Public Health Assessment

Reich Farm
CERCLIS Number: NJD980529713

Dover Township, Ocean County, New Jersey

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Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
BEHP	Bis(2-ethylhexyl) phthalate
CACCCC	Citizens' Action Committee on Childhood Cancer Cluster
CCE	Carbon/chloroform extractable
CCl_4/IR	Carbon tetrachloride extraction/infrared absorption
CREG	Cancer Risk Evaluation Guideline
DTBH	Dover Township Board of Health
DTML	Dover Township Municipal Landfill
EMEG	Environmental Media Evaluation Guide
ESD	Explanation of Significant Difference
HSL	Hazardous Substance List
IARC	International Agency for Research on Cancer
MRL	Minimal risk level
ND	Not detected
NIEHS	National Institute for Environmental Health Sciences
NJDEP	New Jersey Department of Environmental Protection
NJDHSS	New Jersey Department of Health and Senior Services
MCL	Maximum contaminant level
OCHD	Ocean County Health Department
PCE	Perchloroethylene (tetrachloroethylene)
PHAP	Public Health Action Plan
PHRP	Public Health Response Plan
ppb	Parts per billion
ppm	Parts per million
RF	Reich Farm
RfD	Reference dose
RI/FS	Remedial Investigation/Feasibility Study
RMEG	Reference Dose Media Evaluation Guide
ROD	Record of Decision
SAN trimer	Styrene-acrylonitrile trimer
SVOC	Semi-volatile organic chemical
TCE	Trichloroethylene
TCL	Target Compound List
TOC	Total organic carbon
TRWC	Toms River Water Company
UCC	Union Carbide Corporation
USEPA	United States Environmental Protection Agency
UWTR	United Water Toms River
VOC	Volatile organic chemical

Summary

In response to concerns of the Dover Township community regarding an increased incidence of childhood cancers, the New Jersey Department of Health and Senior Services (NJDHSS) and the Agency for Toxic Substances and Disease Registry (ATSDR) developed a Public Health Response Plan to organize and conduct public health investigations. In addition to evaluating the chemical and radiological quality of the community water supply and analyzing New Jersey State Cancer Registry statistics, the NJDHSS and the ATSDR initiated Public Health Assessments for two National Priorities List sites which are located in Dover Township: Reich Farm (RF; CERCLIS #NJD980529713) and Ciba-Geigy Corporation (CERCLIS #NJD001502517). Based upon information collected by the NJDHSS and the ATSDR during health assessment activities for the RF site, and a high level of community concern, the NJDHSS and the ATSDR also began a separate Public Health Assessment to evaluate the public health issues associated with the Dover Township Municipal Landfill (CERCLIS #NJD980771570). The Public Health Assessments provide a review of environmental health issues and evaluate past and current human exposure pathways associated with these sites.

Drummed chemical wastes originating at the Union Carbide Corporation (UCC) facility in Bound Brook, New Jersey were deposited, by a waste hauler contracted by the UCC, at both the Reich Farm (RF) site and the Dover Township Municipal Landfill in 1971. Wastes at the RF site have migrated through groundwater and impacted private and community water supply wells with volatile and semi-volatile organic chemicals. While private well contamination is documented as early as 1974, contamination of certain wells at the Parkway well field of the community water supply was not documented until 1986. Hydrologic models are under development to provide estimates of the time that contaminants might have taken to reach the Parkway well field.

The chemical composition of the groundwater contamination in the past is not well characterized, but a variety of chemicals including trichloroethylene (TCE), tetrachloroethylene (PCE), and a previously unknown material -- styrene-acrylonitrile (SAN) trimer -- have been found in the plume. Although a toxicological evaluation of levels of exposure to known contaminants did not suggest that adverse health effects are likely, this evaluation is based on limited historical environmental data. Much uncertainty exists concerning the composition, levels, and toxicologic characteristics of past exposure to contaminated private and community water supplies. Therefore, although it cannot be documented, the public health significance of past exposures related to the Reich Farm site may have been greater than is apparent from the toxicological evaluation of the levels of known contaminants performed in the Public Health Assessment.

The Reich Farm site is therefore considered by the ATSDR and the NJDHSS to have represented a **public health hazard because of past exposures**. This determination is based on the following considerations, taken together: 1) the presence of completed exposure pathways in the past (through private and community water supplies) to volatile organic chemicals (including PCE and TCE) and other chemicals, to a potentially large exposed population; 2) epidemiological studies in other communities suggesting that exposure to TCE and PCE may increase the risk of certain

childhood cancers and adverse neurological effects; and 3) the presence of an excess of childhood cancers in the community.

Current conditions indicate that exposure to contaminants from the RF site is no longer occurring. The exposure pathway through private well use was interrupted by the establishment of a well restriction zone, and there is no indication that private wells are still in use for potable purposes in the area above the RF plume. The exposure pathway through the community water supply has been interrupted by the diversion and treatment of contaminated water from wells #26 and #28 at the Parkway well field, and the recent installation of treatment for well #29, which has shown sporadic RF-related contamination. (Treatment was also extended to the nearby well #22 as a precaution.) However, treated output from wells #26 and #28 may be pumped into the community water supply in times of high water demand. Containment of the RF-related groundwater plume through effective management of the Parkway well field is essential to ensure that currently unaffected wells remain so. In addition, proper operation of the treatment systems in place is necessary to reduce or eliminate the entry of RF-related contaminants into the distribution system. On-going water monitoring is needed to document the effectiveness of well field management and treatment systems. For these reasons, the ATSDR and the NJDHSS are categorizing the RF site as **no apparent public health hazard under present conditions**. Should NJDHSS or ATSDR become aware of information indicating that RF-related exposure is still occurring, or if private wells are still in use in the plume area, this determination will be reconsidered.

Further epidemiologic and toxicologic evaluations are warranted in order to evaluate the public health significance of past risks posed by the site. The NJDHSS and the ATSDR are conducting an epidemiologic study of childhood cancer in Dover Township. This Public Health Assessment supports the consideration of exposure pathways related to the RF site in that study. In addition, a working group of Federal and State public health and environmental agencies is coordinating the development of toxicologic studies of styrene-acrylonitrile trimer to understand better the public health implications of completed exposure pathways at the RF site.

The Public Health Assessment for the Reich Farm site was released for public comment during the period August 3 to October 1, 1999. A summary of the comments received and the responses of the NJDHSS and the ATSDR are provided in Appendix E.

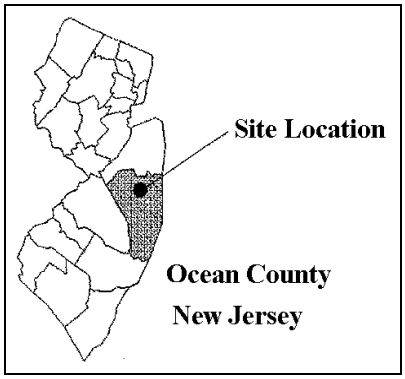
Purpose and Health Issues

As part of the Public Health Response Plan (PHRP) developed by New Jersey Department of Health and Senior Services (NJDHSS) and the Agency for Toxic Substances and Disease Registry (ATSDR) for the Dover Township Childhood Cancer Investigation (NJDHSS/ATSDR, 1996), this Public Health Assessment will document and evaluate the public health significance of human exposure pathways associated with the Reich Farm (RF) site.

Background

Demography and Land Use

The RF site (CERCLIS #NJD980529713) is located in Dover Township, Ocean County, New Jersey (see inset), 500 feet east of New Jersey State Highway 9 and 1,000 feet south of Church Rd. The RF site occupies an area of approximately three acres, with an additional 12 acres included within the scope of past remedial investigations. The site lies 8.4 miles west of the Atlantic Ocean, with the elevation of the site ranging from 65 to 80 feet above mean sea level. The site slopes slightly toward the southwest, and there are wooded areas to the north and east. Soils at the RF site are sandy with minimal loose topsoil, and exhibit a relatively high percolation rate as compared to other soils in the State. The environs of the site are primarily light commercial and residential. There are one story structures immediately adjacent to the site occupied by active businesses.



40^{O}00.5' N, 74^{O}13.0' W

The Kirkwood-Cohansey geologic formation that underlies the RF site is characterized by sand with clay and gravel lenses, and ranges to a depth of approximately 200 feet. The Cohansey is the shallower aquifer associated with this formation, with the water table at the site found at a depth of approximately 30 feet below grade. There is a direct hydraulic connection between the Cohansey and the deeper Kirkwood water bearing formation. Estimates by the United States Environmental Protection Agency (USEPA) of the rate of groundwater flow in the area of the RF range from 0.93 feet per day (340 feet per year) to 1.6 feet per day (580 feet per year) (NUS, 1986; Ebasco, 1988a). The Kirkwood-Cohansey aquifer is extensively utilized as a potable water source in the area of the RF site by both private and community supply wells. Groundwater in the area of the RF site is acidic (median pH = 5.3), and exhibits a relatively high concentration of dissolved iron and manganese.

Population demographics based upon the 1990 census have been prepared by the ATSDR

using area-proportion spatial analysis, and are presented in Figure 1 (see Appendix for figures). ATSDR estimates that within a one mile radius of the RF site, there is a population of approximately 3,325 persons, and 1,209 housing units.

Site History

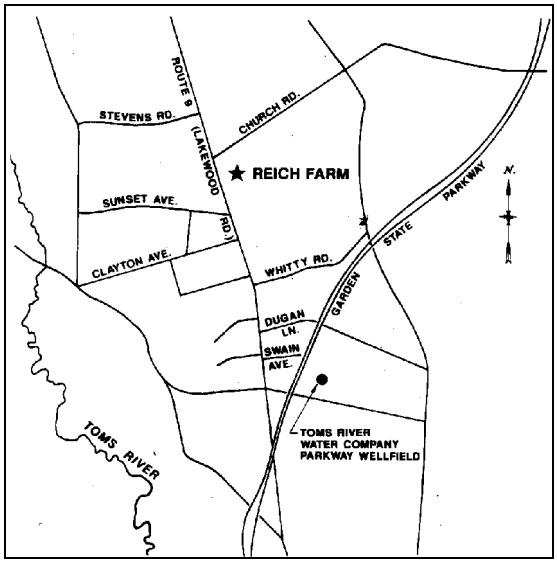
In 1971, the Union Carbide Corporation (UCC) entered into a contract with an independent waste removal contractor to transport 55 gallon drums of chemical wastes from the Bound Brook facility to the Dover Township Municipal Landfill (DTML) for disposal (Ghassemi, 1976). Between March and December 1971, 5,000 to 6,000 drums labeled as containing organic wash solvents, still bottoms, and residues from the manufacture of plastics and resins were removed from the UCC facility by the contractor for disposal. These wastes were reported to contain aromatic hydrocarbons, phenols, halogenated aliphatic hydrocarbons, polymeric resins and unspecified petrochemicals (Ghassemi, 1976). Table 1 (see Appendix for tables) lists general descriptions of UCC wastes found on the RF site.

In August 1971, the waste removal contractor leased a portion of the RF property from the owner on the premise of storing empty drums on the site. In December 1971, the owners of the RF property noticed unusual chemical odors emanating from the portion of the property leased to the waste removal contractor. Visual inspection revealed the presence of drummed chemical wastes and trenches where chemical wastes had been discharged (NUS, 1986). On December 15, 1971, UCC was notified by the owner of the RF property of the presence of thousands of drums bearing UCC labels on the RF site. The waste removal contractor had illegally deposited approximately 4,500 drums on the RF site without the knowledge of the property owner or the UCC. Upon notification of the presence of their drums on the RF property, the UCC immediately terminated their agreement with the waste hauler.

Of the 5,000 to 6,000 drums removed by the waste removal contractor, only some 4,500 were reportedly accounted for on the RF property. Approximately 10% of the drums located on the RF property were partially or completely empty, suggesting that contained wastes were discharged on-site (NUS, 1986). The remainder of the drums removed from the UCC facility were assumed by the USEPA to have been deposited in the DTML, or possibly were emptied on the RF site after which the empty drums were salvaged (Ghassemi, 1976). Figure 2 presents the relative locations of the RF and the DTML.

The RF property owners and the Dover Township Board of Health (DTBH) initiated a court action requesting that UCC remove the drums from the RF property. From February through March 1972, the UCC performed an initial removal of most of the drums on the RF site back to the UCC Bound Brook Facility (Ghassemi, 1976; NUS, 1986). At this time, drums were also taken by the UCC to locations in and out of State for burial or incineration. In June 1974, approximately 51 additional drums and approximately 1,100 cubic yards of contaminated soil were removed from the RF site by the UCC and transferred to the Kin-Buc Landfill in Edison, New Jersey (Ghassemi, 1976;

NUS, 1986). In addition, 37 UCC drums were discovered stored in two trailer trucks (belonging to the contracted waste hauler) which were parked in Dover Township (at Brookside Drive and Briar Avenue). These drums were also removed by the UCC.



Deposition of wastes at the RF site resulted in contamination of the underlying Cohansey aquifer. Beginning in 1974, approximately 2 years after the discovery of drums on the site, investigation of groundwater quality resulted in the condemnation of 148 private wells in the Pleasant Plains section of Dover Township, and a DTBH ordinance restricting the use of private wells in the area (see Figure 3). This contamination was identified as potentially associated with the RF site by the USEPA and the NJDEP (Ghassemi, 1976; NJDEP, 1974). However the proportion of wells (of the 148 closed) actually impacted by the RF plume cannot be accurately established In addition, site-related contamination subsequently affected the Parkway well field of the community water purveyor (the Toms River Water Company, later United Water Toms River) located approximately one mile from the RF site (see inset). The chronology of the RF site's impact on both private and community water supplies, and the resultant public health implications are discussed in the "Environmental Contamination" and "Public Health Implications" sections of this Public Health Assessment.

Health Assessment Activity Summary

The ATSDR conducted a Public Health Assessment of the RF site in April 1989 (ATSDR, 1989), and concluded that the RF site represented ". . .a potential public health concern because of potential exposure to hazardous substances at levels that may result in adverse health effects over time." This conclusion was based upon a potential human exposure pathway to various volatile organic compounds, semi-volatile organic compounds, and heavy metals through oral and/or dermal exposure to contaminated groundwater. More recent evaluations of the data confirm this conclusion with respect to site-related volatile and semi-volatile compounds, but not with respect to ingestion of heavy metals, which do not appear to be site-related. A comprehensive evaluation of human exposure pathways is presented in the "Pathways Analysis" section of this Public Health Assessment.

The 1989 Public Health Assessment further concluded that the remedial actions proposed in the USEPA's Record of Decision (ROD) for the RF site appeared to be protective of public health (USEPA, 1988). Subsequent to the release of the Public Health Assessment, the USEPA issued an Explanation of Significant Difference (ESD) for remedies regarding the RF site as discussed in the

1985 Remedial Investigation/Feasibility Study (RI/FS) (NUS, 1985). The ESD (USEPA, 1995), which presented a modification to the originally selected remedy for groundwater contamination, was not reviewed by the ATSDR.

The 1989 Public Health Assessment recommended that private wells in areas potentially affected by the RF site be monitored. This recommendation was satisfied as part of the activities performed for the present Public Health Assessment. The NJDHSS and the ATSDR have reviewed private well data associated with the Pleasant Plains section of Dover Township (the area denoted in the 1974 well restriction ordinance; proximal to the RF site; see Figure 3). Areas near the DTML (the Silverton Road Groundwater Investigation and the Silverton Private Well Contamination Investigation) are evaluated in a separate Public Health Assessment. In addition, in support of this Public Health Assessment, the NJDHSS and the ATSDR have conducted an exposure investigation of potentially affected private potable wells in Dover Township to determine current groundwater quality (see Figure 4). The nature and extent of groundwater contamination in the RF study area and consequent public health implications are discussed in the "Environmental Contamination", "Pathways Analysis" and "Public Health Implications" sections of this Public Health Assessment.

In the 1989 Public Health Assessment, the ATSDR did not make a specific recommendation for follow-up health study activities, citing insufficient human exposure data. The document further stated that should data become available suggesting that human exposure to hazardous substances is occurring at a level of public health significance, the site would be evaluated for follow-up health studies. Based in part on findings related to the development of this Public Health Assessment, and in response to concerns regarding childhood cancer incidence in Dover Township, the NJDHSS and the ATSDR are currently conducting an epidemiologic study of childhood cancer in Dover Township which will consider relevant completed human exposure pathway information including, but not limited to, the RF site.

In October 1993, the ATSDR released a Lead Initiative Summary Report (ATSDR, 1993). This report did not identify a RF site-related lead hazard associated with groundwater. The report concluded that lead levels detected in private wells, which were cited in the ATSDR's 1989 Public Health Assessment, were the result of corrosion of household plumbing by acidic groundwater, or an unidentified circumstance at individual residences. The Lead Initiative Summary Report recommended additional groundwater monitoring for lead.

Site Visits

As part of the activities conducted in support of this Public Health Assessment, staff of the NJDHSS and the ATSDR performed multiple visits of the RF site and other locations within Dover Township during 1996, 1997, 1998, and 1999.

Community Concerns

The discovery of contamination at the RF site and the consequent impact to area groundwater quality have resulted in a high level of community concern and media attention over the years. Residents of Dover Township have also expressed concern about the incidence of childhood cancer in the community. In the summer of 1995, the ATSDR asked the NJDHSS to perform an analysis of childhood cancer statistics for the township. The NJDHSS found an elevated occurrence of certain childhood cancers.

Community concerns about this finding led the ATSDR and the NJDHSS to formulate a multi-activity Public Health Response Plan (PHRP) in June 1996 (NJDHSS/ATSDR, 1996). The PHRP included an updating and reevaluation of information on childhood cancer incidence and assessments of environmental issues of concern to the community. Originally included in the PHRP were Public Health Assessments of the RF site and the Ciba-Geigy Corporation site (CERCLIS #NJD001502517); subsequently, the NJDHSS and the ATDSR added a third Public Health Assessment for the DTML site (CERCLIS #NJD980771570). The PHRP also included a Public Health Consultation, performed jointly with the NJDEP, that evaluates extensive water quality testing data from the community water system in Dover Township.

Other activities of the PHRP are the development of a community and health professionals education program (see "Public Health Action Plan" section), compilation of a compendium of environmental contamination sources in Dover Township, and inclusion of New Jersey in a multi-state study of brain cancer incidence in proximity to National Priorities List sites.

Since March 1996, the NJDHSS and the ATSDR have participated in monthly public meetings of the Citizens Action Committee on Childhood Cancer Cluster (CACCCC) in order to discuss progress toward implementation of the PHRP, cancer incidence, environmental sampling data, and community concerns related to the on-going investigation.

The Public Health Assessment for the Reich Farm site was released for public comment during the period August 3 to October 1, 1999. A summary of the comments received and the responses of the NJDHSS and the ATSDR are provided in Appendix E.

Statement of Issues

Based upon past and current data on the RF site, and other environmental concerns communicated to the NJDHSS and the ATSDR, this Public Health Assessment will address the following issues:

Exposure Pathways Associated With Private Wells

This Public Health Assessment will evaluate the potential public health significance of past and present exposure pathways associated with private well water quality in areas of Dover Township near the RF site.

Exposure Pathways Associated With Community Water System Wells

Several wells in the United Water Toms River's Parkway well field have been, and continue to be, impacted by RF site-related contamination. This Public Health Assessment will evaluate the potential public health significance of exposure pathways associated with these community water supply wells.

Discussion

This Discussion will review the history of remedial activities conducted in relation to the RF site and the findings of investigations of environmental contamination. Based on these findings, an analysis of exposure pathways will be presented. The Discussion will conclude with an assessment of the public health implications of completed exposure pathways.

Remedial History

Subsequent to the unauthorized deposition of wastes on the RF property, the UCC removed all visible drums in 1972. In addition, buried drums and 1,100 cubic yards of contaminated soils were removed in 1974. Both actions were conducted under the supervision of the NJDEP. In 1982, the USEPA included the RF site on the National Priorities List of sites being remediated under the Superfund program.

A Remedial Investigation (RI) was performed for the RF site by the NUS Corporation for the USEPA in 1986 (NUS, 1986; NUS, 1985). A supplemental Remedial Investigation and Feasibility Study (RI/FS) was completed for the RF site by the Ebasco Corporation in 1988 (Ebasco, 1988a; Ebasco, 1988b; Ebasco, 1988c). The remedial investigations confirmed the presence of contaminants in on-site soil and in on-site and off-site groundwater (see "Environmental Contamination" section below). Goals of the remedial actions were listed as reduction of volatile organic compounds (VOCs) in groundwater (for example, trichloroethylene to less than 1 part per billion, or ppb), reduction of VOCs to less than 1 part per million (ppm) in soils, reduction of SVOCs (including bis(2-ethylhexyl) phthalate (BEHP)) to less than 10 ppm in soils, and prevention of contaminant transport from soils to groundwater.

In response to the discovery of contamination of certain wells at the Parkway well field, the TRWC installed a packed tower aeration (air stripper) treatment system for the output of two wells

(#26 and #28) at the well field in 1988, as a treatment method to remove VOC contamination.

In September 1988, the USEPA issued a Record of Decision (ROD) for the RF site describing the selected remedy for the contaminated soils and groundwater (USEPA, 1988). The ROD specified additional soil and groundwater sampling to further delineate contaminants, the excavation and thermal desorption of VOCs and semi-volatile organic compounds (SVOCs) from contaminated soils, and the installation of a groundwater pumping, treatment, and re-injection system designed to remove VOCs. The excavation and treatment of over 14,000 cubic yards of contaminated soils was completed by the UCC, with oversight by the USEPA, in May 1995.

Subsequent to the ROD, the UCC conducted predesign activities from 1990 to 1994 (Malcolm Pirnie, 1992; Malcolm Pirnie, 1993). The predesign groundwater evaluation led the USEPA to a reevaluation of the state of the groundwater contamination. It was determined that a contaminant plume existed which extended beyond the RF site's boundary, which consequently made on-site pumping, treatment, and re-injection of groundwater infeasible.

The contaminant plume was documented as extending to the Parkway well field of the United Water Toms River (UWTR) community water supplier (formerly Toms River Water Company, or TRWC). The plume was estimated to have been approximately 400 feet wide at the RF site, and approximately 1,500 feet wide at the Parkway well field. In 1993, the centroid of the plume was estimated to be 700 feet up-gradient of the Parkway well field, with 50 percent of the contaminant mass in the aquifer estimated to be 4,000 feet south of the RF site in the vicinity of Dugan Lane, approximately 1,000 feet up-gradient of the Parkway well field. The high rate of pumpage at the Parkway well field was influencing the movement and spatial distribution of the contaminant plume (see Figure 8).

In September 1995, the USEPA issued an Explanation of Significant Difference (ESD) which modified the groundwater remedy selected in the 1988 ROD (USEPA, 1995). This document presented USEPA's decision to abandon plans for an up-gradient groundwater treatment system. Instead, the existing Parkway well field wells and treatment system would continue to be used to capture and treat the groundwater plume emanating from the RF site. In addition, the treated groundwater would not be re-injected, but instead would continue to be distributed to the community water supply, dependent upon water quality meeting Federal and State drinking water standards. Based upon the predesign evaluation (Malcolm Pirnie, 1993), the USEPA concluded that air stripping alone was necessary to meet New Jersey's drinking water standards. As part of the ESD, the UCC agreed to finance the operation and maintenance of the UWTR air stripper and committed to a program of monitoring the effectiveness of the treatment system at the well field.

In 1996, RF site-related non-target semi-volatile compounds were discovered by the NJDEP (in conjunction with the laboratories of the USEPA and the NJDHSS) in water from two wells (#26 and #28) of the Parkway well field (see "Environmental Contamination" section below). As a

result, the entire Parkway well field was temporarily taken out of service in November 1996. The treatment system for wells #26 and #28 was then enhanced to include activated carbon contactors for the removal of organic chemicals. Wells #26 and #28 (and a new well #26B installed in late June 1999) are controlling the RF plume, with their effluent being treated and pumped to waste. (In times of high water demand, treated output from wells #26 and #28 may be pumped to the Parkway well field point of entry.) Well #29 has also shown evidence of sporadic contamination by the RF plume. In response to detected contamination in this well between July and September 1998 (see "Environmental Contamination" section below), the State of New Jersey provided for the construction of additional activated carbon treatment for well #29 and the nearby well #22. Treatment was initiated in June 1999, with treated water entering the UWTR distribution system.

Environmental Contamination

Environmental contamination concerns at the RF site have included on-site soils and both on-site and off-site groundwater contamination (Table 2). Air contamination may have occurred during the dumping of materials at the site, as evidenced by odor complaints at the time (Ghassemi, 1976), and during site investigation and removal activities; however, no off-site air contamination data have been generated during remedial investigations. Surface water contamination has not been an issue at the RF site. The nearest surface water feature to the RF site is the Toms River located nearly two miles to the southeast.

