

**Public Health Assessment**

**Dover Township Municipal Landfill  
CERCLIS Number: NJD980771570**

**and the**

**Silverton Private Well Contamination Investigation  
CERCLIS Number: NJD981877780**

Dover Township, Ocean County, New Jersey

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Under a Cooperative Agreement with:  
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**Contents**

Abbreviations ..... iv

Summary ..... 1

Purpose and Health Issues ..... 3

Background ..... 3

    Demography and Land Use ..... 3

    Site History ..... 4

    Health Assessment Activity Summary ..... 5

    Site Visits ..... 5

    Community Concerns ..... 5

    Statement of Issues ..... 6

Discussion ..... 6

    Remedial History ..... 7

    Environmental Contamination ..... 8

    Pathway Analysis ..... 10

    Public Health Implications ..... 13

Conclusions ..... 18

Recommendations ..... 19

Public Health Action Plan ..... 20

Certification ..... 23

Preparers of Report ..... 24

References ..... 25

Appendices

    Appendix A: Definition of Comparison Values ..... 29

    Appendix B: ATSDR’s Public Health Hazard Categories ..... 33

    Appendix C: Tables ..... 37

    Appendix D: Figures ..... 45

    Appendix E: Response Summary ..... 53

## **Abbreviations**

AL	Action Level
ATSDR	Agency for Toxic Substances and Disease Registry
CACCCC	Citizens' Action Committee on Childhood Cancer Cluster
CREG	Cancer Risk Evaluation Guide
DTML	Dover Township Municipal Landfill
EMEG	Environmental Media Evaluation Guide
IARC	International Agency for Research on Cancer
MCL	Maximum Contaminant Level
MRL	Minimal Risk Level
ND	Not Detected
NJDEP	New Jersey Department of Environmental Protection
NJDHSS	New Jersey Department of Health and Senior Services
OCHD	Ocean County Health Department
PCE	Perchloroethylene (tetrachloroethylene)
PHAP	Public Health Action Plan
PHRP	Public Health Response Plan
RfD	Reference Dose
RMEG	Reference Dose Media Evaluation Guide
SAN trimer	Styrene-acrylonitrile trimer
SVOC	Semi-Volatile Organic Chemical
TCE	Trichloroethylene
UCC	Union Carbide Corporation
USEPA	United States Environmental Protection Agency
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 (CERCLIS #NJD980529713) and Ciba-Geigy Corporation (CERCLIS #NJD001502517).

Based upon information collected by the NJDHSS and the ATSDR during health assessment activities for the Reich Farm site, and a high level of community concern, the NJDHSS and the ATSDR also began a Public Health Assessment to evaluate the public health issues associated with the Dover Township Municipal Landfill (CERCLIS #NJD980771570). Because of a high degree of community concern, private well contamination in the Silverton section of Dover Township (Silverton Private Well Contamination Investigation (CERCLIS #NJD981877780)) is also evaluated in this Public Health Assessment, although the source of this contamination is not known. Together, the Public Health Assessments provide a review of environmental health issues and evaluate past and current human exposure pathways associated with these sites.

There are multiple sources of wastes at the Dover Township Municipal Landfill (DTML), including chemical wastes from the Union Carbide Corporation (UCC) facility at Bound Brook, N.J. which were deposited by a waste hauler contracted by the UCC at both the Reich Farm site and the Dover Township Municipal Landfill in late 1971. Groundwater contamination (volatile organic chemicals and possibly lead) associated with the Dover Township Municipal Landfill impacted private wells in 1987 to 1989, in areas adjacent to the landfill, requiring provision of alternate water supplies under the New Jersey Spill Fund law. Earlier, in 1982, several private wells located approximately 8,000 feet to the east of the DTML were found to be contaminated with volatile organic chemicals, including carbon tetrachloride, benzene, chloroform, 1,1,2,2-tetrachloroethane and others.

Based upon the information reviewed, the DTML 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 the use of private wells) to benzene, chlorinated benzenes, tetrachloroethylene, vinyl chloride and possibly lead; and 2) toxicological evaluation of lead indicating a health hazard to the developing fetus and young children. The exposure pathway through private wells adjacent to the landfill was interrupted through the provision of alternate water sources and extension of the community water supply in 1991. Therefore, the DTML site is considered to represent **no apparent public health hazard at present**. However, the nature and

extent of the DTML groundwater contamination plume is currently under investigation, and the status of the DTML as a continuing source of groundwater contamination has not been determined. The potential for a future exposure pathway associated with the use of private potable wells down-gradient of the DTML site may be determined by the results of the on-going Remedial Investigation. Should NJDHSS or ATSDR become aware of information indicating that DTML-related exposure is occurring, this determination will be reconsidered.

The contamination of Silverton private wells is categorized as a **public health hazard because of past exposures**. This determination is based on the following considerations, taken together: 1) the presence of a completed exposure pathway in the past (through the use of private wells) to methylene chloride, 1,2-dichloroethane, chloroform, carbon tetrachloride, 1,2-dichloropropane, trichloroethylene (TCE), 1,1,2,2-tetrachloroethane, benzene and chlorobenzene; 2) toxicological evaluations indicating a public health hazard because of adverse non-carcinogenic effects of exposures to carbon tetrachloride and an estimated low increased cancer risk from exposure to several volatile organic chemicals; 3) epidemiologic studies in other populations suggesting that exposure to benzene and TCE may increase the risk of certain cancers; and 4) the presence of an excess of childhood cancers in the community. Because the exposure pathway has been interrupted for the wells studied in this investigation, there is **no public health hazard at present**.

The past completed human exposure pathway associated with the Silverton Private Well Contamination Investigation was of sufficient public health significance to warrant consideration of this pathway in the on-going epidemiological study of childhood cancer incidence in Dover Township.

The Public Health Assessment for the DTML site and the Silverton Private Well Contamination Investigation 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.

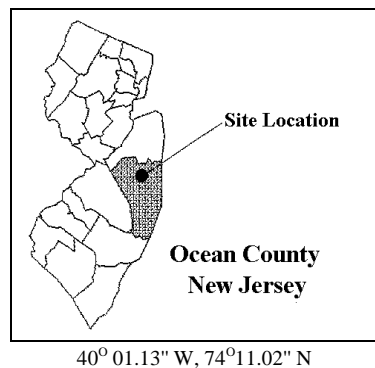
## Purpose and Health Issues

As part of the Public Health Response Plan (PHRP) developed by the 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 evaluate the public health significance of human exposure associated with the Dover Township Municipal Landfill and the Silverton Private Well Contamination Investigation.

## Background

### Demography and Land Use

The Dover Township Municipal Landfill (DTML) site is located in Dover Township, Ocean County, New Jersey (see inset). The site is bounded by the Garden State Parkway and North Bay Avenue on the west and Silverton Road and Church Road on the north and south, respectively (Figure 1; see Appendix for figures). The DTML site occupies an area of approximately 91 acres, with the landfill itself occupying approximately 22 acres (Block 231, Lots 7 and 10). The environs of the site are primarily residential in nature with light commercial use, with the Ocean County College located 1 mile to the southeast. The DTML site is mounded to approximately 100 feet above the level of the Garden State Parkway with wooded areas to the north and west. There are one and two story structures immediately adjacent to the site, occupied by the Township of Dover which maintains a public works yard and recycling facility on the property. The DTML lies approximately 8 miles west of the Atlantic Ocean, with the maximum elevation of the site approximately 150 feet above mean sea level. The site exhibits a slope toward the southeast. The DTML is located within the outcrop area of the Cohansey Formation, with some thin layers of younger formations capping the Cohansey. The soils at the site consist of quartz gravel and sand which exhibit a relatively high percolation rate.



