Haley & Aldrich, Inc.

Consulting
Geotechnical Engineers,
Geologists and
Hydrogeologists

30 April 1987
File No. 627800

Town of Sharon
Town Office Building
90 South Main Street
Sharon, Massachusetts 02067

Attention: Mr. Benjamin Puritz
Executive Secretary - Board of Selectmen

Subject: Groundwater Impact Assessment
Proposed On-site Septic System
Former Sacred Heart School Property
Sharon, Massachusetts

Gentlemen:

The following letter report summarizes the results of a groundwater impact assessment conducted in connection with the proposed development of an on-site septic system at the former Sacred Heart School property in Sharon, Massachusetts. The groundwater assessment included evaluation of the potential impacts of the proposed on-site leaching field on Municipal Well #3 and the impacts that would occur should the abandoned leaching field, operated by the former Sacred Heart School, be reopened. The impact on the water supply pumped from Municipal Well #3 has been expressed as a daily incremental increase over reported background levels. Reduction in impact due to dilution as a result of precipitation and through the use of a package treatment plant were also investigated. This report was prepared in accordance with our proposal dated 12 February 1987. The location of the subject site is shown on Figure 1, Project Locus.

Introduction

The subject site is comprised of approximately 2.2 acres on which the abandoned Sacred Heart School is located. We understand that the site is owned by the Town of Sharon and is for sale, and that at least one proposed use of the site includes plans for 33 one-bedroom condominiums which would generate approximately 4000 gpd of domestic sewage. Given that no on-site sewer or septic systems exist, the Town is interested in the suitability of the site for on-site domestic sewage disposal via a conventional septic system. The purpose of this study was to assess the suitability of the site for on-site sewage disposal, and the potential impacts of that disposal on Lake Massapoag, located approximately 1500 ft. southeast of the site, and the Town of Sharon Municipal Well #3, located approximately 2400 ft. northwest of the subject site. Further the study also assessed the impact due to additional nutrient loading should the sewage from some of the homes on Lake Massapoag be transferred to the existing Sacred Heart School leaching field located approximately 1900 ft. east of Municipal Well #3. The town was also interested in the potential benefit of installing a package treatment plant for renovation of effluent.

This assessment is based upon a review of readily available information including previous aquifer and site studies conducted by IEP, Inc. (1), and GHR Environmental, Inc. (2), supplemented by reconnaissance-level surveys of the site, and a limited subsurface exploration program.

Site Conditions

The 2.2-acre parcel is located near the intersection of Cedar Street and East Foxboro Street, approximately 1500 ft. northwest of Lake Massapoag, as shown on Figure 1. The site is currently occupied by two abandoned buildings which in part, comprised the Sacred Heart School. Nearby, on adjacent Town property are tennis courts and a small pond which reportedly is not used for any recreational purposes (3). The site is located on level terrain ranging in elevation from approximately 260 to 265 ft. mean sea level, which slopes gently down to the southeast towards the wetlands adjacent to Lake Massapoag. The area appears to be an outwash plain formed by sands and gravels deposited by glacial meltwater streams. The topography of the site area appears to form a surface drainage divide which separates southeast-oriented flow towards

Lake Massapoag, from northwesterly flow towards Beaver Brook. The small pond to the east of the site appears to be an isolated, body of water with no inflow or outflow streams and appears to be directly connected to the groundwater flow system.

Subsurface Explorations

A total of 4 test borings were completed at the site by Carr-Dee Corporation of Medford, Massachusetts on 6 and 9 March 1987. Observation wells were installed in all of the completed borings. Six observation wells were installed by GHR, Inc. in 1982 as part of a previous study. The boring logs are included in Appendix A.

The borings were completed using 3-3/4-inch inside diameter hollow-stem augers. Soil sampling was performed at 5-ft. intervals from ground surface to borehole completion using a split-spoon sampler driven by a 140-pound hammer. The conduct of the test borings, the soil sampling, and the installation of the observation wells were observed by a Haley & Aldrich, Inc. hydrogeologist. The logs of the test borings are included as Appendix B. Approximate locations of all test borings are shown on Figure 2, Subsurface Exploration Location Plan.

Observation wells are installed in all of the completed test borings. The wells were constructed of 2-inch inside diameter, flush-joint, threaded PVC riser pipes and machine-slotted well screens with 0.01-inch width openings. Each well screen was surrounded by a fine-sand pack extending to at least the top of the screen. A bentonite seal was installed above the top of the sand pack and a cement seal was installed at ground surface at each well. Each well was equipped with a locked standpipe to protect the PVC riser. Water levels were measured periodically in the observation wells using a 100-ft. tape and plunker. Well installation details and groundwater monitoring reports are included in Appendix C. The ground surface elevation of each well was surveyed by Town personnel.

The boring locations were chosen to provide a distributed data base for information on soils and water levels, and to allow a reasonable estimate of groundwater flow directions using the observation wells and existing town monitoring wells shown on Figure 3, Groundwater Level Contour Map.

Subsurface Conditions

The results of the subsurface exploration program indicate that the area is generally underlain by the following materials:

- Fill materials consisting of medium dense to very dense brown coarse to medium sand with varying amounts of cobbles and gravel.

- Glacial outwash deposits consisting of medium dense brown to gray silty fine sand and fine sandy silt with varying amounts of gravel and coarse to medium sand.