Historic information on groundwater contamination related to the RF site is sparse. Much of the data that exist were generated using analytical methods that were non-specific indicators of organic chemical contamination, and little documentation remains on the sampling procedures and quality of the analytical data. Nonetheless, these data are presented in detail below in order to provide as complete a historic perspective as possible on the potential for RF-related contamination of groundwater in Dover Township.

Groundwater Investigations: 1974 to 1976

In early 1974, approximately two years after the deposition and discovery of the chemical wastes at the Reich Farm, residents of three properties near the site began to notice abnormal tastes and odors in their well water. The DTBH recommended that homeowners submit samples of their water to private laboratories for analysis. Subsequent analysis indicated that one of the wells was contaminated with unspecified levels of toluene and the other two with phenolic compounds. In addition, the DTBH received a similar complaint concerning a well next to the DTML where subsequent testing revealed the presence of phenolic compounds. These wells were condemned, and in two cases were replaced by deeper wells whose quality was found to be satisfactory (Ghassemi, 1976).

As a result of these initial complaints, the Ocean County Health Department (OCHD) initiated a wider survey of potable wells in the area during the period from March through June

1974. Analysis was performed by the New Jersey Department of Health (now NJDHSS) Laboratory in Trenton. The analysis method employed detected total organic compounds through ether extraction. (Organic compounds were adsorbed on activated carbon; the carbon was then dried and eluted with ether to recover and quantify the adsorbed organic chemicals.) As indicated in Table 3, concentrations of total (ether extractable) organic compounds were reported to range from not detected (ND) to over 21,000 ppb. At the time of the analysis, there existed no Federal or State standards regarding ether extractable compounds in potable water supplies. Ghassemi (1976) concluded, "However, such extractable organics are not naturally occurring and should not be in the water."

During the period from June 19 through July 30, 1974, the USEPA analyzed additional samples of private wells in the area near the RF site, and TRWC public supply wells (#20 at Indian Head and #26 at the Parkway well field). Activated carbon filters were installed at six selected locations. After saturation, the filters were collected and transported to the USEPA laboratory in Cincinnati, Ohio for determination of chloroform extractables. Table 4 presents the summary of this investigation. Analysis indicated the presence of carbon /chloroform extractable compounds (CCE) ranging from 100 to 1,200 ppb. Only one sample, from a private residence located due south of the RF site on Lakewood Ave., exceeded the U.S. Public Health Service drinking water standard of 700 ppb for CCE in effect in 1974.

On July 11, 1974, the USEPA obtained four additional samples for organic chemical analysis by a gas chromatograph/mass spectrophotometer method in the USEPA laboratory in Edison, New Jersey. This analysis showed no contamination (at a method detection limit of 0.1 ppb) in the Toms River Water Company well # 22, or in wells supplying the Ocean County Agricultural Building and the North Dover School. The well at the Lakewood Ave. private residence noted in Table 4 (with CCEs at 1,200 ppb) was found to contain toluene at 12 ppb and styrene at 30 ppb. Although there were no standards for these chemicals at the time, the levels are below current drinking water maximum contaminant levels (MCLs) or ATSDR comparison values (1,000 ppb for toluene and 100 ppb for styrene).

During the periods from July 31 through August 27, and October 12 through November 9, 1974, the NJDEP and the USEPA conducted a sampling program of private wells within one to 1.5 miles of the RF site. Analyses were performed by the New Jersey Department of Health (now NJDHSS) Laboratory in Trenton and the USEPA Laboratory in Edison, utilizing the carbon tetrachloride extraction/infrared absorption (CCl_4/IR) method. The method was calibrated using an equivolume blend of seven likely contaminants (Ghassemi, 1976). Table 5 summarizes the results of this sampling episode. The July 31, 1974 samples showed anomalously high levels, which were not confirmed with repeated samples at the same locations taken one week later; these data are not presented in Table 5. Results from private wells in the area ranged from not detected to 1,900 ppb. The highest level was found in the same private well that had the highest CCE level and that contained toluene and styrene. However, the overall pattern of contamination could not be attributed to the Reich Farm site alone (Ghassemi, 1976; NUS, 1986).

In June 1974, the DTBH had requested the assistance of the NJDEP (Bureau of Potable Water) in determining the nature and extent of groundwater contamination in the Pleasant Plains section of Dover Township. After review of the above data, the recurrent reports of taste and odor problems associated with some private wells, and the documentation of hazardous chemical waste dumping at the Reich Farm site, the NJDEP concluded that a groundwater contamination problem existed in portions of Pleasant Plains. The Bureau of Potable Water directed the Township of Dover to take action to protect the public health on July 30, 1974. The DTBH, on September 16, 1974, passed an ordinance which forbade the use of groundwater within a designated area of Pleasant Plains.

In December 1974, the NJDEP issued a report entitled "Final Report -- Delineation of Extent of Groundwater Contamination, Pleasant Plains Section of Dover Township, Ocean County, N.J." (NJDEP, 1974). This report delineated areas of groundwater contamination into three zones and set requirements for private well usage in an area including and expanding beyond the area denoted by the DTBH (Figure 3). Zone I was classified as "Contaminated" and was condemned as a source of water for any purpose; no new wells were permitted to be installed in this area, and all existing and new homes were to connect to the TRWC supply service. Zone II was designated as a "Questionable Area," and included those areas which were perceived as susceptible to future contamination based upon their location with regard to groundwater movement. The NJDEP recommended that a well monitoring program be established for Zone II wells and all new wells were to utilize the Kirkwood aquifer. Zone III was designated as "Uncontaminated," and included those areas thought to be not likely to become contaminated based upon information available at the time. A total of 148 wells in Zone I were condemned and ordered capped. Area residents and public facilities relied upon water tanker trucks and bottled water for a period of approximately six months while the infrastructure for community water supplies was completed (Ghassemi, 1976).

Of the analytical methods discussed above, results from the gas chromatography/mass spectrophotometry method are likely to be most reliable and interpretable. As noted above, interpreting results of the other early groundwater analyses is difficult because: 1) there is little information on sampling procedures employed; 2) the analytical tests are not chemical-specific; 3) there is considerable variation in results from the same location over short periods of time; and 4) the different extraction techniques represent different fractions of the compounds potentially present.

Nonetheless, the data generated by these methods may provide useful information regarding water quality. The laboratory manual *Standard Methods* (1965 edition) states, in reference to the carbon chloroform extraction (CCE) method, ". . .where concentrations of 200 µg/l [micrograms per liter, equivalent to ppb] have been found, the taste and odor of the water have nearly always been poor." Although the CCE method does not determine the total organic content of the water (due to the escape of the lighter volatile compounds in the carbon drying process, variability to the degree which compounds are adsorbed onto the charcoal, and solubility of specific compounds in the solute), mass recovery ranges from 50 to 90 percent. The CCE method was described as useful for ". . .revealing stress on water from most industrial contaminants, particularly synthetic

chemicals." Finally, *Standard Methods* indicated that clean surface and groundwater will usually contain only 25 to 50 µg/l of CCE (APHA, 1965). In 1960, the CCE method was described as capable of recovering nitriles, 60 to 70 percent of phenolic compounds, substituted nitrobenzenes, aromatic ethers, hydrocarbons, and chlorinated insecticides (Ettinger, 1960). This source evaluated CCE values above 200 µg/l as a useful criterion for chemical pollution of a watershed, and maintained that above this level, consideration be given to alternative water sources and adoption of treatment procedures designed to remove organic contaminants. Another reference source at that time stated that clean water will exhibit less than 25 to 50 µg/l of CCEs, and water known to be polluted with industrial wastes will commonly contain CCEs in the hundreds and sometimes thousands of micrograms per liter (Middleton and Lichtenberg, 1960). With reference to values generated by the CCl_4/IR method, Ghassemi (1976) notes that the USEPA Region II Chief of Laboratories at the time considered 1,000 ppb to constitute reason for suspicion of organic chemical contamination.

Newspaper accounts from the period report that two of the TRWC supply wells at the Parkway well field sampled during the July to November 1974 investigation exhibited "phenol" contamination at a maximum level of 42 ppb, while TRWC supply well #20 located at Indian Head Road was reported to have exhibited "phenol" contamination at 6 ppb (APP, 1975a; APP, 1975b). In March 1976, "phenol" was detected in nine of fifteen private potable wells approximately 4,000 feet down-gradient of the RF site in the area of Dugan Lane. "Phenol" concentrations were reported to have ranged from 10 to 5,900 ppb (NUS, 1986). These wells were ordered closed by the DTBH. The test for "phenol" is sensitive to a variety of phenolic compounds (such as phenol itself, ortho- and meta-substituted phenols, and some para-substituted phenols), so the specific chemical composition cannot be determined from this test. No additional information was available for evaluation by the ATSDR or the NJDHSS regarding the analytical methods employed for these sampling events.

The "Pathway Analysis" and "Public Health Implications" sections of this Public Health Assessment evaluate the public health significance of the data presented above.

Groundwater Investigations: USEPA Remedial Investigations, 1986 to 1993

The 1989 Public Health Assessment by ATSDR reviewed the soil and groundwater data collected for the 1986 and 1988 RI reports (ATSDR, 1989). Table 2 and Figures 5, 6 and 7 present summaries from the 1986 and 1988 RIs of hazardous substance list (HSL) and target compound list (TCL) contaminants detected in on-site soils and groundwater. The USEPA identified public health risks associated with the migration of ethylbenzene, chlorobenzene, trichloroethylene (TCE), tetrachloroethylene (perchloroethylene, or PCE), and bis(2-ethylhexyl)phthalate (BEHP) into groundwater (Ebasco, 1988b).

Table 6 summarizes data collected by the USEPA in 1986 and 1987 regarding off-site groundwater quality in eight private wells in the Pleasant Plains area and TRWC community supply wells at the Parkway and Indian Head well fields (NUS, 1986; Ebasco, 1988b). One private well

(RW-7), located just up-gradient from the RF site, exhibited contamination with VOCs. PCE, carbon tetrachloride and bromoform exceeded health-based comparison values, while 1,1,1-trichlorethane and chloroform did not (Table 6). (See the appendix for a description of health-based comparison values). An initial report of contamination in another private well was not confirmed in a duplicate or re-sample (Ebasco, 1988c; ATSDR, 1989).

Three of the Parkway well field wells (#26, #27 and #28) also showed evidence of VOC contamination with TCE, PCE and benzene (Table 6). A sample from Parkway well #23 contained N-nitrosodiphenylamine, a contaminant also found in one on-site monitoring well, at a level near the health-based comparison value. On the basis of the data from on-site and off-site wells, ATSDR identified TCE, PCE, N-nitrosodiphenylamine, and BEHP as contaminants of concern in off-site groundwater in 1989 (ATSDR, 1989).

Newspaper accounts from November 1987 reported that in July 1987, TRWC Parkway well #26 contained TCE at 13 µg/l, and TRWC Indian Head well #20 showed TCE at 1 µg/l, 1,1,1-trichloroethane at 0.6 µg/l, chlorobenzene at 0.5 µg/l and benzene at 0.2 µg/l (APP, 1987a; OCO, 1987a).

As part of the predesign activities conducted by Malcolm Pirnie on behalf of the UCC, TRWC community water supply wells and two TRWC monitoring wells (at Dugan Lane and at Swain Ave.) were sampled in 1990 and 1991 (Table 7). Samples of untreated water from TRWC wells #26 and #28, and a sample from well #29, exhibited contamination by volatile organic contaminants at or exceeding health-based comparison values; well #22 did not show signs of contamination. TCE was found at 120 µg/l at the Swain Ave. well, and at 33 µg/l in well #26. Lower levels of 1,2-dichloroethane, 1,1,1-trichloroethane, and PCE were also found in the Swain Ave. well and in well #26. Wells #28 and #29 contained TCE at 1 and 3 µg/l, respectively. At the time of this sampling, the output of wells #26 and #28 was being treated by packed tower aeration (air stripping), while the output of well #29 was not being treated. These wells were intercepting the RF groundwater plume.

The “Pathways Analysis” and “Public Health Implications” sections of this Public Health Assessment evaluate the public health significance of the data presented in the Phase I and II Predesign Report.

Groundwater Investigations: 1996 to 1998

As part of the activities conducted for this Public Health Assessment, and in support of other activities denoted in the PHRP for the Dover Township Childhood Cancer Investigation, the NJDHSS and the ATSDR initiated an exposure investigation in 1996. In an effort to supplement existing data on groundwater quality, the NJDHSS sampled private wells in the Township in 1997. The analyses of private wells, soils and sediments will be summarized in a separate document. In addition, together with the NJDEP, the NJDHSS extensively sampled and analyzed the chemical and radiological quality of the community water system between 1996 and 1998. A separate Public Health Consultation provides a complete review of analytical data for all UWTR wells and points of entry in this period (NJDHSS, NJDEP and ATSDR, 2001). However, information from the private well and community water supply testing that is related to the RF site is also presented here.

Private Wells

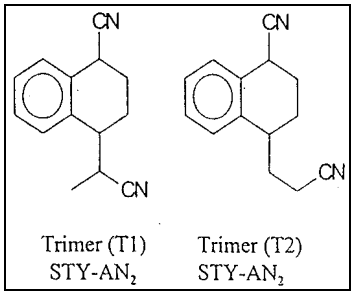
A total of 54 private wells were sampled by the NJDHSS from February through May 1997. Of these, twenty were located in areas pertinent to the RF and DTML public health assessment study areas (Figure 4). Analyses were performed utilizing USEPA Methods 524.2, 525.2 and 625 for organic chemicals, and other standard methods appropriate for heavy metals, gross alpha and beta activity (900.0, 903.0), general chemistry, and dissolved oxygen. Of the twenty wells sampled, four contained chloroform in the range of 0.4 to 4.0 µg/l, below the ATSDR comparison value (cancer risk evaluation guide: 6 µg/l) and the MCL of 100 µg/l for trihalomethanes, a group of chemicals to which chloroform belongs. Chloroform is not considered to be a RF site-related contaminant.

Eighteen of the 20 wells also contained lead (range: 1.5 to 27.4 µg/l) (NJDHSS, 1996-1999, Volumes 68 to 81). The presence of lead is not considered to be RF-related. Lead may be present in samples as a naturally occurring constituent of groundwater or aquifer matrix, or as the result of corrosion of well materials and plumbing. Samples from several private wells exceeded the MCL for gross alpha activity (15 pCi/l). Gross alpha activity was determined to be due to radium species (isotopes 224, 226 and 228) in groundwater. The presence of radium in the Cohansey aquifer is a phenomenon not associated with the RF site, and is common to many areas of southern New Jersey. The public health significance of lead and radium in these private wells will be discussed in the separate summary of the exposure investigation.

Parkway Well Field Public Supply Wells

Beginning in 1996, public supply wells of the Parkway well field have undergone extensive testing. Analyses have been performed utilizing USEPA Methods 524.2, 525.2 and 625 for organic chemicals, and other standard methods appropriate for heavy metals, and radiological activity (900.0, 903.0).

In 1996, laboratory scientists at NJDEP noticed the possible presence of an unknown non-target semi-volatile compound in samples from well #26, the Parkway point of entry, and nearby distribution system samples. Further investigation by the NJDEP revealed the presence of the unknown compound in data generated by previous investigations of the groundwater quality at the Parkway well field. After extensive efforts by laboratory scientists at the NJDEP, the USEPA, the UCC and the NJDHSS, the unknown material was identified as a mixture of isomers of 4-cyano-1,2,3,4-tetrahydro-α-methyl-naphthalene-acetonitrile (THNA; labeled T1 in the inset) and 4-cyano-1,2,3,4-tetrahydro-1-naphthalene-propionitrile (THNP; labeled T2 in the inset), now collectively known as styrene-acrylonitrile (SAN) trimer. These closely related compounds are formed as by-products of the styrene-acrylonitrile co-polymerization process. Wastes from UCC's use of this process were deposited at the RF site in 1971.



T1: CAS 57964-39-3
T2: CAS 57964-40-6

The initial estimate of SAN trimer concentration in well #26 was 6 µg/l (NJDHSS, 1996-1999, Volumes 39 to 41). Subsequent tests, specifically calibrated for SAN trimer measurement, have shown concentration ranges of 2 to 5 µg/l in well #26 (NJDHSS, NJDEP and ATSDR, 2001). Lesser amounts have been detected repeatedly in well #28, and sporadically in well #29. Analytical data showed that the treatment system in place in 1996 at the Parkway well field (air stripping) was ineffective at removing SAN trimer.

During the period 1996 to 1999, TCE was found in the untreated water from wells #26 and #28 in the range of 2 to 8 µg/l, and sporadically in well #29 at up to 2 µg/l (NJDHSS, 1996-1999). Other volatile organic chemicals, including PCE and 1,1,1-trichloroethane, have also been found consistently in wells #26 and #28. These data are fully described in the separate Public Health Consultation (NJDHSS, NJDEP and ATSDR, 2001).

Other organic chemicals have been tentatively identified in the RF groundwater plume. The NJDEP established a committee of laboratory scientists to examine recent and past analytical data to determine if there are additional non-target compounds that could be identified from the plume. A report of the committees findings was released in April 2000 (NJDEP, 2000). In addition to SAN trimers, dimers and associated hydrolysis products, the committee tentatively identified the following: tetrachlorophthalic anhydride, chlorendic anhydride, chlorostyrene, dichlorostyrene, bis(4-chlorophenyl) sulfone, triallyl isocyanurate, diphenylhydrazine, n-methyl-p-toluene sulfonamide, n-ethyl-p-toluene sulfonamide, and possibly others. The ATSDR evaluated the toxicological information available on these tentatively identified chemicals (ATSDR, 2000), and is presently evaluating additional chemicals.

The "Pathways Analysis" and "Public Health Implications" sections of this Public Health Assessment evaluate the public health significance of the Parkway well field water quality data generated from 1996 to 1998.

Other Data

The UCC continues to monitor groundwater contamination associated with the RF site. On-site and off-site monitoring wells were sampled in May 1997, with split samples provided to the NJDHSS Environmental Laboratory. These data were reviewed by the NJDHSS and found to be consistent with previous data describing groundwater quality. A summary of these data is being prepared as a separate document by NJDHSS.

Pathways Analysis

To determine whether residents of Dover Township were or are currently being exposed to contaminants migrating from the RF site, the NJDHSS and the ATSDR evaluate the environmental and human components that lead to exposure (ATSDR, 1992). An exposure pathway consists of five elements: (1) a source of contamination; (2) transport through an environmental medium; (3) a point of human exposure; (4) a route of human exposure; and (5) a receptor population.

The ATSDR and the NJDHSS classify exposure pathways into three groups: (1) *completed pathways*, that is, those in which it is likely that some persons in the receptor population were exposed, are being exposed, or will be exposed; (2) *potential pathways*, that is, those in which exposure might have occurred, may be occurring, or may yet occur; and (3) *eliminated pathways*, that is, those which can be eliminated from consideration because one of the five elements is missing and will never be present, or in which no contaminants of concern can be identified. Completed or potential pathways may be interrupted by remedial actions.

Private Wells

The NJDHSS and the ATSDR have determined that a completed human exposure pathway to RF-related groundwater contaminants existed in the past through the domestic use of private wells. Exposure to some members of the population may have occurred through ingestion, inhalation and/or dermal contact, depending on water use patterns and volatility of contaminants.

The presence of contaminants is documented in private wells as early as 1974. Non-specific methods indicated the existence of contamination of unknown composition. However, the USEPA did find toluene (12 ppb), and styrene (30 ppb) in a well at one private residence in July 1974, using a method capable of detecting specific volatile organic compounds. These compounds were found in the material dumped at the RF site, and the private well is in an area now known to be in the path of the RF groundwater plume.

The specific locations affected, and the time of impact, is dependent upon the flow of groundwater, contaminant characteristics, and the location of wells relative to the path of the RF groundwater plume. Exposure through private wells is believed to have been interrupted in 1975 when wells were ordered sealed and community water supplies became available, although compliance with the directive met with some resistance (Ghassemi, 1976). There were an estimated

148 homes with private wells in the area designated as contaminated (Zone I) by NJDEP, but because the number of wells actually contaminated by the RF plume is not known, the total number of persons potentially associated with this exposure pathway cannot be accurately estimated.

Private wells exhibiting contamination potentially related to the RF plume were reported after 1975, including nine wells with "phenols" in 1976 in the vicinity of Dugan Lane, south of the RF site. The duration of this exposure to phenolic compounds for persons using these wells is not known. The pathway was interrupted when the wells were ordered closed by the DTBH.

The specific chemical characteristics of the past private well exposure pathway cannot be determined from existing data. However, based on monitoring well data, the NJDHSS and the ATSDR have determined that a completed human exposure pathway to a variety of VOCs and SVOCs in groundwater existed in the past through domestic use of private well water in the vicinity of the RF site. The VOCs include TCE, PCE, 1,1,1-trichloroethane, toluene, styrene, benzene and others. The SVOCs include the SAN trimer, BEHP, and possibly others.

In general, the private well exposure pathway has been interrupted by the establishment of a well restriction zone and related well closure actions in the Pleasant Plains area. There is no indication that private wells are still in use in the area known to be above the RF groundwater contamination plume.

(It should be noted that an Ocean County ordinance passed in 1987 requires private potable wells to be tested for a variety of possible contaminants including volatile organic chemicals, when new and at the time of property transfer. This requirement provides an additional mechanism for the detection of local groundwater contamination problems and the interruption of exposure pathways.)

Public Wells (Parkway Well Field)

The NJDHSS and the ATSDR have determined that, for some members of the population, a completed human exposure pathway to RF-related groundwater contaminants existed in the past through the community water supply. Contaminants from the RF were discharged to groundwater and were later drawn into supply wells at the Parkway well field, and then pumped into the community water distribution system. The duration of this exposure pathway is unknown. The travel time of groundwater from below the RF site to the Parkway well field has not been established. Preliminary estimates by NJDEP and UCC (Malcolm Pirnie, 1992) ranged between approximately five and 10 years. An updated model by UCC (Sykes, 1999) predicts a travel time of approximately 10 to 15 years. However the UCC and the NJDEP continue to refine groundwater models estimating transit times.

The chemical composition of past exposures cannot be determined, although since 1986 the following volatile organic chemicals have been identified in the RF groundwater plume and in Parkway well field wells: TCE, PCE, 1,1,1-trichloroethane, benzene, toluene, 1,2-dichloroethane,

and chlorobenzene. Semi-volatile compounds include the SAN trimer and several other tentatively identified compounds.

In 1986, there were not yet any federal or State MCLs established for TCE or other VOCs, although the NJDEP had established an interim guidance level of 2 µg/l for TCE, above which remedial action was recommended. To achieve this level (and to reduce exposure through this pathway), water from contaminated Parkway wells was blended with water from other wells in the Parkway well field with the intention of introducing the water into the point of entry at no more than 2 µg/l of TCE. According to newspaper reports at the time, samples at the Toms River Nursery School (located near the point of entry for the Parkway well field) taken subsequent to blending showed 3 µg/l of TCE (OCO, 1987b). In addition, further sampling by the TRWC showed TCE levels above 2 µg/l at Toms River High School North, and Intermediate West, with lower levels at North Dover and West Dover Elementary Schools (APP, 1987b). Subsequent to these tests, the TRWC closed the Parkway well field's Cohansey wells and began the planning and installation of a packed tower aeration system (air stripper) for wells # 26 and #28; the air stripper was installed and in operation by May 1988. This action served to interrupt the pathway for volatile organic chemicals.

However, this effort to interrupt the exposure pathway was not effective at reducing SVOCs, since semi-volatile chemicals are not removed by air stripping. In 1996, following the discovery of the SAN trimer, wells #26 and #28 were diverted from the water supply. An activated carbon treatment system has been installed for these wells; the treated effluent is primarily being pumped to waste. In June 1999, another activated carbon treatment system was installed to protect against sporadic RF-related contamination in well #29; treatment was also extended to the nearby well #22 as a precaution. Thus, the completed exposure pathway to VOCs and SVOCs from Parkway well field wells is now interrupted and should now be considered only a potential pathway. To ensure continued interruption of the exposure pathway, it is necessary to effectively manage the well field to contain the RF plume, and to properly operate and monitor the treatment systems now in place.

In 1986, well #23 had been found to contain 8 ppb of N-nitrosodiphenylamine. In the late 1980s and early 1990s, wells #23, # 25 and #27 at the Parkway well field were closed and sealed by TRWC. Wells 23, 25,and 27 were screened in the Kirkwood element, at a depth of approximately 280 feet. These actions would have served to eliminate exposure pathways associated with these wells.

The total number of persons associated with the completed exposure pathway through the community water supply in the past is difficult to determine. Exposure potential is dependent upon the dynamics of the water system during the period in question, and the location of potentially affected residences relative to the point of entry within the water system. Because the Parkway well field is a major source of water for the community water system, the number of exposed persons was potentially large.

