COMMENTS ON

EPA'S FOCUSED FEASIBILITY STUDY
TYSON'S LAGOON SITE

UPPER MERION TOWNSHIP
MONTGOMERY COUNTY, PENNSYLVANIA

SEPTEMBER 10, 1986

PREPARED FOR
CIBA-GEIGY CORPORATION
ARDSLEY, NEW YORK
10502-1699

PREPARED BY: S.H. Siddiqui

EARTH DATA INCORPORATED
34 EAST MARKET STREET
WEST CHESTER, PENNSYLVANIA 19382

SUMMARY AND CONCLUSIONS

Based on the review of various reports related to the Tyson's Lagoon site and our experience, the following summary and conclusions are presented.

- Contrary to the Risk Assessment report by ICF Clement, the Tyson's Lagoon site is not located in the uppermost aquifer of the Stockton Formation. As there is a significant difference between the hydrologic characteristics of the three members (lower, middle and upper) of the Stockton Formation, they should not be mixed. The Tyson's Lagoon site is underlain by the lower member of the Stockton Formation, which is approximately 1,000 feet thick in the site area. It consists of medium- to very coarse-grained arkosic sandstone and some interbedded silty and sandy shale. The bedrock in the area between the Tyson's Lagoon site and the Schuylkill River also belongs to the lower member of the Stockton Formation.
- In general, the bedrock of the Stockton Formation contains both intergranular and fracture porosity and permeability. The ERM investigation has shown that the bedrock in the Tyson's Lagoon site area also contains both intergranular and fracture porosity and permeability. The DNAPLS are present in

the bedrock and the ground water in the bedrock is contaminated.

- There is no surficial on-site aquifer in the unconsolidated material on top of the bedrock.
- Contaminants are present in the bedrock both at the site and in the area north of it between the Schuylkill River and the site. As expected, they are present in variable amounts.
- The extent of the problem of ground-water contamination in the bedrock is not defined.
- The selected alternative (excavation and off-site disposal) is based upon incomplete and deficient investigations which completely ignored the bedrock.
- Although the lagoons were sitting directly on top of the bedrock in a sandstone quarry, no investigation was conducted to define the extent of ground-water contamination in the bedrock.
- The remedial action should consider both the bedrock and the unconsolidated material on top of it.
- Excavation of the unconsolidated material at the site would not remove the DNAPLS from the bedrock, which are the main source of ground-water contamination in the bedrock.
- In several other cases, bedrock wells in the Stockton and Brunswick Formations have experienced continued contamination for several years, even after

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the contaminated soil over the bedrock was removed; for example, Hatfield Borough Well No. 5, Audubon Water Company Wells No. 3 and No. 5, and North Penn Water Authority Wells NP-21 and NP-22. Based on this experience, excavation of the unconsolidated material at the Tyson's Lagoon site will not solve the problem of ground-water contamination in the bedrock.

- Once the organic contamination has entered the bedrock, its cleaning becomes very difficult. In order to be cost-effective, the remedial actions should be based on the real threats to the ground water and its existing and potential future uses. There are no water-supply wells at the site or in the nearby downgradient area.
- The nearby residences are on public water. The ground water in the contaminated area is not used for any beneficial purposes. As the area between the Lagoons site and the Schuylkill River is occupied by the railroad yard and flood plain, there is little or no chance that it will be developed as a source of private or public water supply. As a result, there is no real threat to the ground water in the area.

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- The risk assessment presented is mostly hypothetical, based on invalid assumptions that there will be water-supply wells at the river bank, at or near the site boundary and at the flood-plain-river boundary. Under the existing regulations of the Pennsylvania Department of Environmental Resources, water-supply wells would not be allowed in those areas.
- The estimated volume of the contaminated material proposed for excavation has changed three times, and its actual volume may not be known unless the proposed excavation is carried out. In any case, its removal and off-site disposal would not solve the problem of ground-water contamination in the bedrock. In fact, excavation and off-site disposal of the contaminated material would not protect the ground water but would move the contaminated material to another as yet unidentified area where it may only leak again.
- Excavation of the contaminated material would cause the odor and vapor problems which were the concerns that initiated various investigations. Transportation of the contaminated material over long distances has a substantial risk to human beings and to the environment.

