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AT LAKE GEORGE



THIRTY-FIVE YEARS OF CONTINUOUS DISCHARGE OF
SECONDARY TREATED EFFLUENT ONTO SAND BEDS

By:

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Abstract

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The Lake George Village sewage treatment plant was put into operation in 1939. Even at this time, regulations were in effect preventing the discharge of any sewage, raw or treated, into the waters of Lake George or into any streams discharging into this recreational lake. The basic treatment plant consisted of circular Imhoff tanks, trickling filters followed by secondary sedimentation, and the discharge of the treated effluent onto sand beds which were determined to be "more than 25 ft in depth." Presently, the flows at the treatment plant reach a maximum of about one million gallons per day during the summer tourist season and the effluent is discharged onto approximately 6.4 acres of sand beds. Previous studies showed the capacity of the top 10 ft of the sand beds for reducing coliforms, BOD, organic nitrogen and ammonia nitrogen. Phosphate reduction appeared to be a function of the extent of prior usage of a particular bed. Resistivity studies showed the probable path of the effluent through the ground. As a result of these studies, a series of wells was placed in this path. Observations were made of the depth of water in each of the wells and the physical and chemical quality of the water at each location. The quality of the effluent was also monitored where it emerges along the banks of West Brook approximately 2000 ft (600 m) from the treatment plant. The quality of this emergent water was studied in relation to its effects upon the waters of Lake George. Studies were made on the operation of the dosing of the sand beds. The soil system appears to be quite efficient in the removal of total phosphorus from the treated effluent but results in only partial reduction in total nitrogen.

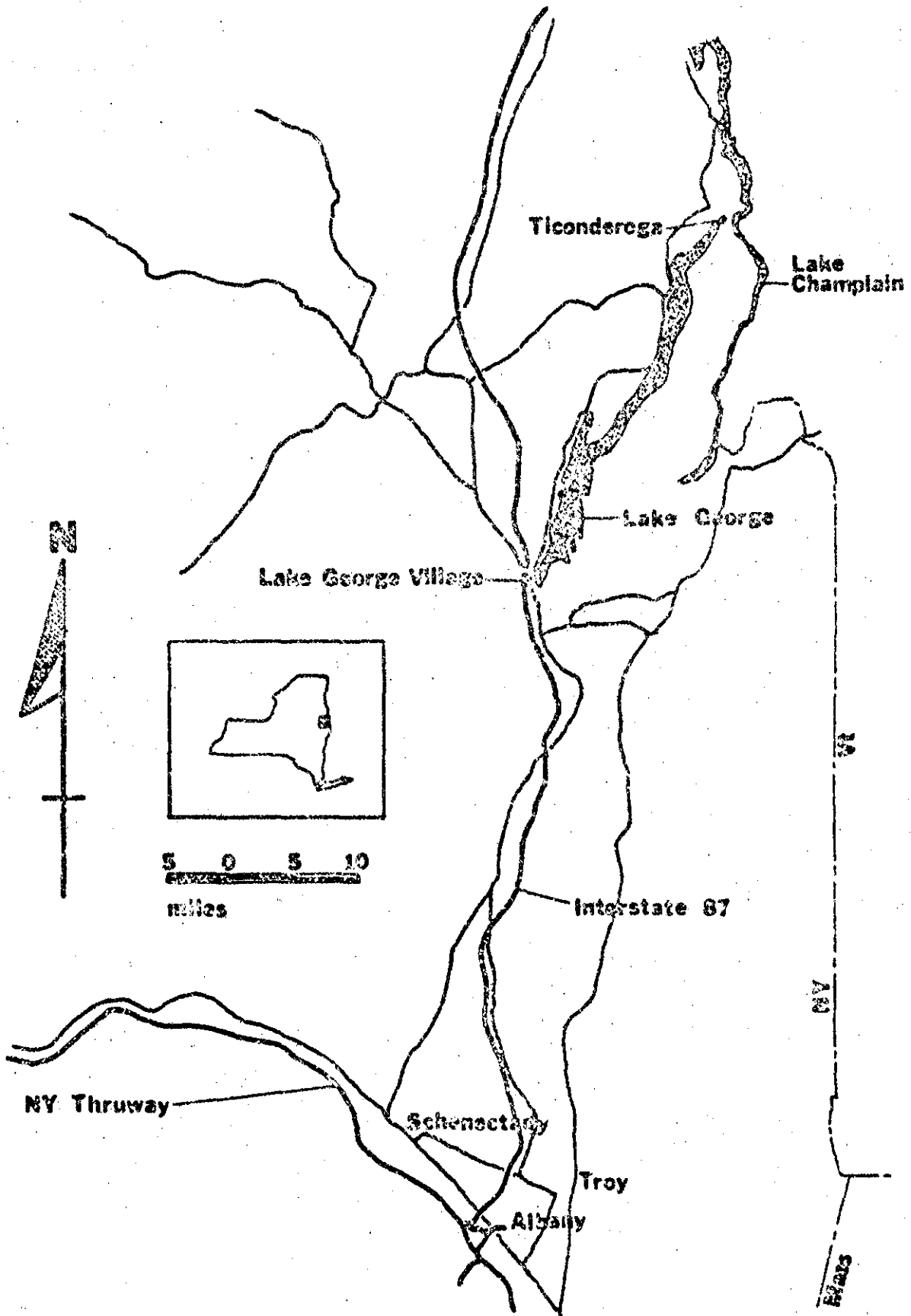
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INTRODUCTION

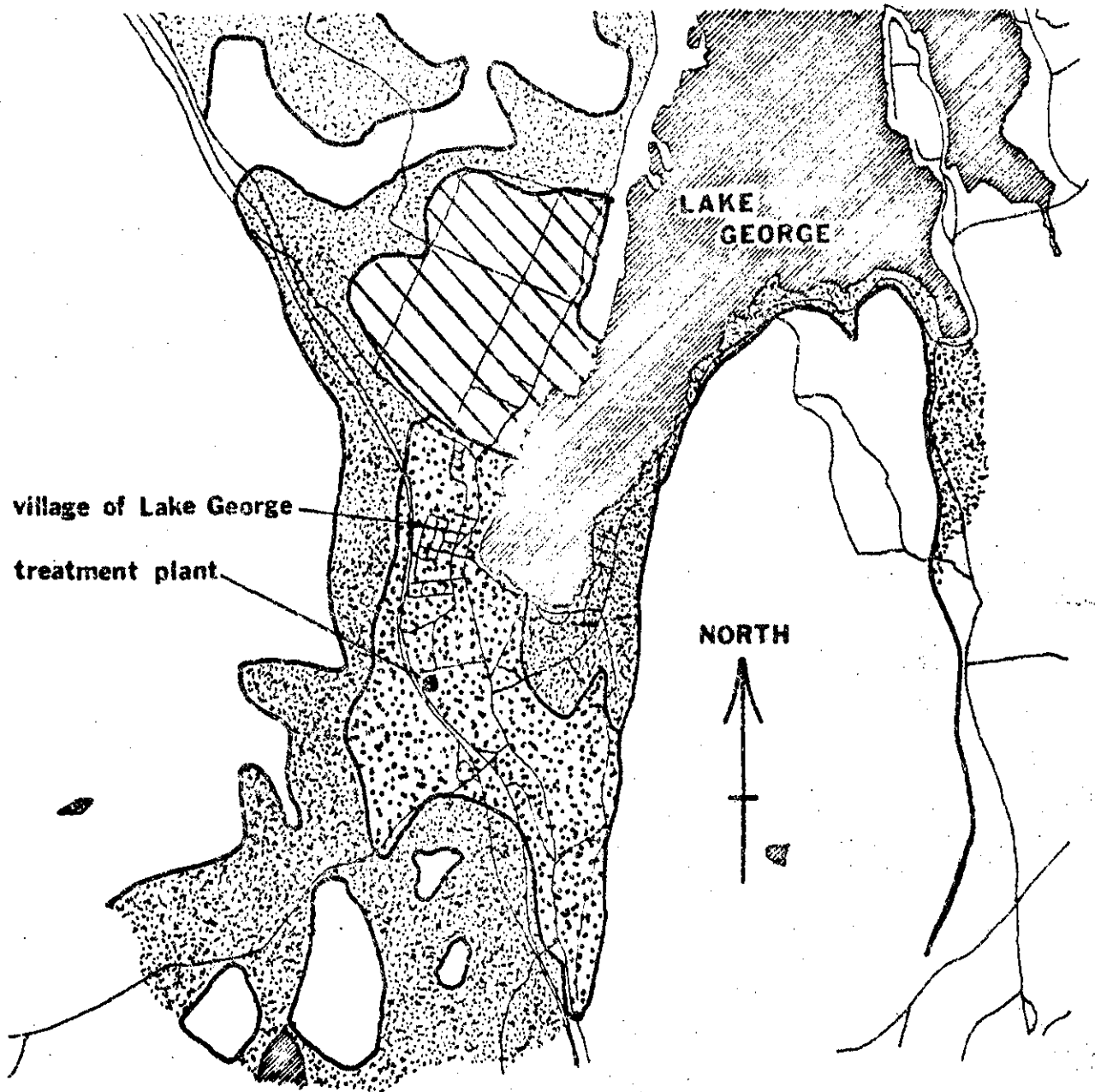
Lake George is located in the southeastern portion of the Adirondack Forest Preserve in the State of New York (Figure 1). The lake was formed approximately ten thousand years ago when the receding glacier deposited moraine in the area which is now Dunham Bay, thereby blocking off the previous outlet toward the southeast into the present Hudson River. As the former river valley filled up, it overflowed a lower lying area now known as The Narrows and then flowed northward into another river valley which now flows out at Ticonderoga. In general, the area of the Lake George watershed is underlain by rock consisting of pre-Cambrian gneisses, with the valleys underlain by lower Paleozoic strata (Hill, 1965). The soil cover varies in the range of 0 to 20 ft. However, in a few areas there have been some natural delta sand deposits created by outwash from the receding glaciers. One such delta sand deposit is located at the southwest corner of Lake George as shown in Figure 2 (Hill, 1965 and Newland and Vaughan, 1942).

The Lake George Village sewage treatment plant has made good use of this natural delta sand deposit for the final polishing of the sewage treatment plant effluent. Lake George itself has always been known as a clear recreational lake. In order to keep it such, New York State has imposed upon Lake George a special class AA rating. Thus when plans were being made to construct a waste treatment plant for the Village of Lake George in 1936, there were already restrictions as to the discharge of untreated or treated wastes into the lake. The regulations state that there shall be no discharge of any liquid waste, treated or untreated,





FIGURE 1



LOCATION OF LAKE GEORGE, N. Y.



LEGEND

-  unclassified by Hill
-  moraine sand, gravel, & boulders (Newland)
-  delta deposits (Newland)
-  lakes

SCALE

 6000ft

GEOLOGY OF THE SOUTHERN LAKE GEORGE DRAINAGE BASIN

FIGURE 2

directly into Lake George or into any tributary thereof. In the case of the Lake George Village sewage treatment plant, this has been interpreted to mean that the only alternatives for final disposal of the treated effluent are recharge into the ground or diversion out of the basin. With the location of this natural delta sand deposit near the southwest portion of the Village of Lake George, it was decided to construct a treatment plant discharging the final effluent into the ground where it "becomes groundwater which in all probability seeps eventually to some water course as a highly purified liquid which cannot be identified as a sewage effluent" (Vrooman, 1940). Thus, if nothing else, the effluent became out of sight, out of mind.

