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Investigations of Low-Temperature Geothermal Potential in New York State

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by

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ABSTRACT

The Association of American Petroleum Geologists (AAPG) temperature gradient map and published heat flow data indicate a possible potential for a geothermal resource in western and central New York State. A new analysis of bottom-hole temperature data for New York State confirms the existence of three positive gradient anomalies: the East Aurora, Cayuga, and Elmira anomalies, with gradients as high as 32°C/km, 36°C/km, and 36°C/km, respectively. Ground waters from two of these anomalies are enriched in silica relative to surrounding areas. Heat flows based on silica geothermometry are 50-70 mWm^{-2} for the anomalies and 41.4 mWm^{-2} for bordering regional flux. A correlation between Bouguer gravity anomalies and the temperature gradient map suggests that the geothermal anomalies may occur above radioactive granites in the basement.

I. INTRODUCTION

Inspection of the Association of American Petroleum Geologists (AAPG) temperature gradient map for the US [AAPG-US Geological Survey (USGS), 1976] reveals that two of the most prominent anomalies in the eastern US are near Cayuga Lake and East Aurora, New York. Temperature gradients greater than 36°C/km were estimated from corrected bottom-hole temperatures from oil and gas boreholes. Because these two areas are located near large population

centers, considerable potential exists for use of geothermal energy, and an evaluation of subsurface temperatures, heat flow, and the causes of the anomalies has been undertaken.

The study focused on (1) preliminary geochemical sampling of the two possible resource areas, (2) analysis of gravity data to determine the subsurface distributions of mass, and (3) acquisition of a more complete set of bottom-hole temperature data for New York State.

The only published heat flow data for central and western New York is the work of Diment et al. (1972). As shown in Fig. 1, heat flow values for three areas near Buffalo are 50 mW/m^2, and values for three localities southwest of Syracuse are in the range of 60 to 70 mWm^{-2}. These values are significantly

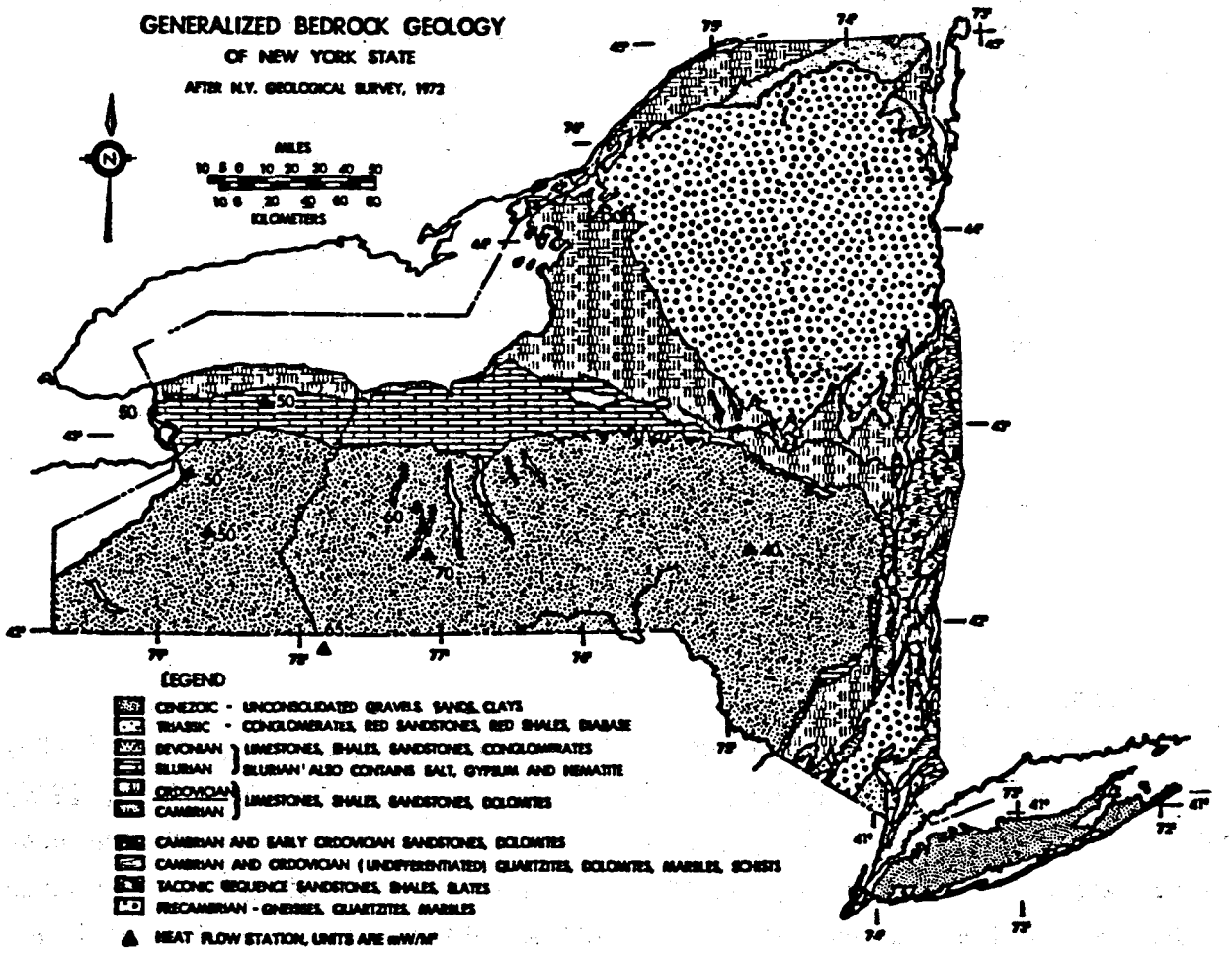

Fig. 1.
Geologic map of New York State showing that Cambrian through Devonian sediments cover the area studied in this report. Heat flow data are from Diment, Urban, and Revetta (1972).

above the norm for the eastern US, although Diment and others question the reliability of some of the data. The values indicate, however, that anomalously high flux may exist in restricted areas in the region.

II. REGIONAL GEOLOGY

The central and western portions of New York State are characterized by relatively simple geologic structure. Cambrian through Devonian shales and limestones dip gently to the south. The thickness of this sedimentary sequence ranges from 1000 m at the shore of Lake Ontario (Fig. 1) to over 3200 m in some areas to the south. Precambrian crystalline basement rocks underlie the Paleozoic sediments. Although the Paleozoic section contains some evaporites, most of it is shales and sandstones. The veneer of glacial debris that covers most of the area may be as thick as 200 m in some valleys.

III. TEMPERATURE GRADIENTS

The temperature gradient map prepared by the AAPG (1976) for the geothermal survey of North America made use of bottom-hole temperatures from approximately 125 wells in New York State. Bottom-hole temperatures have been compiled for 837 additional wells (Appendix A), and the gradients from the central and western portions of New York State have been reevaluated. Surface temperatures for the gradient calculations were estimated from mean annual temperatures compiled by the National Oceanic Atmospheric Administration (NOAA) for 73 recording stations in the State (Fig. 2). Sea level temperatures were calculated using a lapse rate of 9.8°C/km (Jaeger 1964), and a second-order trend surface was fitted to the results (Fig. 3). The trend surface corrected to borehole collar elevation was then used to calculate the surface temperature at each well location.

The lateral variation in geothermal gradients calculated from bottom-hole temperatures is shown on contour maps. A computer code developed by the Kansas Geological Survey (Sampson, 1975) was used for contouring. Various data sets were selected and grid systems were established using a two-phase procedure.

In the first phase of gridding, a search procedure finds the four neighbors that are closest to the data point being considered. A weighted trend surface is then fitted to these four points and the central data point. The neighboring points are assigned statistical weighting factors that are

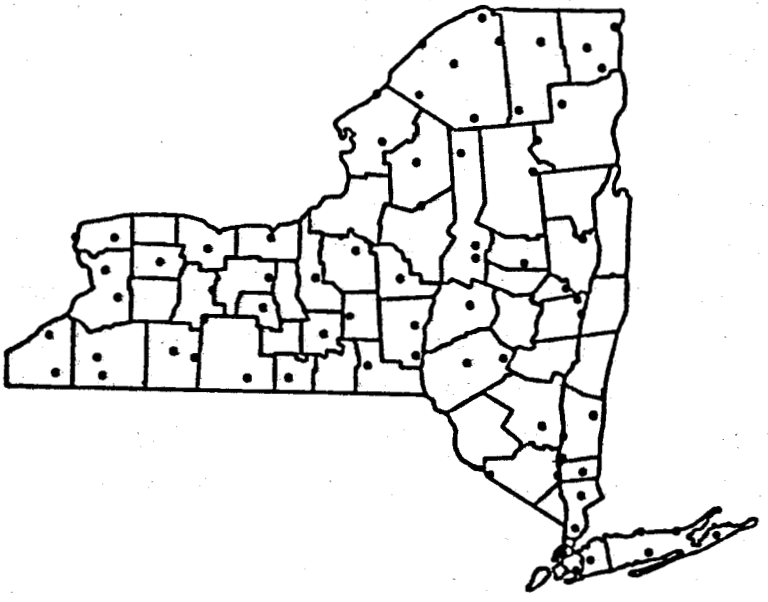

Fig. 2.
Locations of surface temperature recording stations in New York State.

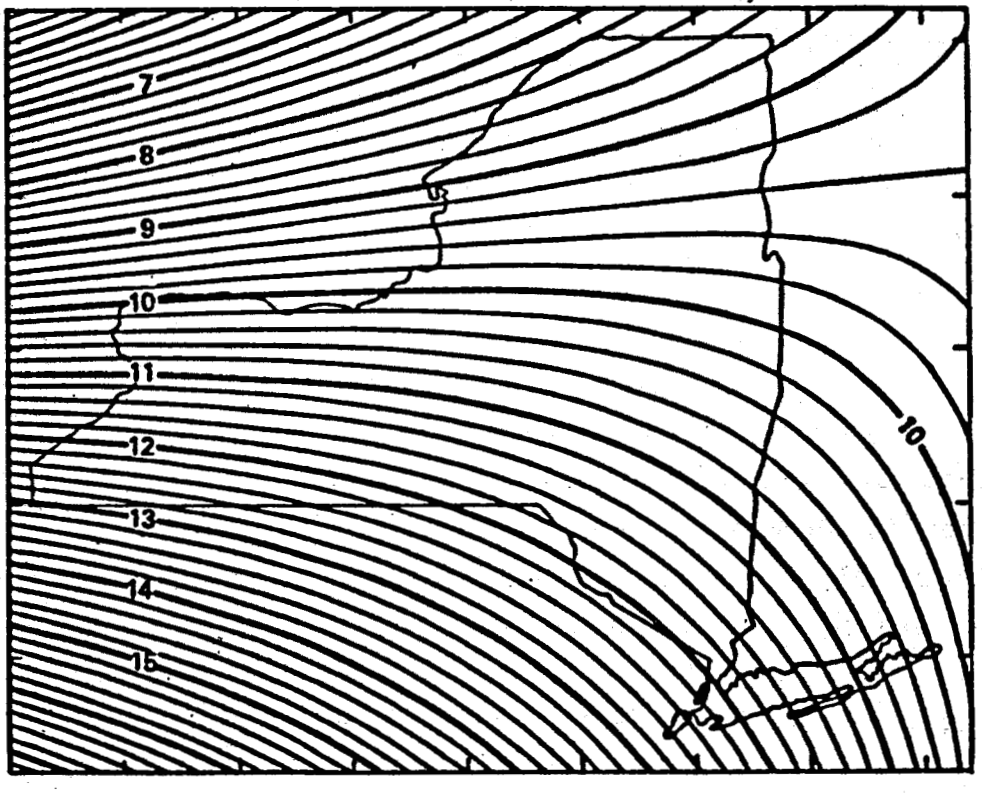

Fig. 3.
Second-order trend surface of surface temperature reduced to sea level. Temperatures in °C.

inversely proportional to the distance from the one being evaluated. The constant of the fitted regression is adjusted so that the plane passes through the data point under consideration. This process is repeated for all points and the coefficients of the trend surface are saved.

The second phase of gridding finds the four data points that are nearest to a node in a predetermined grid matrix. The coordinates of the node are substituted into the trend surface equation calculated for the four neighboring points. The effect is that of projecting the slopes to the node. An inverse-distance weighting procedure is again applied to the slope projections at the node, and the value there is estimated by a weighted average. If an actual data point is on or very near a grid intersection, the original value for it is used for the value at the node.

The grid matrix was then smoothed to reduce undesired noise that may be present in the system. Smoothing was done using weighted arithmetic averaging of adjacent gradient values in the grid matrix. The weighted smoothing procedure multiplied each center point by a factor of two and averaged the result with the grid nodes in the adjacent two rows and columns of the matrix. Each adjacent grid value was assigned a weighting factor equal to the square of the inverse of its distance from the grid node being smoothed. Therefore, the more distant locations in the matrix contributed less to the smoothed point. The smoothing operation was performed for each node in the matrix. At this stage of the procedure, randomly scattered data have been replaced by a regularly spaced grid matrix. Simple linear interpolation was used to determine the point at which a contour line intersects the side of a grid cell. A series of such intersections defines a contour line path, and a set of plotting instructions was then developed and subsequently run on a CalComp model 925/936 plotting system.

The above procedure was applied to 789 wells deeper than 500 m in western and central New york (Fig. 4) and the resulting information was contoured (Fig. 5). The geothermal gradients were calculated as the quotients of the bottom-hole temperatures minus the estimated surface temperature divided by the well depth. The bottom-hole temperatures were not corrected for drilling disturbances. The calculated geothermal gradients in the data set ranged from 10.64°C/km to 41.85°C/km. The gradients in the computer generated grid matrix are in the range of 13.32°C/km to 35.4°C/km, and the arithmetic smoothing process performed on the grid altered the range to 15.67°C/km to 30.94°C/km.

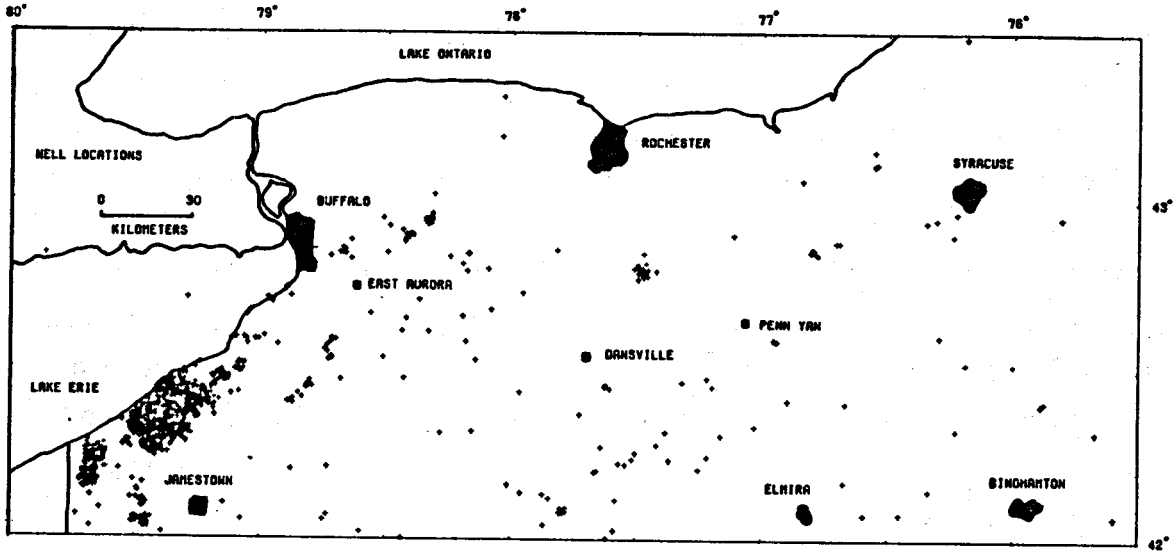

Fig. 4.
Location of wells with recorded bottom-hole temperatures.

Three prominent anomalies are evident in the map: one at East Aurora (27°C/km), a second east of Rochester (30°C/km), and a third between Elmira and Binghamton (30°C/km).

Our field work (see Table I) and studies by Evans and Coleman (1974) and Dowdle and Cobb (1974) document the need for a procedure that corrects bottom-hole temperature measurements for the thermal effects of drilling

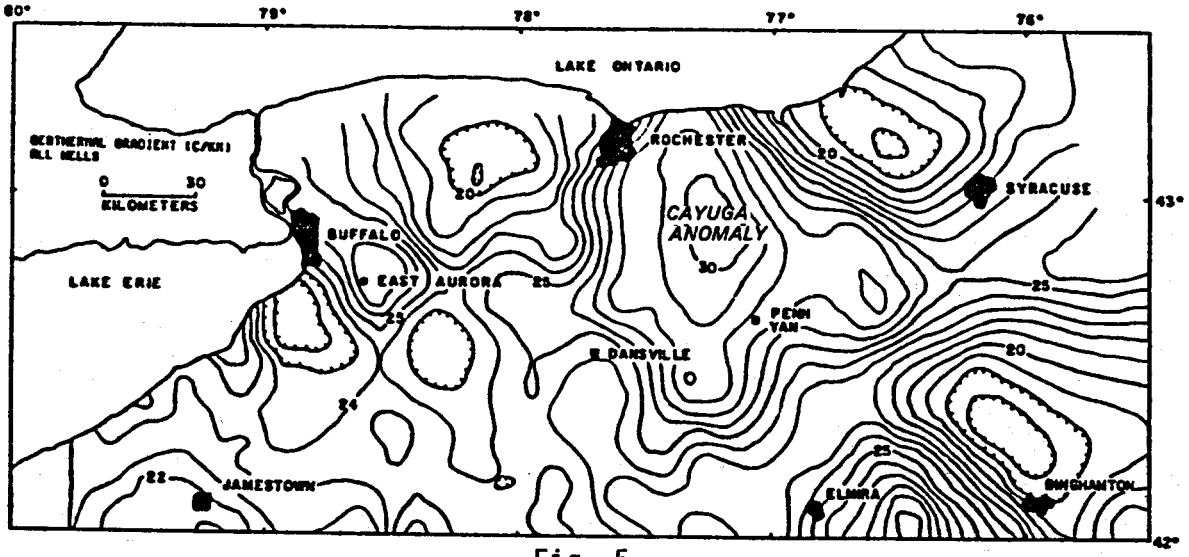

Fig. 5.
Contoured temperature gradients for wells deeper than 500 m assuming no drilling disturbance correction.

TABLE I

TEMPERATURES MEASURED IN WELL 14324, AUGUST 1, 1979

Time, A.M.	Temperature, °C	Time, A.M.	Temperature, °C
3:30	22.0	10:20	33.5
9:00	26.5	10:30	34.7
9:10	28.0	10:40	34.7
9:20	32.5	10:50	34.9
9:30	39.9	11:00	35.7
9:40	40.6	11:10	35.9
9:50	34.6	11:20	36.1
10:00	34.4	11:30	36.0
10:10	33.8		

drilling. The measured bottom-hole temperatures may be significantly lower than the undisturbed equilibrium temperatures in the host rock if the temperature of the drilling medium (fluid or air) is lower than the in situ values.

Our investigations of drilling disturbances in the oil and gas wells in New York State have not been completed. Consequently, a correction was developed from the 1971 study by the AAPG, and the technique was used to correct the bottom-hole temperatures herein discussed. The correction increased temperatures in boreholes that are deeper than 75 m, where the correction is 0°C. At a depth of 1830 m, for example, the corrected temperatures are 12.5°C higher than the bottom-hole values that were measured shortly after drilling was terminated.

Figure 6 is a contour map of the gradients that were calculated using "corrected" bottom-hole temperatures in all 837 oil and gas wells. The gradients in the data set ranged from 15.52°C/km to 47.28°C/km. Gradient values in the computed grid matrix ranged from 21.27°C/km to 39.09°C/km, and arithmetic grid smoothing altered the range to 22.31°C/km to 37.57°C/km. From comparisons with Fig. 5, it is evident that the magnitudes of the anomalies are increased when the modified AAPG correction is applied. Another prominent feature of the corrected gradient map is the short lateral increase in the temperature gradients trending north-south near Buffalo (Fig. 6). Inasmuch as some of the shallow wells ($\leq$500 m) in this area have anomalously high recorded temperatures, these elevated gradients probably reflect nonconductive temperatures of relatively shallow ground-water circulation systems in the underlying rocks.

To obtain a map of "conductive" corrected gradients, data for wells shallower than 500 m were neglected and the remaining 789 control points were

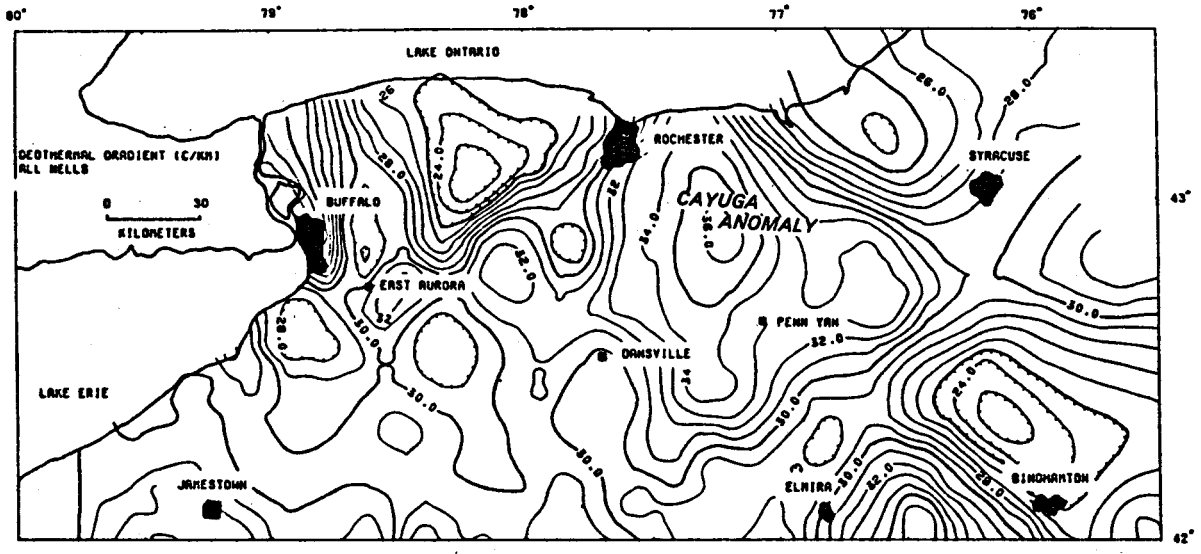

Fig. 6.
Contoured temperature gradients for all wells assuming drilling disturbance correction similar to correction used for the AAPG geothermal gradient map.

contoured. The resulting map is shown in Fig. 7. The range of geothermal in the data set for this figure is from 15.52°C/km to 47.28°C/km. In the computed grid matrix, values for gradients ranged from 21.48°C/km to 38.85°C/km. The grid-smoothing process reduced the range of values to 22.58°C/km to 36.63°C/km. The contoured gradients for the East Aurora, Cayuga, and Elmira anomalies are 32, 36, and 36°C/km, respectively (Fig. 7).

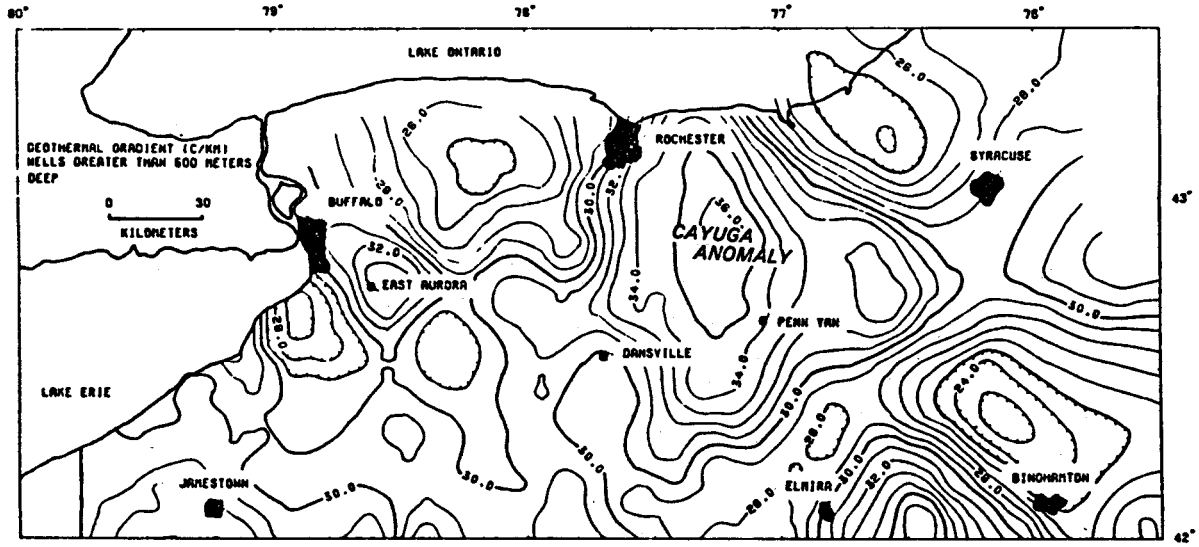

Fig. 7.
Contoured temperature gradients for all wells deeper than 500 m assuming drilling disturbance correction as in Fig. 6.

Figure 8 shows a perspective diagram of the elevated temperatures highlighting the relative magnitude of the gradients. These gradients are considered maxima because the true gradients probably are between the corrected (Fig. 7) and uncorrected (Fig. 5) values.

Figure 9 is a gradient map that is based on data for 640 wells that are deeper than 750 m. The gradients in the data set are in the range 21.28°C/km to 45.06°C/km. Gridding created gradients in the range 22.96°C/km to 38.32°C/km, and smoothing of the grids altered the range to 23.71°C/km to 36.06°C/km. The Elmira and Cayuga anomalies are evident in this map, but the East Aurora anomaly has been eliminated. Figure 9 also shows a single low-gradient zone in the vicinity of East Aurora, whereas Fig. 7 shows two regions with lower gradients in this area.

Comparisons of the revised temperature gradient map (Fig. 7) and the AAPG gradient map reveal that both show a positive anomaly near East Aurora. The gradients here are greater than 32°C/km. Although both maps show a positive anomaly near Cayuga Lake, the new map is significantly different in the sense that the zone of highest gradients (>36°C/km) plots further to the west in an area between Rochester and Penn Yan. The new map also differs from the AAPG map in that a positive anomaly between Binghamton and Elmira has been separated from the Cayuga anomaly, and the gradients in the region are greater than 36°C/km. Our analysis of the bottom-hole temperature data from western and

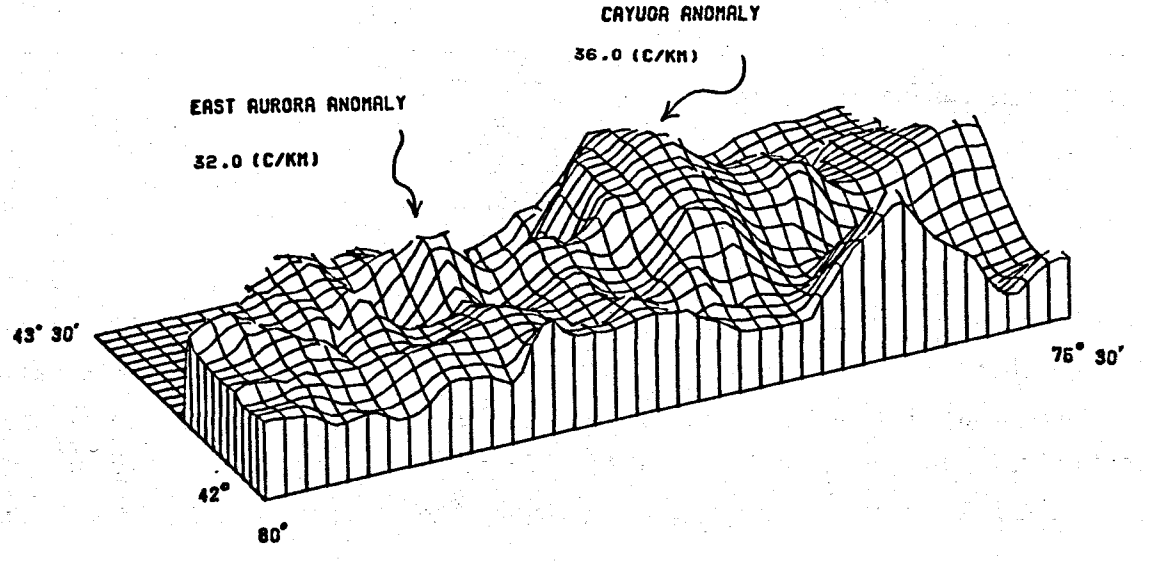

Fig. 8.
Perspective diagram of temperature gradients in New York State showing relative magnitude of the anomalies.

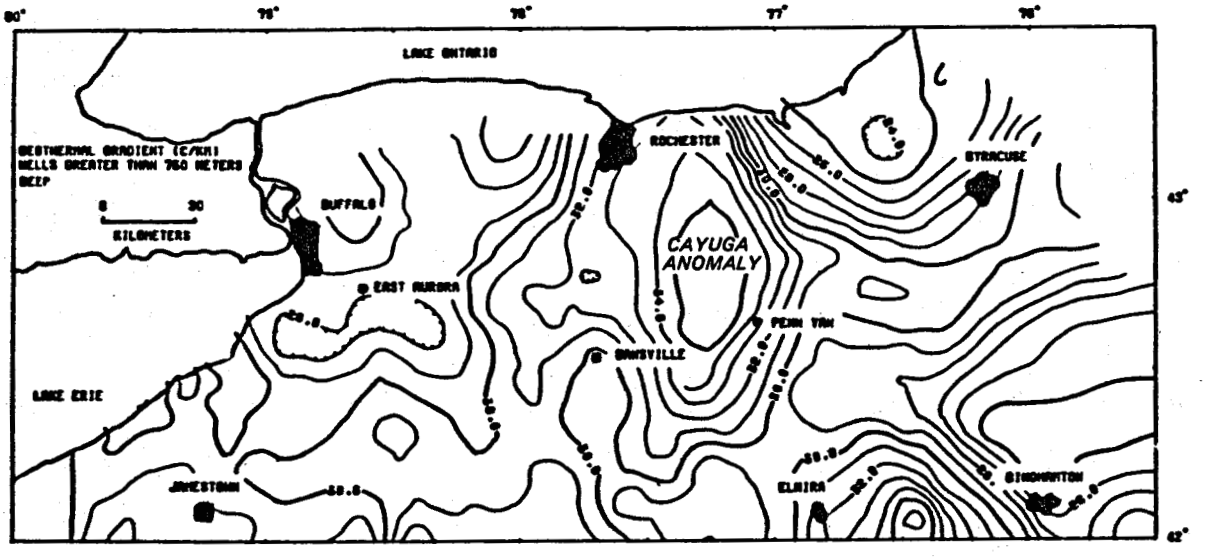

Fig. 9.
Contoured temperature gradients for wells deeper than 750 m. A drilling disturbance correction has been applied. The East Aurora anomaly disappears because shallow data is not included.

central New York, therefore, confirms the validity of the high-gradient anomalies shown on the AAPG map, but it better defines the position of the Cayuga anomaly.

IV. DETAILED GEOTHERMAL GRADIENTS

Reliable geothermal resource assessments require determinations of equilibrium thermal gradients in undisturbed underground openings (drill holes, tunnels, etc.). The conductive heat flow q normal to the earth's surface is calculated from the basic relation

$$q = K \frac{dT}{dz} \quad , \qquad (1)$$

where K is thermal conductivity of the local rock units and dT/dz is the vertical geothermal gradient. In studies in sedimentary basins, it is important to show that the heat flow is vertically uniform and that there is a sympathetic relation between K and dT/dz; for example, the highest geothermal gradients should exist in layers that have the lowest conductivity. Such analyses are important in geothermal studies in New York and Pennsylvania because the geothermal gradients within a borehole that penetrates different

sediments should reflect the contrasting conductivities of each lithologic unit.

Equilibrium temperatures were measured in a number of wells that were drilled for purposes of extracting gas. Locations for the measured wells are listed in Table II, as are bottom-hole temperatures, average gradients, and the gradients above and below prominent formation boundaries in the holes. The gradients for the intervals above and below the indicated contacts were estimated from linear portions of the temperature-depth profiles for the holes. The temperature data and the temperature profiles for the wells are listed and plotted in Appendix B.

The temperature-depth logs for the wells southwest of the East Aurora anomaly (13000, 14269, 14270) show identical gradients throughout the same stratigraphic depth interval (see for example, Fig. 10, Table II, and Appendix B.). A change in the slopes of the profiles occurs at depths that correspond to the top of the Onondaga formation. In the sediments above the Onondaga, the gradient is about 36°C/km. Below this unit the average geothermal gradient decreases to about 16°C/km. When the average surface temperatures are subtracted from the bottom-hole temperatures for wells 13000, 14269, and 14270, the average gradients are calculated to be 25.7, 23.6, and 20. °C/km, respectively. These gradients agree with those on the map in Fig. 7.

Well 14324 is near the edge of the East Aurora anomaly. The relatively linear portions of the temperature profile for the hole suggest that the

TABLE II

DATA ON WELLS LOGGED IN JULY, AUGUST, OR SEPTEMBER, 1979

Well No.	Latitude	Longitude	Bottom-hole Temp., °C	Well depth meters	Average surface temp., °C	Average Gradient °C/km	Gradient above Onondaga Ls °C/km	Gradient below Onondaga Ls °C/km
13738	42° 52' 25"	76° 40' 21"	27.69	573.0	9.48	31.78[+]		39.95
13000	42° 37' 49"	79° 00' 23"	24.86	618.0	8.9	25.7	35.01	17.72
14269	42° 39' 29"	78° 55' 29"	22.45	566.9	9.1	23.6	31.55	16.85
14270	42° 38' 45"	78° 56' 09"	22.9	686.1	9.2	20.09	33.71	14.50
14310	42° 03' 34"	79° 18' 28"	38.9	1310.6	8.29	23.36	27.36	16.84
14324	42° 43' 53"	78° 37' 25"	28.7	640.1	7.84	32.6	38.87	19.94
14365	42° 04' 47"	79° 21' 13"	38.9	1249.7	8.59	24.26	18.93	5.9
14172	42° 47' 57"	77° 27' 45"	18.72	426.7	6.73	28.09	23.75	22.57
14423	42° 45' 45"	78° 40' 10"	22.57	548.6	8.269	26.067	37.45	17.70

[+]Average gradient directly follows bottom-hole temperature in Queenston Shale and the calculated surface temperature.

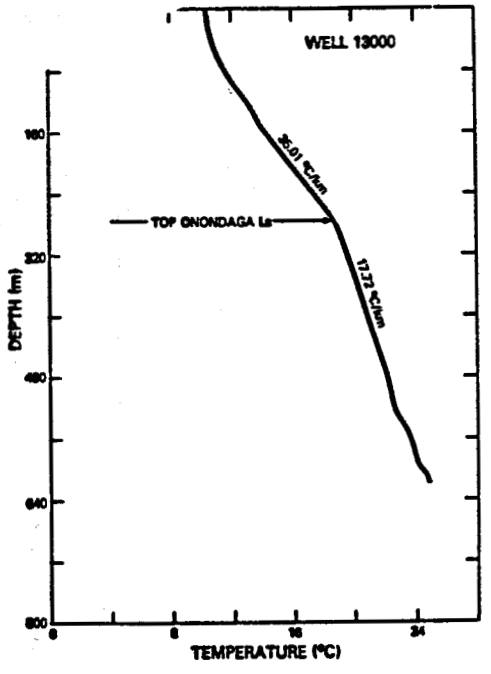

Fig. 10.