A summary of exposure pathways associated with private wells and community water supply

wells at the Parkway well field is presented in the following table:

Completed Human Exposure Pathways Associated with Reich Farm						
Pathway Name	**Source**	**Environmental Media**	**Point of Exposure**	**Route of Exposure**	**Exposed Population**	**Contaminants (Time Documented)**
Private Wells	Reich Farm plume	Groundwater	Residences and other locations with private water supplies	Ingestion, dermal contact, inhalation	Residents receiving water from private potable wells. (Number unknown)	VOCs/TOC (1974 to 1975); "Phenols"(1976); VOCs (1986) Exposure duration uncertain
Community Water Supply	Reich Farm plume	Groundwater	Residences and other locations served by water from Parkway well field of the community water supply	Ingestion, dermal contact, inhalation	Residents receiving water from Parkway well field (Number unknown)	VOCs/SVOCs (1986 and 1987); VOCs/SAN Trimer (1996) Exposure duration uncertain

Public Health Implications

The public health implications of the completed exposure pathways in the past will now be considered. Several contaminants were confirmed to be present in water from private wells and community water supply wells at levels above health-based comparison values. (See the appendix for definitions and uses of comparison values.) The NJDHSS and the ATDSR have further evaluated the public health significance of past exposures to these contaminants through an examination of relevant toxicologic and epidemiologic information. In addition, this section will include a brief summary of the findings of an analysis of childhood cancer incidence data for Dover Township.

Health Outcome Data

An "illness survey" was reported to have been conducted by the OCHD in 1974, among 23 families (48 persons) in Pleasant Plains with and without contaminated private wells (Ghassemi, 1976). No association was reported between use of contaminated private wells and self-reported illnesses. However, illness surveys are of limited use in determining links between exposure and chronic health effects.

Childhood Cancer Incidence in Dover Township

The NJDHSS and the ATSDR reviewed cancer incidence data in the period 1979 to 1995 for Dover Township, as part of the Public Health Response Plan. Findings are fully described in a separate Public Health Consultation by the NJDHSS and the ATSDR (NJDHSS/ATSDR, 1997). Dover Township was the only municipality in Ocean County in which overall childhood cancer incidence (ages up to 19 years) was statistically elevated. Ninety cases were observed in the 17-year period, compared to 67 that would have been expected if childhood cancer rates were the same in the township as in the entire State of New Jersey. Leukemia incidence was elevated in Dover Township, particularly in females under the age of five years. In the Toms River section of the township, overall childhood cancer was elevated (24 observed vs. 14 expected). Both leukemia and brain/central nervous system cancers were elevated, with the excess occurring primarily in female children under age five.

Toxicologic and Epidemiologic Evaluation

Before actions were taken in the mid-1970s to interrupt the private well exposure pathway, it is clear that many wells in the Pleasant Plains section of Dover Township were contaminated with organic chemicals, as evidenced by the TOC, CCE, CCl_4/IR and "phenol" analytical results from the 1970s. However, the specific compounds and the levels that persons were exposed to through the use of water from their private wells is not known, although complaints of abnormal tastes and odors indicate substantial contamination levels. Much uncertainty exists as to the public health significance of past exposures through consumption of contaminated private well water.

In 1986, one private well (RW-7), located just up-gradient from the RF-site, had levels of PCE, carbon tetrachloride and bromoform exceeding, but similar to, the health-based comparison values. A toxicological evaluation of these contaminants, taken on an individual basis, would not indicate that an adverse health effect (carcinogenic or non-carcinogenic) is likely from past exposure to persons consuming water from RW-7 (ATSDR, 1990; ATSDR, 1994a; ATSDR, 1997a).

As seen from Tables 6 and 7, several contaminants have been detected in untreated raw water samples from the TRWC community water supply wells. Those contaminants detected at or above health-based comparison values include TCE, PCE, 1,2-dichloroethane, benzene and N-nitrosodiphenylamine. In addition, persons were exposed in the past through this pathway to SAN trimer and possibly other organic constituents of unknown composition and toxicological significance. With the exception of TCE in well #26 in 1990 (33 µg/l), the levels of the contaminants detected are generally only slightly above their respective health-based comparison values. However, it is important to note that this measured level is not reflective of the actual concentration a household in the TRWC distribution system would receive because of the installation of the air stripping treatment to remove VOCs in 1988, the blending of water from several wells at the Parkway well field, and the mixing of water within the distribution system from other well fields. For these reasons, a toxicological evaluation of the known contaminants, taken on an individual basis, would not indicate that an adverse health effect (carcinogenic or non-carcinogenic) is likely from past exposures to persons consuming well water from the Parkway well field (ATSDR, 1994b; ATSDR, 1997a; ATSDR, 1997b; ATSDR, 1997c).

It should be noted that toxicologic evaluations of individual chemicals do not take into account the potential for adverse health effects from the combined exposure to mixtures of these contaminants, although research on the toxicity of mixtures indicates that adverse health effects are unlikely when the mixture components are present at levels well below their individual toxicologic thresholds (Bond et al., 1997; Groton et al., 1997; Seed et al., 1995; and Yang et al., 1989). Because documented contaminant levels indicate that the exposures were well below their respective individual toxicologic thresholds, the *toxicological* evidence suggests that exposures to combinations of *known* contaminants detected in private wells and in untreated water from the Parkway well field are not likely to lead to adverse health effects.

However, it is clear from the previous discussions in the Environmental Contamination and Pathways Analysis sections that the water from private wells and the Parkway well field, and subsequently individual households using the water from the system, were contaminated with organic contaminants of an undetermined nature and level in the past. Therefore, much uncertainty exists as to the public health significance of past exposures through consumption of contaminated water. In order to help evaluate the public health significance of human exposure pathways associated with community water supply wells, the ATSDR is developing a model of the UWTR/TRWC water system which will enable a more accurate evaluation of the patterns of distribution associated with the wells. (The NJDHSS and the ATSDR will use this model in assessments of exposure to drinking water sources in epidemiologic studies of childhood cancer in Dover Township.)

The public health significance of the pathway associated with exposure to SAN trimer cannot be fully evaluated at this time (ATSDR, 1997e). However, there are some preliminary toxicological information regarding the toxicity of the SAN trimer. In 1996, when the SAN trimer was first recognized to be present in the community water supply, nothing was known about the toxicology of this material. Since that time, UCC has sponsored genetic toxicology assays and short-term toxicologic testing. In a first round of testing, SAN trimer was found to be mutagenic in two strains of *Salmonella* and induced chromosomal aberrations in Chinese hamster ovary (CHO) cells, but there was no evidence of mutagenicity in two other assays (Bioreliance, 1998; Bioreliance, 1999). A second round of *Salmonella* assays suggested that mutagenicity may be attributable to an impurity in the SAN trimer batch used in the first round (Bioreliance, 2000). The lethal single dose (LD_{50}) was estimated to be 440 and 590 mg/kg in male and female rats (Huntingdon Life Sciences, 1999a). A two-week repeat dosing study showed that daily dose of 300 mg/kg were lethal to rats, while doses of 150 mg/kg resulted in a variety of toxic effects including lethargy, tremors, anemia, and increased liver weight. No adverse effects were observed at 75 mg/kg under the conditions of this test (Huntingdon Life Sciences, 1999b).

No determination about the toxicity of long-term exposure to lower levels of SAN trimer can be made from this limited set of data from these short-term, very high dose studies. Plans for further toxicological testing are being coordinated by the USEPA and a working group of scientists from the National Institute of Environmental Health Sciences, ATSDR, NJDEP, and NJDHSS, with input from UCC and a consultant to the OCHD. The results of these on-going toxicological studies may provide additional information to further the understanding of the public health implications of past exposures to this contaminant through consumption of community or private water supplies.

The available analyses of water from private and public water samples indicates that VOCs (primarily TCE and PCE) were the most consistently detected contaminants. For this reason and because of the uncertainty in the historical levels of contamination of private wells and the Parkway well field, a discussion of the current scientific knowledge regarding the public health implications of these contaminants is presented below.

Effects of TCE and PCE in Adults

The effects of exposure to TCE and PCE have been evaluated in scientific studies for their possible impact upon adult human health. TCE and PCE are classified as probable human carcinogens by the International Agency for Research on Cancer (IARC, 1995) based on the weight of evidence from laboratory animal experiments and limited human epidemiologic studies.

Laboratory animals have been exposed to these chemicals via contaminated air, drinking water, and food. The results of these studies indicate that the nervous system and liver, and to a lesser degree the kidney and heart, are the primary organs of adult animals affected by these VOCs (ATSDR, 1997a; ATSDR, 1997c). Following long-term, high level exposure, TCE has been shown to produce liver cancer in mice and kidney and testicular tumors in rats (ATSDR, 1997c; IARC,

1995). Chronic, high level PCE exposure produces liver cancer in mice and kidney tumors and mononuclear cell leukemia in rats (ATSDR, 1997a; IARC, 1995). The exposure levels needed to cause these adverse impacts in laboratory animals are many times higher than exposure levels that could have occurred through the use of contaminated drinking water (ATSDR, 1997a; ATSDR, 1997c).

Epidemiological studies of occupationally-exposed workers suggest an association between long-term inhalation exposure to high levels of TCE and increased risk of liver and biliary tract cancer, kidney cancer, and non-Hodgkin's lymphoma (IARC, 1995; ATSDR, 1997c; Wartenberg et al, 2000). Increased risks of esophageal cancer, cervical cancer, and non-Hodgkin's lymphoma have been observed in workers exposed to high levels of PCE (IARC, 1995; ATSDR, 1997a). Participants in the ATSDR TCE Exposure Subregistry (approximately 4,300 individuals with exposure to TCE in drinking at levels ranging from 2 to 19,000 µg/l for as long as 18 years) have reported a variety of health problems at rates above national averages. However, only the rate for strokes was reported to increase with increasing concentration of TCE in drinking water. Results from the Subregistry have not documented any increased occurrence of cancer in the study population (ATSDR, 1999).

Effects of TCE and PCE in Children and the Fetus

Children may be particularly susceptible to the toxic effects of chemicals; fetuses may also be sensitive to toxic effects if the chemicals can cross the placental barrier. Recent epidemiologic studies suggest that fetal exposure to VOCs in drinking water could result in adverse health effects. The NJDHSS evaluated the effects of VOCs in drinking water on birth outcomes in an area of northern New Jersey (Bove et al., 1995). This exploratory study found that maternal residence during pregnancy in areas with TCE-contaminated drinking water was associated with an increased risk of birth defects of the neural tube and oral cleft. Exposure to PCE during pregnancy was associated with an increased risk of oral cleft defects. The authors concluded that their study by itself cannot determine whether the drinking water contaminants caused the reported adverse birth outcomes.

A recent ATSDR study of exposure to VOCs in drinking water and occurrence of adverse pregnancy outcomes was conducted for residents of the U.S. Marine Corps Base at Camp LeJeune, North Carolina (ATSDR, 1997d). The researchers reported a significantly decreased mean birth weight and increased small for gestational age babies for two potentially susceptible subgroups: infants of mothers older than 35 years of age and infants of mothers with histories of fetal death. However, length of exposures to VOCs was not known for the entire period during which pregnancy outcomes were evaluated. Therefore, this study provides limited evidence for a causal relationship between exposure to VOCs and the reproductive and developmental effects evaluated.

A study of childhood leukemia conducted in Woburn, Massachusetts, concluded that the incidence of childhood leukemia was associated with the mother's potential for exposure to water from specific wells contaminated with TCE, PCE and other chemicals, particularly for exposure

during pregnancy (MDPH, 1997). The study did not find any association between the development of childhood leukemia and the child's exposure to contaminated water after birth. The Woburn study should be interpreted with caution, however, since small numbers of study subjects led to imprecise estimates of risk. A study by the NJDHSS found a statistically elevated rate of childhood leukemia in towns served by community water supplies contaminated with TCE and PCE in the years 1979 to 1987 (before current drinking water regulations had been implemented), compared to towns without a history of such contamination (Cohn et al., 1994). Overall, the associations drawn from these limited epidemiological data in humans are suggestive, yet inconclusive, that exposure to these VOCs through drinking water may cause birth defects or childhood leukemia in children exposed while a fetus. ATSDR and others are conducting or sponsoring research to clarify this possible relationship.

Conclusions

Hazard Category for the Reich Farm Site

Based on a weight-of-evidence analysis of the health and environmental information compiled, each Public Health Assessment assigns a hazard category (see Appendix) in response to the public health risk posed by the site being evaluated. Each category relates to a set of additional actions or interventions that may be considered by the ATSDR, the NJDHSS or other public health agencies, as well as recommendations for further action to the USEPA, NJDEP or other environmental agencies.

The Reich Farm site is considered by the ATSDR and the NJDHSS to have represented a **public health hazard because of past exposures**. This determination is based on the following considerations, taken together: 1) the presence of completed exposure pathways in the past (through private and community water supplies) to VOCs (including PCE and TCE) and other chemicals, to a potentially large population; 2) epidemiologic studies from other communities suggesting that exposure to TCE and PCE may increase the risk of certain childhood cancers and adverse neurological effects; and 3) the presence of an excess of childhood cancers in the community.

Much uncertainty exists concerning the composition, levels and toxicologic characteristics of past exposure to contaminated private and community water supplies. Although the toxicological evaluation performed for this Public Health Assessment did not suggest that adverse health effects from documented past exposures to contaminated drinking water (through private wells or the community water supply) were likely, this evaluation is based on limited historical environmental data. Therefore, although it cannot be documented, the public health significance of past exposures related to the Reich Farm site may have been greater than is apparent from the toxicological evaluation of the known levels of contaminants performed in the Public Health Assessment. For the reasons above, further evaluation and follow up actions are warranted in order to evaluate the public health significance of past risks posed by the site.

Current conditions indicate that exposure to contaminants from the RF site is no longer occurring. The exposure pathway through private well use was interrupted by the establishment of a well restriction zone, and there is no indication that private wells are still in use for potable purposes in the area above the RF plume. The exposure pathway through the community water supply has been interrupted by the diversion and treatment of contaminated water from wells #26 and #28 at the Parkway well field, and the recent installation of treatment for well #29. However, treated output from wells #26 and #28 may be pumped into the community water supply in times of high water demand. Containment of the RF-related groundwater plume through effective management of the Parkway well field is essential to ensure that currently unaffected wells remain so. In addition, proper operation of the treatment systems in place is necessary to reduce or eliminate the entry of RF-related contaminants into the distribution system. On-going water monitoring is needed to document the effectiveness of well field management and treatment systems. For these reasons, the ATSDR and the NJDHSS are categorizing the RF site as **no apparent public health hazard under present conditions**. Should NJDHSS or ATSDR become aware of information indicating that RF-related exposure is still occurring, or if private wells are still in use in the plume area, this determination will be reconsidered.

Past completed human exposure pathways associated with the Reich Farm are of sufficient public health significance to warrant further epidemiological evaluation of childhood cancer incidence in Dover Township. Also, because there is uncertainty about the toxicity of unusual RF site-related contaminants now found in the groundwater plume (for example, SAN trimer), further toxicological evaluation is needed.

Recommendations

Cease/Reduce Exposure Recommendations

The ATSDR and the NJDHSS recommend routine sampling of all shallow Cohansey Aquifer wells of the Parkway well field at an appropriate interval to ensure the groundwater plume remains delineated, controlled, and does not impact the currently unaffected public supply wells. Monitoring (at appropriate intervals) of the effectiveness of treatment systems now in place is necessary to ensure that RF site-related contaminants are not introduced into the community water distribution system.

The groundwater plume associated with the RF site is of public health concern, and merits continuation of the well restriction zone (with respect to the Cohansey aquifer) in the Pleasant Plains area of Dover Township.

Site Characterization Recommendations

The ATSDR and the NJDHSS could not locate and review the original data reports related to the groundwater investigations in the early 1970s. The NJDHSS and the ATSDR should review

such information, or any other data relevant to the characterization of past exposure, if it becomes available.

Public Health Recommendations

Based upon review of completed human exposure pathways at the RF site, and in conjunction with the concerns of the community regarding the incidence of childhood cancer, consideration of RF-related exposure pathways in the on-going epidemiologic investigation by the NJDHSS and the ATSDR is warranted. Estimates of exposure to water though this pathway should include the use of private wells and community water supply wells. To account for the complex dynamics of a community water system, water system models should be employed to trace the flow of water from the Parkway well field to points in the distribution system.

The ATSDR and NJDHSS recommend that toxicity testing of the SAN trimer continue to be pursued, particularly for its potential to be carcinogenic.

Public Health Action Plan

The Public Health Action Plan (PHAP) for the Reich Farm Site contains a description of the actions to be taken at or in the vicinity of the site. The purpose of the PHAP is to ensure that this Public Health Assessment not only identifies public health hazards, but provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of ATSDR and NJDHSS to follow up on this plan to ensure its implementation. The public health actions taken or to be implemented are as follows:

Public Health Actions Undertaken by NJDHSS/ATSDR:

Reich Farm

1) The NJDHSS and the ATSDR have evaluated available information to determine the public health significance of past and present human exposure pathways associated with the Reich Farm Site.

2) The NJDHSS and the ATSDR, in cooperation with the NJDEP, have conducted an extensive program of sampling of the UWTR community water supply. Results of samples from wells at the Parkway well field led to the discovery of previously uncharacterized contaminants entering the distribution system and subsequent remedial actions.

3) NJDHSS acquired and conducted analyses of split samples of monitoring wells associated with the RF site. These data have been reviewed and are being summarized by NJDHSS in a separate document.

4) In cooperation with the USEPA, the ATSDR (Division of Toxicology) and the NJDHSS have participated in an on-going working group to review initial toxicity testing data and draft protocols for further testing of SAN trimer.

5) The ATSDR has evaluated toxicological information on tentatively identified compounds in the Reich Farm Groundwater plume (ATSDR, 2000).

General

1) Results of private well analysis have been communicated to participants in the groundwater phase of the exposure investigation. The NJDHSS has provided assistance in interpreting data where necessary. In addition, the NJDHSS has provided recommendations for minimizing exposure, and educational materials regarding the health issues associated with exposure to lead and radiological activity to the appropriate participants.

2) The NJDHSS and the ATSDR have prepared a Public Health Consultation describing a review and analysis of childhood cancer incidence data for Dover Township during the period 1979 to 1995.

3) The NJDHSS and the ATSDR (Division of Health Studies) are conducting an epidemiologic study of childhood cancers in Dover Township. The study will examine whether environmental exposures (including but not limited to completed pathways associated with the RF) and other risk factors are associated with the incidence of these diseases. An Interim Report of this study was released in December 1999.

4) The ATSDR is developing a community water supply distribution system model which will be used in the epidemiologic study to estimate past exposure to water from the Parkway and other points of entry.

5) In response to concerns about childhood brain cancer in several states, the ATSDR has initiated a multi-state epidemiologic study to explore the role of environmental risk factors in the development of childhood brain cancer. Findings from this study may be applicable to diverse areas and populations.

6) The ATSDR (Division of Health Education and Promotion) and the NJDHSS have implemented a variety of physician and community education initiatives in Dover Township as part of the Public Health Response Plan, including:

Health Care Provider Education

* The NJDHSS distributed approximately 100 Resource Guides for Health Care Providers to physicians in Ocean County.

* The NJDHSS developed and distributed a series of Health Care Provider Updates to approximately 430 physicians and physician groups and 30 school nurses in the area. The first Update in the series (August 1996) reviewed the Public Health Response Plan. A survey of educational needs was sent with the first Update; 77 physicians responded to the survey, with 33 requesting additional informational materials. Physicians were most interested in professional seminars and patient education materials on general pollution issues. Six additional Health Care Provider Updates have been completed and distributed by the NJDHSS: information on the Ciba-Geigy and Reich Farm Health Public Health Assessments, the initial results of the community water supply investigation, cancer incidence statistics, the epidemiological study protocol, and a summary of the Interim Report of the childhood cancer epidemiologic study.

Community Education

* Health Care Provider Updates and Resource Guides have been made available to area residents upon request.

* A one-year progress report of the Dover Township Childhood Cancer investigation has been developed and distributed (September 1997) by the NJDHSS for concerned citizens. The ATSDR issued a the second progress report of the investigation in May 1998.

* In cooperation with the ATSDR, the Environmental and Occupational Health Sciences Institute provided curriculum training in environmental health issues for primary school teachers of the Toms River school district.

Public Health Actions Planned By NJDHSS/ATSDR:

Reich Farm

1) The ATSDR and the NJDHSS will continue to review water quality data associated with the Parkway well field generated during future sampling episodes for public health significance, and recommend or take appropriate mitigative public health actions if necessary.

2) In cooperation with the USEPA, the NIEHS and the NJDEP, the NJDHSS and the ATSDR will review the public health significance of exposure to the SAN trimer upon availability of relevant toxicological data.

3) The ATSDR will continue to review toxicological information on tentatively identified compounds in the Reich Farm groundwater contamination plume.

General

1) The NJDHSS will contact local health officials and community leaders to assess the need for future community educational activity. Site specific educational materials will be prepared and disseminated as necessary. Periodically, new Progress Reports and Health Care Provider Updates will be developed an distributed.

2) The ATSDR and the NJDHSS will reevaluate and revise this Public Health Action Plan (PHAP) as warranted. New environmental, toxicological, health outcome data, or the results of implementing the above proposed actions may determine the need for additional actions at the RF site by the NJDHSS and/or the ATSDR.

Certification

This Public Health Assessment was prepared by the New Jersey Department of Health and Senior Services (NJDHSS) under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the Public Health Assessment was begun.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this Public Health Assessment and concurs with its findings.

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Appendix A: Description of Comparison Values

Description of Comparison Values

ATSDR's comparison values are media-specific concentrations that are considered to be "safe" under default conditions of exposure. They are used as screening values in the preliminary identification of site-specific chemical substances that the health assessor has selected for further evaluation of potential health effects.

Generally, a chemical is selected for evaluation because its maximum concentration in air, water, or soil at the site exceeds one of ATSDR's comparison values. However, it cannot be emphasized strongly enough that comparison values are not thresholds of toxicity. While concentrations at or below the relevant comparison value may reasonably be considered safe, it does not automatically follow that any environmental concentration that exceeds a comparison value would be expected to produce adverse health effects. Indeed, the whole purpose behind highly conservative, health-based standards and guidelines is to enable health professionals to recognize and resolve potential public health problems before they become actual health hazards. The probability that adverse health outcomes will actually occur as a result of exposure to environmental contaminants depends on site-specific conditions and individual lifestyle and genetic factors that affect the route, magnitude, and duration of actual exposure, and not solely on environmental concentrations.

Screening values based on non-cancer effects are generally based on the level at which no health adverse health effects (or the lowest level associated with health effects) found in animal or (less often) human studies, and include a cumulative margin of safety (variously called safety factors, uncertainty factors, and modifying factors) that typically range from 10-fold to 1,000-fold or more. By contrast, cancer-based screening values are usually derived by linear extrapolation with statistical models from animal data obtained at high exposure doses, because human cancer incidence data for very low levels of exposure are rarely available. Cancer risk estimates are intended to represent the upper limit of risk, based on the available data.

Listed and described below are the types of comparison values that the ATSDR and the NJDHSS used in this Public Health Assessment:

Cancer Risk Evaluation Guides (CREGs) are estimated concentrations of contaminants in an environmental medium (such as drinking water) that are expected to cause no more than one excess cancer case for every million persons who are continuously exposed to the concentration for an entire lifetime (equaling a risk of 1×10^{-6}). These concentrations are calculated from the USEPA's cancer slope factors, which indicate the relative potency of carcinogenic chemicals. Only chemicals that are known or suspected of being carcinogenic have CREG comparison values.

Environmental Media Evaluation Guides (EMEGs) and Reference Dose Media Evaluation Guides (RMEGs) are estimates of chemical concentrations in an environmental medium (such as drinking water) that are not likely to cause an appreciable risk of deleterious, non-cancer health effects, for fixed durations of exposure. These guides may be developed for special sub-populations such as children. EMEGs are based on ATSDR's minimal risk level (MRL) while RMEGs are based on the USEPA's reference dose (RfD).

Other health-based guides may also be used as comparison values, including drinking water maximum contaminant levels (MCLs) established by the USEPA or the NJDEP.

