00	.00	87.00	178.00	.00	.00	83.80	175.30	.00	83.40	176.90	4.57	82.40	174.90	80.94	130.20	174.90	151.17
	133.00	178.00	.00	133.00	178.00	.00	.00	129.60	175.30	.00	129.20	176.90	.00	130.20	174.90	151.17			

	Oct 85		May 86		Oct 86		May 87		Oct 87										
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka									
KC	.00	25.40	4.83	.00	25.00	57.70	6.33	.00	28.00	36.26	5.62	.00	25.50	49.83	6.00	.00	27.50	26.85	4.75
	.00	57.00	11.08	.00	57.00	23.96	9.30	.00	55.90	42.03	12.08	.00	53.00	25.95	9.00	.00	49.00	38.77	10.17
	.00	87.00	16.55	.00	87.00	22.74	13.83	.00	83.80	39.25	17.50	.00	84.40	25.37	14.17	.00	77.40	30.16	14.17
	.00	133.00	22.33	.00	133.00	20.35	20.00	.00	127.00	29.96	23.17	.00	127.20	33.85	24.67	.00	118.20	25.77	20.00
	.00	178.00	28.33	.00	178.00	.00	.00	.00	170.20	31.97	32.08	.00	169.90	34.64	33.33	.00	158.90	25.98	27.00
	25.40	57.00	35.21	25.00	57.00	7.75	.00	28.00	55.90	48.25	25.50	53.00	10.71	27.50	49.00	57.20	27.50	77.40	32.07
	25.40	87.00	32.58	25.00	87.00	13.17	.00	28.00	83.80	40.80	25.50	84.40	17.32	27.50	77.40	32.07	27.50	118.20	25.44
	25.40	133.00	23.81	25.00	133.00	14.42	.00	28.00	127.00	28.28	25.50	127.20	30.33	27.50	118.20	25.44	27.50	158.90	25.81
	25.40	178.00	21.34	25.00	178.00	.00	.00	28.00	170.20	31.16	25.50	169.90	32.24	27.50	158.90	25.81	49.00	77.40	17.85
	57.00	87.00	29.92	57.00	87.00	20.52	.00	55.90	83.80	33.97	53.00	84.40	24.40	49.00	77.40	17.85	49.00	118.20	18.16
	57.00	133.00	19.72	57.00	133.00	17.84	.00	55.90	127.00	21.90	53.00	127.20	40.14	49.00	118.20	18.16	49.00	158.90	21.11
	57.00	178.00	18.29	57.00	178.00	.00	.00	55.90	170.20	27.56	53.00	169.90	38.99	49.00	158.90	21.11	77.40	118.20	18.38
	87.00	133.00	14.21	87.00	133.00	16.19	.00	83.80	127.00	15.50	84.40	127.20	54.17	77.40	118.20	18.38	77.40	158.90	22.30
	87.00	178.00	15.08	87.00	178.00	.00	.00	83.80	170.20	25.63	84.40	169.90	45.20	118.20	158.90	26.62	118.20	158.90	26.62
	133.00	178.00	16.00	133.00	178.00	.00	.00	127.00	170.20	38.29	127.20	169.90	37.02						



Depth CM	Oct 85		May 86		Oct 86		May 87		Oct 87	
	Range	Ka	Range	Ka	Range	Ka	Range	Ka	Range	Ka
.00	25.00	33.59	4.83	.00	25.00	43.56	5.50	.00	25.40	44.06
.00	57.00	39.89	12.00	.00	57.00	45.60	12.83	.00	55.90	46.24
.00	87.00	21.03	13.30	.00	87.00	39.95	18.33	.00	86.30	37.01
.00	133.00	15.58	17.50	.00	133.00	.00	.00	.00	127.00	35.80
.00	178.00	14.92	22.92	.00	178.00	.00	.00	.00	172.70	31.87
25.00	57.00	45.18		25.00	57.00	47.22		25.40	55.90	48.09
25.00	87.00	16.80		25.00	87.00	38.54		25.40	86.30	34.25
25.00	133.00	12.39		25.00	133.00	.00		25.40	127.00	33.87
25.00	178.00	12.58		25.00	178.00	.00		25.40	172.70	29.97
57.00	87.00	1.69		57.00	87.00	30.25		55.90	86.30	22.72
57.00	133.00	4.71		57.00	133.00	.00		55.90	127.00	28.53
57.00	178.00	7.33		57.00	178.00	.00		55.90	172.70	25.94
87.00	133.00	7.50		87.00	133.00	.00		86.30	127.00	33.31
87.00	178.00	10.06		87.00	178.00	.00		86.30	172.70	27.13
133.00	178.00	13.06		133.00	178.00	.00		127.00	172.70	22.15