Temperature-depth profile for well 13000 showing different gradients above and below the top of the Onondaga Limestone.

well was close to therm
rium when measurements were ma
The calculated gradient above the Onondaga is 38.87°C/km and that for the units below is 19.94°C/km. The average geothermal gradient for the hole is 32.6°C/km, a value close to that shown for the area in the contour map in Fig. 6.

The temperature profiles for the wells in the southwest section of New York State exhibit similar variations in geothermal gradients. The distinct change in the slope of the profiles occurs at a greater depth in wells 14310 and 14365 than it does in the East Aurora wells. The gradient in the upper section of 14310 is 27.4°C/km, and the lower section has a gradient of 16.8°C/km. Like the profiles for the wells near East Aurora, the stratigraphic location of the change of slope corresponds to the top of the Onondaga limestone.

The relatively higher gradients in the shallower parts of the above-discussed wells occur in sections of Devonian shale. These data suggest that these shales have a low conductivity and the corresponding gradient is high.

Thermal disequilibrium and/or disturbances in a drill hole can be caused by water circulation, thermal effects of drilling, natural gas expulsion, and chemical reactions. Some of our temperature measurements were made in wells that were not cased to total depth, so water circulation may have occurred near the bottoms of these holes. In wells 13738 and 14172 apparent water circulation caused a depression in the measured geothermal gradients. In well 14172 the temperatures were logged within minutes of the time that stored gas was released from the hole. When gas was released, the ambient pressure dropped from 40 psi to 0 psi in about 5 minutes of expulsion. Because gas cools rapidly during expansion and release to the surface, the measured

temperatures in this well may be lower than the undisturbed ambient values and may not indicate the equilibrium geothermal gradients.

Most of the gas wells in New York State are drilled with air percussion rigs, and the transient thermal effects of air percussion drilling are not accurately known for this study area.* To evaluate this effect and estimate a correction for bottom-hole temperatures, measurements were made in one well for a period of several hours after drilling was terminated. The results show that the bottom-hole temperature increased from 22.0°C to 36°C over 8.0 hours (Table I). This isolated experiment precludes quantitative evaluation of the effect of drilling, but the time-dependent change of the bottom-hole temperature is consistent with results reported by other authors (for example, Middleton 1974).

V. THERMAL CONDUCTIVITY OF SEDIMENTS IN NEW YORK

The lateral and vertical variations of conductivity must be known if bottom-hole and other temperature data are to be utilized to produce detailed heat flow and subsurface temperature maps. Thus structure contour maps of the Lower Devonian Onondaga Limestone, the Upper Ordovician Queenston Shale, and the Precambrian basement were prepared.

Data were taken from Kreidler et al. (1972), Kreidler (1975), and drillers' logs obtained from the New York State Geological Survey. To help alleviate "edge effect" problems, data were obtained for those counties in northern Pennsylvania that border New York (Commonwealth of Pennsylvania, 1960-1978). Gridding of the data was done using a specially adapted transverse mercator projection FORTRAN program. The data, except those taken directly from Kreidler's (1975) map of deep disposal wells, are listed in Appendix C.

The Onondaga Limestone is of particular interest because it appears to mark a distinct change of subsurface geothermal gradients. Additionally, the Onondaga is overlain by several hundred meters of Upper Devonian black shales (Richard, 1975). This sharp contrast in lithology is usually noted in driller logs and so it provides an excellent stratigraphic marker. Two hundred thirty data points of sub-sea-level depths of the Onondaga (Appendix C) were machine-contoured using the Surface II Graphics System (Sampson, 1975) (Fig. 11). A

*Bottom-hole temperatures are normally measured about 4-12 hours after drilling is stopped in potential gas wells.

sixth-order trend surface polynomial was also formulated. The results permit reasonably accurate prediction of the depth to the Onondaga at any arbitrary location within western and central New York State.

The Queenston Shale is also of considerable interest to the natural gas industry of New York, and, as a result, it is frequently noted in drilling logs; its distinctive red coloration makes accurate identification probable. The large number of depth control points (190) and the fact that the Queenston is in the middle of the sedimentary section (Fisher, 1977) makes it a good second choice for a marker horizon (Fig. 12).

Basement structure also must be known for reliable interpretation of heat flow and other geophysical studies. In addition, determinations of thickness of sediments above a postulated abnormal source of heat in the basement are essential for estimation of the subsurface temperatures. Inasmuch as some high geothermal gradients in New York State correlate with areas of anomalously low Bouguer gravity, it is necessary to determine whether the gravity anomalies are due to lateral compositional variation (and perhaps truly related to heat flow), or whether these gravity anomalies can be attributed to basement topography. Accurate determination of basement structure requires adequate control. Because sedimentary cover thickens markedly to the south in New York State (Fisher, 1977); at least 50% of all control wells are located within 50 km of the shore of Lake Ontario. Therefore, control was judged

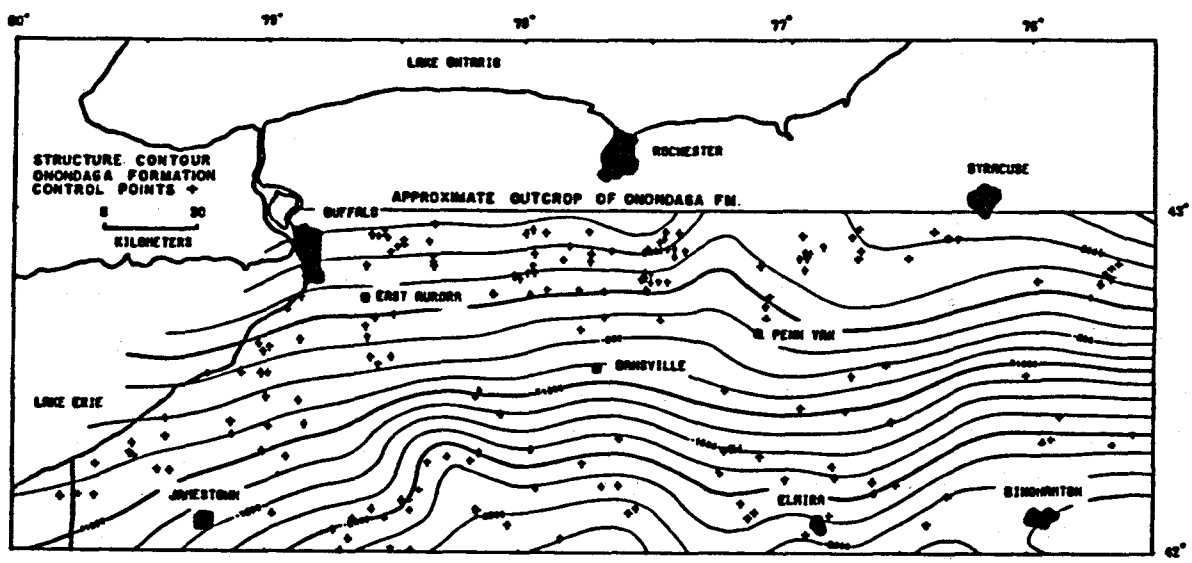

Fig. 11.
Depth below sea level to the top of the Onondaga Formation. Devonian black shales occur above this contact.

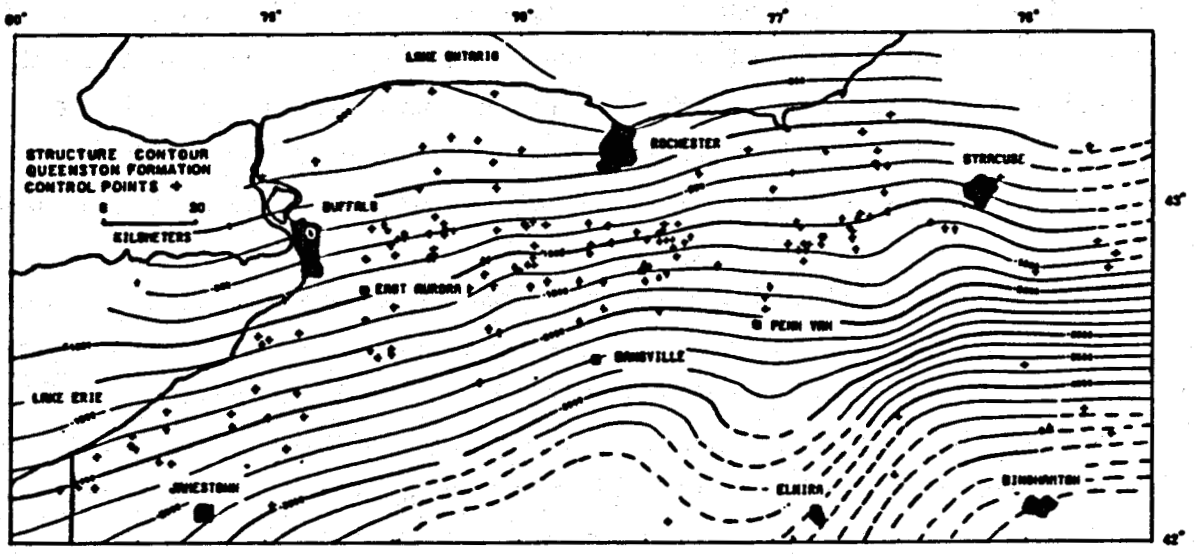

Fig. 12.
Depth below sea level to the top of the Ordovician Queenston Formation.

insufficient for direct contouring. Instead, a third-order trend surface map was prepared using Surface II (Fig. 13). Fortunately, stratigraphic control in the northern and central parts of the Cayuga anomaly was sufficient to allow study of basement topographic trend surface residuals.

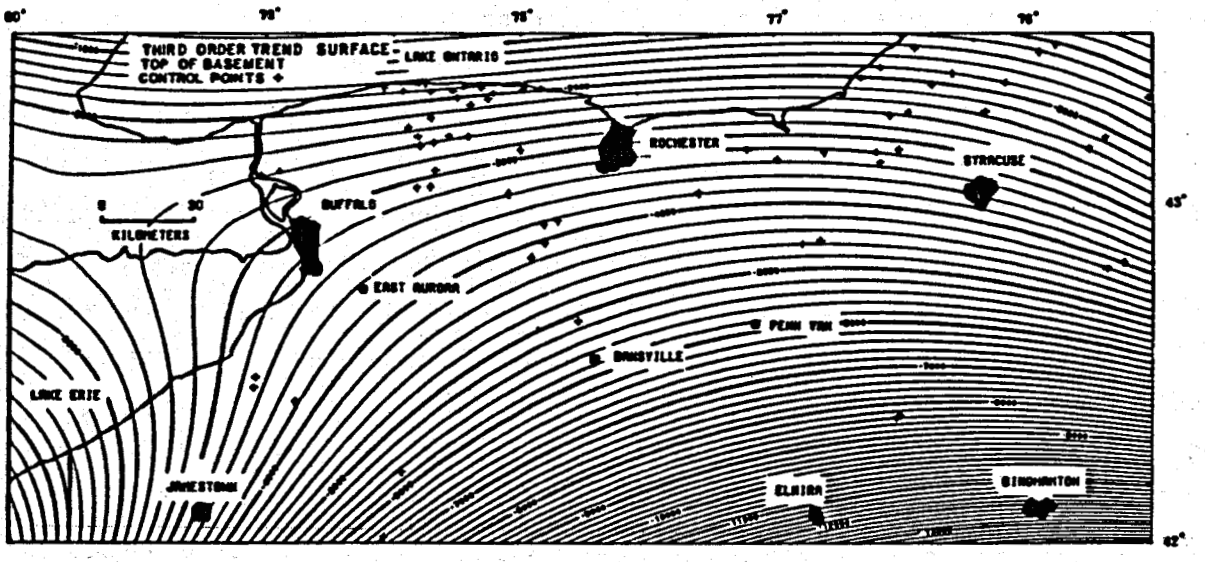

Fig. 13.
Depth below sea level to the basement. Data are approximated by a third-order trend surface.

The structure contour map of the basement (Fig. 13) shows a gradual deepening from about 600 m below sea level in the extreme northwest to about 4000 m below sea level near Binghamton in the southeasten part of the map. Control is rather poor and the mathematical trend surface contour lines begin to show an inflection that is unjustified by the data just west of the longitude for Jamestown.

In Fig. 11 the Onondaga Limestone is shown to dip gradually to the south; the elevation of the upper contact changes from about 155 m above sea level at the outcrop in the north to about 770 m below sea level in the south. Figure 12 shows a similar trend for the Queenston Shale, which is about 325 m lower in the stratigraphic column. Control is very good for the Onondaga and, checks of well data against the map show excellent correlation.

Spot checks of original well data around the northern and north-central parts of the Cayuga anomaly indicate no variation greater than 40 m from the known basement elevation (Fig. 13) for the mathematical trend surface calculated over an area at least twice as wide as the anomaly itself. There is no reason at the present time to believe that basement topography bears any relation to the gravity low in this region (see below). It is much more reasonable to conclude that a lateral compositional contrast in the Precambrian is responsible.

Detailed temperature logs for several wells show excellent agreement between predicted depth to the Onondaga Limestone and the depth to a prominent change of temperature gradient. This change always occurs as an abrupt decrease from a higher gradient to a lower gradient as depth increases; this implies an abrupt increase in conductivity below the Upper Devonian Marcellus Shale-Onondaga Limestone contact. Joyner (1960) also noted contrasting gradients in the "Marcellus type" Upper Devonian Shales and the Onondaga Limestone in West Virginia and Pennsylvania and inferred that they were related to the thermal conductivities of the sediments. Our data and that of Joyner suggest that the lithologic units in New York State can be separated into distinct conductivity units (see Table III). The structural contour maps of the basement, Onondaga, and Queenston horizons therefore allow a three-dimensional representation of the conductivity variation throughout the State. This conductivity variation could be combined with bottom-hole temperatures to produce a map of heat flow. The heat flow and conductivity maps could then be used to predict subsurface temperatures throughout the region.

TABLE III

THERMAL CONDUCTIVITIES OF SAMPLES FROM WELLS IN NEW YORK, PENNSYLVANIA, AND WEST VIRGINIA

Category	No. Samples	Average Conductivity at 30°C in W/°C m	Range of Conductivity in W/°C m
Quartzose Sandstones	7	4.40	3.35 - 5.23
Impure Sandstones	5	2.67	1.88 - 3.35
Sandy Sandstones	3	1.98	1.61 - 2.21
Shales	5	1.41	1.26 - 1.51
Limestones	3	2.58	2.23 - 2.91
Calcareous Shales	2	1.89	1.76 - 2.05

Adapted from Joyner (1960, Table, p. 1232).

VI. GEOCHEMISTRY

Samples of ground water from the Cayuga and East Aurora anomalies and adjacent areas were collected and analyzed to determine if there was chemical evidence for local hydrothermal activity. The analyses were performed by standard procedures and results are listed in Appendix D.

Qualitative and quantitative geothermometry (SiO_2, NaKCa, and NaKCaMg geothermometers) was applied to the analyses and the results were compared to the geophysical interpretations. None of the samples showed clear evidence of having originated within an active hydrothermal system. More encouraging results, however, were obtained by using the silica-heat flow method of Swanberg and Morgan (1979).

The silica geothermometer is based on the temperature dependence of quartz solubility in water. The procedure can be used to estimate the last temperature of water-rock equilibrium (Fournier and Rowe, 1966; Fournier et al., 1974) and to estimate regional heat flow (Swanberg and Morgan, 1979). The following equations can be used to convert ground-water silica content (ppm) to geotemperature and heat flow.

$$T\ SiO_2 = \frac{1913}{5.205 - \log_{10} SiO_2} - 273.15 \qquad (2)$$

and

$$T\ SiO_2 = .67q + 13.2\ , \qquad (3)$$

where $T\ SiO_2$ is the silica geotemperature in °C and q is heat flow in mW/m^{-2}.

Figure 14 is a histogram of heat flow values obtained by applying the silica method. The mean regional flux predicted for the study area is 41.4 mWm^{-2}, a value that is tectonically reasonable and consistent with the values obtained by traditional heat flow techniques (Diment et al., 1972). Further, an attempt was made to isolate the higher silica-heat flow values to determine if their areal distribution would delineate the Cayuga and East Aurora anomalies in a manner similar to the gravity and bottom-hole temperature data. Figure 15 shows the areal distribution of the higher silica-heat flow values (>45 mWm^{-2}) and the rest of the data set. This approach appears to work

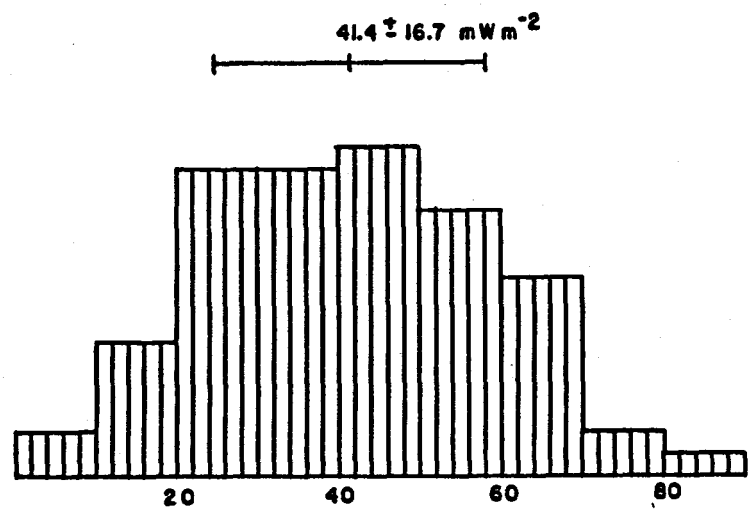

Fig. 14.
Frequency histogram of heat flow values determined using silica geothermometry.

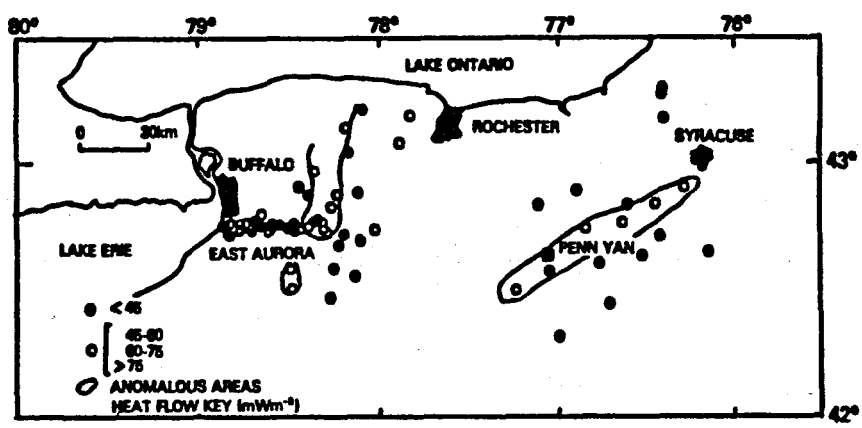

Fig. 15.
Map showing heat flow values determined using silica geothermometry.

reasonably well for the Cayuga anomaly. The higher values plot along a line trending northeast-southwest through an area which includes the Cayuga anomaly as defined by the bottom-hole temperature data (Fig. 6), the gravity data (Fig. 16), and the previously published temperature gradient map of North America (AAPG, 1976).

The silica technique is only partially successful for the East Aurora anomaly. As shown in Fig. 15, the higher heat flow values tend to cluster in several discrete groups in an area that includes the East Aurora anomaly, but the pattern is different from those implied by the gravity and bottom-hole temperature data (Figs. 7 and 16). Part of this difference probably results from the nature of the ground waters available for study. At the Cayuga anomaly, the samples were collected from wells that penetrated the older sediments, so they may represent "old" meteoric waters that have circulated in the sedimentary section for a period of time long enough to permit chemical equilibrium with the host rock. Such equilibrium is a fundamental requirement of chemical geothermometry. On the other hand, some of the samples from the East Aurora area were from wells that penetrated glacial tills in topographic lows. Such waters may reflect "new" meteoric waters that have not had sufficient time in the ground to achieve chemical equilibrium. From the silica data, both geothermal areas have heat flows in the range 50-70 mWm^{-2}.

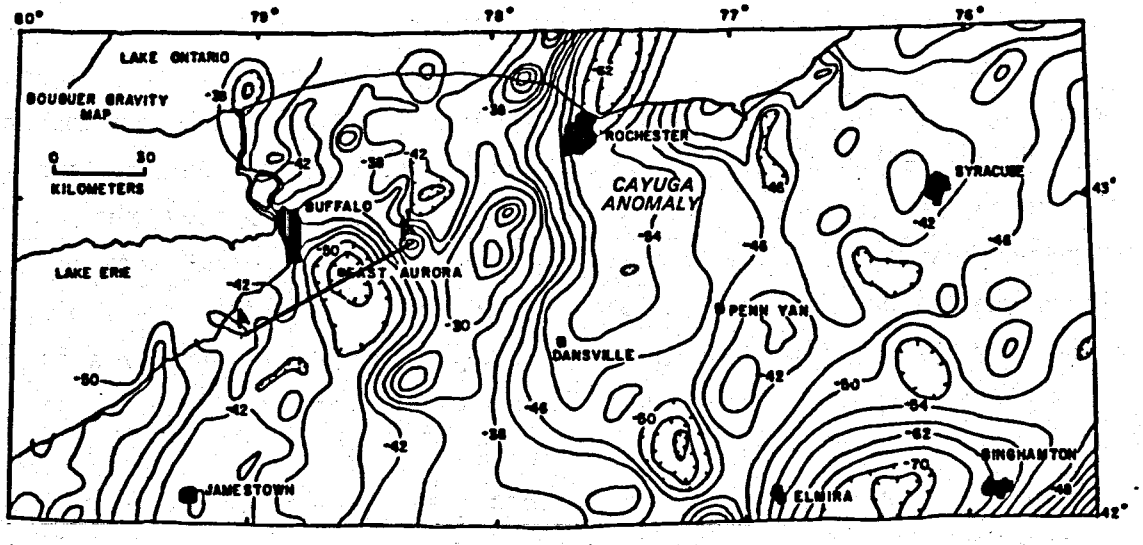

Fig. 16.
Bouguer gravity map of central and western New York State (after Revetta and Diment, 1971).

VII. BOUGUER GRAVITY OF CENTRAL AND WESTERN NEW YORK

The Bouguer gravity map of central and western New York (Fig. 16) was largely taken from the Bouguer map of New York State (Revetta and Diment, 1971). The Bouguer anomaly field is characterized by two distinct zones that are separated by a north-south trending high gravity gradient area that is west of Rochester and extends as far south as Arcade, New York. This high gradient zone coincides with the Clarendon-Linden fault zone (Diment et al., 1972). The Bouguer anomaly field in the western part of the area shows distinct positive and negative closed anomalies and a prominent negative anomaly near East Aurora (the East Aurora anomaly).

In the eastern part of the map area the anomalies are much more subdued, with few positive anomalies. A low-amplitude negative anomaly occurs about 20 km east of Rochester. This relative low strikes north-south and becomes a large negative anomaly over Lake Ontario. This negative anomaly (the Cayuga anomaly) coincides with a distinct temperature gradient anomaly shown in Fig. 6. The Bouguer anomaly on the southeast corner of Fig. 16 decreases to -76 mgals in the area where depth to bedrock exceeds 3700 m. A positive temperature gradient anomaly coincides with this Bouguer negative anomaly.

Because undeformed, near-horizontal sedimentary rocks are found to depths greater than 1080 m, most of the changes in the Bouguer field reflect density differences in the Precambrian basement. Similar basement rocks crop out in southern Ontario, and the Bouguer gravity in this part of Canada shows a strong correlation with Precambrian geology. Briefly, the Bouguer anomalies over granitic rocks are typically negative, and those over gabbroic igneous rocks are strongly positive. These plutonic units are bordered by metamorphic rocks. Using the geologic relations as a general guide, the negative anomaly over East Aurora is attributed to a granitic pluton that is near the top of the Precambrian basement. For a density contrast of -0.09 gm/cm^3 and assuming a two-dimensional approximation, a density contrast as thick as 5 km may explain the East Aurora low (Fig. 17). The Cayuga negative anomaly also may be due to a granitic pluton in the basement. The gravity low here is not as distinct as that near East Aurora.

There are distinct correlations between the temperature gradient and gravity maps (Figs. 7 and 16). The East Aurora negative gravity anomaly coincides spatially with a positive temperature gradient anomaly. The positive Cayuga temperature gradient anomaly trends in a north-south direction and also

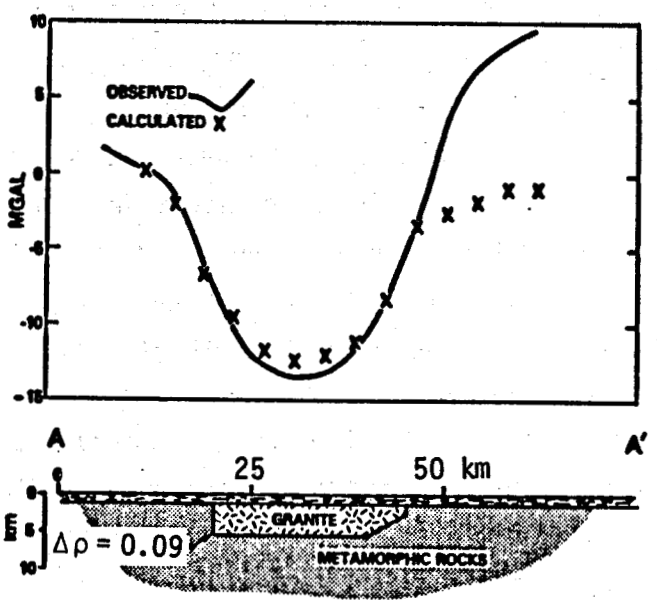

Fig. 17.
Profile and computed gravity model over the East Aurora temperature gradient anomaly.

correlates with a Bouguer gravity low. The correlations between the Bouguer gravity map and the temperature gradient map suggest that the thermal anomalies may be due to radioactive heat from Precambrian granitic rocks in the basement. Low geothermal gradients occur with low gravity values in the southeastern portion of the map. Part of this relative Bouguer low (≈ -70 mgal) could be due to low densities of the underlying thick sediments.

VIII. CONCLUSIONS

Bottom-hole temperatures in a major part of New York State have been analyzed to produce two contour maps: (1) one of minimum estimated geothermal gradients, and (2) one of gradients based on temperatures corrected for the first-order effects of drilling disturbances (after AAPG, 1971). The general features of the two contour maps are similar, but the magnitudes of the gradient anomalies are significantly different. On the new map produced using the corrected temperatures, there are distinct anomalies near East Aurora, Cayuga Lake, and Elmira. Maximum temperature gradients for these anomalies are 32°C/km, 36°C/km, and 36°C/km, respectively.

Equilibrium temperature measurements in a number of wells indicate that the thick Devonian black shales in New York are a low conductivity layer that has temperature gradients in the range 32° to 40°C/km. The gradients are lower

in the underlying sediments. The detailed structural contour maps presented herein may be used to estimate thermal conductivities of the sedimentary rocks and thus subsurface temperatures in the region.

There is a remarkable correlation between the spacial distribution of the high-temperature gradient anomalies and negative Bouguer gravity anomalies. Comparison of the temperature gradient and gravity maps suggests that the same subsurface bodies explain heat flow and Bouguer anomalies. A few basement samples and examinations of the gravity field in exposed areas of the Precambrian shield in Canada strongly suggest that the negative gravity anomalies are due to granitic rocks in the basement. Inasmuch as granitic rocks often contain more uranium, thorium, and potassium than mafic units, the anomalous temperature gradients may occur in sediments that overlay relatively high radioactive granites in the basement.

The preliminary results indicate that New York State has temperature gradients that are as high as any of those observed elsewhere in the eastern United States. Therefore, future analyses may define the magnitude and extent of the existing and new geothermal anomalies.

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APPENDIX A

BOTTOM-HOLE TEMPERATURE DATA FOR WELLS IN NEW YORK STATE

D.S. HODGE - STATE UNIVERSITY OF NEW YORK AT BUFFALO
GEOLOGICAL SCIENCES

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
1	6 16 62	41.5833	76.2500	475.8	480.4	3914.5	98.9	7.9	23.2	26.3	30.0
2	1 13 63	41.7838	76.3252	417.9	420.6	2012.9	42.8	8.3	17.1	13.0	23.6
3	11 19 63	41.7212	76.6056	339.5	341.4	1226.2	35.0	9.3	21.0	7.5	27.1
7	8 20 72	41.8725	76.2656	403.3	407.2	1402.1	40.6	8.3	23.0	8.7	29.2
9	9 3 73	40.6500	76.3429	412.4	417.3	2286.6	58.9	9.0	21.8	14.9	28.3
15	11 9 76	42.0780	77.7925	618.1	621.8	1468.2	40.6	6.4	23.3	9.2	29.5
16	5 26 76	42.0787	77.8017	624.5	628.2	1504.2	46.7	6.4	26.8	9.4	33.1
17	9 8 76	42.0917	77.7797	655.9	659.6	1504.5	38.9	6.0	21.8	9.4	28.1
18	9 27 76	42.0818	77.7797	594.7	598.3	1435.9	43.3	6.6	25.6	9.0	31.8
19	9 19 76	42.0902	77.8006	599.2	602.9	1435.3	44.4	6.6	26.4	9.0	32.6
291	6 3 72	42.0039	77.6175	627.6	631.9	1531.9	48.9	6.4	27.7	9.6	34.0
412	6 9 77	42.0802	77.8041	595.3	599.8	1430.7	43.3	6.6	25.7	8.9	31.9
412	9 30 76	42.0802	77.8041	595.3	599.8	1430.7	43.9	6.6	26.0	8.9	32.3
1142	0 0 0	42.4859	79.3261	182.9	185.9	605.9	26.1	10.0	26.6	3.2	31.9
2655	10 16 69	42.4311	79.0875	417.3	421.8	937.9	30.0	7.8	23.7	5.5	29.5
3200	7 19 54	42.0682	79.4156	479.1	479.1	2042.2	48.9	8.1	20.0	13.2	26.4
3859	3 22 75	42.7917	77.4576	430.4	431.0	901.3	34.4	6.9	30.5	5.2	36.3
3929	4 11 75	42.7743	77.4731	318.2	318.5	809.2	33.3	8.1	31.2	4.6	36.9
3930	3 20 75	42.7889	77.4746	363.9	364.2	843.4	27.2	7.6	23.3	4.8	29.0
3931	3 23 75	42.7806	77.4655	417.3	417.9	891.5	31.7	7.1	27.6	5.2	33.4
3945	3 26 75	42.8430	77.4720	354.2	354.5	823.0	32.2	7.6	29.9	4.7	35.6
3947	3 25 75	42.7878	77.4845	307.2	307.5	788.2	28.3	8.1	25.6	4.4	31.2
3964	4 10 76	42.7670	77.4951	324.6	324.9	410.0	18.9	8.0	26.5	1.8	30.9
3971	4 2 75	42.7851	77.4936	285.3	285.9	765.0	29.4	8.4	27.6	4.3	33.1
3976	4 10 75	42.7971	77.4553	452.0	452.3	915.0	33.9	6.7	29.7	5.3	35.5
3978	3 27 75	42.8136	77.4633	443.5	443.8	904.3	33.9	6.8	30.0	5.3	35.8
3985	3 31 75	42.7946	77.4716	422.8	423.1	889.1	32.8	7.0	29.0	5.1	34.8
3991	3 24 75	42.7762	77.4568	405.4	405.7	886.7	32.8	7.2	28.8	5.1	34.6
3997	3 28 75	42.7985	77.5087	296.6	296.9	703.5	34.4	8.2	37.3	3.9	42.7
4005	4 1 75	42.8015	77.4939	335.6	335.9	791.0	28.9	7.8	26.6	4.5	32.2
4023	4 10 75	42.7990	77.4852	350.8	351.1	807.7	29.4	7.7	26.9	4.6	32.6
4027	4 5 75	42.7917	77.4212	466.0	466.3	937.6	35.0	6.6	30.3	5.5	36.2
4036	4 11 75	42.8095	77.4951	312.1	312.4	752.2	26.7	8.1	24.7	4.2	30.3
4040	4 3 75	42.8012	77.4754	394.1	394.4	848.6	30.0	7.3	26.8	4.9	32.5
4138	11 14 61	42.8127	77.9437	279.2	280.4	634.0	17.8	8.3	14.9	3.4	20.2
4152	2 7 62	42.1639	79.7372	452.6	453.8	1086.6	42.2	8.1	31.4	6.5	37.4
4158	2 23 62	42.9177	76.8629	152.4	152.4	492.9	17.8	9.4	17.0	2.4	21.8
4161	1 28 62	42.2922	79.4928	412.4	415.4	988.2	32.8	8.2	24.9	5.8	30.8
4178	3 17 62	42.2887	79.4677	414.5	417.6	1004.3	35.0	8.2	26.7	6.0	32.6
4203	6 19 62	42.8763	76.8593	162.8	165.5	1689.8	48.9	9.4	23.4	10.7	29.7
4204	8 31 62	42.1609	79.6741	453.2	453.2	1105.2	32.8	8.2	22.3	6.7	28.3
4214	5 28 65	41.9321	74.0054	530.4	534.6	3345.2	55.0	6.1	14.6	22.3	21.3
4232	9 14 62	42.0158	79.2537	481.6	481.6	234.1	21.1	8.2	55.3	-.6	57.8
4241	11 13 62	42.9188	76.6424	186.2	189.6	561.1	30.0	9.1	37.3	2.9	42.4
4347	1 19 63	42.1601	79.6789	454.5	455.4	1103.4	30.0	8.1	19.8	6.6	25.8
4350	1 28 63	42.1866	76.5915	439.2	440.1	1039.4	45.6	7.8	36.4	6.2	42.3
4363	4 11 63	42.8618	77.8159	188.4	188.4	489.2	17.8	9.1	17.6	2.4	22.5
4364	4 29 63	42.3163	75.2678	505.4	509.3	2355.5	43.3	6.6	15.6	15.4	22.1
4379	7 4 63	42.2736	74.6279	559.0	563.0	2753.9	50.6	5.9	16.2	18.2	22.8
4389	5 30 63	42.9025	76.6638	155.4	156.1	533.1	32.2	9.4	42.8	2.7	47.8
4408	8 12 63	42.9278	76.8875	153.0	153.0	498.3	24.4	9.4	30.2	2.4	35.0
4437	11 2 63	42.1843	79.3382	536.4	540.4	1263.4	32.2	7.2	19.8	7.8	25.9
4437	11 15 63	42.1843	79.3382	536.4	540.4	2339.6	66.7	7.2	25.4	15.3	31.9
4448	11 1 63	42.9018	76.6742	148.7	149.7	538.0	33.9	9.5	45.4	2.7	50.4
4455	12 4 63	42.3905	75.0446	452.6	456.6	2417.7	62.2	7.0	22.9	15.8	29.4