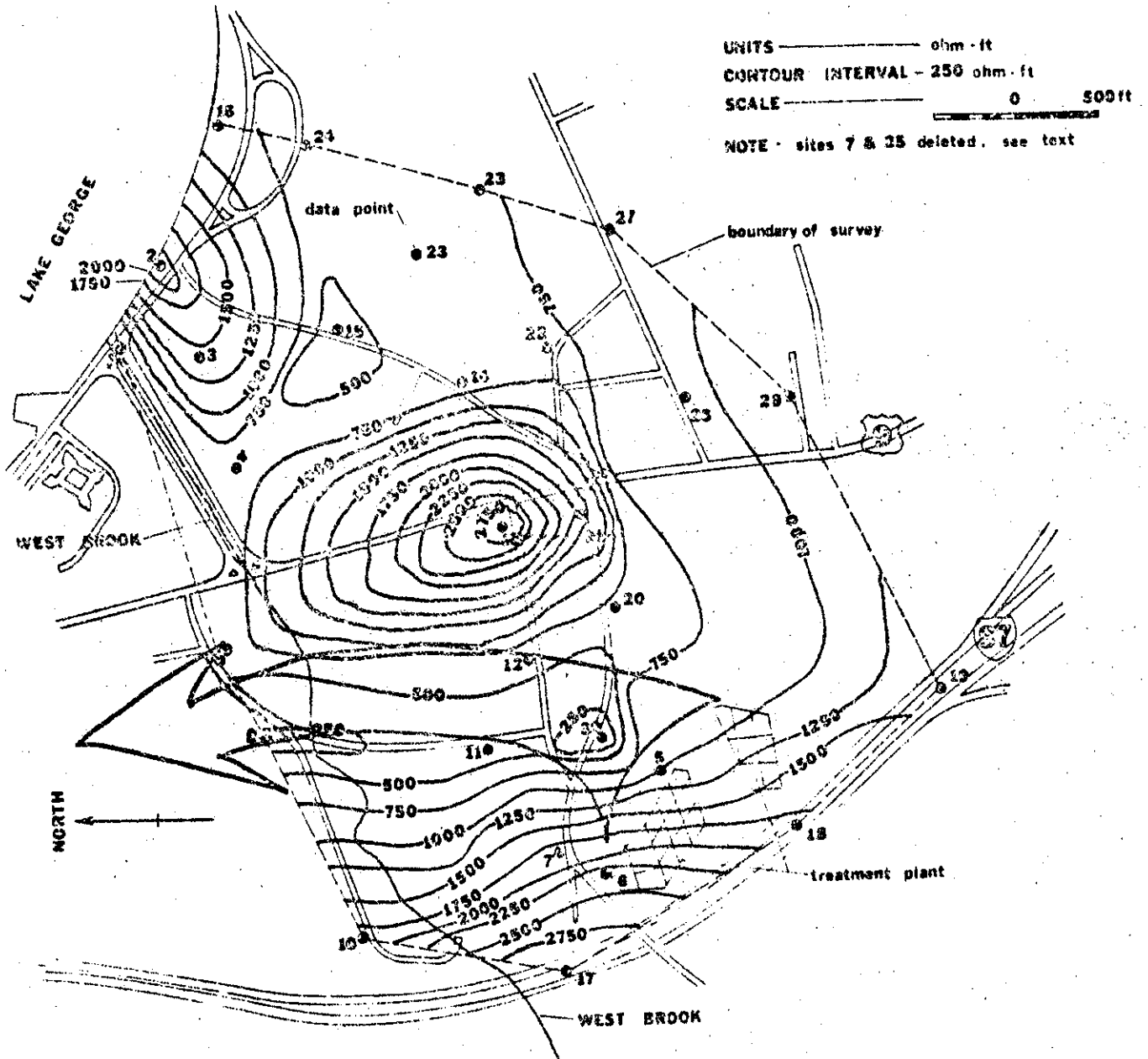
With the increased anthropogenic stresses on Lake George and the awareness by learned persons of the potential detriment to Lake George of any nutrients from this central treatment plant, concern arose over the ultimate point of emergence of the groundwater from the sewage treatment plant and its quality with respect to the lake. Of prime concern was the potential need for nutrient removal prior to discharge into the ground or diversion of the effluent out of the basin. It was with the goal of identifying the groundwater and its quality that the initial studies at the Lake George Village sewage treatment plant were begun by Rensselaer Polytechnic Institute in 1968.

The studies at the sand beds (Aulenbach, et al. 1974) were begun with the misinformation that the groundwater was located close to the surface of the ground. If the groundwater were truly shallow, a series of driven wells could be installed to trace the direction and determine the quality of the effluent as it flows through the ground away from the treatment plant site. However, the depth to groundwater was found to be in excess of 56 ft and this goal of the initial study had to be abandoned.

In a subsequent effort to locate the effluent from the treatment plant in the ground, resistivity studies were performed in 1972 (Fink and Aulenbach, 1974). These studies indicated that the general direction of the sewage treatment plant effluent was in a northerly direction along Gage Road toward West Brook (see Figure 3). This was concluded from the assumption that the lowest resistivity, representing a higher dissolved solids in the water, was due to the effluent from the treatment plant. However, this study could not conclude whether the effluent passed under or entered West Brook, nor determine the quality of the effluent as it passed through the soil.

Based on the findings that the general direction of flow from the treatment plant in the ground was in a northerly direction, a walking survey was conducted in the area of West Brook in the early spring of 1973. West Brook flows in a relatively narrow valley towards Lake George. In the area of Gage Road, sand is located on both walls of the valley. On the southern side of the stream towards the treatment plant, the valley is approximately 70 ft deep. It is less deep on the northern side. The bottom of the valley is relatively flat and is in the order of 100 m wide in this area. The walking survey revealed the presence of considerable seepage from the bottom of the hill at the valley floor. Measurements of the dissolved solids of this seepage showed the highest values nearest to Gage Road (Figure 4). With this information, additional chemical measurements were made of this seepage which fairly conclusively confirm it to be the emergence from the ground of the effluent from the sewage treatment plant. Measurements of the seepage on the opposite side of West Brook showed a much higher water quality occurring in this area. Thus it was concluded that the treated sewage effluent from the Lake George Village treatment plant reappears from the ground on the southern banks of West Brook and ultimately flows into Lake George via West Brook. Based upon this conclusion, a more thorough

FIGURE 3



FLOW OF GROUND WATER BY RESISTIVITY STUDIES

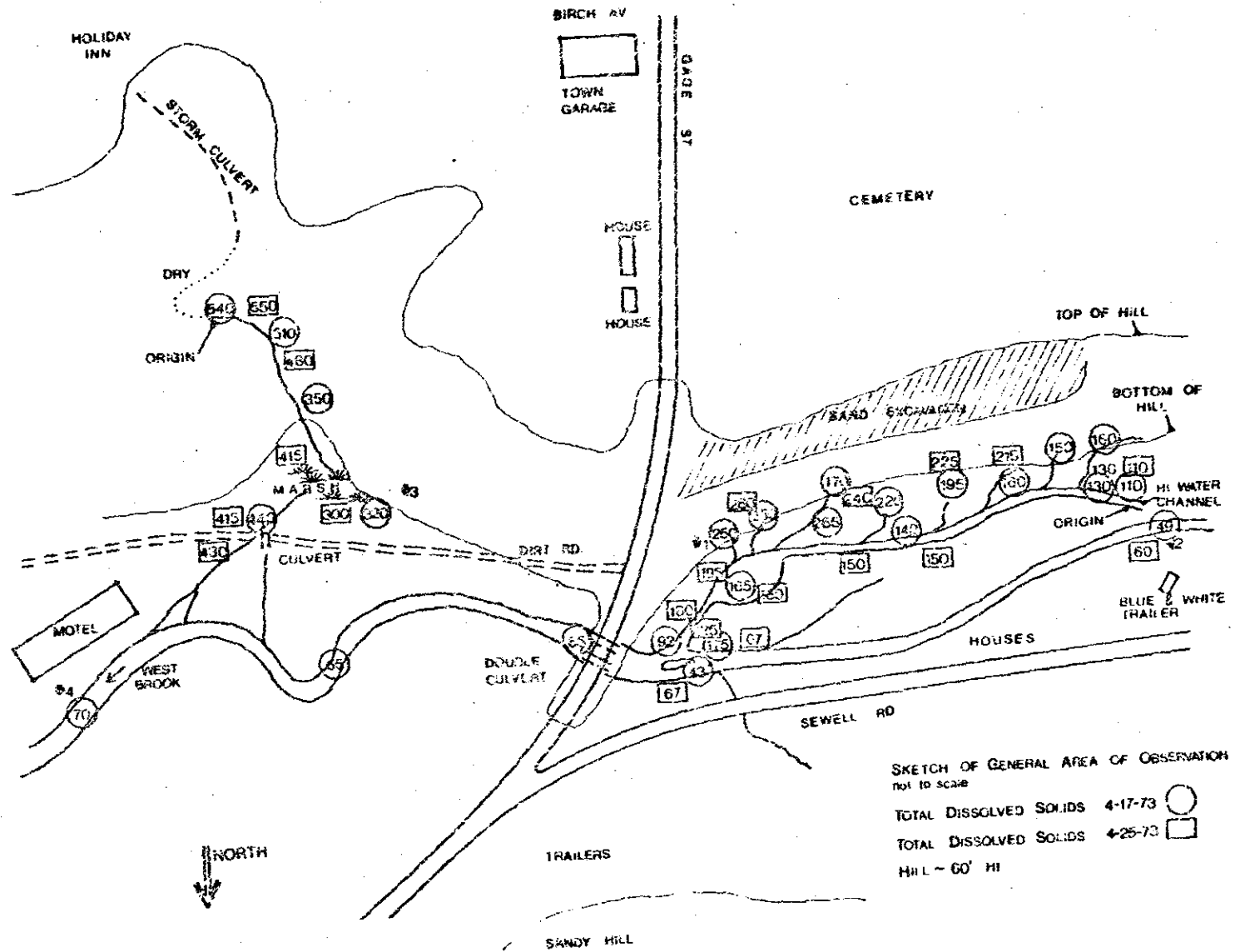


FIGURE 4 OBSERVATION OF SEEPAGE ALONG WEST BROOK

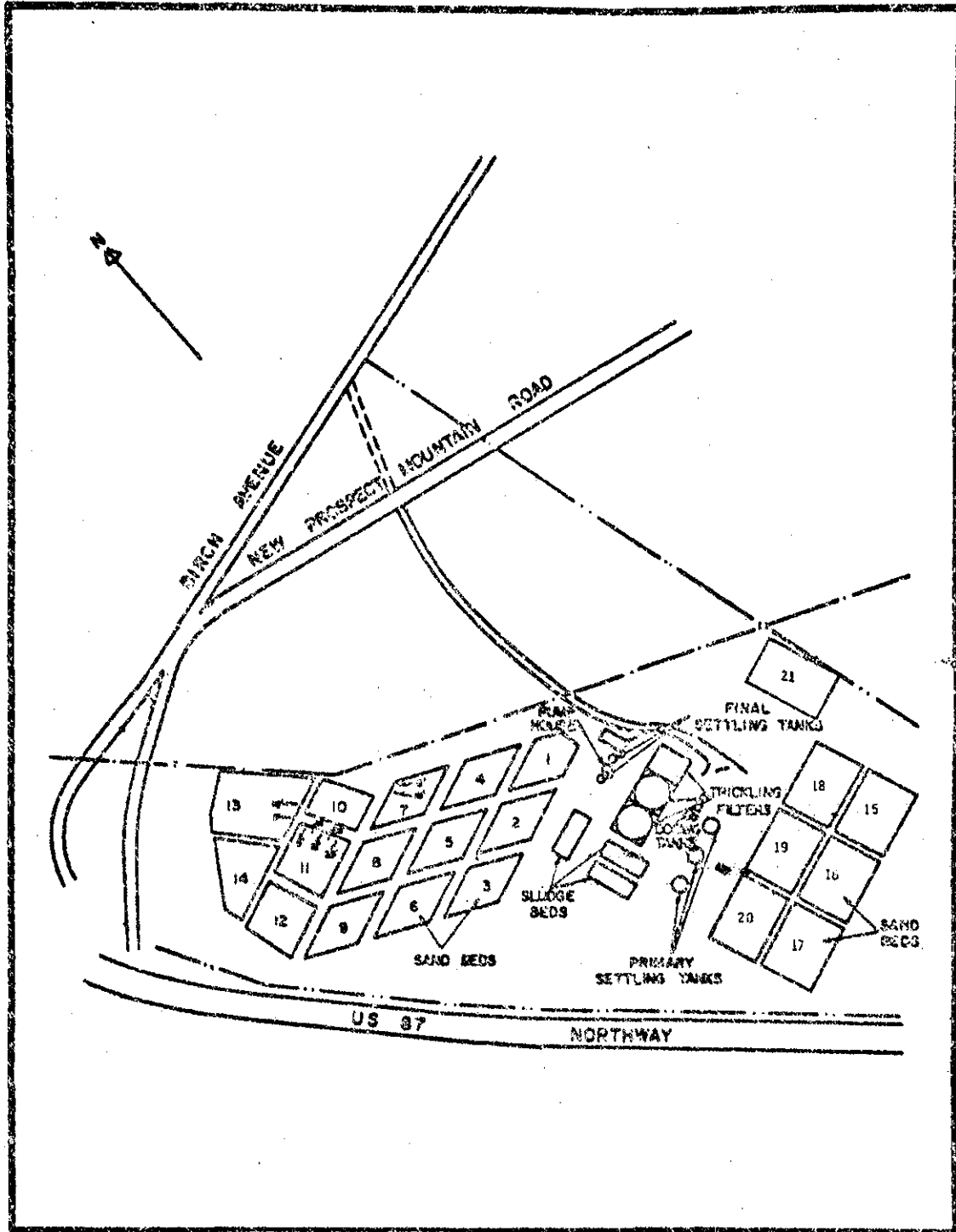
investigation of the area was made in order to identify the quality of the effluent as it passes from the recharge bed to its reappearance on the banks of West Brook.