**K Data for Mormon Wells to Zama Pipeline Route Site 84-108**

Depth CM	Oct 85		May 86		Oct 86		May 87		Oct 87	
	Range	Ka	Range	Ka	Range	Ka	Range	Ka	Range	Ka
.00	25.40	12.89	3.04	.00	25.00	25.04	4.17	.00	22.90	15.45
.00	57.00	10.24	6.08	.00	57.00	7.64	5.25	.00	50.80	25.67
.00	87.00	11.12	9.67	.00	87.00	7.59	7.99	.00	78.70	17.58
.00	133.00	8.38	12.83	.00	133.00	6.73	11.50	.00	127.00	12.56
.00	178.00	5.83	14.33	.00	178.00	6.11	14.67	.00	170.20	8.29
25.40	57.00	8.33		25.00	57.00	1.03		22.90	50.80	36.00
25.40	87.00	10.43		25.00	87.00	3.42		22.90	78.70	18.50
25.40	133.00	7.45		25.00	133.00	4.15		22.90	127.00	11.96
25.40	178.00	4.93		25.00	178.00	4.24		22.90	170.20	7.37
57.00	87.00	12.89		57.00	87.00	7.51		50.80	78.70	6.77
57.00	133.00	7.10		57.00	133.00	6.09		50.80	127.00	6.39
57.00	178.00	4.18		57.00	178.00	5.45		50.80	170.20	3.79
87.00	133.00	4.25		87.00	133.00	5.24		78.70	127.00	6.17
87.00	178.00	2.36		87.00	178.00	4.85		78.70	170.20	3.05
133.00	178.00	1.00		133.00	178.00	4.47		127.00	170.20	.85

Oct 85			May 86			Oct 86			May 87			Oct 87		
Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka
CM			CM			CM			CM			CM		
.00	25.40	14.02	3.17	.00	25.40	14.02	3.17	.00	21.50	13.88	2.67	.00	23.00	17.97
.00	57.00	16.98	7.83	.00	57.00	8.38	5.50	.00	53.40	29.51	9.67	.00	49.00	26.01
.00	87.00	16.89	11.92	.00	87.00	7.99	7.99	.00	81.20	22.47	12.83	.00	74.40	18.51
.00	133.00	11.36	14.94	.00	133.00	6.38	11.20	.00	127.00	15.81	16.83	.00	118.20	15.67
.00	178.00	10.07	18.83	.00	178.00	6.54	15.17	.00	167.70	13.23	20.33	.00	162.90	12.90
25.40	57.00	19.57		25.00	57.00	4.14		25.40	53.40	48.50		21.50	52.00	34.36
25.40	87.00	18.16		25.00	87.00	5.08		25.40	81.20	26.97		21.50	78.40	18.76
25.40	133.00	10.77		25.00	133.00	4.78		25.40	127.00	16.27		21.50	118.20	15.32
25.40	178.00	9.48		25.00	178.00	5.39		25.40	167.70	13.09		21.50	162.90	12.14
57.00	87.00	16.73		57.00	87.00	6.20		53.40	81.20	11.63		49.00	74.40	7.64
57.00	133.00	7.88		57.00	133.00	5.06		53.40	127.00	8.52		49.00	118.20	10.13
57.00	178.00	7.44		57.00	178.00	5.75		53.40	167.70	7.83		49.00	162.90	8.66
87.00	133.00	3.88		87.00	133.00	4.38		81.20	127.00	6.86		74.40	118.20	11.73
87.00	178.00	5.19		87.00	178.00	5.60		81.20	167.70	6.77		74.40	162.90	8.96
133.00	178.00	6.73		133.00	178.00	7.00		127.00	167.70	6.66		118.20	162.90	6.61