The Kirkwood-Cohansey aquifer underlies the DTML site, and is characterized by sand with occasional clay and gravel lenses. It has a depth of approximately 235 feet. The water table at the site is about 20 feet below the normal grade. Groundwater in the area of the DTML site flows generally eastward toward Silverton, with potential contaminants (for example, benzene) having been estimated by the New Jersey Department of Environmental Protection (NJDEP) to travel at up to approximately 1.6 feet/day (Montgomery, 1990). The Kirkwood-Cohansey aquifer is extensively utilized as a potable water source in Dover Township by both private and community supply wells. Groundwater in the area of the DTML site is acidic (median pH = 5.6), 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 2. Within a one mile radius of the DTML site, there is a population of approximately 6,182 persons who live in 3,547 housing units/residences.

### **Site History**

The DTML operated from 1956 through 1981, and received approximately 960 tons of waste per week at its peak of operations. In May 1970, the New Jersey Solid Waste Management Act (N.J.S.A. 13:1E-1 et seq.) gave the NJDEP regulatory oversight of the DTML. The DTML was then certified by the NJDEP to accept household, commercial, industrial, and other waste classes, and received wastes from numerous sources.

In 1971, the Union Carbide Corporation (UCC) entered into a contract with an independent waste removal contractor to remove 55 gallon drums of chemical wastes from the UCC Bound Brook facility and transport them to the DTML for disposal (Ghassemi, 1976). Between March and December 1971, 5,000 to 6,000 UCC drums labeled as containing organic wash solvents, still bottoms, and residues from the manufacture of plastics and resins were removed by the contractor for disposal. Of the 5,000 to 6,000 drums removed by the waste removal contractor, approximately 4,500 were reportedly accounted for on the nearby Reich Farm property (see Figure 3). Some or all of the remainder of the drums removed from the UCC facility were assumed by the U.S. Environmental Protection Agency (USEPA) to have been deposited in the DTML. On April 1, 1971, a UCC representative verified the initial deposition of drums into the DTML (Ghassemi, 1976).

In 1978, as part of a continuation and expansion plan for the DTML, the NJDEP authorized the construction of six monitoring wells and methane gas vents, and the institution of operational controls and closure methods. At that time, waste classes permitted to be deposited into the DTML were restricted to household, commercial, institutional, and vegetation debris.

In 1982, lead, arsenic, and VOCs were detected in groundwater from on-site monitoring wells (Przywara, 1982). The Township of Dover retained the BCM Corporation in early 1988 to conduct a hydrogeologic investigation of the DTML under the supervision of the NJDEP (BCM, 1987; BCM, 1988). Sampling of the DTML monitoring wells has been conducted on a quarterly basis (Shannon, 1991).

The number and the physical condition of the UCC drums which were deposited into the DTML is not known.

### **Health Assessment Activity Summary**



As part of the activities performed for this Public Health Assessment, the ATSDR and the NJDHSS have reviewed private well data associated with the NJDEP's DTML/Silverton Road Groundwater Investigation (1987 to 1989), which examined wells close to the DTML, and the Silverton Private Well Contamination Investigation (1982), which examined wells to the east and down-gradient of the DTML. In addition, in support of this Public Health Assessment, the ATSDR and the NJDHSS have conducted an exposure investigation of potentially affected private potable wells in these areas to determine current groundwater quality. Figure 4 presents the approximate locations of private wells associated with the DTML (and the Reich Farm site) sampled by the NJDHSS in 1997 during the groundwater phase of the exposure investigation.

There have been no previous activities by the NJDHSS or the ATSDR at the DTML site or associated study areas prior to the activities conducted in the preparation of this Public Health Assessment.

### **Site Visits**

Staff of the NJDHSS and the ATSDR performed multiple visits of the DTML and other locations within Dover Township during 1996, 1997, 1998, and 1999.

### **Community Concerns**

Members of the community have expressed to the NJDHSS and the ATSDR a high degree of concern regarding the quality of private wells directly adjacent to the DTML (DTML/Silverton Road Groundwater Investigation) and private wells located in the Silverton section of the Township (Silverton Private Well Contamination Investigation). Although the NJDEP has not considered the private well contamination in the Silverton section of Dover Township to be related to the DTML, the concerns of the community over the possibility of this relationship, together with the public health significance of the contaminant levels, have led to this public health evaluation of the data.

Residents of Dover Township have 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, prompting 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 Reich Farm site and the Ciba-Geigy Corporation site; subsequently, the NJDHSS and the ATSDR added a third Public Health Assessment for the DTML site. 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 Dover Township Municipal Landfill and the Silverton Private Well Contamination Investigation 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**

This Public Health Assessment will evaluate the public health significance of past private well contamination associated with the DTML, as documented during the DTML/Silverton Road Groundwater Investigation. It will also evaluate the results of the Silverton Well Private Well Investigation and current private well data from the area collected by the NJDHSS and the ATSDR in 1997.

### **Discussion**

This Discussion will review the history of remedial activities conducted in relation to the DTML site and to private wells in the Silverton section of Dover Township, and the findings of investigations of environmental contamination. Based on these findings, an analysis of exposure pathways will be presented. At this time, available information is limited to the potential for exposure to contaminated groundwater. Therefore, this Public Health Assessment will only discuss this pathway. The Discussion will conclude with an assessment of the public health implications of completed exposure pathways.

## **Remedial History**

### **DTML/Silverton Road Groundwater Investigation**

In 1987, the NJDEP began to collect groundwater quality data from 27 private potable wells along Silverton Road, an area immediately adjacent to the DTML (see Figure 1). This area was originally classified in 1974 as potentially threatened by groundwater contamination (Ghassemi, 1976). Wells in this area utilize the Cohansey Aquifer, and average 70 to 90 feet in depth. One-third of the wells sampled by NJDEP exhibited contamination with volatile organic chemicals (VOCs) similar to those compounds detected in DTML monitoring wells (NJDEP, 1990). As a result of the impact of the DTML upon private wells in the area of the site, the NJDEP determined there was sufficient evidence to warrant the capping of the impacted residential wells and extension of community water service to the affected area under the New Jersey Spill Fund Act (N.J.S.A. 58:10-23.11 et seq.) (Mack, 1990).

A Preliminary Assessment of the DTML has been conducted by a contractor for Dover Township with the oversight of the NJDEP (Raviv, 1997a). A geophysical survey identified possible locations of UCC drums within the landfill. A Remedial Investigation is currently underway by the contractor for Dover Township (Raviv, 1997b).

### **Silverton Private Well Contamination Investigation**

The Silverton Private Well Contamination Investigation site is located in the Silverton section of Dover Township (see Figures 1 and 5). The NJDEP investigated a groundwater contamination plume affecting private wells located on Mount Lane, Larch Drive, and Beechtree Drive. According to the Ocean County Health Department (OCHD) and Silverton residents, wells in this area utilize the Cohansey Aquifer and tend to be relatively shallow, averaging 60 to 80 feet in depth. In June 1981, the OCHD began to receive complaints from residents in Silverton regarding chemical tastes and odors in private well water. The source of the contamination was thought by the NJDEP and the OCHD to have originated from a leaking underground storage tank. The NJDEP inspected all gasoline stations in the vicinity, but an inventory showed that none were missing product, and no potential sources of the contamination were identified at the time (NJDEP, 1981).