The basic sewage treatment plant is shown in Figure 5. The plant consists of primary settling tanks, trickling filters, secondary settling tanks and discharge of the final effluent without chlorination onto a series of natural delta sand beds. Flows at the treatment plant reach slightly over 1 mgd ($3,785 \text{ m}^3/\text{day}$) during the summer tourist season. The combined area of the sand beds is presently 6.4 acres (2.6 hectares). Normal operation is to dose one upper and one lower bed during the day, and to direct the flow to another pair of beds at night. Most beds drain to dryness in 0.5 to 2 days. Depending upon the need for the beds, they may be flooded several times before they are allowed to remain dry for reconditioning which involves removing the surface mat by scraping, followed by raking and re-leveling.

GROUNDWATER PROFILES

In order to study the quality of the groundwater, a series of wells was placed between the sand beds and West Brook as shown in Figure 6. Several wells were located out of the direction of flow to serve as controls. With recent funding, new wells are being installed to improve the quality of the information derived from this system. The wells presently installed are listed in Table 1 and their depths and depth to groundwater are depicted in Figure 7. From the information on depth to water and depth to bedrock obtained from these wells, a series of cross-sectional diagrams has been able to be estimated as shown in Figures 8 - 11. The cross-sectional areas indicated in these figures are identified on Figure 6.

FIGURE 5



LAKE GEORGE VILLAGE SEWAGE TREATMENT PLANT

DOWNSTREAM PT.

LAKE GEORGE SEWAGE DISPOSAL BEDS

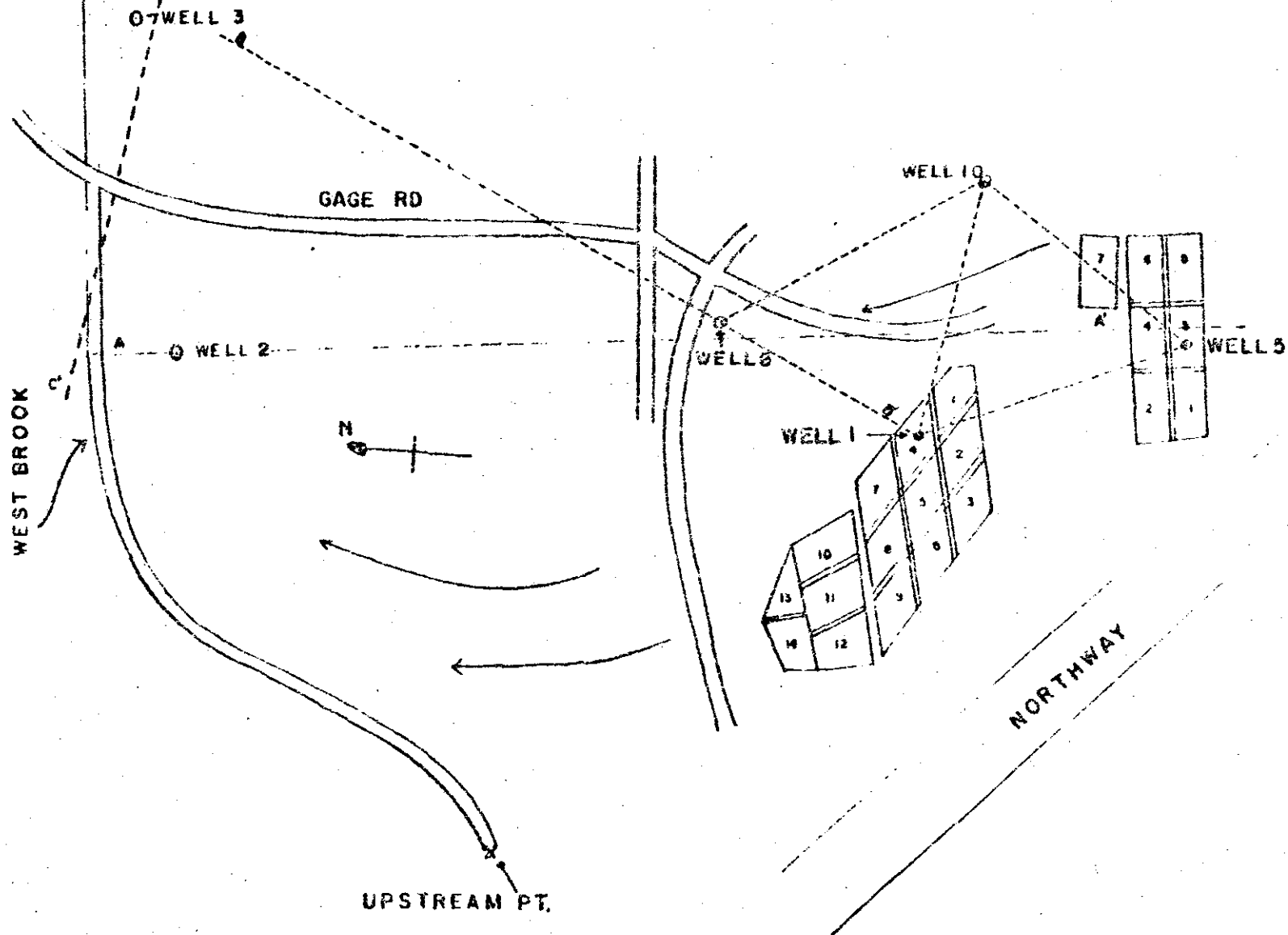


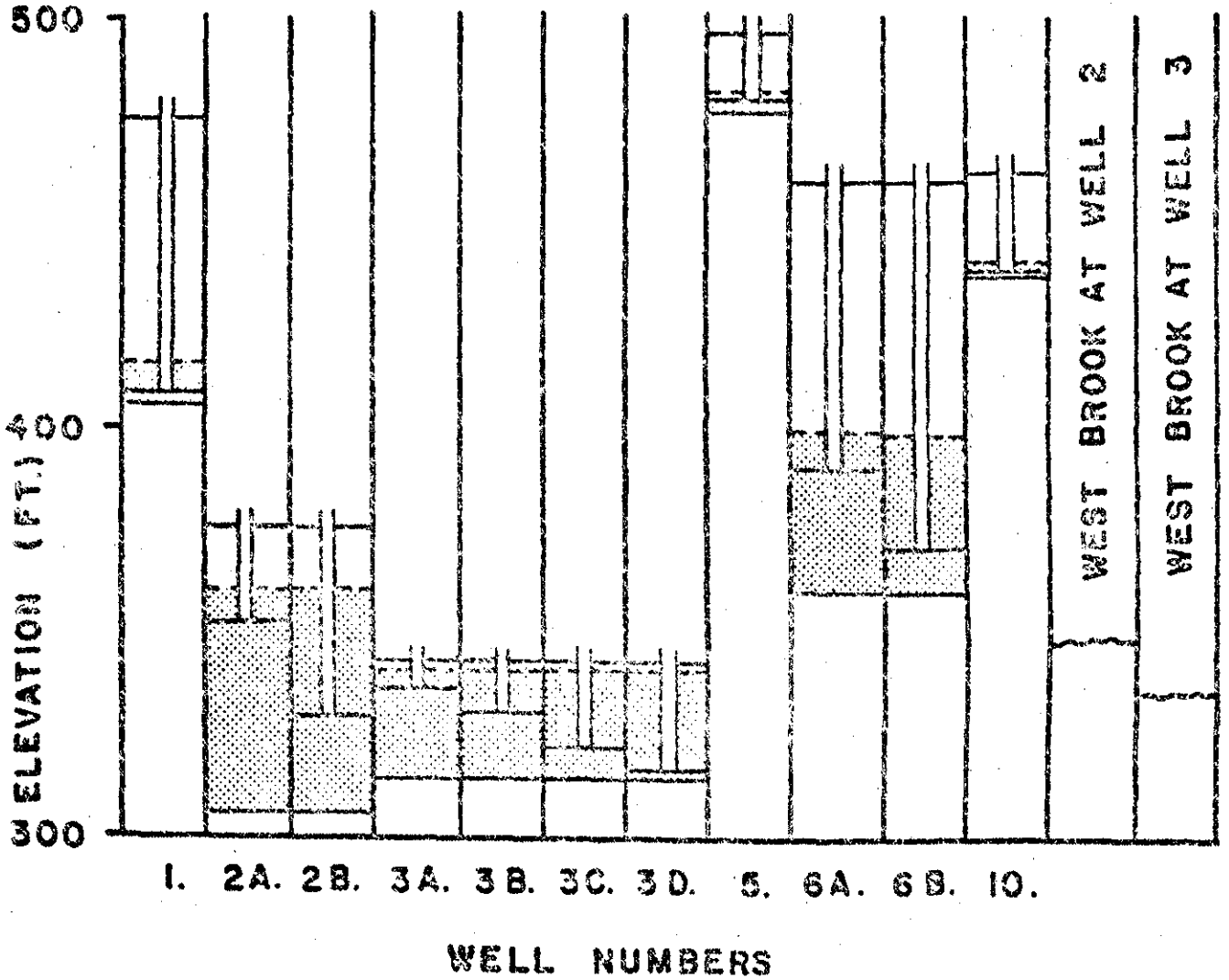
FIGURE 6 LOCATION OF WELLS IN RELATION TO LAKE GEORGE VILLAGE SEWAGE TREATMENT PLANT

TABLE 1
WELL DATA

	<u>Surface Elevation</u>	<u>Groundwater Elevation</u>	<u>Bottom of Point</u>	<u>Bedrock Elevation</u>
Well 1	475.0	415.66	407.80	405.0
Well 2A	375.40	359.22	352.13	306
Well 2B	375.40	359.2	330.35	306
Well 3A	339.90	339.74	336.44	314
Well 3B	339.90	340.01	329.06	314
Well 3C	339.90	340.08	321.23	314
Well 3D	339.90	340.0	315.64	314
Well 4	-	-	-	-
Well 5	495.37	480.98	479.40	477.40
Well 6A	458.7	397.6	388.13	360.0
Well 6B	458.7	397.6	370.68	360.0
Well 10	462.73	441.7	438.91	438.91
West Brook at Well 2	348.0	-	-	-
West Brook at Well 3	334.9	-	-	-

FIGURE 7

WELL ELEVATION DATA



UPPER SOLID LINE IS GROUND SURFACE LEVEL

UPPER BROKEN LINE IS GROUND WATER LEVEL

NEXT SOLID LINE IS BOTTOM OF WELL POINT

BOTTOM SOLID LINE IS BEDROCK LEVEL

SHADED AREA REPRESENTS GROUND WATER SATURATION

WAVY LINE IS WEST BROOK WATER SURFACE

Section A-A' (Figure 8) covers the greatest distance across the area studied from West Brook to the upper sand beds at well 5. The slope of the ground surface from well 5, through the treatment plant and to the steep banks of West Brook is shown. The data point on the plateau adjacent to West Brook is the location of well site 2. This plateau was created by an excavation of the sand in this area. Were it not for this artificial plateau, the surface would be a rather smooth line, eliminating this little dip in the surface level. It may be seen that the water table also slopes downward toward West Brook and intersects the surface of the ground adjacent to West Brook. The bedrock slopes in this same general direction. The thickness of the aquifer increases from the area of the upper bed to the area under West Brook.

Section B-B' (Figure 9) is a section in the same general direction from well 3 to well 1 in the lower sand beds. Again, the general downward slope of the surface of the ground from well 1 toward West Brook may be seen with a corresponding slope of both the water table and the bedrock in this general direction. The water table intersects the ground surface at well site 3. In this cross-section, the thickness of the aquifer does not increase appreciably in the area between well site 6 and well site 3.

Section 1-5 (Figure 10) indicates the change in the contour between well 1 in the lower sand beds and well 5 in the upper sand beds. It may be seen that the water table and bedrock slopes are greater than the ground surface slope in this cross-section. The thickness of the aquifer increases in the direction of well 1.