Appendix B: ATSDR Public Health Hazard Categories

ATSDR's Interim Public Health Hazard Categories

Category / Definition	Data Sufficiency	Criteria
A. Urgent Public Health Hazard This category is used for sites where short-term exposures (< 1 yr) to hazardous substances or conditions could result in adverse health effects that require rapid intervention.	This determination represents a professional judgement based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.	Evaluation of available relevant information* indicates that site-specific conditions or likely exposures have had, are having, or are likely to have in the future, an adverse impact on human health that requires immediate action or intervention. Such site-specific conditions or exposures may include the presence of serious physical or safety hazards.
B. Public Health Hazard This category is used for sites that pose a public health hazard due to the existence of long-term exposures (> 1 yr) to hazardous substance or conditions that could result in adverse health effects.	This determination represents a professional judgement based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.	Evaluation of available relevant information* suggests that, under site-specific conditions of exposure, long-term exposures to site-specific contaminants (including radionuclides) have had, are having, or are likely to have in the future, an adverse impact on human health that requires one or more public health interventions. Such site-specific exposures may include the presence of serious physical or safety hazards.
C. Indeterminate Public Health Hazard This category is used for sites in which "*critical* data are *insufficient* with regard to extent of exposure and/or toxicologic properties at estimated exposure levels.	This determination represents a professional judgement that critical data are missing and ATSDR has judged the data are insufficient to support a decision. This does not necessarily imply all data are incomplete; but that some additional data are required to support a decision.	The health assessor must determine, using professional judgement, the "criticality" of such data and the likelihood that the data can be obtained and will be obtained in a timely manner. Where some data are available, even limited data, the health assessor is encouraged to the extent possible to select other hazard categories and to support their decision with clear narrative that explains the limits of the data and the rationale for the decision.

Category / Definition	Data Sufficiency	Criteria
D. No Apparent Public Health Hazard This category is used for sites where human exposure to contaminated media may be occurring, may have occurred in the past, and/or may occur in the future, but the exposure is not expected to cause any adverse health effects.	This determination represents a professional judgement based on critical data which ATSDR considers sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.	Evaluation of available relevant information* indicates that, under site-specific conditions of exposure, exposures to site-specific contaminants in the past, present, or future are not likely to result in any adverse impact on human health.
E: No Public Health Hazard This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard.	Sufficient evidence indicates that no human exposures to contaminated media have occurred, none are now occurring, and none are likely to occur in the future	

* *Such as environmental and demographic data; health outcome data; exposure data; community health concerns information; toxicologic, medical, and epidemiologic data; monitoring and management plans.*

Appendix C: Tables

Table 1 - General description of UCC wastes found on the Reich Farm site. After Ghassemi, 1976.

UCC Code	Material Description	UCC Code	Material Description
001	Phenolic Resin from "B" batches	306	Solvent washes of process equipment
010	Waste solvents from Quality Control Labs	307	Dichlorobenzene and styrene residue mixtures
101	Miscellaneous drums of phenol and butyl phenol	308	Lab waste solvents
102	Miscellaneous drums of solid phenol and butyl	309	Styrene and fatty acids mixture
103	Tar pitch	310	Flash pot bottoms (solid) styrene
104, 105	Butyl phenol pitch	311	Styrene, acrylonitrile and solvents mixtures
106	Miscellaneous liquid (some phenol)	312	Flash pot bottoms (solid) C-11
200	Phenolic resin scrap with solvents	313	Styrene, acrylonitrile, MEK, chloral, and toluene
201	Waste epoxy hardeners	314	Styrene, MEK, toluene, and trichloroethylene mixtures
202,204	Waste epoxy resins (reactive with other resins)	315	Color room; cleaning of pots, degreaser, and mixing bowls
203	Waste acrylic resins with solvents	316	Alumina and styrene mixtures
205	Fines from substituted phenolic resins	400	Solvents (combined)
206	Filter cartridges with resins	401	Partially filled bottles test tubes, etc.
208	Substandard phenolic resins	402	MEK, toluene, ethanol, and acetone mixtures
209	Lab samples of resins	403	Pilot work on polystyrene
210	Acetone still wash with phenolic resin	404	Waste resin, solvent, and water mixtures
211	Methyl isobutyl ketone from production of epoxy	405	High boiling out of epoxy resin purification molecular still
212	Dirty xylene from still wash	406	Resin, toluene, isopropanol, sodium chloride
213	Epichlorohydrin, ethanol, and water mixture	407	Polysulfone resin, methanol, MCB and toluene
214	Toluene and ethanol still wash mixture	408	Waste solids
215	Toluene still wash	409	Miscellaneous solid resin wastes
216	Epichlorohydrin recycle from epoxy resins	410	Resin and methanol mixtures
217	Toluene and phenolic resin mixture	500	Printer wash solvents
300	Butanol and toluene mixture	501	Mineral sprits, solvent, and plastizol mixtures
301	Butanol, toluene, and phenoxy polymer mixtures	502	Blend of resin and oil
302	Waste polystyrene	600	Vinyl operations; vinyl production waste
303	Bisphenol, epichlorohydrin, caustic, butanol, toluene mixture	803	Filters from phenol plant
304	Substandard phenoxy solutions	900	Waste oil, grease, and lubricants
305	Phenoxy polymer and MEK mixtures		

Table 2 - Maximum concentrations of selected chemicals found in on-site soils and groundwater monitoring wells, from samples taken in 1986 and 1987, at the Reich Farm site.

Compound	Subsurface Soils (µg/kg)	Surface Soils (µg/kg)	Monitoring Wells (µg/l)
Acetone	12,000	17	190
2-Butanone	31,000	11	320
1,1-Dichloroethane	ND	ND	8
1,2-Dichloroethane	ND	ND	5
Tetrachloroethylene	13,900	22	19
Carbon tetrachloride	ND	ND	16
1,1,1-Trichloroethane	118 J	7	130
Trichloroethylene	1	ND	15
1,2-Dichloroethylenes	ND	1	7
Toluene	53,000	99	3 J
Ethylbenzene	9,300	59	ND
Styrene	170,000	ND	ND
Xylenes	3,600	180	ND
Chlorobenzene	36,100	100	1 J
1,2-Dichlorobenzene	9,500	ND	ND
1,3-Dichlorobenzene	15,000 J	ND	ND
1,4-Dichlorobenzene	64,000	ND	ND
1,2,4-Trichlorobenzene	6,600 J	ND	ND
Phenol	6,700	ND	4 J
2-Chlorophenol	340 J	ND	ND
Bis(2-ethylhexyl)phthalate *	160,000	5,700	2,200
Di-n-octylphthalate *	67 - 1,900	570	4
N-Nitrosodiphenylamine	83	ND	6

Sources: NUS, 1986; Ebasco, 1988c.

J Estimated value
ND Not detected

* Other phthalates and several polycyclic aromatic hydrocarbons were also detected in soil samples.

Table 3 - Ether extractable total organic carbon (TOC) results, March to June 1974. After Ghassemi,1976.

Sampling Locations	TOC Ether Extractables in parts per billion (ppb)
Lakewood Road (Monroe Ave. to Church Rd.)	ND to 18,000
Church Road (Lakewood Rd. to Old Freehold Rd.)	ND to 9,500
Sunset Ave. (Lakewood Rd. to Whitesville Rd.)	1,100 to 5,200
Clayton Ave. (Lakewood Rd. to Whitesville Rd.)	ND to 21,300
Caroline La. (Clayton to Sunset)	4,100 to 4,200
Monroe Ave. (Lakewood Rd. to Sunset)	2,800 to 6,600
Lena Ave.	ND

Note : There were no Federal or State Standards for levels of ether extractable compounds in potable water.

Table 4 - Carbon/chloroform extractable results, Pleasant Plains, June 19 to July 20, 1974. After Ghassemi, 1976.

Date	Location	CCE in parts per billion (ppb)
June 19 - 21	Pleasant Plains Fire Department	400
June 19 - 21	Toms River Water Company # 20	100
July 7 - 11	Private Residence	1,200
July 16 - 18	First Aid Building; Clayton Ave.	400
July 16 - 18	N. Dover Elementary School, Church Road	100
July 18 - 20	Toms River Water Company Well # 26	200

Note : According to U.S. Public Health Service drinking water standards in place at the time of this sampling, the maximum allowable CCE level was 700 ppb.

Table 5 - Organic chemical results (carbon tetrachloride extraction/infrared absorption analysis), Pleasant Plains, samples taken July to November 1974. After Ghassemi, 1976.

Sampling Location	Number of Wells	Total Organics by CCl_4/IR Range in parts per billion (ppb)
Lakewood Road Residences *	9	ND to 1,900
N. Dover Elementary School	1	100 to 1,200
St. Andrews Church	1	100 to 1,000
Old Freehold Road Residences	5	30 to 500
Silverton Rd. Residences	2	270 to 980
Whitesville Rd. Residences	4	100 to 820
Whitty Rd. Residence	1	650
Dugan Lane Residences	4	70 to 1,060
Toms River Water Company # 20	N/A	1,230
Toms River Water Company # 22	N/A	40 to 920
Toms River Water Company # 24	N/A	80 to 1,240
Toms River Water Company # 26	N/A	110

Notes: There were no Federal or State Standards for levels of CCl_4/IR compounds in potable water.

Results of samples taken on July 31, 1974 were considerably higher than those samples taken from the same locations in August through November 1974. The 7/31/74 data are not considered reliable and are not reported in this table.

* The highest value was detected in the private residence noted in Table 4.

N/A: Not applicable

Table 6 - Concentrations of selected organic chemicals in residential and community water supply wells, samples taken in 1986 and 1987, near Reich Farm site.

Compound (µg/l)	Residential Wells *		TRWC Community Supply Wells **						Comparison Value
	#5	#7	# 23	#25	#26	#27	#28	#29	
2-Butanone	5	ND	ND	3 J	ND	14	7	3 J	6,000 (RMEG)
Trichloroethylene	ND	ND	ND	ND	2.3	1	2	ND	1 (MCL)
Benzene	ND	ND	ND	ND	ND	ND	1	ND	1 (MCL)
Toluene	ND	ND	ND	ND	ND	1 J	ND	ND	200 (EMEG)
Tetrachloroethylene	ND	5	ND	ND	ND	1	ND	ND	0.7 (CREG)
Chloroform	ND	3	ND	ND	ND	ND	ND	ND	6 (CREG)
1,1,1-Trichloroethane	ND	5	ND	ND	ND	ND	ND	ND	30 (MCL)
Carbon tetrachloride	ND	7	ND	ND	ND	ND	ND	ND	0.3 (CREG)
Bromoform	ND	8	ND	ND	ND	ND	ND	ND	4 (CREG)
N-Nitrosodiphenylamine	ND	ND	8	ND	ND	ND	ND	ND	7 (CREG)
Di-n-octylphthalate	ND	ND	6	ND	ND	ND	ND	ND	730 (@)

Sources: NUS, 1986; Ebasco, 1988c.

J Estimated value
ND Not detected
EMEG Environmental media evaluation guide
RMEG Reference dose media evaluation guide
CREG Cancer risk evaluation guide for 10^{-6} excess cancer risk
MCL Maximum contaminant level

@ Risk-based level developed by USEPA Region III

* No contaminants were detected in residential wells designated #1, #2, #4, #6 and #8. Results from residential well #3 taken in 1986 are not reported in this table because one of two duplicate samples contained numerous contaminants at high levels, but none were found in the other duplicate or in a re-sample taken on 1987. RW7 is upgradient of the Reich Farm site.

** No contaminants were reported in samples taken in community supply wells #20, #22 and #24.

Note: Results for acetone and methylene chloride are not reported in this table because analyses did not pass quality assurance/quality control requirements.

Table 7 - Volatile organic analyses of Toms River Water Company community water supply wells at the Parkway well field, and nearby monitoring wells at Dugan Lane and Swain Ave., samples taken 1990 and 1991. Note that well data are for untreated water; at the time of sampling, the output of TRWC wells #26 and #28 were directed through air stripping treatment to remove volatile organic chemicals.

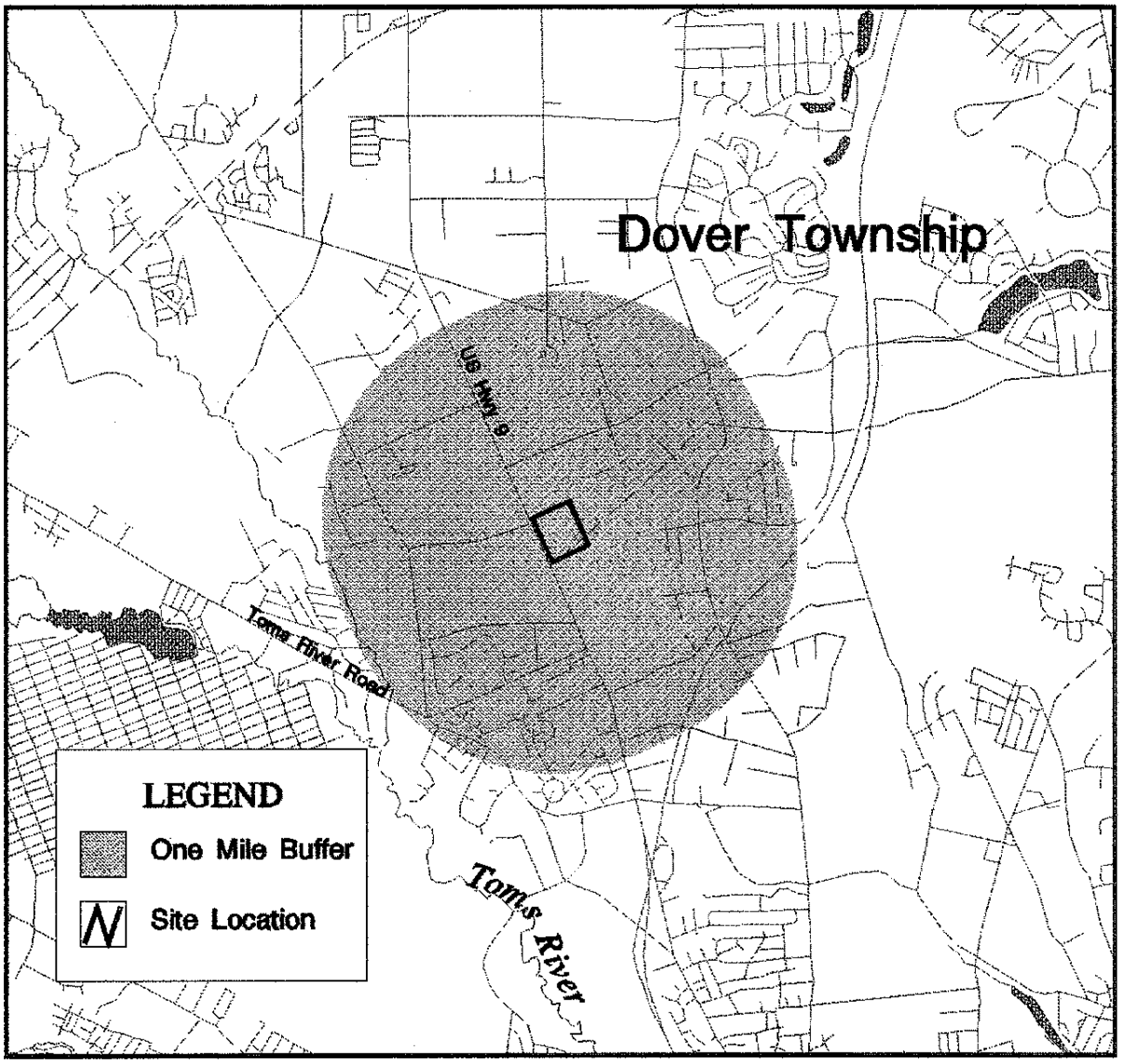
Compound (µg/l)	TRWC #22	TRWC # 26	TRWC # 28	TRWC # 29	TRWMWD (Dugan Lane)	TRWMWS (Swain Ave.)	Comparison Value
1,2-Dichloroethane	ND	1	ND	ND	ND	3 J	0.4 (CREG)
1,1,1-Trichloroethane	ND	2	0.2 J	ND	ND	3	30 (MCL)
Trichloroethylene	ND	33	1	3	ND	120 J	1 (MCL)
Tetrachloroethylene	ND	1	ND	ND	ND	5	0.7 (CREG)
Benzene	ND	ND	0.2 J	ND	ND	ND	1 (MCL)
Chlorobenzene	ND	0.5	ND	ND	ND	ND	50 (MCL)
1,1-Dichloroethylene	ND	0.2 J	ND	ND	ND	ND	2 (MCL)

Source: Malcolm Pirnie, 1992.

J: Estimated value
ND: Not detected
CREG: Cancer risk evaluation guide for 10^{-6} excess cancer risk
MCL: Maximum contaminant level

Appendix D: Figures

Figure 1 - Demographic Statistics Within One Mile of the Reich Farm Site; 1990 Census.



Population of Dover Township	76,371 (1990)		
Total Population within 1 Mile	3,325 (1996)		
White	3,193	Children Aged 6 and Younger	328
Black	18	Adults Aged 65 and Older	671
Asian	91	Females Aged 15 - 44	670
Hispanic	101		
Other	27	Total Housing Units	1209

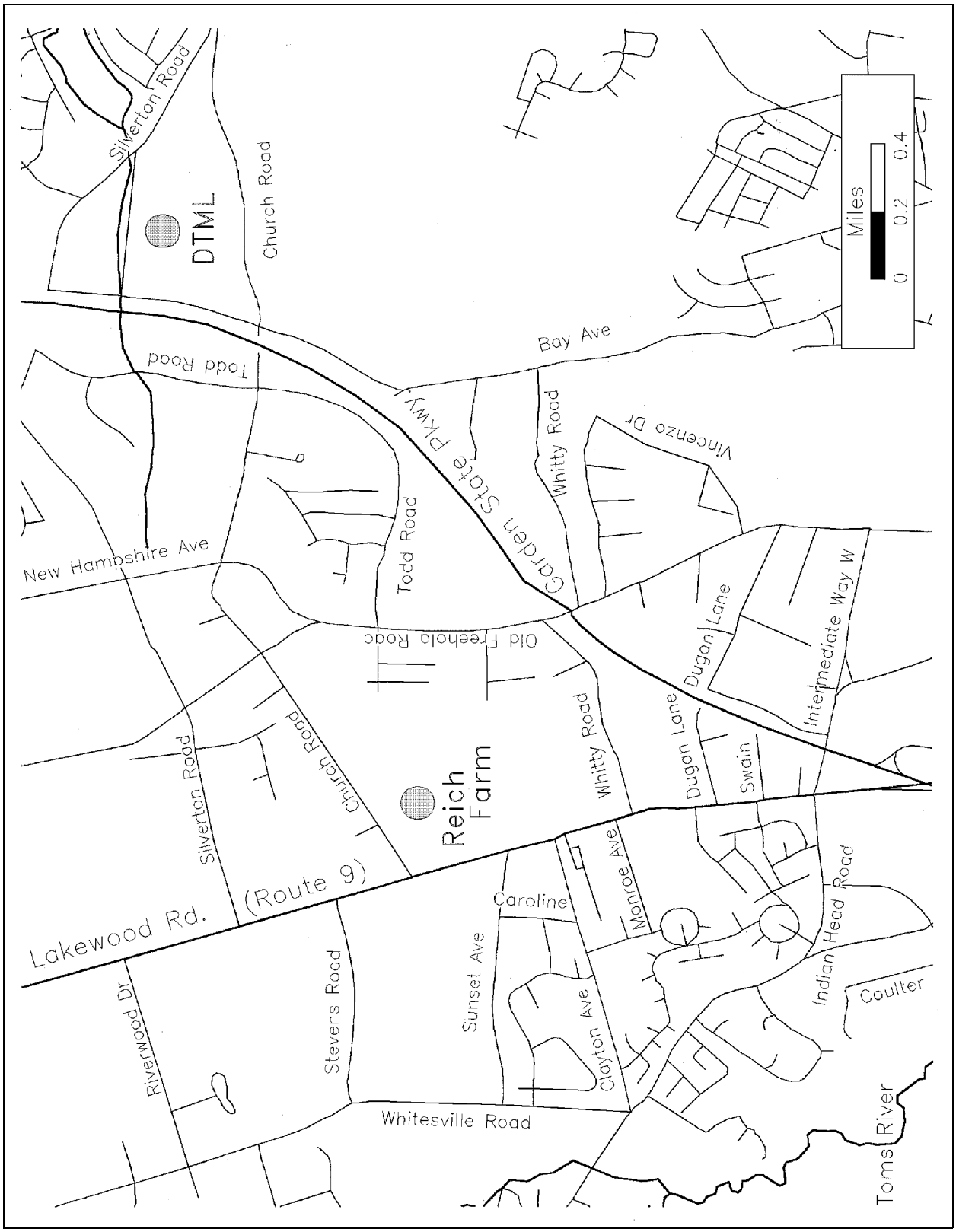
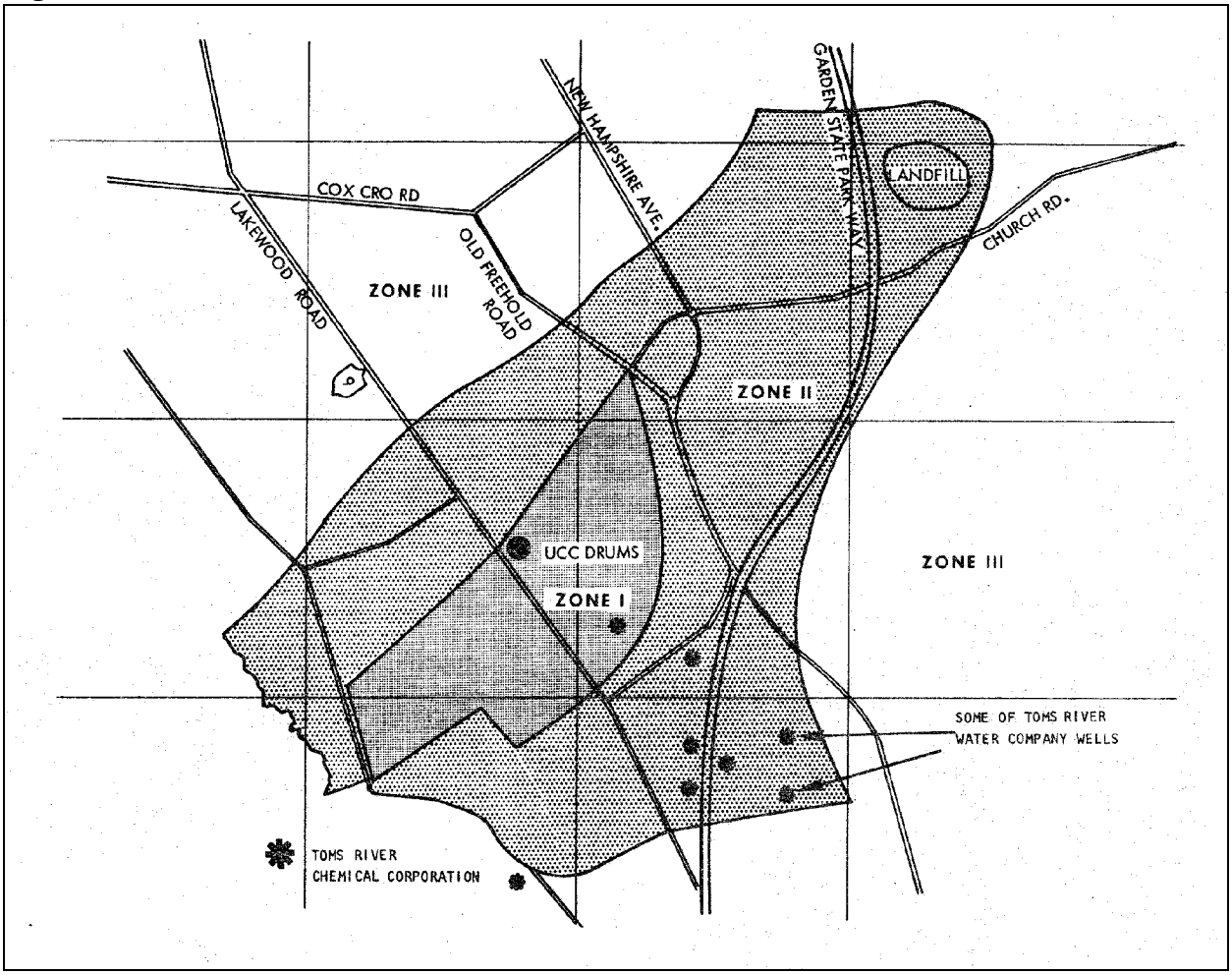


Figure 2 - Pleasant Plains Area of Dover Township

Figure 3 - Delineation of Areas of Groundwater Contamination - 1974



Source: Ghassemi, 1976.

Zone I This zone includes those locations known to be contaminated, where private well use of the shallow Cohansey Aquifer for any purpose was prohibited.

Zone II This zone includes areas thought to be suceptable to future contamination because of their location with respect to groundwater movement.

Zone III This zone was uncontaminated at the time of the restriction in 1974.