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COMMENTS

The Tyson's Lagoon site, located in Upper Merion Township, Montgomery County, Pennsylvania, is reported to cover an area of approximately four acres. It is an abandoned septic and chemical waste-disposal area which consisted of a series of lagoons constructed in an old sandstone quarry. It is reported that the lagoons received liquid wastes and sludges from bulk tank trucks during the approximate period of 1961 to 1970. General Devices, Inc., the property owner, closed the site in 1973 to comply with an order from the Pennsylvania Department of Environmental Resources (DER). It is reported that in closing the operation, the lagoons were emptied of collected water, backfilled and vegetated, and the water was transported off site.

In response to an anonymous complaint early in 1983, the U. S. Environmental Protection Agency (EPA) instituted several measures (security fence, leachate collection and treatment system, and partial capping and regrading) to alleviate imminent threats to public health associated with the site. A series of field investigations were then conducted by the EPA and its consultants to define the extent of contamination. As a result of the various investigations, several reports and correspondence, including Remedial Investigation (RI), Feasibility Study (FS), Record of Decision (ROD) based on the original RI/FS reports, Risk

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Assessment (RA) and Focused Feasibility Study (FFS), reports were prepared.

The ROD presented the EPA's remedial actions for the site, which were based on an investigation conducted only in the unconsolidated material on top of the bedrock. The remedial actions decisions included the following:

- Excavation and off-site disposal of contaminated soils and wastes to a permitted RCRA landfill.
- Upgrading the existing air-stripping facility.
- Excavation and off-site disposal of contaminated sediments within the tributary which receives effluent from the existing air stripper.

There are no residential dwelling units on, or downgradient from, the site but there are houses to the east, west and south. However, public water and public sewers are available in the area. There are no private water-supply wells on the site, in the downgradient area between the site and the Schuylkill River or in the housing developments near the site. There is a steep quarry high wall to the south and a Conrail railroad switching yard to the north. The area between the tracks and the Schuylkill River is covered by wetlands and flood plain. Therefore, potential for any housing and ground-water supply development in the downgradient area is non-existent.

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The statements, "Although the uppermost aquifer in the Stockton Formation has a yield of only about 20 gallons per minute (gpm), . . ." on page 6-3 and "All of these samples were drawn from the upper aquifer of the Stockton Formation," on page 6-5 of the Risk Assessment report, are misleading. Apparently there is some confusion or misunderstanding on the part of the investigators about the site geology. The site is not located in the uppermost aquifer of the Stockton Formation. It is located entirely in the lower member of the Stockton Formation. Moreover, nine of twelve bedrock wells installed by ERM at the well-nest locations 7, 8, 9 and 10 in the area between the railroad and the Schuylkill River had yields of less than 1.0 gpm. The other three had yields of 1 gpm, 2.5 gpm and 8.0 gpm.

As there is a significant difference between the hydrologic characteristics of the three members (lower, middle and upper) of the Stockton Formation, they should not be confused and mixed. The entire Tyson's Lagoon site (4 acres), the area underlain by the rail yard, the flood plain, the Schuylkill River downstream from the site, and almost 90 per cent of Barbadoes Island, are all underlain by the lower member of the Stockton Formation. Any well drilled at the site to a depth of up to 1,000 feet would be expected to remain within the lower member of the Stockton

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Formation. This situation would change only if there were some subsurface faults not seen on the surface in the area.