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
4493	5 13 64	42.9222	76.6627	156.1	156.7	530.0	27.2	9.4	33.7	2.6	38.6
4497	4 27 64	42.9352	76.6403	167.3	168.2	536.8	27.2	9.2	33.5	2.7	38.5
4500	9 2 64	42.8130	75.6455	510.5	511.5	1024.7	33.9	6.0	27.2	6.1	33.1
4502	5 17 64	43.3309	77.9648	94.5	95.1	411.5	38.3	8.9	71.5	1.8	75.9
4511	6 5 64	42.9234	76.6301	190.5	191.1	585.8	32.2	9.0	39.6	3.0	44.7
4515	5 31 64	41.7381	74.2159	343.2	346.6	2445.4	64.4	8.0	23.1	16.0	29.6
4544	9 12 61	42.8689	76.9265	152.1	152.1	632.2	37.2	9.5	43.8	3.4	49.1
4561	8 21 64	42.2400	79.4148	464.5	468.5	1127.8	35.6	7.8	24.6	6.8	30.7
4581	1 6 65	42.2393	79.4080	483.7	484.6	1121.7	31.7	7.6	21.4	6.8	27.5
4590	11 13 64	42.8563	76.8831	165.8	165.8	626.7	32.2	9.4	36.4	3.3	41.7
4600	12 21 64	42.8744	76.9223	152.4	152.4	631.9	26.7	9.5	27.2	3.3	32.5
4630	11 29 64	42.6505	77.7563	182.6	186.5	1943.4	47.2	9.6	19.4	12.5	25.8
4630	11 23 64	42.6505	77.7563	182.6	186.5	804.7	23.9	9.6	17.7	4.6	23.4
4652	2 26 65	42.9468	76.7032	154.2	154.8	557.2	31.1	9.3	39.1	2.8	44.1
4671	11 11 66	42.2398	79.4202	472.4	473.4	1101.9	38.3	7.8	27.7	6.6	33.8
4671	11 15 66	42.2398	79.4202	472.4	473.4	1096.1	37.2	7.8	26.9	6.6	32.9
4671	11 11 66	42.2398	79.4202	472.4	473.4	1101.9	38.3	7.8	27.7	6.6	33.8
4671	11 15 66	42.2398	79.4202	472.4	473.4	1096.1	37.2	7.8	26.9	6.6	32.9
4714	12 7 65	42.5163	76.0017	478.2	484.3	2521.0	57.2	6.8	20.0	16.5	26.6
4715	11 6 65	42.9204	76.6722	156.4	157.3	1450.2	50.0	9.4	28.0	9.1	34.3
4719	7 23 65	43.3357	78.5131	100.0	102.4	658.1	33.3	8.7	37.4	3.5	42.8
4814	2 18 66	42.8947	76.7879	144.8	144.8	565.1	30.0	9.5	36.2	2.9	41.3
4820	3 29 66	42.0036	78.4349	657.1	657.8	1454.8	51.7	6.3	31.2	9.1	37.4
4867	6 2 66	42.4314	79.3875	201.2	201.2	655.9	23.9	10.0	21.2	3.5	26.6
4986	12 9 66	42.4106	79.4102	213.4	214.3	678.8	27.8	9.9	26.4	3.7	31.8
5000	10 29 66	43.1051	76.5529	130.1	132.6	1143.6	32.2	9.3	20.1	6.9	26.1
5011	12 19 66	43.1465	76.5538	120.4	123.1	1090.0	26.7	9.3	16.0	6.6	22.0
5032	3 13 67	43.0592	76.8405	144.2	146.6	1194.2	35.6	9.2	22.1	7.3	28.2
5061	2 3 67	42.8534	77.8167	184.4	185.6	514.2	17.2	9.2	15.6	2.5	20.5
5086	3 12 67	43.3073	78.0340	114.3	115.8	746.8	25.6	8.8	22.5	4.2	28.1
5087	3 26 69	42.3235	75.9480	303.6	307.2	2934.0	55.6	8.7	16.0	19.4	22.6
5087	7 30 67	42.3235	75.9480	303.6	307.2	2891.0	54.4	8.7	15.8	19.1	22.4
5087	3 26 69	42.3235	75.9480	303.6	307.2	2180.2	41.1	8.7	14.9	14.2	21.4
5087	8 7 67	42.3235	75.9480	303.6	307.2	2933.7	55.6	8.7	16.0	19.4	22.6
5087	3 26 69	42.3235	75.9480	303.6	307.2	2891.6	54.4	8.7	15.8	19.1	22.4
5087	6 3 67	42.3235	75.9480	303.6	307.2	2177.2	41.1	8.7	14.9	14.1	21.4
5123	5 31 67	42.1157	77.5809	687.0	687.9	1448.7	28.9	5.7	16.0	9.1	22.3
5129	1 26 68	42.4270	79.4064	193.5	194.8	646.8	26.7	10.0	25.7	3.5	31.1
5267	9 7 67	42.4318	79.4197	186.8	187.1	627.3	23.9	10.1	22.0	3.3	27.3
5783	11 3 68	41.7006	74.3467	662.9	666.3	2921.8	71.7	5.0	22.8	19.3	29.4
5783	11 3 68	41.7006	74.3467	662.9	666.3	2923.3	71.7	5.0	22.8	19.4	29.4
6636	10 8 69	42.4062	75.8782	442.9	442.9	1750.8	40.0	7.3	18.7	11.2	25.1
6668	5 8 68	42.8031	78.8444	178.6	180.7	1314.6	40.0	9.3	23.4	8.1	29.5
6718	5 9 69	42.7094	78.9436	212.8	213.4	453.5	23.3	9.2	31.2	2.1	35.8
6743	4 17 69	42.0969	78.6332	423.7	424.6	457.2	23.9	8.5	33.7	2.1	38.4
6745	7 18 69	42.3785	79.1884	432.8	433.4	698.3	27.8	7.8	28.6	3.8	34.0
6745	3 10 72	42.3785	79.1884	432.8	433.4	981.5	31.7	7.8	24.3	5.8	30.2
6745	7 18 69	42.3785	79.1884	432.8	433.4	698.3	27.8	7.8	28.6	3.8	34.0
6762	8 15 69	42.0453	78.5861	540.1	540.4	290.2	20.0	7.4	43.3	1.0	46.7
6780	2 18 69	43.1091	76.5434	137.5	140.2	944.3	23.9	9.2	15.6	5.5	21.4
6918	10 1 69	42.6982	78.9523	213.4	214.0	445.9	18.3	9.2	20.5	2.1	25.1
6922	11 12 69	42.7098	79.2921	198.7	199.6	428.9	15.6	9.3	14.6	1.9	19.1
6925	5 20 70	42.7118	78.9700	193.5	194.2	419.1	17.8	9.4	20.1	1.9	24.5
7184	10 9 69	42.0429	78.5913	627.3	628.5	381.0	22.8	6.6	42.5	1.6	46.7
7269	7 23 70	42.6606	70.0487	181.4	182.0	461.2	18.3	7.6	23.2	2.2	27.9

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
7278	1 14 71	42.7975	78.0913	319.7	323.4	1516.4	45.6	8.0	24.8	9.5	31.1
7649	12 7 70	42.4071	79.1674	488.0	492.3	1005.5	32.8	7.2	25.5	6.0	31.4
7948	1 27 72	42.0680	77.7550	682.8	683.7	573.6	21.1	5.8	26.7	2.9	31.8
8034	12 7 70	42.1319	77.8714	661.4	665.4	1508.8	51.7	5.9	30.3	9.5	36.6
8318	6 27 71	42.2363	77.5155	646.8	650.1	1338.7	40.0	5.8	25.5	8.3	31.7
8342	8 23 72	42.3977	75.8909	448.1	448.7	1832.2	40.6	7.2	18.2	11.7	24.6
8348	7 22 71	42.2778	77.4176	496.8	500.2	1156.7	40.6	7.2	28.8	7.0	34.9
8348	7 22 71	42.2778	77.4176	496.8	500.2	1157.0	40.6	7.2	28.8	7.0	34.9
8578	10 14 71	41.9111	74.8758	549.6	554.4	2315.6	58.9	6.3	22.7	15.1	29.2
8578	11 13 71	41.9111	74.8758	549.6	554.4	3043.7	63.9	6.3	18.9	20.2	25.6
8578	10 14 71	41.9111	74.8758	549.6	554.4	2315.6	58.9	6.3	22.7	15.1	29.2
8578	10 22 71	41.9111	74.8758	549.6	554.4	2524.7	62.8	6.3	22.4	16.6	28.9
8633	8 12 78	42.0528	78.6010	573.0	573.9	306.3	19.4	7.1	40.4	1.1	43.9
8756	1 2 71	42.4131	79.1850	430.4	433.4	954.0	33.3	7.7	26.8	5.6	32.7
8757	1 16 72	42.4270	79.1955	368.8	371.9	883.0	32.8	8.3	27.7	5.1	33.5
8862	10 20 71	42.6605	79.0542	178.3	178.9	470.6	21.1	9.6	24.4	2.2	29.1
8881	2 7 72	42.7383	78.8985	211.8	212.4	459.9	16.1	9.1	15.2	2.1	19.9
8882	3 14 72	42.6746	79.0406	179.8	180.4	459.3	20.0	9.6	22.7	2.1	27.4
8931	3 2 72	42.1002	73.6007	443.8	444.7	461.2	22.2	6.7	33.7	2.2	38.4
9120	3 19 72	42.0561	78.7489	682.1	686.1	1329.2	39.4	6.0	25.2	8.2	31.3
9151	6 6 72	42.0704	78.7346	678.5	682.4	1316.1	36.1	6.0	22.9	8.1	29.1
9194	6 15 72	42.4332	77.9653	586.7	591.0	1040.0	35.0	6.1	27.8	6.2	33.8
9196	9 1 72	42.6661	79.0490	177.7	178.6	469.1	22.2	9.6	26.9	2.2	31.6
9330	0 20 72	42.1197	77.8471	669.3	673.6	1509.4	40.6	5.8	23.0	9.5	29.3
9343	10 6 72	43.0417	78.4004	239.9	239.9	246.0	16.1	8.2	32.4	.7	35.0
9343	9 23 72	43.0417	78.4004	239.9	239.9	259.1	16.1	8.2	30.7	.7	33.6
9344	10 6 72	43.0407	78.3802	263.0	263.0	274.6	18.3	7.9	37.9	.9	41.0
9344	9 2 72	43.0407	78.3802	263.0	263.0	275.8	18.3	7.9	37.7	.9	40.8
9345	9 12 72	43.0407	78.3708	260.3	261.2	283.8	19.4	8.0	40.5	.9	43.7
9346	9 6 72	43.0478	78.3610	270.4	271.3	284.7	18.3	7.8	36.9	.9	40.1
9356	6 16 77	42.0422	77.8682	676.0	676.0	1503.3	42.8	6.0	24.5	9.4	30.8
9524	10 27 72	42.8167	78.2447	283.2	287.1	1247.2	32.2	8.3	19.2	7.6	25.4
9540	11 5 72	43.1890	78.0389	180.7	185.0	874.8	25.6	8.4	19.6	5.0	25.4
9557	5 8 73	42.1461	76.3373	452.6	457.8	1567.0	41.1	7.6	21.4	9.9	27.7
9557	5 8 73	42.1461	76.3373	452.6	457.5	1539.2	41.1	7.6	21.8	9.7	28.1
9557	5 10 73	42.1461	76.3373	452.6	457.8	1563.9	41.1	7.6	21.4	9.9	27.8
9557	5 8 73	42.1461	76.3373	452.6	457.8	1567.0	41.1	7.6	21.4	9.9	27.7
9557	5 10 73	42.1461	76.3373	452.6	457.8	1563.9	41.1	7.6	21.4	9.9	27.8
9563	11 15 72	43.0794	70.1102	198.1	202.4	1030.5	23.9	7.7	15.7	6.1	21.7
9578	10 13 73	42.9511	75.8080	413.9	417.6	793.4	32.2	6.8	32.1	4.5	37.7
9578	10 22 73	42.9511	75.8080	413.9	417.6	1492.3	44.4	6.8	25.3	9.4	31.5
9582	12 4 72	42.2779	77.4222	542.5	546.8	1184.1	34.4	6.7	23.4	7.2	29.5
9616	6 8 73	42.3687	79.3402	448.1	448.1	988.8	33.9	7.7	26.5	5.8	32.4
9617	4 5 73	42.1694	79.6767	455.1	455.1	1090.9	33.3	8.1	23.1	6.6	29.1
9619	4 28 73	42.3767	79.4561	241.4	241.4	723.6	29.4	9.7	27.3	4.0	32.8
9620	4 30 73	42.2845	79.5235	427.3	427.3	998.2	32.2	8.1	24.2	5.9	30.1
9829	3 29 73	42.0249	78.4219	557.8	558.1	457.5	18.3	7.3	24.2	2.1	28.9
9848	6 3 73	42.0759	76.4523	393.8	399.0	1593.5	70.0	8.3	38.7	10.1	45.1
9867	5 13 73	42.2782	79.5312	454.8	458.4	1014.7	31.1	7.8	23.0	6.0	28.9
9868	5 22 73	42.2408	79.6655	479.1	479.1	1003.7	31.7	7.7	23.9	5.9	29.8
9870	5 24 73	42.3755	79.3181	356.6	356.6	910.1	30.0	8.6	23.5	5.3	29.4
9871	6 16 73	42.2475	79.6655	441.0	444.7	1055.5	35.6	8.0	26.1	6.3	32.1
9938	11 5 73	42.7412	78.8949	208.5	209.1	438.0	21.7	9.1	28.6	2.0	33.1
9939	5 23 73	42.4158	79.3788	225.2	228.6	732.7	27.2	9.7	23.9	4.1	29.4

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
9939	5 31 73	42.4158	79.3788	225.2	228.6	1523.7	40.0	9.7	19.9	9.6	26.2
9939	5 23 73	42.4158	79.3788	225.2	228.6	732.7	27.2	9.7	23.9	4.1	29.4
9940	5 11 73	42.4065	79.4028	225.6	229.2	719.9	26.7	9.8	23.5	4.0	29.0
9941	6 27 73	42.4121	79.3874	225.6	228.6	719.6	29.4	9.7	27.4	4.0	32.9
9958	10 4 73	42.8454	78.8350	176.8	177.7	329.5	18.3	9.2	27.7	1.2	31.5
9960	6 26 73	42.2408	79.6655	457.2	464.8	1067.7	32.2	7.8	22.8	6.4	28.8
9961	6 6 73	42.3758	79.4466	245.4	247.2	733.0	32.2	9.6	30.8	4.1	36.3
9962	6 22 73	42.3687	79.4574	254.5	259.7	766.0	29.4	9.5	26.0	4.3	31.6
9962	6 22 73	42.3687	79.4574	254.5	259.7	766.3	29.4	9.5	26.0	4.3	31.6
9963	7 6 73	42.1783	79.6657	445.0	448.4	1116.8	37.8	8.2	26.5	6.7	32.6
9963	7 6 73	42.1783	79.6657	445.0	448.4	1116.5	37.8	8.2	26.5	6.7	32.6
9964	8 28 73	42.1661	79.6923	461.8	464.8	1100.9	33.3	8.0	23.0	6.6	29.0
9964	8 28 73	42.1661	79.6923	461.8	464.8	1101.9	33.3	8.0	23.0	6.6	29.0
10024	7 31 73	42.4430	77.6063	621.8	626.7	1051.0	30.0	5.7	23.1	6.3	29.1
10025	7 11 73	42.3635	79.4739	271.3	271.3	779.4	32.2	9.4	29.2	4.4	34.8
10028	7 21 73	42.2598	79.6682	391.7	391.7	970.8	32.2	8.5	24.4	5.7	30.3
10032	6 30 73	42.3723	79.4645	243.8	243.8	761.1	30.0	9.7	26.7	4.3	32.3
10033	6 29 74	42.3793	79.2980	371.9	371.9	923.2	33.3	8.4	27.0	5.4	32.8
10065	9 12 73	42.2464	79.6592	454.8	454.8	1062.5	31.1	7.9	21.8	6.4	27.8
10066	10 11 73	42.1710	79.6696	449.0	449.0	1118.3	36.7	8.2	25.5	6.7	31.5
10069	9 17 73	42.3780	79.3269	406.0	406.0	952.5	33.9	8.1	27.1	5.6	33.0
10084	9 8 73	42.3763	79.4754	236.2	236.2	730.0	26.7	9.8	23.2	4.0	28.7
10086	8 17 73	42.2350	79.6685	477.0	477.0	1108.3	32.8	7.7	22.6	6.7	28.6
10087	9 5 73	42.2302	79.6615	490.7	490.7	1097.6	34.4	7.6	24.4	6.6	30.5
10089	8 14 73	42.1546	79.6793	482.2	482.2	1148.2	32.2	7.9	21.2	7.0	27.3
10090	9 9 73	42.1617	79.6962	469.4	469.4	1120.7	35.6	8.0	24.6	6.8	30.6
10091	10 18 73	42.3720	79.3523	457.2	459.6	1007.1	36.7	7.6	28.9	6.0	34.8
10093	1 14 74	42.4247	79.4147	195.7	197.8	661.1	26.7	10.0	25.2	3.6	30.6
10096	9 2 73	40.1212	74.7307	513.6	519.4	1919.9	49.4	6.3	22.5	12.3	28.9
10107	11 16 73	42.2425	77.5136	584.6	586.7	1250.3	47.8	6.4	33.1	7.7	39.2
10107	11 17 73	42.2425	77.5136	584.6	586.7	1250.3	48.3	6.4	33.5	7.7	39.6
10109	1 13 74	42.3556	79.4553	329.2	331.3	875.4	29.4	8.9	23.5	5.1	29.3
10110	9 19 73	42.1747	79.6782	458.7	460.9	1112.8	39.4	8.0	28.2	6.7	34.2
10111	10 31 73	42.3655	79.3689	452.6	455.1	1008.6	32.2	7.6	24.4	6.0	30.3
10111	10 31 73	42.3655	79.3689	452.6	455.1	1008.9	32.2	7.6	24.4	6.0	30.3
10138	11 4 73	42.6935	75.0952	495.9	499.9	830.0	28.9	6.2	27.3	4.7	33.0
10145	10 31 74	42.3649	79.4361	321.6	323.7	878.7	29.4	8.9	23.4	5.1	29.1
10146	9 19 73	42.3879	79.4629	283.2	285.9	805.0	28.3	9.2	23.7	4.6	29.4
10173	10 19 73	42.3533	79.3485	480.1	483.1	1035.4	36.1	7.4	27.7	6.2	33.7
10173	10 19 73	42.3533	79.3485	480.1	483.1	1035.1	35.0	7.4	26.7	6.2	32.6
10175	10 26 73	42.2434	79.6784	414.5	417.6	1029.6	37.8	8.3	28.6	6.1	34.6
10175	10 26 73	42.2434	79.6784	414.5	417.6	1030.5	37.8	8.3	28.6	6.1	34.6
10176	9 20 73	42.2508	79.6495	457.2	460.2	1040.0	38.3	7.9	29.3	6.2	35.3
10176	9 20 73	42.2508	79.6495	457.2	460.2	1040.3	38.3	7.9	29.3	6.2	35.2
10177	10 9 73	42.2878	79.4229	466.6	469.1	1102.5	34.4	7.7	24.3	6.6	30.3
10227	10 11 73	42.3000	74.6250	608.7	613.6	2055.3	46.1	5.4	19.8	13.3	26.3
10227	10 8 73	42.3000	74.6250	608.7	613.6	1722.4	41.1	5.4	20.8	11.0	27.1
10227	10 8 73	42.3000	74.6250	608.7	613.6	1720.6	41.1	5.4	20.8	11.0	27.1
10227	10 11 73	42.3000	74.6250	608.7	613.6	2055.3	46.1	5.4	19.8	13.3	26.3
10227	10 8 73	42.3000	74.6250	608.7	613.6	1705.7	38.3	5.4	19.3	10.9	25.7
10243	11 3 73	42.4010	76.6685	561.1	566.0	1119.8	32.2	6.2	23.2	6.8	29.2
10246	10 29 73	42.2014	77.6555	637.6	642.5	1406.3	41.7	6.0	25.4	8.8	31.6
10250	2 24 74	42.1599	79.6696	454.8	457.2	1125.6	34.4	8.1	23.4	6.8	29.4
10251	10 30 73	42.1823	79.6595	467.9	470.3	1138.4	35.0	7.9	23.8	6.9	29.8
10252	10 20 73	42.1746	79.6581	445.0	447.1	1113.4	36.7	8.2	25.6	6.7	31.6

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
10253	2 3 74	42.3547	79.3638	358.4	360.6	905.0	32.2	8.6	26.1	5.3	31.9
10254	12 19 73	42.3499	79.3559	475.5	477.9	1030.2	36.7	7.4	28.4	6.1	34.3
10258	11 4 73	42.2404	79.6940	390.1	391.7	984.2	36.7	8.6	28.6	5.8	34.5
10259	11 5 73	42.2442	77.2167	323.1	325.8	887.3	28.9	8.9	22.5	5.1	28.3
10263	11 22 73	42.4424	74.6206	638.6	642.5	1304.5	37.2	5.0	24.7	8.1	30.9
10263	11 21 73	42.4424	74.6206	638.6	642.5	1303.6	37.2	5.0	24.7	8.0	30.9
10278	11 17 73	42.1727	79.6990	462.1	463.6	1126.2	38.9	8.0	27.4	6.8	33.4
10278	11 17 73	42.1727	79.6990	462.1	463.6	1128.1	38.9	8.0	27.4	6.8	33.4
10285	11 3 73	42.3690	79.4795	241.7	243.8	766.9	31.7	9.7	28.6	4.3	34.2
10285	11 3 73	42.3690	79.4795	241.7	243.8	767.2	31.7	9.7	28.6	4.3	34.2
10286	12 7 73	42.3566	79.4854	262.7	264.9	781.8	28.9	9.5	24.8	4.4	30.4
10286	12 7 73	42.3566	79.4854	262.7	264.9	782.1	28.9	9.5	24.8	4.4	30.4
10287	5 17 74	42.3504	79.4889	281.3	287.1	814.4	27.8	9.3	22.7	4.6	28.3
10287	5 17 74	42.3504	79.4889	281.3	287.1	815.6	27.8	9.3	22.6	4.6	28.3
10288	2 22 74	42.3518	79.4652	329.8	337.4	852.8	26.7	8.8	20.9	4.9	26.7
10289	4 10 74	42.3667	79.4845	232.3	234.7	762.0	29.4	9.8	25.8	4.3	31.4
10290	11 24 73	42.3622	79.4805	249.3	251.5	766.9	31.7	9.6	28.7	4.3	34.3
10292	12 10 73	42.2457	79.6718	427.9	427.9	1040.3	32.2	8.2	23.1	6.2	29.1
10293	1 7 74	42.2480	79.6780	399.6	402.6	1003.4	26.7	8.4	18.2	5.9	24.1
10293	1 7 74	42.2480	79.6780	399.6	402.6	1002.2	26.7	8.4	18.2	5.9	24.1
10298	11 13 73	42.3502	79.3689	469.7	472.4	1023.2	36.7	7.5	28.5	6.1	34.4
10298	11 13 73	42.3502	79.3689	469.7	472.4	1022.6	36.7	7.5	28.5	6.1	34.5
10299	11 25 73	42.3605	79.3328	411.5	414.2	961.9	31.7	8.0	24.6	5.7	30.4
10316	11 19 73	42.2289	79.6731	472.4	475.5	1080.8	37.8	7.8	27.8	6.5	33.8
10316	11 19 73	42.2289	79.6731	472.4	475.5	1080.2	37.8	7.8	27.8	6.5	33.8
10332	12 7 73	42.1781	79.7045	463.9	466.3	1128.7	34.4	8.0	23.4	6.8	29.5
10332	12 7 73	42.1781	79.7045	463.9	466.3	1128.4	34.4	8.0	23.4	6.8	29.5
10335	1 15 74	42.1690	76.6745	432.2	437.1	1678.8	47.8	7.8	23.8	10.7	30.1
10335	4 24 74	42.1690	76.6745	432.2	437.1	3234.2	74.4	7.8	20.6	21.5	27.3
10345	11 29 73	42.2455	79.6920	370.3	373.4	985.7	34.4	8.7	26.1	5.8	32.0
10370	8 8 74	42.1847	79.7063	447.4	450.5	1085.1	32.2	8.1	22.2	6.5	28.2
10375	12 20 73	42.4235	79.3762	226.2	229.5	686.7	30.6	9.7	30.4	3.7	35.8
10382	1 28 74	42.1595	79.6577	447.4	450.5	1127.8	35.0	8.2	23.8	6.8	29.8
10389	8 14 73	42.1546	79.6793	482.2	485.2	1147.6	32.2	7.9	21.2	7.0	27.3
10406	1 22 74	42.2488	79.6979	357.8	360.9	956.5	32.2	8.8	24.4	5.6	30.3
10407	2 2 74	42.2333	79.6857	424.3	424.3	1030.2	33.9	8.3	24.9	6.1	30.8
10417	1 11 74	42.4233	79.3155	266.7	269.7	728.2	26.7	9.3	23.8	4.0	29.4
10448	1 21 74	42.4542	79.3536	199.3	202.4	698.6	29.4	9.9	28.0	3.8	33.4
10455	2 1 74	42.4134	79.3411	287.1	290.8	770.2	29.4	9.1	26.4	4.3	32.0
10456	4 29 74	42.3624	79.3756	466.3	469.4	1019.6	29.4	7.5	21.5	6.1	27.5
10457	2 16 74	42.2284	79.6865	443.2	443.2	1059.5	29.4	8.1	20.2	6.3	26.1
10458	12 2 74	42.2371	79.6990	389.2	392.3	976.9	32.8	8.6	24.8	5.8	30.7
10460	7 21 74	42.3624	79.3756	466.3	468.8	1016.8	34.4	7.5	26.5	6.0	32.4
10461	5 14 74	42.3572	79.3804	473.4	475.8	1038.1	35.0	7.5	26.5	6.2	32.5
10469	2 19 74	42.2721	79.5279	461.8	464.8	1036.9	26.7	7.8	18.2	6.2	24.2
10470	8 3 74	42.2648	79.5166	485.9	489.2	1060.4	32.2	7.5	23.3	6.3	29.3
10477	2 14 74	42.4115	79.4432	199.6	203.0	674.8	26.7	10.0	24.7	3.7	30.1
10479	2 21 74	42.3460	79.3631	455.1	457.2	1016.2	26.7	7.7	18.7	6.0	24.6
10484	3 7 74	42.3473	79.4835	318.8	323.7	852.5	29.4	9.0	24.0	4.9	29.8
10485	2 27 74	42.2234	79.6584	496.8	499.9	1114.7	32.2	7.5	22.1	6.7	28.2
10485	2 27 74	42.2234	79.6584	496.8	499.9	1115.9	32.2	7.5	22.1	6.7	28.1
10486	5 28 74	42.2295	79.6493	509.0	512.1	1131.7	33.9	7.4	23.4	6.8	29.4
10486	5 28 74	42.2295	79.6493	509.0	512.1	1131.7	36.7	7.4	25.8	6.8	31.9
10489	3 20 74	42.3437	79.4916	313.3	315.5	856.5	26.7	9.1	20.6	4.9	26.3
10528	3 2 74	42.4075	79.4574	204.2	207.6	684.6	29.4	10.0	28.5	3.7	33.9

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
10530	11 6 74	42.3616	79.4417	341.1	343.2	883.9	30.0	8.7	24.0	5.1	29.8
10531	4 12 74	42.3451	79.3739	410.6	413.0	973.8	29.4	8.1	21.9	5.7	27.8
10532	3 12 74	42.2250	79.6645	490.1	492.9	1108.3	35.6	7.6	25.2	6.7	31.2
10532	3 12 74	42.2250	79.6645	490.1	492.9	1107.6	35.6	7.6	25.2	6.7	31.3
10534	4 2 74	42.4859	79.3261	182.9	185.9	708.4	28.9	10.0	26.7	3.9	32.2
10535	3 12 74	42.3818	79.4741	222.5	225.9	714.1	29.4	9.8	27.4	3.9	32.9
10550	3 25 74	42.2286	79.6517	496.2	496.2	1116.5	30.0	7.6	20.1	6.7	26.1
10550	3 25 74	42.2286	79.6517	496.2	496.2	1117.1	30.0	7.6	20.1	6.7	26.1
10554	3 13 74	42.3363	79.3733	403.3	405.4	962.6	28.3	8.2	20.9	5.7	26.8
10564	3 19 74	42.3895	79.4752	201.2	204.5	697.7	26.7	10.0	23.8	3.8	29.3
10564	3 19 74	42.3895	79.4752	201.2	204.5	696.5	26.7	10.0	23.9	3.8	29.3
10566	3 25 74	42.2876	79.5339	431.0	434.0	1012.2	28.9	8.0	20.6	6.0	26.5
10566	3 25 74	42.2876	79.5339	431.0	434.0	1012.5	28.9	8.0	20.6	6.0	26.5
10577	4 10 74	42.4113	78.8739	445.0	448.1	1045.8	25.6	7.6	17.2	6.2	23.1
10578	3 26 74	42.4018	79.4451	204.5	204.5	686.1	25.6	10.0	22.7	3.7	28.1
10578	3 26 74	42.4018	79.4451	204.5	204.5	685.8	25.6	10.0	22.7	3.7	28.1
10579	5 26 74	42.3470	79.4746	340.2	342.3	878.7	32.8	8.8	27.3	5.1	33.1
10580	3 23 74	42.3324	79.5154	402.3	402.3	969.0	26.7	8.2	19.0	5.7	24.9
10580	3 23 74	42.3324	79.5154	402.3	402.3	968.3	26.7	8.2	19.0	5.7	24.9
10584	4 1 74	42.3667	79.4924	235.0	237.1	753.5	25.6	9.8	21.0	4.2	26.5
10584	4 1 74	42.3667	79.4924	235.0	237.1	752.6	25.6	9.8	21.0	4.2	26.5
10585	11 15 74	42.3586	79.4326	338.3	340.5	882.4	30.0	8.8	24.1	5.1	29.8
10596	4 1 74	42.3379	79.3801	405.7	405.7	964.7	29.4	8.2	22.0	5.7	27.9
10597	4 7 74	42.2159	79.6578	501.1	504.1	1150.3	36.1	7.5	24.9	7.0	30.9
10601	4 13 74	42.3876	79.4386	235.0	235.0	801.6	29.4	9.7	24.6	4.5	30.2
10605	10 23 74	42.3412	79.4439	418.8	420.9	981.5	30.0	8.0	22.4	5.8	28.3
10607	4 28 74	42.4511	75.4848	523.3	528.8	1611.2	32.8	6.3	16.4	10.2	22.8
10608	6 3 74	42.3172	75.6714	426.7	431.3	2008.6	43.3	7.4	17.9	13.0	24.3
10608	6 3 74	42.3172	75.6714	426.7	431.3	2010.8	43.3	7.4	17.8	13.0	24.3
10608	6 3 74	42.3172	75.6714	426.7	431.3	2015.0	43.3	7.4	17.8	13.0	24.3
10655	4 20 74	42.2104	79.6575	501.4	504.4	1200.9	37.8	7.5	25.2	7.3	31.3
10656	4 24 74	42.3892	79.4500	217.9	221.3	712.0	27.8	9.9	25.2	3.9	30.6
10656	4 24 74	42.3892	79.4500	217.9	221.3	711.4	27.8	9.9	25.2	3.9	30.7
10658	4 8 74	42.3832	79.4432	241.1	241.1	730.0	28.3	9.7	25.5	4.0	31.1
10700	4 21 74	42.3552	79.4953	249.0	251.2	770.2	28.9	9.7	25.0	4.3	30.6
10701	6 16 74	42.8763	76.7064	125.3	128.3	550.8	23.9	9.7	25.7	2.8	30.7
10702	6 9 74	42.8766	76.6932	138.4	141.4	553.5	27.8	9.6	32.8	2.8	37.9
10705	4 30 74	42.1899	79.6605	472.4	475.5	1108.6	35.6	7.9	25.0	6.7	31.0
10706	5 19 74	42.1932	79.6551	474.9	477.9	1119.2	33.9	7.8	23.3	6.8	29.3
10725	5 19 74	42.5298	75.2468	347.2	352.3	1212.5	36.7	7.9	23.7	7.4	29.8
10756	6 6 74	42.3644	79.4480	318.5	321.0	858.0	31.1	9.0	25.8	4.9	31.6
10756	6 6 74	42.3644	79.4480	318.5	321.0	860.1	31.1	9.0	25.8	4.9	31.5
10757	5 7 74	42.2705	79.5481	420.6	423.1	1028.7	35.6	8.2	26.6	6.1	32.6
10771	6 1 74	42.1655	79.6660	437.4	440.4	1116.8	36.1	8.3	24.9	6.7	31.0
10836	10 10 74	42.6650	78.5612	321.6	322.5	666.9	31.1	8.2	34.3	3.6	39.7
10836	11 11 74	42.6650	78.5612	321.6	322.5	354.5	20.6	8.2	34.7	1.4	38.7
10838	6 24 74	42.3290	75.3750	365.2	370.3	1778.5	39.4	8.0	17.7	11.4	24.1
10855	3 20 77	42.0210	78.6008	558.4	559.9	1272.2	28.3	7.3	16.5	7.8	22.7
10872	6 27 74	42.0539	79.4637	473.0	476.4	1312.5	38.9	8.2	23.4	8.1	29.6
10873	7 28 74	42.0559	79.0773	440.1	443.8	1398.7	37.8	8.4	21.0	8.7	27.2
10875	6 10 74	42.1503	79.6861	486.8	489.8	1153.7	36.7	7.8	25.0	7.0	31.1
10877	7 17 74	42.2953	79.4667	443.8	445.9	1004.3	33.3	7.9	25.3	6.0	31.3
10878	6 27 74	42.3357	79.4532	463.0	463.0	1034.5	34.4	7.6	25.	6.2	31.9
10883	6 6 74	42.3665	79.2977	420.6	423.1	993.0	37.2	7.9	29.5	5.9	35.4
10884	9 26 74	42.3697	79.4422	276.1	279.2	801.3	28.9	9.4	24.4	4.5	30.0