Based on the borings undertaken for this investigation and test pits from prior investigations (2) it appears that the soils are suitable for domestic effluent disposal.

Published information indicates the site is underlain by the Sharon Syenite and the Dedham granodiorite formations (4). Depth to bedrock at the site is uncertain; however, no bedrock outcrops were observed during the investigation and the borings were drilled to depths of 17 to 27 ft. without encountering indications of bedrock. GHR borings logs do not indicate evidence of bedrock for borings drilled to depths of 17 to 37 ft.

Hydrology

Groundwater was encountered in the vicinity of subject site in the glacial outwash deposits at depths ranging from approximately 6 to 30 ft. below ground surface (approximately El. 258 to 230 ft. mean sea level). Groundwater was encountered on-site at a depth of approximately 13 ft. Water levels were observed in the site observation wells and in monitoring wells which were installed in the site vicinity during the GHR study. Based on these water levels, groundwater flow appears to be northwest from the site towards Beaver Brook, which is probably a regional groundwater discharge point. The velocity of groundwater flow beneath the subject site was calculated using the hydraulic gradient (defined as the change in groundwater elevation over a lateral distance) of 0.02 derived from the flow contours shown in Figure 3, a hydraulic conductivity (permeability) value of 100 $ft^2/ft/day$ and a porosity value of 0.4, both based on typical values reported in the literature for fine-sand aquifers (5). A regional flow velocity of 5.0 ft. per day was determined, which implies that groundwater flowing from the subject site would take approximately 1.6 years to reach Beaver Brook which is 2900 ft. away.

The Town of Sharon draws its water supply from a series of municipal wells including Municipal Well #3, which is the well closest to the subject site, located approximately 2400 ft. to the northwest and adjacent to Beaver Brook. The average pumping rate for this gravel packed well was 204,140 gpd in 1986. The radius of influence, which is defined as the area over which a well draws its water under pumping conditions, was evaluated by IEP (1) for Municipal Well #3. Under water stressed conditions (pumping at two times the average rate and assuming no recharge) the radius of influence of the well is about 2000 ft. Although the subject site is outside the radius of influence of Municipal Well #3 under these <u>worst case</u> pumping conditions, the topographic setting of the site and the groundwater flow directions indicate that the site is located within the regional recharge area of the well and will be analyzed as such for this report.

To assess the impact of the recharging effluent on the ambient groundwater flow the height of the groundwater mound beneath the leaching field was predicted using the Hantush analytical solution (6). It is necessary that a sufficient thickness of unsaturated soil exists along the projected effluent pathway to prevent saturation of the field and flow of effluent onto the ground surface. The Hantush solution is conservative in that it assumes that recharge occurs uniformly and continuously beneath the leaching field. Aquifer properties obtained from the literature included a specific yield of 0.25 and a transmissivity of 14,955 gal/day/ft. The application rate, 1 gal/day/ft. calculated over long term conditions, 180 days, resulted in a mound height of 0.16 ft. in the center of the field. On the center edges of the field (63.2 ft. by 63.2 ft.), the mound would be 0.15 ft. In the spring of the year, the groundwater elevation is at or near maximum levels. With at least 10 feet of unsaturated soil, a rise in the water table of up to 5 feet could be permitted, thus allowing at least 4 feet between the water table and the leaching area as required by Title 5.

Septic System Impacts

In order to assess the impacts of an on-site septic system servicing the proposed 33 one-bedroom condominiums at the subject site, a computer model which estimates the attenuation of contaminants in groundwater with distance from a given waste source was utilized. The model is the Vertical and Horizontal Spread (VHS) Model which was developed by the Environmental Protection Agency (EPA) and is based on research by P.A. Domenico and V.V. Pakiauskas (7). The model was developed out of a need in solid waste management to predict potential impacts of contaminant-sources on down-gradient receptors, such as water-supply wells and reservoirs, via groundwater-solute transport.

The VHS model determines attenuation of pollutants in groundwater by the process of geometrical spreading, or dispersion. Assuming that the pollutants maintain a constant concentration and are introduced as a continuous source, the model predicts the decline in concentration with distance from the source based on vertical dispersion within the saturated thickness of the aquifer and transverse dispersion perpendicular to the direction of groundwater flow. The model is very conservative (predicts worst-case conditions) in that it assumes a constant source-concentration over time, the receptor is on a direct line emanating from the center of the waste source, no dispersion is considered in the longitudinal direction parallel to the direction of groundwater flow, and no retardation or dilution by recharge are considered. In addition the model ignores other natural attenuation mechanisms such as soil adsorption, biodegradation, oxidation-reduction reactions, and longitudinal dispersion which are difficult and often impossible to quantify.

An initial nitrogen concentration of 40 mg/l was used to model the migration of contaminants in the groundwater (8,9). Nitrogen, in the form of nitrate, nitrite, and ammonia, is considered the most stable element in sewage effluent and therefore a conservative groundwater tracer. For the purpose of this study all of the nitrogen was assumed to be nitrate nitrogen. Chemical and physical processes such as adsorption, filtration, and precipitation retard the movement of other solutes such as phosphates and bacteria. According to the EPA no satisfactory techniques have been developed to accurately measure phosphorous flux from septic tanks (10) to lakes or other receptors. It is difficult to predict the flux of phosphorous and other solutes because of the considerable affects of soil retention which are site specific and time dependent. Percolation of effluent through 5 ft. of moderately permeable soil may reduce nitrogen by up to 85% and phosphorous by up to 95% of initial concentrations even before reaching the groundwater table (11).