Section C-C' is approximately perpendicular to the other sections and crosses West Brook in the area of Gage Road. The ground surface line indicates the south bank of West Brook at the extreme left end, the bottom of West Brook,

LAKE GEORGE SECTION A-A'

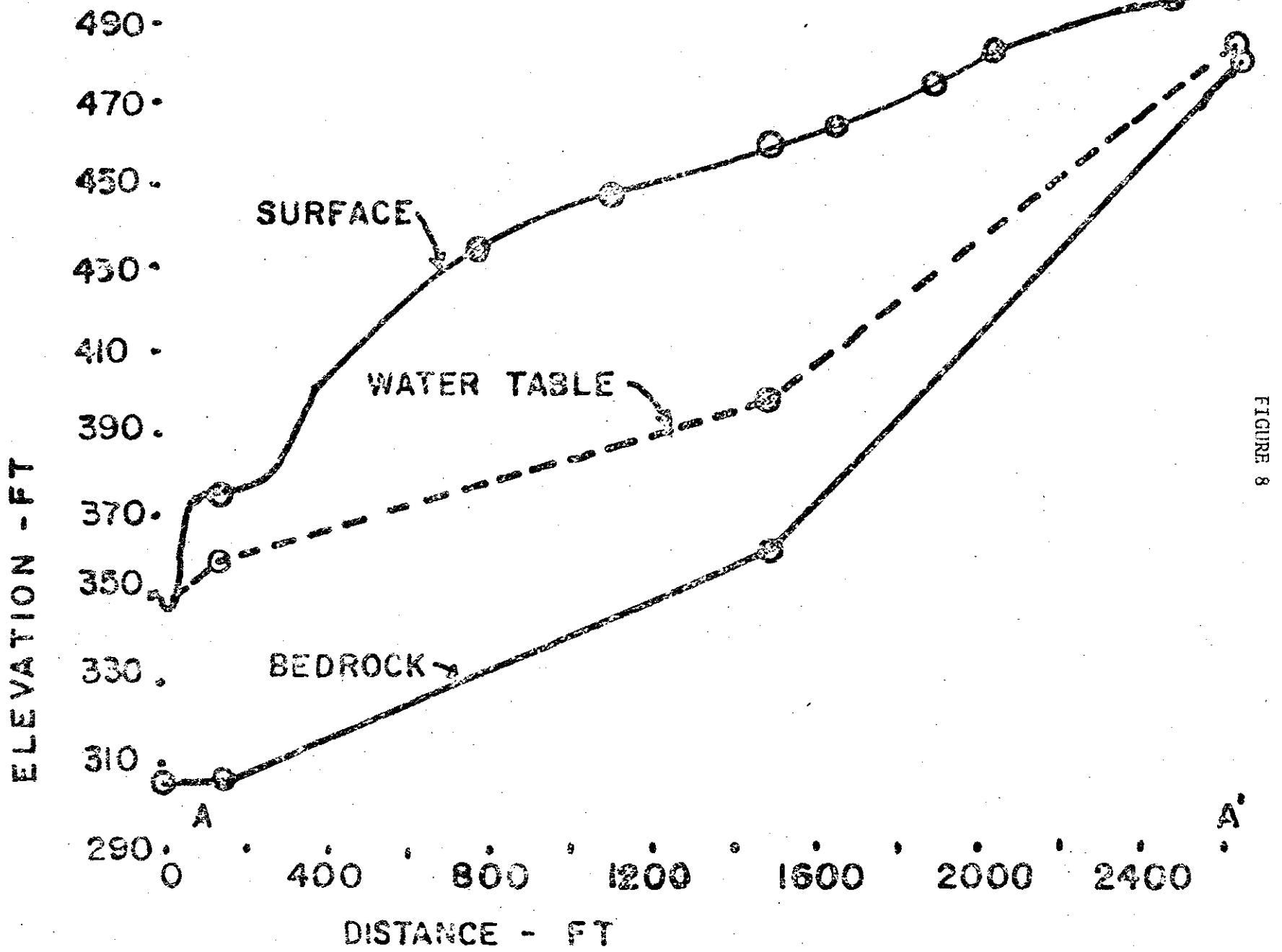


FIGURE 8

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LAKE GEORGE SECTION B-B'

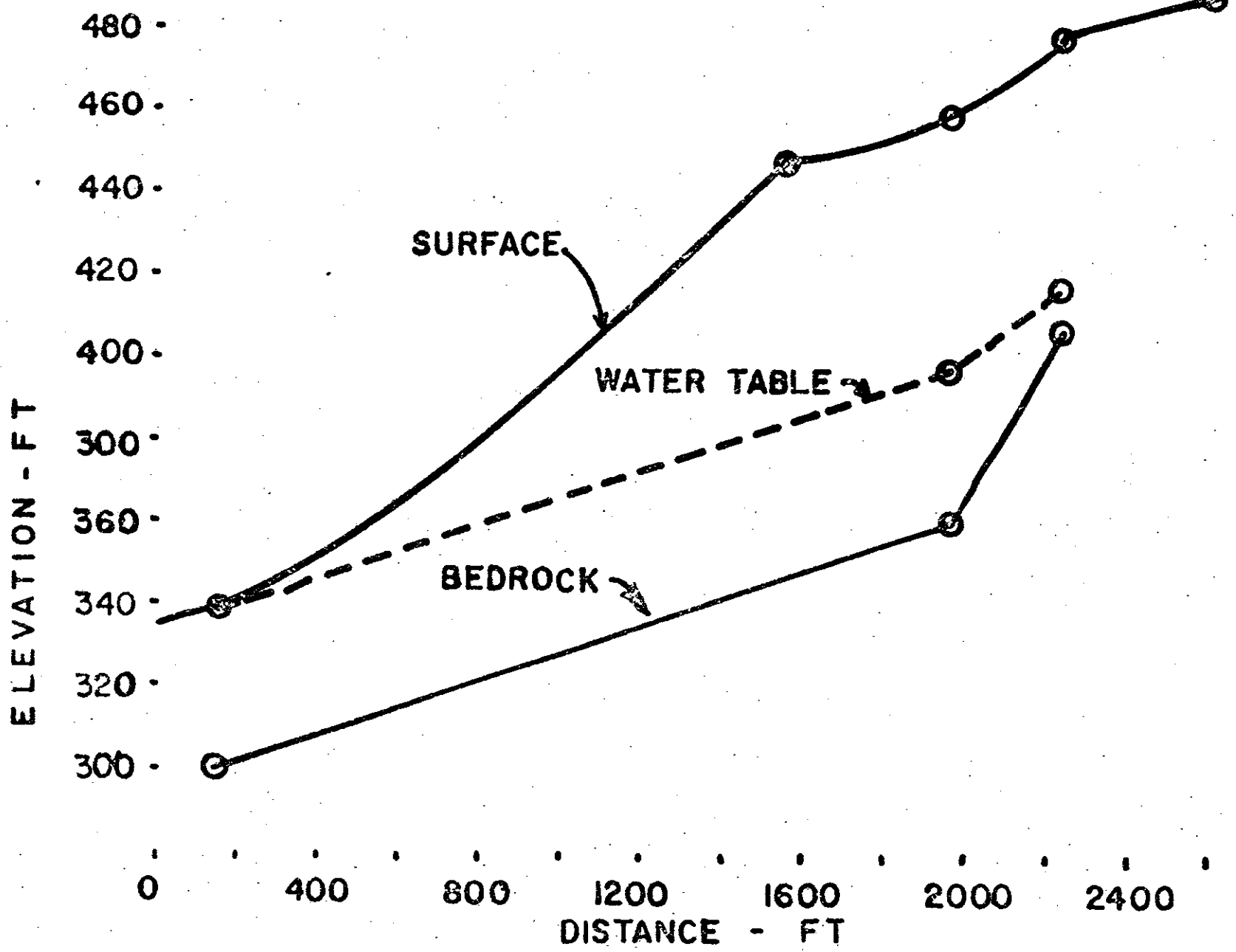
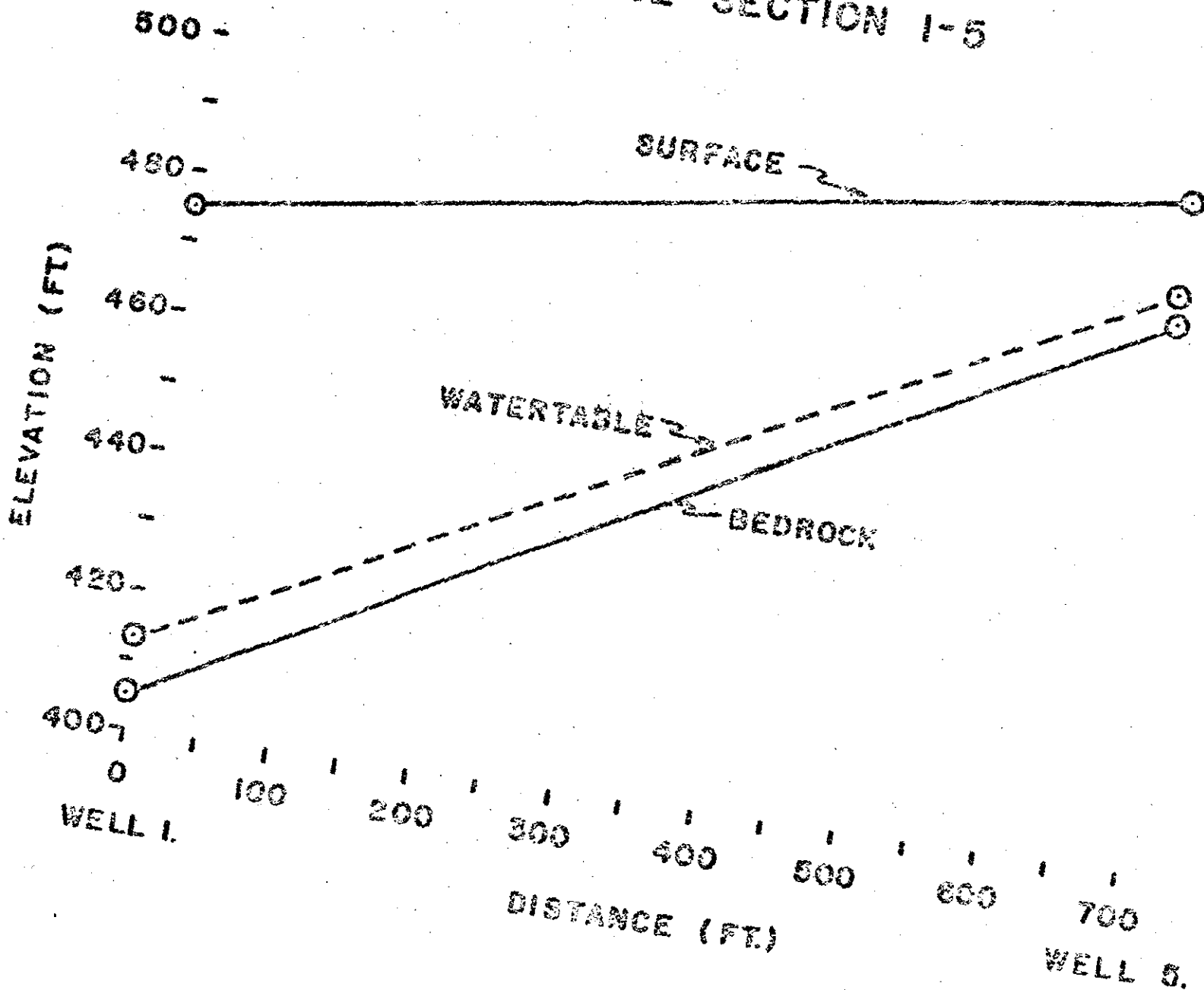


FIGURE 9

LAKE GEORGE SECTION 1-5



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FIGURE 10

and the north bank as it proceeds toward the right of Figure 11. In this case, the water table appears to be below the surface at all locations. The bedrock slope appears to indicate a sharp dropoff in the eastern end of this section but is relatively constant throughout the remainder of this section.

WATER QUALITY

During the period from April, 1973 through September, 1974, samples were secured from the various wells as they were installed, from West Brook above and below the influence of the seepage from the stream banks, and from the sewage treatment plant influent and effluent. Although in some instances there was very little data for interpretation of results and there are some other data points which are questioned, the mean values of the data relating to the effluent discharged from the treatment plant are summarized in Table 2. Details of the amount of data available and the period of time covered for each sampling location are shown in tables A1 through A10 of the Appendix.

Wells 1 and 5 are located in the lower and upper sand seepage beds respectively and are subject to extreme fluctuations depending upon whether the bed was flooded or dry at the time of sampling. Since there was an insufficient number of samples secured under each condition, all of the results under both conditions for each of these two wells are combined in Table 2. Also, since more samples were secured during the summertime, the average results would be biased in this direction. For example, the temperature would produce a higher average than would be secured if sampling had proceeded at the same intensity during the winter. Nevertheless, much useful information can be obtained from Table 2.