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
10884	9 26 74	42.3697	79.4422	276.1	279.2	808.6	28.9	9.4	24.2	4.6	29.8
10894	6 27 74	42.3366	79.3899	404.8	406.9	963.8	32.8	8.2	25.5	5.7	31.4
10895	6 13 74	42.3580	79.2992	415.1	417.6	996.4	30.0	8.0	22.1	5.9	28.0
10895	6 13 74	42.3580	79.2992	415.1	417.6	995.8	30.0	8.0	22.1	5.9	28.0
10896	6 19 74	42.1530	79.6921	488.6	491.6	1151.8	36.7	7.8	25.1	7.0	31.1
10898	8 11 74	42.1707	79.6458	463.9	468.5	1137.2	38.3	8.0	26.7	6.9	32.7
10899	6 22 74	42.2178	79.6819	475.2	475.2	1112.5	35.6	7.8	24.9	6.7	31.0
10899	6 22 74	42.2178	79.6819	475.2	475.2	1112.8	35.6	7.8	24.9	6.7	31.0
10900	7 5 74	42.1516	79.6683	479.8	482.8	1166.5	36.7	7.9	24.7	7.1	30.7
10917	7 3 74	42.7612	78.4442	477.0	480.7	681.5	35.0	6.5	41.9	3.7	47.3
10923	7 7 74	42.3439	79.4621	442.9	445.0	985.1	38.9	7.8	31.6	5.8	37.5
10931	7 24 74	42.2008	79.5665	488.6	491.9	1143.0	35.0	7.7	23.9	6.9	30.0
10937	7 5 74	42.3447	79.4012	405.4	407.8	980.8	33.3	8.1	25.7	5.8	31.6
10937	7 5 74	42.3447	79.4012	405.4	407.8	980.5	33.3	8.1	25.7	5.8	31.6
10939	7 25 74	42.7668	78.4179	457.2	460.6	1652.0	42.2	6.7	21.5	10.5	27.9
10943	7 8 74	42.1685	79.6892	455.4	458.4	1083.3	37.2	8.1	26.9	6.5	32.9
10944	7 15 74	42.3345	79.3983	423.1	452.9	979.6	33.3	7.7	26.1	5.8	32.0
10944	7 15 74	42.3345	79.3983	423.1	452.9	979.9	33.3	7.7	26.1	5.8	32.0
10945	10 22 74	42.3525	79.3317	407.8	410.3	969.3	30.0	8.1	22.6	5.7	28.5
10946	11 19 74	42.4278	79.3019	265.2	268.2	746.8	23.3	9.3	18.8	4.2	24.3
10948	7 18 74	42.1525	79.6573	454.8	457.8	1164.6	36.1	8.1	24.0	7.1	30.1
10948	7 18 74	42.1525	79.6573	454.8	457.8	1163.7	36.1	8.1	24.0	7.1	30.1
10949	7 16 74	42.2244	79.6956	417.0	420.0	1041.5	34.4	8.3	25.1	6.2	31.0
10949	7 16 74	42.2244	79.6956	417.0	420.0	1040.6	34.4	8.3	25.1	6.2	31.1
10955	12 12 74	42.2232	79.6839	459.3	462.4	1068.3	35.0	7.9	25.4	6.4	31.3
10957	8 14 74	42.3291	79.3926	415.4	418.8	995.2	38.9	8.1	31.0	5.9	36.9
10960	9 28 74	42.8566	78.7851	159.1	160.0	609.6	26.7	9.3	28.4	3.2	33.6
10962	9 27 74	42.4160	78.8353	426.7	429.8	1039.4	33.3	7.8	24.6	6.2	30.6
10967	8 10 74	42.3486	79.4453	414.5	416.7	968.3	32.8	8.1	25.5	5.7	31.4
10968	8 4 74	42.3678	79.2916	422.8	425.2	984.5	34.4	7.9	26.9	5.8	32.8
10972	8 11 74	42.3557	79.2508	424.9	427.0	999.4	36.1	7.9	28.2	5.9	34.1
10973	8 1 74	42.1773	79.7103	439.2	442.3	1113.4	33.3	8.2	22.6	6.7	28.6
10973	7 31 74	42.1773	79.7103	439.2	442.3	1119.2	33.3	8.2	22.4	6.8	28.5
10993	1 24 74	42.3507	79.3780	420.6	420.9	975.4	29.4	8.0	22.0	5.8	27.9
10999	9 11 74	42.1880	79.6924	475.5	478.5	1106.7	40.0	7.8	29.1	6.7	35.1
11000	9 19 74	42.1919	79.6863	487.7	490.7	1135.1	36.7	7.7	25.5	6.9	31.6
11000	9 19 74	42.1919	79.6863	487.7	490.7	1135.4	36.7	7.7	25.5	6.9	31.6
11002	8 31 74	42.5575	78.7447	509.0	512.7	1909.6	53.3	6.6	24.5	12.3	30.9
11002	8 31 74	42.5575	78.7447	509.0	512.7	1909.6	54.4	6.6	25.0	12.3	31.5
11004	8 30 74	42.3422	79.4083	454.8	458.1	997.9	32.2	7.7	24.6	5.9	30.5
11005	8 22 74	42.3368	79.4052	414.8	417.9	1030.2	38.9	8.1	29.9	6.1	35.9
11021	10 16 74	42.3366	79.4454	453.5	455.7	1019.3	31.1	7.7	23.0	6.1	28.9
11022	9 18 74	42.3176	79.3813	402.3	404.5	1010.4	33.3	8.2	24.8	6.0	30.8
11022	9 18 74	42.3176	79.3813	402.3	404.5	1010.4	35.0	8.2	26.5	6.0	32.4
11023	8 31 74	42.1486	79.7102	460.6	463.6	1136.9	35.0	8.1	23.7	6.9	29.7
11023	8 31 74	42.1486	79.7102	460.6	463.6	1136.6	35.0	8.1	23.7	6.9	29.7
11027	9 18 74	42.4634	77.3177	443.5	447.1	811.7	33.9	7.4	32.6	4.6	38.3
11030	8 26 74	42.1776	79.6920	468.8	471.8	1114.0	36.7	7.9	25.8	6.7	31.8
11031	12 4 74	42.3734	79.4940	218.5	220.7	725.1	27.2	9.9	23.9	4.0	29.4
11032	8 29 74	42.4097	79.2619	451.1	453.5	969.9	33.3	7.5	26.6	5.7	32.5
11033	9 15 74	42.3340	79.4833	424.6	426.7	981.5	30.6	8.0	23.0	5.8	28.9
11036	9 5 74	42.4128	79.2729	395.0	397.5	892.8	30.0	8.1	24.5	5.2	30.3
11038	8 21 74	42.1024	79.1462	384.4	387.7	1264.9	38.9	8.9	23.7	7.8	29.9
11040	9 29 74	42.1921	79.6693	1079.0	1082.0	1081.7	32.2	1.9	28.0	6.5	34.0
11041	10 17 74	42.1941	79.6798	435.9	438.9	1073.5	35.0	8.2	25.0	6.4	30.9

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
11042	9 8 74	42.1588	79.6860	472.4	506.0	1139.6	35.0	7.6	24.0	6.9	30.1
11043	9 2 74	42.1874	79.6781	484.6	488.3	1121.1	34.4	7.7	23.8	6.8	29.9
11054	9 12 74	42.3610	79.2917	424.6	427.0	984.5	32.2	7.9	24.7	5.8	30.6
11059	10 4 74	42.3185	79.3682	399.0	402.0	1004.3	32.8	8.3	24.4	6.0	30.3
11063	11 14 74	42.2482	79.6357	487.1	487.4	1089.7	34.4	7.6	24.6	6.5	30.6
11066	10 23 74	42.4032	78.8924	390.1	393.2	1001.0	32.2	8.1	24.1	5.9	30.0
11067	10 8 74	42.4283	78.8511	451.1	454.2	1055.2	33.9	7.5	25.0	6.3	31.0
11067	10 8 74	42.4283	78.8511	451.1	454.2	1055.2	35.0	7.5	26.1	6.3	32.0
11069	10 29 74	42.3892	79.1920	423.7	424.6	607.2	21.1	7.9	21.8	3.2	27.0
11069	10 29 74	42.3892	79.1920	423.7	424.6	603.8	21.1	7.9	21.9	3.2	27.1
11076	11 3 74	42.4161	79.3150	271.3	274.6	763.8	24.4	9.3	19.8	4.3	25.4
11079	9 16 74	42.1466	79.7029	460.9	463.9	1138.4	35.0	8.1	23.6	6.9	29.7
11094	9 26 73	42.3223	79.3991	406.6	409.0	993.6	31.1	8.2	23.1	5.9	29.0
11096	10 27 74	42.1909	79.7009	457.8	460.9	1107.0	31.7	8.0	21.4	6.7	27.4
11097	10 9 74	42.3255	79.4799	442.9	444.4	1000.0	31.1	7.8	23.3	5.9	29.2
11098	10 1 74	42.3284	79.4718	436.2	438.3	999.7	31.1	7.9	23.2	5.9	29.1
11105	10 12 74	42.2202	77.5427	646.2	649.8	1375.6	43.3	5.9	27.2	8.5	33.5
11110	10 11 74	42.1565	79.6990	449.0	452.0	1107.3	32.8	8.2	22.2	6.7	28.2
11111	10 3 74	42.3351	79.4156	416.7	416.7	992.4	32.2	8.1	24.3	5.9	30.2
11112	11 29 74	42.3430	79.3861	398.7	401.1	958.3	32.8	8.2	25.6	5.6	31.5
11114	2 11 75	42.5976	78.9841	243.8	246.9	1469.7	39.4	9.1	20.6	9.2	26.9
11117	10 8 74	42.1858	79.6676	445.0	448.1	1082.0	32.2	8.1	22.3	6.5	28.3
11118	1 31 75	42.3403	79.4218	420.0	422.5	990.0	32.8	8.0	25.0	5.9	30.9
11119	8 8 75	42.3401	79.3958	398.7	401.7	969.9	32.8	8.2	25.3	5.7	31.2
11120	10 17 74	42.3200	79.3492	469.4	472.1	1076.6	32.8	7.6	23.4	6.5	29.4
11121	11 2 74	42.4032	79.2938	329.2	332.5	853.4	25.6	8.7	19.7	4.9	25.4
11126	10 18 74	42.2706	77.6400	473.4	477.0	1118.6	32.8	7.5	22.6	6.8	28.7
11130	11 6 74	42.1716	79.7096	438.9	442.0	1091.2	32.2	8.2	22.0	6.6	28.0
11131	10 19 74	42.1713	79.7189	438.9	442.0	1090.6	32.8	8.2	22.5	6.6	28.5
11132	10 1 74	42.1647	79.7221	442.3	445.3	1095.8	32.8	8.2	22.4	6.6	28.4
11133	11 11 74	42.1905	79.7098	447.4	450.5	1078.7	32.2	8.1	22.4	6.5	28.4
11135	11 7 74	42.4538	77.6231	538.0	541.6	970.5	29.4	6.5	23.6	5.7	29.5
11136	11 3 74	42.1964	79.6975	445.0	448.1	1077.8	32.2	8.1	22.4	6.5	28.4
11137	11 9 74	42.1971	79.7091	439.8	442.9	1077.8	33.9	8.2	23.9	6.5	29.9
11138	10 30 74	42.3259	79.3422	504.4	507.5	1150.0	31.7	7.2	21.3	7.0	27.3
11146	11 8 74	42.3225	79.3756	457.8	460.2	1029.3	32.2	7.7	23.8	6.1	29.8
11147	10 31 74	42.4056	78.8784	435.9	438.3	1051.0	32.2	7.7	23.3	6.3	29.3
11148	11 16 74	42.3985	78.8738	435.9	438.3	1050.6	32.8	7.7	23.9	6.3	29.8
11152	11 25 74	42.3395	79.4975	321.0	323.4	866.2	30.6	9.0	24.9	5.0	30.7
11153	12 9 74	42.3639	79.3117	405.7	408.1	962.3	29.4	8.1	22.2	5.7	28.1
11154	11 24 74	42.3250	79.3671	400.5	402.9	1208.5	31.7	8.2	19.4	7.4	25.5
11162	12 22 74	42.2176	79.6389	511.8	514.2	1134.2	36.1	7.4	25.3	6.9	31.3
11163	12 11 74	42.2229	79.6255	513.0	515.4	1132.9	33.3	7.4	22.9	6.9	28.9
11165	12 21 74	42.2532	79.6288	481.0	483.7	1083.0	32.2	7.6	22.7	6.5	28.7
11167	12 13 74	42.2512	79.6210	477.9	481.0	1089.7	35.0	7.7	25.1	6.5	31.1
11169	12 19 74	42.3283	79.3575	438.3	440.7	1026.3	36.7	7.9	28.1	6.1	34.0
11170	12 12 74	42.3626	79.4998	235.0	237.1	756.2	28.9	9.8	25.3	4.2	30.8
11178	11 27 74	42.4373	79.2936	262.1	265.2	731.5	24.4	9.3	20.7	4.0	26.2
11179	12 4 74	42.2557	79.6389	458.4	461.5	1051.0	33.3	7.8	24.3	6.3	30.2
11180	1 16 75	42.2295	79.6361	489.2	494.4	1105.2	35.6	7.6	25.3	6.7	31.3
11181	1 6 75	42.3283	79.3780	419.7	423.4	997.6	33.9	8.0	25.9	5.9	31.8
11182	1 7 75	42.2561	79.6154	465.7	465.7	1079.6	35.0	7.8	25.2	6.5	31.2
11183	6 9 75	42.8456	78.8337	176.8	176.8	347.8	23.3	9.2	40.6	1.4	44.5
11192	1 8 75	42.2036	79.6537	481.9	484.9	1122.3	36.1	7.7	25.3	6.8	31.3
11193	12 19 74	42.3585	79.5036	232.9	235.0	752.9	26.7	9.8	22.4	4.2	28.0

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAI C/KM
11197	12 22 74	42.2023	79.6696	471.8	474.9	1097.3	32.8	7.8	22.7	6.6	28.7
11199	1 17 75	42.2051	79.6273	483.7	486.2	1091.8	35.6	7.7	25.5	6.6	31.5
11200	1 29 75	42.2467	79.6167	478.5	481.6	1092.1	35.6	7.7	25.5	6.6	31.5
11205	1 20 75	42.3324	79.3448	511.1	513.6	1090.6	33.3	7.1	24.0	6.6	30.0
11207	1 14 75	42.3533	79.5083	239.0	241.1	772.7	28.3	9.8	24.0	4.3	29.6
11208	1 31 75	42.3500	79.5166	238.0	240.2	792.8	28.9	9.8	24.1	4.5	29.7
11210	9 10 75	42.1004	79.4640	478.5	481.9	1244.2	36.1	8.0	22.6	7.6	28.7
11211	8 6 75	42.1008	79.4553	467.3	470.6	1040.9	33.3	8.1	24.2	6.2	30.2
11212	9 29 75	42.0946	79.4635	468.5	471.8	1240.5	33.3	8.1	20.3	7.6	26.5
11254	2 12 75	42.2278	79.6272	483.7	486.2	1103.7	35.6	7.7	25.3	6.6	31.3
11255	2 8 75	42.2598	79.6322	470.0	473.0	1067.7	35.0	7.7	25.5	6.4	31.5
11256	1 28 75	42.2337	79.6242	485.2	487.7	1100.9	35.0	7.6	24.9	6.6	30.9
11257	1 16 75	42.2643	79.6568	408.4	411.5	985.4	31.7	8.3	23.7	5.8	29.6
11258	1 27 75	42.2689	79.6491	416.1	419.1	992.7	33.3	8.2	25.3	5.9	31.2
11262	2 19 75	42.3648	79.5063	216.1	218.2	738.2	29.4	10.0	26.4	4.1	31.9
11263	2 27 75	42.3589	79.5136	226.2	228.6	750.1	29.4	9.9	26.1	4.2	31.7
11265	2 18 75	42.4177	79.3718	237.7	240.5	716.3	22.8	9.6	18.4	3.9	23.9
11267	3 8 75	42.3247	79.4507	485.2	487.7	1051.6	32.2	7.4	23.6	6.3	29.6
11268	2 24 75	42.3195	79.4073	442.6	445.0	1028.4	31.1	7.8	22.6	6.1	28.6
11269	3 25 75	42.2604	79.6904	296.3	299.3	1174.4	31.1	9.4	18.5	7.1	24.5
11273	4 27 75	42.3351	79.5033	429.8	431.9	895.8	30.6	7.9	25.2	5.2	31.0
11274	5 5 75	42.3371	79.5120	294.7	296.9	834.8	29.4	9.3	24.2	4.8	29.9
11275	2 9 75	42.3451	79.5038	271.0	273.1	810.5	30.6	9.5	26.0	4.6	31.7
11285	7 25 75	42.1070	79.4583	483.1	486.5	1259.1	37.8	7.9	23.7	7.7	29.8
11294	3 7 75	42.3207	79.4158	438.9	441.4	1020.2	31.7	7.9	23.3	6.1	29.3
11295	3 16 75	42.2628	79.6828	310.9	313.9	878.7	29.4	9.3	23.0	5.1	28.7
11296	5 5 75	42.3145	79.3985	442.6	445.0	1034.5	31.1	7.9	22.5	6.2	28.4
11297	2 16 75	42.3199	79.3892	406.0	408.4	989.1	30.0	8.2	22.0	5.8	27.9
11298	5 19 75	42.2667	79.6877	262.7	265.8	824.2	31.1	9.7	25.9	4.7	31.6
11304	3 16 75	42.3285	79.4443	467.0	469.4	1033.9	31.1	7.6	22.8	6.2	28.7
11305	12 20 75	42.3240	79.4363	449.9	452.0	1016.2	30.0	7.8	21.9	6.0	27.8
11310	4 29 75	42.4065	79.3890	239.3	242.9	737.3	22.2	9.6	17.1	4.1	22.6
11311	2 27 75	42.7552	78.3475	539.5	542.5	872.0	28.3	5.9	25.7	5.0	31.5
11312	3 20 75	42.8119	78.1939	498.3	501.4	815.3	18.9	6.2	15.6	4.6	21.3
11314	3 9 75	42.2740	79.6242	442.9	445.9	1011.6	29.4	8.0	21.2	6.0	27.2
11315	3 10 75	42.3343	79.4924	377.3	379.5	930.9	28.3	8.5	21.4	5.4	27.2
11316	3 17 75	42.3248	79.4213	424.3	426.7	1026.3	35.0	8.0	26.3	6.1	32.
11323	2 7 75	42.3329	79.3835	421.5	424.0	999.7	33.3	8.0	25.3	5.9	31.2
11337	3 20 75	42.3264	79.4893	437.4	439.5	1000.4	40.0	7.9	32.1	5.9	38.0
11339	10 2 75	42.3357	79.4296	417.0	420.0	982.7	31.7	8.1	24.0	5.8	29.9
11340	4 21 75	42.3062	79.3562	394.1	396.5	1003.4	31.1	8.4	22.7	5.9	28.6
11341	4 28 75	42.2991	79.3542	395.6	395.6	1006.4	36.1	8.4	27.6	6.0	33.5
11342	4 3 75	42.3149	79.3544	405.4	407.8	1002.2	33.3	8.2	25.1	5.9	31.0
11349	4 18 75	42.3288	79.5062	354.5	356.6	910.1	31.7	8.7	25.2	5.3	31.1
11350	5 14 75	42.3241	79.5104	359.4	361.5	941.2	32.8	8.7	25.6	5.5	31.5
11352	3 26 75	42.3291	79.3329	494.1	496.5	1083.6	30.6	7.3	21.4	6.5	27.5
11353	6 2 75	42.3241	79.5003	411.8	413.9	977.2	30.6	8.1	22.9	5.8	28.8
11354	4 10 75	42.3133	79.4953	415.1	417.0	982.4	32.8	8.1	25.1	5.8	31.0
11355	7 10 75	42.3328	79.4383	445.6	447.8	1013.2	33.3	7.8	25.2	6.0	31.1
11358	6 27 76	42.4251	79.3485	241.4	241.4	723.9	29.4	9.6	27.4	4.0	32.9
11362	7 12 75	42.2132	79.7015	425.2	428.2	1020.8	33.9	8.3	25.1	6.1	31.0
11363	7 3 75	42.2182	79.6983	419.7	422.8	1033.9	35.0	8.3	25.8	6.2	31.8
11364	5 12 75	42.2733	79.6904	232.3	235.3	794.3	28.9	10.0	23.8	4.5	29.4
11370	12 23 75	42.4155	79.2932	295.7	296.6	780.0	29.4	9.1	26.1	4.4	31.7
11372	4 12 75	42.3092	79.3510	411.5	413.9	1014.4	31.7	8.2	23.2	6.0	29.1

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
11373	7 11 75	42.3276	79.3230	458.7	461.2	1051.0	33.9	7.7	25.0	6.3	30.9
11387	5 1 75	42.2214	79.6668	493.2	496.2	1886.4	47.2	7.6	21.0	12.1	27.4
11388	5 22 75	42.1058	79.4780	466.3	469.7	1225.9	33.3	8.1	20.6	7.5	26.7
11403	8 1 75	42.7258	77.9534	334.1	337.4	791.6	30.0	8.0	27.8	4.5	33.5
11405	6 24 75	42.3240	79.3157	410.3	412.7	1008.0	33.3	8.1	25.0	6.0	30.9
11406	7 1 75	42.3195	79.3104	399.6	402.0	998.2	33.9	8.3	25.7	5.9	31.6
11407	6 3 75	42.2083	79.6944	443.5	446.5	1073.2	33.3	8.1	23.5	6.4	29.5
11414	6 25 75	42.1971	79.6499	470.9	474.0	1116.2	34.4	7.9	23.8	6.7	29.8
11415	7 19 75	42.3154	79.3439	490.7	493.2	1086.0	33.3	7.4	23.9	6.5	29.9
11422	5 23 75	42.3951	79.4102	248.4	252.1	746.8	32.2	9.6	30.4	4.2	35.9
11423	6 2 75	42.3920	79.3532	365.8	369.1	864.4	26.1	8.4	20.5	5.0	26.2
11424	5 15 75	42.3125	79.4075	458.1	460.6	1051.9	34.4	7.7	25.4	6.3	31.4
11427	6 8 75	42.3070	79.3835	441.0	443.5	1043.9	32.2	7.9	23.3	6.2	29.3
11428	5 26 75	42.8972	77.1142	242.3	245.1	646.5	30.0	8.5	33.2	3.5	38.5
11429	5 26 75	42.2691	79.6424	414.5	417.6	978.4	32.2	8.2	24.5	5.8	30.4
11430	7 19 75	42.3331	79.5240	273.4	275.5	819.0	31.1	9.5	26.4	4.7	32.1
11431	5 30 75	42.3094	79.3933	447.4	449.9	1042.7	33.9	7.8	25.0	6.2	31.0
11447	8 14 75	42.8783	78.8109	182.3	185.6	339.5	23.3	9.0	42.1	1.3	45.9
11448	6 9 75	42.3922	79.3438	376.4	379.8	885.4	31.7	8.3	26.4	5.1	32.2
11453	10 1 75	42.3925	79.4028	252.4	255.4	756.8	24.4	9.5	19.7	4.2	25.3
11454	6 11 76	42.4115	79.3555	265.2	268.2	761.4	29.4	9.4	26.4	4.3	32.0
11455	6 12 75	42.3215	79.4843	429.8	432.2	988.2	32.2	8.0	24.5	5.8	30.5
11456	9 1 75	42.3251	79.5204	327.4	329.5	876.9	30.6	9.0	24.6	5.1	30.4
11457	8 7 75	42.3096	79.5063	397.8	399.9	962.3	34.4	8.3	27.2	5.7	33.0
11459	6 15 75	42.2235	79.6419	520.0	523.0	1135.4	35.6	7.3	24.9	6.9	30.9
11462	9 4 75	42.2069	77.2508	462.1	462.1	1079.6	27.8	7.7	18.6	6.5	24.6
11469	10 23 75	42.4498	79.2962	244.8	247.8	699.5	22.2	9.5	18.2	3.8	23.7
11470	12 11 75	42.4543	79.3028	231.0	234.4	690.4	23.3	9.6	19.9	3.8	25.4
11471	11 24 75	42.4526	79.2828	251.2	254.5	691.9	25.6	9.4	23.4	3.8	28.8
11472	10 29 75	42.4463	79.2896	255.4	259.1	711.7	28.3	9.4	26.7	3.9	32.1
11473	11 10 75	42.4416	79.2517	356.6	359.7	813.5	24.4	8.4	19.7	4.6	25.4
11477	7 20 75	42.2382	79.6276	479.8	482.8	1096.4	34.4	7.7	24.4	6.6	30.4
11478	8 12 75	42.4735	78.4283	531.6	534.9	1230.8	35.6	6.6	23.5	7.5	29.7
11480	9 2 75	42.2038	78.8767	555.7	559.0	1409.7	42.2	7.0	25.0	8.8	31.2
11482	6 16 75	42.3129	79.3704	409.7	412.1	1007.7	33.9	8.2	25.5	6.0	31.4
11486	6 23 75	42.3191	79.4750	458.7	460.9	1021.4	35.0	7.7	26.7	6.1	32.7
11487	8 15 75	42.3062	79.3666	395.0	397.5	1004.3	33.3	8.3	24.9	6.0	30.8
11488	7 2 75	42.3239	79.4671	445.9	448.1	1008.6	33.9	7.8	25.9	6.0	31.8
11489	8 23 75	42.2988	79.3675	394.4	396.8	1004.3	33.3	8.4	24.9	6.0	30.8
11499	8 19 75	42.3677	79.2750	450.2	453.2	1001.6	31.7	7.6	24.0	5.9	29.9
11500	7 27 75	42.2596	79.6986	269.7	272.8	853.4	31.1	9.7	25.1	4.9	30.8
11501	10 15 75	42.3123	79.3037	398.4	401.4	1012.5	32.2	8.3	23.6	6.0	29.6
11502	8 25 75	42.3654	79.2669	459.3	462.4	1013.5	34.4	7.6	26.5	6.0	32.5
11503	9 3 75	42.3605	79.2597	473.4	476.4	1030.5	31.7	7.4	23.5	6.1	29.5
11504	11 20 75	42.3648	79.2530	474.9	477.3	1064.1	32.2	7.4	23.3	6.4	29.3
11505	12 12 75	42.3664	79.3181	402.3	404.8	965.3	30.6	8.1	23.2	5.7	29.1
11510	8 14 75	42.5869	78.7008	325.2	328.6	790.7	25.0	8.4	21.0	4.5	26.7
11511	7 22 75	42.3986	79.3789	283.2	286.5	774.2	35.6	9.2	34.0	4.3	39.6
11512	8 8 75	42.4380	79.2701	339.9	342.6	815.0	28.3	8.6	24.3	4.6	29.9
11513	7 30 75	42.3115	79.5141	374.0	376.4	933.0	32.2	8.5	25.4	5.5	31.2
11524	9 10 75	42.3184	79.5193	371.9	374.0	899.5	32.2	8.5	26.3	5.2	32.1
11525	9 19 75	42.3281	79.4965	421.2	423.4	982.1	31.7	8.0	24.1	5.8	30.0
11526	10 16 75	42.3949	79.3651	316.1	319.1	823.3	26.7	8.9	21.6	4.7	27.3
11530	8 22 75	42.1143	79.4696	519.7	523.0	1271.0	36.7	7.6	22.9	7.8	29.0
11532	9 16 75	42.3741	79.4345	256.6	259.7	780.3	28.9	9.5	24.8	4.4	30.4

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
11536	8 15 75	42.3854	79.3580	397.8	401.1	920.5	30.0	8.1	23.8	5.4	29.6
11537	11 28 76	42.3873	79.3350	400.5	402.3	911.4	31.1	8.1	25.2	5.3	31.1
11538	10 4 75	42.3771	79.3583	477.0	480.4	994.0	29.4	7.4	22.2	5.9	28.1
11552	10 21 75	42.4446	79.2720	306.3	309.7	796.4	22.8	8.9	17.5	4.5	23.1
11553	9 11 75	42.4203	79.2955	295.7	298.7	796.1	26.7	9.0	22.1	4.5	27.8
11555	9 12 75	42.4428	79.3434	216.4	220.1	670.0	23.3	9.8	20.3	3.6	25.7
11557	8 25 75	42.3117	79.4866	436.5	438.6	1010.1	33.3	7.9	25.2	6.0	31.1
11558	9 29 75	42.3159	79.4623	461.2	463.3	1041.8	32.2	7.7	23.6	6.2	29.5
11561	11 3 75	42.4499	77.1982	357.8	360.9	679.7	30.0	8.2	32.0	3.7	37.4
11562	8 31 75	42.3683	79.3258	400.8	403.3	951.9	32.2	8.1	25.3	5.6	31.2
11563	9 5 75	42.3031	79.3470	413.9	416.4	1020.2	32.2	8.2	23.6	6.1	29.5
11564	9 13 75	42.3097	79.3218	498.3	500.8	1110.1	32.2	7.3	22.4	6.7	28.5
11568	2 27 75	42.3169	79.3230	515.4	517.9	1115.0	34.4	7.1	24.5	6.7	30.5
11570	1 7 76	42.4753	77.2191	413.6	417.0	698.9	25.0	7.7	24.8	3.8	30.3
11583	9 19 75	42.4461	79.3146	236.2	239.3	706.8	25.6	9.6	22.6	3.9	28.1
11584	10 10 75	42.3328	79.4230	420.6	423.7	992.4	30.0	8.0	22.1	5.9	28.1
11585	9 30 75	42.3143	79.4167	476.7	479.1	1066.8	32.2	7.5	23.2	6.4	29.1
11586	9 11 75	42.3572	79.2523	510.5	513.6	1084.8	32.2	7.1	23.2	6.5	29.2
11595	9 18 75	42.3740	79.2682	439.8	442.9	983.6	31.7	7.7	24.3	5.8	30.2
11596	9 9 75	42.3538	79.3053	406.9	409.3	984.2	32.8	8.1	25.1	5.8	31.0
11597	11 1 75	42.3586	79.2455	524.3	526.7	1085.7	31.1	6.9	22.3	6.5	28.3
11599	1 6 76	42.1422	79.4932	487.7	491.0	1215.5	36.7	7.8	23.7	7.4	29.8
11603	9 16 75	42.3456	79.3004	448.1	450.5	1033.9	31.7	7.7	23.2	6.2	29.1
11604	9 20 75	42.2934	79.3565	393.2	395.6	1006.8	31.1	8.4	22.6	6.0	28.5
11605	10 2 75	42.3188	79.3002	399.0	400.5	1001.3	32.2	8.3	23.9	5.9	29.8
11606	9 24 75	42.3270	79.3017	401.1	403.6	995.8	31.1	8.2	23.0	5.9	28.9
11609	2 20 76	42.9112	78.4343	283.5	283.5	438.9	24.4	8.0	37.4	2.0	41.9
11610	10 2 75	43.0174	78.3102	266.1	267.6	341.1	13.3	8.0	15.8	1.3	19.6
11612	10 21 76	42.4429	79.3301	227.1	227.1	680.6	26.1	9.7	24.1	3.7	29.6
11613	2 17 76	42.4446	79.2655	324.6	327.4	818.4	25.6	8.7	20.6	4.7	26.3
11614	10 24 75	42.3632	79.4236	316.4	319.4	860.1	30.6	9.0	25.1	4.9	30.8
11615	12 6 75	42.3701	79.4169	329.2	331.3	864.7	28.9	8.8	23.2	5.0	28.9
11616	10 3 75	42.3785	79.2805	437.4	440.4	985.7	31.7	7.7	24.3	5.8	30.2
11617	9 25 75	42.3788	79.2727	423.7	426.7	973.8	31.7	7.9	24.4	5.7	30.3
11621	9 6 75	42.8991	78.4193	285.0	286.5	463.9	20.0	8.0	25.8	2.2	30.5
11623	10 15 75	42.8919	78.4095	298.7	300.2	484.0	14.4	7.9	13.5	2.3	18.2
11626	5 18 76	42.3969	79.2871	371.9	374.9	856.2	36.1	8.3	32.4	4.9	38.2
11627	11 6 75	42.4259	79.2953	286.5	289.6	771.4	24.4	9.1	19.9	4.3	25.5
11634	10 9 75	42.3123	79.4571	496.8	499.0	1082.6	28.9	7.3	19.9	6.5	25.9
11635	12 12 75	42.3215	79.4286	454.2	457.2	1032.1	30.6	7.7	22.1	6.1	28.1
11636	10 14 75	42.3159	79.4375	441.4	443.8	1058.6	34.4	7.9	25.1	6.3	31.1
11637	10 29 75	42.3095	79.4490	503.5	505.7	1098.8	33.3	7.3	23.7	6.6	29.7
11638	10 6 75	42.3151	79.4278	469.4	471.8	1064.7	33.3	7.6	24.2	6.4	30.2
11641	10 15 75	42.4457	79.3753	192.0	195.4	650.1	22.2	10.0	18.8	3.5	24.2
11643	10 11 75	42.3807	79.2876	395.9	399.0	954.9	31.7	8.1	24.6	5.6	30.5
11645	10 23 75	42.5867	79.0068	225.6	228.6	615.1	20.6	9.3	18.3	3.2	23.5
11648	10 29 75	42.3100	79.4404	479.1	481.6	1068.9	32.2	7.5	23.1	6.4	29.1
11649	11 6 75	42.3040	79.4424	495.0	497.1	1089.1	33.9	7.4	24.3	6.5	30.4
11650	11 6 75	42.3055	79.4352	477.0	479.5	1064.1	32.8	7.5	23.7	6.4	29.7
11654	2 1 76	42.8983	76.2389	417.6	420.3	931.5	28.9	6.8	23.7	5.4	29.5
11655	12 30 75	42.9450	76.3085	344.4	347.5	794.6	26.7	7.5	24.2	4.5	29.8
11657	10 17 75	42.3060	79.4926	417.0	419.1	992.4	31.1	8.1	23.2	5.9	29.1
11659	11 11 75	42.1157	79.4949	499.9	503.2	1243.3	33.9	7.8	21.0	7.6	27.1
11661	12 15 75	42.0907	79.4732	457.2	460.6	1236.0	34.4	8.2	21.2	7.6	27.3
11664	1 5 76	42.1696	79.5091	469.4	472.7	1179.6	35.6	7.9	23.4	7.2	29.5

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
11666	11 20 75	42.8452	76.7878	172.8	176.2	641.3	27.8	9.3	28.8	3.4	34.1
11667	10 30 75	42.0663	79.7366	429.8	433.4	1176.8	38.9	8.6	25.8	7.2	31.8
11671	10 22 75	42.3103	79.4237	484.6	487.1	1080.5	31.1	7.5	21.9	6.5	27.9
11672	3 22 76	42.1615	79.4705	477.9	481.3	1196.3	28.9	7.9	17.6	7.3	23.7
11676	11 17 75	42.4505	79.3678	196.6	199.9	654.4	20.0	9.9	15.4	3.5	20.7
11678	12 5 75	42.4356	79.3623	207.3	210.6	672.7	26.7	9.9	25.0	3.6	30.4
11679	7 9 76	42.4539	79.3656	192.0	195.4	652.0	28.9	10.0	29.0	3.5	34.4
11680	7 17 76	42.4273	79.3719	220.1	223.1	706.5	28.3	9.8	26.3	3.9	31.8
11681	1 12 76	42.4342	79.3737	208.8	211.2	673.0	28.3	9.9	27.5	3.6	32.9
11682	6 24 76	42.4302	79.3538	228.6	231.6	700.4	32.2	9.7	32.2	3.8	37.7
11683	5 20 76	42.4458	79.2331	381.6	384.7	857.4	27.2	8.1	22.3	4.9	28.0
11684	5 14 76	42.4402	79.2335	402.3	405.4	885.1	31.1	7.9	26.2	5.1	32.0
11686	6 7 76	42.4417	79.1992	342.9	345.9	834.2	28.9	8.5	24.4	4.8	30.1
11687	6 2 76	42.4461	79.1941	336.8	339.9	848.9	27.8	8.6	22.6	4.9	28.4
11691	11 11 75	42.4561	79.2597	277.4	280.7	730.6	28.9	9.1	27.0	4.0	32.6
11696	12 5 75	42.3041	79.4615	481.3	483.7	1066.5	31.7	7.5	22.7	6.4	28.6
11697	12 4 75	42.3207	79.4425	486.8	489.8	1054.9	31.1	7.4	22.5	6.3	28.5
11698	11 13 75	42.3165	79.4475	503.5	506.0	1082.3	31.7	7.3	22.6	6.5	28.6
11699	11 3 75	42.8784	78.4251	289.6	291.4	511.5	21.1	8.0	25.5	2.5	30.4
11701	11 2 75	42.3745	79.2864	430.7	433.7	991.2	30.0	7.8	22.4	5.9	28.3
11702	1 5 76	42.3884	79.2949	323.1	326.1	851.3	27.2	8.8	21.6	4.9	27.3
11705	11 17 75	42.0316	79.6815	435.9	439.2	1249.4	37.8	8.6	23.4	7.7	29.5
11706	8 12 76	42.4500	78.7951	341.4	341.4	872.0	27.8	8.5	22.1	5.0	27.8
11708	11 27 75	42.8386	76.7793	175.0	178.3	661.4	30.0	9.3	31.3	3.6	36.6
11710	2 2 76	42.4859	79.3261	182.9	185.9	613.0	26.1	10.0	26.3	3.2	31.6
11711	12 13 75	42.3593	79.4172	345.9	349.0	905.3	29.4	8.7	22.9	5.3	28.7
11712	11 26 75	42.3459	79.4239	418.2	420.3	975.4	31.1	8.0	23.7	5.8	29.6
11713	1 14 76	42.3341	79.3139	395.9	398.7	986.9	30.0	8.3	22.0	5.8	27.9
11714	11 9 75	42.3679	79.3061	393.2	396.2	947.0	31.1	8.2	24.2	5.6	30.0
11715	11 27 75	42.2971	79.4040	504.4	506.9	1112.8	34.4	7.3	24.4	6.7	30.4
11716	11 28 75	42.3033	79.3896	449.0	450.8	1056.4	32.2	7.8	23.1	6.3	29.1
11717	11 19 75	42.3053	79.3329	463.6	466.6	1081.7	31.7	7.7	22.2	6.5	28.2
11718	11 15 75	42.2900	79.3474	399.9	402.0	1016.2	30.0	8.3	21.3	6.0	27.3
11720	11 20 75	42.3544	79.2604	484.9	486.8	1075.9	32.8	7.4	23.6	6.5	29.6
11721	11 23 75	42.4446	79.3497	204.2	207.6	668.4	21.1	9.9	16.8	3.6	22.2
11723	11 23 75	42.4690	78.6807	417.6	420.6	1001.6	32.8	7.7	25.0	5.9	30.9
11724	11 8 75	42.3884	79.3688	369.4	371.6	893.4	30.6	8.4	24.8	5.2	30.6
11728	12 17 75	42.5695	78.7350	506.3	509.6	962.3	32.2	6.6	26.6	5.7	32.5
11730	12 16 75	42.7142	78.5182	428.9	431.9	1688.9	42.8	7.1	21.2	10.7	27.5
11734	11 26 75	42.1161	79.5186	554.7	558.1	1293.6	37.8	7.2	23.6	8.0	29.8
11742	11 20 75	42.8870	78.4210	320.0	321.9	501.4	20.0	7.7	24.5	2.4	29.3
11748	2 18 76	41.9458	78.4047	478.5	478.5	195.1	16.1	8.2	40.7	.3	42.2
11751	1 25 76	42.3384	79.3071	404.8	406.9	987.9	29.4	8.2	21.5	5.8	27.4
11752	12 23 75	42.2944	79.4161	499.9	504.7	1106.4	33.9	7.3	24.0	6.7	30.0
11753	11 10 75	42.3847	79.3754	393.2	395.6	911.4	30.0	8.2	24.0	5.3	29.8
11754	12 11 75	42.3668	77.7259	545.6	548.9	1056.1	30.6	6.6	22.7	6.3	28.6
11762	3 28 76	42.1599	78.0128	611.7	615.1	1361.8	36.1	6.4	21.8	8.5	28.0
11764	11 25 75	42.3807	79.3881	390.8	393.5	918.7	30.0	8.2	23.7	5.4	29.6
11765	12 12 75	42.2985	79.4424	498.3	500.5	1095.1	30.0	7.4	20.7	6.6	26.7
11766	12 12 75	42.3036	79.4519	509.0	511.1	1097.9	30.6	7.2	21.2	6.6	27.3
11774	1 21 76	42.4415	79.3580	205.7	208.8	671.2	26.7	9.9	25.0	3.6	30.4
11776	12 7 75	42.8968	78.4080	295.7	295.7	488.3	21.7	8.0	28.1	2.3	32.9
11777	12 22 75	42.9007	78.4038	303.3	304.5	490.1	13.9	7.9	12.3	2.4	17.1
11778	1 9 76	42.8992	78.3975	294.1	295.7	504.4	13.3	8.0	10.7	2.5	15.5
11781	12 22 75	42.3056	77.1636	533.4	536.8	991.8	35.0	6.8	28.5	5.9	34.4