In February 1982, the NJDEP issued an Administrative Order directing Dover Township to expedite the connection of affected residences to the community water supply, and to cap contaminated private wells (Schiffman, 1982). In April 1982, 78 private wells were capped and the community water supply was extended to the residences. The New Jersey Spill Compensation Fund was used to cover the costs of installing the water lines to affected residences.

Throughout the period from 1982 to 1989, the NJDEP installed and sampled monitoring wells in the Silverton area (Diaz, 1985). These monitoring wells continued to indicate the presence of benzene, xylene, 1,2-dichloroethane, and chloroform, but a source of the groundwater

contamination was never established by the NJDEP.

## **Environmental Contamination**

### **DTML/Silverton Road Groundwater Investigation, 1988**

In 1982, VOCs (benzene, xylenes, toluene, and ethylbenzene) were first measured in on-site monitoring wells (Przywara, 1982). Between 1987 and 1989, the NJDEP detected VOCs in the DTML monitoring wells (summarized in Table 1 in Appendix). Volatile organic contaminants included benzene, chlorobenzene, dichlorobenzenes, methylene chloride, and naphthalene. Lead and arsenic were also found in the monitoring wells.

In 1990, the NJDEP issued the “Silverton Road Private Wells Ground-Water Impact Area Report,” which presented analytical data for twenty-seven private wells sampled by the NJDEP from 1987 to 1989 (NJDEP, 1990). These wells were described by the NJDEP as being affected by off-site migration of contaminants emanating from the DTML. The contaminated wells were located along Silverton Road. Nine of the wells exhibited contamination with volatile organic compounds and/or lead. Table 2 summarizes the contaminant levels found during this investigation. Six of the wells contained one or more of the following contaminants at levels exceeding health comparison values: benzene, tetrachloroethylene (also known as perchloroethylene, or PCE), vinyl chloride and lead. (See Appendix A for a definition and description of the use of comparison values.)

The “Pathways Analysis” and “Public Health Implications” sections of this Public Health Assessment evaluate the public health significance of the private well water data generated during the DTML/Silverton Road Groundwater Investigation.

### **Silverton Private Well Contamination Investigation, 1982**

In January and February 1982, the OCHD and the NJDEP sampled private potable wells in the Silverton section of Dover Township. The majority of the wells were located on Mount Lane, Larch Drive, and Beechtree Drive (Figure 5). Twenty wells (designated as “well A” through “well T” in Table 3) exhibited contamination with VOCs. Table 3 summarizes the data generated during this investigation (Diaz, 1985). Sixteen of these 20 wells contained at least one of the following contaminants at levels exceeding comparison values: methylene chloride, 1,2-dichloroethane, chloroform, carbon tetrachloride, 1,2-dichloropropane, trichloroethylene (TCE), 1,1,2,2-tetrachloroethane, benzene and chlorobenzene.

The “Pathways Analysis” and “Public Health Implications” sections of this Public Health Assessment evaluate the public health significance of the data generated during the Silverton Private Well Contamination Investigation.

### **NJDHSS/ATSDR Groundwater Investigation, 1997**

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. One part of the exposure investigation was an effort to supplement existing data on groundwater quality by sampling private wells in the Township in 1997. A summary of the exposure investigation will be provided separately, but information from the private well testing that is relevant to the DTML site and the Silverton section is also presented here.

A total of fifty-four private wells were sampled by the NJDHSS from February through May 1997. Of these, twenty were located in areas pertinent to the Reich Farm and DTML health assessment study areas (Figure 4). Analyses were performed utilizing USEPA standard 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 in this area, four contained chloroform in the range of 0.4 to 4.0 micrograms per liter ( $\mu\text{g/l}$ ), below the ATSDR comparison value (Cancer Risk Evaluation Guide: 6  $\mu\text{g/l}$ ) and the drinking water Maximum Contaminant Level (MCL) of 100  $\mu\text{g/l}$  for trihalomethanes, a group of chemicals to which chloroform belongs. Chloroform is not considered to be a DTML site-related contaminant.

Eighteen of these 20 wells contained lead (range: 1.5 to 27.4  $\mu\text{g/l}$ ) (NJDHSS, 1996-2000, Volumes 68 to 81). The presence of lead is not considered to be DTML-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 naturally occurring radium isotopes in groundwater. The presence of radium in the Cohansey aquifer is a phenomenon not associated with the DTML 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.

### **NJDHSS/ATSDR Monitoring Well Analyses, 1999 - 2000**

In June 1999, 10 of the 16 monitoring wells on site at DTML (and two private wells immediately adjacent to the site) were sampled for VOCs, semi-volatile organic chemicals (SVOCs), and metals. Split samples were taken by NJDHSS and Dan Raviv Associates, Inc. (contractor for Dover Township). Analyses were conducted by the NJDHSS and Lancaster Laboratories (for Dan Raviv Associates).

NJDHSS analyses showed that five of the ten sampled monitoring wells contained benzene (up to 8  $\mu\text{g/l}$ ) and chlorobenzene (up to 44  $\mu\text{g/l}$ ) at concentrations in excess of the drinking water MCLs (1 and 4  $\mu\text{g/l}$ , respectively). In addition, 4 of the 10 sampled wells were found to contain up

to 4.25 µg/l styrene-acrylonitrile (SAN) trimer. SAN trimer is an indicator of UCC wastes deposited at the DTML. Three of the 10 sampled monitoring wells showed cadmium in excess of the drinking water MCL (5 µg/l), and low levels of lead (up to 2.0 µg/l). The two private wells that were sampled showed low levels (less than the Action Level of 15 µg/l) of lead (up to 7.7 µg/l). Results from the NJDHSS and Lancaster Laboratories were generally consistent.

In September 2000, after installation of 14 new monitoring wells, 11 well samples (on- and off-site) were split by NJDHSS and Dan Raviv Associates, Inc. and analyzed for VOCs, SVOCs (including SAN trimer), and metals. The NJDHSS analyses showed that three (all on-site) samples contained benzene at concentrations up to 2.7 µg/l (in excess of the drinking water MCL (1 µg/l), and chlorobenzene at concentrations up to 20 µg/l (in excess of the MCL of 4 µg/l). Two sampled monitoring wells showed cadmium in excess of the drinking water MCL (5 µg/l). Eight of the wells showed low levels of lead (up to 8.0 µg/l) below the Action Level ( 15 µg/l). No SAN trimer was detected in any of the wells split-sampled and analyzed by NJDHSS. These data are presented in detail in a separate summary prepared by the NJDHSS and the ATSDR.

### **Pathways Analysis**

To determine whether residents of Dover Township were or are exposed to contaminants migrating from the DTML site, the ATSDR and the NJDHSS evaluate the environmental and human components that lead to exposure. 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 further analysis 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.

### **DTML/Silverton Road Groundwater Investigation**

The ATSDR and the NJDHSS have determined that a completed human exposure pathway to DTML-related groundwater contaminants existed in the past through the domestic use of private wells on Silverton Road near the landfill. Exposure may have occurred through ingestion, inhalation or dermal contact, depending on water use patterns and volatility of contaminants. Documented contaminants in the pathway include benzene, chlorobenzene, dichlorobenzenes, PCE, vinyl chloride and lead. Benzene, chlorobenzene, dichlorobenzenes and lead were also found in on-site monitoring wells.