The temperature of the sewage was consistently higher than the temperature of any of the groundwater or the stream samples secured. There was no significant change in temperature between the influent and the effluent of the treatment

LAKE GEORGE CROSS SECTION C - C'

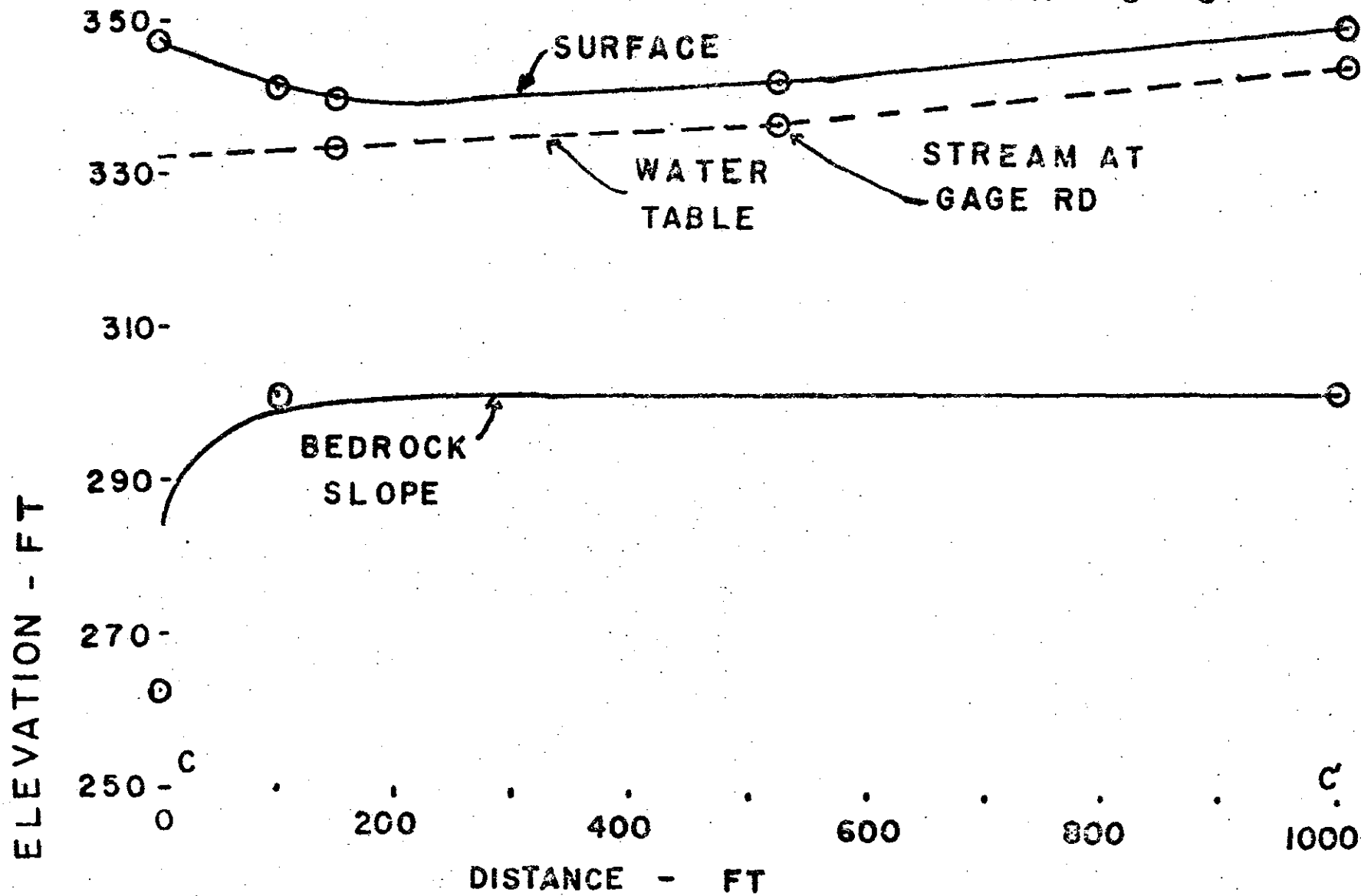


FIGURE 11

TABLE 2

Mean Values of Data Relating to
the Effluent Discharged from the
Lake George Village Sewage Treatment Plant
During the Period 4/17/73-9/19/74

Sample Location	Temp. °C	DO mg/l	Diss. Sols. mg/l	pH	Alk. mg/l	Cl. mg/l	Tot. Sol. P ug/l	NO ₃ N mg/l	NH ₃ N mg/l	TKN mg/l
Well 1	14.7	5.8	205	6.51	90.4	41	440	7.82	0.35	0.612
Well 2A	11.9	9.4	195	7.66	134	28	67.6	4.06	0.08	0.082
Well 2B	-	1.6	-	8.50	-	44	126	0.14	0.44	-
Well 3A	18.9	4.6	330	7.13	313	36	47.6	0.43	0.42	0.381
Well 3B	16.9	4.0	332	7.05	188	55	36.2	7.70	0.09	0.182
Well 3C	14.5	3.4	301	6.94	166	54	42.7	9.28	0.05	0.092
Well 3D	-	1.4	262	8.51	184	48.5	50	0.41	2.05	-
Well 5	21.8	6.1	127	6.37	53.3	26	936	7.81	0.13	0.623
Well 6A	-	2.8	-	8.10	-	28	80	14.2	0.59	-
Well 6B	12.8	5.2	186	8.79	142	36	68.4	2.58	3.24	3.80
Well 10	-	6.3	71	6.86	43.4	6.3	24.9	0.31	0.11	0.594
West Brook Upstream	13.0	12.0	61	7.49	40.3	12	49.9	0.35	0.05	0.065
West Brook Downstream	13.4	11.5	98	7.49	69.8	19	57.7	1.43	0.10	0.107
STP Inf.	22.5	2.3	243	7.20	163	38	4,471	-	-	13.01
STP Eff.	22.5	2.6	206	6.94	135	38	2,172	1.08	2.67	11.47

plant. The shallowest wells showed the highest temperature. In general, the temperature decreased with depth. It may be seen that West Brook is a cold water stream. The highest temperature ever recorded during the sampling period was 14.5°C.

The DO results were quite variable. However, the one important point that the DO measurements indicate is that there was sufficient dissolved oxygen present in the groundwater at all times to maintain aerobic conditions. This is considered desirable for the continuing process of renovating the wastewater as it passes through the soil.

Dissolved solids and chlorides could normally be used as a tracer of the treated effluent applied to the sand beds. The exception in this case occurs at well location 3. It may be seen that both the dissolved solids and the chloride content of the wells at all depths at this location exceeded the corresponding values of the sewage treatment plant effluent. This seemingly unusual situation has been traced to a former open salt storage area operated by the local highway department, located at the top of the hill near well site 3. It has been surmised that this salt has entered the groundwater and reappears at well site 3, thus producing the high values and ruling out the use of dissolved solids and chloride as a tracer of the sewage effluent applied to the sand beds. Excluding the results from well site 3, the dissolved solids and chloride content were generally highest in the sewage effluent. The values of these parameters were nearly the same in well 1 located in the sand recharge beds. Where sufficient data were available from the well points at two different depths at a well location, the chloride content was consistently higher at the deeper well point. Well 10 was low in both dissolved solids and chloride, confirming the use of well 10 as a control not being contaminated by the sewage effluent. West Brook was also low in dissolved solids, and chlorides; however,

the downstream location shows increases in both of these parameters due to the influence of the seepage which enters the stream between these two locations.

Again excluding the results in wells at location 3, the alkalinity in the test wells showing the influence of the sewage was generally as high as the alkalinity of the sewage with the exception of well 5. It is felt that the low alkalinity at well 5 represents an average which includes periods during which the bed in which the well is located was dry and the alkalinity during this period of time was that of the natural groundwater in the area. The alkalinity in control well 10 was quite low. The alkalinity in West Brook shows the influence of the seepage between the upstream and downstream sampling locations.

The total soluble phosphorus results indicate that the sewage treatment plant is capable of reducing the phosphorus content by about 50 percent. The effluent from the treatment plant contains approximately 2 mg/l as it is discharged onto the sand bed. Wells 1 and 5 in the sand beds contained the highest concentration of phosphorus in the groundwater. With the exception of scant results at well 2B, the phosphorus content of all the other wells averaged less than 100 $\mu\text{g/l}$. Well 10 had the lowest phosphorus concentration of approximately 25 $\mu\text{g/l}$. The phosphorus content of West Brook above the seepage was approximately 50 $\mu\text{g/l}$. A slight increase in phosphorus content from the upstream to the downstream sampling locations was indicated; however, due to the sampling and analytical techniques, this is not considered to be a significant increase.

The nitrogen analyses indicate a small but significant concentration of nitrate in the sewage treatment plant effluent. This symbolizes a reasonably high degree of treatment of the sewage. However, over 2 mg/l of ammonia nitrogen and over 11 mg/l of total Kjeldahl nitrogen in the sewage treatment plant effluent indicate that there remains some unoxidized nitrogen which is discharged into the ground. Nitrate values higher than the sewage effluent were

found in wells 1, 2A, 3B, 3C, 5, 6A and 6B. Slightly less nitrate was found in the deeper well 2B and in the control well 10. At well site 3, low values were found at the shallowest well 3A and the deepest well 3D; whereas high values were found at the two in-between depths. The relatively low value of 0.35 mg/l of nitrate nitrogen in the upstream area of West Brook was significantly increased to 1.43 mg/l below the seepage. With the exception of well 6B, there was a reduction in the ammonia content from the initial values applied at the sand beds to each one of the test wells. At both well sites 2 and 6, the deeper well points contained greater concentration of ammonia nitrogen. At well location 3, the upper well 3A had a higher value than wells 3B and 3C but well 3D had an ammonia nitrogen content only slightly lower than that of the applied sewage effluent. Only a slight increase in ammonia nitrogen content of West Brook was observed as the stream passed the seepage area. Little reduction in total Kjeldahl nitrogen was observed through the treatment plant, but the total Kjeldahl nitrogen was reduced to low values in all wells with the possible exception of well 6B. The change in total Kjeldahl-nitrogen of West Brook in the area of the seepage was insignificant.

GROUNDWATER LEVEL FLUCTUATIONS

In order to indicate any effect of the discharge of the treated effluent onto the sand beds upon the groundwater level, groundwater level measurements were made in each of the test wells on a routine basis. These results are shown in Figures 12 - 17. The peak flows at the treatment plant occur during July and August through Labor Day weekend. Thereafter, flows taper off with some slight increases during the month of February during which time the winter carnival is held on weekends. Thus the water level in the wells may reflect the discharge of the sewage onto the sand beds. Furthermore, wells 1 and 5 are located in

sand beds N-4 and S-3, respectively. Thus, information is provided in the figures as to when these beds were dosed, to determine if there is any direct relation between the dosing of these beds and the water level in the respective wells. At the urging of the authors, the plant began to record specific data as to time of flooding of the sand beds, starting in September of 1973. Prior to that time, the only records available were when RPI and Environmental Conservation personnel visited the treatment plant and observed whether or not the bed was flooded at the time of sampling. In general, bed N-4 takes 1-1/2 days to drain whereas bed S-3 drains very rapidly in about 1/2 day.

Figure 12 shows the water level changes with time for well 1 and the corresponding days of flooding of sand bed N-4 in which well 1 is located. In general, the water level was highest in July and tapered off gradually throughout the rest of the year with one peak occurring at the beginning of January 1974 after which the downward trend in water level continued through the end of February. Unfortunately, well 1 became clogged after the February sampling and no more information could be obtained from this well. There seemed to be no direct correlation of the frequency of dosing of this sand bed to the level of water in the well. Inasmuch as this is a rather deep well, it is not expected that there would be a significant change in the water level due to the dosing of this bed alone. Any fluctuation in ground water level in this well should be the overall result of the dosing of all of the sand beds at the treatment plant. The total fluctuation observed during this period was approximately 6 ft.