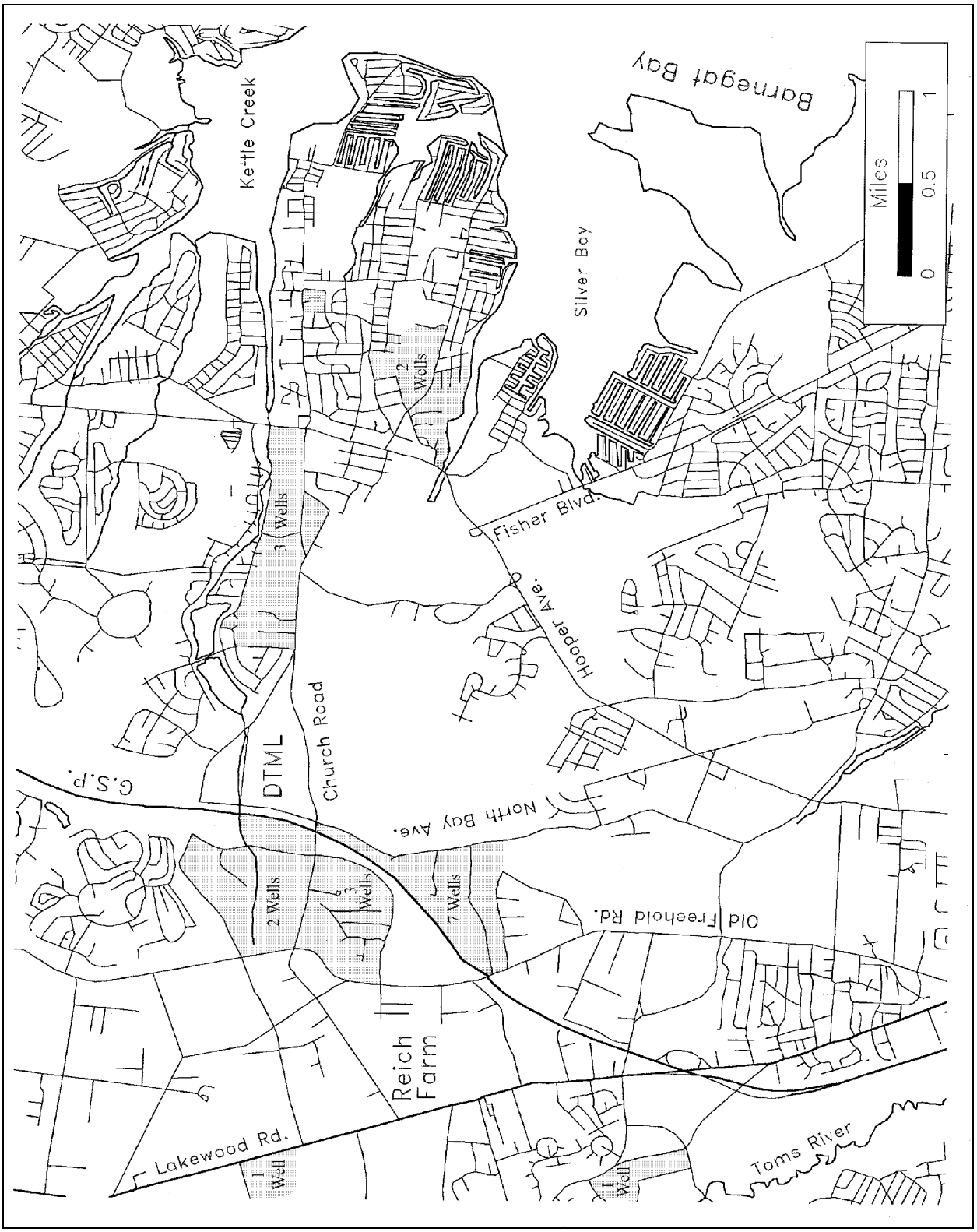


Figure 4 - General Locations of Private Wells Associated with the Reich Farm and the DTML, Sampled during the ATSDR/NJDHSS Exposure Investigation.

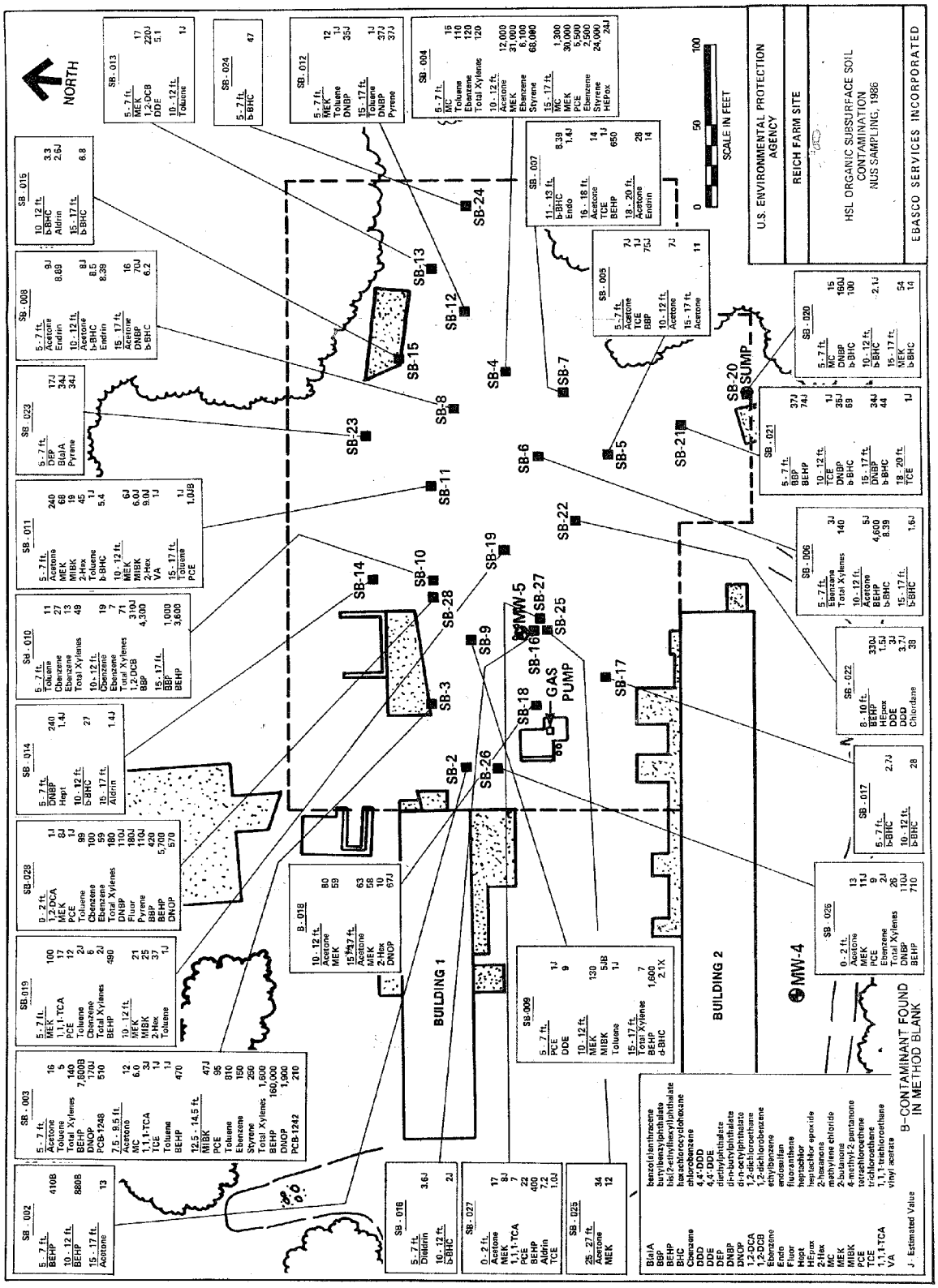


Figure 5 - HSL Organics in Subsurface Soils; NUS Sampling 1986.

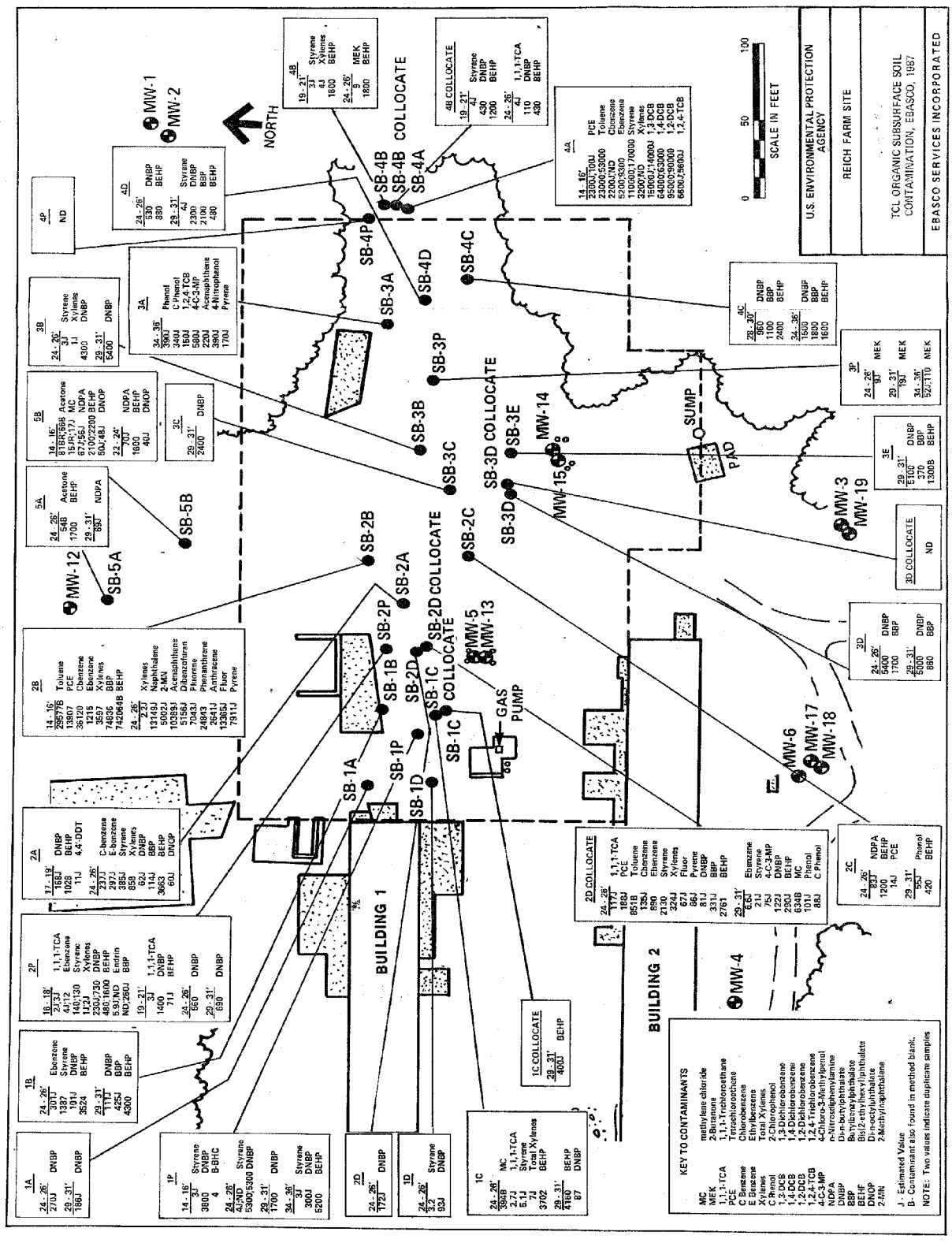


Figure 6 - TCL Organics in On-site Subsurface Soils; Ebasco, 1988a.

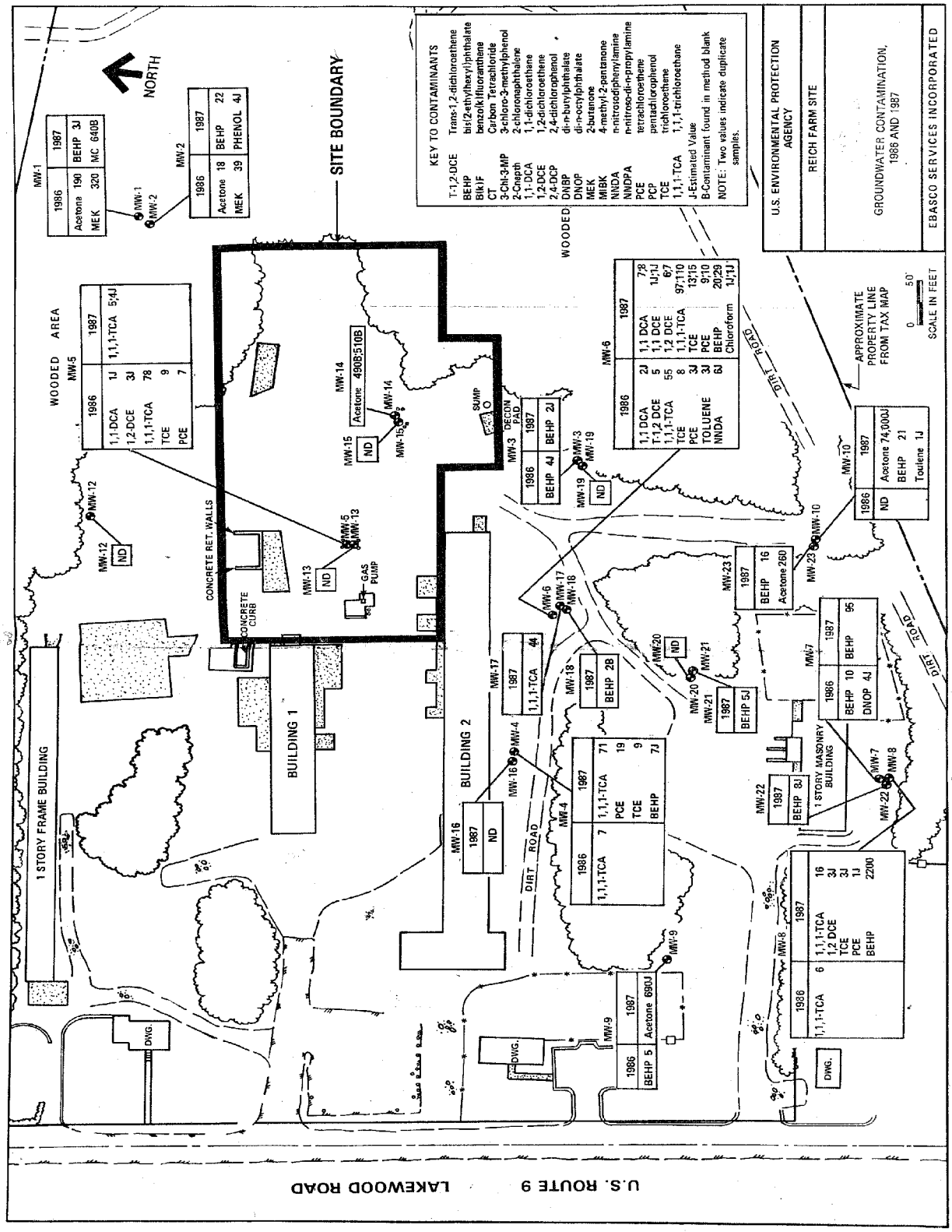


Figure 7 - On-site Groundwater Contamination, Ebasco 1988a.

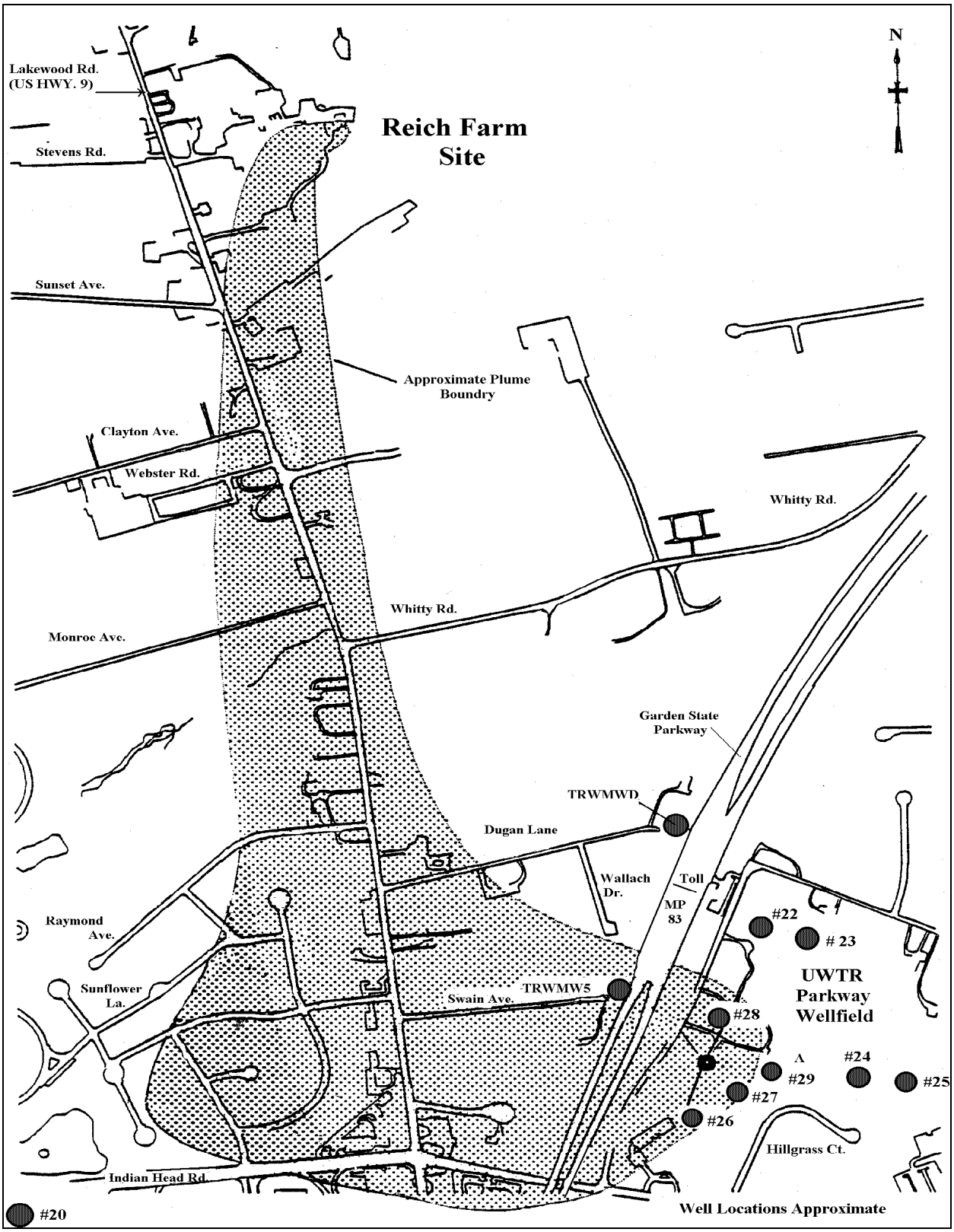


Figure 8 - Reich Farm Groundwater Plume; Adapted From Malcolm Pirnie, 1993.

Appendix E: Response Summary

Appendix E

Summary of Public Comments and Responses
Reich Farm Public Health Assessment

This summary presents the comments received from interested parties on the public comment draft of the Reich Farm Public Health Assessment, and the subsequent responses of the NJDHSS and the ATSDR. The public was invited to review the draft Public Health Assessment during the public comment period which occurred August 3 through October 1, 1999. Questions regarding this summary or any aspect of this Public Health Assessment may be addressed to the New Jersey Department of Health and Senior Services at (609) 633-2043.

Comments are grouped by commenter, without personal identifiers. Note that page numbers in the comments and responses refer to the public comment draft of the Public Health Assessment.

Commenter A:

Comment 1:

"Page 2 (Paragraph one, first sentence) of the Summary states, 'Current conditions indicate that exposure to contaminants from the RF site is no longer occurring.' I disagree with this statement since the wells are still being treated with air strippers and hits for trimer have occurred in the past. You cannot make this claim unless you are testing this water daily. Contaminant breakthrough of carbon filters can occur at any time."

Response 1:

The contaminant plume from the RF site is currently being captured by wells 26, 26B, and 28. Water is treated and discharged to waste, and, according to the current utilization plan only to be used in the water system on an emergency basis. In addition, well 29 had experienced sporadic contamination before June 1999, but since then has been treated with activated carbon to remove organic compounds. Water from well 22 has also been treated since that time. Other Cohansey wells at the Parkway well field, as well as the point of entry at Parkway, are being monitored on a monthly basis. Finally, carbon contactors are operating in series with each being refreshed on a staggered basis, with the oldest carbon first in line. The result of this arrangement is that even if the first contactor became saturated and experienced breakthrough, the next contactor (with relatively fresh carbon) would insure the water is still adequately treated. On the basis of this arrangement, the NJDHSS and the ATSDR consider the treatment system adequate to interrupt the exposure pathway, and protective of the public health.

Comment 2:

"Page 2 same paragraph [as comment above]. '.....no apparent public health hazard under present condition.' This well field is dynamic, due to the changing volumes of water being drawn out of the aquifer by this well field. The above classification could only be used if all wells in the Parkway Well are off line and all water movement are static in time. I feel the Category used should be 'Public Health Hazard'

due to the past history of the site (>1 yr.) and the unknown nature of all the tic's found in our water supply, which could have or result in adverse health effects."

Response 2:

The assignment of a "no apparent public health hazard" category was based on several factors that must be carefully monitored so that no community member is exposed to contamination at levels that may result in adverse health effects. See Response 1 above. Containment of the RF-related groundwater plume through effective management of the Parkway well field is critical to ensure that currently unaffected wells remain so. In addition, proper operation of the treatment system in place is necessary to reduce or eliminate the entry of Reich Farm-related contaminants into the distribution system. On-going water monitoring is needed to document the effectiveness of well field management and treatment systems.

Comment 3:

"Page 3, bottom paragraph. 'Population demographics based on the 1990 census have been prepared by the ATSDR using proportion spatial analysis.' I question why you are using data that is not current."

Response 3:

Population data from the year 2000 U.S. Census are not yet available. Data from the most recent U.S. Census (1990) was therefore used by ATSDR to make population estimates.

Comment 4:

"Page 4, paragraph 3. 'Of the 5,000 to 6,000 drums removed by the waste removal contractor, only some 4,500 were reportedly accounted for on the RF property.' Somehow the numbers do not add up. ... Please provide a detailed break down of where these drums were deposited using the above information."

Response 4:

The NJDHSS and the ATSDR cited the number of drums as reported in the remedial investigation reports for the Reich Farm site. Approximately 4,500 drums were removed from the Reich Farm property. Thirty-seven drums from Union Carbide were also recovered from trailer trucks at Brookside Ave. and Briar Ave. The remainder of the drums were reported to have been interred at the Dover Township Municipal Landfill, but the exact number and location of these drums is presently undetermined.

(*Comment 5 suggests a wording change.*)

(Comments 6, 8, 9, 16 and 17 requests references, but the text refers to sections of the draft Public Health Assessment, not separate documents.)

Comment 7:

"Page 5 under Health Assessment Activity Summary, paragraph 1 second to last sentence. '..., but not with respect to ingestion of heavy metals, which do not appear to be site-related.' Please provide the

source of these heavy metals or mention source is unknown, if it is truly unknown.

Response 7:

Lead was discussed in the 1989 Public Health Assessment for Reich Farm, but is not site-related. Lead (and copper and other metals) may be found in drinking water as a result of corrosion of piping and plumbing.

Comment 10:

"Page 6 second to last paragraph. '...and inclusion of New Jersey in a multi-state study of brain cancer incidence in proximity to National Priorities List sites' I would like inclusion of leukemias in this study.

Response 10:

The ATSDR is conducting multi-state studies of brain cancers. Leukemias are not included in these particular studies; however, there are other epidemiologic studies of leukemias and other childhood cancers that have been and are being conducted around the world.

Comment 11:

"Page 9 para 2, '...dependent upon water quality meeting Federal and State drinking standards.' ... Please insert a table or figure indicating what those standards are."

Response 11:

For a complete list of drinking water standards, please refer to Table 2 in the NJDHSS, NJDEP and ATSDR Public Health Consultation, "Drinking Water Quality Analyses, March 1996 to June 1999, United Water Toms River." Drinking water standards or other health-based guidelines for selected compounds are given in Tables 6 and 7 of the Draft Public Health Assessment in the columns labeled "Comparison Value."

Comment 12:

"Page 9, paragraph 2, last sentence the words 'effectiveness monitoring' please explain what this means or use a better descriptive word."

Response 12:

In this context, "effectiveness monitoring" means ascertaining that treatment is accomplishing the intended effect, that is, removal of Reich Farm-related contaminants from the groundwater.