The input parameters for the model and sources of information are listed in Table I. Based on Massachusetts State Environmental Code, Title 5 requirements the proposed condominium complex would produce nearly 4,000 gpd of sewage requiring an area of 63.2-ft. wide x 63.2-ft. long (12). Transverse and vertical dispersivity (6.56 ft. and 0.66 ft.) values correspond to the EPA definition of a minimally acceptable drinking water aquifer (13). A "minimally acceptable" aquifer has a very low transmissivity and therefore small dispersivity values. Dispersivity is defined as a characteristic of the porous material which "spreads out" or dilutes a tracer front along the flow path. The smaller the dispersivity value the less the tracer is diluted and the more conservative the estimate.

A sensitivity analysis was conducted on the model to see if variation in any one parameter dramatically affected the resulting concentrations (Table II). The most important variable appears to be the saturated thickness of the aquifer. Once the contaminant reaches the bottom of the aquifer vertical dispersion can be neglected. A minimum aquifer thickness of 20 ft. was assumed based on boring logs completed in the area. The size of the leaching field itself also affected the results. A square leaching field has been assumed for all of the calculations. None of the variables appeared to be so sensitive that minor changes resulted in much higher or lower concentrations at the receptor.

The results of the model predicted the total nitrogen (as nitrate) concentration of the effluent as it approaches Well #3 to be 0.8 mg/l, assuming an initial effluent concentration of 40 mg/l. The average background nitrate concentration (as measured in Well #3) for the years 1983 to 1987 is 2.4 mg/l (15), therefore the cumulative concentration in groundwater would be approximately 3.2 mg/l in this worst case situation. This value remains well below the EPA Primary Drinking Water Regulation of 10 mg/l (14).

The most conservative evaluation assumes no renovation of the effluent (initial concentration equal to 40 mg/l of nitrogen as nitrate) and all effluent (4000 gpd) is intercepted by the well. The maximum potential impact of the effluent on the water withdrawn from the well would increase the nitrate concentrations by approximately 33% over the reported background. This estimation also assumes an average well yield of 204,140 gpd (for 1986) and an average background nitrate concentration of 2.4 mg/l using the following equations:

$$C_F = (V_P C_o + V_E C_E)/V_P \qquad (1)$$

$$\% \text{ Increase} = (C_F - C_o)/C_o \qquad (2)$$

Where,

C_F = Final Nitrate Concentration
C_o = Background Nitrate Concentration
C_E = Effluent Nitrate Concentration
V_P = Volume Pumped by Supply Well
V_E = Volume Effluent Discharged

According to reported literature values, nitrate concentrations may be reduced within the vadose zone up to 95% (9,11). Therefore, if we conservatively assume a 75% reduction of the initial effluent concentration of 40 mg/l due to renovation as it moves through soil profile, the resulting 10 mg/l in the groundwater immediately beneath the leaching field could increase the nitrate concentration in Well #3 by 0.2 mg/l. This represents an 8% increase over the average background level of 2.4 mg/l of nitrogen, as nitrate, which was reported for the years 1983-1987. Table III illustrates the impact of varying the effluent concentration due to renovation. The final nitrate nitrogen concentration in groundwater at Well #3 was well below the EPA Primary Drinking Water Regulation of 10 mg/l despite the level of renovation and the percentage increase in nitrate nitrogen over background levels.

The model was also used to predict the additional impact of effluent produced from re-opening the abandoned Sacred Heart School leaching field to service some of the homes on Lake Massapoag. According to GHR this leaching field was capable of supporting 25,000 gpd of sewage effluent. The leaching field, located near the intersection of East Foxboro and Gunhouse

Streets, is about 1,900 ft. from Municipal Well #3. If it is assumed that both leaching fields were utilized to full capacity and are directly up-gradient from the well, the cumulative total nitrogen concentration in groundwater approaching the well, due to both leaching fields, is predicted to be 6.1 mg/l. The potential impact on the water withdrawn from the well would be an increase of approximately 238% over reported background nitrate concentrations. Figure 4, where cumulative total nitrogen concentrations were predicted versus distance, indicates elevated nitrogen levels, however, they do not exceed the EPA Primary Drinking Water Regulation of 10 mg/l assuming all the nitrogen is in the form of nitrate. The second peak in the cumulative concentration curve represents the introduction of the second and larger contaminant source.

Dilution by Precipitation

In addition to chemical and biological processes which attenuate effluent concentrations, dilution of the effluent will occur in the groundwater as it leaves the site as a result of infiltration of precipitation. This dilution is estimated to further reduce the concentration of effluent based on our estimates of the amount of precipitation recharge between the site and Beaver Brook. Assuming conservatively that the only area available for recharge is a 2,400-ft. long x 200-ft. wide (480,000 sq. ft.) area between the site and the brook, approximately 4.2 million gallons of annual recharge is available for dilution of the flow from the site. This is based on a water budget which assumes that half of the annual 42 inches of precipitation is lost to evapotranspiration and that two-thirds of the remaining water is available for groundwater recharge (approximately 14 inches or 1.17 ft. per year).