Figure 13 shows the fluctuation in water level in wells 2A and 2B. There was little significant difference between the levels of water in wells 2A and 2B, although there is a shorter period of record for well 2B. The highest level occurred during May through August of 1973 after which it dropped to a minimum at the beginning of January 1974, and then climbed to higher levels by the end

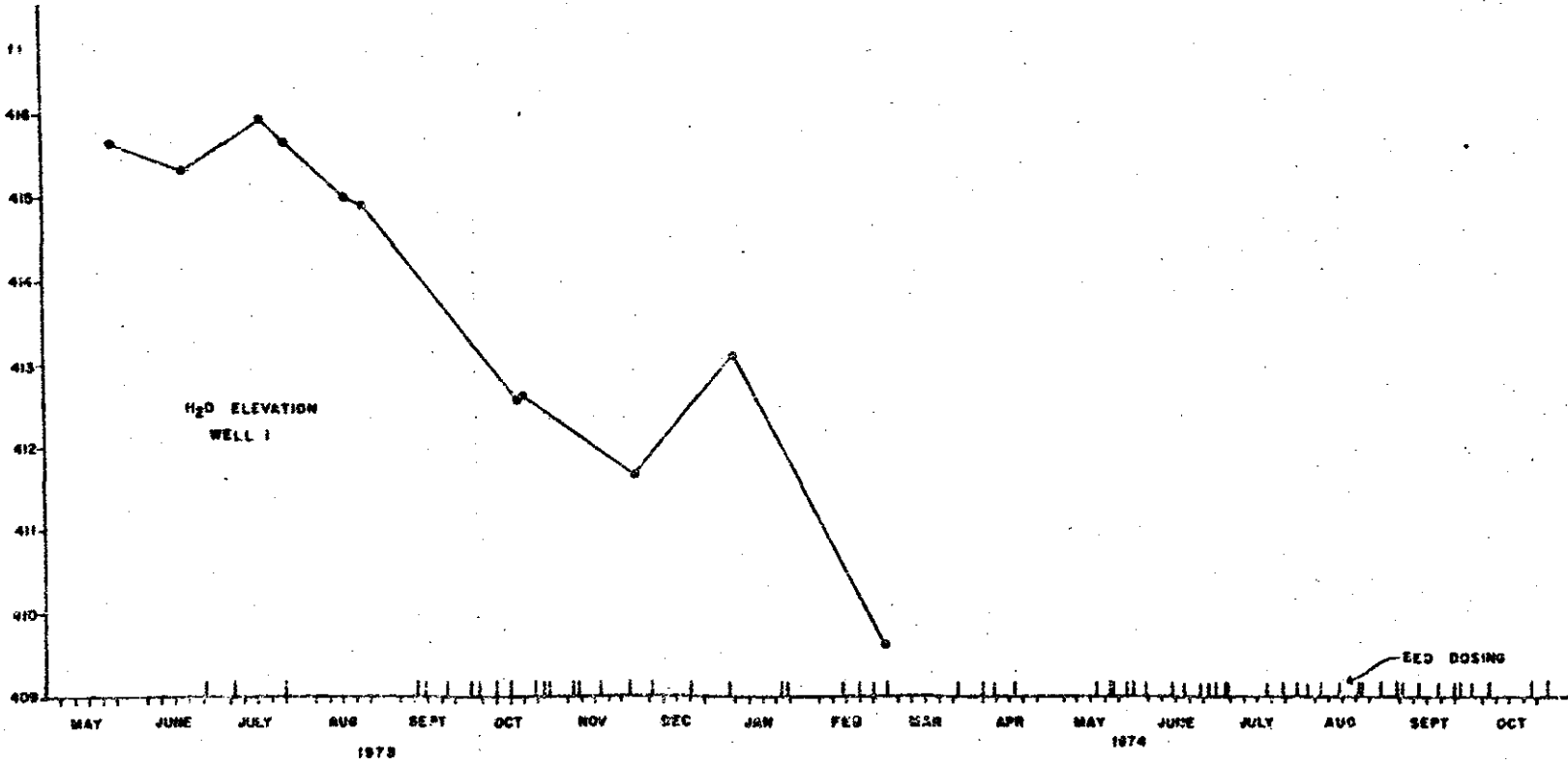


FIGURE 12

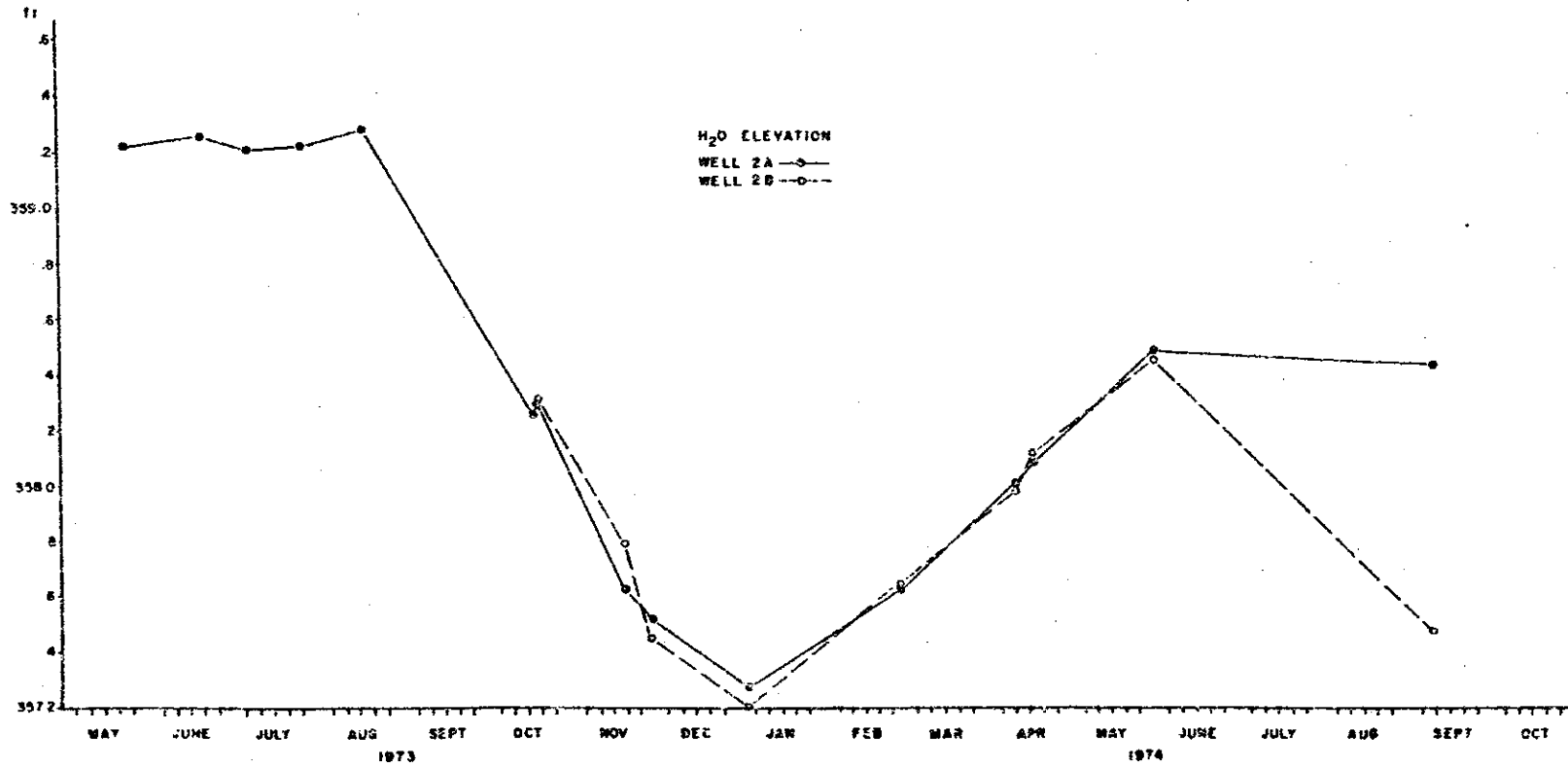


FIGURE 13

of May 1974. This trend corresponds with the peak summer flows at the sewage treatment plant, the dropoff in both sewage flow and precipitation during the fall and the increase in spring due probably to spring thaw and increased groundwater flow. The overall fluctuation was about 2 ft.

The changes in elevation of the water levels in the four wells at well site 3 are shown in Figure 14. With one notable exception in November 1973, wells 3A, 3B and 3C were fairly constant in their water level. The one low value in November for well 3A is questioned. The water level in well 3D which was installed in September 1973 was consistently lower than that for the other depths of wells. There was a slight trend of lower water level in February but the entire variation in water level over the full year was only approximately 0.8 ft.

The system for flooding the beds is to flood one of the lower beds and one of the upper beds simultaneously, changing beds twice a day. Valves are adjusted in the morning for daytime flow and at night to handle the nighttime flows. Since there are more beds in the lower area (14) than in the upper area (7) the frequency of loading of any of the individual beds in the upper bed area is approximately twice that of the beds in the lower area. The flooding of bed S-3 is shown in Figure 15 along with the water level changes determined in well 5. There seemed to be no direct correlation between the depth of water in the well and the dosing of the bed. The highest water level occurred during August of 1973 with a second peak in January 1974. The variation in height of the water was approximately 4.5 ft.

Once the newer well 6A was established, it showed little significant difference in water level from well 6A (Figure 16). This showed the same pattern as wells 1 and 2 with peak levels in July and August and low values in January.