The lower member of the Stockton Formation consists of medium-to-coarse-, coarse- and very coarse-grained arkosic sandstone and arkosic conglomerate of gray, reddish brown, and pale-orange color. It is approximately 1,000 feet thick in the area of the Tyson's Lagoon site. It contains some interbedded silty and sandy red shale. It has both intergranular and fracture porosity and permeability. Based on our experience in locating many water-supply and monitoring wells, the distribution of fracture porosity is very irregular. In many cases, the water was encountered at a lithologic change and in fractures within the shale bedrock. Such lithologic changes and fractures would control the presence and migration of the DNAPLS. They would tend to accumulate on top of the shale and siltstone beds and sink into fracture openings. It is not feasible to identify all the fractures which could potentially contain DNAPLS. For a detailed discussion on DNAPLS, please refer to the report prepared by Feenstra and Cherry, which is also a part of the CIBA-GEIGY response to FFS.

The water in the Stockton Formation occurs under both confined and water-table conditions. Moreover, there is differential head distribution in different water-producing

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zones penetrated by many wells in the Stockton Formation. Also, there is internal flow from one water-producing zone to another during non-pumping conditions. Some observation wells may show rising water level when another well is being pumped. Such water-level conditions were also observed during the pumping test conducted by ERM in one of the bedrock wells (No. 5) north of the railroad. In some cases, the head in the deeper zone is so low that the water is not removed unless the pump intake is set very deep. If DNAPLS enter near the bottom of such a well, the recovery process may require careful definition and site specific recovery process. It is likely that the water may be pumped and pure DNAPL may sink and accumulate into the well bottom.

When the well is pumped continuously, the water level declines to a certain depth and a drainage area is established around the well. If no recharge is available, the water level in the well and the surrounding area is continuously lowered. In the contaminated ground-water zones, pumpage and dewatering process remove the contaminants. However, residual contaminants remain trapped in fine fractures and small pores for a long time. As a result, the water in the bedrock remains contaminated even after the source in the unconsolidated material may have been removed.

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All the investigations conducted and decisions made were expected to effectively mitigate and minimize threats to and provide adequate protection for public health and welfare and the environment in a cost-effective manner. As presented in different reports, nine alternatives were considered and the one listed above (excavation and off-site disposal) was selected. It should be noted that all the decisions and alternative selections were based on investigations conducted only in the unconsolidated material on top of the bedrock. Thus, if there were any deficiencies in the investigations, the final decision and alternative selection could be inappropriate, inadequate and perhaps completely useless for achieving the main objective of protecting the public health and welfare.

Based on the review of the available reports, it is my opinion that the selected alternative is based more on hypothetical analyses and assessments and less on the actual site conditions. It does not consider present and future potential land use of the site and the properties between it and the Schuylkill River. It pays no attention to the practical constraints and technical limitations. It is based on investigations which completely ignored the bedrock, even though the lagoons were sitting directly on top of the bedrock. After all, it was a sandstone and not a sand and gravel quarry.

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It is surprising that until ERM conducted some investigations in the bedrock, no investigator could realize that the dense organic contaminants could penetrate the consolidated bedrock even if the main source were not sitting directly on top of the bedrock. It shows the lack of understanding of the fractured-rock hydrogeology and local experience on the part of the previous investigators. It is conceivable and understandable that, being a dense liquid phase, the contaminants would tend to flow on top of the bedrock at the interface of the unconsolidated material and the bedrock. However, at the same time, they would tend to penetrate the intergranular pores and fracture openings in the sandstone. They would easily penetrate the openings along joints and bedding planes which are visible in the bedrock outcrops at the site and are known to be present throughout the Stockton Formation. In any case, even rumors that the waste lagoons were sitting in a sandstone quarry would warrant some investigation into the bedrock. Indeed, the length of time (1961 to 1984) would indicate that some organic contaminants would have penetrated the bedrock aquifer, thereby requiring investigation into bedrock.

Apparently, all efforts were geared to the so-called "cleanup of the toxic waste sites," which means dig it out. Although the estimated cost has increased from about

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6 million dollars to 19 million dollars (300 per cent higher), the alternative is still considered by EPA to be a cost-effective remedy. Similarly, the estimated volume of unconsolidated material to be removed has kept on changing. Based on my field experience (not as much in supervising soil excavations as other hydrogeologic investigations), the volume of the material to be excavated could increase significantly if the criterion described in the FFS and RA reports is used to decide the limits of excavation once it has started.