Pretreatment

In instances where natural renovation of effluent is of concern, package treatment plants can be used to further reduce the initial concentration of the effluent. The installation of a package treatment plant would reportedly decrease total nitrogen concentrations in the leachate by 20 to 30% (16). Assuming an initial concentration of 30 mg/l instead of 40 mg/l as a result of treatment, in this case decreases the nitrates by 40%, from 0.8 mg/l to 0.5 mg/l as groundwater approaches Municipal Well #3. A package treatment plant is effective in decreasing effluent parameters released to the soil, however it may not be cost effective for treating sewage of this small volume, and low solute concentration. In addition to the initial installation costs, a package treatment plant being a mechanical device subject to malfunction requires operation and maintenance. The use of leaching fields for renovation of domestic sewage is simple, reliable, and relatively maintenance free.

Reopening the former Sacred Heart School leaching field would service about 62 homes, each using 400 gpd. Transferring the individual septic systems of homes on the lake shore to this leaching field would reduce the total nitrogen loading to the lake by up to 1400 kg/yr and the phosphate loading by up to 900 kg/yr assuming no attenuation. However, while decreasing nutrient loading on the lake the effluent source would be moved to within the radius of influence of the well. The lake is used for recreational purposes it is not a primary drinking water source such as Municipal Well #3. Decreasing nitrogen and phosphate in the lake would probably be more efficiently accomplished by treatment rather than by moving the source to another groundwater basin. The use of a package treatment plant for the off-site system might prove to be beneficial considering the volume of effluent involved and the proximity to a municipal water supply well.

Conclusions

- Groundwater contours interpreted from Haley & Aldrich and GHR observation wells data do not indicate any substantial groundwater movement from the proposed on-site leaching field towards Lake Massapoag.

- The proposed on-site sewage-disposal system may increase nitrate concentrations by 0.8 mg/l as groundwater approaches Municipal Well #3 (2,400 ft. away). The potential impact of the effluent on the water withdrawn from the well would be to increase the nitrate concentrations by 33% over reported background levels of 2.4 mg/l. The assumption and model used to estimate effluent concentrations was very conservative ignoring biodegradation, adsorption, dilution by recharge, and longitudinal dispersion therefore 33% represents a maximum increase in effluent concentration near Municipal Well #3. Actual concentration levels may be as much as 95% lower than predicted. In either case the impact of operating a 4000 gpd septic system on the site as discussed is well below the EPA Primary Drinking Water

Regulation of 10 mg/l. Installation of a package treatment plant could further decrease initial concentrations by 20 to 30% however, this would probably not be cost effective considering the small volume of effluent and low solute concentrations produced by the proposed leaching field.

- Utilizing the full available capacity of the leaching field on the former Sacred Heart School property may result in an effluent nitrate concentration of 6.1 mg/l as groundwater approaches Well #3, assuming an additional application rate of 25,000 gpd. This corresponds to a predicted incremental increase in nitrate of 238% over background levels reported in Municipal Well #3, assuming no attenuation. There is no apparent groundwater seepage towards Lake Massapoag from this location. Decreasing nitrogen and phosphate in the lake would probably be more efficiently accomplished by lake side treatment rather than by moving the source to within the radius of influence of a municipal water supply well.

Limitations

This letter has been prepared for the exclusive use of the Town of Sharon in connection with a site presently under consideration for development in Sharon, Massachusetts.

The conclusions provided by Haley & Aldrich, Inc. are based solely on the scope of work conducted and the sources of information referenced in this report. Any additional information that becomes available concerning this site should be provided to Haley & Aldrich, Inc. so that our conclusions and recommendations may be revised and modified as necessary.

The work performed by Haley & Aldrich, Inc. is subject to the terms and conditions stated in our proposal to the Town of Sharon, Massachusetts, dated 12 February 1987 (Work Items 1-5). This work has been undertaken in accordance with generally accepted hydrogeological practices. No other warranty, express or implied, is made.

Thank you for inviting us to undertake this project. Please contact us if you have any questions or require any additional information concerning this project.

Sincerely yours,
HALEY & ALDRICH, INC.

Barbara J. Kickham
Assistant Hydrogeologist

Wesley E. Stimpson
Vice President

BJK:WES:rec/0354t
Enclosures:
Sources of Information
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Table II -- Sensitivity Analyses for EPA VHS Model
Table III -- Changes in Nitrate Concentrations in Groundwater near Well #3
Figure 1 -- Project Locus
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Appendix A - GHR, Inc. Test Boring Reports
Appendix B - Haley & Aldrich, Inc. Test Boring Reports
Appendix C - Groundwater Observation Well Reports and Groundwater Monitoring Reports

SOURCES OF INFORMATION

1. IEP, Inc., 1986, Unpublished Report of Soil Borings for the Town of Sharon.

2. GHR Environmental, Inc., 1982, Unpublished Environmental Impact Report on the Proposed Condominium Conversion in Sharon, Massachusetts.

3. Personal Communication, 1987, Sharon Department of Public Works, James Miller, Town Engineer.

4. Chute, N.E., 1966, "Geology of the Norwood Quadrangle Norfolk and Suffolk Counties, MA," Geological Survey Bulletin 1163-B.

5. Freeze, R.A., Cherry, J.A., 1979, Groundwater, Prentice-Hall, Inc., 604 pp.

6. Hantush, M.S., 1967, "Growth and Decay of Groundwater-Mounds in Response to Uniform Percolation," Water Resources Research, No. 1, pp. 227-234.

7. Domenico, P.A., Palciauskas, V.V., 1982, "Alternative Boundaries in Solid Waste Management," Ground Water, Vol. 20, No. 3, pp. 303-311.