The presence of contaminants was documented between 1987 and 1989. Based upon an assumed discharge from the DTML occurring in 1971, and compound-specific migration rates calculated by the NJDEP, wells may have been contaminated with benzene as early as 1973, or with PCE by 1977 (Montgomery, 1990). Lead was found in samples of all six of the on-site monitoring wells; it also occurred in several private potable wells in conjunction with other site-related contaminants. This information suggests that the lead in the private wells was site-related, at least in part. Other sources of lead contamination of private wells have been observed in Dover Township. 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. It is not possible to determine to what degree, these or other sources may have contributed to the documented levels of lead contamination. The exposure to VOCs and lead through this pathway was interrupted in 1991 when New Jersey Spill Fund claims financed the voluntary connection of the community water supply to affected residences in the area adjacent to the landfill.

The total number of persons associated with this past exposure pathway based upon the number of households is estimated to be approximately 23 (nine residences times 2.5 persons per residence) (ATSDR, 1992a). The NJDHSS/ATSDR exposure investigation did not indicate the presence of VOC or semi-volatile organic chemical contaminants in private wells sampled in the area.

The following table summarizes the completed human exposure pathway for the DTML/Silverton Road Groundwater Investigation area:

Completed Human Exposure Pathway Associated with the Dover Township Municipal Landfill						
Pathway Name	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposed Population	Contaminants (Time Documented)
DTML/ Silverton Road Private Wells	DTML	Groundwater	Residences with private wells	Ingestion, dermal contact, inhalation	Residents (Estimated 23 persons)	VOCs and Lead (1987)

The nature and extent of the DTML groundwater contamination plume is currently under investigation. Furthermore, the status of the DTML as a continuing source of groundwater contamination has not been determined. Therefore, there is a potential future exposure pathway associated with the use of private potable wells down-gradient of the DTML site.

#### **Silverton Private Well Contamination Investigation**

The ATSDR and the NJDHSS have determined that a completed human exposure pathway to groundwater contaminants existed in the past through the domestic use of private wells in the Silverton section of Dover Township. Exposure may have occurred through ingestion, inhalation or dermal contact, depending on water use patterns and volatility of contaminants. Contaminants in the pathway at levels above comparison values include methylene chloride, 1,2-dichloroethane, chloroform, carbon tetrachloride, 1,2-dichloropropane, TCE, 1,1,2,2-tetrachloroethane, benzene and chlorobenzene.

Contamination of private wells was first documented in June 1981 in response to taste and odor complaints, but may have existed for an unknown amount of time before then, as contaminants increased to a noticeable level. The pathway was interrupted at the time that community water supplies were extended to affected residences beginning in April 1982.

The NJDHSS and the ATSDR could not address the community's concern that groundwater contamination in the Silverton section was associated with the DTML, because of uncertainty of the following factors: the source or sources of the contaminants; times of contamination; and the direction and velocity of groundwater and contaminant flow. However, if the DTML was a source, contaminant migration rates estimated by the NJDEP suggest that the most mobile compounds (benzene, 1.6 feet/day) might have taken as much as approximately 13 years to travel the approximately 8,000 feet between the DTML and the Silverton section private wells.

The total number of persons associated with this past exposure pathway based upon the number of households is estimated to be approximately 50 (20 residences times 2.5 persons per



residence) (ATSDR, 1992a). The NJDHSS/ATSDR exposure investigation did not indicate the presence of VOC or SVOC contaminants in private wells sampled in the area.

The following table summarizes the completed human exposure pathway for the Silverton Private Well Contamination Investigation area:

Completed Human Exposure Pathway Associated with the Silverton Private Well Contamination Investigation						
Pathway Name	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposed Population	Contaminants (Time Documented)
Silverton Private Wells	Unknown	Groundwater	Residences with private wells	Ingestion, dermal contact, inhalation	Residents (Estimated 50 persons)	VOCs (1981)

### **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 at levels above health-based comparison values in both the DTML/Silverton Road Groundwater Investigation and the Silverton Private Well Contamination Investigation. The NJDHSS and the ATSDR 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.

#### **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 to interrupt the private well exposure pathways, it is clear that wells along Silverton Road adjacent to the DTML and in the Silverton section of Dover Township were contaminated with various VOCs and lead (for the Silverton Road private wells only) for an undetermined length of time. Wells in the Silverton section of Dover Township were contaminated as early as 1981, when taste and odor problems were first reported. As previously indicated, the well contamination along Silverton Road is likely to be a result of contaminants migrating in groundwater from the DTML. However, the source of contamination of the private wells in the Silverton section of Dover Township is not known.

### *DTML/Silverton Road Groundwater Investigation*

Between 1987 and 1989, nine private wells along Silverton Road were found to be contaminated with various VOCs. Of these nine wells, water from six of the wells contained either benzene, tetrachloroethylene, or vinyl chloride slightly exceeding health-based comparison values (wells D, E, F, G, H and I -- see Table 2). Because the levels found were close to the comparison values, a toxicological evaluation of these contaminants, taken on an individual basis, would not indicate that an adverse carcinogenic or non-carcinogenic health effect is likely from past exposure to persons consuming water from these wells (ATSDR 1997a, 1997b, and 1997c). However, this evaluation is based only on one round of sampling, and there remains uncertainty as to the duration and levels of exposure that residents along Silverton Road may have experienced before their wells were tested.

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 VOC exposures to combinations of contaminants detected in private wells D, E, F, G, H, and I along Silverton Road are not likely to lead to adverse health effects.

Lead was detected in four private wells (Wells D, E, G and H -- see Table 2) at concentrations ranging from 6 to 161 µg/l. Lead is toxic to the nervous system, particularly in the fetus and young children whose nervous systems are undergoing rapid development (ATSDR, 1993a). To protect against the neurotoxic effects of lead, the USEPA has established an Action Level of 15 µg/l for lead in drinking water for community water systems. As indicated in Table 2, water from three wells contained lead concentrations well in excess of the Action Level. If the above lead concentrations in well water were sustained throughout the day, they could pose a public health hazard, particularly to a developing fetus or a young child.

*Silverton Private Well Contamination Investigation*

As seen from Table 3, 16 of the 20 private wells sampled in the Silverton section of Dover Township exhibited contamination above health-based comparison values. Five of these wells (Wells D, F, J, R and T) had levels of contaminants (either benzene, chloroform or carbon tetrachloride) that were similar to their respective health-based comparison values. A toxicological evaluation of these contaminants, taken on an individual basis, would not indicate that an adverse carcinogenic or non-carcinogenic health effect is likely from past exposures to persons consuming water from these five private wells (ATSDR 1994a; ATSDR, 1997b; ATSDR, 1997d). This evaluation does not account for the possibility of the effects of combinations of contaminants. However, as discussed above, the available research indicates that exposures to these mixtures were well below their respective toxicologic thresholds. Therefore, past exposure to residents using these five wells are not likely to lead to adverse health effects. However, as with the DTML/Silverton Road well contamination evaluation above, this evaluation is based only on one round of sampling. Therefore, there remains uncertainty as to the duration and levels of exposure that residents of the Silverton Private Well Contamination Investigation Area may have experienced before their wells were tested.