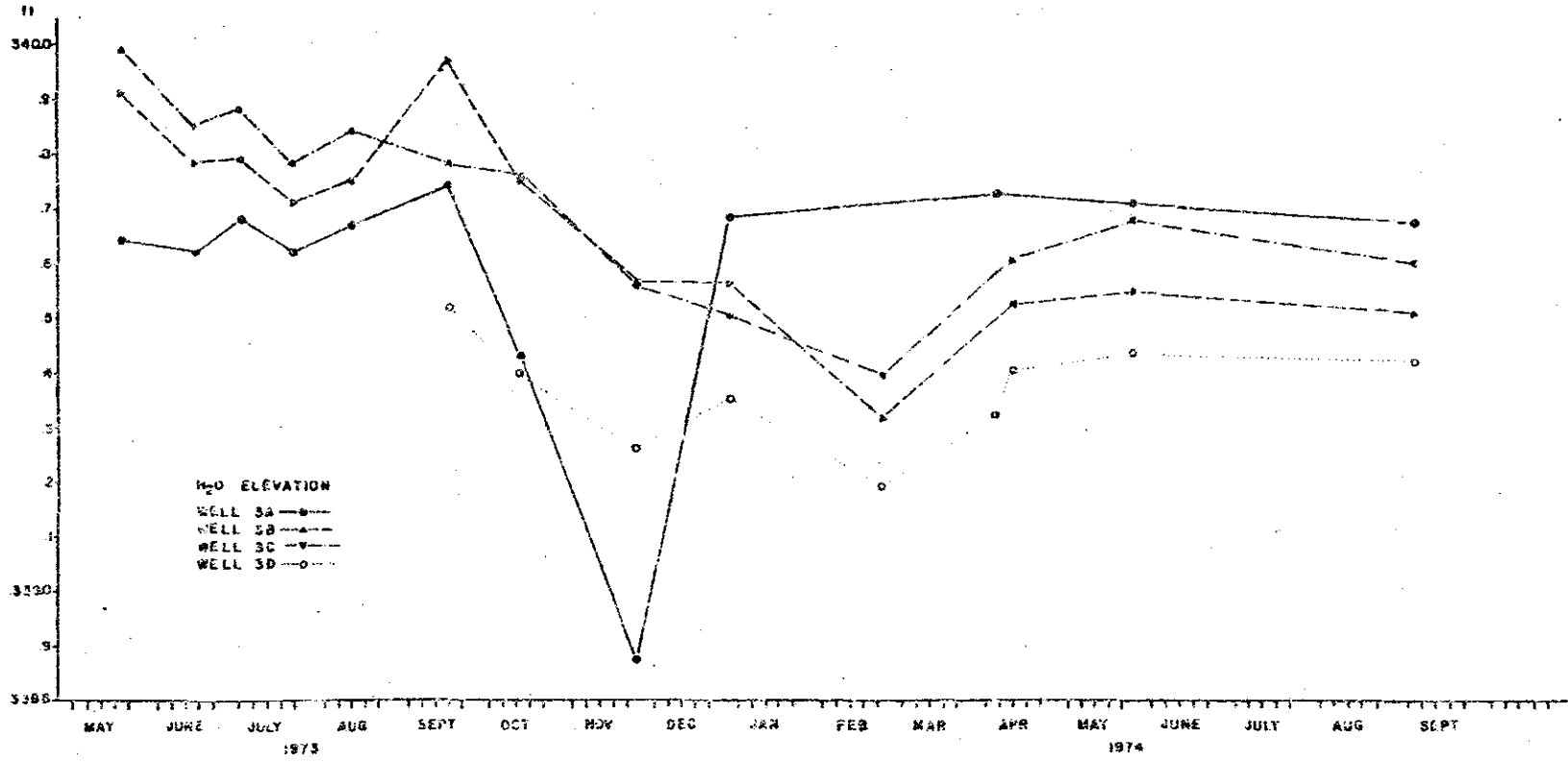


FIGURE 14

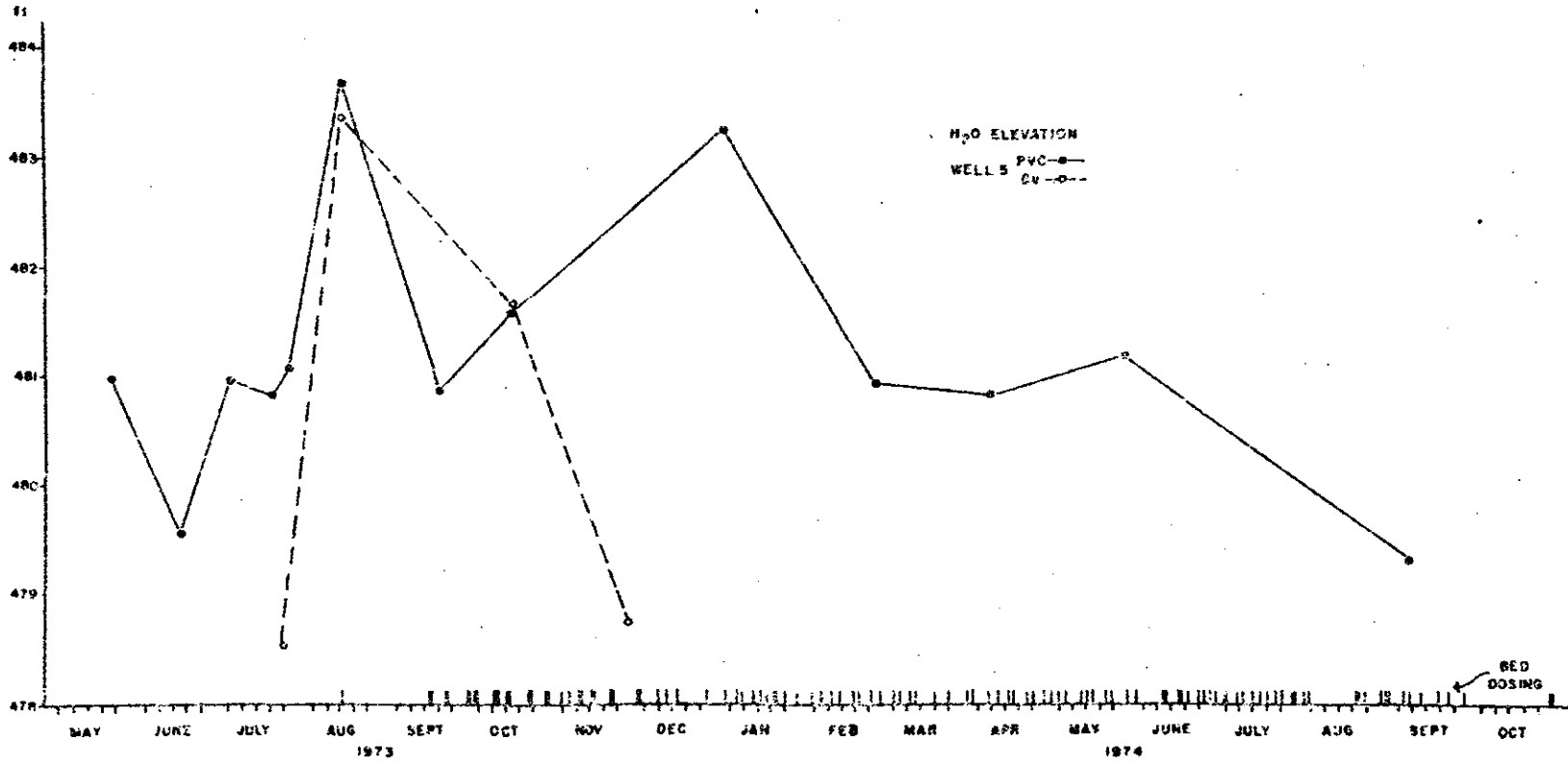


FIGURE 15

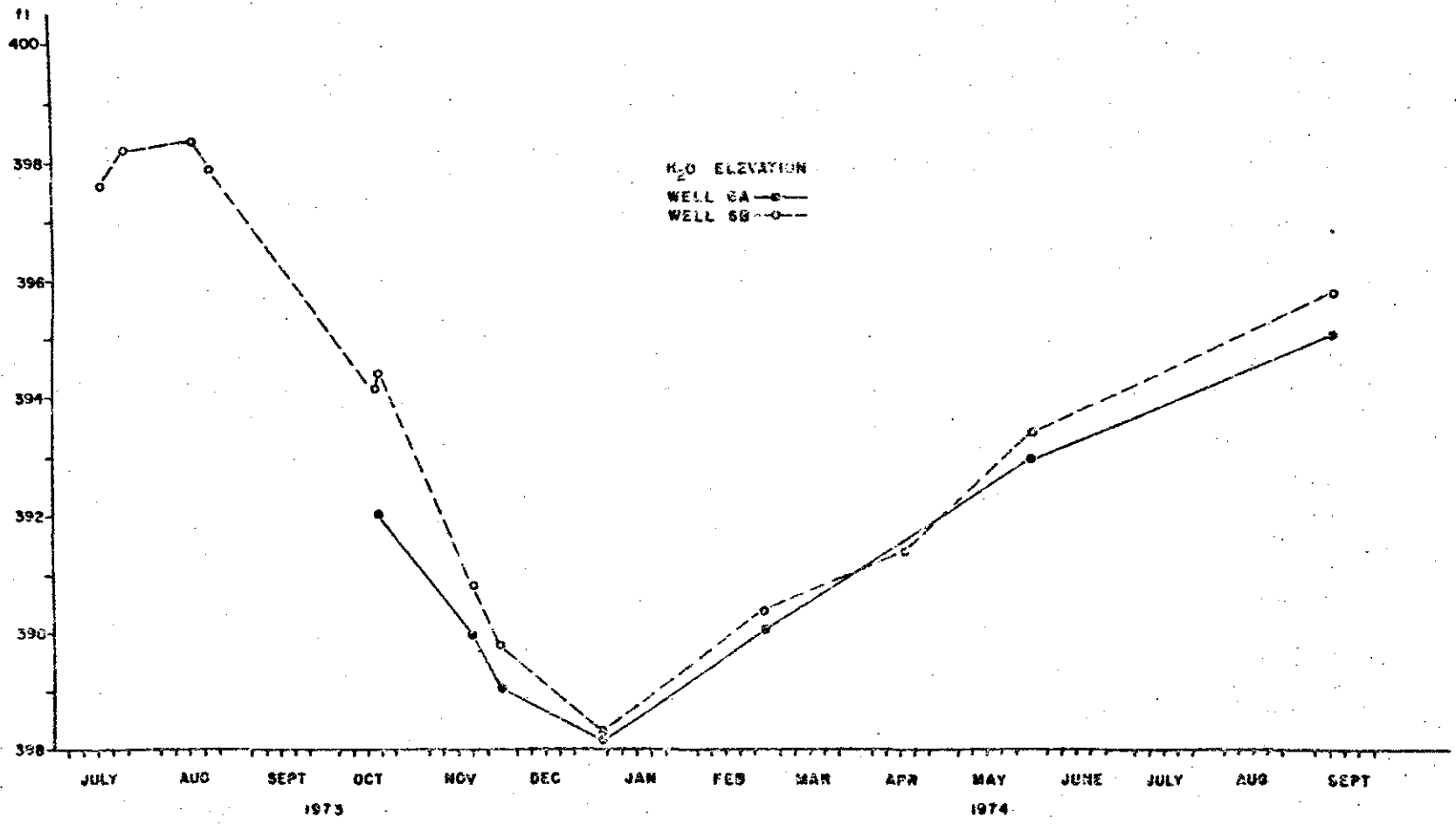


FIGURE 16

The water level again increased beginning with the samples in February. These wells showed the greatest fluctuation in water level, being approximately 10 ft.

Figure 17 indicates that well 10 is little influenced by the sewage discharge. The lowest level of water in this well occurred during October with the highest values in April during the time of spring thaw. The levels of water in this well can be used to determine the background changes in water level not influenced by the treatment plant effluent. The total fluctuation over the year's time was approximately 4 ft.

SUMMARY

The Lake George Village sewage treatment plant presents a rather unique study in the interrelationships between groundwater and surface water. The treatment plant has been discharging its effluent into natural delta sand beds for approximately 35 years. The effluent apparently flows downward to the groundwater table and then flows in a northward direction along with the natural groundwater. West Brook intersects the groundwater, and along the southern banks of West Brook there is a considerable seepage of water from the same sand deposit into which the sewage treatment plant effluent is discharged. The groundwater elevation in test wells in direct line between the recharge area and the seepage area shows the influence of the flow rate at the treatment plant. The water level in the wells at site 3 were fairly consistent due to the fact that basically the groundwater head is above the ground level and this relieves all the pressure allowing the level in the wells to be maintained at essentially the ground level. The passage of the treated effluent through 600 m (2000 ft) of sand from the treatment plant to West Brook achieves a high degree of treatment of the effluent. There is dissolved oxygen present in the groundwater at all times at all of the wells installed in the area. The chloride content of the groundwater is influenced by both the sewage effluent and

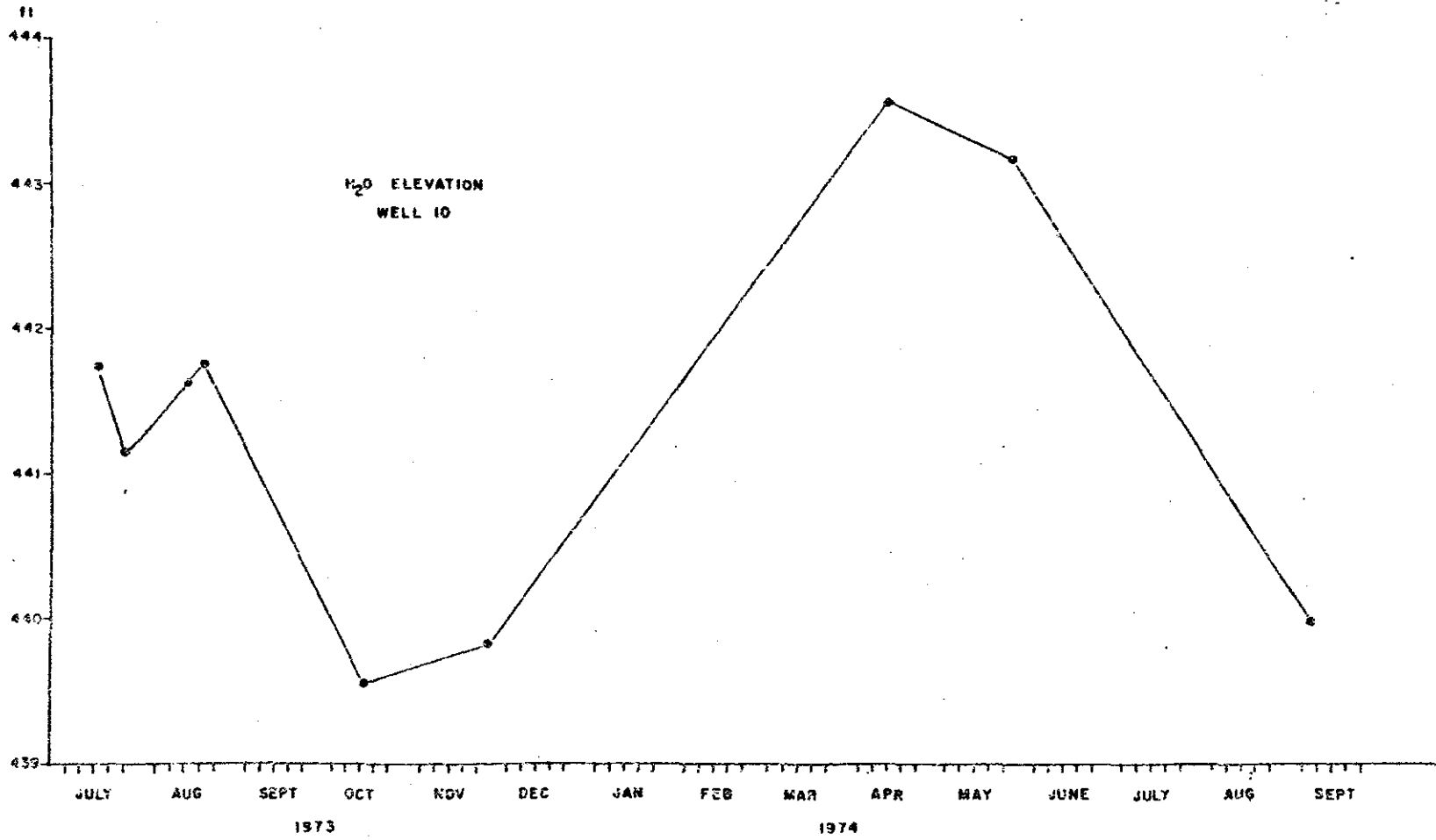


FIGURE 17

by salt which has been stored at the nearby highway department garage. The phosphorus, ammonia, and organic nitrogen have essentially all been removed from the plant effluent in passing through the soil. Apparently, most of the ammonia and organic nitrogen has been converted to nitrate nitrogen. In passing by the area at which the seepage contributes to the flow of West Brook, there is a significant increase in the chloride and the nitrate content of the waters of West Brook. However, the increase in nitrate is well within the acceptable limits for drinking water standards and only well 6A showed a nitrate content exceeding 10 mg/l. Thus the combination of the treatment plant and the discharge of the effluent into the soil provides satisfactory treatment of the sewage to enable the water to be reused as it emerges and enters the surface water phase.