Oct 85			May 86			Oct 86			May 87			Oct 87		
Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka	Depth	Range	Ka
CM			CM			CM			CM			CM		
.00	25.00	25.04	4.17	.00	25.00	59.35	6.42	.00	28.00	33.72	5.42	.00	23.00	56.25
.00	57.00	42.73	12.42	.00	57.00	41.57	12.25	.00	55.90	51.18	13.33	.00	53.00	37.58
.00	87.00	52.39	20.99	.00	87.00	47.51	19.99	.00	83.80	58.31	21.33	.00	83.40	42.72
.00	133.00	.00	.00	.00	133.00	63.83	35.42	.00	132.10	53.91	32.33	.00	132.20	57.21
.00	178.00	27.00	30.83	.00	178.00	59.66	45.83	.00	170.20	62.91	45.00	.00	169.90	54.14
25.00	57.00	59.82		25.00	57.00	29.87		28.00	55.90	72.34		23.00	53.00	25.81
25.00	87.00	66.24		25.00	87.00	43.11		28.00	83.80	73.17		23.00	83.40	38.06
25.00	133.00	.00		25.00	133.00	64.89		28.00	132.10	60.14		23.00	132.20	57.41
25.00	178.00	27.33		25.00	178.00	59.71		28.00	170.20	69.73		23.00	169.90	53.81
57.00	87.00	73.44		57.00	87.00	59.91		55.90	83.80	74.00		53.00	83.40	52.47
57.00	133.00	.00		57.00	133.00	83.65		55.90	132.10	55.96		53.00	132.20	72.64
57.00	178.00	20.83		57.00	178.00	69.32		55.90	170.20	69.09		53.00	169.90	62.64
87.00	133.00	.00		87.00	133.00	101.26		83.80	132.10	46.68		83.40	132.20	86.86
87.00	178.00	10.52		87.00	178.00	72.57		83.80	170.20	67.55		83.40	169.90	66.43
133.00	178.00	.00		133.00	178.00	48.16		132.10	170.20	99.53		132.20	169.90	44.04

K Data for Morawa Wells to Zama Pipeline Route Site 84-11

KS	Oct 85		May 86		Oct 86		May 87		Oct 87											
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka										
	.00	25.40	38.45	5.25	.00	25.00	38.49	5.17	.00	25.40	37.29	5.17	.00	23.50	43.56	5.17	.00	23.50	31.12	4.37
	.00	57.00	34.01	11.08	.00	57.00	18.85	8.25	.00	53.40	41.16	11.42	.00	52.00	21.73	8.08	.00	50.00	30.27	9.17
	.00	87.00	33.04	16.67	.00	87.00	13.54	10.67	.00	83.80	41.52	18.00	.00	82.40	17.02	11.33	.00	79.40	35.77	15.83
	.00	133.00	24.22	21.82	.00	133.00	10.82	14.58	.00	127.00	29.52	23.00	.00	130.20	16.58	17.67	.00	124.20	28.68	22.17
	.00	178.00	21.48	27.50	.00	178.00	10.99	19.67	.00	167.70	26.91	23.00	.00	169.90	15.55	22.33	.00	162.90	28.86	29.17
	25.40	57.00	30.63		25.00	57.00	8.34		25.40	53.40	44.84		23.50	52.00	9.38		23.50	50.00	29.53	
	25.40	87.00	30.93		25.00	87.00	7.08		25.40	83.80	43.44		23.50	82.40	9.84		23.50	79.40	37.83	
	25.40	133.00	21.34		25.00	133.00	6.83		25.40	127.00	27.72		23.50	130.20	12.35		23.50	124.20	28.12	
	25.40	178.00	19.13		25.00	178.00	8.08		25.40	167.70	25.24		23.50	169.90	12.37		23.50	162.90	28.49	
	57.00	87.00	31.25		57.00	87.00	5.86		53.40	83.80	42.16		52.00	82.40	10.29		50.00	79.40	46.18	
	57.00	133.00	17.97		57.00	133.00	6.24		53.40	127.00	22.28		52.00	130.20	13.54		50.00	124.20	27.63	
	57.00	178.00	16.57		57.00	178.00	8.02		53.40	167.70	21.29		52.00	169.90	13.15		50.00	162.90	28.24	
	87.00	133.00	11.28		87.00	133.00	6.50		83.80	127.00	12.06		82.40	130.20	15.83		79.40	124.20	18.02	
	87.00	178.00	12.75		87.00	178.00	8.80		83.80	167.70	15.47		82.40	169.90	14.22		79.40	162.90	22.97	
	133.00	178.00	14.34		133.00	178.00	11.51		127.00	167.70	19.56		130.20	169.90	12.40		124.20	162.90	29.45	
MC																				
	.00	25.40	37.29	5.17	.00	25.00	43.56	5.50	.00	25.40	46.12	5.75	.00	25.50	44.50	5.67	.00	25.50	36.28	5.12
	.00	57.00	34.56	11.17	.00	57.00	26.77	9.83	.00	55.90	40.31	11.83	.00	53.00	27.89	9.33	.00	52.00	39.69	10.92
	.00	87.00	32.37	16.50	.00	87.00	15.73	11.50	.00	86.30	34.23	16.83	.00	83.40	16.87	11.42	.00	80.40	28.59	14.33
	.00	133.00	28.51	23.67	.00	133.00	20.35	20.00	.00	127.00	32.60	24.17	.00	126.20	19.34	18.50	.00	118.20	34.08	23.00
	.00	178.00	22.80	28.33	.00	178.00	16.35	23.99	.00	172.70	27.76	30.33	.00	170.90	17.73	23.99	.00	163.90	25.95	27.83
	25.40	57.00	32.45		25.00	57.00	16.48		25.40	55.90	35.76		25.50	53.00	15.94		25.50	52.00	43.11	
	25.40	87.00	30.45		25.00	87.00	8.43		25.40	86.30	29.79		25.50	83.40	8.88		25.50	80.40	25.33	
	25.40	133.00	26.60		25.00	133.00	16.22		25.40	127.00	29.58		25.50	126.20	14.61		25.50	118.20	33.48	
	25.40	178.00	20.73		25.00	178.00	13.14		25.40	172.70	25.06		25.50	170.90	14.29		25.50	163.90	24.23	
	57.00	87.00	28.41		57.00	87.00	2.79		55.90	86.30	24.35		53.00	83.40	4.25		52.00	80.40	12.98	
	57.00	133.00	24.35		57.00	133.00	16.12		55.90	127.00	27.11		53.00	126.20	14.12		52.00	118.20	29.97	
	57.00	178.00	18.10		57.00	178.00	12.33		55.90	172.70	22.58		53.00	170.90	13.91		52.00	163.90	20.55	
	87.00	133.00	21.87		87.00	133.00	30.73		86.30	127.00	29.27		83.40	126.20	24.63		80.40	118.20	47.35	
	87.00	178.00	15.21		87.00	178.00	16.95		86.30	172.70	21.97		83.40	170.90	18.57		80.40	163.90	23.53	
	133.00	178.00	9.65		133.00	178.00	7.08		127.00	172.70	16.35		126.20	170.90	13.58		118.20	163.90	10.05	