In eight of the Silverton wells (A, B, C, G, I, L, N and O), the concentrations of carbon tetrachloride exceeded comparison values for intermediate and chronic exposure duration (ATSDR, 1994a). In several of these wells, the carbon tetrachloride concentration also exceeded the 10-day USEPA Health Advisory level (200 µg/l). Since these wells were used as a drinking water source for one year or more, the NJDHSS and the ATSDR conclude that past use of these eight wells could have posed a public health hazard for potential adverse non-carcinogenic health effects.

Carbon tetrachloride is metabolized in the liver to a free radical intermediate by the cytochrome P-450 enzyme system. This reactive intermediate can bind to cellular macromolecules resulting in damage to the liver (ATSDR, 1992b). Because the toxicity of carbon tetrachloride is dependent on the action of the cytochrome P-450 enzyme system, other chemicals that activate this enzyme system can increase the toxicity of carbon tetrachloride. Such chemicals can include certain medications (such as barbiturates), chlorinated insecticides (such as DDT), and halogenated industrial chemicals (such as polychlorinated biphenyls). In addition, it has been demonstrated that alcohol use or poorly controlled diabetes can increase the risk of carbon tetrachloride toxicity (ATSDR, 1992b).

Of the chemicals found in the Silverton wells, the non-carcinogenic toxicity of carbon tetrachloride was of greatest concern. In addition, all of the wells that contained elevated levels of carbon tetrachloride, also contained elevated levels of other chlorinated VOCs, such as methylene chloride, 1,2-dichloroethane, chloroform, 1,2-dichloropropane, TCE, and 1,1,2,2-tetrachloroethane. These chlorinated volatile organic chemicals are metabolized by the liver and excreted by the kidneys. Hence, these organs are often the target for toxic effects caused by exposure to these chemicals (ATSDR, 1989; ATSDR, 1993b; ATSDR, 1994b; ATSDR, 1996; ATSDR, 1997d; ATSDR, 1997e).

While it is not possible to quantify the effect of concurrent exposure to mixtures of these chemicals, at the levels found, it is possible that the cumulative toxicity of exposure to the contaminated water would increase.

Several chemicals classified as known or probable human carcinogens were found in the Silverton wells. Benzene, found at levels up to 609 µg/l, is classified as a human carcinogen by the USEPA, based on epidemiologic data. Carbon tetrachloride, chloroform, methylene chloride, 1,2-dichloroethane and TCE have been classified as probable human carcinogens by the USEPA and/or the International Agency for Research on Cancer (ATSDR, 1993b; ATSDR, 1994a; ATSDR, 1994b; ATSDR, 1997d; IARC, 1995), based primarily on experimental evidence that exposure to high doses can cause cancer in laboratory animals. The NJDHSS and ATSDR calculated estimates of the upper limit of cancer risk associated with exposures that occurred to adults and children, based on the maximum levels of the above contaminants found in the Silverton wells and the USEPA cancer slope factors. Assuming an approximate one year duration of exposure, the results of this evaluation indicate that there is a low increased risk of cancer in both adults and children (ATSDR, 1992a). However, there is uncertainty in estimations of this kind since the duration and historical levels of exposure are not known.

Because of the excess incidence of childhood cancers in Dover Township, a specific discussion of contaminants at either the DTML/Silverton Road or the Silverton Private Well Investigation area that have been associated with leukemias and/or childhood cancers follows. Benzene was found in both private well investigation areas, PCE was found only in the DTML/Silverton Road investigation (in private wells but not site monitoring wells), and TCE was found only in the Silverton Private Well Investigation area.

#### *Benzene*

Occupational exposure to benzene and benzene-containing mixtures can result in damage to the blood-forming system (ATSDR, 1997b). Several studies of rubber workers have shown an increased risk of acute myelogenous leukemia and possibly other cancers. Experimental animal studies also indicate that high-level benzene exposure can lead to the development of multiple tumor types. It is not known what effects exposure to benzene might have on the developing human fetus. Studies with pregnant animals show that breathing benzene has harmful effects on the developing fetus. These effects include low birth weight, delayed bone formation and bone marrow damage (ATSDR, 1997b). Although some of the residents in the Silverton area who used benzene-contaminated well water for drinking and household uses were exposed to benzene at levels of public health concern for cancer effects, the exposure levels in the occupational epidemiologic studies were much higher than those experienced by residents.

#### *TCE and PCE*

Following long-term, high level exposure, TCE has been shown to produce liver cancer in

mice and kidney and testicular tumors in rats (ATSDR, 1997e; 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, 1997e).

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 and non-Hodgkin's lymphoma (IARC, 1995; ATSDR, 1997e). 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).

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 at the U.S. Marine Corps Base at Camp LeJeune, North Carolina (ATSDR, 1997f). Decreased mean birth weight and increased small for gestational age babies were reported for two potentially susceptible subgroups: infants of mothers older than 35 years of age and infants of mothers with histories of fetal death. 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 and PCE, 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**

Based on a weight-of-evidence analysis of the health and environmental information compiled, each Public Health Assessment assigns a hazard category (see Appendix B) 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.

### **Hazard Category for the Dover Township Municipal Landfill**

Based upon the information reviewed, the Dover Township Municipal Landfill 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 the use of private wells) to benzene, chlorinated benzenes, PCE, vinyl chloride and lead; and 2) toxicological evaluation of lead indicating a health hazard to the developing fetus and young children.

While a toxicological evaluation of the volatile organic contaminants in private wells, taken on an individual basis, would not indicate that an adverse carcinogenic or non-carcinogenic health effect is likely from past exposures, this evaluation is based on only one round of sampling and a limited suite of analytical methods. There remains uncertainty as to the duration, nature, and levels of exposure that residents may have experienced before their wells were tested. The exposure pathway through private wells adjacent to the landfill was interrupted through the provision of alternate water sources and extension of the community water supply in 1991.

The DTML site is considered to represent **no apparent public health hazard at present** due to the absence of a current completed human exposure pathway. However, the nature and extent of the DTML groundwater contamination plume is currently under investigation, and the status of the DTML as a continuing source of groundwater contamination has not been determined. The potential for a future exposure pathway associated with the use of private potable wells down-gradient of the DTML site may be determined by the results of the on-going Remedial Investigation.

## **Hazard Category for the Silverton Private Well Contamination Investigation Area**

The contamination of Silverton private wells is categorized as a **public health hazard because of past exposures**. This determination is based on the following considerations, taken together: 1) the presence of a completed exposure pathway in the past (through the use of private wells) to methylene chloride, 1,2-dichloroethane, chloroform, carbon tetrachloride, 1,2-dichloropropane, TCE, 1,1,2,2-tetrachloroethane, benzene and chlorobenzene; 2) toxicological evaluations indicating a public health hazard because of adverse non-carcinogenic effects of exposures to carbon tetrachloride and an estimated low increased cancer risk from exposure to several VOCs; 3) epidemiologic studies in other populations suggesting that exposure to benzene and TCE may increase the risk of certain cancers; and 4) the presence of an excess of childhood cancers in the community. Because the exposure pathway has been interrupted for the wells studied in this investigation, there is **no public health hazard at present**.

There was insufficient information available to the NJDHSS and the ATSDR to address the community's concern that groundwater contamination in the Silverton Private Well Contamination Investigation area was associated with the DTML.

The past completed human exposure pathway associated with the Silverton Private Well Contamination Investigation was of sufficient public health significance to warrant consideration of this pathway in the on-going epidemiological study of childhood cancer incidence in Dover Township.