8. Canter, L.W., Know, R.C., 1985, Septic Tank System Effects on Ground Water Quality, Lewis Publishers, Inc., 306 pp.

9. Winneberger, J.H.T., 1984, Septic-Tank Systems: A Consultant's Toolkit: Volume II, The Septic-Tank, Butterworth Publishers, 123 pp.

10. Quantitative Techniques for the Assessment of Lake Quality, 1979, U.S. Environmental Protection Agency, EPA-440/5-79-015.

11. Linsley, R.K., Kohlen, M.A., Paulhus, J.L.H., 1982, Hydrology for Engineers, McGraw-Hill Book Club Co., 508 pp.

12. Massachusetts State Environmental Code, Title 5: Minimum Requirements for the Subsurface Disposal of Sanitary Sewage, MA CMR 310, 15.03.

13. Federal Register, Vol. 50, No. 229, pp. 48899.

14. Environmental Protection Agency Drinking Water Regulations, 40 CFR, 132:0103.

15. Personal communication, 1987, Sharon Town Selectman, Benjamin Puritz and the Sharon Department of Public Works.

16. Process Design Manual for Nitrogen Control, 1975, U.S. Environmental Protection Agency Technology Transfer.

TABLE I

Input Parameters for EPA VHS Model

Parameter	Value	Reference
Initial Concentration of Total Nitrogen	= 40 mg/l	8,9,11
Transverse Dispersivity	= 6.56 ft.	13
Vertical Dispersivity	= 0.66 ft.	13
Discharge Volume (110 gal per bedroom)	= 4,000 gpd	12
Bottom Area of Leaching Field	= 4,000 sq. ft.	12
Length = Width	= 63.2 ft.	
Percolation Rate	= 2 min/in	9
Aquifer Thickness	= 20 ft.	

Distance (feet)	Total Nitrogen (mg/l)
0	40
100	10.510
200	5.798
276	5.251
345	3.711
500	2.310
1000	1.333
1500	0.934
2400	0.789

TABLE II

Sensitivity Analyses for VHS Model

The sensitivity of the model for each of the input parameters was examined and compared to the standard case. The standard is as described in Table 1.

1.	Aquifer Thickness (ft):	15	20	25
	Concentration (mg/l) at 100 ft:	10.51	10.51	10.51
	Concentration (mg/l) at 2,400 ft:	1.404	0.789	0.369
2.	Initial Concentration (mg/l):	30	40	50
	Concentration (mg/l) at 100 ft:	7.882	10.510	13.137
	Concentration (mg/l) at 2,400 ft:	0.476	0.789	1.077
3.	Transverse Dispersivity (ft):	6.56	13.12	
	Vertical Dispersivity (ft):	0.66	1.31	
	Concentration (mg/l) at 100 ft:	10.510	7.925	
	Concentration (mg/l) at 2,400 ft:	0.789	0.862	
4.	a) Length (parallel to flow) = Width (perpendicular to flow = 141.4 ft.			
	Concentration (mg/l) at 100 ft:	22.746		
	Concentration (mg/l) at 2,400 ft:	5.545		
	b) Length = 200 ft. Width = 100 ft.			
	Concentration (mg/l) at 100 ft:	22.737		
	Concentration (mg/l) at 2,400 ft:	2.265		
	c) Length = 100 ft. Width = 200 ft.			
	Concentration (mg/l) at 100 ft:	20.644		
	Concentration (mg/l) at 2,400 ft:	11.444		