Comment 13:

"Page 9, paragraph 3. ... Please explain why you are using the term carbon contactors, instead of carbon filters. The word contactors means to come in contact with, it does not imply filtration."

Response 13:

The treatment of water with activated carbon to remove semi-volatile organic compounds (SVOCs) uses a technique of carbon adsorption which involves physical contact of the water with carbon.

Comment 14:

"Page 9, paragraph 3. "Wells #26 and #28 (and a new well #26B installed in late June 1999) are considered to be controlling the RF plume...' The opening statements in this report state, 'Current conditions indicate that exposure to contaminants from the RF site is no longer occurring.' Why the word 'considered,' either it is or it is not. Please state one way or the other.

Response 14:

See Responses 1 and 2.

Comment 15:

"Page 11, top paragraph, last sentence, 'However, the overall pattern of contamination could not be attributed to the Reich Farm site alone.' Please provide information on where the other contamination was from, list source.

Response 15:

The NJDHSS and the ATSDR cited an evaluation presented in the Ghassemi report which was written in 1976. The context of the statement implies uncertainty as to the source or sources of the documented contamination.

Comment 18:

The comment asks for clarification about the availability of the separate exposure investigation report.

Response 18:

The NJDHSS and the ATSDR will release a separate report containing a data summary of analyses of private wells, soils and sediments. These data have already been publicly discussed at meetings of the CACCCC.

Comment 19:

"Page 19 ... This section is misleading and does not take into account the affects on children. You do not address the contamination problem in the water distribution system prior to air strippers being placed on the wells as a protective action. ... Private wells and information of the Public water supply should be separated into two sub-sections when discussing either, this applies to the whole study."

Response 19:

Data regarding private potable and public supply well contamination have been presented separately.

Toxicological consideration is given to compounds in completed human exposure pathways, whether the source was a private or community supply well. Where human health data are available specifically for children, the draft Public Health Assessment includes such a discussion (see pages 21 and 22).

(Comments 20 through 22 repeat Comments 1 and 2. See Responses 1 and 2.)

(Comment 23 notes a missing line on the top of page 24. The NJDHSS and the ATSDR issued an erratum page to the draft Public Health Assessment, correcting this mistake. The final version of the Public Health Assessment will also be corrected.)

Commenter B:

(Cover Pages)

Comment 1:

"Many of the attachments [provided by the commenter], beginning in 1974, refer to both a plan for testing of public wells at the Parkway Wellfield and Well #20, and the resultant analyses generated by that plan. ... The testing methods ... and resultant data yielded emergent enough data to cause 148 private well owners to be required to use an alternate water supply, ... seal their wells and connect to the public water supply. ... The inability to produce the early analytical data and reports appears integral to estimating an accurate date of a potentially completed exposure pathway of Reich Farm contaminants to the public via the public water supply through the Parkway wellfield. ... Recalculation of groundwater contaminant time-of-travel ... is indicated."

Response 1:

With available information documenting human exposure pathways through use of private wells and the community water supply, the ATSDR and the NJDHSS have concluded that the Reich Farm site represented a public health hazard because of past exposures. The Public Health Assessment acknowledges that the nature, magnitude and duration of exposure is uncertain, and discusses reasons for this uncertainty. See Response 1 under "Commenter B, Outline Pages" below for a discussion of the calculation of time to travel for groundwater contaminants between the Reich Farm and the Parkway well field.

Comment 2:

"Aside from the S(AN) trimer (a TIC first seen in EPA data from the late 1980's, but not identified until 1997), identification of an estimated additional 250 (NJDEP) - 750 (UC) Tentatively Identified Compounds associated with the Reich Farm ... has not been made a priority. Subsequently these TICs remain under evaluated as potential factors in the Childhood Cancer Cluster Investigation."

Response 2:

As stated on page 14 of the Public Health Assessment, the tentative identification of other non-target compounds is the subject of study by a committee convened by the NJDEP. The report of this committee, released after the draft Public Health Assessment was issued, will be summarized in the final Public Health

Assessment. Exposure pathways related to Reich Farm, even without complete knowledge of the nature of contamination, are being evaluated in the childhood cancer epidemiologic study being conducted by the NJDHSS and the ATSDR.

Comment 3:

"Currently allowable practices should be reassessed from a regulatory policy standpoint on both the State and Federal level when a water supply source is in proximity to a hazardous waste site with potentially serious impacts to the public water supply." The comment suggests strengthening of actions related to unregulated contaminants and re-evaluation of monitoring guidelines related to blending to meet drinking water quality standards.

Response 3:

The Public Health Assessment addresses human exposure pathways and interruption of pathways to prevent or reduce exposure; specifically, the document makes recommendations regarding the monitoring of groundwater contamination and effectiveness of treatment systems in place.

Decisions about the methods and technologies to apply for exposure reduction are the responsibility of environmental regulatory agencies. In New Jersey, the NJDEP is the responsible agency, operating under specific authorities granted in state and federal laws. Many water supplies, both in New Jersey and across the country, have experienced contamination. Contaminants may be naturally occurring or come from a variety of sources related to human activities, including agriculture, sewage and septic systems, industrial discharges, and improper waste disposal. The challenge is to protect water supplies from contamination in the first place, and to develop and use effective treatment systems when prevention efforts fail. At the same time, a sufficient supply of water must be maintained to meet short-term demands for water distribution and fire protection, and long-term demands of an expanding population.

Comment 4:

"I am confused about what explanation there would be for the following: Reich Farm PHA, 1989, took into consideration historic (1974) and then-current (1985-1989) data that led to a determination of "a Potential Public Health Hazard because of Potential Exposure". Reich Farm PHA, 1999, appears to have determined that the site represented "a Public Health Hazard due to Past Exposures and No Apparent Hazard Under Current Conditions" citing consideration of the same historic data (1974), which is not available to reviewers for this PHA, data from the mid-to-late 1980's and current data (1996-present). Please clarify which of the cited data sets represents a Public Health Hazard 'in the past'? Is this discrepancy driven by the moving target of changes to the safe drinking water standards?

Response 4:

The reason for ATSDR's assignment of two different hazard categories for the same time frame (past) in the two Public Health Assessments is due to a change in the way ATSDR categorizes sites, and the availability of additional data from other sources that assisted ATSDR in making the public health hazard assessment in the 1999 PHA. In 1989, the hazard category options included a potential public health hazard

category which is indicated when exposures had probably occurred, but there were not enough exposure and/or toxicological data to make a determination of a public health hazard. For the 1989 PHA, ATSDR did not have the knowledge of the current literature on the associations of certain cancers and exposures to TCE and PCE, and ATSDR was not aware of the presence of an excess of childhood cancers in the community. Additional information became available to the ATSDR (and the NJDHSS) during the interim period, and the two respective hazard categories reflect that input/analysis. The 1989 and the 1999 PHAs are consistent in that both evaluations indicated much uncertainty in assessing the toxicological implications of exposures. The assignment of the hazard categories does not represent a "discrepancy", and was not driven by the "moving target of changes to safe drinking water standards." The category of "Public Health Hazard" in the past presented in the current PHA was selected based on the information that is summarized in the Completed Exposure Pathway table on page 18.

(Commenter B, Outline Pages)

Comment 1:

"RECONSIDER selected DOCUMENTED DATE OF EXPOSURE as 1986 from the Reich Farm through the Public Water Supply route citing the following references: A. Past concerns regarding testing of TRWC Wells ... B. Documented Contamination in the Dugan Lane public wells ... C. Reconsider Time of Travel from the Reich Farm site to Public Supply Wells ... D. 'P. 4, paragraph 5, 'This contamination ... was identified as associated with the RF site by the USEPA and the NJDEP (Ghassemi, 1976, NJDEP, 1974.) ... E. This date of the hauling between Fernicola and UCC does not have to be this vague. Insert the date of the contract and dates on manifests from UCC when Fernicola made a pick ups of drums. ... Deposition of the drums at Reich farm would logically have occurred between August 1971 and December 1971, when the Reichs first noticed the chemical smells, drums and trenches."

Response 1:

The Public Health Assessment describes the documented impact to the Parkway Wellfield by Reich Farm-related contaminants in 1986. It also states that there is uncertainty as to the nature, magnitude and duration of exposure through this pathway. Limitations of earlier data are described in the Public Health Assessment.

Both the Union Carbide Corporation and the NJDEP are in the process of developing groundwater models capable of estimating travel time of contaminants from the Reich Farm to the Parkway well field. The draft Public Health Assessment (page 16) cited the range of estimates of travel time that were available at the time it was prepared (between five and ten years). The final Public Health Assessment will be updated to reflect the further development of the Union Carbide model and the fact that the models continue to be developed and refined.

Local and state actions to condemn private wells in 1974 were conducted in the context of a perceived threat from the Reich Farm site, although the USEPA (Ghassemi, 1976) noted the possibility of other sources of contamination. The NJDHSS and the ATSDR will revise the final Public Health Assessment to reflect the uncertainty in the source(s) of contamination leading to the closure of the 148 wells.

As discussed in the draft Public Health Assessment (page 4), wastes from the Union Carbide Corporation's Bound Brook plant were deposited at the RF site during the period August to December 1971.

Comment 2:

"Page 19. Absence of documentation reference as to the reasons for the closure of the following Parkway wellfield wells : #23 sealed in 1992, WHY? (N-nitroso-diphenylamine)?; #25, sealed in 1989, WHY?; #27, sealed in 1989, WHY?"

Response 2:

Wells #23, #25, and #27 were screened in the Piney Point aquifer, at depths ranging from approximately 270 to 290 feet. These wells were reportedly sealed due to their inability to deliver a sufficient volume of water.

Comment 3:

Pertaining to TICs, the comment refers to a statement in the 1989 Public Health Assessment by ATSDR, in which the potential for carcinogenicity of bis(2-ethylhexyl) phthalate (BEHP) (also known as di(2-ethylhexyl) phthalate) is discussed.

Response 3:

BEHP is considered a target analyte for the standard semi-volatile organic chemical drinking water analysis methods (#525.2 and 625). As reported in the 1989 Public Health Assessment, BEHP was found in subsurface soils at the Reich Farm site, but not in on-site groundwater or off-site private wells. However, it was reported in off-site monitoring wells. Measurement of phthalates is susceptible to laboratory contamination. In the recent extensive monitoring of Parkway well field wells, BEHP and other phthalates were not detected above 2 µg/l; below this level, detections cannot be distinguished from laboratory contamination.

Comment 4:

"P. 4, paragraph 4, Brier Ave. incorrect; correct to W. Briar Ave."

Response 4:

This typographical error will be corrected in the final Public Health Assessment.

Comment 5:

"P. 3, paragraph 4 and Fig. 1, P. 47. Appears to be an incorrect number of Total Housing Units as listed at 240. Divided by the Tot. Pop. within 1 mile would yield an unlikely 15.475 persons per housing unit."

Response 5:

The final Public Health Assessment will be modified. Population demographic figures have been regenerated by ATSDR.

Comment 6:

"P.2, paragraph 1. '... may be pumped into the community water supply in times of high demand.' This should be clarified to list the circumstances which would necessitate this action."

Response 6:

The circumstances under which treated water from wells #26 and #28 might be used is a matter that is determined by the NJDEP and United Water Toms River. For the purposes of the Public Health Assessment, the NJDHSS and the ATSDR wanted to note that exposure pathways are interrupted through the diversion of water from wells #26 and #28, and further through treatment of that water, but that at times of high demand, the treated water may be used.

Comment 7:

"P. 5, paragraph 2. References the ATSDR Public Health Assessment of the RF site in 1989. ... P.2, paragraph 2. Zone II was peripheral to Zone I, and encompassed an area within which no wells were permitted in the upper sand aquifer (Cohansey Aquifer). ... a. The map included in the 1999 PHA of this site, Page 49, clearly shows at least two public wells in Zone 2. Please identify these wells by well #." The comment continues with questions about and quotes from the conclusions section of the 1989 Public Health Assessment.

Response 7:

The map presented on page 49 of the Public Health Assessment (Figure 3) was adapted from the Ghassemi report (1974) and was based upon the NJDEP report "Final Report, Delineation of Extent of Groundwater Contamination, Pleasant Plains Section of Dover Township, Ocean County, New Jersey." This report does not identify the individual wells indicated.

Comments 8 and 9:

"On-site Carbon Filtration as a component in a pump and treat system, although recommended and acknowledged repeatedly, over time, for what reasons? ... Carbon Filtration as a precautionary measure has been requested and acknowledged as under consideration since 1974, for what reasons?" The comment attaches copies of documents on these topics dating from 1974 to 1994.

Response 8 and 9:

As documented in the comment attachments, in 1974, the Ocean County Health Department requested that NJDEP direct the Tom River Water Company to install carbon filtration units on the Parkway wells and Well 20. The NJDEP implemented a monitoring program on the wells.

Comment 10:

The comment discusses groundwater remedial design issues, specifically related to the design and permitting of an air stripper at the Parkway well field.

Response 10:

Air emissions from the packed tower aeration system that operates on Wells 26 and 28 are permitted by the NJDEP. Specific questions regarding this system may be directed to the NJDEP.

Commenter C:

Comment 1:

"On page 5 under Health Assessment Activity Summary, paragraph 2. The ESD...was not reviewed by the ATSDR, Why not?"

Response 1:

The U.S. EPA Explanation of Significant Difference (ESD) regarding the Reich Farm Superfund site was released in 1995 after the 1989 Public Health Assessment. As indicated in this draft Public Health Assessment, the ESD presented a modification to the originally selected remedy (as presented in the U.S. EPA's 1988 Record of Decision) for groundwater contamination related to the Reich Farm site. Although ATSDR does review available documents for its Public Health Assessments, it does not routinely review all Records of Decisions, Proposed Action Plan, etc., that are released by the U.S. EPA. A specific review of one of these types of documents by the ATSDR is usually conducted at the request of the U.S. EPA, the community, or some other group. For example, ATSDR, at the request of the CACCCC, has reviewed the proposed remedial alternative for the remediation of on-site soils and drums for the Ciba-Geigy site.

Comment 2:

"Same page, paragraph 3 refers to an exposure investigation of potentially affected wells in Dover Township. This is inadequate due to the fact that random sampling was done for approximately 50/2000 + homes. It is necessary to test more private wells."

Response 2:

The 54 wells that were sampled as part of the Dover Township exposure investigation conducted by the NJDHSS and the ATSDR were selected as being representative of private wells in the township, with an emphasis on wells in areas of concern for contamination. Specific wells were selected from owners who volunteered to have their wells tested at no expense to themselves. Had any of the private wells shown evidence of site-related contamination, expanded investigation in the area would have occurred.

Comment 3:

"On page 6, first full paragraph about Lead Initiative Summary Report (ATSDR, 1993a) First I've heard of this report and would like to see it."

Response 3:

A copy of the report was provided to the commenter.

Comment 4:

"On Page 7 under Exposure Pathways Associated with Community Water System Wells refers to well field being problem in the past and not now! Why Not? Is the contamination all cleaned up? When did it actually stop being an exposure pathway, August 1999?!!!"

Response 4:

The NJDHSS and the ATSDR state on page 7 of the Public Health Assessment that "...several wells in the United Water Toms River's Parkway well field have been, and continue to be, impacted by [Reich Farm] site-related contamination." On-going monitoring has shown that wells 26 and 28 continue to be contaminated by volatile organic chemicals and styrene-acrylonitrile trimer; well 29 has also sporadically been affected. The Pathways Analysis section discusses the installation of treatment systems and diversion of well output at the Parkway well field, and states, "In June 1999, another activated carbon treatment system was installed to protect against sporadic RF-related contamination in well #29; treatment was also extended to nearby well #22 as a precaution. Thus, the completed exposure pathway to VOCs and SVOCs from Parkway well field wells is now interrupted."

Comments 5, 6 and 7:

*"Under **Discussion** there was documented contamination shown in newspaper articles and public information as early as 1/10/74. ... EPA lab did extensive testing! Where is it? ... In Ghassemi reference is made to samples taken by DEP in 1974. Where is the analysis?"*

Response 5, 6 and 7:

The data shown in Tables 3, 4, and 5 have been extracted from the Ghassemi (1976) document and the remedial investigation NUS (1986). These data and the resultant tables represent all the information available for review and evaluation by the NJDHSS and the ATSDR.

Comment 8:

"Under Groundwater Investigation: 1974 to 1976 it disheartens me to see comments about possible hits of chemicals, that because a subsequent test didn't show it; it didn't exist. Please! We know enough now to see that this contamination moves like slugs and periodically breaks through. Contamination could possibly have come from the same site materials dumped at other places known to Mr. Fernicola. Ex: Sambol's property. Where are those missing barrels that were supposed to be removed? It's a question that begged answering in the 70's and still does present day."

Response 8:

The Public Health Assessment devotes considerable attention to the data from 1974 to 1976 (pages

10 to 12), and attempts to present a fair discussion of its limitations and interpretation.

The Public Health Assessment focuses on the public health implications of environmental contamination relative to the Reich Farm site, and is not an investigation of the activities of the waste hauler, Mr. Fernicola. However, the Public Health Assessment notes (page 4) that drums from Union Carbide were likely to have been deposited at the Dover Township Municipal Landfill.

Comment 9:

*"On page 15 under **Private Wells** The sentence that begins: Exposure to some members ...inhalation and/or dermal contact."*

Response 9:

The text will be modified to read "and/or" instead of "or".

Comment 10:

"Page 16 top of page refers to148 homes w/private wells Did you and do you really have a clue to the number?"

Response 10:

According to the Ghassemi report, 148 private wells were condemned by the Dover Township Board of Health at the time of the establishment of the well exclusion zone in Pleasant Plains. The Public Health Assessment acknowledges (page 16) that the number of private wells actually contaminated by the Reich Farm plume is not known.

Comment 11:

"Further down the paragraph that starts with 'In general...There is no indication that private wells are still in use in the area known to be above the RF groundwater contamination plume.' Please document this."

Response 11:

This statement is based upon discussions with the Ocean County Health Department. In addition, the NJDHSS received no responses to the private well canvass from residents in this area during the exposure investigation.

Comment 12:

"The whole section on Public Wells (Parkway Well Field) I find quite disturbing. You have enough documentation through articles and reports to show that contamination hit the well fields before the 80's. I think more of NJGS, Steven Spayd information should be included here."

Response 12:

As stated in the above-referenced section of the Public Health Assessment (page 16), "... The travel time of groundwater from below the RF site to the Parkway Well Field has not been established. Estimates by NJDEP and UCC (Malcolm Pirnie, 1992) have ranged between approximately 5 and ten years, indicating that contaminants from the site may have reached the wellfield beginning sometime in the period 1976 to 1981." There have been several models of groundwater movement in the Dover Township aquifers which show a variety of estimates for the time of arrival of contaminants from the Reich Farm site at the Parkway Well Field. Both the NJDEP and a consultant to the Union Carbide Corporation continue to refine groundwater models to estimate travel time. Groundwater data in the 1974-1976 period, and limitations of these data, are discussed on pages 10 through 12 of the draft Public Health Assessment.

Comment 13:

"To say that there is no apparent public health hazard under present conditions is not acceptable at this point.

1) *Repeated mistakes on the part of many government agencies historically on this site leaves one gun shy.*
2) *We have repeatedly been told that contamination wouldn't impact other well at the site, when in essence it has repeatedly.*
3) *There are 2 other wells that are in the same shallow aquifer without added protection.*
4) *Contamination has shown at the point of entry with chemicals known to be present at RF, simultaneously treated wells tested clean. This indicates further investigation of the well field into the deeper aquifers and/or the other untreated wells.*
5) *Everyone involved from a health protection agency owes it to the people, most especially the children, to eliminate and/or put a barrier between us and contamination that is still present."*

Response 13:

The assignment of a "no apparent public health hazard" category was based on several factors that must be carefully monitored so that no community member is exposed to contamination at levels that may result in adverse health effects. As indicated in the Public Health Assessment, the current conditions at the site indicate that exposure to contaminants from the Reich Farm site is no longer occurring. The exposure pathway through private well use was interrupted by the establishment of a well restriction zone, and there is no indication that private wells are still in use for potable purposes in the area above the RF plume. The exposure pathway through the community water supply system has been interrupted by the diversion and treatment of contaminated water from well #26 and #28 at the Parkway well field, and the installation of treatment for well #29, which has shown sporadic RF-related contamination. (Treatment was also extended to the nearby well #22 as a precaution.) However, treated output from wells #26 and #28 may be pumped into the community water supply in times of high demand. Containment of the RF-related groundwater plume through effective management of the Parkway well field is critical to ensure that currently unaffected wells remain so. In addition, proper operation of the treatment system in place is necessary to reduce or eliminate the entry of RF-related contaminants into the distribution system. On-going water monitoring is needed to document the effectiveness of well field management and treatment systems. The NJDHSS and ATSDR maintain that the current treatment system appears to be protective of public health. However, as indicated in the draft public

health assessment, if we become aware of information indicating that RF-related exposures is still occurring, or if private wells are still in use in the plume area, the determination of "no apparent public health hazard" will be reconsidered.

Comment 14:

"On page 20 under ***Public Health Implications*** *reference is made to combined exposures of chemical probably not being toxic because of being below their individual toxicological thresholds, Excuse me, but what toxicological thresholds are we referring to considering we don't know what hundreds of the TICs are? How can any of you make this statement?"*

Response 14:

The Public Health Assessment states, "... the *toxicological* evidence suggests that exposures to combinations of *known* contaminants detected in private wells and in untreated water from the Parkway well field are not likely to lead to adverse health effects. ... However, ... the water from private wells and the Parkway well field ... were contaminated with organic contaminants of an undetermined nature and level in the past. Therefore, much uncertainty exists as to the public health significance of past exposures through consumption of contaminated water."

Comment 15:

On page 20 last paragraph you should footnote the data being referred to and have it all available to the public in printed form. Not summaries."

Response 15:

The NJDHSS and the ATSDR presented information regarding SAN toxicity provided by the UCC and the USEPA. The final version of the Public Health Assessment will be modified to indicate the source of this information.

Comment 16:

"Ground Water impact area designated for Pleasant Plains/Reich Farm needs to be addressed in the ESD to the ROD. Must extend GWIA beyond its present boundaries. It does not appear to include the Parkway Well Field and other areas that have been impacted."

Response 16:

The groundwater contamination zones in the Pleasant Plains area (Figure 3 of the Public Health Assessment) were defined in 1974, within which restrictions on the use and construction of private wells were established. Zone II includes a portion of the Parkway well field area. The Reich Farm groundwater contamination plume area (Figure 8) was developed by a contractor to Union Carbide, with oversight by the USEPA. This area includes a portion of the Parkway well field. The Explanation of Significant Difference is a document completed by the USEPA in 1995.

Commenter D:

Comment:

"The Dover Township Environmental Commission supports and calls for the expenditure of public resources in implementing the recommendations of the Public Health Assessment as follows: 1) Routine sampling of all shallow Cohansey Aquifer wells of the Parkway Well Field; 2) Monitoring of the effectiveness of treatment systems now in place; 3) Continuation of the well restriction zone in the Pleasant Plains area; 4) Continued review of data regarding identification of all chemicals in the Reich Farm ground water plume; 5) Employment of water system models to trace the flow of water from Parkway wells to points in the distribution system; 6) Pursuit of toxicity testing of the SAN trimer; 7) Expediting model development and testing; 8) Such further evaluation and follow-up action as deemed necessary."

Response:

The draft Public Health Assessment contains recommendations and a specific Public Health Action Plan to address the recommendations, and commits the NJDHSS and the ATSDR to ensuring their implementation. Regarding the specific recommendations in the comment: The Parkway well field wells and treatment systems have continued to be monitored. The well restriction zone remains in effect. The New Jersey Department of Environmental Protection has released a report discussing the tentative identification of non-target chemicals in the Reich Farm groundwater contamination plume, and the ATSDR is evaluating the toxicological literature for information on selected substances. The ATSDR is also developing historical water distribution system models to be used in the assessment of exposure to drinking water sources in the childhood cancer epidemiologic study being conducted by the NJDHSS and the ATDSR. Finally, the U.S. Environmental Protection Agency is coordinating an effort to assess the toxicological characteristics of the styrene-acrylonitrile trimer.

Commenter E:

(General Critique)

Comment 1:

"... a PHA should provide the public with an easily understood summary of the present state of knowledge regarding potential adverse health effects which may stem from exposure to site-specific contaminants. ... In particular, it should be obvious to the reader whether or not a continuing public health problem exists and the degree of uncertainty regarding ongoing investigations. The draft PHA for the Reich Farm site fails these barometers of public usefulness."

Response 1:

The NJDHSS and the ATSDR have attempted to assemble and interpret a large volume of technical information, and to communicate this information through the Public Health Assessment, an accompanying Citizens' Guide, and a presentation at an open meeting of the Citizens' Action Committee on Childhood Cancer Cluster.