## **Recommendations**

### **Cease/Reduce Exposure Recommendations**

#### **Dover Township Municipal Landfill**

Based upon available information, the areas along Silverton Road and in the Silverton section of Dover Township, which have exhibited groundwater contamination in the past, should remain well restriction zones with regard to the Cohansey aquifer.

### **Site Characterization Recommendations**

#### **Dover Township Municipal Landfill**

During the conduct of the DTML Remedial Investigation, environmental media should be analyzed using laboratory methods sensitive to the potential contaminant profile present at the DTML, to fully characterize the nature and extent of groundwater contamination associated with the site.

The potential for future contaminant release to groundwater should be considered during the Remedial Investigation. Because of the presence of private potable wells down-gradient of the DTML, long term protection of groundwater quality should be ensured. Proposals for remedial activity at the DTML should be reviewed by the NJDHSS and/or the ATSDR for potential public health implications.

### **Public Health Recommendation**

Based upon review of the completed human exposure pathway in the Silverton section of Dover Township, and in conjunction with the concerns of the community regarding the incidence of childhood cancer, exposure through this pathway should be examined in the on-going epidemiologic investigation by the NJDHSS and the ATSDR.

### **Public Health Action Plan**

The Public Health Action Plan (PHAP) for the Dover Township Municipal Landfill 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 ATSDR/NJDHSS:**

##### **Dover Township Municipal Landfill**

- 1) The NJDHSS and the ATSDR have evaluated public health concerns regarding potential human exposure pathways associated with the DTML/Silverton Road Groundwater Investigation.
- 2) The NJDHSS has reviewed a Preliminary Assessment report and Remedial Investigation Workplan for the DTML (Raviv, 1997a; Raviv, 1997b) and has offered commentary regarding sampling protocols and public health concerns through the NJDEP.
- 3) The NJDHSS has acquired split samples of monitoring wells sampled during the DTML Remedial Investigation. The NJDHSS Laboratory has analyzed the samples using methods capable of detecting potential site-related contaminants.

##### **General**



*Public Health Assessment: Dover Township Municipal Landfill*

- 1) The NJDHSS and the ATSDR have evaluated public health concerns regarding potential human exposure pathways associated with the Silverton Private Well Contamination study area.
- 2) Results of private well analyses have been communicated to participants in the groundwater testing phase of the exposure investigation. The NJDHSS has provided assistance in interpreting data where necessary. In addition, the NJDHSS has provided educational material regarding the health issues and possible mitigative measures associated with exposure to lead and radiological activity to the appropriate participants.
- 3) 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.
- 4) The NJDHSS and the ATSDR are conducting an epidemiologic study of childhood cancers in Dover Township. The study will examine whether environmental exposures (including but not limited to completed human exposure pathways associated with groundwater contamination in the Silverton section) and other risk factors are associated with the incidence of these diseases. An Interim Report of the study was released in December 1999.
- 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 Resource Guides for Health Care Providers to approximately 100 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

*Public Health Assessment: Dover Township Municipal Landfill*

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 ATSDR/NJDHSS:**

**Dover Township Municipal Landfill**

- 1) The ATSDR and the NJDHSS will work with the NJDEP to provide a public health review of data generated during the site Remedial Investigation to further evaluate the public health significance of the DTML site.

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

**Certification**

*Public Health Assessment: Dover Township Municipal Landfill*

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**

*Public Health Assessment: Dover Township Municipal Landfill*

## **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  $1 \times 10^{-6}$ ). 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**

*Public Health Assessment: Dover Township Municipal Landfill*

**ATSDR's Interim Public Health Hazard Categories**

Category / Definition	Data Sufficiency	Criteria
<p><b>A. Urgent Public Health Hazard</b></p> <p>This category is used for sites where short-term exposures (&lt; 1 yr) to hazardous substances or conditions could result in adverse health effects that require rapid intervention.</p>	<p>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.</p>	<p>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.</p>
<p><b>B. Public Health Hazard</b></p> <p>This category is used for sites that pose a public health hazard due to the existence of long-term exposures (&gt; 1 yr) to hazardous substance or conditions that could result in adverse health effects.</p>	<p>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.</p>	<p>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.</p>

Public Health Assessment: Dover Township Municipal Landfill

Category / Definition	Data Sufficiency	Criteria
<p><b>C. Indeterminate Public Health Hazard</b></p> <p>This category is used for sites in which “critical” data are <i>insufficient</i> with regard to extent of exposure and/or toxicologic properties at estimated exposure levels.</p>	<p>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.</p>	<p>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.</p>
<p><b>D. No Apparent Public Health Hazard</b></p> <p>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.</p>	<p>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.</p>	<p>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.</p>
<p><b>E: No Public Health Hazard</b></p> <p>This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard.</p>	<p>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</p>	

\* 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**



*Public Health Assessment: Dover Township Municipal Landfill*



Public Health Assessment: Dover Township Municipal Landfill

**Table 2** Contaminant levels, private potable wells, sampled 1987 to 1989. DTML/Silverton Road Groundwater Investigation.

Compound (µg/l)	Private Potable Wells									Comparison Value
	A	B	C	D	E	F	G	H	I	
Chlorobenzene	ND	ND	ND	ND	27.4 (c)	28.8 (c)	16 (b)	3.3 (b)	7 (c)	50 (MCL)
Benzene	ND	ND	ND	ND	4.5 (c)	11.1 (d)	4.4 (g)	2.2 (h)	1.5 (c)	1 (MCL)
Tetrachloroethylene	ND	ND	ND	5.7 (b)	ND	ND	ND	4.5 (b)	ND	0.7 (CREG)
Trans-1,2-Dichloroethylene	ND	ND	ND	ND	ND	ND	ND	1.3 (h)	ND	100 (MCL)
p-Dichlorobenzene	ND	ND	ND	ND	2.3 (c)	2.4 (c)	1.5 (b)	ND	1.1 (c)	75 (MCL)
o-Dichlorobenzene	ND	ND	ND	ND	0.5 (c)	0.6 (c)	ND	ND	ND	600 (MCL)
1,2,4-Trichlorobenzene	0.3 (a)	ND	ND	ND	ND	ND	ND	ND	ND	9 (MCL)
Toluene	ND	ND	ND	ND	ND	ND	6 (g)	ND	ND	1000 (MCL)
Chloroform	1.7 (a)	3.3 (a)	1.5 (a)	0.8 (a)	ND	ND	ND	ND	ND	6 (CREG)
Xylenes	ND	ND	ND	ND	ND	20.4 (e)	11 (e)	6.2 (h)	ND	1,000 (MCL)
Vinyl chloride	ND	ND	ND	ND	ND	0.3 (f)	ND	ND	ND	0.2 (Child EMEG)
Lead	ND	ND	ND	6 (b)	161 (b)	ND	60 (i)	80 (c)	ND	15 (AL)

Source: NJDEP, 1990

Sample Dates: a = 10/4/88; b = 9/9/87; c = 10/12/88; d = 6/18/87; e = 6/24/87; f = 10/11/88; g = 6/4/87; h = 6/30/87; i = 7/27/89

MCL Maximum contaminant level  
 CREG Cancer risk evaluation guide  
 ND Not detected  
 EMEG Environmental media evaluation guide  
 AL Action level