It is surprising that an alternative which would require exhuming the chemical waste for its transportation over many miles is considered adequate by EPA to protect the public health and welfare and the environment. In fact, the selected alternative (excavation and off-site disposal) will not solve any problem but will merely move the contaminated material from the Tyson's Lagoon site to another as yet unidentified area where it may leak again. It should be noted that vapors and odor were the main concerns to initiate various actions. If the contamination at the site is as bad as indicated by some of the samples, then excavation and transportation of the contaminated material would create vapor and odor problems and might turn out to be a nightmare. At that time, cost-effectiveness may not

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be given any consideration, and whatever would be necessary must be done at any cost.

In any case, excavation and removal of the on-site unconsolidated material (heavily contaminated, less contaminated and clean) is not going to retrieve the contaminants from the bedrock. The bedrock contamination would persist even if excavation was done.

Although I have not participated in as many Superfund sites as the EPA personnel and other consultants working on this project, I have been involved in many water-supply well projects where bedrock wells in the Stockton and Brunswick Formations were contaminated with organic substances. In order to correct the problem, soils in the source area were excavated and taken for off-site disposal (Hatfield Borough Well No. 5; Audubon Water Company Wells No. 3 and 5). In another case, the problems of leaky pipeline and overflowing sewer manholes were corrected (Hatfield Borough Well No. 6). However, the contamination in the bedrock wells is still present even after about five years of correcting the leaks and excavation of the contaminated soils.

The ground water at the site and in the area north of it is not being used for any beneficial purposes and is expected to be discharged into the Schuylkill River. The estimated low flow of the Schuylkill River at a point downstream from

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the Tyson's Lagoon site is reported to be at least 320 cfs or 207.36 million gallons per day, or 144,000 gallons per minute. For a worst case, it may be assumed that all water from precipitation falling on the site and upgradient area to the topographic divide (an area of about 4.0 + 5.3 = 9.3 acres) becomes contaminated when it passes through the Tyson's Lagoon site. Thus, the potential maximum volume of water that could become contaminated due to the presence of contaminants at the Tyson's Lagoon site would be less than 20 gallons per minute (gpm). This amount (20 gpm) is insignificant as compared to the low flow (144,000 gpm) of the Schuylkill River. Thus, depending upon the concentration of the contaminated water, the Schuylkill River may not experience the presence of any significant level of contamination. Therefore, it is highly unlikely that there is a real threat to the health and welfare of the public with respect to the water supply.

The current regulations do not permit the construction of public water-supply wells in the floodways. Due to wetland and flood-plain area and availability of public water supply, no housing development with on-site water supply would be anticipated in the area between the railroad tracks and the river.

An evaluation of the reports related to risk assessment and excavation volume calculations indicates that most of the

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analysis presented and recommendations made are hypothetical and based on many assumptions. For example, the methodology used in the report by ICF SRW Associates, Inc., is based upon at least nine assumptions. Several of the assumptions are listed "probably not true." All of the analyses presented are based upon providing adequate protection of public health, welfare and the environment at the two assumed receptor points: Ca-Groundwater within the on-site aquifer and Crb-Groundwater at the point of discharge to the Schuylkill River.

The Ca is on-site aquifer, also referred to as surficial aquifer, based on the borings done in the unconsolidated material on top of the bedrock. A careful review of the geology of the site and the lower member of the Stockton Formation shows that there is no surficial aquifer in the unconsolidated material on top of the bedrock aquifer. The unconsolidated material at the site appears to be the fill material used to backfill the lagoons at the site. Even if there is any naturally occurring unconsolidated material on top of the bedrock, a public water-supply well cannot be developed in it because the required minimum casing lengths (40 feet in sandstone and 5 to 10 feet below the pumping level in sand; PA DER Manual) would prohibit its use as a source of water supply even if the Tyson's Lagoon site was not used for any waste disposal purposes. Under the cur-

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rent rules and regulations, even dug wells will not be allowed at the Tyson's Lagoon site or in the area beween the site and the Schuylkill River.