Oct 85		May 86		Oct 86		May 87		Oct 87			
Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka	Depth	Ka		
CM		CM		CM		CM		CM			
.00	25.00	3.25	.00	25.00	.00	.00	24.00	.00	23.50	.00	.00
.00	57.00	8.92	.00	57.00	.00	.00	.00	57.00	.00	51.00	.00
.00	87.00	14.33	.00	87.00	.00	.00	.00	87.00	.00	76.40	.00
.00	133.00	22.42	.00	133.00	.00	.00	.00	133.00	.00	127.20	.00
.00	178.00	26.29	.00	178.00	.00	.00	.00	178.00	.00	162.90	.00
25.00	57.00	28.26	25.00	57.00	.00	28.00	24.00	57.00	.00	51.00	.00
25.00	87.00	28.74	25.00	87.00	.00	28.00	24.00	87.00	.00	76.40	.00
25.00	133.00	24.28	25.00	133.00	.00	28.00	24.00	133.00	.00	127.20	.00
25.00	178.00	28.38	25.00	178.00	.00	28.00	24.00	178.00	.00	162.90	.00
57.00	87.00	29.27	57.00	87.00	.00	55.90	57.00	87.00	.00	76.40	.00
57.00	133.00	22.70	57.00	133.00	.00	55.90	57.00	133.00	.00	127.20	.00
57.00	178.00	28.42	57.00	178.00	.00	55.90	57.00	178.00	.00	162.90	.00
87.00	133.00	18.87	87.00	133.00	.00	83.80	87.00	133.00	.00	127.20	.00
87.00	178.00	28.14	87.00	178.00	.00	83.80	87.00	178.00	.00	162.90	.00
133.00	178.00	39.52	133.00	178.00	.00	132.10	133.00	178.00	.00	127.20	.00