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
11782	4 5 76	42.8390	79.8644	175.6	178.6	338.0	20.6	9.0	34.0	1.3	37.9
11783	5 12 76	42.4816	79.3092	198.1	201.2	634.3	28.3	9.8	29.2	3.4	34.5
11784	4 27 76	42.4498	79.3492	198.1	201.2	668.7	28.9	9.9	28.4	3.6	33.8
11786	1 17 76	42.5179	79.2430	204.2	207.3	603.5	22.8	9.7	21.7	3.2	26.9
11787	1 30 76	42.4280	79.3280	246.9	248.4	728.8	23.3	9.5	19.0	4.0	24.5
11788	1 25 76	42.4240	79.3371	248.4	249.9	719.3	24.4	9.5	20.8	4.0	26.3
11793	12 30 75	42.3062	79.4697	429.8	432.2	1008.6	30.6	8.0	22.4	6.0	28.3
11800	2 8 76	42.4636	79.3174	208.8	211.8	662.3	23.9	9.8	21.3	3.6	26.7
11802	2 14 76	42.4661	79.3027	216.1	219.2	665.1	22.8	9.7	19.7	3.6	25.0
11803	6 11 76	42.3828	79.2788	417.6	420.9	871.1	34.4	7.9	30.4	5.0	36.2
11804	6 17 76	42.3896	79.2788	405.4	408.7	938.2	33.9	8.0	27.6	5.5	33.4
11806	5 29 76	42.4872	79.2966	199.6	202.7	625.1	30.6	9.8	33.2	3.3	38.5
11807	6 4 76	42.4811	79.2955	204.2	207.6	630.6	25.6	9.8	25.0	3.3	30.3
11808	4 19 76	42.4542	79.3536	196.3	199.3	654.1	27.8	9.9	27.3	3.5	32.6
11809	4 21 76	42.4456	79.3540	210.3	213.4	673.6	29.4	9.8	29.1	3.6	34.6
11810	4 12 76	42.4331	79.3440	237.1	240.2	713.2	28.9	9.6	27.1	3.9	32.6
11811	8 31 76	42.4426	79.4146	186.5	189.6	641.0	28.3	10.0	28.5	3.4	33.8
11812	2 6 76	42.4456	79.4062	183.2	186.2	637.6	25.0	10.1	23.4	3.4	28.7
11866	6 15 76	42.2913	79.4471	501.7	504.1	1092.4	33.9	7.3	24.3	6.6	30.3
11867	2 27 76	42.2878	79.4412	490.7	493.2	1094.2	31.7	7.5	22.1	6.6	28.1
11868	1 5 76	42.2871	79.4308	472.7	474.9	1102.8	30.0	7.6	20.3	6.6	26.3
11869	4 16 76	42.2818	79.4300	469.4	472.4	1089.4	35.6	7.7	25.6	6.5	31.6
11870	4 27 76	42.2751	79.4285	445.0	448.1	1067.7	35.0	7.9	25.4	6.4	31.4
11871	3 8 76	42.2807	79.4479	490.7	493.2	1202.1	35.0	7.5	22.9	7.3	29.0
11872	5 22 76	42.2813	79.4637	432.5	434.9	1046.4	32.2	8.0	23.1	6.2	29.1
11873	5 6 76	42.2779	79.4704	410.0	412.4	1018.3	34.4	8.3	25.7	6.1	31.6
11874	5 14 76	42.2727	79.4728	406.0	408.4	1019.9	32.8	8.3	24.0	6.1	29.9
11875	6 8 76	42.2725	79.4641	442.3	444.7	1054.9	33.3	8.0	24.0	6.3	30.0
11876	4 26 76	42.2683	79.4693	410.0	412.4	1016.5	33.3	8.3	24.6	6.0	30.6
11877	4 17 77	42.2656	79.4602	449.6	451.7	1069.5	33.9	7.9	24.3	6.4	30.3
11879	4 16 76	42.2753	79.4525	472.4	474.9	1085.7	33.9	7.7	24.2	6.5	30.2
11880	4 29 77	42.2587	79.4507	467.0	469.4	1097.3	35.6	7.8	25.3	6.6	31.4
11882	5 6 76	42.2690	79.4290	426.1	428.5	1051.3	32.2	8.1	22.9	6.3	28.9
11883	5 10 77	42.2582	79.4349	414.5	416.7	1064.7	31.7	8.3	22.0	6.4	28.0
11884	5 2 77	42.2639	79.4312	420.9	423.1	1054.6	33.3	8.2	23.8	6.3	29.8
11885	2 20 77	42.2757	79.4209	452.6	455.1	1058.9	33.9	7.9	24.6	6.3	30.6
11886	2 16 76	42.2878	79.4229	466.6	469.1	1077.5	32.8	7.7	23.3	6.5	29.3
11887	5 14 76	42.2885	79.3969	522.7	525.2	1153.7	36.7	7.1	25.6	7.0	31.7
11888	5 23 76	42.2830	79.3937	516.3	518.8	1137.8	33.9	7.2	23.4	6.9	29.5
11889	7 22 76	42.2878	79.3847	472.4	474.9	1092.4	33.9	7.6	24.0	6.6	30.1
11890	6 9 76	42.2903	79.3776	441.4	443.8	1060.4	33.3	7.9	24.0	6.3	29.9
11891	6 1 76	42.2818	79.2982	484.3	486.8	1116.5	34.4	7.5	24.1	6.7	30.1
11893	6 22 76	42.2890	79.3953	395.3	397.8	1015.6	33.3	8.4	24.6	6.0	30.5
11894	7 15 76	42.2807	79.3904	394.7	397.2	1029.9	33.9	8.4	24.7	6.1	30.7
11895	6 29 76	42.2869	79.3526	391.4	393.8	1011.0	35.0	8.4	26.3	6.0	32.2
11896	7 9 76	42.2844	79.3421	396.2	398.7	1021.4	34.4	8.4	25.5	6.1	31.5
11897	7 29 76	42.2517	79.3708	431.0	433.4	1052.5	29.4	8.1	20.3	6.3	26.2
11900	7 27 76	42.2915	79.3157	395.9	398.1	1024.1	30.0	8.4	21.1	6.1	27.1
11901	7 6 76	42.2957	79.3226	429.8	431.9	1048.5	32.8	8.0	23.6	6.3	29.6
11902	6 28 76	42.3009	79.3253	442.6	444.7	1057.4	33.9	7.9	24.6	6.3	30.6
11903	2 18 76	42.3038	79.3101	399.0	402.0	1012.9	32.2	8.3	23.6	6.0	29.6
11904	7 20 76	42.2968	79.3126	399.3	401.4	1018.0	32.8	8.3	24.0	6.0	30.0
11905	2 5 76	42.3099	79.3104	402.3	404.5	1018.9	28.3	8.3	19.7	6.1	25.6
11907	8 11 76	42.2871	79.2985	398.7	401.1	1026.6	33.3	8.3	24.3	6.1	30.3
11909	6 13 76	42.3294	79.2895	411.2	413.3	1000.0	32.2	8.1	24.1	5.9	30.0

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
11910	6 20 76	42.3269	79.2806	451.4	453.5	1042.7	32.8	7.7	24.0	6.2	30.0
11911	6 3 76	42.3225	79.2898	408.4	410.6	998.5	33.9	8.2	25.8	5.9	31.7
11912	5 21 76	42.3165	79.2874	411.8	413.9	1020.5	32.2	8.2	23.6	6.1	29.5
11913	1 23 78	42.3089	79.2849	436.5	439.5	1048.8	33.3	7.9	24.2	6.3	30.2
11914	5 12 76	42.3115	79.2910	421.2	423.4	1033.9	31.7	8.1	22.8	6.2	28.8
11916	2 8 78	42.3063	79.2755	467.0	470.0	1079.9	33.9	7.6	24.3	6.5	30.3
11918	2 22 76	42.4427	79.3184	237.7	240.5	710.5	23.9	9.6	20.2	3.9	25.7
11920	4 29 76	42.4516	79.3106	230.1	233.2	691.9	28.3	9.6	27.1	3.8	32.5
11921	1 15 76	42.3328	77.0291	446.5	449.9	882.4	28.3	7.5	23.6	5.1	29.3
11922	4 14 76	42.4419	79.3714	197.5	200.6	661.7	30.6	9.9	31.1	3.6	36.5
11923	5 27 76	42.4405	79.2235	408.4	411.5	899.2	30.0	7.9	24.6	5.2	30.4
11928	5 24 76	42.4656	79.3557	190.5	199.6	638.3	27.8	9.9	28.0	3.4	33.3
11929	6 17 76	42.4654	79.3644	182.9	185.9	630.9	28.3	10.0	29.0	3.3	34.3
11931	1 26 76	42.0748	76.5941	393.2	396.5	1297.2	40.6	8.3	24.8	8.0	31.0
11932	2 2 76	42.9398	78.3225	287.4	289.0	417.9	17.2	7.9	22.2	1.9	26.7
11934	1 11 76	42.3003	79.5027	406.9	409.3	986.3	32.2	8.2	24.3	5.8	30.2
11939	2 8 76	42.2057	79.6179	512.1	515.4	1165.6	33.3	7.4	22.2	7.1	28.3
11940	1 20 76	42.3009	79.4710	415.1	417.6	1000.7	30.0	8.2	21.8	5.9	27.7
11941	6 1 76	42.2937	79.4806	409.3	411.8	989.7	33.9	8.2	25.9	5.9	31.8
11946	2 20 76	42.9642	76.2261	291.1	293.8	707.7	24.4	8.0	23.3	3.9	28.8
11950	3 27 76	43.2928	75.2748	265.8	266.4	222.2	14.4	7.7	30.4	.5	32.6
11951	1 22 76	42.5511	78.7334	462.4	465.7	950.1	22.8	7.1	16.5	5.6	22.4
11952	4 24 76	42.4484	79.3045	237.7	240.8	707.4	28.3	9.5	26.6	3.9	32.1
11956	2 14 76	42.5031	79.2595	202.1	204.2	601.7	21.1	9.8	18.9	3.1	24.1
11961	6 26 76	42.4490	79.3704	192.9	196.3	661.4	30.6	10.0	31.1	3.6	36.5
11975	4 20 76	42.5578	78.7442	447.8	451.1	932.4	22.2	7.2	16.1	5.4	21.9
11977	5 3 76	42.2114	78.7331	431.0	434.3	920.8	32.2	8.2	26.1	5.4	32.0
11978	5 10 76	42.3123	78.2815	649.2	652.6	1218.3	36.1	5.8	24.9	7.4	31.0
11983	3 28 76	42.2235	77.5686	442.0	444.7	1147.3	31.7	7.9	20.7	7.0	26.8
11984	8 3 76	42.4567	79.3599	192.0	194.8	634.0	27.8	10.0	28.1	3.4	33.4
11985	8 7 76	42.4606	79.3547	192.0	193.2	637.6	25.6	10.0	24.4	3.4	29.8
11985	8 7 76	42.4606	79.3547	192.0	193.2	637.6	25.0	10.0	23.6	3.4	28.9
11989	7 19 76	42.6775	78.0799	475.2	477.9	1015.0	33.9	6.7	26.8	6.0	32.7
12001	4 15 76	42.1362	79.4888	509.0	512.4	1226.8	34.4	7.6	21.9	7.5	28.0
12016	6 2 76	42.1667	77.5833	701.6	705.0	593.1	41.7	5.4	61.1	3.1	66.3
12045	10 11 76	42.4342	79.3323	233.2	234.7	706.5	27.2	9.6	24.9	3.9	30.4
12051	7 18 76	42.8481	76.8081	164.0	167.3	814.4	33.3	9.4	29.4	4.6	35.1
12052	8 4 76	42.8545	76.7945	175.9	240.2	683.1	25.6	8.7	24.7	3.7	30.1
12053	7 28 76	42.8580	76.8020	167.0	170.4	675.7	24.4	9.4	22.3	3.7	27.7
12059	7 13 76	42.9318	78.3227	282.2	282.2	430.1	16.1	8.0	18.8	1.9	23.3
12075	7 7 76	42.4494	77.6259	531.9	535.8	974.1	29.4	6.6	23.5	5.7	29.4
12077	7 14 76	42.4880	79.1714	254.8	257.9	707.7	30.6	9.3	30.1	3.9	35.6
12078	7 24 76	42.4891	79.1631	250.5	253.9	711.1	27.8	9.3	26.0	3.9	31.5
12089	6 20 76	42.0593	79.4367	216.1	216.4	720.2	18.9	10.7	11.4	4.0	16.9
12090	7 20 76	42.4836	79.1661	258.2	261.2	716.6	31.1	9.3	30.5	3.9	36.0
12091	7 24 76	42.4846	79.1569	260.6	264.9	723.9	27.8	9.2	25.6	4.0	31.2
12093	8 4 76	42.4786	79.1538	313.3	316.4	783.3	28.3	8.7	25.0	4.4	30.7
12094	7 20 76	42.4786	79.1845	293.2	296.3	746.2	31.7	8.9	30.5	4.1	36.0
12095	7 25 76	42.4772	79.1928	294.1	297.2	733.0	27.8	8.9	25.7	4.1	31.3
12096	8 1 76	42.4732	79.1865	318.5	321.6	781.2	30.0	8.7	27.3	4.4	32.9
12099	8 7 76	42.4556	79.1831	324.0	327.1	810.5	31.7	8.7	28.4	4.6	34.0
12100	8 3 76	42.4502	79.1891	298.7	300.8	799.8	28.3	8.9	24.2	4.5	29.9
12101	8 9 76	42.4495	79.1795	362.7	365.8	858.6	31.1	8.3	26.6	4.9	32.3
12102	8 5 76	42.3617	79.1841	359.7	362.1	866.2	31.7	8.6	26.7	5.0	32.4
12103	8 10 76	42.4652	79.1489	367.6	369.7	853.7	30.0	8.2	25.5	4.9	31.2

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
12105	8 12 76	42.4732	79.1502	338.9	341.4	816.3	30.6	8.5	27.0	4.6	32.7
12106	8 11 76	42.4734	79.1578	318.5	320.6	791.6	28.9	8.7	25.5	4.5	31.2
12130	7 1 76	42.3864	79.4070	294.1	297.5	807.7	31.7	9.1	27.9	4.6	33.6
12131	7 9 76	42.3836	79.4984	278.9	282.2	796.7	36.1	9.3	33.7	4.5	39.3
12132	7 3 76	42.3892	79.4167	247.5	250.9	768.1	28.3	9.6	24.4	4.3	30.0
12133	11 23 76	42.3849	79.4223	243.2	246.3	769.0	28.3	9.6	24.3	4.3	29.9
12134	7 14 76	42.4848	79.3023	606.6	609.9	623.6	26.1	5.8	32.5	3.3	37.8
12135	6 29 76	42.9452	78.3227	279.5	279.5	409.7	15.0	8.0	17.1	1.8	21.4
12148	9 19 76	42.7894	76.1742	556.9	559.6	1268.9	38.9	5.6	26.2	7.8	32.4
12149	9 27 76	42.5978	76.2958	483.1	486.8	1386.8	41.1	6.7	24.8	8.6	31.1
12151	8 14 76	42.0413	79.4684	495.3	499.0	1312.2	35.6	8.0	21.0	8.1	27.2
12152	7 28 76	42.4565	79.3174	216.4	217.6	669.6	26.1	9.7	24.4	3.6	29.8
12163	9 8 76	42.9369	76.3460	303.9	306.6	1274.4	37.2	7.9	23.0	7.8	29.2
12167	9 14 76	42.4630	79.3833	182.9	185.9	623.9	26.7	10.0	26.7	3.3	31.9
12168	8 31 76	42.4628	79.3756	185.9	189.0	641.6	26.7	10.0	26.0	3.4	31.3
12169	8 21 76	42.4591	79.3892	183.8	185.9	635.8	26.7	10.0	26.1	3.4	31.5
12171	8 16 76	42.4584	79.3702	190.8	191.4	640.4	26.7	10.0	26.0	3.4	31.4
12173	8 24 76	42.4723	79.3561	187.5	190.5	625.8	27.2	10.0	27.6	3.3	32.9
12174	8 22 76	42.4661	79.3416	194.8	197.8	643.1	26.7	9.9	26.1	3.4	31.4
12175	8 17 76	42.4638	79.3480	195.1	198.1	650.4	27.8	9.9	27.5	3.5	32.8
12178	8 29 76	42.7908	78.1754	457.8	461.2	1625.2	58.3	6.6	31.8	10.3	38.2
12179	10 24 76	42.2545	77.5033	536.8	540.4	1216.2	37.8	6.9	25.4	7.4	31.5
12186	8 21 76	42.5130	79.0892	263.7	266.1	725.7	29.4	9.1	28.0	4.0	33.5
12188	8 22 76	42.5203	79.0839	267.6	270.7	732.1	30.0	9.1	28.6	4.1	34.1
12189	8 16 76	42.5169	79.0633	268.5	271.6	723.3	28.3	9.1	26.6	4.0	32.1
12190	9 8 76	42.0856	79.6419	531.6	534.9	1290.2	31.1	7.5	18.3	7.9	24.4
12191	8 27 76	42.4977	79.1009	281.9	284.1	745.2	28.9	9.0	26.7	4.1	32.3
12198	9 6 76	42.4774	79.3564	183.2	185.6	630.6	26.7	10.0	26.4	3.3	31.7
12202	8 14 76	42.4963	79.1543	248.4	249.3	698.9	28.9	9.3	28.0	3.8	33.4
12203	8 24 76	42.0413	79.4583	516.6	520.3	1351.2	36.7	7.8	21.4	8.4	27.6
12204	8 19 76	42.2968	79.3343	460.6	463.0	1079.3	30.0	7.7	20.6	6.5	26.6
12210	9 17 76	42.4512	79.4028	180.1	181.7	628.2	27.2	10.1	27.2	3.3	32.5
12211	9 6 76	42.4520	79.3769	185.9	189.0	650.7	26.7	10.0	25.6	3.5	30.9
12213	1 21 76	42.4391	79.4003	189.0	192.0	652.0	25.6	10.0	23.8	3.5	29.2
12214	9 6 76	42.4333	79.3855	202.7	204.2	677.9	27.8	9.9	26.3	3.7	31.7
12215	2 19 77	42.4288	79.3907	210.9	214.0	690.1	26.7	9.8	24.4	3.8	29.8
12216	9 20 76	42.4284	79.3991	202.1	205.1	681.2	26.7	9.9	24.6	3.7	30.0
12219	8 19 76	42.5171	79.0746	264.6	266.7	719.3	28.9	9.1	27.5	4.0	33.0
12220	8 29 76	42.4997	79.0894	266.7	269.1	735.8	28.9	9.1	26.8	4.1	32.4
12232	9 13 76	42.3984	79.2068	429.8	432.2	974.8	31.1	7.8	23.9	5.7	29.8
12233	11 20 76	42.3920	79.2086	461.8	464.2	1014.4	31.1	7.5	23.3	6.0	29.2
12234	10 9 76	42.4156	79.2398	524.9	527.3	1035.7	34.4	6.8	26.7	6.2	32.6
12235	9 9 76	42.4095	79.2485	494.4	496.5	1009.5	34.4	7.1	27.1	6.0	33.0
12236	9 29 76	42.4091	79.2390	518.8	520.3	1021.4	30.6	6.9	23.2	6.1	29.1
12237	9 21 76	42.4001	79.2355	527.3	529.7	1060.1	34.4	6.8	26.1	6.3	32.0
12238	9 25 76	42.4001	79.2483	499.3	501.4	1023.8	33.3	7.1	25.6	6.1	31.6
12239	10 2 76	42.3999	79.2562	479.1	481.3	1001.3	33.3	7.3	26.0	5.9	31.9
12240	10 24 76	42.4008	79.2633	446.8	449.0	970.8	27.2	7.6	20.2	5.7	26.1
12242	10 12 76	42.3951	79.2526	481.6	483.7	1000.4	31.1	7.3	23.8	5.9	29.7
12243	11 11 76	42.3848	79.2553	458.7	460.9	984.8	31.1	7.5	23.9	5.8	29.8
12244	8 26 76	42.4080	79.2733	408.1	410.6	920.8	28.3	8.0	22.1	5.4	27.9
12246	9 22 76	42.4009	79.2797	392.0	394.4	914.4	32.8	8.1	26.9	5.3	32.8
12258	8 31 76	42.4954	79.0752	279.8	282.9	764.7	26.7	9.0	23.1	4.3	28.7
12259	10 9 76	42.5124	79.0684	269.7	272.8	736.7	27.8	9.1	25.4	4.1	30.9
12262	9 11 76	42.4542	79.3960	181.7	184.7	627.9	22.8	10.1	20.2	3.3	25.5

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
12264	9 4 76	42.4912	79.0829	318.5	320.6	782.7	30.6	8.7	28.0	4.4	33.6
12265	9 9 76	42.4739	79.1256	369.4	372.5	872.0	31.1	8.2	26.3	5.0	32.1
12266	9 15 76	42.4679	79.1284	379.8	382.8	887.3	32.2	8.1	27.2	5.1	33.0
12267	9 22 76	42.4650	79.1398	377.3	380.4	872.0	30.6	8.1	25.7	5.0	31.5
12273	10 8 76	42.4233	79.2089	376.7	376.7	890.3	30.0	8.3	24.4	5.2	30.2
12274	9 29 76	42.4199	79.2155	410.0	412.1	926.9	32.2	7.9	26.2	5.4	32.1
12275	11 11 76	42.4143	79.2121	406.6	408.7	931.2	27.8	8.0	21.3	5.4	27.1
12276	9 21 76	42.4093	79.2084	396.2	398.4	932.4	29.4	8.1	22.9	5.4	28.8
12277	9 2 76	42.4065	79.2037	427.3	427.3	898.6	32.2	7.8	27.2	5.2	33.0
12278	12 16 76	42.3988	79.2151	457.2	459.6	989.7	31.7	7.5	24.4	5.9	30.3
12286	9 5 76	42.4064	79.2831	368.2	370.6	954.0	33.9	8.4	26.8	5.6	32.6
12287	11 21 76	42.5929	79.1061	189.6	191.4	556.0	25.6	9.7	28.6	2.8	33.6
12288	11 1 76	42.5921	79.0975	191.1	192.9	558.1	26.7	9.7	30.5	2.8	35.6
12289	10 18 76	42.5884	79.1142	181.7	183.2	554.4	26.7	9.8	30.5	2.8	35.6
12290	11 11 76	42.5870	79.0542	202.7	204.5	574.9	24.4	9.6	25.9	3.0	31.0
12292	10 24 76	42.5929	79.0653	197.5	199.3	586.7	25.6	9.6	27.2	3.0	32.4
12294	9 13 76	42.4067	79.2176	455.1	457.2	973.5	31.1	7.5	24.2	5.7	30.1
12296	9 30 76	42.3994	79.2886	362.7	365.2	892.5	31.7	8.4	26.0	5.2	31.8
12297	10 22 76	42.4347	79.2333	431.3	433.7	933.0	27.8	7.7	21.5	5.5	27.4
12298	10 6 78	42.4295	79.2280	445.3	447.4	939.4	29.4	7.6	23.3	5.5	29.2
12299	10 12 76	42.4339	79.2186	524.0	526.4	905.3	28.9	6.8	24.4	5.3	30.2
12300	9 27 76	42.4301	79.2385	473.0	475.5	961.6	27.2	7.3	20.7	5.7	26.6
12301	11 9 76	42.4202	79.2686	453.8	456.3	930.9	28.9	7.5	23.0	5.4	28.8
12302	11 1 76	42.4186	79.2775	367.3	369.7	882.4	29.4	8.3	23.9	5.1	29.7
12305	9 30 76	42.4879	79.1491	275.8	278.9	736.4	30.0	9.1	28.4	4.1	34.0
12306	10 7 76	42.4819	79.1470	313.3	316.4	785.2	29.4	8.7	26.4	4.4	32.0
12307	10 8 76	42.4774	79.1415	338.9	342.0	822.4	30.6	8.5	26.8	4.7	32.5
12309	10 1 76	42.4754	79.1333	353.6	356.6	841.9	31.7	8.3	27.7	4.8	33.4
12310	10 8 76	42.4800	79.1279	344.4	346.3	820.8	28.3	8.4	24.2	4.7	29.9
12329	9 20 76	42.5000	79.0687	292.3	295.4	773.3	28.9	8.9	25.9	4.3	31.5
12332	9 29 76	42.0478	79.4994	533.4	536.4	1358.2	37.8	7.6	22.2	8.4	28.4
12339	10 16 76	42.4162	79.2845	332.2	334.7	855.6	29.4	8.7	24.3	4.9	30.0
12350	8 5 77	42.5910	78.7154	327.7	330.7	763.5	26.1	8.3	23.3	4.3	28.9
12351	11 23 76	42.4139	79.2555	488.3	490.7	997.0	28.3	7.2	21.2	5.9	27.1
12359	11 17 76	42.7160	78.8788	233.2	234.7	506.0	18.3	9.0	18.5	2.5	23.4
12366	11 3 76	42.3943	79.1830	421.2	423.1	972.6	29.4	7.9	22.2	5.7	28.1
12367	10 23 76	42.3893	79.1848	423.1	425.2	981.8	30.0	7.9	22.5	5.8	28.4
12383	11 12 76	42.8273	78.6394	248.4	249.9	460.6	17.2	8.6	18.8	2.2	23.5
12385	9 16 76	42.4032	79.2417	510.5	512.7	1026.9	29.4	7.0	21.9	6.1	27.8
12386	10 21 76	42.3954	79.2299	533.4	535.8	1067.7	32.8	6.8	24.4	6.4	30.3
12387	12 4 76	42.3970	79.2420	520.6	523.0	1053.4	26.7	6.9	18.8	6.3	24.7
12388	11 2 76	42.3918	79.2369	543.2	545.6	1083.6	31.7	6.7	23.1	6.5	29.1
12390	11 10 76	42.3902	79.2441	515.4	517.9	1061.9	32.2	7.0	23.8	6.4	29.8
12391	1 20 77	42.3861	79.2394	505.4	507.8	1045.5	32.2	7.1	24.1	6.2	30.0
12393	11 11 76	42.7715	77.4962	320.0	322.8	347.2	17.8	8.0	28.1	1.4	32.0
12397	10 24 76	42.4217	79.2859	329.5	331.9	836.7	28.3	8.7	23.5	4.8	29.2
12397	10 21 76	42.4616	79.3384	199.6	202.7	656.8	27.8	9.9	27.3	3.5	32.6
12398	3 8 77	43.4868	76.1890	119.2	119.8	556.0	23.3	8.7	26.4	2.8	31.4
12399	3 4 77	43.5087	76.1958	103.0	103.6	544.1	18.3	8.8	17.6	2.7	22.6
12399	3 4 77	43.5087	76.1958	103.0	103.6	544.1	18.9	8.8	18.6	2.7	23.6
12402	11 11 76	42.3167	77.3822	521.5	525.2	1791.6	47.2	6.9	22.5	11.5	28.9
12403	10 27 76	42.5354	78.5111	424.3	427.0	980.5	33.3	7.5	26.3	5.8	32.2
12406	2 22 77	43.5019	76.2002	100.0	100.6	546.5	22.8	8.8	25.5	2.8	30.6
12408	11 5 76	42.9613	78.3170	281.6	284.1	396.2	13.9	7.9	15.0	1.7	19.3
12411	11 30 76	42.3902	79.4244	238.4	240.8	748.9	28.3	9.7	24.9	4.2	30.5

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
12411	11 30 76	42.3902	79.4244	238.4	240.8	748.9	27.8	9.7	24.2	4.2	29.7
12413	3 28 77	42.3770	79.3672	469.4	471.8	995.2	33.3	7.4	26.0	5.9	31.9
12414	1 13 77	42.3713	79.3635	466.3	469.4	1012.9	30.6	7.5	22.8	6.0	28.7
12418	3 24 77	42.4628	79.1688	323.1	324.0	792.5	23.9	8.7	19.2	4.5	24.8
12419	11 17 76	42.4255	79.1184	189.0	190.8	553.2	25.6	10.1	28.0	2.8	33.0
12421	2 18 77	42.3819	79.2348	492.3	494.1	1027.8	32.8	7.2	24.9	6.1	30.8
12423	11 9 76	42.4024	79.2244	484.9	487.4	1020.8	30.6	7.2	22.9	6.1	28.8
12426	11 15 76	42.4325	79.2859	306.9	309.4	803.8	26.7	8.9	22.1	4.6	27.8
12427	11 22 76	42.4251	79.2177	402.0	404.2	964.1	30.6	8.0	23.4	5.7	29.3
12445	11 23 76	42.3902	79.2598	464.5	466.6	996.1	31.7	7.5	24.3	5.9	30.2
12447	2 27 77	42.5189	76.1909	94.8	95.4	511.1	18.9	10.6	16.2	2.5	21.1
12450	12 10 76	42.7405	78.5184	356.6	359.1	678.2	25.6	7.7	26.3	3.7	31.7
12452	12 18 76	42.7406	78.5044	326.1	326.1	659.9	26.7	8.0	28.2	3.5	33.6
12458	11 23 76	42.2893	79.4138	478.8	481.3	1069.8	29.4	7.6	20.5	6.4	26.4
12459	12 18 76	42.4564	78.8102	289.0	293.2	876.3	30.6	9.0	24.6	5.1	30.4
12461	1 22 77	42.4444	78.8191	347.5	350.5	971.1	31.7	8.5	23.9	5.7	29.8
12465	12 16 76	42.5740	79.0523	198.1	198.1	585.5	21.1	9.7	19.6	3.0	24.7
12480	1 12 77	42.4507	78.8087	289.6	292.6	871.4	30.0	9.0	24.1	5.0	29.8
12481	12 16 76	42.2889	79.4040	508.4	510.8	1115.3	26.7	7.3	17.4	6.7	23.4
12482	1 13 77	42.2748	79.3541	395.3	397.8	1024.4	32.8	8.4	23.8	6.1	29.7
12505	1 6 77	42.4511	78.8172	289.6	292.6	864.1	30.0	9.0	24.3	5.0	30.0
12550	9 30 76	42.4007	79.2888	360.0	362.4	892.5	31.7	8.5	26.0	5.2	31.8
12553	1 29 77	42.4336	79.4009	193.5	196.6	665.1	22.2	10.0	18.4	3.6	23.8
12564	4 26 77	42.8445	78.4949	307.8	309.7	534.6	22.8	7.9	27.7	2.7	32.7
12578	5 20 77	42.0548	79.4893	533.1	536.4	1359.7	37.2	7.6	21.8	8.4	28.0
12579	4 5 77	42.0497	79.4919	515.1	518.5	1342.6	36.1	7.8	21.1	8.3	27.3
12580	3 17 77	42.0548	79.4893	524.3	527.6	1347.8	36.7	7.7	21.5	8.4	27.7
12581	2 28 77	42.0541	79.4961	515.1	518.5	1340.5	36.1	7.7	21.2	8.3	27.4
12582	6 3 77	42.0424	79.4633	522.7	526.1	1350.0	38.9	7.7	23.1	8.4	29.3
12583	6 11 77	42.0449	79.5114	530.4	533.7	1358.5	38.3	7.6	22.6	8.4	28.8
12584	5 4 77	42.0580	79.5058	550.2	553.5	1360.0	33.3	7.4	19.1	8.4	25.3
12585	4 20 77	42.0530	79.4657	527.9	531.3	1342.6	36.7	7.6	21.6	8.3	27.8
12587	4 27 77	42.0594	79.4997	527.3	530.7	1341.1	36.1	7.6	21.2	8.3	27.4
12588	9 16 77	42.0474	79.4624	480.1	483.4	1318.6	36.1	8.1	21.2	8.1	27.4
12589	8 23 77	42.0338	79.4479	531.9	535.2	1387.1	37.8	7.6	21.7	8.6	28.0
12591	6 19 77	42.0350	79.4678	490.7	500.2	1352.4	38.9	8.0	22.9	8.4	29.1
12592	8 11 77	42.0408	79.4480	518.2	521.5	1331.4	40.0	7.7	24.2	8.2	30.4
12593	8 3 77	42.0464	79.4527	508.4	511.8	1335.9	43.3	7.8	26.6	8.3	32.8
12594	6 25 77	42.0345	79.4597	521.2	524.6	1399.6	38.3	7.7	21.9	8.7	28.1
12597	7 19 77	42.2755	79.5457	388.0	390.1	1012.9	31.7	8.5	22.9	6.0	28.8
12598	4 24 77	42.2788	79.4401	499.9	502.3	1112.5	32.8	7.4	22.8	6.7	28.9
12599	4 24 77	42.2630	79.4667	417.0	419.1	1039.7	31.7	8.2	22.5	6.2	28.5
12600	5 30 77	42.2528	79.4460	438.9	441.0	1092.4	33.3	8.0	23.1	6.6	29.2
12601	5 19 77	42.2508	79.4377	409.0	411.2	1054.6	32.8	8.3	23.2	6.3	29.1
12602	5 9 77	42.2591	79.4274	424.3	426.4	1066.8	31.1	8.2	21.5	6.4	27.5
12603	5 15 77	42.2531	79.4276	432.5	434.6	1078.1	33.3	8.1	23.4	6.5	29.4
12604	5 22 77	42.2585	79.4189	451.1	453.2	1097.6	33.3	7.9	23.2	6.6	29.2
12605	6 3 77	42.2661	79.4192	453.8	453.8	1079.0	32.2	7.9	22.6	6.5	28.6
12606	6 12 77	42.2649	79.4108	465.7	467.9	1098.2	33.3	7.8	23.3	6.6	29.3
12607	6 19 77	42.2627	79.4038	499.0	501.1	1137.2	35.6	7.4	24.7	6.9	30.8
12609	6 5 77	42.2701	79.3601	523.3	526.4	1150.0	33.3	7.2	22.8	7.0	28.8
12610	5 17 77	42.2673	79.3993	500.8	503.8	1135.7	36.7	7.4	25.8	6.9	31.8
12611	5 27 77	42.2634	79.3936	522.4	525.5	1147.3	37.2	7.2	26.2	7.0	32.2
12612	6 26 77	42.2579	79.3945	516.6	518.8	1164.9	33.9	7.3	22.9	7.1	28.9
12614	6 13 77	42.2517	79.3933	521.2	524.3	1169.2	30.0	7.2	19.5	7.1	25.6