In another section, the RA report presents, "It is conceivable that private wells may be established at or near the vicinity of the site boundary sometime in the future." The area is on public water, so there will be no need for any private wells.

In another section, the RA report presents, "There is a potential use for groundwater at a point near the bank of the Schuylkill River." No, there is no potential use of ground water at any point near the bank of the Schuylkill River near the site because the present regulations restrict the ground water development and construction in the flood-plain areas.

According to FFS report, it is assumed that contaminated ground water is in equilibrium with the contaminated soils outside the former lagoon areas. The quantity of contaminated pore water has been calculated on the basis of water balance and assumed steady state loading rate. Although the actual loading rates would vary and the system would rarely be under steady state conditions, the quantity of contaminated pore water may be estimated on an average yearly basis. The estimates presented in the FFS report

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(page 6) are based on incorrect assumptions which are significantly different from some of the published results. For example, the FFS report assumes that evapotranspiration is 6 inches (14.6%) out of the 41 inches of annual precipitation. Based on a recent investigation, the baseflow rate for the sandstone aquifers is 0.64 mgd/mi^2 which is 33 per cent of the total precipitation (Special Groundwater Study of the Middle Delaware River Basin Study Area II). Thus, if there was no runoff, the evapotranspiration would be about 67 per cent of total annual precipitation.

In other parts of southeastern Pennsylvania, it has been estimated that about 65 per cent of total annual precipitation becomes evapotranspiration. The presence of heavily grown vegetation at the site and in the area between the rail yard and the Schuylkill River indicates that evapotranspiration could be substantially high. At 65 per cent rate, 26.7 inches of total annual precipitation (41 inches) would become evapotranspiration, and infiltration will be reduced. Therefore, infiltration will be 14.3 inches per year, or 0.003 feet/day, which is significantly less than the rate used in FFS.

The RA report recommends "that the actual limits of excavation be based on soil sampling and testing for the indicator chemicals used in the risk assessment during con-

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struction. If performed, this may result in a more positive remedial construction effort." Based on experience that subsurface hydrogeologic conditions are always different than assumed, it is my opinion that the actual excavation limits (both volumetric and areal), if determined by field testing and cleanup criteria as described in the FFS/RA reports, would be significantly different from the ones proposed in different reports.

The selected alternative is supposed to be cost effective. However, from the assumptions, uncertainties and qualified statements presented in different reports (FS, RA, WWC, FFS, etc.), it appears that the actual volumes and the cost of excavation would be so high that it is no longer cost effective. Once excavation has started, it may appear necessary to excavate most of the four-acre site, the cost of which would be astronomically high. Above all, it is not feasible to excavate the bedrock, which has contaminants under the lagoons and in the nearby area. As a result, the remedial actions should consider both the bedrock and the unconsolidated material on top of it.

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PROFESSIONAL PROFILE

Shams H. Siddiqui, Ph.D., P.HG.,P.G.

RESPONSIBILITIES:

- Co-founder, partner, vice-president of Earth Data
- Manager of West Chester, PA office
- Quality Assurance Director
- Technical project management
- Proposal preparation
- Client/regulatory agency relations
- Editorial review

EXPERTISE:

- Fracture-trace analysis for high-yield well location
- Consolidated rock aquifer hydrogeology
- Pumping test analysis of fractured rock aquifers
- Evaluation of ground-water contaminant migration
- Statistical analysis of hydrogeologic data
- Expert testimonpyy

EXPERIENCE:

Following is a selected list of ground-water contamination projects in which Dr. Siddiqui has participated:

Hatfield Borough Water Company: Two of the eleven wells were found to be contaminated with organic compounds. The level of contamination in one of the two wells is still above the limits, even though the soil at the source area was excavated several years ago. The other well was contaminated from the wastewater that leaked from a sewer main and overflowed from a manhole whose lid was designed to pop up during the spring surcharge period. The overflowed water seeped into the soil and fractured bedrock. The well is located within 500 feet of the sewer line. The problem was detected as an odor and taste problem. The lab results did not show the presence of any organics above the detection limit. Although the sewer line has been repaired and the surcharge overflow has been eliminated, some odor and taste persist even after about 5 years of correcting the problem at the source. The water is treated with an activated carbon filter which has been successful in removing the odor and taste. The two wells are located in the fractured-rock aquifers of the Brunswick Formation. Apparently, some organic chemicals leave their imprints in the bedrock for a long time.