K Data for Norman Wells to Zama Pipeline Route Site 84-12A

May 85		Oct 85		May 86		Oct 86								
Depth	Ka	tt (ns)	Depth	Ka	Depth	Ka	Depth	Ka						
CM			CM		CM		CM							
.00	25.00	.00	.00	25.40	14.02	.00	25.00	20.25	3.75	.00	25.40	17.88	3.58	
.00	57.00	10.55	6.17	57.00	31.54	10.67	.00	57.00	18.85	8.25	.00	55.90	40.92	11.92
.00	87.00	.00	.00	87.00	26.15	14.83	.00	87.00	18.58	12.50	.00	83.80	36.30	16.83
.00	133.00	10.45	14.33	133.00	23.89	21.67	.00	133.00	20.33	19.99	.00	127.60	31.26	23.67
.00	178.00	.00	.00	178.00	27.74	31.25	.00	178.00	30.00	32.50	.00	170.20	30.34	31.25
25.00	57.00	.00	25.40	57.00	50.70	25.00	25.00	57.00	17.80	25.40	25.40	55.90	67.29	
25.00	87.00	1.00	25.40	87.00	32.25	25.00	25.00	87.00	17.93	25.40	25.40	83.80	46.33	
25.00	133.00	.00	25.40	133.00	26.60	25.00	25.00	133.00	20.35	25.40	25.40	127.00	35.19	
25.00	178.00	.00	25.40	178.00	30.47	25.00	25.00	178.00	31.78	25.40	25.40	170.20	32.86	
57.00	87.00	.00	57.00	87.00	17.31	57.00	57.00	87.00	18.06	55.90	55.90	83.80	27.87	
57.00	133.00	10.38	57.00	133.00	18.85	57.00	57.00	133.00	21.48	55.90	55.90	127.00	24.58	
57.00	178.00	.00	57.00	178.00	26.04	57.00	57.00	178.00	36.15	55.90	55.90	170.20	25.74	
87.00	133.00	.00	87.00	133.00	19.90	87.00	87.00	133.00	23.86	83.80	83.80	127.00	22.56	
87.00	178.00	.00	87.00	178.00	29.30	87.00	87.00	178.00	43.47	83.80	83.80	170.20	25.07	
133.00	178.00	.00	133.00	178.00	40.79	133.00	133.00	178.00	69.56	127.00	127.00	170.20	27.71	

	Oct 85		May 86		Oct 86		May 87		Oct 87	
	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka	Depth Range CM	Ka
<b>MC</b>										
	.00 25.00	.00	.00 25.00	32.49	.00 25.00	30.21	4.58	.00 28.00	24.08	4.58
	.00 57.00	11.70	.00 48.30	25.75	.00 57.00	11.52	6.45	.00 55.90	23.33	9.00
	.00 87.00	.00	.00 87.00	25.00	.00 87.00	11.89	10.00	.00 85.90	28.66	15.33
	.00 133.00	.00	.00 106.70	22.39	.00 111.80	9.81	11.67	.00 111.80	24.11	18.30
	.00 178.00	4.21	.00 152.50	25.82	.00 157.50	15.98	20.99	.00 157.50	25.81	26.67
	25.00 57.00	.00	25.00 48.30	19.39	25.00 57.00	3.07		28.00 55.90	22.59	
	25.00 87.00	.00	25.00 87.00	22.26	25.00 87.00	6.88		28.00 85.90	31.02	
	25.00 133.00	.00	25.00 106.70	19.68	25.00 111.80	6.00		28.00 111.80	24.12	
	25.00 178.00	.00	25.00 152.50	24.60	25.00 157.50	13.80		28.00 157.50	26.19	
	57.00 87.00	.00	48.30 87.00	24.08	57.00 87.00	12.60		55.90 85.90	40.07	
	57.00 133.00	.00	48.30 106.70	19.79	57.00 111.80	8.17		55.90 111.80	24.91	
	57.00 178.00	1.98	48.30 152.50	25.85	57.00 157.50	18.84		55.90 157.50	27.22	
	87.00 133.00	.00	87.00 106.70	12.59	87.00 111.80	4.08		85.90 111.80	11.83	
	87.00 178.00	.00	87.00 152.50	26.93	87.00 157.50	21.87		85.90 157.50	22.58	
	133.00 178.00	.00	106.70 152.50	34.75	111.80 157.50	37.43		111.80 157.50	30.19	
<b>MP</b>										
	.00 25.00	.00	.00 25.00	38.49	.00 25.00	42.30	5.42	.00 28.00	32.61	5.33
	.00 57.00	14.24	.00 57.00	30.08	.00 57.00	26.77	9.83	.00 55.90	36.45	11.25
	.00 87.00	.00	.00 87.00	27.94	.00 87.00	18.08	12.33	.00 83.80	32.12	15.83
	.00 133.00	9.04	.00 133.00	25.01	.00 133.00	22.08	20.83	.00 124.50	30.72	23.00
	.00 178.00	.00	.00 178.00	30.78	.00 178.00	25.55	29.99	.00 167.70	33.80	32.50
	25.00 57.00	.00	25.00 57.00	24.22	25.00 57.00	17.09		28.00 55.90	40.52	
	25.00 87.00	.00	25.00 87.00	24.17	25.00 87.00	11.18		28.00 83.80	31.87	
	25.00 133.00	.00	25.00 133.00	22.30	25.00 133.00	18.32		28.00 124.50	30.18	
	25.00 178.00	.00	25.00 178.00	29.61	25.00 178.00	23.21		28.00 167.70	34.04	
	57.00 87.00	.00	57.00 87.00	24.11	57.00 87.00	6.25		55.90 83.80	24.25	
	57.00 133.00	5.91	57.00 133.00	21.51	57.00 133.00	18.85		55.90 124.50	26.40	
	57.00 178.00	.00	57.00 178.00	31.12	57.00 178.00	24.98		55.90 167.70	32.51	
	87.00 133.00	.00	87.00 133.00	19.90	87.00 133.00	30.73		83.80 124.50	27.93	
	87.00 178.00	.00	87.00 178.00	33.63	87.00 178.00	33.90		83.80 167.70	35.53	
	133.00 178.00	.00	133.00 178.00	51.36	133.00 178.00	37.29		124.50 167.70	43.52	