TABLE 111

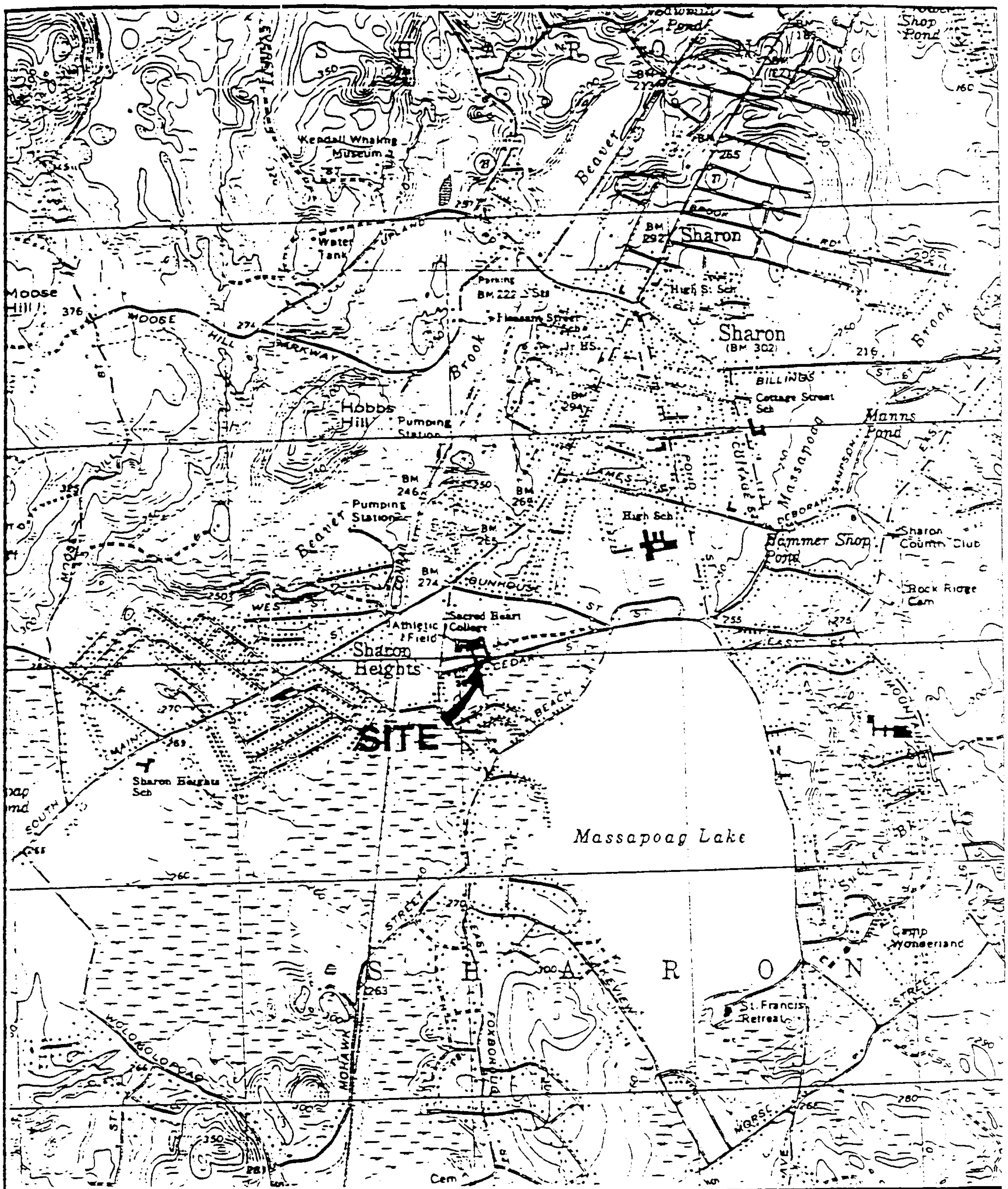
Changes in Nitrate Concentrations in Groundwater Near Well #3

Initial Effluent Concentration (mg/l)	Percent Renovation (%)	Effluent Concentration (mg/l)	Increase in Nitrate Concentration (mg/l)	Final Groundwater Concentration (mg/l)	Increase over Background (%)
40	75	10	0.2	2.6	8
40	63	15	0.3	2.7	13
40	50	20	0.4	2.8	17
40	25	30	0.6	3.0	25
40	0	40	0.8	3.2	33

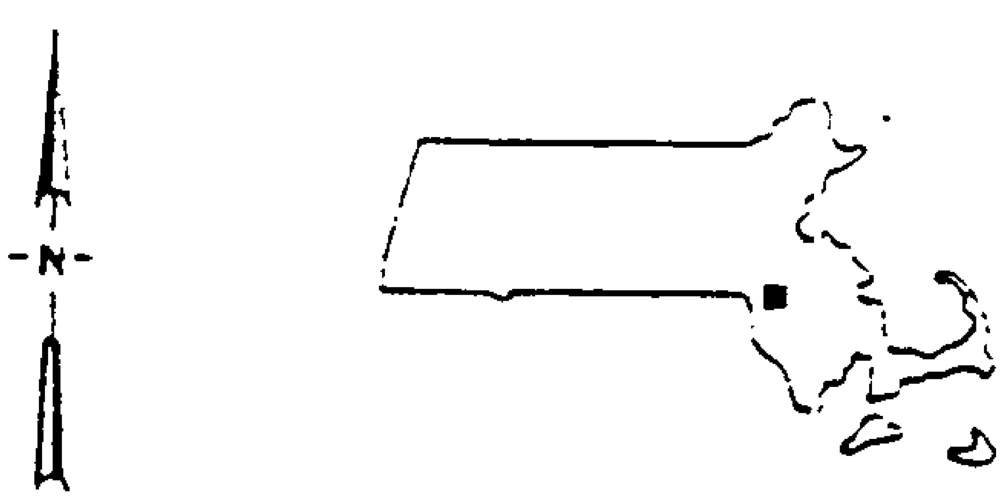
NOTE:

Calculations were made using equations 1,2, and the following assumptions.

Co = 2.4 mg/l (Background Nitrate Concentration)
Vp = 204140 gpd (Volume Pumped By Supply Well)
Ve = 4000 gpd (Volume Effluent Discharged)



SITE COORDINATES: 42°06'33"N 71°11'13"W



U.S.G.S. QUADRANGLE: MANSFIELD, MA

Haley & Aldrich, Inc.