North Penn Water Authority: Ground-water contamination by organic compounds of Trichloroethylene, perchloroethylene, etc., in the North Penn Water Authority water-supply system. The system includes more than 60 wells located in the fractured-rock aquifers (Brunswick and Lockatong shales) of the Triassic basin. A number of wells have been found to be contaminated with organic contaminants entering the wells at different depths depending upon a number of factors. In at least one case, the soil was excavated at one of the source areas. The well in the area is still contaminated.

Audubon Water Company wells located in the Stockton Formation (about four miles west of the Tyson site also have an organic contamination problem, even after the soil at the source area was excavated.

Warminster Municipal Authority wells (42 wells) are located in the middle member of the Stockton Formation. Performed testing of wells for the potential presence of contaminants. Two wells have organic contamination to render them out of service. One of the wells was continuously pumped to control the migration of contaminants to another high-yield well. Recently, a treatment system has been installed to improve the water quality. One of the wells had experienced bacterial contamination. The source of contamination and the problem were defined with the help of borehole geophysical logging and by conducting packer tests. There was internal flow and differential head distribution in the well.

Definition of the problem of soil and ground-water contamination by organic compounds in the area of a spent-chemical recycling facility. The site is underlain by carbonate rocks where the bedrock has directional porosity and permeability.

Performed fracture-trace analysis in a contaminated ground-water area in the Triassic rocks in the Manassas area of Virginia. Some of the fracture traces identified the directions of the contaminant movement to residential wells.

Cyanide contamination of the ground water in an area underlain by carbonate rocks. Conducted hydrogeologic investigation to define the problem and designed a contaminant recovery system to effect aquifer restoration.

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Located more than 100 successful high-yield wells using fracture trace analysis in consolidated rock terrains, including Stockton Formation (at least 25 wells). Has worked on several projects in the Audubon-Valley Forge corporate center area which is located within five miles west of the Tyson site.

Determined extent of subsurface contamination from petrochemicals and designed a contaminant-recovery system for a major oil refinery in Italy.

Designed monitoring and recovery well system for existing landfills.

Prepared hydrogeologists' reports for ground water withdrawal applications to Delaware River Basin Commission in the Ground Water Protected Area.

Prepared and supervised implementation of RCRA monitoring and lagoon closure plans.

Expert technical testimony in ground-water availability based zoning conflict.

Evaluation of impacts of subsurface wastewater disposal.

Research on hydrogeology of fractured carbonate rocks and application of statistical techniques to hydrologic data.

Reclamation projects to control water-logging and salinity in the irrigated plains of the Indus River Basin in West Pakistan.

PROFESSIONAL
REGISTRATIONS:

Professional Geologist, Delaware #176
Professional Geologist, Georgia #518
Certified Professional Hydrogeologist #397

PROFESSIONAL
AFFILIACIONS:

American Geophysical Union
American Institute of Hydrology
Society of Petroleum Engineers (AIME)
American Association for the Advancement of Science
National Water Well Association
American Water Works Association
American Statistical Association
Biometric Society
Water Works Operators Association of Pennsylvania
Water Resources Association of the Delaware River Basin

AR311994

EDUCATION:

B.Sc. Geology, Physics and Mathematics, 1955
Aligarh Muslim University, India

M.Sc. Geology, 1959
University of Karachi, Pakistan

Ph.D. Hydrogeology, 1969
Pennsylvania State University

Regional Training Course in Arid Zone Hydrogeology arranged by UNESCO, 1962

Short course in analog and digital simulation models, 1969

EMPLOYMENT HISTORY:

1982 - Present	- Earth Data Incorporated, Vice-President
1977 - 1982	- Moorshead-Siddiqui and Associates, Partner and Consultant
1972 - 1977	- Roy F. Weston, Inc., Senior Hydrogeologist
1963 - 1972	- The Pennsylvania State University: (1969-1972) Research Associate; (1963-1969) Research Assistant
1959 - 1963	- West Pakistan Water and Power Development Authority, Ground-water Geologist

PAPERS AND PUBLICATIONS:

Siddiqui, S. H., 1969, Hydrogeologic Factors Influencing Well Yields and Aquifer Hydraulic Properties of Folded and Faulted Carbonate Rocks in Central Pennsylvania, Unpublished Ph.D. dissertation, The Pennsylvania State University, September 1969, 502 pp.

Parizek, R. R., S. H. Siddiqui, 1969, Determining the Sustained Yields of Wells in Carbonate and Fractured Aquifers: Water Well Journal, Vol. 23, No. 9, pp. 81-82 (Abstract).*

Siddiqui, S. H., R. R. Parizek, 1969, Hydrogeologic Factors Influencing Well Yields in Folded and Faulted Carbonate Rocks, Central Pennsylvania: Trans. A.G.U. Vol. 50, No. 4, p. 154 (Abstract).

Parizek, R. R., S. H. Siddiqui, 1970, Determining the Sustained Yields of Wells in Carbonate and Fractured Aquifers: Ground Water, Vol. 8, No. 5, pp. 12-20.

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Siddiqui, S. H., R. R. Parizek, 1971, Evaluation of Measurement Errors by Repeated Pumping Tests: Journal of Hydrology, Vol. XIII, No. 2, pp. 182-191.

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Siddiqui, S. H., R. R. Parizek, 1971, An Application of Parametric Statistical Tests to Well-Yield Data from Carbonates of Central Pennsylvania: Trans. A.G.U., Vol. 52, No. 4, p. 296 (Abstract).

Siddiqui, S. H., R. R. Parizek, 1972, Application of Nonparametric Statistical Tests in Hydrogeology: Ground Water, Vol. 10, No. 2.

Siddiqui, S. H., R. R. Parizek, 1971, Variations in Well Yields and Controlling Hydrogeologic Factors: in Hydrogeology and Geochemistry of Folded and Faulted Carbonate Rocks of the Central Appalachian Type and Related Land Use Problems, by Parizek, R. R. et al.; G.S.A. Guidebook, pp. 87-95.

Siddiqui, S. H., R. R. Parizek, 1974, An Application of Parametric Statistical Tests to Well Yield Data from Carbonates of Central Pennsylvania: Journal of Hydrology, Vol. 21, pp. 1-14.

* All papers presented by Siddiqui.

AR311996

PROFESSIONAL PROFILE

Shams H. Siddiqui, Ph.D., P.HG.,P.G.

RESPONSIBILITIES:

- Co-founder, partner, vice-president of Earth Data
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Cyanide contamination of the ground water in an area underlain by carbonate rocks. Conducted hydrogeologic investigation to define the problem and designed a contaminant recovery system to effect aquifer restoration.

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Located more than 100 successful high-yield wells using fracture trace analysis in consolidated rock terrains, including Stockton Formation (at least 25 wells). Has worked on several projects in the Audubon-Valley Forge corporate center area which is located within five miles west of the Tyson site.

Determined extent of subsurface contamination from petrochemicals and designed a contaminant-recovery system for a major oil refinery in Italy.

Designed monitoring and recovery well system for existing landfills.

Prepared hydrogeologists' reports for ground water withdrawal applications to Delaware River Basin Commission in the Ground Water Protected Area.

Prepared and supervised implementation of RCRA monitoring and lagoon closure plans.

Expert technical testimony in ground-water availability based zoning conflict.

Evaluation of impacts of subsurface wastewater disposal.

Research on hydrogeology of fractured carbonate rocks and application of statistical techniques to hydrologic data.

Reclamation projects to control water-logging and salinity in the irrigated plains of the Indus River Basin in West Pakistan.