May 87		Oct 87		May 87		Oct 87		May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM		CM		CM		CM		CM		CM	
.00	25.50	24.07	4.17	.00	24.50	17.85	3.45	.00	23.50	15.46	3.08
.00	53.00	19.64	7.83	.00	54.00	41.39	11.58	.00	55.00	12.88	6.58
.00	81.40	17.96	11.50	.00	80.40	37.91	16.50	.00	82.40	11.96	9.50
.00	109.20	29.20	19.67	.00	121.20	33.35	23.33	.00	128.20	6.83	11.17
.00	155.90	31.51	29.17	.00	167.90	33.72	32.50	.00	172.90	9.75	18.00
25.50	53.00	15.94		24.50	54.00	68.36		23.50	55.00	11.11	
25.50	81.40	15.47		24.50	80.40	49.05		23.50	82.40	10.69	
25.50	109.20	30.86		24.50	121.20	38.04		23.50	128.20	5.37	
25.50	155.90	33.08		24.50	167.90	36.93		23.50	172.90	8.98	
53.00	81.40	15.03		54.00	80.40	31.26		55.00	82.40	10.22	
53.00	109.20	39.95		54.00	121.20	27.52		55.00	128.20	3.54	
53.00	155.90	38.71		54.00	167.90	30.36		55.00	172.90	8.44	
81.40	109.20	77.73		80.40	121.20	25.22		82.40	128.20	1.20	
81.40	155.90	50.63		80.40	167.90	30.09		82.40	172.90	7.94	
109.20	155.90	37.24		121.20	167.90	34.70		128.20	172.90	21.01	

**K Data for Morgan Wells to Zama Pipeline Route Site 84-12B**

May 85		Oct 85		May 86		Oct 86		May 87		Oct 87		
Depth Range	Ka	tt (ns)	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka
CM			CM		CM		CM		CM		CM	
.00	25.00	.00	.00	25.40	6.81	2.21	.00	25.00	6.23	2.08	.00	28.00
.00	57.00	9.42	5.83	.00	57.00	15.58	7.50	.00	57.00	15.58	7.50	.00
.00	87.00	.00	.00	87.00	10.55	9.42	.00	87.00	9.63	9.00	.00	86.30
.00	133.00	6.35	11.17	.00	133.00	10.45	14.33	.00	133.00	9.73	13.83	.00
.00	178.00	.00	.00	178.00	7.12	15.83	.00	178.00	7.57	16.33	.00	172.70
25.00	57.00	.00	25.40	57.00	25.22		25.00	57.00	25.82		28.00	58.50
25.00	87.00	1.00	25.40	87.00	12.33		25.00	87.00	11.21		28.00	86.30
25.00	133.00	.00	25.40	133.00	11.42		25.00	133.00	10.65		28.00	134.70
25.00	178.00	.00	25.40	178.00	7.17		25.00	178.00	7.81		28.00	172.70
57.00	87.00	.00	57.00	87.00	3.69		57.00	87.00	2.25		58.50	86.30
57.00	133.00	4.44	57.00	133.00	7.27		57.00	133.00	6.24		58.50	134.70
57.00	178.00	.00	57.00	178.00	4.27		57.00	178.00	4.79		58.50	172.70
87.00	133.00	.00	87.00	133.00	10.25		87.00	133.00	9.92		86.30	134.70
87.00	178.00	.00	87.00	178.00	4.47		87.00	178.00	5.84		86.30	172.70
133.00	178.00	.00	133.00	178.00	1.00		133.00	178.00	2.78		134.70	172.70