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
12615	5 29 77	42.2524	79.4151	473.7	474.3	1121.4	36.1	7.7	25.3	6.8	31.4
12616	7 7 77	42.2512	79.3860	531.3	533.4	1182.9	33.9	7.1	22.6	7.2	28.7
12623	1 5 78	42.3955	79.2136	466.3	468.8	1029.3	31.1	7.4	23.0	6.1	29.0
12624	1 17 78	42.3707	79.2561	451.1	453.8	1001.0	30.6	7.6	22.9	5.9	28.8
12625	12 22 77	42.3679	79.2634	475.5	478.5	1024.7	31.1	7.4	23.1	6.1	29.1
12641	3 22 77	42.8348	78.7207	217.9	220.1	394.7	23.3	8.8	36.8	1.7	41.1
12654	2 25 77	42.4945	79.3047	189.3	192.3	615.1	26.1	9.9	26.4	3.2	31.6
12676	3 9 77	42.3434	79.5523	212.8	215.8	740.4	27.2	10.0	23.2	4.1	28.8
12677	3 17 77	42.3498	79.5527	205.4	208.5	731.8	26.1	10.1	21.9	4.0	27.4
12703	6 29 77	42.1233	79.6791	454.2	457.2	1226.8	36.1	8.2	22.7	7.5	28.9
12706	11 2 76	42.7865	77.8689	177.4	177.4	199.9	18.9	9.4	47.4	.3	49.0
12719	4 14 77	42.8458	78.6708	225.6	227.1	421.5	16.1	8.7	17.5	1.9	22.0
12721	5 16 77	42.8421	78.1718	342.3	342.3	422.5	23.9	7.7	38.4	1.9	42.9
12724	5 6 77	42.8432	78.1690	350.8	350.8	424.3	19.4	7.6	28.0	1.9	32.5
12731	5 5 77	42.4179	79.3236	273.4	276.8	773.3	32.2	9.3	29.7	4.3	35.3
12745	5 23 77	42.5792	78.7205	441.4	444.4	773.3	28.3	7.2	27.3	4.3	32.9
12745	6 7 77	42.5792	78.7205	441.4	444.4	1679.8	43.9	7.2	21.8	10.7	28.2
12745	6 4 77	42.5792	78.7205	441.4	444.4	1403.9	41.7	7.2	24.5	8.7	30.8
12765	6 18 77	42.1980	77.6657	668.1	670.6	1417.6	37.8	5.7	22.6	8.8	28.9
12778	7 14 77	42.8451	78.6841	225.6	227.1	424.9	17.8	8.7	21.3	1.9	25.8
12782	7 15 77	42.8528	78.6618	230.1	231.6	424.3	17.8	8.7	21.5	1.9	25.9
12783	7 20 77	42.8591	78.6714	211.8	213.4	394.1	16.7	8.8	19.9	1.7	24.2
12784	7 21 77	42.8432	78.6620	227.1	228.6	424.6	18.3	8.7	22.6	1.9	27.1
12800	9 10 77	42.9639	78.6158	225.9	228.6	340.8	15.6	8.4	20.9	1.3	24.8
12805	7 7 77	42.0696	75.5967	570.0	573.0	1349.0	38.3	6.3	23.8	8.4	30.0
12806	8 25 77	42.5718	78.9311	347.5	349.0	767.2	23.3	8.2	19.7	4.3	25.3
12812	8 16 77	42.5839	76.9427	223.4	225.9	419.7	22.2	9.3	30.8	1.9	35.2
12813	8 5 74	42.5884	76.9545	241.7	244.1	437.1	20.6	9.1	26.1	2.0	30.7
12819	6 30 77	42.8822	78.6392	178.0	180.1	338.3	17.8	9.1	25.6	1.3	29.5
12837	7 27 77	42.4701	79.3223	205.7	205.7	651.7	27.2	9.8	26.7	3.5	32.0
12848	10 10 77	42.8959	78.3905	285.6	285.6	483.1	18.9	8.1	22.4	2.3	27.2
12859	11 14 77	42.4088	76.8981	248.4	248.4	896.7	27.8	9.4	20.5	5.2	26.3
12891	9 27 77	42.9468	78.3152	280.1	280.7	408.7	15.0	8.0	17.1	1.8	21.5
12892	9 30 77	42.9391	78.3163	284.4	286.8	417.6	15.0	8.0	16.9	1.9	21.3
12893	9 30 77	42.9306	78.3337	279.8	281.6	417.6	16.7	8.0	20.7	1.9	25.1
12894	9 30 77	42.9390	78.3358	288.3	288.3	417.6	13.9	7.9	14.2	1.9	18.7
12895	9 16 77	42.9548	78.3174	276.8	276.8	394.1	16.7	8.0	21.9	1.7	26.2
12910	11 12 77	42.4665	78.8038	350.5	353.6	1777.6	48.9	8.4	22.8	11.4	29.2
12927	9 28 77	42.1367	77.9594	467.9	467.9	549.6	21.1	7.9	24.1	2.8	29.2
12944	10 15 77	42.0160	79.3913	498.3	502.3	1391.4	38.3	8.0	21.8	8.7	28.0
12960	11 17 77	42.3711	77.3896	404.2	407.8	911.0	27.8	7.9	21.8	5.3	27.6
12970	10 18 77	42.5282	78.7291	426.7	429.8	909.5	30.0	7.5	24.7	5.3	30.6
12972	12 7 77	42.2341	77.3690	586.7	590.1	1271.6	35.6	6.4	22.9	7.8	29.1
12973	2 21 78	42.0578	79.4747	456.6	460.6	1283.8	36.7	8.3	22.1	7.9	28.2
12974	11 11 77	42.0559	79.4464	499.9	499.9	1308.8	38.3	7.9	23.2	8.1	29.4
12975	11 26 77	42.0622	79.4545	462.1	466.0	1289.6	34.4	8.2	20.3	7.9	26.5
12982	12 31 77	42.0472	79.4739	464.8	467.0	1312.5	37.8	8.3	22.5	8.1	28.7
12983	11 7 77	42.5375	78.7197	467.9	470.9	967.1	27.8	7.1	21.4	5.7	27.3
12985	10 26 77	42.5327	78.7147	454.2	457.2	953.7	30.6	7.2	24.5	5.6	30.3
13011	1 20 78	42.0266	77.5871	553.2	557.2	1516.7	42.8	7.1	23.5	9.5	29.8
13043	12 9 77	42.0577	79.4626	454.2	458.1	1274.1	35.0	8.3	20.9	7.8	27.1
13050	12 22 77	42.4201	79.3491	243.2	245.1	736.1	30.0	9.6	27.8	4.1	33.3
13058	1 11 78	42.4750	79.3248	198.1	201.5	648.3	26.1	9.9	25.1	3.5	30.4
13082	2 22 78	42.7059	78.3672	490.7	493.8	876.0	24.4	6.5	20.5	5.1	26.3
13083	2 3 78	42.6124	78.4348	461.8	464.8	950.7	27.8	7.0	21.9	5.6	27.8

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
13084	2 14 78	42.6510	78.4193	416.1	419.1	868.7	25.6	7.3	21.0	5.0	26.7
13085	3 9 78	42.6107	78.3299	533.4	536.4	1058.3	28.3	6.3	20.8	6.3	26.8
13113	1 22 78	42.5875	79.0208	228.6	228.6	611.4	22.2	9.3	21.1	3.2	26.3
13241	5 5 78	42.6571	78.1943	520.6	524.0	1048.5	31.7	6.3	24.2	6.3	30.2
13242	4 25 78	42.3166	78.1555	498.3	501.7	983.9	30.0	7.2	23.2	5.8	29.1
13248	5 24 78	42.9383	78.3417	280.4	280.4	386.8	16.1	8.0	20.9	1.6	25.2
13249	5 9 78	42.9458	78.3337	277.4	277.4	386.5	19.4	8.0	29.5	1.6	33.8
13250	5 16 78	42.9447	78.3428	273.1	273.1	379.2	21.1	8.1	34.4	1.6	38.6
13268	5 31 78	42.5814	78.1807	490.7	494.1	1070.2	31.1	6.8	22.8	6.4	28.8
13271	5 24 78	42.9471	78.5120	277.7	277.7	392.6	20.0	8.0	30.6	1.7	34.8
13308	6 10 78	42.5279	78.1417	478.5	485.5	1133.2	33.3	6.9	23.3	6.9	29.3
13316	6 16 78	42.9240	78.4864	256.0	256.0	409.3	16.7	8.3	20.5	1.8	24.9
13537	7 8 79	42.3307	78.7914	525.8	529.1	1247.5	41.1	7.0	27.4	7.7	33.5
13545	8 8 78	42.0634	79.4301	508.7	509.3	1353.0	37.8	7.8	22.1	8.4	28.3
13546	6 7 79	42.2596	79.7369	213.4	213.4	786.4	38.9	10.3	36.4	4.4	42.0
13546	6 7 79	42.2596	79.7369	213.4	213.4	787.3	38.9	10.3	36.4	4.4	42.0
13550	7 18 78	42.0618	79.4386	497.7	501.1	1324.4	36.1	7.9	21.3	8.2	27.5
13552	10 31 78	42.0708	79.4581	470.9	474.3	1274.1	36.1	8.1	22.0	7.8	28.1
13573	8 27 78	42.4180	79.3900	219.5	222.5	702.9	28.3	9.8	26.4	3.8	31.9
13576	8 17 78	42.0669	79.4456	473.4	474.3	1300.3	36.7	8.1	21.9	8.0	28.1
13577	8 27 78	42.0507	79.4247	447.4	450.8	1307.0	43.3	8.4	26.7	8.1	32.9
13578	11 20 78	42.1551	77.6962	702.0	702.3	1497.2	43.3	5.5	25.3	9.4	31.6
13603	9 22 78	42.2930	79.1669	644.3	647.7	1306.4	38.9	5.9	25.2	8.1	31.4
13604	9 11 78	42.3277	79.1882	628.8	632.2	1249.7	38.3	6.0	25.9	7.7	32.0
13625	9 10 78	42.5079	78.7549	423.7	426.7	938.8	33.9	7.6	28.0	5.5	33.9
13642	10 15 78	42.4152	79.2265	481.6	484.0	1009.2	33.3	7.2	25.9	6.0	31.8
13662	1 10 79	42.7708	78.0864	445.3	448.4	826.6	25.0	6.8	22.0	4.7	27.7
13664	12 31 78	42.7687	78.0239	447.4	450.5	816.6	28.9	6.8	27.1	4.6	32.8
13666	12 5 78	42.7610	78.0144	440.4	443.5	835.2	26.1	6.9	23.1	4.8	28.8
13672	10 8 78	42.9935	77.9522	240.8	243.8	1281.1	40.6	8.3	25.2	7.9	31.3
13673	10 14 78	42.0219	79.5178	466.0	469.1	1289.9	38.3	8.3	23.3	7.9	29.4
13676	10 25 78	42.8555	76.8374	161.5	164.9	699.5	23.3	9.4	19.9	3.8	25.4
13684	12 8 78	42.4410	78.0159	554.7	559.6	959.8	33.9	6.4	28.6	5.6	34.5
13689	11 10 78	42.8484	76.8474	173.7	178.0	719.9	28.3	9.3	26.4	4.0	31.9
13690	11 8 78	42.0867	77.6142	698.0	701.3	1534.7	46.1	5.6	26.4	9.7	32.7
13699	3 15 79	42.4662	77.2657	566.3	571.5	1417.9	39.4	6.2	23.5	8.8	29.7
13699	5 1 79	42.4662	77.2657	566.3	571.5	2810.3	64.4	6.2	20.7	18.6	27.3
13699	3 15 79	42.4662	77.2657	566.3	571.5	1176.5	37.8	6.2	26.9	7.2	33.0
13699	5 22 79	42.4662	77.2657	566.3	571.5	2989.5	67.8	6.2	20.6	19.8	27.2
13700	1 1 79	42.6972	77.8919	266.1	271.3	793.7	30.6	8.7	27.6	4.5	33.2
13700	1 29 79	42.6972	77.8919	266.1	271.3	1942.8	47.8	8.7	20.1	12.5	26.6
13702	3 30 79	42.8359	78.8237	179.8	179.8	329.5	15.6	9.2	19.3	1.2	23.0
13707	1 8 79	42.6185	79.0644	185.9	185.9	532.5	29.4	9.7	37.1	2.7	42.1
13722	5 25 79	42.8662	73.5369	271.3	271.3	455.4	18.9	8.0	23.9	2.1	28.5
13725	5 30 79	42.6462	78.4163	434.3	437.4	887.0	28.3	7.2	23.9	5.1	29.7
13730	12 30 78	42.3821	79.1865	420.0	420.0	421.8	30.0	7.9	52.3	1.9	56.8
13736	2 9 79	42.4348	72.4098	453.2	456.6	1478.0	38.9	6.0	22.3	9.3	28.5
13736	2 17 79	42.4348	72.4098	453.2	456.6	1463.3	38.9	6.0	22.5	9.2	28.7
13755	1 26 79	42.1819	79.4583	407.5	407.5	1106.4	35.6	8.5	24.4	6.7	30.4
13757	12 22 78	42.2597	79.5447	422.1	422.1	1028.7	33.9	8.2	25.0	6.1	30.9
13758	1 22 79	42.2626	79.5536	457.2	457.2	1053.4	30.6	7.9	21.5	6.3	27.5
13760	2 8 79	42.2674	79.5646	426.7	426.7	1015.0	30.6	8.2	22.1	6.0	28.0
13762	2 26 79	42.2485	79.5697	432.8	432.8	1037.5	33.9	8.1	24.8	6.2	30.8
13765	5 7 79	42.2509	79.5370	408.4	411.5	1030.2	31.1	8.3	22.1	6.1	28.1
13778	1 12 79	42.2560	79.5574	435.9	435.9	1038.8	31.1	8.1	22.2	6.2	28.1

APPENDIX A (Cont)

WELL NO	DATE LOG	LATITUDE DEGREES	LONGITUDE DEGREES	ELEV M	KBELV M	DEPTH M	BHT C	STEMP C	GRADIENT C/KM	BHTCOR C	AAPGRAD C/KM
13782	5 26 79	42.2468	79.5471	451.1	451.1	1073.2	32.2	8.0	22.6	6.4	28.6
13790	3 15 79	42.5988	78.3792	512.4	515.4	1043.0	29.4	6.5	22.0	6.2	28.0
13796	2 20 79	42.3888	76.9328	422.8	426.1	740.7	24.4	7.7	22.6	4.1	28.2
13812	1 13 79	42.7983	78.6156	275.8	275.8	525.8	31.1	8.4	43.2	2.6	48.2
13841	3 1 79	42.7350	77.9534	326.1	326.1	804.7	29.4	8.1	26.6	4.6	32.2
13854	2 2 79	42.1905	79.4558	403.9	403.9	1098.2	35.6	8.6	24.6	6.6	30.6
13859	5 23 79	42.8288	78.6629	237.7	239.3	448.1	18.3	8.7	21.6	2.1	26.2
13862	2 10 79	42.1858	79.4546	402.9	402.9	1101.2	35.0	8.6	24.0	6.6	30.0
13887	3 12 79	42.2147	79.4818	413.0	413.0	1085.7	35.0	8.4	24.5	6.5	30.5
13891	3 16 79	42.7797	78.0483	463.3	463.3	818.7	26.7	6.6	24.5	4.7	30.2
13892	3 11 79	42.7587	78.0845	451.7	451.7	822.7	28.3	6.8	26.2	4.7	31.9
13893	3 1 79	42.1844	79.4639	408.4	408.4	1099.7	38.9	8.5	27.6	6.6	33.6
13907	3 23 79	42.3080	79.5961	230.1	230.1	784.6	35.6	10.0	32.6	4.4	38.2
13919	4 21 79	42.7587	78.0777	455.7	456.3	830.9	25.0	6.7	22.0	4.7	27.7
13982	6 6 79	42.2720	79.7075	214.9	214.9	715.4	38.9	10.2	40.1	3.9	45.6
13983	5 24 79	42.2746	79.7124	207.3	208.2	763.2	32.2	10.3	28.7	4.3	34.3
14178	5 24 79	42.7239	77.9726	329.2	332.5	788.8	26.1	8.0	22.9	4.4	28.6
14250	6 14 79	42.2786	79.7057	207.0	207.0	761.7	28.3	10.3	23.7	4.3	29.3

APPENDIX B

TEMPERATURE-DEPTH MEASUREMENTS AND TEMPERATURE-DEPTH PROFILES FOR WELLS MEASURED BY PERSONNEL OF THE STATE UNIVERSITY OF NEW YORK AT BUFFALO

TABLE B-I

WELL NO. 13738 PATTERSON-SPRINGPORT CAYUGA CO. NEW YORK 9-11-79

LATITUDE 14620. FEET N of 42. 50. 0.
LONGITUDE 15100. FEET W of 76. 37. 30.
ELEVATION 510. FEET

DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C
0.0	18.01	15.2	8.05	30.5	4.35	45.7	4.37
61.0	4.46	76.2	6.58	91.4	10.07	106.7	10.15
121.9	11.62	137.2	12.47	152.4	12.93	167.6	13.52
182.9	14.05	198.1	14.61	213.4	15.28	228.6	15.53
243.8	16.09	259.1	16.85	274.3	17.51	289.6	17.94
304.8	18.48	310.9	18.57	317.0	18.92	323.1	18.98
329.2	19.16	335.3	19.38	341.4	19.78	347.5	19.95
353.6	20.23	359.7	20.47	365.8	20.87	371.9	20.97
378.0	21.12	384.0	21.32	390.1	21.57	396.2	21.80
402.3	22.07	408.4	22.55	414.5	22.59	420.6	22.90
426.7	23.21	432.8	23.53	438.9	23.80	445.0	24.07
451.1	24.44	457.2	24.85	463.3	25.22	469.4	25.41
475.5	25.55	481.6	25.72	487.7	25.85	493.8	26.01
499.9	26.04	506.0	26.39	512.1	26.74	518.2	26.70
524.3	26.53	530.4	26.61	536.4	26.73	542.5	27.09
548.6	26.98	554.7	27.10	560.8	27.18	566.9	27.41
573.0	27.69						

APPENDIX B (Cont)

TABLE B-II

WELL NO. 13000 BLAKELY - N COLLINS ERIE CO., NEW YORK 7-7-79

LATITUDE 13200. FEET S of 42. 40. 0.
LONGITUDE 10750. FEET W of 78. 52. 30.
ELEVATION 856. FEET

DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C
6.1	10.40	9.1	10.44	12.2	10.48	15.2	10.50
18.3	10.54	21.3	10.56	24.4	10.59	27.4	10.61
30.5	10.64	33.5	10.68	36.6	10.71	39.6	10.75
42.7	10.79	45.7	10.84	48.8	10.89	51.8	10.94
54.9	11.00	57.9	11.06	61.0	11.13	64.0	11.20
67.1	11.27	70.1	11.34	73.2	11.42	76.2	11.50
79.2	11.59	82.3	11.69	85.3	11.80	88.4	11.91
91.4	12.03	94.5	12.15	97.5	12.26	100.6	12.37
103.6	12.48	106.7	12.58	109.7	12.70	112.8	12.81
115.8	12.92	118.9	13.02	121.9	13.12	125.0	13.22
128.0	13.35	131.1	13.45	134.1	13.52	137.2	13.55
140.2	13.61	143.3	13.71	146.3	13.83	149.4	13.94
152.4	14.07	155.4	14.18	158.5	14.30	161.5	14.41
164.6	14.53	167.6	14.66	170.7	14.77	173.7	14.89
176.8	15.00	179.8	15.10	182.9	15.22	185.9	15.33
189.0	15.45	192.0	15.56	195.1	15.68	198.1	15.80
201.2	15.91	204.2	16.03	207.3	16.14	210.3	16.26
213.4	16.38	216.4	16.49	219.5	16.61	222.5	16.73
225.6	16.85	228.6	16.97	231.6	17.09	234.7	17.21
237.7	17.32	240.8	17.43	243.8	17.52	246.9	17.63
249.9	17.74	253.0	17.85	256.0	17.95	259.1	18.05
262.1	18.15	265.2	18.29	268.2	18.44	271.3	18.59
274.3	18.71	277.4	18.79	280.4	18.85	283.5	18.90
286.5	18.96	289.6	19.01	292.6	19.06	295.7	19.12
298.7	19.18	301.8	19.23	304.8	19.29	307.8	19.35
310.9	19.40	313.9	19.46	317.0	19.51	320.0	19.56
323.1	19.61	326.1	19.66	329.2	19.71	332.2	19.75
335.3	19.80	338.3	19.85	341.4	19.92	344.4	19.97
347.5	20.02	350.5	20.06	353.6	20.10	356.6	20.15
359.7	20.19	362.7	20.23	365.8	20.26	368.8	20.30
371.9	20.33	374.9	20.38	378.0	20.42	381.0	20.45
384.0	20.48	387.1	20.52	390.1	20.56	393.2	20.60
396.2	20.65	399.3	20.70	402.3	20.76	405.4	20.83
408.4	20.91	411.5	20.98	414.5	21.02	417.6	21.08
420.6	21.15	423.7	21.20	426.7	21.26	429.8	21.32
432.8	21.38	435.9	21.42	438.9	21.49	442.0	21.55
445.0	21.61	448.1	21.68	451.1	21.72	454.2	21.76

APPENDIX B

TABLE B-II (Cont)

DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C
603.5	24.57	606.6	24.63	609.6	24.66	612.6	24.86
615.7	24.83	618.7	24.84				
457.2	21.82	460.2	21.87	463.3	21.92	466.3	21.97
469.4	22.00	472.4	22.05	475.5	22.07	478.5	22.10
481.6	22.14	484.6	22.16	487.7	22.19	490.7	22.22
493.8	22.26	496.8	22.30	499.9	22.33	502.9	22.36
506.0	22.39	509.0	22.44	512.1	22.46	515.1	22.50
518.2	22.54	521.2	22.59	524.3	22.65	527.3	22.71
530.4	22.81	533.4	22.90	536.4	23.01	539.5	23.10
542.5	23.20	545.6	23.29	548.6	23.37	551.7	23.43
554.7	23.49	557.8	23.57	560.8	23.63	563.9	23.68
566.9	23.74	570.0	23.79	573.0	23.83	576.1	23.87
579.1	23.91	582.2	23.94	585.2	24.00	588.3	24.10
591.3	24.17	594.4	24.20	597.4	24.29	600.5	24.37

APPENDIX B (Cont)

TABLE B-III

WELL NO. 14270 WILLIAMS 1 - EDEN ERIE CO., NEW YORK 7-10-79

LATITUDE 7600. FEET S of 42. 40. 0.
LONGITUDE 5200. FEET W of 78. 55. 0.
ELEVATION 765. FEET

DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C
15.5	10.83	30.8	11.00	46.0	11.39	61.3	11.66
76.5	11.81	91.7	11.99	107.0	12.58	122.2	13.04
137.5	13.36	152.7	14.34	167.9	14.66	183.2	14.99
198.4	15.47	213.7	16.38	228.9	17.06	244.1	17.32
259.4	17.54	274.6	17.77	289.9	17.98	305.1	18.24
320.3	18.42	335.6	18.60	350.8	18.83	366.1	19.14
381.3	19.42	396.5	19.72	411.8	19.95	427.0	20.13
442.3	20.31	457.5	20.47	472.7	20.70	488.0	21.17
503.2	21.66	518.5	21.71	533.7	21.80	548.9	21.90
564.2	21.96	579.4	22.13	594.7	22.24	609.9	22.50
625.1	22.62	640.4	22.75	655.6	22.86	670.9	22.91
686.1	22.93						

APPENDIX B (Cont)

TABLE B-IV

WELL NO. 14269 LARDO 1 - EDEN ERIE CO., NEW YORK 7-9-79

LATITUDE 3160. FEET S of 42. 40. 0.
LONGITUDE 2200. FEET W of 78. 55. 0.
ELEVATION 782. FEET

DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C
0.0	15.61	6.1	12.78	12.2	11.53	18.3	11.08
24.4	11.02	30.5	11.01	36.6	11.04	42.7	11.09
48.8	11.19	54.9	11.30	61.0	11.43	67.1	11.70
73.2	11.85	79.2	12.00	85.3	12.15	91.4	12.34
97.5	12.56	103.6	12.74	109.7	12.94	115.8	13.15
121.9	13.32	128.0	13.52	134.1	13.72	140.2	13.82
146.3	14.00	152.4	14.19	158.5	14.38	164.6	14.60
170.7	14.82	176.8	15.05	182.9	15.27	189.0	15.47
195.1	15.71	201.2	15.90	207.3	16.11	213.4	16.37
219.5	16.58	225.6	16.70	231.6	16.83	237.7	16.93
243.8	17.04	249.9	17.15	256.0	17.24	262.1	17.37
268.2	17.46	274.3	17.53	280.4	17.62	286.5	17.74
292.6	17.82	298.7	17.91	304.8	18.00	310.9	18.08
317.0	18.16	323.1	18.24	329.2	18.30	335.3	18.37
341.4	18.44	347.5	18.59	353.6	18.70	359.7	18.86
365.8	19.02	371.9	19.13	378.0	19.26	384.0	19.42
390.1	19.53	396.2	19.66	402.3	19.78	408.4	19.87
414.5	19.95	420.6	19.99	426.7	20.05	432.8	20.13
438.9	20.18	445.0	20.25	451.1	20.31	457.2	20.40
463.3	20.49	469.4	20.64	475.5	20.83	481.6	20.99
487.7	21.18	493.8	21.27	499.9	21.38	506.0	21.48
512.1	21.55	518.2	21.63	524.3	21.75	530.4	21.92
536.4	21.98	542.5	21.19	548.6	22.37	554.7	22.46
560.8	22.45	566.9	22.45				

APPENDIX B (Cont)

TABLE B-V

WELL NO. 14310 ANDERSON 1 - BUSTI CHAUTAUQUA CO., NEW YORK 8-24-79

LATITUDE 8760. FEET S of 42. 5. 0.
LONGITUDE 4350. FEET W of 79. 17. 30.
ELEVATION 1510. FEET

DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C
0.0	13.40	15.2	11.30	30.5	11.00	45.7	11.20
61.0	11.40	76.2	11.50	91.4	11.60	106.7	11.80
121.9	12.00	137.2	12.20	152.4	12.40	167.6	12.70
182.9	12.90	198.1	12.90	213.4	13.20	228.6	13.60
243.8	14.10	259.1	14.40	274.3	14.80	289.6	15.50
304.8	16.10	320.0	16.10	335.3	16.80	350.5	17.20
365.8	17.70	381.0	18.20	396.2	18.80	411.5	19.30
426.7	20.20	442.0	20.60	457.2	21.00	472.4	21.30
487.7	21.80	502.9	22.00	518.2	22.60	533.4	23.10
548.6	23.50	563.9	23.90	579.1	24.00	594.4	24.30
609.6	24.70	624.8	25.00	640.1	25.40	655.3	25.70
670.6	26.00	685.8	26.50	701.0	26.90	716.3	27.30
731.5	27.90	746.8	28.20	762.0	28.80	777.2	29.20
792.5	29.60	807.7	30.10	823.0	30.30	838.2	30.70
853.4	31.20	868.7	31.60	883.9	31.80	899.2	32.30
914.4	32.40	929.6	32.70	944.9	32.90	960.1	33.00
975.4	33.20	990.6	33.30	1005.8	33.60	1021.1	33.70
1036.3	34.00	1051.6	34.20	1066.8	36.90	1082.0	35.50
1097.3	36.60	1112.5	36.00	1127.8	36.10	1143.0	36.40
1158.2	36.40	1173.5	36.50	1188.7	36.80	1204.0	37.00
1219.2	37.30	1234.4	37.80	1249.7	38.10	1264.9	38.10
1280.2	38.10	1295.4	38.60	1310.6	38.90		

APPENDIX B (Cont)

TABLE B-VI

WELL NO. 14324 E AURORA HIGH SCHOOL ERIE CO., NEW YORK 8-9-79

LATITUDE 6800. FEET S of 42. 45. 0.
LONGITUDE 10875. FEET W of 78. 35. 0.
ELEVATION 1140. FEET

DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C
6.1	14.30	12.2	12.20	18.3	12.20	24.4	12.20
30.5	12.20	36.6	12.20	42.7	12.30	48.8	12.40
54.9	12.40	61.0	12.50	67.1	12.70	73.2	12.90
79.2	13.00	85.3	13.30	91.4	13.60	97.5	13.80
103.6	13.90	109.7	14.10	115.8	14.40	121.9	14.60
128.0	14.90	134.1	15.00	140.2	15.30	146.3	15.60
152.4	15.80	158.5	16.00	164.6	16.40	170.7	16.50
176.8	16.70	182.9	17.00	189.0	17.30	195.1	17.40
201.2	17.80	207.3	17.90	213.4	18.00	219.5	18.80
225.6	18.50	231.6	18.90	237.7	19.20	243.8	19.40
249.9	19.60	256.0	19.90	262.1	20.20	268.2	20.40
274.3	20.70	280.4	20.90	286.5	21.10	292.6	21.30
298.7	21.50	304.8	22.00	310.9	22.10	317.0	22.30
323.1	22.40	329.2	22.50	335.3	22.60	341.4	22.70
347.5	23.00	353.6	23.10	359.7	23.30	365.8	23.40
371.9	23.50	378.0	23.60	384.0	23.70	390.1	23.80
396.2	23.80	402.3	23.90	408.4	23.90	414.5	24.00
420.6	24.10	426.7	24.20	432.8	24.40	438.9	24.50
445.0	24.70	451.1	24.70	457.2	24.90	463.3	25.00
469.4	25.10	475.5	25.30	481.6	25.40	487.7	25.60
493.8	25.70	499.9	25.90	506.0	26.00	512.1	26.00
518.2	26.10	524.3	26.20	530.4	26.30	536.4	26.30
542.5	26.40	548.6	26.50	554.7	26.70	560.8	26.80
566.9	27.10	573.0	27.40	579.1	29.10	585.2	29.30
591.3	29.50	597.4	30.20	603.5	30.30	609.6	31.00
615.7	30.20	621.8	29.90	627.9	28.60	634.0	28.60
640.1	28.70						

APPENDIX B (Cont)

TABLE B-VII

WELL NO. 14365 NELSON L-A - BUSTI CHAUTAUQUA CO., NEW YORK 8-6-79

LATITUDE 1300. FEET S of 42. 5. 0.
LONGITUDE 5500. FEET W of 79. 20. 0.
ELEVATION 1395. FEET

DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C
15.2	18.10	30.5	12.20	45.7	23.60	61.0	25.30
76.2	24.30	91.4	22.00	106.7	20.50	121.9	20.60
137.2	20.80	152.4	20.70	167.6	20.90	182.9	21.10
198.1	22.10	213.4	22.80	228.6	23.30	243.8	24.10
259.1	23.90	274.3	24.20	289.6	24.70	304.8	25.10
320.0	25.60	335.3	25.80	350.5	26.60	365.8	26.70
381.0	26.90	396.2	27.10	411.5	27.30	426.7	27.70
442.0	28.10	457.2	28.20	472.4	28.60	487.7	28.80
502.9	29.30	518.2	29.50	533.4	29.40	548.6	29.80
563.9	29.80	579.1	30.00	594.4	30.20	609.6	30.70
624.8	30.90	640.1	31.20	655.3	31.00	670.6	31.40
685.8	31.40	701.0	32.00	716.3	32.50	731.5	32.80
746.8	32.90	762.0	33.30	777.2	33.60	792.5	34.00
807.7	34.10	823.0	34.70	838.2	35.10	853.4	35.50
868.7	35.80	883.9	36.00	899.2	35.70	914.4	37.00
929.6	37.00	944.9	37.20	960.1	37.30	975.4	37.40
990.6	37.00	1005.8	37.50	1021.1	37.50	1036.3	38.10
1051.6	38.10	1066.8	38.10	1082.0	38.20	1097.3	38.40
1112.5	38.60	1127.8	38.60	1143.0	38.50	1158.2	38.40
1173.5	38.30	1188.7	38.50	1204.0	38.10	1219.2	38.40
1234.4	38.50	1249.7	38.90				

APPENDIX B (Cont)

TABLE B-VIII

WELL NO. 14172 HONEOYE - BRISTOL ONTARIO CO., NEW YORK 7-7-79

LATITUDE 12400. FEET S of 42. 50. 0.
LONGITUDE 1100. FEET W of 77. 27. 30.
ELEVATION 1477. FEET

DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C
6.1	10.11	12.2	9.42	18.3	9.54	24.4	9.65
30.5	9.77	36.6	9.86	42.7	9.93	48.8	10.04
54.9	10.10	61.0	10.24	67.1	10.37	73.2	10.52
79.2	10.67	85.3	10.79	91.4	10.90	97.5	10.97
103.6	11.08	109.7	11.20	115.8	11.28	121.9	11.41
128.0	11.91	134.1	12.05	140.2	12.19	146.3	12.30
152.4	12.47	158.5	12.60	164.6	12.74	170.7	12.88
176.8	13.00	182.9	13.17	189.0	13.37	195.1	13.49
201.2	13.63	207.3	13.77	213.4	13.88	219.5	14.02
225.6	14.16	231.6	14.23	237.7	14.37	243.8	14.53
249.9	14.65	256.0	14.80	262.1	14.99	268.2	15.13
274.3	15.33	280.4	15.45	286.5	15.54	292.6	15.61
298.7	15.77	304.8	15.92	310.9	16.07	317.0	16.22
323.1	16.36	329.2	16.50	335.3	16.67	341.4	16.82
347.5	16.97	353.6	17.13	359.7	17.28	365.8	17.44
371.9	17.60	378.0	17.82	384.0	18.00	390.1	18.20
396.2	18.35	402.3	18.45	408.4	18.54	414.5	18.61
420.6	18.66	426.7	18.72				

APPENDIX B (Cont)

TABLE B-IX

WELL NO. 14423 MILL - EAST AURORA ERIE CO., NEW YORK 9-19-79

LATITUDE 4500. FEET N of 42. 45. 0.
LONGITUDE 14250. FEET W of 78. 37. 30.
ELEVATION 970. FEET

DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C	DEPTH M	TEMP C
12.2	10.19	18.3	9.90	24.4	10.23	30.5	10.33
36.6	10.42	42.7	10.53	48.8	10.75	54.9	10.87
61.0	10.96	67.1	11.13	73.2	11.29	79.2	11.44
85.3	11.66	91.4	11.86	97.5	12.05	103.6	12.27
109.7	12.49	115.8	12.70	121.9	12.91	128.0	13.15
134.1	13.35	140.2	13.59	146.3	13.83	152.4	14.08
158.5	14.34	164.6	14.59	170.7	14.85	176.8	15.04
182.9	15.25	189.0	15.53	195.1	15.79	201.2	15.99
207.3	16.19	213.4	16.45	219.5	16.74	225.6	16.85
231.6	16.96	237.7	17.05	243.8	17.17	249.9	17.25
256.0	17.33	262.1	17.43	268.2	17.52	274.3	17.60
280.4	17.71	286.5	17.83	292.6	17.93	298.7	18.02
304.8	18.08	310.9	18.15	317.0	18.23	323.1	18.31
329.2	18.38	335.3	18.47	341.4	18.59	347.5	18.71
353.6	18.85	359.7	18.96	365.8	19.07	371.9	19.20
378.0	19.31	384.0	19.44	390.1	19.60	396.2	19.71
402.3	19.82	408.4	19.93	414.5	20.01	420.6	20.06
426.7	20.15	432.8	20.20	438.9	20.28	445.0	20.36
451.1	20.43	457.2	20.51	463.3	20.62	469.4	20.77
475.5	20.96	481.6	21.17	487.7	21.36	493.8	21.51
499.9	21.65	506.0	21.75	512.1	21.86	518.2	21.93
524.3	22.01	530.4	22.13	536.4	22.24	542.5	22.47
548.6	22.57						

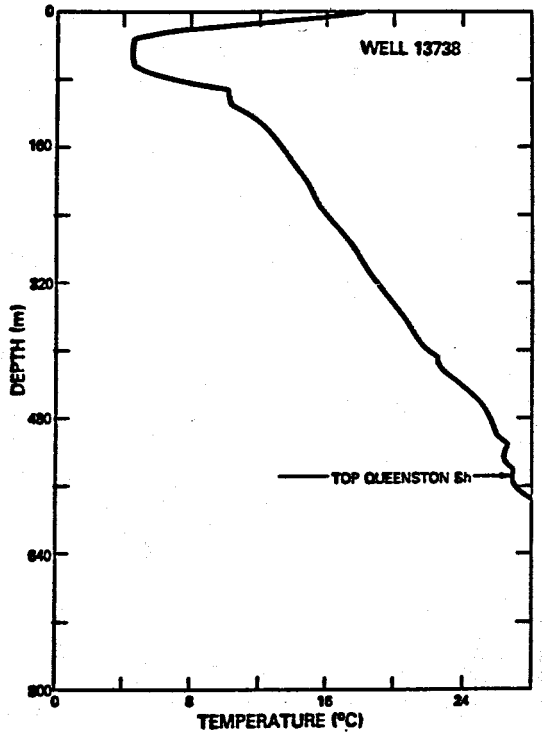

Fig. B-1.
Temperature-depth profile for Well 13738.