Public Health Assessment: Dover Township Municipal Landfill

**Table 3** Silverton Private Well Contamination Investigation

Compound µg/l	Well A	Well B	Well C	Well D	Well E	Well F	Well G	Comparison Value
	Sample Date 1/18/82	Sample date 1/20/82	Sample Date 1/20/82	Sample Date 1/18/82	Sample Date 1/18/82	Sample Date 1/18/82	Sample Date 1/30/82	
Methylene Chloride	<b>46.0</b>	<b>23.0</b>	<b>20.0</b>	ND	ND	ND	ND	2 (MCL)
1,2-Dichloroethane	<b>217</b>	<b>133</b>	<b>122</b>	ND	ND	ND	ND	0.4 (CREG)
Chloroform	<b>105</b>	<b>40.0</b>	<b>40.0</b>	ND	ND	ND	<b>114</b>	6 (CREG)
Carbon Tetrachloride	<b>239</b>	<b>110</b>	<b>130</b>	ND	ND	ND	<b>385</b>	0.3 (CREG)
1,2-Dichloropropane	<b>76.0</b>	<b>70.0</b>	<b>82.0</b>	ND	ND	ND	<b>52.0</b>	5 (MCL)
Trichloroethylene	<b>138</b>	<b>110</b>	<b>150</b>	ND	ND	ND	<b>114</b>	1 (MCL)
Benzene	<b>0.7</b>	<b>3.0</b>	<b>140 (a)</b>	<b>1.2</b>	ND	<b>1.5</b>	<b>382</b>	1 (MCL)
1,1,2,2- Tetrachloroethane	<b>96.0</b>	<b>90.0</b>	<b>96.0</b>	ND	ND	ND	<b>2,014</b>	400 (EMEG)
Toluene	<b>0.5</b>	<b>7.0</b>	<b>9.0</b>	<b>1.5</b>	<b>0.8</b>	<b>24.9</b>	<b>8.0 (b)</b>	1,000 (MCL)
Chlorobenzene	<b>0.3</b>	<b>27.0</b>	<b>29.0</b>	ND	ND	ND	ND	50 (MCL)
Ethylbenzene	ND	ND	ND	<b>3.4</b>	<b>1.1</b>	<b>6.4</b>	ND	700 (MCL)
Xylene	ND	ND	ND	ND	ND	<b>0.5</b>	ND	1,000 (MCL)

Public Health Assessment: Dover Township Municipal Landfill

Table 3, continued.

Compound µg/l	Well H	Well I	Well J	Well K	Well L	Well M	Well N	Comparison Value
	Sample Date 2/8/82*	Sample Date 1/30/82	Sample Date 2/8/82	Sample Date 1/30/82	Sample Date 1/30/82	Sample Date 1/30/82	Sample Date 1/30/82	
Methylene Chloride	ND	ND	ND	ND	ND	ND	ND	2 (MCL)
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	ND	0.4 (CREG)
Chloroform	ND	<b>470</b>	<b>10.7</b>	ND	<b>2,280</b>	ND	<b>2,780</b>	6 (CREG)
Carbon Tetrachloride	ND	<b>151</b>	<b>3.3</b>	ND	<b>807</b>	ND	<b>850</b>	0.3 (CREG)
1,2-Dichloropropane	ND	<b>15.0</b>	ND	<b>0.6</b>	<b>64.0</b>	ND	<b>80.0</b>	5 (MCL)
Trichloroethylene	ND	<b>36.0</b>	<b>0.9</b>	<b>45.0</b>	<b>145</b>	<b>23.0</b>	<b>150</b>	1 (MCL)
Benzene	<b>80.0</b>	<b>126</b>	<b>2.5</b>	ND	<b>548</b>	<b>4.0</b>	<b>522</b>	1 (MCL)
1,1,2,2- Tetrachloroethane	ND	ND	ND	ND	<b>44.0</b>	<b>110</b>	<b>172</b>	400 (EMEG)
Toluene	<b>42.0</b>	ND	ND	<b>1.0</b>	<b>44.0</b>	<b>0.2</b>	<b>23.0</b>	1,000 (MCL)
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND	50 (MCL)
Ethylbenzene	ND	ND	ND	ND	ND	ND	ND	700 (MCL)
Xylene	ND	ND	ND	ND	ND	ND	ND	1,000 (MCL)

Public Health Assessment: Dover Township Municipal Landfill

Table 3, continued.

Compound µg/l	Well O	Well P	Well Q	Well R	Well S	Well T	Comparison Value
	Sample Date 1/30/82	Sample Date 2/8/82	Sample Date 2/8/82	Sample Date 1/29/82	Sample Date 2/6/82	Sample Date 1/30/82	
Methylene Chloride	ND	ND	ND	ND	ND	ND	2 (MCL)
1,2-Dichloroethane	ND	ND	ND	ND	ND	ND	0.4 (CREG)
Chloroform	<b>2,295</b>	ND	<b>2.0</b>	<b>18.5</b>	ND	<b>1.7</b>	6 (CREG)
Carbon Tetrachloride	<b>1,140</b>	ND	ND	<b>5.6</b>	ND	ND	0.3 (CREG)
1,2-Dichloropropane	<b>86.0</b>	ND	ND	ND	ND	ND	5 (MCL)
Trichloroethylene	<b>185</b>	ND	<b>0.5</b>	<b>1.0</b>	ND	ND	1 (MCL)
Benzene	<b>609</b>	ND	<b>0.5</b>	<b>3.0</b>	ND	<b>3.0</b>	1 (MCL)
1,1,2,2- Tetrachloroethane	<b>350</b>	<b>35.0</b>	<b>8.5</b>	ND	<b>9.2</b>	ND	400 (EMEG)
Toluene	<b>45.0</b>	ND	<b>1.0</b>	ND	ND	ND	1,000 (MCL)
Chlorobenzene	<b>364</b>	ND	ND	ND	ND	ND	50 (MCL)
Ethylbenzene	ND	ND	ND	ND	ND	ND	700 (MCL)
Xylene	ND	ND	ND	ND	<b>5.0</b>	ND	1,000 (MCL)

Data From the New Jersey Department of Environmental Protection, Ocean County Health Department

a = Sample Date: 1/27/82

b = Sample Date: 2/8/82

\* Estimated date

MCL Maximum contaminant level

EMEG Environmental media evaluation guide

*Public Health Assessment: Dover Township Municipal Landfill*

CREG Cancer risk evaluation guide ND Not detected

**Appendix D: Figures**



*Public Health Assessment: Dover Township Municipal Landfill*



Figure 1 - The DTML and related study areas.