Comment 2:

"...the summary entitled Childhood Cancer Incidence in Dover Township on p. 19 of the draft PHA is grossly inadequate."

Response 2:

The draft Public Health Assessment makes reference in the above-mentioned section to the full report on cancer incidence (1979 - 1995) prepared by the NJDHSS and the ATSDR.

(Commenter E, Specific Recommendations)

Comment 1:

"It should be clear in the Summary that the draft PHA for the Dover Township Landfill is a separate document."

Response 1:

The draft Public Health Assessment states, "...the NJDHSS and the ATSDR also began a Public Health Assessment to evaluate the public health issues associated with the Dover Township Municipal Landfill..."

Comment 2:

"A table should be added which summarizes childhood cancer statistics for Toms River and Dover Township by site and year, along with the statistical significance of the data."

Response 2:

As noted above, a detailed data report is referenced in the Public Health Assessment.

Comment 3:

"A plume map more detailed than that on p.5 of the draft PHA should show the area of site-specific contamination as a feature of time, with detailed location of public wells within the Parkway well field delineated. It is uncertain during which time frame the Fig. 8 'snapshot' was pertinent, the meaning of the shaded area or how long the plume took to reach this condition."

Response 3:

The locations of the Parkway Well Field wells and the limits of the groundwater plume are shown in Figure 8, as extracted from the referenced source, Malcolm Pirnie, 1993. The plume dimensions reflect data that were obtained from monitoring well sampling in March 1993. The location of the plume as a function of time is the subject of ongoing groundwater modeling currently being conducted by the Union

Carbide Corporation and the NJDEP.

Comment 4:

"It would be helpful to have more legible summaries of contaminant concentrations than those contained in Figs. 5-7. Perhaps these figures could be rendered on 11x17" sheets and folded."

Response 4:

The NJDHSS and the ATSDR reproduced Figure 5 from the original reference (NUS, 1986) Similarly, Figures 6 and 7 are reproduced from the original reference (EBASCO, 1988a). Please consult these reports for larger versions of these figures.

Comment 5:

"Although there is an obvious groundwater monitoring data gap in transitioning from 1974 to 1976 (pp. 10-12) to 1986 to 1993 (pp. 12-13), this 10 year data gap is not explained. What conclusions can be drawn about plume progress during this 10 year data gap?"

Response 5:

Given the lack of compound-specific monitoring data, progress of the Reich Farm groundwater contamination plume in the time period will be best addressed through hydrogeologic modeling efforts in development by the NJDEP and the Union Carbide Corporation.

Comment 6:

"Although there are protracted discussions of the toxicology of SAN trimer, TCE and PCE, there is no discussion of the toxicologies of several other site-specific contaminants. My professional opinion is that neither TCE nor PCE alone have had any bearing on the persistently high incidence of childhood cancer in the community. Although SAN trimer may, indeed, represent a carcinogenic threat, studies of this single tentatively identified compound (TIC) are too premature for a realistic assessment."

Response 6:

Styrene-acrylonitrile (SAN) trimer was identified in 1996 in conjunction with re-analysis of GC/MS spectra for non-target compounds. The USEPA is coordinating an effort to study the toxicology of SAN trimer since it appears to be a major component of the non-target materials in the groundwater plume at present, and little is known of its toxicology. As stated on page 14 of the Public Health Assessment, the tentative identification of other non-target compounds is the subject of study by a committee convened by the NJDEP. The report of this committee, released after the draft Public Health Assessment was issued, will be summarized in the final Public Health Assessment. The NJDHSS and the ATSDR acknowledge (page 23) that, "Much uncertainty exists concerning the composition, levels and toxicologic characteristics of past exposure..."

Comment 7:

"...I would urge the addition of toxicologic data regarding the following site-specific contaminants, most of which are discussed elsewhere in the draft PHA: [List:] Benzene, 1,2-Dichlorobenzene, N-nitrosodiphenylamine, Styrene, Acrylonitrile, Carbon tetrachloride, Phenol and other phenolics, BEHP, Toluene, Chlorobenzene, and 1,1,1-Trichloroethane."

Response 7:

In the Public Health Assessment, the NJDHSS and the ATSDR discuss the toxicology of those compounds documented in the human exposure pathway associated with the community water supply. For detailed information, on the toxicology of each of these additional species, please consult the appropriate ATSDR Toxicological Profile.

Comment 8:

"In addition, from a public health perspective, it would be useful to summarize whether various control technologies, such as air-stripping and carbon filtration are useful in removal of each site-specific contaminant from groundwater."

Response 8:

The efficiencies of various remediation technologies are evaluated in the Feasibility Study (reference Malcolm Pirnie, 1993), since the USEPA is the agency responsible for evaluating and ensuring the efficacy of a remedial technology. The NJDHSS and the ATSDR do not evaluate treatment technologies in the Public Health Assessment. However, post treatment sampling indicate that the treatment system currently employed has successfully interrupted the human exposure pathway.

Comment 9:

"Although various radium isotopes, including Ra-224, may be naturally occurring in the aquifer, it may be useful to characterize whether or not potential synergistic toxicities may exist between site-related contaminants and these radionuclides."

Response 9:

The toxicology of radium (a naturally occurring species in Dover Township) is based on its characteristic as an emitter of ionizing radiation. There is no information available to the NJDHSS and the ATSDR regarding potential synergism with exposure to chemical contaminants.

Comment 10:

"...[T]here is no discussion of the preponderance of TICs other than SAN trimer in the draft PHA. In that as many as 100 additional TICs have been detected in groundwater on-site, many in the low ppb range, and many in off-site groundwater, it would be useful to summarize the state (or lack) of our knowledge concerning these substances. Many appear to be other trimers, dimers or amides associated with production of plastics."

Response 10:

As noted in Response 6, the tentative identification of other non-target compounds is the subject of study by a committee convened by the NJDEP. The report of this committee, released after the draft Public Health Assessment was issued, will be summarized in the final Public Health Assessment.

Comment 11:

"...[M]y professional opinion is that potentially mutagenic (carcinogenic initiating) TICs should be identified in a groundwater condensate at the Reich Farm Site prior to long-term testing of that one mutagenic TIC, the SAN trimer, identified thus far. More potent chemicals could easily be among other, as yet identified, TICs.

Response 11:

In the process of developing toxicity testing protocols, the NJDEP, the USEPA and others considered toxicity testing of concentrated water from the Reich Farm plume, but did not take this approach. The approach was originally considered in part because it was not certain whether SAN trimer (from a present day waste stream) would be available for direct testing.

Commenter F:

(Summary)

Comment 1:

"...[d]ata provided on Page 42 Table 4 indicate that water from Well 26 in the Parkway Well Field on July 18-20, 1974 contained carbon/chloroform extractable (CCE) compounds at a concentration of 200 micrograms per liter (µg/l). Sources cited on Page 12 of the health assessment note that background concentrations should range from 25 to 50 µg/l and that CCE concentrations above 200 µg/l indicate 'chemical contamination of a watershed'. ...What do the authors consider to be the significance of these findings that the Parkway Well Field was contaminated as early as July 1974? ... Where do the authors believe the centroid and majority of contaminant mass were located with respect to the Parkway Well Field in 1974?"

Response 1:

The ATSDR and the NJDHSS state (page 9), "Historic information on groundwater contamination related to the RF site is sparse. Much of the data that exist were generated using analytical methods that were non-specific indicators of organic chemical contamination, and little documentation remains on the sampling procedures and quality of the analytical data." After discussing the results of these analyses, the Public Health Assessment continues, "...interpreting results of ... early groundwater analyses is difficult because:

1) there is little information on sampling procedures employed; 2) the analytical tests are not chemical-specific; 3) there is considerable variation in results from the same location over short periods of time; and 4) the different extraction techniques represent different fractions of the compounds potentially present." The Public Health Assessment then presents a comparison of the data to various levels though to be indicative of organic chemical pollution of a water source. In the Pathways Analysis section (page 16), the Public Health Assessment states that the duration of the exposure pathway through the community water supply is unknown, and presents a range of estimates of groundwater travel time from the Reich Farm to the Parkway well field. The NJDEP and the Union Carbide Corporation are continuing to develop hydrogeologic models of the Reich Farm groundwater contamination plume through time.

Comment 2 :

"The authors categorize the Reich Farm site as 'no apparent public health hazard under present conditions.' Wells contaminated by compounds originating from Reich Farm continue to be used to provide drinking water to the community. Only recently, was the SAN-trimer identified in water samples from these wells. Numerous other compounds that have been detected in laboratory analyses of well water samples have not been identified. Potential human health effects from these unidentified compounds have been characterized. Furthermore, the air stripping and recently employed carbon adsorption techniques may not sufficient to reduce known contaminant concentrations in the well water. Prior to the authors determining that there is 'no apparent public health hazard under present conditions', they should determine the nature of the unidentified compounds in groundwater, the potential human health effects from these compounds, and that the treatment technologies employed are removing the contaminants prior to distributing the water to consumers or discharging to the down gradient recharge area."

Response 2:

The assignment of a "no apparent public health hazard" category was based on several factors that must be maintained so that no community member is exposed to contamination at levels that may result in adverse health effects. As indicated in the Public Health Assessment, the current conditions at the site indicate that exposure to contaminants from the Reich Farm site is no longer occurring. The exposure pathway through private well use was interrupted by the establishment of a well restriction zone, and there is no indication that private wells are still in use for potable purposes in the area above the RF plume. The exposure pathway through the community water supply system has been interrupted by the diversion and treatment of contaminated water from well #26 and #28 at the Parkway well field, and the installation of treatment for well #29, which has shown sporadic RF-related contamination. (Treatment was also extended to the nearby well #22 as a precaution.) However, treated output from wells #26 and #28 may be pumped into the community water supply in times of high demand. Containment of the RF-related groundwater plume through effective management of the Parkway well field is critical to ensure that currently unaffected wells remain so. In addition, proper operation of the treatment system in place is necessary to reduce or eliminate the entry of RF-related contaminants into the distribution system. On-going water monitoring is needed to document the effectiveness of well field management and treatment systems. Current treatment systems in place appear to be protective of public health, since post-treatment sampling has shown that all known site-related contaminants are being removed. However, as indicated in the draft Public Health Assessment, if the ATSDR or the NJDHSS become aware of information indicating that RF-related exposures is still occurring, or if private wells are still in use in the plume area, the determination of a "no apparent public health hazard" will be reconsidered.

(Commenter F, Background)

Comment 3:

"Groundwater within the Cohansey Formation is considered to be acidic with a pH of approximately 5.3. Did the authors or any previous investigators evaluate the effects of this acidic environment on the contaminants or the byproducts from the mixing of the contaminants? Furthermore, did the authors or any previous investigators consider the effects of the low pH on contaminant migration?"

Response 3:

The NJDHSS and the ATSDR have based their evaluation of the public health implications of the Reich Farm site upon analysis of completed exposure pathways to site-related contaminants, as documented by laboratory analysis of water quality at specific exposure points. Contaminant reactions and/or formation of chemical byproducts in the environment, as a result of pH or any other condition, would therefore be captured in point-of-exposure sampling.

(Commenter F, Site History)

Comment 4:

"If 10 percent of the 4,500 55-gallon drums on the Reich Farm were empty or partially empty and considered to have been discharged at the site, then more than 20,000 gallons of liquid wastes may have been disharged. ... Have the authors or any previous investigators quantified the volume of liquid waste discharge to the Cohansey aquifer? Did the authors or any previous investigators determine the effects of this large discharge on contaminant plume migration and configuration? Given the potential volume of the discharge, did the authors or any previous investigators consider that the liquid wastes would migrate almost immediately to groundwater? ... Do the authors concur that soils beneath the Reich Farm site had little, if any, influence on slowing the migration of the liquid wastes from the discharge point to groundwater?"

Response 4:

The NJDHSS and the ATSDR are not aware of any accurate estimate of the volume of liquid released to the environment from the drums at Reich Farm, although it is stated in the draft Public Health Assessment (page 4) that, "Approximately 10% of the drums... were partially or completely empty..." That is, the contents of about 450 55-gallon drums may have been discharged. The site documents cited in the Reich Farm Public Health Assessment contain information regarding the extent of the groundwater contamination plume (see Figure 8 of the Public Health Assessment). Contaminant travel time to groundwater is not known. The groundwater contaminant migration model under development by the Union Carbide Corporation assumes a one year travel time from the surface through the unsaturated zone to the water table beneath the Reich Farm site.

(Commenter F, Health Assessment Activity Summary)

Comment 5:

"Why do the authors make the distinction between past and present health hazards in 1999? ...

Would the authors concur that based on the continued presence of contaminated groundwater, that Reich Farm represents a present and future health hazard?"

Response 5:

See Response 2. The distinction between a public health hazard in the past, and no apparent public health hazard at present, is based upon the previous existence of human exposure pathways which have since been interrupted. Although groundwater still is being impacted by the RF contamination plume, mitigative measures have served to prevent exposure. Thus, based upon currently available information regarding human exposure pathways, the site represents "no apparent public health hazard."

Comment 6:

"Why did the U.S. EPA revise the planned remedial approach to Reich Farm and issue the Explanation of Significant Difference (ESD) without obtaining ATSDR input regarding the public health hazard? ... Did the U.S. EPA's change in remedial plans for the site change ATSDR's conclusion regarding the protection of human health? ... Would the authors recommend that the remedial plans outlined in the 1989 ROD be implemented to limit the continued public exposure to contaminated groundwater?"

Response 6:

The USEPA Explanation of Significant Difference (ESD) regarding the Reich Farm Superfund site was issued in 1995. As indicated in the draft Public Health Assessment, the ESD presented a modification to the originally selected remedy (as presented in the U.S. EPA's 1988 Record of Decision) for groundwater contamination related to the Reich Farm site. ATSDR does not routinely review all Records of Decision, Proposed Remedial Action Plans, or other documents that are released by the USEPA. A specific review of one of these types of documents by the ATSDR is usually conducted at the request of the USEPA, local health agencies, or the community, when a public health issue is of concern.

As stated above, the evaluation of the RF site with respect to human health is based upon the existence or absence of completed exposure pathways. All remedial activity at the Reich Farm site is considered in that context, and the NJDHSS and ATSDR consider the public health implications of the site accordingly. The USEPA is the agency charged with determining the most appropriate remedial technology to utilize for site clean-up. The USEPA determined that implementation of the the 1989 ROD was not feasible. The Public Health Assessment will be revised to clarify the USEPA's reason for issuing the ESD.

(Commenter F, Remedial History)

Comment 7:

"The authors' use 1993 data to indicate that approximately 50 percent of the contaminant mass is located 1,000 feet upgradient of the Parkway Well Field. Do the authors believe that the mass will continue migrating toward the well field and the contaminant concentrations in groundwater will increase? Are the treatment technologies sufficient to completely remove these contaminants from drinking water?"

Response 7:

Groundwater models of the NJDEP and the Union Carbide Corporation indicate that the groundwater contamination plume is "captured" by wells at the Parkway well field, and that as long as the well field is operated, contaminants will flow in that direction. As stated in Response 2, current treatment systems in place appear to be protective of public health, since post-treatment samples do not show site-related contaminants. The draft Public Health Assessment recommends routine monitoring of the Parkway wells and treated water quality.

(Commenter F, Environmental Contamination)

Comment 8:

"The authors indicate on page 9 that no off-site air contamination was generated other than at the time of disposal in 1971. Were contaminants removed from groundwater by the air stripping system at the Parkway Well Field discharge to the atmosphere? Wouldn't these discharges represent a potential health hazard?"

Response 8:

The Public Health Assessment actually states (page 9), "Air contamination may have occurred during the dumping of materials at the site, as evidenced by odor complaints at the time (Ghassemi, 1976), and during site investigation and removal activities; however, no off site air contamination data have been generated during remedial investigations." The packed tower aeration (i.e., air stripping) at the Parkway Well Field is permitted by the New Jersey Department of Environmental Protection.

(Commenter F, Groundwater Investigations: 1974 to 1976)

Comment 9:

"Do the authors consider a 1974 drinking water standard appropriate for evaluating the safety of drinking water? ...[S]houldn't the detection of any contamination downgradient of Reich Farm at a concentration in excess of 25 to 50 micrograms per liter (µg/l) with the CCE method be considered a public health hazard? ...[S]houldn't the detection of any compounds with this method be of serious concern since several light volatile organic compounds which are the primary contaminants of concern for the site, may have escaped and therefore, not been reported by the analysis? ...[S]houldn't the July 1974 result for Parkway Well 26 be considered indicative of "chemical pollution of a watershed" and therefore, conclusive evidence of Reich Farm impacts to the Parkway Well Field?"

Response 9:

See Response 1. The carbon chloroform extraction (CCE) method of analysis for organic compounds in an aqueous matrix that was used in 1974 relied on the adsorption of organic compounds on activated carbon, extraction of the adsorbed compounds with chloroform, and then distillation/evaporation of the chloroform. The residue was then weighed. The method provided no identification of compounds that were contained in the residues. While the data may indicate contamination of some kind, without specific identification of the potentially present compounds, a conclusive link to the Reich Farm site cannot be made.

(Commenter F, Public Wells; Parkway Well Field)

Comment 10:

"Are the authors convinced that the air stripping system and blending of the water from Parkway Wells 26 and 28 was sufficient to reduce contaminant concentrations in drinking water to current maximum contaminant levels (MCLs) or maximum contaminant level goals (MCLGs)? Are the authors aware that the NJDEP recommended to Toms River Water Company that they install carbon filtration units in 1974?"

Response 10:

Historic water quality data are summarized in the draft "Public Health Consultation: Drinking Water Quality Analyses, March 1996 to June 1999, United Water Toms River" by the NJDHSS, NJDEP and the ATSDR. In that document, it is stated that, "...[United Water Toms River] completed installation of a packed tower aeration system (air stripper) in 1988 to remove volatile organic chemicals from wells #26 and #28. Since then, treatment has generally been effective at removing TCE, but there have been occasional low level detections due to treatment failures and sporadic occurrences of TCE in well #29." In addition, on page 17 of the draft Reich Farm Public Health Assessment, the NJDHSS and the ATSDR summarize what is known regarding contamination of the community water supply in relation to the Reich Farm plume, prior to the construction of the air stripper in 1988. At that time, some distribution system samples exhibited TCE contamination between 2 and 3 ppb; this level exceeds today's MCL of 1 ppb. The NJDHSS and the ATSDR are aware of the request by the Dover Township Board of Health and the Ocean County Health Department to the NJDEP in 1974. At the time, the NJDEP determined that installation of treatment was premature but that monitoring should continue.

Comment 11:

"Is the current air stripping and carbon filtration system fully capable of removing volatile and semi-volatile compounds from groundwater pumped from Parkway Wells 26, 28, and 29? ... Are the authors fully satisfied that this system will prevent the discharge of any Reich Farm related contaminants, either identified or currently unidentified, to the distribution system or downgradient of the well field?"

Response 11:

See Response 2.

Comment 12:

"Did the authors of any previous investigators evaluate the effect of more than two years of pumping of 148 private wells on the plume nature, configuration, and migration rate? Did the authors or any previous investigators consider the effects of plume configuration and migration resulting from the increased pumping of the Parkway Well Field to replace the 148 private wells closed in 1974?"

Response 12:

As previously stated, the NJDHSS and the ATSDR evaluate the RF site on the basis of the presence or absence of completed human exposure pathways. Issues regarding the aspects of groundwater flow patterns either in the past or presently are considered by the NJDEP and the Union Carbide Corporation as part of the ongoing development of groundwater models for the Reich Farm site.

(Commenter F, Conclusions)

Comment 13:

"...it is apparent that Reich Farm represents a past, present, and future public health hazard. The continued presence of contaminated groundwater within the Parkway Well Field represents a long-term future health hazard. ... Furthermore, only recently has the hazardous SAN-trimer been identified in water from the Parkway Well Field and this compound was not adequately treated with the previous air stripping system. Numerous other compounds have not been identified in groundwater from the Parkway Well Field and until the '...committee of laboratory scientists...' established by the NJDEP can identify all compounds in the treated and untreated groundwater from the Parkway Well Field, it is premature to classify Reich Farm as not representing a present health hazard."

Response 13:

Refer to Response 2, 3 and 5. The presence of Reich Farm-related contaminants (including SAN trimer and other chemicals) in the community water supply human exposure pathway is one of the considerations leading to the determination that the site "...represented a public health hazard because of past exposures." The report of the NJDEP committee to tentatively identify non-target compounds in the Reich Farm groundwater contamination plume, released after the draft Public Health Assessment, will be discussed in the final version.

Commenter G:

Comment 1:

"While I agree on most of the assessments findings, I must disagree with certain conclusions in the report. My concern is the report would make the community complacent with the conclusion that there is no public health risk at this time. I do not believe that this can be concluded currently. While I agree that many steps have been taken to reduce the public health risk, there still remains some concerns. Not all tentatively identified compounds (TICS), have been identified, nor have all the Parkway Well Field Wells been protected. We also do not know whether the carbon filtration and aeration systems are completely effected in removing all chemicals from the drinking water supplies. Further we do not know whether the water supply has been affected by chemicals not properly treated by aeration or carbon filtration."

Response 1:

The assignment of a "no apparent public health hazard" category was based on several factors that must be carefully monitored so that no community member is exposed to contamination at levels that may result in adverse health effects. As indicated in the Public Health Assessment, current conditions indicate that exposure to contaminants from the Reich Farm site is no longer occurring. The exposure pathway through private well use was interrupted by the establishment of a well restriction zone, and there is no indication that private wells are still in use for potable purposes in the area above the RF plume. The exposure pathway through the community water supply system has been interrupted by the diversion and treatment of contaminated water from well #26 and #28 at the Parkway well field, and the installation of treatment for well #29, which has shown sporadic RF-related contamination. (Treatment was also extended to the nearby well #22 as a precaution.) Containment of the RF-related groundwater plume through effective management of the Parkway well field is critical to ensure that currently unaffected wells remain so. In addition, proper operation of the treatment system in place is necessary to reduce or eliminate the entry of RF-related contaminants into the distribution system. On-going water monitoring is needed to document the effectiveness of well field management and treatment systems.

The current treatment systems in place are protective of public health. Packed tower aeration (i.e., air stripping) and adsorption by granular activated carbon (commonly known as carbon filtration) of wells 26 and 28 have been shown to be effective at removing the contaminants that have been found in the raw water; this is evidenced by the continued absence of measurable site-related contamination in treated water. Similarly, carbon treatment of water from wells 22 and 29 should remove site-related contaminants should those wells be impacted.

Comment 2:

"The fact is that a public drinking supply should never be used as remediation for a known contaminated water supply. ... I believe that a final version of the report should reflect the Departments recommendation that public drinking supplies should never be used as chemical waste remediation. Certainly there are short term public problems taking drinking supply wells off line, this however does not compare with the long range problems when a drinking supply is tainted with cancer causing chemicals."

Response 2:

The Public Health Assessment addresses human exposure pathways and interruption of pathways to prevent or reduce exposure. Decisions about the methods and technologies to apply for exposure reduction are the responsibility of environmental regulatory agencies. In New Jersey, the NJDEP is the responsible agency, operating under specific authorities granted in state and federal laws. Many water supplies, both in New Jersey and across the country, have experienced contamination. Contaminants may be naturally occurring or come from a variety of sources related to human activities, including agriculture, sewage and septic systems, industrial discharges, and improper waste disposal. The challenge is to protect water supplies from contamination in the first place, and to develop and use effective treatment systems when prevention efforts fail. At the same time, a sufficient supply of water must be maintained to meet short-term demands for water distribution and fire protection, and long-term demands of an expanding population.

Commenter H:

(*Cover Letter)*

Comments in the cover letter are repeated and expanded upon in the "Major Comments: Extended Discussion" portion of the comments. Responses will be developed below for the extended discussion comments.

(Major Comments: Extended Discussion)

A) Site Health Hazard Classification

Major Comment:

"The health and exposure data are inadequate to classify Reich Farm as a public health hazard."

Sub-Comment 1:

"The designation of the Reich Farm site by NJDHSS as a public health hazard because of past exposures is inconsistent with the known information on the site and is inconsistent with the study's own conclusions that state on page 20:

'...a toxicological evaluation of the known contaminants, taken on an individual basis, would not indicate that an adverse health effect (carcinogenic or non-carcinogenic) is likely from past exposures to persons consuming well water from the Parkway wellfield.' and...

'Because documented contaminant levels were well below their respective individual toxicological thresholds, the toxicological evidence suggests that exposures to combinations of known contaminants detected in private wells and in untreated water from the Parkway well field are not likely to lead to adverse health effects.'

Response 1:

ATSDR and the NJDHSS provided the following additional context to the above statements in the Reich Farm public health assessment.