May 85				Oct 85				May 86				Oct 86			
Depth	Ka	tt (ns)	Depth	Ka	tt (ns)	Depth	Ka	Depth	Ka	tt (ns)	Depth	Ka	Depth	Ka	
CM			CM			CM		CM			CM		CM		
.00	25.00	.00	.00	25.00	15.21	3.25	.00	25.00	22.92	3.99	.00	25.40	14.73	3.25	
.00	57.00	6.71	4.92	57.00	17.38	7.92	.00	57.00	19.22	8.33	.00	58.50	17.17	8.08	
.00	87.00	.00	.00	87.00	12.08	10.08	.00	87.00	13.54	10.67	.00	86.30	10.16	9.17	
.00	133.00	5.43	10.33	133.00	9.49	13.66	.00	133.00	9.04	13.33	.00	124.50	11.66	14.17	
.00	178.00	.00	.00	178.00	7.89	16.67	.00	178.00	8.37	17.17	.00	172.70	9.24	17.50	
25.00	57.00	.00	25.00	57.00	19.17	.00	25.00	57.00	16.55	25.40	58.50	19.16			
25.00	87.00	.00	25.00	87.00	10.92	.00	25.00	87.00	10.45	25.40	86.30	8.50			
25.00	133.00	.00	25.00	133.00	8.36	.00	25.00	133.00	6.73	25.40	124.50	10.93			
25.00	178.00	.00	25.00	178.00	6.92	.00	25.00	178.00	6.68	25.40	172.70	8.42			
57.00	87.00	.00	57.00	87.00	4.67	.00	57.00	87.00	5.48	58.50	86.30	1.38			
57.00	133.00	4.56	57.00	133.00	5.13	.00	57.00	133.00	3.90	58.50	124.50	7.66			
57.00	178.00	.00	57.00	178.00	4.71	.00	57.00	178.00	4.80	58.50	172.70	6.12			
87.00	133.00	.00	87.00	133.00	5.45	.00	87.00	133.00	3.01	86.30	124.50	15.42			
87.00	178.00	.00	87.00	178.00	4.72	.00	87.00	178.00	4.59	86.30	172.70	8.37			
133.00	178.00	.00	133.00	178.00	4.03	.00	133.00	178.00	6.55	124.50	172.70	4.30			

May 85				Oct 85				May 86				Oct 86			
Depth	Ka	tt (ns)	Depth	Ka	tt (ns)	Depth	Ka	Depth	Ka	tt (ns)	Depth	Ka	Depth	Ka	
CM			CM			CM		CM			CM		CM		
.00	25.00	.00	.00	25.00	17.64	3.50	.00	25.00	15.97	3.33	.00	25.40	10.55	2.75	
.00	57.00	4.82	4.17	57.00	8.14	5.42	.00	48.30	10.96	5.33	.00	48.30	23.65	7.83	
.00	87.00	.00	.00	87.00	17.35	12.08	.00	87.00	8.92	8.66	.00	83.80	28.84	15.00	
.00	133.00	4.67	9.58	133.00	.00	.00	.00	133.00	5.09	10.00	.00	111.80	33.91	21.70	
.00	178.00	.00	.00	178.00	12.17	19.50	.00	178.00	7.27	16.00	.00	170.20	36.28	34.17	
25.00	57.00	.00	25.00	57.00	3.24	.00	25.00	48.30	6.63	25.40	48.30	44.29			
25.00	87.00	.00	25.00	87.00	17.24	.00	25.00	87.00	6.65	25.40	83.80	39.60			
25.00	133.00	.00	25.00	133.00	.00	.00	25.00	133.00	3.43	25.40	111.80	43.29			
25.00	178.00	.00	25.00	178.00	11.31	.00	25.00	178.00	6.17	25.40	170.20	42.38			
57.00	87.00	.00	57.00	87.00	44.36	.00	48.30	87.00	6.66	48.30	83.80	36.71			
57.00	133.00	4.56	57.00	133.00	.00	.00	48.30	133.00	2.74	48.30	111.80	42.94			
57.00	178.00	.00	57.00	178.00	14.56	.00	48.30	178.00	6.09	48.30	170.20	42.02			
87.00	133.00	.00	87.00	133.00	.00	.00	87.00	133.00	.76	83.80	111.80	51.53			
87.00	178.00	.00	87.00	178.00	7.61	.00	87.00	178.00	5.86	83.80	170.20	44.31			
133.00	178.00	.00	133.00	178.00	.00	.00	133.00	178.00	16.00	111.80	170.20	41.03			