Consulting Geotechnical Engineers, Geologists and Hydrogeologists

GROUNDWATER IMPACT ASSESSMENT
EAST FOXBORO STREET
SHARON, MASSACHUSETTS

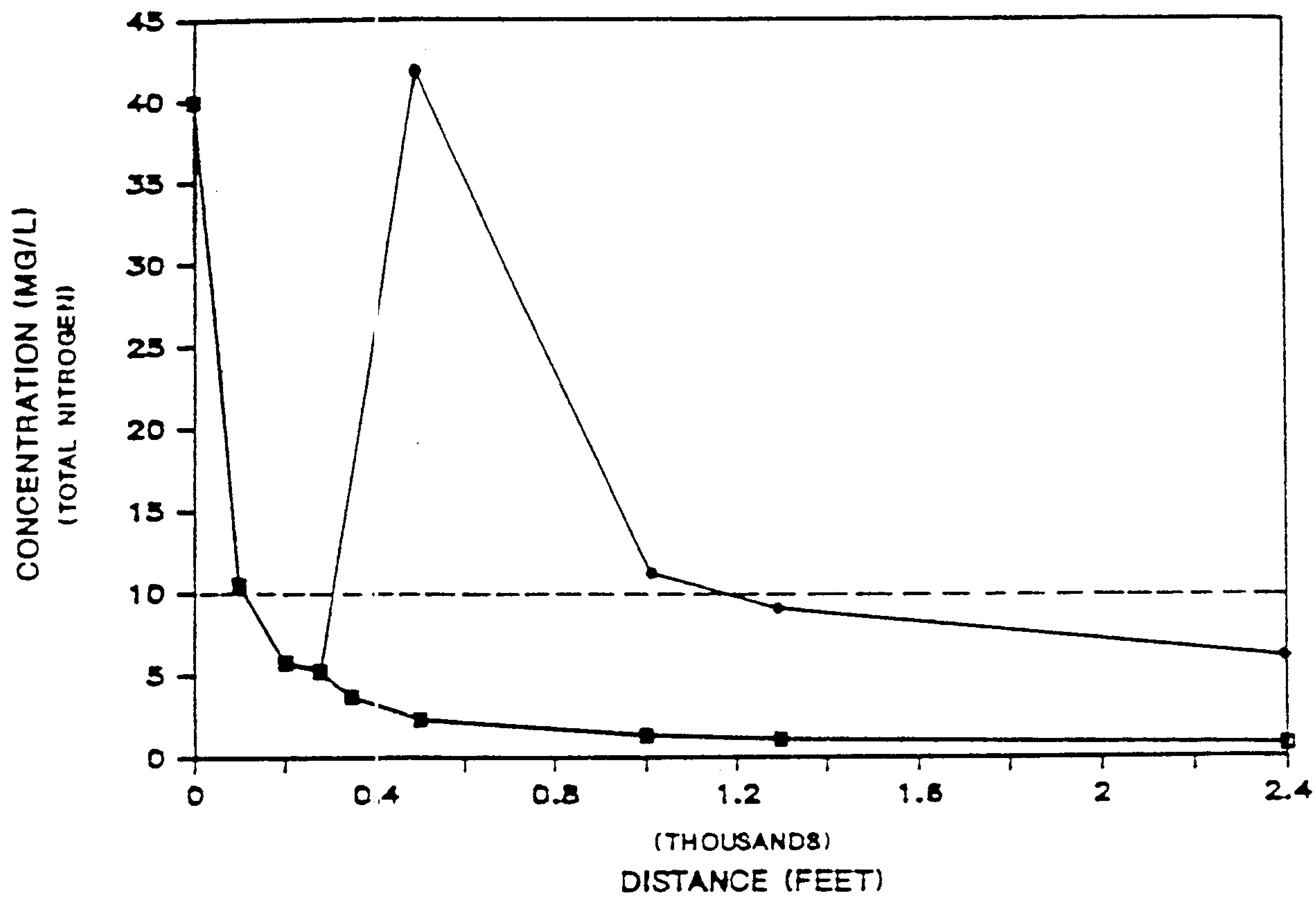
PROJECT LOCUS

APPROX. SCALE 1:25,000

MARCH 1987

FILE NO. 6278 A1

FIGURE



LEGEND:

—□— PREDICTED NITROGEN CONCENTRATION FROM THE PROPOSED CONDOMINIUM LEACHING FIELD.

—●— PREDICTED NITROGEN CONCENTRATION FROM BOTH THE PROPOSED CONDOMINIUM AND FORMER SACRED HEART SCHOOL LEACHING FIELDS (CUMULATIVE).

------ MAXIMUM NITRATE, AS NITROGEN, CONCENTRATION (10 MG/L) ALLOWED BY THE EPA PRIMARY DRINKING WATER REGULATION.

Haley & Aldrich, Inc.
Consulting Geotechnical Engineers, Geologists and Hydrogeologists

GROUNDWATER IMPACT ASSESSMENT
EAST FOXBORO STREET
SHARON, MASSACHUSETTS

CONCENTRATION OF TOTAL NITROGEN vs. DISTANCE FROM THE LEACHING FIELD

SCALE: AS SHOWN

MARCH 1987

FILE NO. 6278 A4

FIGURE 4

APPENDIX A

GHR, INC. TEST BORING REPORTS

TEST BORING LOG

CON–TEC., INC.
P.O. BOX 1153
CONCORD, N.H. 03301
603-224-0020

PROJECT SEPTAGE STUDY

LOCATION SHARON, MA.

HOLE NO. 1

DATE STARTED 10/1/82 COMPLETED 10/1/82

SURF. ELEV. 210.16

GROUND WATER 206.16

JOB NO. 6245

N-NO OF BLOWS TO DRIVE 2" SAMPLER 6" W/140 LB. WEIGHT FALLING 30"

C-NO. OF BLOWS TO DRIVE CASING 12" W/300 LB. WEIGHT FALLING 24"

SHEET 1 OF 1

BORING MADE WITH HOLLOW STEM AUGER CASING

DEPTH	C.	N.	SPL. NO.	SAMPLE DEPTH	DESCRIPTION OF MATERIAL
					Black and brown, dry, SILT, coarse to fine GRAVEL, COBBLES and fine to coarse SAND
5.0'					4.0
		14-50/.4	1	5'-5.9'	Light brown, wet, very dense to medium dense, medium to coarse SAND, some fine to coarse gravel, trace silt
10.0'					
		60-28 9-7	2	10'-12'	
15.0'					
		9-6 4-5	3	15'-17'	17.0
					BOTTOM OF BORING 17.0
20.0'					NOTE: Installed 15.5' of 2" PVC riser pipe in borehole; bottom 10' section is slotted.