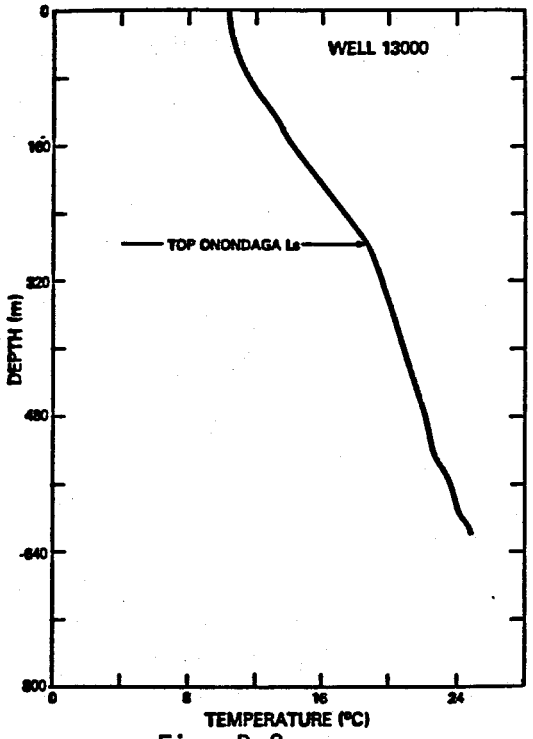

Fig. B-2.
Temperature-depth profile for Well 13000.

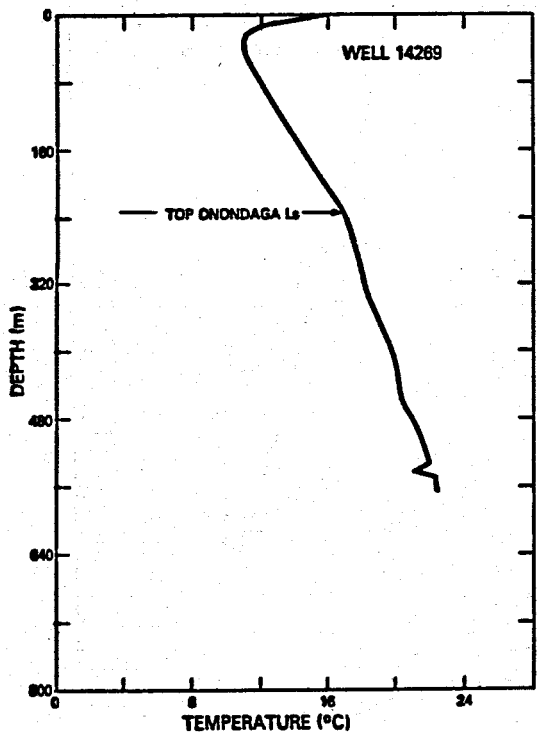

Fig. B-3.
Temperature-depth profile for Well 14269.

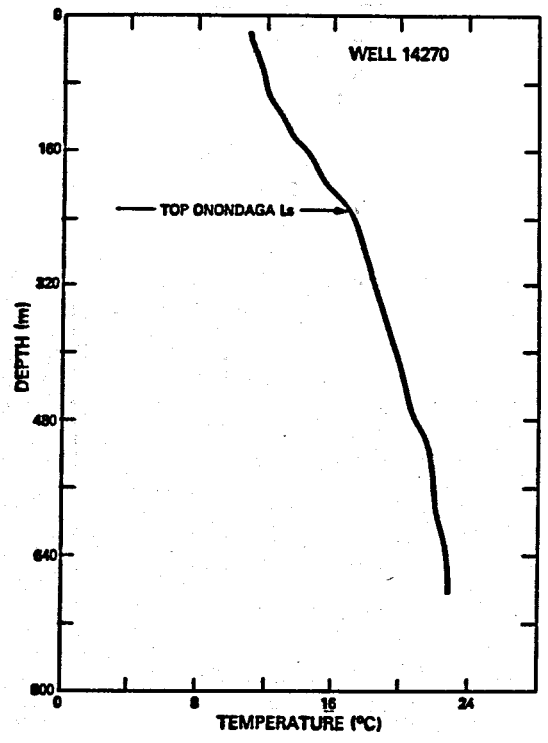

Fig. B-4.
Temperature-depth profile for Well 14270.

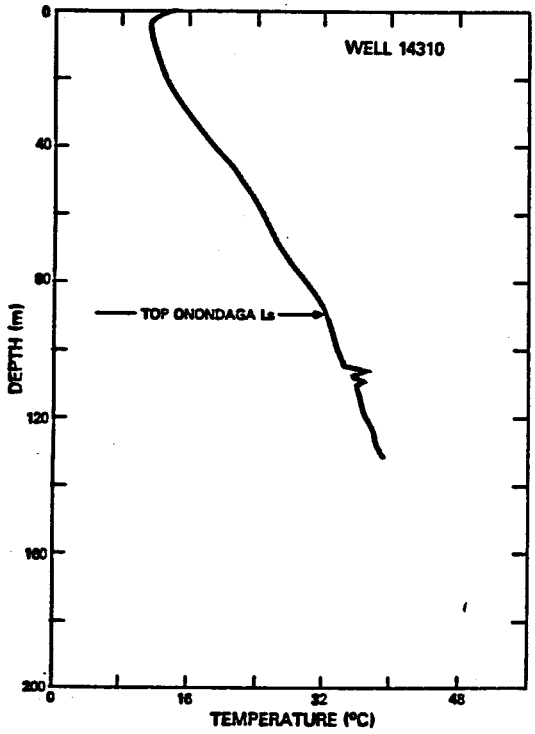

Fig. B-5.
Temperature-depth profile for Well 14310.

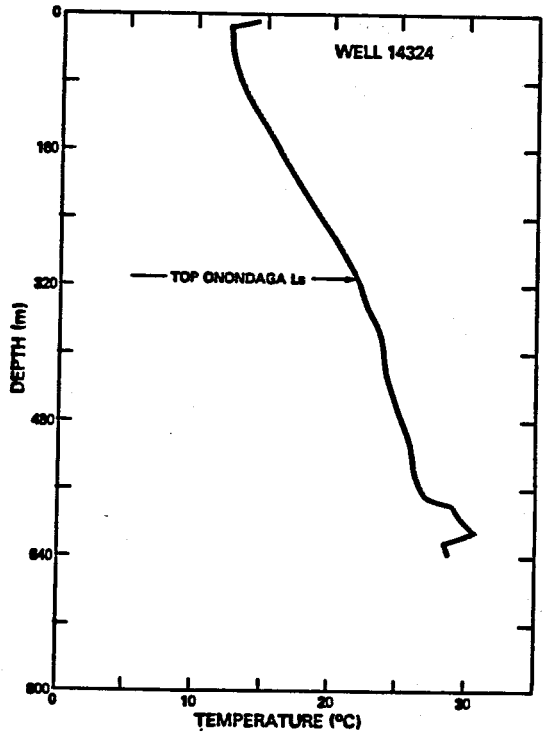

Fig. B-6.
Temperature-depth profile for Well 14324.

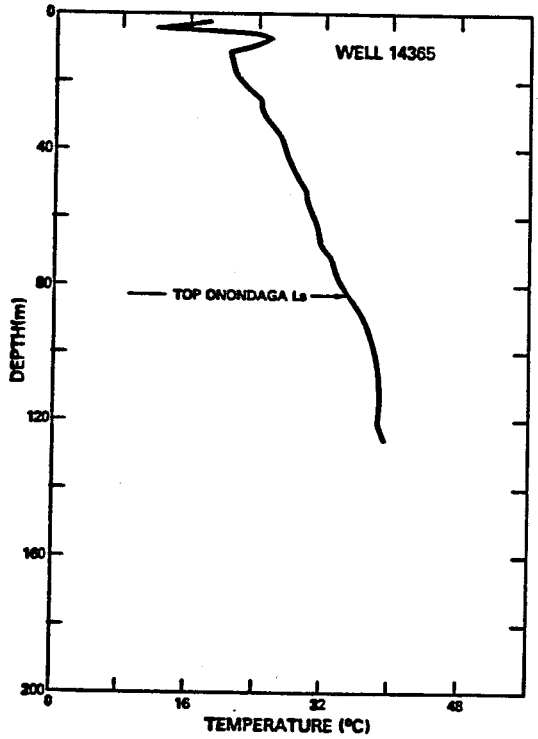

Fig. B-7.
Temperature-depth profile for Well 14365.

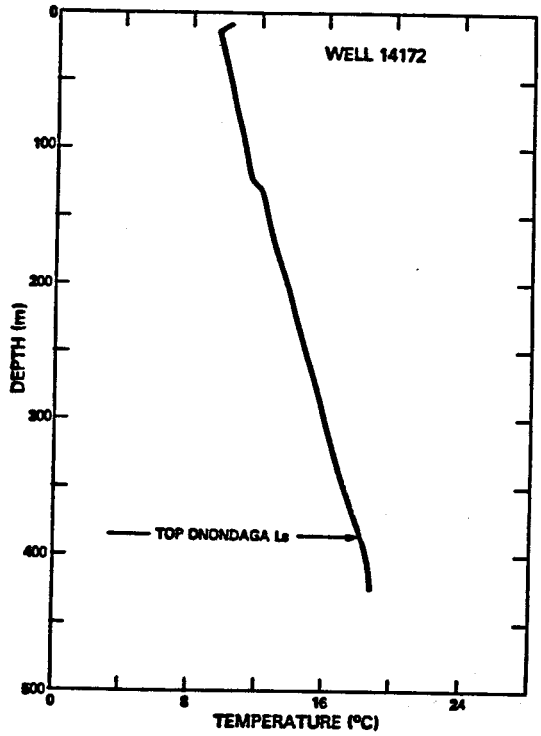

Fig. B-8.
Temperature-depth profile for Well 14172.

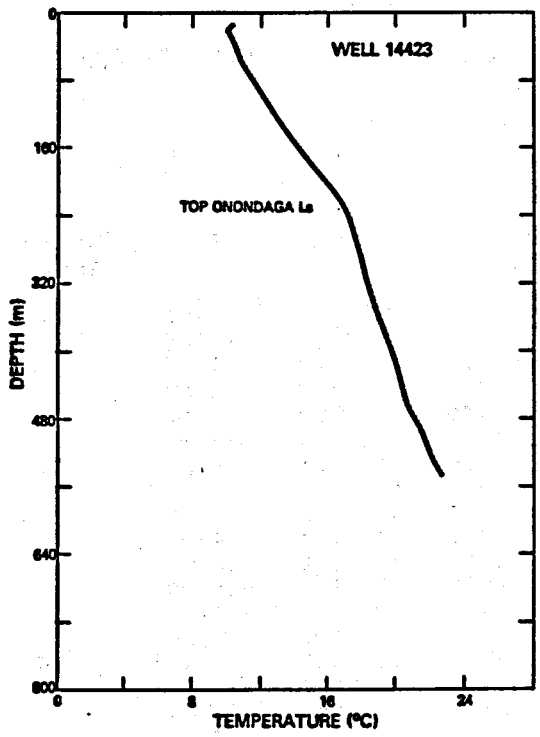

Fig. B-9.
Temperature-depth profile for
Well 14423.

APPENDIX C

TOPS OF FORMATION DATA

WELL DATA FOR STRUCTURE CONTOUR MAPS

PERMIT	AUX ID	LAT	FT	LONG	FT	DEPTH BSMNT	DEPTH ONSTN	DEPTH DNDN	GROUND ELEV
2602	702	41.6667	-4850	79.2500	-21100	0	0	4137	1220
331	702	41.9167	-14700	80.3333	-9100	0	3447	2656	959
5	702	41.7500	-24700	75.1667	-3659	0	0	8200	1565
347	703	42.0000	-950	80.1667	-3700	0	3206	1967	1024
345	703	42.1667	-3300	79.7500	-16600	0	3484	2264	1436
456	703	41.5833	-1950	78.0000	-18300	0	0	6740	2015
6	703	41.8333	-20250	75.6666	-8500	0	0	6848	1246
20355	703	42.0833	-23300	80.1667	-19900	0	3051	1890	922
30629	704	41.8333	-2000	78.5000	-21900	0	6940	5170	2180
20057	704	41.7500	-22000	77.5000	-12800	0	8820	5630	2569
20370	704	42.0000	-17000	79.7500	-20850	0	3976	2605	1367
20371	704	41.9167	-100	80.1667	-10000	0	3822	2450	1521
20393	705	42.0833	-26900	80.1667	-10900	0	3214	1667	966
4463	11	42.3333	-27300	77.7500	-1500	0	0	3811	1753
5510	11	42.0833	-1200	78.0417	-3125	0	0	4600	1974
4925	12	42.3333	-12900	77.9167	-11000	0	0	3414	1613
3995	12	42.3333	-15400	78.0833	-21300	0	0	3362	1593
4865	13	42.0833	-8700	75.0833	-7775	0	0	4840	2185
3990	14	42.4167	-5850	78.0000	-20700	0	0	3625	1607
3956	14	42.5000	-17100	78.1667	-2650	0	0	2270	1669
4248	15	42.5000	-10750	78.0833	-20700	0	3935	2512	1560
4168	16	42.3333	-20400	78.2500	-10150	0	0	3723	209
4052	16	42.3333	-24450	78.1667	-7750	0	0	3680	1863
5060	17	42.2083	-8500	77.9167	-6800	0	0	4250	1964
4153	17	42.3333	-20800	78.9167	-1050	0	4200	2962	1824
4673	18	42.0833	-15650	77.8333	-3800	0	0	4925	2236
4654	19	42.1667	-17200	78.1667	-1900	0	0	4618	2228
4849	19	42.1250	-350	78.1667	-3675	0	0	4446	2030
5087	20	42.3333	-3600	75.9167	-8430	0	5851	3100	995
4854	20	42.3750	8750	75.8750	-1450	0	0	3120	1430
3992	21	42.0833	-27200	78.5000	-3000	0	0	4843	2360
4660	22	42.1667	-5700	78.4167	-14100	0	0	3834	2080
5096	233	43.1667	-1650	78.3333	-10615	3141	347	0	690
4713	23	42.1250	-9600	78.5000	-9675	0	0	3490	1442
3900	24	42.1667	-25825	78.5833	-21500	0	0	3445	1419
4030	25	42.0833	-16700	78.6667	-3200	0	0	4124	1935
4554	27	42.0833	-9800	78.5833	-10200	0	0	0	1861
5327	28	42.3750	-2475	78.9583	-8890	0	3273	2645	1259
5106	29	42.1250	-575	78.5833	-850	0	0	3794	1663
4134	29	42.2500	-22150	75.3333	-5100	0	0	0	1563
4574	30	42.2083	-10075	78.3750	-6950	0	0	3738	1822
4732	31	42.1667	-5275	78.4167	-5800	0	0	3726	1768
4197	33	42.3333	-26150	78.3333	-8200	0	0	3705	1993
4155	33	42.3333	-14850	79.0000	-3700	0	0	2342	1350
4557	34	42.1250	-1200	78.4167	-5975	0	0	3676	1798

LAT,LONG ARE GIVEN AS DECIMAL DEGREES AND FEET.
POSITIVE VALUES INDICATE A NORTHERLY OR EASTERLY DISPLACEMENT.
NEGATIVE VALUES INDICATE SOUTHERLY OR WESTERLY DISPLACEMENT.
AUXILLIARY ID'S BEGINNING WITH 7 INDICATE PENNA WELLS.

APPENDIX C (Cont)

PERMIT	AUX ID	LAT	FT	LONG	FT	DEPTH BSMNT	DEPTH ONSTN	DEPTH GNDN	GROUND ELEV
3993	403	42.9167	-13100	74.9167	100	0	0	0	1523
4214	401	42.2500	-24550	74.9167	-1390	10960	0	0	1770
4203	401	42.9167	-14750	76.8333	-6750	5377	1758	0	534
4379	402	42.3333	-21771	74.5833	-12000	6920	0	0	1835
3973	404	42.4167	-17000	76.5000	-1500	10278	5665	0	1260
3924	404	42.0833	-7400	77.4167	-3800	0	7175	0	1045
4034	405	42.9167	-2700	74.5333	-500	0	0	0	1590
4055	406	42.6667	-13000	74.6667	-11150	0	0	1722	1970
5087	406	42.3333	-3600	75.9167	-8430	0	5851	3100	990
1160	407	42.6667	9700	75.3500	-3150	5531	0	1460	1373
698	409	43.0833	26200	75.7500	11000	2509	185	0	430
443	409	42.1667	11700	76.5000	-10000	0	6654	2984	1177
3868	410	42.4167	14000	79.0000	-10900	6450	2980	0	1328
4150	411	43.6667	-21800	75.5833	-4200	1732	0	0	1733
4714	411	42.0000	-23450	76.0000	-250	0	0	2652	1569
4547	411	42.5833	-19150	74.9000	-13450	0	0	1926	1262
10607	501	42.4583	-650	75.4583	-7200	0	0	3324	1735
10608	501	42.3333	-5700	75.6667	-1200	0	6410	3623	1453
10609	502	42.3750	-10000	75.5833	-1450	0	0	3642	1654
6778	502	42.5833	-23500	76.0000	-250	0	5110	2664	1569
10096	503	42.2500	-23500	74.6667	-13050	0	0	0	1682
0	503	42.3333	0	75.9167	0	0	5850	3110	996
10227	504	42.3333	-12950	74.6250	-40	0	0	4356	2332
4999	505	43.0417	-5700	76.5000	-7700	0	1396	0	986
4719	505	43.4167	-29500	78.5000	-3400	0	0	0	329
9848	601	42.0833	0	76.4167	0	0	0	4196	1292
9557	601	42.1667	0	76.3333	0	0	0	4348	1465
6787	601	42.8333	-17200	75.6667	-6200	0	0	1358	1520
10138	601	42.7083	0	75.0833	0	0	0	1403	1623
10725	601	42.5417	0	75.2083	0	0	0	2165	1150
10335	602	42.2083	0	76.6250	0	0	0	3405	1418
0	602	42.2500	-24600	74.9167	-1375	10965	0	5170	1775
12163	603	42.9583	-7800	76.3333	-3350	0	2276	488	997
11654	603	42.9167	0	76.2500	-1370	0	2870	956	1373
12052	603	42.8750	0	76.7917	0	0	1816	0	977
8578	604	41.9167	0	74.8750	0	0	0	7220	1863
9557	604	42.1667	0	76.3333	0	0	0	4348	1485
5116	604	43.1667	-5490	77.0000	-18400	3690	718	0	567
0	604	42.4167	-11900	76.5000	-11200	0	0	2250	1041
346	701	42.0000	-29300	77.9167	-1350	0	0	5506	2214
2693	701	41.8333	-16425	79.0000	-6100	0	0	0	1981
2453	701	42.0000	-1500	79.2500	-17750	0	0	3041	1306
334	701	41.8333	-200	80.4167	-13600	0	3167	0	878
324	701	41.9167	-20900	80.2500	-22350	0	0	0	1159
7520	702	42.0000	-4750	78.9167	-100	0	5050	3626	1413

LAT,LONG ARE GIVEN AS DECIMAL DEGREES AND FEET.
POSITIVE VALUES INDICATE A NORTHERLY OR EASTERLY DISPLACEMENT.
NEGATIVE VALUES INDICATE SOUTHERLY OR WESTERLY DISPLACEMENT.
AUXILLIARY ID'S BEGINNING WITH 7 INDICATE PENNA WELLS.

APPENDIX C (Cont)

PERMIT	AUX ID	LAT	FT	LONG	FT	DEPTH BSMNT	DEPTH ONSTN	DEPTH ONON	GROUND ELEV
4820	35	42.0417	-13875	78.4167	-4900	0	0	4713	2[illegible]
5375	37	42.3750	-1200	78.8333	-5200	0	3854	2618	1724
4172	38	42.5417	-8050	78.9583	-8825	0	[illegible]	1120	74[illegible]
4177	38	42.5417	-8050	78.9583	-8825	0	0	1120	775
4459	41	42.5417	-6800	79.0000	-4550	0	0	1120	776
4550	42	42.5000	-21600	78.8333	-11500	0	2896	1730	1120
4585	44	42.4583	-2325	79.0000	-1050	0	0	2036	1429
4238	47	42.1667	-20100	78.9167	-10450	0	4767	3469	1662
4115	47	42.0833	-29600	78.6667	-11400	0	0	4595	2300
4241	52	42.9583	-4500	76.6250	-4350	0	1618	12	625
4216	52	42.9167	-2300	76.6250	-9350	0	1498	[illegible]	511
4497	55	42.9583	-8475	76.6250	-3850	0	0	[illegible]	549
4715	56	42.9583	-13350	76.6667	-1325	0	1506	33	513
4652	56	42.9583	-4300	76.6667	-9700	0	1516	[illegible]	517
4954	50	42.0833	-7655	78.7683	-8100	0	0	4031	2[illegible]
5000	57	43.1250	-7260	76.5417	-2950	0	874	0	427
5011	58	43.1250	7600	76.5417	-3150	3376	703	0	345
5467	58	43.1250	-8850	76.5000	-3400	0	952	0	449
6779	59	43.1250	-5730	76.5417	-5295	[illegible]	929	[illegible]	45[illegible]
4624	60	43.2917	-14275	76.4583	-8700	3026	296	[illegible]	449
4043	60	42.8750	-5075	76.4167	-9800	0	0	475	635
4365	61	43.0000	-10750	76.5000	-4525	0	1812	0	742
4068	61	42.9167	-12950	76.6250	-3975	0	0	53	669
4571	63	42.9167	-9200	76.6250	-10100	0	1575	0	535
4651	64	42.9167	-11800	76.6667	-7875	0	0	[illegible]	46[illegible]
6644	66	42.8750	-5850	76.6250	-7200	0	1845	178	628
4519	67	42.9583	-1125	76.5833	-2450	0	1510	0	542
4521	68	43.0000	-13750	76.6250	-700	0	1528	0	526
5031	69	43.2083	-2475	76.5833	-7100	0	594	0	433
6745	69	42.4167	-13900	79.1667	-5750	0	0	[illegible]	1420
4356	70	42.2917	-5450	79.5000	-2575	0	3217	2070	1360
4190	71	42.2917	-1950	79.5000	-8200	0	3245	2098	1410
4200	72	42.3333	-7450	79.5000	-6700	0	3393	2261	1545
4154	72	42.3750	-12000	79.1250	-1850	0	3562	2336	1006
4561	73	42.2500	-5650	79.3333	-10700	0	3612	2440	1524
4671	74	42.2500	-3700	79.4167	-950	0	3597	2423	1525
4173	75	42.5417	-6625	79.0833	-3100	[illegible]	0	1102	637
4204	76	42.1667	-2200	79.6667	-1750	0	3612	2174	1484
4152	76	42.1667	-1200	79.7083	-7525	0	3436	2354	1460
5784	77	42.1667	-6930	79.0833	-570	0	0	[illegible]	430[illegible]
4948	78	42.4167	-10700	79.3333	-15400	0	2760	1614	1158
4986	79	42.4167	-2650	79.3750	-9250	0	0	0	699
4000	81	42.2914	-13750	79.6667	-175	0	3174	2026	1334
4460	82	42.5417	-7475	79.2500	-3300	0	1841	700	614
5034	83	42.5417	-3300	79.2083	-10000	0	0	0	604

LAT,LONG ARE GIVEN AS DECIMAL DEGREES AND FEET.
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AUXILLIARY ID'S BEGINNING WITH 7 INDICATE PENNA WELLS.

APPENDIX C (Cont)

PERMIT	AUX ID	LAT	FT	LONG	FT	DEPTH BSMNT	DEPTH ONSTN	DEPTH ONON	GROUND ELEV
5447	84	42.4167	-13725	79.1250	-2840	0	3404	2225	1605
4156	84	42.3750	-14800	79.3750	-4175	0	3119	1962	1332
4001	85	42.1250	-6025	76.7917	-1500	0	0	2785	863
4191	86	42.2083	-12725	76.5833	-9425	0	0	3157	1276
3974	87	42.0833	-11500	76.8333	-15000	0	0	4250	1570
4222	90	42.2083	-8225	79.5833	-2900	0	0	0	1552
4087	91	42.2500	-10900	76.7500	-5400	0	0	2765	1115
4863	92	42.2917	-14350	76.7500	-7750	0	0	3201	1520
4776	93	42.3750	-1100	75.8333	-1350	0	0	0	1208
4475	93	42.4167	-6400	75.7500	-575	0	0	0	1370
4696	95	42.4167	-11700	75.7500	-13450	0	0	0	1140
5344	97	42.4167	-9575	75.7500	-6300	0	5940	0	1542
4714	97	42.5417	-6450	76.0000	-250	0	5120	2652	1509
4455	98	42.4161	-9550	75.0417	-775	7878	0	3315	1465
4379	99	42.3333	-21771	74.5833	-12000	8920	0	4420	1835
4214	99	42.2500	-24550	74.9167	-1390	10965	0	5125	1770
4010	100	42.9583	-12250	78.5417	-9500	0	1139	100	776
4364	100	42.3333	-6000	75.2083	-6950	0	0	4335	1658
4121	102	42.9583	-13400	78.5417	-2700	0	0	68	790
4147	103	42.9167	-9000	78.4583	-4600	0	1372	299	692
4240	103	42.9167	-14850	78.5000	-800	0	1448	365	917
4647	105	42.9583	-8050	78.5000	-7550	0	1041	55	801
4756	106	42.9583	-14735	78.5000	-3600	0	1227	160	839
4721	107	42.6250	-14700	79.0000	-3050	0	1958	906	715
4779	108	42.6250	-9825	78.9583	-7125	0	1968	923	796
4866	110	42.6250	-6200	79.0000	-7400	0	1807	754	692
4181	111	42.6667	-14725	78.5833	-4725	0	0	1930	1742
4366	112	42.6667	-3575	78.5833	-6600	0	2881	1775	1662
4646	113	42.6250	-2350	78.8333	-8975	0	2390	1345	1219
4157	115	42.8750	-14200	78.5833	-4600	0	1430	396	821
4231	116	42.7083	-4975	79.0000	-3375	0	0	0	650
4049	181	42.8333	-1550	75.6250	-6290	0	0	960	565
4123	119	42.7500	-13020	78.9583	-2150	0	1333	292	622
4663	120	42.7500	-9750	78.9167	-7625	0	0	374	620
6668	123	42.8333	-10940	78.8333	-2970	4251	1174	149	582
4225	127	42.7083	-9550	78.5417	-7050	0	0	935	950
4462	128	42.7083	-5650	78.4583	-9750	0	2676	1527	1512
4183	128	42.8333	-1525	78.8333	-4400	0	1098	120	585
4545	129	43.0000	-14125	78.5000	-1950	0	0	0	795
4095	129	42.5833	-14600	78.8333	-1650	0	0	0	1200
4665	131	42.6250	-7300	78.8333	-4600	0	0	0	1260
4440	133	42.5833	-12100	78.5000	-1700	0	3091	0	1410
4488	133	42.5833	-5100	78.5000	-1900	0	3071	1912	1479
4576	135	42.5833	-13500	78.5417	-4600	0	3354	2203	1756
4632	137	42.5833	-6200	78.5833	-1750	0	3123	1980	1625

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AUXILLIARY ID'S BEGINNING WITH 7 INDICATE PENNA WELLS.

APPENDIX C (Cont)

PERMIT	AUX ID	LAT	FT	LONG	FT	DEPTH BSMNT	DEPTH ONSTN	DEPTH ONGN	GROUND ELEV
5115	137	43.1250	-12520	78.2917	-5825	3560	678	0	724
5117	138	43.0417	-500	78.3750	-4050	3857	826	0	662
4198	138	42.9167	-4500	78.2917	-175	0	1612	0	1095
4367	139	42.9167	-12850	78.2917	-3000	0	0	0	1163
4384	140	42.9583	-7500	78.2917	-300	0	1365	0	930
4375	140	42.9583	-14100	78.2500	-9125	0	1418	0	1016
4477	141	42.9583	-15150	78.0417	-10450	0	1605	0	1255
4434	141	42.9167	-150	78.2500	-1950	0	1666	0	1057
4044	142	43.0833	-6100	76.0417	-6175	0	568	0	634
4593	142	43.0833	-14750	78.0417	-9525	0	724	0	763
4806	143	43.1250	-3500	78.0833	-2200	0	435	0	665
4211	145	42.9167	-7150	78.4167	-8700	0	1444	370	900
4369	146	42.9167	-6000	78.2917	-9250	0	0	0	1078
4374	147	42.9167	-3500	78.3333	-4500	0	1478	295	952
4932	148	42.9167	-2850	78.4167	-9000	0	1373	295	904
5542	149	44.9167	-8900	78.4167	-6625	0	0	0	974
4479	151	42.9583	-8600	77.9583	-2700	0	1504	0	920
4551	152	42.9583	-10625	77.9583	-1200	0	1530	282	930
6726	152	42.9583	-6330	77.9167	-5060	0	1362	220	900
4750	153	42.2500	-19600	73.9167	-6000	0	0	416	1600
5213	153	43.0000	-15000	78.2917	-9300	0	1272	185	930
4034	154	42.9167	-2700	74.8333	-500	0	0	0	1540
3904	154	42.3333	100	74.2500	5200	0	0	3717	1928
4150	155	43.6667	-21800	75.5833	-4200	1732	0	0	1769
4149	156	42.9167	-8200	77.7917	-75	0	0	98	503
4056	156	42.8750	-900	77.6667	-10700	0	1889	450	909
4288	157	42.9167	-14650	77.7500	-14750	0	0	0	565
4567	158	42.9583	-9475	77.8750	-2425	4746	1435	125	780
3942	158	42.6667	6800	77.6667	1300	0	3530	1890	1030
4189	159	42.6333	-1900	79.7917	-2500	0	1876	456	730
4188	159	42.7917	-9200	77.7500	-1375	0	2599	1083	1245
5061	160	42.8750	-7850	77.7917	-6825	0	1635	317	602
4451	161	42.9583	-7800	77.7083	-1250	0	1260	33	865
4166	163	42.8333	-13600	75.9167	-6450	0	1973	739	927
4234	164	42.7917	-14500	77.9167	-8975	0	2398	1040	1050
4217	164	42.7917	-8950	77.6750	-1950	0	1910	512	576
4458	165	42.9583	-10500	77.6250	-2650	0	1516	0	753
4457	165	42.9161	-13200	77.5833	-10500	0	1906	470	930
4435	166	42.8750	-9500	77.7083	-625	0	1900	477	850
4053	166	42.7914	-9750	77.6250	-9200	0	2894	1340	1370
4630	167	42.6667	-5975	77.7500	-1600	6324	2573	941	564
4069	168	42.8750	-1250	77.9167	-4140	0	1759	427	861
4167	169	42.8333	-6600	77.9167	-4150	0	2044	703	900
4218	170	42.9167	-11500	77.9167	-4750	0	0	0	693
4552	172	42.8750	-14475	77.9167	-5450	5625	2005	695	960

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AUXILLIARY ID'S BEGINNING WITH 7 INDICATE PENNA WELLS.

APPENDIX C (Cont)

PERMIT	AUX ID	LAT	FT	LONG	FT	DEPTH BSMNT	DEPTH ONSTN	DEPTH ONGN	GROUND ELEV
1173	173	42.9167	-20150	75.3333	-18500	4162	C	C	1252
3996	174	42.8750	-5650	75.3750	-300	0	C	565	1429
4032	175	42.8333	-13500	75.3750	-7950	C	C	1098	1505
4556	176	42.8750	-3650	75.3333	-650	0	0	718	1604
4085	176	42.9167	-13450	75.6667	-5350	C	2783	943	1565
4185	177	42.9167	-26650	75.5833	-8450	0	2709	955	1494
3970	177	42.8333	-10400	75.5833	-18000	5661	3049	1205	1544
4046	179	42.8333	-6250	75.6667	-1700	C	C	1415	1734
4047	180	42.8333	-8900	75.5833	-20000	C	C	1440	1734
4049	181	42.8333	-1550	75.6250	-6290	C	0	960	1401
3963	182	42.9167	-21200	75.4167	-8050	0	0	0	1465
4499	182	42.9167	-600	75.4167	-6600	C	C	565	1416
4510	183	42.8750	-13600	75.4167	-9825	0	0	910	1526
4502	183	43.3333	-850	77.9583	-1800	2170	0	0	810
4724	184	43.1667	-5750	77.9583	-4500	3724	370	0	643
3879	184	43.1667	7600	77.5833	-6700	0	0	0	455
6669	185	43.0833	-1273	79.0000	-1800	3036	392	0	572
4063	185	43.1250	-850	78.7917	-1725	0	348	0	600
6667	186	42.2083	-280	78.4583	-1800	2715	0	0	558
4719	186	43.3750	-14200	78.5000	-3400	1994	15	0	329
3928	187	42.9167	-17750	75.4167	-2650	4316	0	467	1319
4902	188	42.9583	-13825	76.2500	-10800	0	2471	616	1070
3930	191	42.7917	-1200	77.4583	-4400	0	0	1100	1310
4006	195	42.7917	-5275	77.4167	-6150	0	3094	C	1470
4059	198	42.7917	-325	77.4167	-7450	C	0	1350	2483
4054	198	42.8333	-7800	77.4583	-4000	C	2634	1160	1415
4107	200	42.7917	-725	77.3750	-9225	C	2895	1220	1328
3999	200	42.9167	-13300	77.3333	-475	0	2662	1045	1183
4409	201	42.9167	-7350	77.2917	-4825	C	1825	C	789
4395	201	42.9583	-9300	77.3333	-6650	C	1573	98	725
3998	202	42.8750	-3700	77.3750	-1375	C	2129	475	875
4947	202	42.8750	-13050	77.3333	-9225	0	2307	0	1050
4086	207	42.9167	-11000	77.3750	-8400	0	1897	472	910
4090	207	42.9167	-12100	77.4167	-4100	0	2236	70	1137
4091	208	42.9167	-10000	77.3750	-1400	0	1872	470	866
4118	209	42.9583	-8750	77.3750	-10125	0	1747	208	868
4119	210	42.9167	-200	77.4167	-75	C	1826	225	920
4402	211	42.9167	-4225	77.4167	-5350	C	1723	226	878
6395	215	42.8333	-7550	77.1667	-9700	0	2474	0	1060
4449	216	42.8750	-2275	77.1667	-8000	C	C	0	966
3964	218	42.7917	-9025	77.4583	-9675	0	2719	990	1085
3997	220	42.8333	-12900	77.5000	-2400	0	2505	650	811
4005	221	42.8333	-11700	77.4583	-9650	0	2588	1060	1101
4075	223	42.8333	-5975	77.4583	-10150	0	2423	790	1034
4150	224	42.8750	-13900	77.0000	-9450	0	2121	495	770

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AUXILLIARY ID'S BEGINNING WITH 7 INDICATE PENNA WELLS.