May 87		Oct 87		May 87		Oct 87									
Depth Range	Ka	Depth Range	Ka	Depth Range	Ka	Depth Range	Ka								
CM		CM		CM		CM									
.00	24.50	9.37	2.50	.00	25.50	7.01	2.25	.00	24.50	18.37	3.50	.00	25.50	15.35	3.33
.00	57.00	10.55	6.17	.00	58.00	16.07	7.75	.00	58.00	14.06	7.25	.00	56.00	16.14	7.50
.00	86.40	6.20	7.17	.00	84.40	13.07	10.17	.00	86.40	9.77	9.00	.00	82.40	14.61	10.50
.00	125.20	7.82	11.67	.00	132.20	11.85	15.17	.00	133.20	7.30	12.00	.00	121.20	12.58	14.33
.00	172.90	6.18	14.33	.00	171.90	8.98	17.17	.00	172.90	7.39	15.67	.00	169.90	9.55	17.50
24.50	57.00	11.48		25.50	58.00	25.78		24.50	58.00	11.28		25.50	56.00	16.82	
24.50	86.40	5.12		25.50	84.40	16.27		24.50	86.40	7.11		25.50	82.40	14.29	
24.50	125.20	7.46		25.50	132.20	13.20		24.50	133.20	5.50		25.50	121.20	11.89	
24.50	172.90	5.72		25.50	171.90	9.35		24.50	172.90	6.05		25.50	169.90	8.67	
57.00	86.40	1.04		58.00	84.40	7.56		58.00	86.40	3.42		56.00	82.40	11.62	
57.00	125.20	5.85		58.00	132.20	9.00		58.00	133.20	3.59		56.00	121.20	9.88	
57.00	172.90	4.46		58.00	171.90	6.16		58.00	172.90	4.83		56.00	169.90	6.94	
86.40	125.20	12.11		84.40	132.20	9.85		86.40	133.20	3.70		82.40	121.20	8.77	
86.40	172.90	6.17		84.40	171.90	5.76		86.40	172.90	5.35		82.40	169.90	5.76	
125.20	172.90	2.80		132.20	171.90	2.28		133.20	172.90	7.69		121.20	169.90	3.81	

May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka
CM		CM	
.00	24.50	12.01	2.83
.00	47.00	23.97	7.67
.00	81.40	13.13	9.83
.00	107.20	36.78	21.67
.00	168.90	24.73	28.00
24.50	47.00	41.65	22.50
24.50	81.40	13.62	22.50
24.50	107.20	46.71	22.50
24.50	168.90	27.34	22.50
47.00	81.40	3.55	52.00
47.00	107.20	48.67	52.00
47.00	168.90	25.03	52.00
81.40	107.20	189.54	82.40
81.40	168.90	38.81	82.40
107.20	168.90	9.47	107.20

May 87		Oct 87	
Depth Range	Ka	Depth Range	Ka
CM		CM	
.00	24.50	2.75	2.83
.00	52.00	28.97	7.67
.00	82.40	28.53	9.83
.00	107.20	42.63	21.67
.00	163.90	49.22	28.00
22.50	52.00	44.78	22.50
22.50	82.40	35.64	22.50
22.50	107.20	53.13	22.50
22.50	163.90	56.98	22.50
52.00	82.40	27.77	52.00
52.00	107.20	57.89	52.00
52.00	163.90	60.45	52.00
82.40	107.20	109.74	82.40
82.40	163.90	75.85	82.40
107.20	163.90	62.99	107.20