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A P P E N D I X

TABLE A1

Summary of Temperature Data
as of 10/1/74

Sample Location	No. of Samples	Period Covered		Temp., °C		
		From	To	Avg.	Min.	Max.
Well 1	3	6/19/73	8/16/73	14.7	11.8	17.0
Well 2A	4	6/19/73	8/16/73	11.9	10.1	14.4
Well 2B	-	-	-	-	-	-
Well 3A	4	6/19/73	8/16/73	18.9	16.4	20.4
Well 3B	4	6/19/73	8/16/73	16.9	15.1	19.2
Well 3C	4	6/19/73	8/16/73	14.5	14.3	15.0
Well 3D	-	-	-	-	-	-
Well 5	2	7/25/73	8/16/73	21.8	20.0	23.6
Well 6A	-	-	-	-	-	-
Well 6B	2	7/25/73	8/16/73	12.8	12.1	13.6
Well 10	2	7/25/73	8/16/73	-	14.0	23.4 (?)
West Brook Upstream	3	7/6/73	8/16/73	13.0	11.0	14.5
West Brook Downstream	3	7/6/73	8/16/73	13.4	12.7	14.1
STP Inf.	3	7/6/73	8/16/73	22.5	20.0	24.9
STP Eff.	3	7/6/73	8/16/73	22.5	20.0	24.5

TABLE A2

Summary of DO Data
as of 10/1/74

Sample Location	No. of Samples	Period Covered		DO, mg/l		
		From	To	Avg.	Min.	Max.
Well 1	5	6/19/73	2/28/74	5.8	3.4	7.5
Well 2A	10	6/19/73	9/19/74	9.4	7.1	12.7
Well 2B	6	11/19/73	9/19/74	1.6	0.7	3.4
Well 3A	9	6/19/73	9/19/74	4.6	2.0	7.0
Well 3B	10	6/19/73	9/19/74	4.0	1.1	5.7
Well 3C	10	6/19/73	9/19/74	3.4	1.6	6.2
Well 3D	7	10/17/73	9/19/74	1.4	0.4	2.7
Well 5	8	7/25/73	5/30/74	6.1	1.7	9.0
Well 6A	7	10/17/73	9/19/74	2.8	1.4	4.3
Well 6B	10	7/25/73	9/19/74	3.2	1.1	6.6
Well 10	6	7/25/73	9/19/74	6.3	3.4	8.0
West Brook Upstream	8	7/6/73	5/30/74	12.0	9.6	14.0
West Brook Downstream	8	7/6/73	5/30/74	11.5	9.6	13.8
STP Inf.	1	8/16/73	-	2.3	-	-
STP Eff.	4	7/6/73	11/29/73	2.6	1.3	4.1

TABLE A3

Summary of Dissolved Solids Data
as of 10/1/74

Sample Location	No. of Samples	Period Covered		Diss. Sols., mg/l		
		From	To	Avg.	Min.	Max.
Well 1	4	6/19/73	11/29/73	205	160	230
Well 2A	6	6/19/73	11/29/73	195	165	260
Well 2B	-	-	-	-	-	-
Well 3A	6	"	11/29/73	330	270	390
Well 3B	6	"	"	332	300	360
Well 3C	6	"	"	301	285	330
Well 3D	2	9/8/73	-	262	245	280
Well 5	3	7/25/73	11/29/73	127	82	138
Well 6A	-	-	-	-	-	-
Well 6B	2	7/25/73	8/16/73	186	162	210
Well 10	2	"	"	71	43	99
West Brook Upstream	5	4/17/73	"	61	49	75
West Brook Downstream	4			98	70	120
STP Inf.	4	6/26/73	8/16/73	243	232	250
STP Eff.	5	"	11/29/73	206	190	240

TABLE A4

Summary of pH Data
as of 10/1/74

Sample Location	No. of Samples	Period Covered		pH		
		From	To	Avg.	Min.	Max.
Well 1	6	6/7/73	2/28/74	6.51	5.9	6.7
Well 2A	11	"	5/30/74	7.66	7.0	8.3
Well 2B	5	11/19/73	"	8.50	7.8	9.6
Well 3A	9	6/7/73	"	7.13	5.7	7.5
Well 3B	10	6/7/73	"	7.05	5.9	7.43
Well 3C	10	"	"	6.94	5.9	7.48
Well 3D	5	9/8/73	"	8.51	7.75	9.0
Well 5	6	7/25/73	"	6.37	5.2	7.4
Well 6A	4	11/19/73	"	8.10	7.6	9.1
Well 6B	7	7/25/73	"	8.79	8.5	9.11
Well 10	5	"	"	6.86	6.42	7.2
West Brook Upstream	8	4/25/73	"	7.49	7.1	7.80
West Brook Downstream	8	"	"	7.49	7.1	7.71
STP Inf.	4	6/26/73	8/16/73	7.20	6.88	7.6
STP Eff.	7	"	5/30/74	6.94	6.53	8.0

TABLE A5

Summary of Alkalinity Data
as of 10/1/74

Sample Location	No. of Samples	Period Covered		Alkalinity, mg/l as CaCO ₃		
		From	To	Avg.	Min.	Max.
Well 1	3	6/19/73	8/16/73	90.4	87.3	96
Well 2A	4	"	"	134	122	147
Well 2B	-	-	-	-	-	-
Well 3A	4	6/19/73	8/16/73	313	276	352
Well 3B	4	"	"	188	162	223
Well 3C	4	"	"	166	159	173
Well 3D	1	9/8/73	-	184	-	-
Well 5	2	7/25/73	8/16/73	53.3	31	75.7
Well 6A	-	-	-	-	-	-
Well 6B	2	7/25/73	8/16/73	142	106	178
Well 10	2	"	"	43.4	42	44.8
West Brook Upstream	3	7/6/73	"	40.3	33.3	44.8
West Brook Downstream	3	"	"	69.8	56.7	83.5
STP Inf.	3	"	"	163	142	186
STP Eff.	3	"	"	135	106.5	150

TABLE A6

Summary of Chloride Data
as of 10/1/74

Sample Location	No. of Samples	Period Covered		Chloride, mg/l		
		From	To	Avg.	Min.	Max.
Well 1	7	6/7/73	2/28/74	41	20	60
Well 2A	12	"	5/30/74	28	13	33
Well 2B	6	10/17/73	"	44	31	54
Well 3A	7	6/7/73	4/16/74	36	9	45
Well 3B	11	"	5/30/74	55	30	71
Well 3C	10	6/19/73	"	54	30	80
Well 3D	6	9/8/73	"	48.5	20	84
Well 5	6	7/25/73	"	26	8	36
Well 6A	6	10/17/73	"	28	7	41
Well 6B	9	7/8/73	"	36	30	39
Well 10	6	7/25/73	"	6.3	1	21
West Brook Upstream	9	4/25/73	"	12	5	21
West Brook Downstream	9	"	"	19	9	30
STP Inf.	4	6/26/73	8/16/73	38	35	46
STP Eff.	10	4/19/73	5/30/73	38	31	53

TABLE A7

Summary of Total Soluble Phosphorus Data
as of 10/1/74

Sample Location	No. of Samples	Period Covered		Tot. Sol. P, ug/l		
		From	To	Avg.	Min.	Max.
Well 1		6/19/73	2/28/74	519	200	990
Well 2A	11	6/7/73	5/30/74	67.6	17.9	200
Well 2B	5	10/17/73	"	126	20	200
Well 3A	8	6/19/73	"	47.6	29.9	100
Well 3B	9	"	"	36.2	16.3	100
Well 3C	10	6/7/73	"	42.7	18.0	100
Well 3D	5	8/16/73	"	50	20	100
Well 5	6	7/25/73	"	936	300	1,900
Well 6A	5	10/17/73	"	80	30	100
Well 6B	7	7/25/73	"	68.4	13	200
Well 10	6	7/11/73	"	33.3	8.4	70
West Brook Upstream	8	4/17/73	"	49.9	11	117.6
West Brook Downstream	8	"	"	57.7	7.2	120
STP Inf.	4	6/26/73	8/16/73	4,471	4,010	5,240
STP Eff.	8	4/19/73	5/30/74	2,172	700	4,310

TABLE A8

Summary of Nitrate Nitrogen Data
as of 10/1/74

Sample Location	No. of Samples	Period Covered		NO ₃ -N, mg/l		
		From	To	Avg.	Min.	Max.
Well 1	7	6/7/73	2/28/74	7.82	1.20	14.38
Well 2A	11	6/26/73	5/30/74	4.06	2.34	7.0
Well 2B	5	10/17/73	"	0.14	0.1	0.2
Well 3A	8	6/ 7/73	"	0.43	0.065	2
Well 3B	11	6/ 7/73	"	7.70	3	10.32
Well 3C	11	"	"	9.28	4	14
Well 3D	6	9/8/73	"	0.41	0.1	0.7
Well 5	6	7/25/73	"	7.81	1	21.32
Well 6A	5	10/17/73	"	14.2	4.1	21
Well 6B	9	7/8/73	"	2.58	0.1	5.0
Well 10	5	7/11/73	"	0.31	0.09	0.6
West Brook Upstream	8	4/17/73	"	0.35	0.18	0.439
West Brook Downstream	9	"	"	1.43	0.4	3.218
STP Inf.	-	-	-	-	-	-
STP Eff.	6	4/19/73	5/30/74	1.08	0.40	2.3

TABLE A9

Summary of Ammonia Nitrogen Data
as of 10/1/74

Sample Location	No. of Samples	Period Covered		Ammonia N, mg/l		
		From	To	Avg.	Min.	Max.
Well 1	4	6/7/73	11/29/73	0.35	0.1	0.64
Well 2A	9	"	5/30/74	0.08	0.02	0.18
Well 2B	5	10/17/73	"	0.44	0.19	0.62
Well 3A	8	6/7/73	"	0.42	0.05	0.80
Well 3B	8	"	"	0.09	0.02	0.19
Well 3C	7	6/19/73	4/16/74	0.05	0.02	0.08
Well 3D	5	9/8/73	5/30/74	2.05	0.66	4.2
Well 5	4	7/25/73	"	0.13	0.04	0.26
Well 6A	4	10/17/73	"	0.59	0.21	1.4
Well 6B	5	7/25/73	"	3.24	1.1	6.0
Well 10	3	7/11/73	"	0.11	0.09	0.15
West Brook Upstream	7	4/17/73	"	0.05	0.02	0.12
West Brook Downstream	7	"	"	0.10	0.02	0.40
STP Inf.	-	-	-	-	-	-
STP Eff.	6	4/19/73	5/30/74	2.67	0.40	4.8

TABLE A10

Summary of Total Kjeldahl Nitrogen Data
as of 10/1/74

Sample Location	No. of Samples	Period Covered		TKN, mg/l		
		From	To	Avg.	Min.	Max.
Well 1	3	6/19/73	8/16/73	0.612	0.0207	1.713
Well 2A	4	"	"	0.082	0.0245	0.144
Well 2B	-	-	-	-	-	-
Well 3A	4	6/19/73	8/16/73	0.381	0.033	0.975
Well 3B	3	"	"	0.182	0.047	0.393
Well 3C	2	"	"	0.092	0.087	0.097
Well 3D	-	-	-	-	-	-
Well 5	2	7/25/73	8/16/73	0.623	0.533	0.712
Well 6A	-	-	-	-	-	-
Well 6B	2	7/25/73	8/16/73	3.80	3.65	3.95
Well 10	2	"	"	0.594	0.038	1.15
West Brook Upstream	3	4/17/73	"	0.065	0.063	0.069
West Brook Downstream	3	"	"	0.107	0.028	0.191
STP Inf.	2	7/25/73	"	13.01	8.20	17.82
STP Eff.	6	"	5/30/74	11.47	1.58	26