> "Much uncertainty exists concerning the composition, levels and toxicological characteristics of past exposure to contaminated private and community water supplies. Although the toxicological evaluation performed for this Public Health Assessment did not suggest that adverse health effects from documented past exposures to contaminated drinking water (through private and community water supply) were likely, this evaluation was based on limited historical environmental data. Therefore, although it cannot be documented, the public health significance of past exposures related to the Reich Farm site may have been greater than is apparent from the toxicological evaluation of the known levels of contaminants performed in this Public Health Assessment."

The evaluation of toxicological data is an important part of any public health assessment; however, toxicological data are not the only information that ATSDR and the NJDHSS use for determining a public health hazard category. As indicated in the Appendix to the public health assessment (ATSDR Public Health Hazard Categories), ATSDR evaluates various data sources in to help determine a hazard category. These include, environmental and demographic data, health outcome data (*e.g.*, cancer incidence data), exposure data, community health concerns information, toxicologic, medical, and epidemiological data; and monitoring and management plans. In assigning the past public health hazard category, ATSDR and the NJDHSS relied mostly on the weight-of-evidence provided by the exposure data, health outcome data, demographic data (*i.e.*, the potentially large exposed population), and epidemiological data. For many sites that ATSDR evaluates, a complete understanding of the exposure levels that persons were exposed to over time is not possible. This is often due to the lack of sampling data or sampling adequacy. Therefore, ATSDR does not always base a hazard category solely on the weight of the toxicological evidence. Section 104(i) of the 1986 CERCLA amendments to the Superfund Act specifically indicates the information that ATSDR could consider to guide the evaluation of exposures from the uncontrolled release of contaminants into the environment. ATSDR and the NJDHSS believe that the determination of a past public health hazard is justified based on the weight-of-evidence from all information and that the use of various sources of information to make this assessment of public health is within the mandate set forth by Congress under the Superfund amendments. Moreover, as seen in the Appendix to the public health assessment (ATSDR Public Health Hazard Categories–Data Sufficiency), the determination of a public health hazard category is one of professional judgment based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made. ATSDR feels that the follow-up case-control study, although it will not establish a definitive cause and effect relationship between exposure and the excess of childhood cancers in the community, should provide further information on the risk factors that may have led to an excess of childhood cancers in the community.

Sub-Comment 2:

"Furthermore, this designation [of a public health hazard category] is inconsistent with the conclusions of the 'illness survey' conducted by the Disease Control Section of Ocean County in June 1974 that investigated the possible correlation between the reported concentrations of organics in private well waters and cases of illness and medical complaints (Ghassemi, 1976). This report concluded that, 'no correlation could be established between the use of contaminated well water and the reported illnesses.' The results of the 'illness survey' are not reported in the health assessment document."

Response 2:

The derivation of a public health hazard category is based upon the existence of a completed human exposure pathway. The "illness survey" described in the Ghassemi report is not a definitive indicator of the absence or presence of an exposure pathway. The hazard category presented in the Public Health Assessment is based upon the existence of human exposure pathways associated with contaminated groundwater prior to 1996. However, the final Public Health Assessment will be modified to include a reference to the "illness survey" conducted in 1974.

Sub-Comment 3:

"According to ATSDR's Interim Public Health Hazard Categories, the definition of the category, Public Health Hazard, is as follows:

'This category is used for sites that pose a public health hazard due to the existence of long-term exposures (>1) to hazardous substances or conditions that could result in adverse health effects.'

The criteria for this category are described as follows:

'Evaluation of available relevant information suggests that, under site-specific conditions of exposure, long-term exposures to site-specific contaminants (including radionuclides) have had, are having, or are likely to have in the future, an adverse impact on human health...'

The conclusions from the document are contrary to the conditions that need to be met as stated in the above criteria.

"The justification provided by the Agency's classification of the Reich Farm site as a 'public health hazard because of past exposures' does not attempt to argue that the data meet ATSDR's criteria for such a designation, but rather lists three considerations out of context from these criteria:

- *The presence of completed exposure pathways in the past through private and community water supplies to volatile organic chemicals including TCE and PCE:*
- *Epidemiological studies in other communities suggesting exposure to TCE and PCE may increase the risk of certain childhood cancer, and,*
- *The presence of an excess of childhood cancers in the community.*

The existence of an exposure pathway is a necessary, but not sufficient criterion because it does not address the magnitude or duration of exposure required by the criteria. While Union Carbide agrees that exposure pathways may have existed to low levels of organic contaminants for short periods of time in the past, some of the analytical information for both private and community water supply wells is unsubstantiated and/or requires clarification. It is discussed in the subsequent section of this letter concerning analytical data. These data are insufficient to assign a rating to the site as a past health hazard."

Response 3:

First, it is important to note that the assignment of a public health hazard category does not imply

a cause and effect relationship between exposures at a particular site and adverse health effects. It does, however, indicate that based on the evaluation of all the data sources, not just the toxicological data, there is enough evidence to conclude that a public health hazard exists (or existed, or will exist), and that follow-up actions (such as an epidemiologic study) are necessary.

The three reasons listed above are not "out of context" with ATSDR's criteria for designating the past exposures as a public health hazard. As indicated above, the determination of the likelihood of adverse health effects is not solely based on a toxicological evaluation, but is also based on an evaluation of environmental and demographic data; exposure data; community health concerns information; toxicologic, medical, and epidemiologic data; and monitoring and management plans. The ATSDR and the NJDHSS believe that the three considerations listed above are sufficient to characterize the past exposures at the site as a public health hazard and that follow-up health actions are warranted.

Sub-Comment 4:

"The fact is that ATSDR's Toxicological Profile for TCE (Toxicological Profile for Trichloroethylene (Update), September 1997, page 2) states that the most recent monitoring study found average levels of TCE in groundwater in the U.S. to be 7 ppb, greater than or similar to levels monitored in the Parkway well field from the mid-1980's, the best estimate of the arrival time of Reich Farm contaminants. Also, according to the Toxicological Profile (page 4), "It is uncertain whether people who breathe or drink water containing trichloroethylene are at higher risk of cancer..." More attention is paid in the toxicological profile, than in the health assessment document, to the findings from ATSDR's TCE Exposure Registry of 4,280 people exposed to TCE from their drinking water wells. The TCE Exposure Registry study "found no definitive evidence for an excess of cancers from trichloroethylene exposure." More specifically, although based on small numbers, the ATSDR's National Exposure Registry for Trichloroethylene (TCE) Subregistry Followup 1 Technical Report (March 1996) found no evidence at all of an association with childhood cancers."

Response 4:

ATSDR and the NJDHSS acknowledge that there is scientific debate regarding the carcinogenicity of TCE in humans. A series of recent articles in the journal *Environmental Health Perspectives* (EHP), Volume 108, Supplement 2, May 2000, points out many of the issues surrounding this debate. However, one of the articles in this volume of the EHP by Wartenberg, Reyner, and Scott, entitled "Trichloroethylene and Cancer: Epidemiologic Evidence", concludes by stating that the authors believe that solvent exposure causes cancer in humans and that trichloroethylene likely is one of the active agents and that further study is recommended to better specify the specific agents that confer risks and to estimate the magnitude of that risk. As noted in the draft Public Health Assessment, TCE is considered by the International Agency for Research on Cancer to be a probable human carcinogen. Regarding the comments on the ATSDR TCE Subregistry, the ATSDR and the NJDHSS did acknowledge in the draft Public Health Assessment that the results of the Subregistry have not documented any increased occurrence of cancer in the study population; however, this was based on the 1993 ATSDR Baseline Technical Report. In response to the second part of the above comment, ATSDR and the NJDHSS reviewed the most recent findings of the 1999 TCE Subregistry Baseline Through Followup 3 Technical Report, October 1999. This update concluded the following regarding the most recent data on cancer prevalence in the registrants of the TCE Subregistry:

" A statistically significant excess (O/E = 7.03, 99% CI = 1.18 - 22.13) was seen in females aged

> 18 through 24 and was based on 4 cases. The small number of cases, the number of observed to expected ratios exceeding 1 for all cancers, the number of different types of cancers, and the lack of statistical significance (except for the high rate of female genital organ and breast cancer) present a confusing scenario. ATSDR is validating reported cancers, and obtaining state and regional cancer rates using state cancer registries for use in further statistical analyses. Results of these analyses, as well as comparison to SEER rates [national cancer rates], will provide better insight in interpreting cancer reporting rates. A detailed report on cancer rates in the TCE Subregistry is forthcoming."

The ATDSR notes that there was one cancer case within the two youngest age brackets. The ATSDR and the NJDHSS believe it is premature to make any firm conclusions regarding the findings of the TCE Subregistry and associations with cancer. The current information and citations regarding the TCE Subregistry and the conclusions of the recent article in the EHP will be added to the final Reich Farm Public Health Assessment.

Sub-Comment 5:

"The presence of an excess of childhood cancers in the Dover Township community, for which case control study is being conducted to identify possible causes, is not an appropriate consideration in designating the Reich Farm site as a past public health hazard. There is absolutely no evidence that the occurrence of childhood cancer in the community is related to Reich Farm and the presupposition that there is a connection indicates a bias on the part of the very agencies conducting the evaluation."

Response 5:

The evaluation of morbidity and mortality in a community is part of ATSDR's public health assessment process and can be considered in the overall evaluation of the public health hazard a site may pose. Moreover, as stated above, evaluation of these types of data is specifically indicated in ATSDR's legislative mandate (CERCLA Section 104(i)). The use of the data on the occurrence of childhood cancers in the community in the public health assessment and the determination of a past public health hazard do not imply that the exposures from the site definitely caused the excess of childhood cancers in the community. The case-control study currently being conducted will evaluate exposure pathways related to the Reich Farm site as potential risk factors for childhood cancer in the community.

Sub-Comment 6:

"The Draft Public Health Assessment seems to base its classification as a public health hazard due to past exposures on the presumption that exposures in the past were significantly greater than is documented by the data because it states on page 23 that:

> *'Much uncertainty exists concerning the composition, levels and toxicologic characteristics of past exposures to contaminated private and community water supplies. Although the toxicological evaluation performed for this public health assessment did not suggest that adverse health effects from documented past exposures to contaminated drinking water (through private and wells or the community water supply) were likely, this evaluation is based on limited historical environmental data. Therefore, although it cannot be documented, the public health significance of past exposures related to the Reich Farm site may have been greater than is apparent from the toxicological evaluation of the known levels of contaminants performed for this public health assessment. For the*

reasons above, further evaluation and follow up actions are warranted in order to evaluate the public health significance of past risk posed by the site.'

This uncertainty is not an acceptable justification for classifying the Reich Farm site as a public health hazard based on past exposures. The Agency's conclusion is clear that based on actual data 'toxicological evaluation performed for this Public Health Assessment did not suggest that adverse health effects from documented past exposures to contaminated drinking water (through private wells or the community water supply) were likely...' A weight of the evidence assessment does not support a conclusion that contamination from Reich Farm posed a public health hazard. Union Carbide supports the Agency's further evaluation and follow-up actions to evaluate the public health significance posed by the site, but disagrees that the site can be classified as a public health hazard due to past exposures based on the existing information."

Response 6:

Although the uncertainty related to past exposures and to the toxicological evaluation of these past exposures was not used as a direct justification for classifying the Reich Farm site as a public health hazard, the NJDHSS and the ATSDR did discuss in the Public Health Assessment the limitations of information regarding exposures in the past. The NJDHSS and the ATSDR believe that it was important to note that the nature and magnitude of exposure in the past may have been different from the present, and if compound-specific data on these past exposures were available, the public health significance of these past exposures consequently may have been greater than is apparent from the toxicological evaluation that was performed based on the limited data available.

B) Exposure Assessment

Major Comment:

"The exposure data used by the Agency in the document is incomplete, incorrectly attributed to Reich Farm in several cases, and is of limited utility. Additional data provided in these comments should be considered before a final public health hazard determination is made." ... "Union Carbide agrees that the early data are hardly a sufficient basis on which to assign the site with a ranking as a Public Health Hazard due to past exposures. ... The use of non-specific indicators of organic chemical contamination is particularly problematic in the area of Pleasant Plains surrounding Reich Farm because this area was not served by a public sewer system until 1978-79." The comment goes on to describe the existence of potential sources of contaminants in the Pleasant Plains area. The comment also provides tables of data summarizing phenol data from private wells downgradient of Reich Farm in 1974, and phenol and gas chromatography data from Parkway well field wells, private wells, and monitoring wells from 1974 to 1976. The comment continues, "The detection of toluene and styrene in a private residence located approximately 800 feet southwest of the Reich Farm site ... may well be related to the site because styrene was a site contaminant, styrene is not frequently detected in the environment and the time frame fits the approximate travel time of ground water leaving the Reich Farm site. ... [T]here is no credible evidence that the detection of phenols at the Parkway well field in 1974 and in the ground water wells, especially on Dugan Lane and Wallach Lane in 1976, is related to the site..." The comment then discusses the phenol data with respect to data reproducibility, lack of corroborative contemporaneous analyses, and time of travel.

Response:

The NJDHSS and the ATSDR reviewed and considered the two data tables provided by the commenter, containing water analyses in the period 1974 to 1976. As noted in the comment, impact of the Reich Farm plume on a private well is documented in 1974. Taken together with the documented impact of the Parkway well field in 1986, the ATSDR and the NJDHSS concluded in the Public Health Assessment that available data indicate completed human exposure pathways attributable to the Reich Farm site. In the Public Health Assessment, the NJDHSS and the ATSDR provide a substantial discussion of the quality and utility of the non-specific data from the 1970s, and conclude that there is considerable uncertainty about the nature, magnitude and duration of these exposure pathways.

Regarding private wells, the exact number of wells (of the 148 closed in 1974) and thus the number of persons definitively impacted by the Reich Farm site groundwater contamination plume cannot be established, due to the limitations in existing data as discussed in the Public Health Assessment. The pathways table and discussion in the final Public Health Assessment will be modified to more accurately reflect this degree of uncertainty.

C) Ground Water Time of Travel

Major Comment:

"The most accurate estimate of the arrival of contaminants from Reich Farm to the Parkway well field of the mid-1980's should be reported in this document. ... "Based on a thorough analysis of ground water flow in the vicinity of the Reich Farm Site conducted by Union Carbide over the past 10 years, the five-year travel time cited by the Agency is unrealistically low and is lacking technical basis. Travel time in the order of 10 plus years for ground water flowing in the Cohansey aquifer between Reich Farm and the Parkway well field is supported by the actual data..." The comment then describes at length the work performed for Union Carbide by Dr. Jon Sykes of the University of Waterloo, and a draft report "An Evaluation of Average Water Particle Paths and Travel Times from the Reich Farm Superfund Site, Pleasant Plains, New Jersey" is attached. The comment also provides a comparison of the Sykes model to those of the U.S. Geological Survey and the New Jersey Geological Survey of NJDEP. The comment concludes that the Sykes model predicts a travel time of approximately 10-11 years for groundwater.

Response:

Both the Union Carbide Corporation and the NJDEP are in the process of developing groundwater models capable of estimating travel time of contaminants from the Reich Farm to the Parkway well field. The draft Public Health Assessment (page 16) cited the range of estimates of travel time that were available at the time it was prepared (between five and ten years). The final Public Health Assessment will be updated to reflect the further development of the Union Carbide model and the fact that the models continue to be developed and refined.

Other Comments

Comment 1:

"Only chemical wastes in 55-gallon drums and 5-gallon pails were transported from UCC's Bound Brook Plant by the independent waste hauler, Nicholas Fernicola, between March 1971 and December 1971.

Chemical wastes were not hauled in bulk tanker trucks..."

Response 1:

The final Public Health Assessment will be modified to reflect this comment.

Comment 2:

[Summary, Paragraph 2] "While it is true that uncertainty exists regarding ground water quality at private wells due to very limited and general monitoring, more is known about the Parkway public water supply. A 1984 Parkway Well Field Point of Entry (POE) sample collected by the water company showed no presence of Trichloroethylene (TCE) ... The TCE was first observed in the Parkway well field in mid-1986 ... Semi-volatile compounds were not routinely monitored. However, we know that the SAN Trimer was present in Well #26 in 1990 at about the same concentration found in 1996 – 6 parts per billion (ppb). The Point of Entry concentration of the SAN Trimer would, therefore, have been about 1 ppb or less in 1990 for the SAN Trimer."

Response 2:

The ATSDR and the NJDHSS believe that available analytical data are insufficient to determine with certainty when contaminants first impacted the Parkway well field, particularly since there are contaminants in the groundwater that are not measurable with volatile organic chemical methods (as noted in the comment).

Comment 3:

[Page 4, Paragraph 2] "The term 'bulk' is seemingly distinguished from drummed chemical waste in the Summary section of this document, although no definition of the term is provided."

Response 3:

See Response 1.

Comment 4:

[Page 4, Paragraph 4] "As shown in UCC records, the removal of <u>visible</u> drums was completed in March 1972."

Response 4:

The final Public Health Assessment has been modified to reflect this comment.

Comment 5:

[Page 4, Paragraph 5] "Based on our current knowledge of ground water flow direction, not all wells that were closed in 1974 were the result of off-site contamination from the Reich Farm Site. Only those

southwest and nearby the Reich Farm site could have been affected. ...”

Response 5:

See response to Major Comment B above.

Comment 6:

[Page 8, Paragraph 2] “Both removal actions [in 1972 and 1974] were conducted under the supervision of the NJDEP.”

Response 6:

The paragraph in the final Public Health Assessment has been modified to reflect that both removal actions were conducted under the supervision of NJDEP.

Comment 7:

[Page 8, Paragraph 3] “Reduction of all semi-volatile organic compounds (SVOCs), not just BEHP, to a sum total of 10 ppm or less was a soil remediation goal that was stipulated and achieved by the soil clean up performed in 1995 by UCC under the oversight of the U.S.EPA.”

Response 7:

The text of the final Public Health Assessment has been modified to reflect that total SVOCs (including BEHP) would be remediated to less than 10 ppm in the soils.

Comment 8:

[Page 8, Paragraph 5] “Union Carbide signed a Consent Agreement in March 1990 to perform and pay for the Remedial Design and Remedial Action for the Reich Farm Site. <u>Union Carbide</u> completed the soil remediation under U.S.EPA oversight in 1995.”

Response 8:

The final Public Health Assessment has been modified to reflect this comment.

Comment 9:

[Page 8, Paragraph 6] “The predesign activities began in 1990 and continued through 1994.”

Response 9:

The final Public Health Assessment has been modified to reflect this comment.

Comment 10:

[Groundwater Investigations: 1974 to 1976] "The information presented in this section and these pages is general in nature and the basis for statements made include newspaper articles and previous reports without reference to the original data itself. Specific locations for many of the samples discussed and summarized in tabular form are not provided, nor are well screen intervals provided that would enable the reader to technically evaluate the data. A thorough analysis of this data, as provided under UCC's major comments, shows the inconsistencies and incompleteness of the information presented. The use of analytical techniques that evaluate only general indicators of the presence of organics as the basis for the Draft Public Health Assessment for Reich Farm is not technically valid as discussed in UCC's comments."

Response 10:

The limitations of the data have been discussed in the PHA. Information on the ground water investigations that are discussed in this section of the PHA has been extracted from the references indicated, including NUS (1986) and Ghassemi (1976), which included copies of newspaper articles. The analytical methods in use at the time were not compound-specific (*e.g.*, CCE, CEE, CCl_4/IR). This situation is noted specifically, for example, on page 12 regarding the sampling for phenols: "no additional information was available for evaluation by the ATSDR or the NJDHSS regarding the analytical methods employed for these sampling events." Data shown in Table 4 were obtained by the CCE method (Standard Method 506 , not compound-specific), for which the USPHS standard for potable water was 700 ppb.

Comment 11:

[Page 12, Paragraph 4] "The private well RW-7 is located approximately 1/4 mile upgradient (northwest) of the Reich Farm site and clearly was not impacted by wastes disposed at the site."

Response 11:

Private well RW-7 is identified (page 16) in the PHA as being upgradient. Table 6 has been modified to indicate the location of the well relative to the RF site.

Comment 12:

[Page 13, Paragraph 1] "Lack of identification of the well screen interval for analytical results cited in the Draft Public Health Assessment results in confusion regarding the conclusions to be drawn from the data. For example, Parkway wells #23, #25, and #27 are screened into the Kirkwood aquifer at approximately 300 feet below ground surface. Contamination from the Reich Farm is confined to the Cohansey aquifer, which is hydraulically not in contact with the Kirkwood aquifer at this depth. The contamination in these Kirkwood wells could not, therefore, be related to the Reich Farm site. Based on communications with United Water Company representatives, Wells #23, #25, and #27 were eventually closed not because of contamination problems, but because the Kirkwood aquifer is much less permeable and these particular wells were unable to produce the volume of water desired by the water company."

Response 12:

Contaminants detected in wells 23, 25, and 27, are presented as potential contaminants of concern based upon their documented presence, not on the basis of the depth of the sampled wells. However the text on page 17 has been modified to reflect the depth of the wells.

Comment 13:

[Page 14, Paragraph 3] "UCC played an integral part in providing information to the regulatory agencies and assisted in identifying the particular compound found in Well #26 as the site related SAN Trimer."

Response 13:

This paragraph has been modified in the final Public Health Assessment to reflect that representatives of UCC, NJDEP, NJDHSS, and USEPA were involved in the identification of SAN trimer in well #26.

Comment 14:

[Page 16 top of page, Paragraph starting on previous page] "As noted in Comment #7 and stated in the 1986 NUS Remedial Investigation Report (Section 1), "over one-half of the (well) restricted zones were hydraulically up gradient of the Reich Farm Site in 1974." The same report noted that with respect to the 148 private Cohansey well closings: "A review of the available analytical data failed to show a definite pattern of groundwater contamination attributable to the Reich Farm Site." Additionally, the time of contaminant travel suggests that only a relatively small number of people may have been exposed to Reich Farm contaminants via private wells. This estimate needs to be reduced, consistent with the information available."

Response 14:

See response to Major Comment B above.

Comment 15:

[Page 19, Paragraph 4] "As stated in UCC's comment #14, the private well RW-7 is significantly upgradient of the Reich Farm site. Therefore, any contamination associated with this well should not be included in the health assessment as related to Reich Farm."

Response 15:

RW-7 is identified in the Public Health Assessment as being an upgradient well.

Comment 16:

[Page 20, Paragraph 2] "What is not clear is the source of these contaminants. Many detections were clearly up gradient from Reich Farm, and, therefore, unaffected by this site. It is not scientifically valid to assume that they were related to the Reich Farm site. See the discussions provided under UCC's Major Comments, Section B, Exposure Data, related to ground water contamination."

Response 16:

See response to Major Comment B above.

Commenter I:

Comment 1:

"Deadline to response created to limit response."

Response 1:

The NJDHSS and the ATSDR typically release draft Public Health Assessments for a standard public comment period of 30 days. For Dover Township documents, this period was extended to 60 days because of the degree of complexity and community concern.

Comment 2:

"Reich Farm - the burning - Why no health studies made of it effect on the community?"

Response 2:

The excavation and thermal desorption treatment of soils was conducted by the USEPA in compliance with the remedial action plan.

Comment 3:

"Unknown SAN Trimer and known contaminants did not suggest that adverse effects are likely - SAN Trimer is an unknown - testing as a carcinogenic substance positively, and is found on the site, the Known Cont did not suggest statement unless backed by data - tells one that you do not Know the health effects. It is clear that there remains a public health hazard at the RF site."

Response 3:

The NJDHSS and the ATSDR concluded that there is "no apparent public health hazard" under present conditions since the exposure pathways from the private wells and supply wells of the Parkway Well Field have been interrupted. Because the groundwater remains contaminated, this conclusion is based upon the condition that adequate controls and monitoring continue to ensure that the exposure pathway remains interrupted.

Comment 4:

"...With the presence of excess Childhood Cancers in the community one would think that your documents and studies would cover in details their ages, types of cancers, census tract data, date of incident or death to seek answers and to help prevent those occurrence."

Response 4:

Children over age 5 have not been excluded from consideration in the childhood cancer investigations. The NJDHSS and the ATSDR analyzed cancer incidence in children aged 0 to 19 from 1979

through 1995 in Ocean County, Dover Township, and the "Toms River" section. Detailed data analyses are presented in the report released in 1997, "Childhood Cancer Incidence: A Review and Analysis of Cancer Registry Data, 1979-1995, for Dover Township (Ocean County), New Jersey." The NJDHSS and the ATDSR are also conducting a case-control epidemiologic study of children aged 0 through 19 who were diagnosed with childhood cancers from 1979 through 1996.

Comment 5:

"...37 drums at Brookside and Briar. When were these drums removed?"

Response 5:

As discussed in the Public Health Assessment, all visible drums were removed from the Reich Farm site in February 1972; additional buried drums were removed in 1974. The 37 additional drums found in trailer trucks at Brookside and Briar Avenues were removed in 1974.