PROFESSIONAL
REGISTRATIONS:

Professional Geologist, Delaware #176
Professional Geologist, Georgia #518
Certified Professional Hydrogeologist #397

PROFESSIONAL
AFFILIACIONS:

American Geophysical Union
American Institute of Hydrology
Society of Petroleum Engineers (AIME)
American Association for the Advancement of Science
National Water Well Association
American Water Works Association
Amexican Statistical Association
Biometric Society
Water Works Operators Association of Pennsylvania
Water Resources Association of the Delaware River Basin

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EDUCATION:

B.Sc. Geology, Physics and Mathematics, 1955
Aligarh Muslim University, India

M.Sc. Geology, 1959
University of Karachi, Pakistan

Ph.D. Hydrogeology, 1969
Pennsylvania State University

Regional Training Course in Arid Zone Hydrogeology arranged by UNESCO, 1962

Short course in analog and digital simulation models, 1969

EMPLOYMENT HISTORY:

1982 - Present	- Earth Data Incorporated, Vice-President
1977 - 1982	- Moorshead-Siddiqui and Associates, Partner and Consultant
1972 - 1977	- Roy F. Weston, Inc., Senior Hydrogeologist
1963 - 1972	- The Pennsylvania State University: (1969-1972) Research Associate; (1963-1969) Research Assistant
1959 - 1963	- West Pakistan Water and Power Development Authority, Ground-water Geologist

PAPERS AND PUBLICATIONS:

Siddiqui, S. H., 1969, Hydrogeologic Factors Influencing Well Yields and Aquifer Hydraulic Properties of Folded and Faulted Carbonate Rocks in Central Pennsylvania, Unpublished Ph.D. dissertation, The Pennsylvania State University, September 1969, 502 pp.

Parizek, R. R., S. H. Siddiqui, 1969, Determining the Sustained Yields of Wells in Carbonate and Fractured Aquifers: Water Well Journal, Vol. 23, No. 9, pp. 81-82 (Abstract).*

Siddiqui, S. H., R. R. Parizek, 1969, Hydrogeologic Factors Influencing Well Yields in Folded and Faulted Carbonate Rocks, Central Pennsylvania: Trans. A.G.U. Vol. 50, No. 4, p. 154 (Abstract).

Parizek, R. R., S. H. Siddiqui, 1970, Determining the Sustained Yields of Wells in Carbonate and Fractured Aquifers: Ground Water, Vol. 8, No. 5, pp. 12-20.

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Siddiqui, S. H., R. R. Parizek, 1971, Evaluation of Measurement Errors by Repeated Pumping Tests: Journal of Hydrology, Vol. XIII, No. 2, pp. 182-191.

Siddiqui, S. H., R. R. Parizek, 1971, Hydrogeologic Factors Influencing Well Yields in Folded and Faulted Carbonate Rocks in Central Pennsylvania: Water Resources Research, Vols. 7, No. 5, pp. 1295-1312.

Siddiqui, S. H., R. R. Parizek, 1971, An Application of Parametric Statistical Tests to Well-Yield Data from Carbonates of Central Pennsylvania: Trans. A.G.U., Vol. 52, No. 4, p. 296 (Abstract).

Siddiqui, S. H., R. R. Parizek, 1972, Application of Nonparametric Statistical Tests in Hydrogeology: Ground Water, Vol. 10, No. 2.

Siddiqui, S. H., R. R. Parizek, 1971, Variations in Well Yields and Controlling Hydrogeologic Factors: in Hydrogeology and Geochemistry of Folded and Faulted Carbonate Rocks of the Central Appalachian Type and Related Land Use Problems, by Parizek, R. R. et al.; G.S.A. Guidebook, pp. 87-95.

Siddiqui, S. H., R. R. Parizek, 1974, An Application of Parametric Statistical Tests to Well Yield Data from Carbonates of Central Pennsylvania: Journal of Hydrology, Vol. 21, pp. 1-14.

* All papers presented by Siddiqui.

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