TEST BORING LOG

P.O. BOX 1153
CONCORD, N.H. 03301
603-224-0020

PROJECT SEPTAGE STUDY

LOCATION SHARON, MA.

HOLE NO. 2

DATE STARTED 10/5/82 COMPLETED 10/5/82

SURF. ELEV. 255.65

GROUND WATER PERCHED @ 19'; DEPTH ON COMPLETION - 30.2'

JOB NO. 8245

N-NO OF BLOWS TO DRIVE 2" SAMPLER 6" W/140 LB. WEIGHT FALLING 30"

C-NO. OF BLOWS TO DRIVE CASING 12" W/300 LB. WEIGHT FALLING 24"

SHEET 1 OF 1

BORING MADE WITH HOLLOW STEM AUGER CASING

DEPTH	C.	N.	SPL NO.	SAMPLE DEPTH	DESCRIPTION OF MATERIAL
					Brown, dry, coarse to fine GRAVEL, fine to coarse SAND 4.0'
5.0'		5-6	1	5'-7'	Light brown, dry, medium-dense, fine to medium SAND
		7-9			9.0'
10.0'		6-7	2	10'-12'	Light brown, dry, medium-dense, fine SAND, trace silt in occasional 1/8" to ½" layers
		8-10			
15.0'		5-7	3	15'-17'	
		8-10			19.0'
20.0'		4-6	4	20'-22'	Light brown, wet, medium-dense, fine SAND and SILT
		6-5			
25.0'		3-6	5A	25'-26.5'	26.5'
		9-21	5B	26.5'-27'	Light brown, dry, dense, fine SAND, trace silt 28.0'
30.0'		7-7	6	30'-32'	Light brown, wet, medium-dense, fine SAND, little silt 36.0'
		8-9			Orange-brown, wet, medium-dense, fine SAND 37.0'
35.0'		3-3	7A	35'-36'	BOTTOM OF BORING 37.0'
		11-12	7B	36'-37'	NOTE: Installed 37' of 2" PVC riser pipe in borehole; bottom 14' section is slotted.
40.0'					

TEST BORING LOG

CON-TEC., INC.
P.O. BOX 1153
CONCORD, N.H. 03301
603-224-0020

PROJECT SEPTAGE STUDY

LOCATION SHARON, MA.

HOLE NO. 3

DATE STARTED 9/30/82 COMPLETED 10/1/82

SURF. ELEV. 275.30

GROUND WATER DEPTH ON COMPLETION 29.8'

JOB NO. 8245

N-NO OF BLOWS TO DRIVE 2" SAMPLER 6" W/140 LB. WEIGHT FALLING 30"

C-NO. OF BLOWS TO DRIVE CASING 12" W/300 LB. WEIGHT FALLING 24"

SHEET 1 OF 2

BORING MADE WITH HOLLOW STEM AUGER CASING

DEPTH	C.	N.	SPL. NO.	SAMPLE DEPTH	DESCRIPTION OF MATERIAL
		1-2	1	0-2'	TOPSOIL .5'
		2-2			Light brown, dry, loose SILT 2.5'
5.0'					Coarse to fine GRAVEL, COBBLES and coarse to fine SAND 4.5'
		10-13	2	5'-7'	Light brown, dry, medium-dense, medium to coarse SAND, little fine to coarse gravel, cobbles
		13-21			
10.0'					
		6-9	3	10'-12'	
		11-17			
15.0'					
		19-23	4A	15'-16'	16.0'
		13-11	4B	16'-17'	Light brown, dry, medium-dense, fine SAND, trace fine gravel
20.0'					
		9-8	5	20'-22'	
		8-9			
25.0'					
		6-10	6	25'-27'	
		10-13			
30.0'					30.0'
		4-12	7	30'-32'	Light brown, wet, medium-dense, fine to medium SAND, trace fine gravel, trace silt
		11-12			
35.0'					
		4-6	8	35'-37'	37.0'
		9-9			BOTTOM OF BORING 37.0'
40.0'					

TEST BORING LOG

CON–TEC., INC.
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PROJECT SEPTAGE STUDY

LOCATION SHARON, MA.

HOLE NO. 3

DATE STARTED 9/30/82 COMPLETED 10/1/82

SURF. ELEV.

GROUND WATER DEPTH ON COMPLETION 29.8'

JOB NO. 8245

N-NO OF BLOWS TO DRIVE 2" SAMPLER 6" W/140 LB. WEIGHT FALLING 30"

C-NO. OF BLOWS TO DRIVE CASING 12" W/300 LB. WEIGHT FALLING 24"

SHEET 2 OF 2

BORING MADE WITH HOLLOW STEM AUGER CASING

DEPTH	C.	N.	SPL. NO.	SAMPLE DEPTH	DESCRIPTION OF MATERIAL
					NOTE: Installed 39.3' of 2" PVC riser pipe in borehole; bottom 10' section is slotted.