APPENDIX C (Cont)

PERMIT	AUX ID	LAT	FT	LONG	FT	DEPTH BSMNT	DEPTH CNSTN	DEPTH UNCN	GROUND ELEV
5056	225	42.8333	-3880	77.0417	-4200	C	0	0	852
3866	225	42.6667	4300	77.4167	-7100	0	3671	1965	1759
4394	226	42.9167	-2350	77.5000	-6400	0	1831	0	943
4450	226	42.9167	-11050	77.4583	-6245	0	1921	501	914
4611	227	43.2083	-6350	78.2500	-2200	3020	260	0	656
4730	227	43.2083	-10225	78.1250	-7375	0	415	0	684
4873	228	43.3750	-3600	78.1667	-10300	1985	0	0	277
5007	229	43.3750	-6250	78.1250	-6300	0	0	0	297
4912	229	43.2917	-3400	78.1667	-2000	2518	0	0	434
5091	230	43.3333	-9950	78.2083	-4300	2318	0	0	564
5069	231	43.3333	-5200	78.0417	-10820	2306	1	0	354
5008	232	43.2500	-2100	78.2917	-10000	2640	0	0	501
4489	233	43.3750	-9450	78.3750	-1000	2055	0	0	315
4752	234	43.3333	-9700	75.4167	-9625	2208	0	0	350
4764	235	43.3333	-2700	78.2917	-10700	2185	50	0	332
4208	235	43.3333	-26000	76.0833	-5300	2195	0	0	500
5012	236	43.3750	-2080	76.5833	-4875	2501	0	0	516
4209	236	43.3333	5300	76.3333	3800	2559	0	0	462
4201	237	43.6667	-9900	76.0833	-6700	0	0	0	419
4245	238	42.5833	-12050	74.8333	-13950	0	0	2122	1617
4357	238	43.5000	-20400	75.8333	-11600	1654	0	0	736
4547	239	42.5417	-4050	74.6750	-2250	0	0	1928	1262
4050	240	42.6667	-22650	75.1667	-20000	0	0	2062	1530
4055	240	42.6667	-13000	74.6667	-11150	0	0	0	1979
4400	241	42.3750	-2675	76.8333	-8250	0	0	0	448
4187	241	42.4167	-1400	76.7083	-3675	0	0	2667	1570
3946	242	42.6667	-20200	77.0000	-18250	0	0	0	1753
4120	243	42.2917	-4050	77.0417	-5000	0	0	3380	1823
3891	244	42.4167	-500	76.9167	7100	0	0	0	478
3940	245	42.4583	-13675	76.8333	-16600	0	0	1402	805
4082	245	42.8750	-325	76.8333	-1775	0	1678	19	469
4111	246	42.8750	-6300	76.8333	-5800	0	1824	70	559
4203	246	42.9167	-14750	76.8333	-6750	0	1665	75	534
4244	248	42.8333	-3000	76.8333	-8650	0	1970	384	660
4600	249	42.8750	-50	76.9167	-1425	0	1662	0	500
4590	249	42.8750	-6775	76.8750	-1950	0	1749	165	544
5095	250	43.0417	-2450	76.9167	-16050	0	1105	0	400
4768	250	42.9167	-7800	76.7500	-6650	0	1444	0	464
4428	257	42.3333	-10075	77.1250	-6800	0	0	3313	1092
4814	251	42.9167	-8000	76.7500	-10000	0	1556	350	478
4378	252	42.9583	-12550	76.8333	-9400	0	1536	40	503
3994	307	42.6667	-13300	77.0000	-5000	0	0	1226	1119
4524	253	42.9583	-6600	76.8750	-3025	0	1427	0	483
3966	254	42.3333	-12800	77.1667	-9300	0	0	2663	1111
4224	255	42.3333	-10300	77.1667	-1750	0	0	3314	1317

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AUXILLIARY ID'S BEGINNING WITH 7 INDICATE PENNA WELLS.

APPENDIX C (Cont)

PERMIT	AUX ID	LAT	FT	LONG	FT	DEPTH BSMNT	DEPTH ONSTN	DEPTH UNDN	GROUND ELEV
4380	257	42.3333	-10025	77.1250	-2725	0	0	3237	1850
4573	258	42.2500	-5300	77.2083	-3850	0	0	3322	1456
5377	258	42.2083	-4560	77.5833	-9880	0	0	3812	1354
4575	260	42.1667	-8100	77.1250	-4350	0	0	3362	1115
3943	260	42.1667	-17500	77.0833	-1100	0	0	4165	1728
7031	262	42.2083	-5400	77.6667	-5225	0	0	4174	1748
3932	263	42.2500	-13250	77.0000	9100	0	0	3299	1271
3914	263	42.1250	-8200	77.0833	-8250	0	0	3237	1657
4474	264	42.3333	-750	77.5833	-7800	0	0	3552	1800
5123	265	42.1250	-3475	77.5417	-10290	0	0	4792	2254
5300	267	42.1667	-14150	77.5417	-2440	0	0	4640	2057
5063	269	42.5000	-8900	77.1667	-7450	0	0	2208	1417
4247	270	42.2917	-8550	77.3333	-375	0	0	0	1750
3897	270	42.0833	-4950	77.5833	-4700	0	0	0	2269
4712	271	42.0833	-24400	77.6667	-19450	0	0	0	2094
5782	271	42.0833	-6280	77.4583	-7220	0	0	0	1662
3924	272	42.0833	-7400	77.4167	-3800	0	0	0	1645
3973	273	42.3750	-1750	76.5000	-1700	0	0	0	1687
4007	273	42.3750	-3500	76.5000	-900	0	0	0	1313
4446	274	42.4267	-28100	76.4167	-21600	0	0	0	1448
3938	275	42.5833	-12800	76.5833	8125	0	0	1228	590
4467	275	42.4167	-11770	76.5000	-10995	0	0	0	1041
4130	274	42.4583	-5900	76.5833	-2550	0	0	0	1454
4051	276	42.5417	-9000	76.6667	-6800	0	0	1760	1678
5017	276	42.5417	7400	76.5833	3400	0	0	0	875
4202	277	42.1667	-19500	74.0000	-7950	0	0	2466	420
4515	277	41.7500	-4350	74.1667	-13250	0	0	0	1126
5783	278	41.7500	-18000	74.3333	-3400	0	0	0	2175
4666	278	42.1667	-24250	73.9167	-10200	0	0	0	140
5116	279	43.1667	-5350	77.0417	-7500	3690	735	0	587
5041	279	43.1667	-7600	76.7500	-3080	3658	665	0	423
6719	280	42.0417	-4550	76.9167	-7250	0	0	0	392
5032	280	43.0833	-800	76.8667	-7850	0	996	0	473
5114	281	44.2250	-4900	77.0000	-5500	0	250	0	467
4754	281	43.0833	-325	77.2500	-5225	0	774	0	499
4445	282	42.8750	-4150	78.3333	-500	0	1930	760	1251
4199	283	42.8750	-10100	78.3333	-225	0	2105	970	1374
4243	284	42.8750	-7075	78.4583	-2650	0	0	0	1052
4377	285	42.8750	-10750	78.4583	-7600	0	1640	0	984
4432	286	42.8750	-14200	78.2917	-10900	0	2226	1075	1442
4469	286	42.8333	-5675	78.3750	-10300	0	0	0	1196
4542	287	42.8750	-14375	78.3333	-5275	0	2070	0	1390
4487	289	42.8333	-9300	78.0000	-3350	0	3224	1025	1262
4390	289	42.8333	-6925	77.9583	-200	0	2049	739	977
4092	291	42.6250	-2800	78.0417	-10350	0	3366	0	1560

LAT,LONG ARE GIVEN AS DECIMAL DEGREES AND FEET.
POSITIVE VALUES INDICATE A NORTHERLY OR EASTERLY DISPLACEMENT.
NEGATIVE VALUES INDICATE SOUTHERLY OR WESTERLY DISPLACEMENT.
AUXILLIARY ID'S BEGINNING WITH 7 INDICATE PENNA WELLS.

APPENDIX C (Cont)

PERMIT	AUX ID	LAT	FT	LONG	FT	DEPTH BSMNT	DEPTH ONSTA	DEPTH GNON	GROUND ELEV
4385	294	42.6667	-13350	76.0917	-7750	0	3368	0	1768
4133	295	42.8333	-1000	78.0833	-9000	0	2381	0	1516
4447	296	42.8333	-11175	78.1250	-6725	0	0	0	1596
4536	297	42.8333	-2405	78.1250	-3600	0	2425	0	1501
4546	298	42.8750	-8200	78.1667	-6000	0	0	0	1586
4649	300	42.7917	-1850	78.1250	-2850	0	2592	0	1560
4392	301	42.7500	-850	78.1667	-8350	0	2802	0	1605
4468	302	42.8333	-12300	77.9583	-8625	0	2319	1030	1224
4212	303	42.7500	-1800	78.8333	-6650	0	0	1220	1328
6073	304	42.7500	.1910	78.1250	7340	0	2660	1380	1501
4342	304	42.7500	-3250	78.3333	-7000	0	2366	1177	1265
4795	305	42.7500	-11650	77.0000	-5975	0	2718	1031	684
4796	306	42.7083	-8950	77.0000	-5975	0	2876	1104	964
4797	306	42.7500	-215	77.0000	-1030	0	2536	846	628
4410	307	42.5000	-9500	76.9167	-10450	0	0	0	1100
3994	307	42.6667	-13300	77.0000	-5000	0	0	1226	990
3994	307	42.6667	-13300	77.0000	-5000	0	0	1226	990

APPENDIX D

SAMPLE LOCATIONS AND WATER GEOCHEMISTRY DATA

Sample Locations - Cayuga Anomaly (July, 1978)

NY001 - Baldwinville, NY depth 25 m, T=11.0°C. Sample from doan well-tap at wellhead. Perfect collection site - well pumping. Sample about 100 m from river. Probably river water. Wells used because of pollution in river.

NY002 - Fulton 3. Depth 20 m, T=11.4°C. Sample from valve at wellhead - maybe 100 m from river alluvium.

NY003 - Fulton 6. Depth 20 m. Sample from valve at wellhead - maybe 100 m from river. Just about 1 mile from NY002 the bear wells are 37 m but cannot be sampled.

NY004 - Bear well - still at Fulton - their deepest well may be 200 m from river. Over 22 m deep, 120 sample baled from casing - small lead.

NY005 - Near Fleming. Dug well about 9 m deep, sample taken from tap at farm house. T=16.2°C. Temp is not valid due to sampling conditions. About 1.6 km west of Fleming on 34B.

NY006 - 3.2 km out of Fleming on 34B. T-14.6°C. May be bad water from 62 m well to pressure tank - sample from tap at house - Guliver Ranch.

NY007 - Scipioville - well about 62 m deep. Sample from house tap - well to tank to tap. T=17.0°C but probably bad temp. About 1.6 km out of Scipioville - shale.

NY008 - About 4.8 km south of Genoa at Baun Egg Farm. Well 85 m deep. Sample from valve in bldg. T = 12.8°C suspension - well goes to pipe - sample from pipe.

NY009 - City of Homer - Newton pump station 3. Well 25 m deep behind city water works. Well pumping and sample from tap - good temp a 8.8°C.

NY010 - Sempronius - Well 39 m deep at pump house. Sample from tap at wellhead. Hopkins farm.

NY011 - Spring at Sempronius - dug well 2 m deep. Then siphoned down to lake by rubber tube. T = 13.0°C. Spring & tube flow continuously. Hopkins lumber

NY012 - On hill about 3.2 km east of rd jct to Owasco on 38A above the lake 17.0°C. Questionable. Well 49 m deep to pressure pump to lawn tap for samples. E. Niles.

NY013 - 1.6 km east on U.S. 20 from junction with 174 to Navarino - on top of hill - depth of well not known - iron & hard water rumored. T - 12.0°C. Water from tap, but run long enough to drain pipe. Marcellus.

NY014 - At intersection of county line with Hwy 79 at Mecklenburg. Well 23 m deep. Pressure pump & tap in barn. 18.4°C.

NY015 - 3.2 km west of Interlaken on 96A. Dug well to 6 m. Standing water in well pumped to tank to garden hose for sample. T = 22.8°C. High even though hot water from hose was drained.

NY016 - Just north of Romulus at dairy farm. Dug well 8 m deep. Water table at 4 m depth. T = 12.8°C. Standing water in well - pumped from depth - hose drained.

NY017 - 3.2 km north of Waterloo on 96. Well 32 m deep and reported to be very hard water. T = 14°C. Water pumped to tank to garden hose for our sample.

NY018 - 3.2 km west of Flint on U.S. 20. Pumped well depth unknown. Sample at tap at side of house. T = 17.8°.

NY019 - 1.6 km south of Townsend on 329. Well shallow-hand dug maybe 10 m. Well pumped to lawn hose for sample 14°C. In mountains - shaleoutcrops. Precisely 5.6 km from Townsend.

NY021 - Just east of Prattsburg on unnamed highway; Well 37 m deep - sample from stock tank by lifting float valve & getting water.

APPENDIX D (Cont)

EAST AURORA ANOMALY: COMPARISON OF LABORATORY ANALYSES

Three samples were analyzed by the State University of New York at Buffalo Geology Lab and New Mexico State University Lab for comparison of results as shown below:

	New Mexico Sample 781	SUNY NY001	New Mexico Sample 782	SUNY NY005	New Mexico Sample 783	SUNY NY010
	mg/l					
ph	8.09	7.6	8.16	7.5	7.92	7.7
Ca	59.3	57.0	85.0	87.2	42.3	41.7
Mg	25.3	26.4	23.2	24.4	8.1	8.0
Na	5.3	5.0	44.1	40.7	3.7	3.6
K	0.8	0.7	0.8	0.7	0.4	0.4
Cl	15.2	11	77.3	78	4.2	2.7
CO_3	0	0	0	0	0	0
HCO_3	242.8	252	322.2	322	150.1	149
SO_4	31.2	25	37.0	35	20.2	19
	ppm					
F	<.20	.09	<.20	.08	<.20	.07
Fe	<.10	.08	<.10	.04	<.10	.04
SiO_2	9.75	9.25	6.5	5.95	7.0	6.85
NO_3	16.5	14	17.5	16	11.0	3.5

APPENDIX D (Cont)

RESULTS OF CHEMICAL ANALYSIS

	WY001	WY002	WY003	WY004	WY005	WY006	WY007	WY008	WY009
SiO_2	9.3A2 9.2N2	10.6A2 10.3N2	10.5A2 10.2N2	9.0A2 8.1N2	6.0A2 5.9N2	8.8A2 7.0N2	16.6A2 16.1N2	9.6A2 7.7N2	5.1A2 5.1N2
Total iron (g/ml NAT_1)	80	80	60	40	40	60	600	90	30
MgO A2	43.9	31.7	26.1	33.2	40.5	3.0	56.3	7.9	17.3
N2	43.8	31.5	25,9	32.8	40.6	2.5	55.8	7.0	17.3
CaO A2	79.5	132.	79.7	53.8	122.	6.9	73.8	22.7	76,1
N2	80.0	133.	78.2	53.9	122.	6.6	74.1	20.9	75.2
Na_2O A2	6.6	87.5	26.5	6.4	54.9	155.	27.0	229.	9.7
N2	6.8	87.4	25.8	6.3	55.0	155.	26.6	233	9.6
K_2O A2	0.8	4.4	2.0	1.4	0.9	1.7	1.6	1.0	0.8
N2	1.1	4.7	2.1	1.5	1.0	1.6	1.8	1.0	0.8
Carbonate N1	0	0	0	0	0	8.7	0	0	0
Bicarbonate N1	252	253	219	169	322	210	331	312	192
Fluoride NAT_2	0.09	0.11	0.08	0.07	0.08	0.97	0.82	0.64	0.05
Chloride N2	11.	193	41.	4.	78.	3.	1.4	220.	6.1
Sulphate	26N2 24A2 37N2 25N2	34N2 33N2	19N2 17N2	37N2 37N2 39N2	35N2 35N2	101NAT_2 94$ACID_2$	46N2 55N2	12N2	17N2
Nitrate NAT_2	14	4.0	8.1	1.4	16	1.9	1.3	2.4	14
Initial Bottle ph N1	7.6	7.4	7.5	7.5	7.5	8.6	7.4	7.6	7.6

Comments: All concetrations in mg/l unless otherwise noted

N1 = NAT_1 = Data from natural (as is) sample, unfiltered

A1 = $ACID_1$ = Data from acidified sample, unfiltered

N2 = NAT_2 = Data from natural (as is) sample, filtered

	WY010	WY011	WY012	WY013	WY014	WY015	WY016	WY017	WY018
SiO_2	6.5A2 7.2N2	7.8A2 7.7N2	12.2A2 12.3N2	12.1A2 11.6N2	10.1A2 10.0N2	8.1A2 8.0N2	12.1A2 12.3N2	10.7A2 10.5N2	9.1A2 9.3N2
Total iron (g/ml)NAT_1	40	100	70	440	70	80	70	210	120
MgO A2	13.3	14.2	33.9	55.8 55.0	8.2	29.6	56.9 55.9	159	44.6
N2	13.2	14.0	33.7	55.5 54.3	8.2	29.1	58.4 57.6	160	45.5
CaO A2	58.3	74.4	67.1	123 122	30.5	114	156 152	719	117
N2	58.3	74.6	66.7	108 101	30.3	111	163 149	712*	117
Na_2O A2	4.8	2.3	38.7	6.0 5.9	131	88.4	8.7 8.7	133	15.3
N2	4.8	2.3	38.8	5.5 5.4	131	86.4	9.0 9.1	134	15.9
K_2O A2	0.5	0.5	1.6	1.0 1.0	1.3	3.4	1.9 1.9	5.7	9.6
N2	0.6	0.6	1.8	1.2 1.1	1.3	3.6	2.2 2.2	5.9	10.5
Carbonate N1	0	0	0	0	0	0	0	0	0
Bicarbonate N1	149	148	305	349	305	462	348	99	309
Fluoride N2	0.07	0.05	0.20	0.19	0.27	0.21	0.16	0.83	0.12
Chloride N2	2.7	10.8	2.1	5.	23.	21.	43.	60.	14.
Sulphate	19N2	25N2	21N2 22A2	52N2 77NAT_2 77N2 71$ACID_2$	28N2 26N2	24N2	97$ACID_2$	179$OACID_2$ 172$ORCID_2$	59A2 64A2
Nitrate	3.5	25	0.2	0.2	0.2	0.0	0.0	0.2	44.
Initial bottle pH N1	7.7	7.7	7.6	7.5	7.7	7.3	7.5	7.3	7.6

Comments:

*WY017 - High CaO concentration will interfere with MgO determination.

APPENDIX D (Cont)

RESULTS OF CHEMICAL ANALYSIS

		NY019	NY020	NY021
SiO_2		10.8A2 11.3N2	9.4A2 9.1N2	17.0A2 16.5N2
Total iron (µg/ml)	N1	<100	<100	60
MgO	A2	16.6 17.4	12.4	41.1 41.2
	N2	20.6 21.5	12.4	39.0 38.6
CaO	A2	54.3 53.7	39.3	99.9 99.5
	N2	67.2 57.8	39.1	71.4 62.8
Na_2O	A2	67 103	28.4	31.3 31.6
	N2	61.4 61.4	28.2	30.0 30.1
K_2O	A2	1.9 1.9	0.9	2.5 2.5
	N2	1.9 1.9	1.1	2.6 2.7
Carbonate	N1	0	0	0
Bicarbonate	N1	304	170	355
Fluoride	N2	0.19	0.23	0.15
Chloride	N2	14.	3.	1.3
Sulphate		8A2	11A2	46A2 40A2
Nitrate		0.2	0.2	2.3
Initial bottle pH	N1	7.4	7.6	7.6
Comments:				

CHEMISTRY OF THE WATER SAMPLES FOR EAST AURORA ANOMOLY

Sample No.	meq/l Ca	Mg	Na	K	Total Cations	Cl	CO_3	HCO_3	SO_4	Total Anions
784	1.62	.53	.27	.08	2.50	.41	0	2.00	.29	2.70
785	4.25	1.21	1.31	.04	6.81	1.49	0	4.98	.67	7.14
786	3.52	4.10	1.95	.12	9.69	2.23	0	6.10	1.00	9.33
787	5.89	.69	.79	.03	7.40	.83	0	3.46	1.71	6.00
788	3.10	2.49	.48	.02	6.09	.57	0	4.98	.64	6.19
789	7.75	2.21	1.66	.06	11.68	2.16	0	6.62	3.16	11.94
790	4.96	1.70	9.01	.08	15.75	10.40	0	1.84	1.50	13.74
791	2.76	.85	2.42	.05	6.08	3.60	0	1.30	.92	5.82
792	3.17	1.21	7.69	.08	12.15	3.48	0	8.58	.33	12.39
793	2.58	.73	.42	.03	3.76	1.10	0	1.08	.67	2.85
794	5.83	2.65	.51	.04	9.03	1.36	0	5.24	2.-6	9.06
795	1.87	.85	.19	.01	2.92	.04	0	2.60	.33	2.97
796	1.67	.64	.43	.02	2.76	.03	0	2.66	.12	2.81
797	2.37	.78	1.06	.03	4.24	.86	0	2.76	.50	4.12
798	3.43	1.07	.60	.05	5.15	2.18	0	2.24	.42	4.84
799	2.06	.85	.31	.03	3.25	.10	0	2.64	.37	3.11
800	3.58	1.47	.59	.06	5.70	.81	0	3.86	.79	5.46
801	2.26	.72	.35	.04	3.37	.60	0	2.24	.56	3.40
802	2.88	2.10	1.28	.03	6.29	.06	0	5.60	.21	5.87
803	11.25	3.29	2.10	.20	16.84	2.18	0	5.92	9.37	17.47
804	12.13	4.81	.39	.04	17.37	.04	0	4.30	13.50	17.84
805	4.74	3.02	5.93	.17	13.86	3.42	0	6.98	3.33	13.73
807	3.17	1.36	.84	.06	5.43	.70	0	4.20	.87	5.77
808	4.71	3.69	1.50	.11	10.01	1.50	0	5.04	3.70	10.24

APPENDIX D (Cont)

CHEMISTRY OF THE WATER SAMPLES FOR EAST AURORA ANOMOLY

Sample			mg/l							
No.	pH	TDS	Ca	Mg	Na	K	Cl	CO_3	HCO_3	SO_4
784	6.82	88	32.5	6.4	6.2	3.1	14.5	0	122.0	129.7
785	7.25	252	85.2	14.7	30.1	1.6	52.8	0	303.9	342.9
786	6.94	428	70.5	49.8	44.8	4.7	79.1	0	372.2	448.1
787	7.13	448	118.0	8.4	18.2	1.2	29.4	0	211.1	288.2
788	7.27	240	62.1	30.3	11.0	.8	20.2	0	303.9	297.3
789	6.89	596	155.3	26.9	38.2	2.3	76.6	0	403.9	573.5
790	6.47	1016	99.4	20.7	207.1	3.1	368.7	0	112.3	659.9
791	6.02	304	55.3	10.3	55.6	1.9	127.6	0	79.3	279.5
792	6.82	528	63.5	14.7	176.8	3.1	123.4	0	523.5	595.1
793	6.62	188	51.7	8.9	9.6	1.2	39.0	0	65.9	136.9
794	7.17	492	116.8	32.2	11.7	1.6	48.2	0	319.7	387.1
795	7.59	128	37.5	10.3	4.4	.4	1.4	0	158.6	142.6
756	7.67	84	33.5	7.8	9.8	.8	1.1	0	162.3	135.0
797	6.68	180	47.49	9.5	24.4	1.2	30.5	0	168.4	197.9
798	7.41	292	68.7	13.0	13.8	1.9	77.3	0	136.7	232.5
799	7.26	108	41.3	10.3	7.1	1.2	3.5	0	161.1	110.9
800	7.48	232	71.7	17.9	13.6	2.3	28.7	0	235.5	262.2
801	7.26	168	45.3	8.7	8.0	1.6	21.3	0	136.7	163.3
802	7.49	248	57.7	25.5	29.4	1.2	2.1	0	341.7	281.9
803	7.12	1020	225.4	40.0	48.3	7.8	77.3	0	361.2	
804	7.36	1180	243.1	58.5	9.0	1.6	1.4	0	262.4	856.9
805	7.28	788	95.0	36.7	136.3	6.6	121.2	0	425.9	707.5
807	7.34	280	63.5	16.5	19.3	2.3	24.8	0	256.3	277.1
808	7.31	640	94.4	44.8	17.2	4.3	53.2	0	344.1	520.6

Sample		ppm						
No.	E.C.	B	F	Fe	P	SiO_2	As	NO_3
784	.26	0	<.05	<.10	.03	10.1	<.001	0.50
785	.78	0	<.05	<.10	0	7.25	.001	32.7
786	.96	.05	<.05	3.45	.01	16.25	.002	0.02
787	.78	.05	<.05	<.10	0	6.25	.001	85.9
788	.59	0	.05	.61	.009	18.25	.009	0.58
789	1.14	.03	<.20	2.66	.009	12.75	.001	<.05
790	1.75	0	<.20	<.10	0	7.5	.004	110.4
791	.70	0	<.20	1.45	.009	15.75	.002	0.04
792	1.21	.42	<.20	1.03	.015	10.5	.007	0.02
793	.43	0	<.20	<.10	0	11.0	.001	44.5
794	.85	0	<.20	1.97	.01	16.25	<.001	<.05
795	.28	0	<.20	.35	.015	15.25	.001	0.37
796	.27	0	<.20	.32	.02	13.25	.001	0
797	.43	0	<.20	<.10	0	6.1	<.001	4.95
798	.57	.02	<.20	<.10	0	9.75	<.001	0.87
799	.32	0	.24	<.10	0	9.00	<.001	0
800	.59	0	<.20	<.10	0	8.25	<.001	21.9
801	.36	0	<.20	<.10	.009	10	<.001	0.62
802	.56	.12	<.20	.86	.009	14.25	.002	0.45
803	1.57	0	.43	<.10	.02	9.85	.002	35.7
804	1.50	0	1.32	34	.01	25.0	.005	0.04
805	1.36	.30	.47	<.10	.01	6.25	.003	0.23
807	.54	.10	<.20	<.10	.009	11.5	.001	1.29
808	.99	.17	.52	.10	.01	12.75	or <.001	0.26

APPENDIX D (Cont)

RESULTS OF CHEMICAL ANALYSIS

		NY050⁻	NY051⁺	NY052⁻	NY053⁻	NY054⁻	NY055⁻	NY056⁻	NY057⁺	NY058⁻
SiO_2	A1	7.8	17.7	10.6	9.5	4.7	13.5	10.9	8.3	10.2
	N2	7.9	17.6	10.4	9.3	4.3	14.7	10.4	7.9	11.2
Total Iron (ug/ml.)	A1	20	<10	130	170	<10	250	2940	10	<10
Mg	A1	20.8	26.2	9.9	17.3	11.6	16.8	21.4	9.2	13.6
	N2	20.7	26.0	9.8	17.2	11.7	16.8	21.4	9.3	13.5
Ca	A1	151	86.1	60.7	67.4	63.2	45.0	108	32.7	53.6
	N2	153	86.1	61.0	67.7	63.8	45.0	108	33.0	54.6
Na	A1	49.1	12.2	10.8	18.0	16.8	20.0	23.1	67.0	1.9
	N2	49.7	12.6	10.8	18.1	17.1	20.3	23.3	67.0	2.0
K	A1	2.8	1.7	0.9	6.3	1.8	2.5	3.5	2.7	0.2
	N2	3.0	2.0	1.0	6.9	2.0	2.9	1.8	2.9	0.3
Carbonate	N1	0	0	0	0	0	0	0	0	0
Bicarbonate	N1	385	342	163	154	124	275	346	272	217
Fluoride	N2	0.19	0.07	0.04	0.06	0.04	0.24	0.04	0.53	0.05
Chloride	N2	70	17	21	77	45	10	35	21	1.9
Sulphate	N2	188	59.3	63.5	63.1	49.2	1.9	68.0	39.1	20.5
Nitrate	N2	1.6	0.2	0.1	6.5	59	0.3	0.1	0.1	9.8
Sulfide	A1	<.1	3.5	<.1	<.1	<.1	<.1	<.1	1.6	<.1
Initial Bottle pH	N1	7.6	7.6	7.9	7.0	7.9	7.8	7.6	7.7	7.7

Comments: All concentrations are in mg/l unless otherwise noted.
N1 = Data from natural, unacidified sample, unfiltered.
N2 = Data from natural, unacidified sample, filterd.
A1 = Data from acidified sample, filtered.
+ = Sulfur smell from acidified sample.
- = No sulfur smell from acidified sample.

		NY059⁻	NY060⁻	NY061⁻	NY062⁻	NY063⁻	NY064⁻	NY065⁻	NY066⁺	NY06
SiO_2	A1	7.2	7.5	10.6	16.0	13.2	12.4	8.0	12.9	9.9
	N2	7.2	7.0	10.1	15.6	12.7	11.9	7.6	12.5	9.7
Total Iron (ug/ml.)	A1	<10	200	140	1190	360	1870	1710	450	50
Mg	A1	18.7	27.6	14.7	29.3	32.2	13.1	12.5	18.7	14.5
	N2	18.6	27.8	13.4	29.2	32.0	13.4	12.6	18.6	14.5
Ca	A1	91.5	102	44.4	99.1	131	43.8	42.4	74.7	65.5
	N2	92.0	102	42.1	99.0	132	45.2	42.5	75.4	66.1
Na	A1	8.3	12.7	112	13.1	25.7	30.9	5.2	31.0	43.8
	N2	8.4	13.0	146	13.8	25.6	32.5	5.4	31.6	43.9
K	A1	1.4	2.1	3.0	1.9	2.1	2.2	4.8	3.2	2.0
	N2	1.6	2.6	3.6	2.3	2.2	2.3	5.5	3.6	2.1
Carbonate	N1	0	0	0	0	0	0	0	0	0
Bicarbonate	N1	269	324	448	368	332	191	154	301	276
Fluoride	N2	0.05	0.09	0.31	0.09	0.08	0.37	0.07	0.15	0.17
Chloride	N2	31	44	141	33	46	43	5.2	64	81
Sulphate	N2	39.7	87	9.0	76	211	33.8	48.0	18.3	11.7
Nitrate	N2	56	0.6	0.4	0.2	0.3	3.3	0.2	0.2	0.5
Sulfide	A1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1	<.1
Initial Bottle pH	N1	7.4	7.6	7.8	7.6	7.6	7.5	7.0	7.7	7.8

Comments: All concentrations are in mg/l unless otherwise noted.
N1 = Data from natural, unacidified sample, unfiltered.
N2 = Data from natural, unacidified sample, filtered.
A1 = Data from acidified sample, filtered.

APPENDIX D (Cont)

RESULTS OF CHEMICAL ANALYSIS

		WY068⁻	WY069⁻	WY070⁻	WY071⁺	WY072⁻	WY073⁺	WY074⁻	WY075⁻	WY076⁻
SiO_2	A1	14.9	5.8	7.3	14.9	13.5	6.3	12.6	14.7	8.2
	N2	14.0	5.8	6.7	14.4	12.9	6.1	12.6	14.4	8.1
Total Iron (ug/ml.)	A1	620	<10	5110	240	380	<10	170	1010	<10
Mg	A1	12.8	7.3	14.3	28.3	12.0	5.0	33.7	16.4	6.5
	N2	12.7	7.3	14.5	28.5	11.9	4.9	32.7	16.3	6.4
Ca	A1	41.2	32.3	76.2	134	48.1	16.1	179	97.5	62.4
	N2	41.6	33.1	76.9	134	48.2	16.3	176	96.9	62.7
Na	A1	7.1	3.8	11.0	9.9	19.2	298	26.3	14.8	27.8
	N2	7.3	4.1	11.8	10.4	19.4	299	26.1	14.6	27.9
K	A1	0.7	0.7	0.6	1.8	1.6	4.3	3.7	2.5	2.3
	N2	0.9	1.0	1.0	2.3	1.8	4.3	3.9	2.7	2.6
Carbonate	N1	0	0	0	0	0	0	0	0	0
Bicarbonate	N1	209	111	241	398	245	595	362	251	110
Fluoride	N2	0.07	0.03	0.05	0.06	0.34	1.00	0.38	0.09	0.02
Chloride	N2	6.9	6.9	29	49	17	249	69	34	66
Sulphate	N2	1.6	26.2	58.7	104	1.7	4.6	266	105	65.1
Nitrate	N2	<.1	2.0	0.1	0.2	0.2	0.4	0.2	<.1	14
Sulfide	A1	<.1	<.1	<.1	0.8	<.1	0.1	<.1	<.1	<.1
Initial Bottle pH	N1	8.0	7.9	7.5	7.7	7.8	8.0	7.6	7.2	7.3

Comments: Concentrations are in mg/l unless otherwise noted.
N1 = Data from natural, unacidified sample, unfiltered.
N2 = Data from natural, unacidified sample, filtered.
A1 = Data from acidified sample, filtered.

		WY077⁻	WY078⁻	WY079⁻
SiO_2	A1	15.1	8.3	18.6
	N2	15.5	8.0	19.0
Total Iron (ug/ml.)	A1	2930	320	2870
Mg	A1	24.7	28.8	23.2
	N2	24.2	28.8	23.1
Ca	A1	82.5	95.5	105
	N2	82.9	95.4	105
Na	A1	89.0	30.1	40.9
	N2	88.7	29.4	41.0
K	A1	4.6	4.0	3.2
	N2	4.8	4.0	3.3
Carbonate	N1	0	0	0
Bicarbonate	N1	539	370	412
Fluoride	N2	0.25	0.28	0.14
Chloride	N2	76	106	113
Sulphate	N2	1.4	7.8	2.9
Nitrate	N2	0.2	0.3	0.2
Sulfide	A1	<.1	<.1	<.1
Initial Bottle pH	N1	7.5	7.6	7.4

Comments: All concentrations are in mg/l unless otherwise noted.
N1 = Data from natural, unacidified sample, unfiltered.
N2 = Data from natural, unacidified sample, filtered.
A1 = Data from acidified sample, filtered.

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