**Figure 2 -** Demographic Statistics Within One Mile of the Dover Township Municipal Landfill; 1990 U.S. Census.



Population of Dover Township	76,371 (1990)		
Total Population within 1 Mile	6,182		
White	6,042	Hispanic	93
Black	20	Children Aged 6 and Under	210
American Indian	3	Adults Aged 65 and Older	3,265
Asian	110	Females Aged 15 - 44	551
Other	8	Total Housing Units	3,547

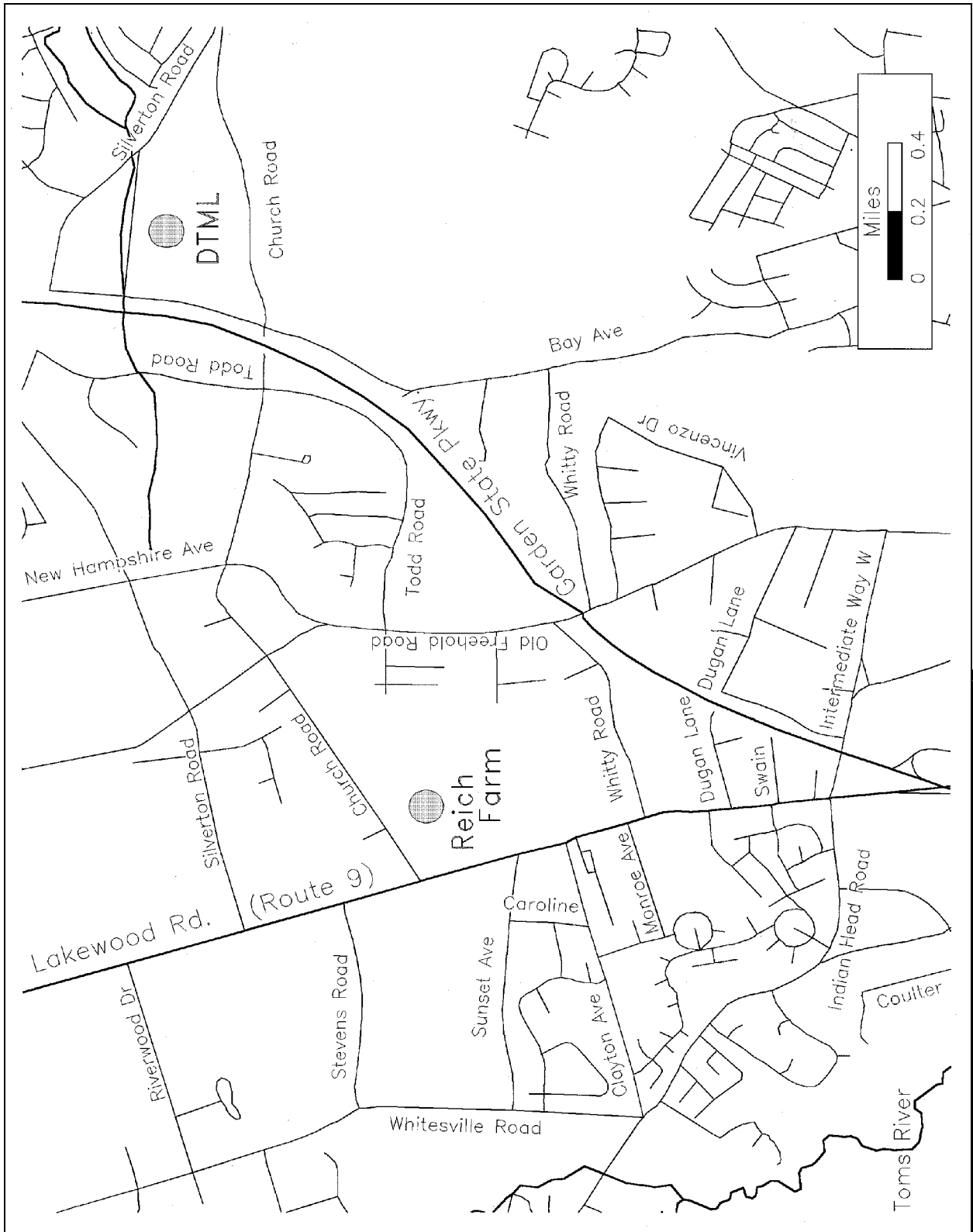
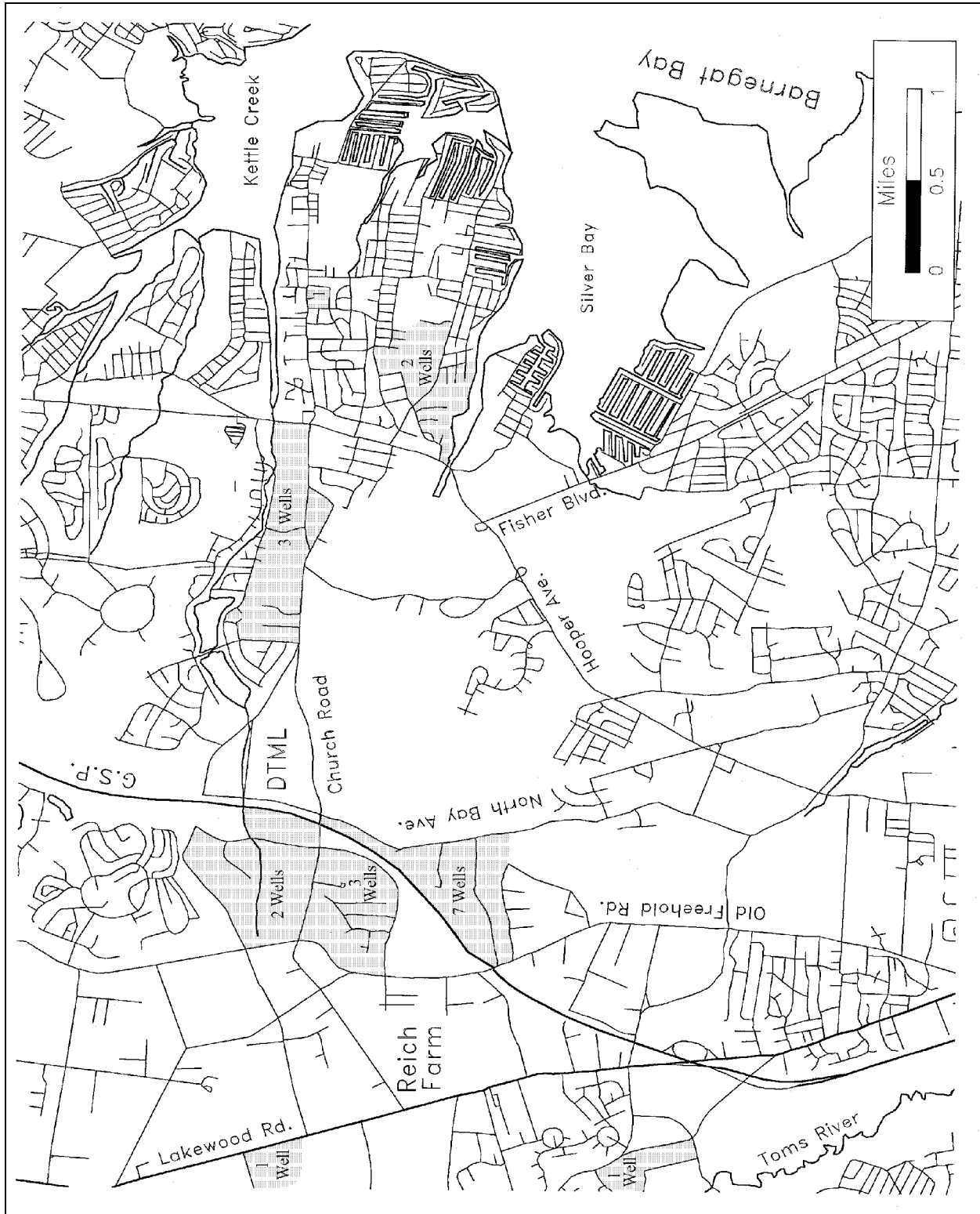


Figure 3 - Relative Locations of the DTML and the Reich Farm Site.



**Figure 4** - General Locations of Private Wells associated with the Reich Farm and the DTML, sampled during the ATSDR/NJDHSS exposure investigation.

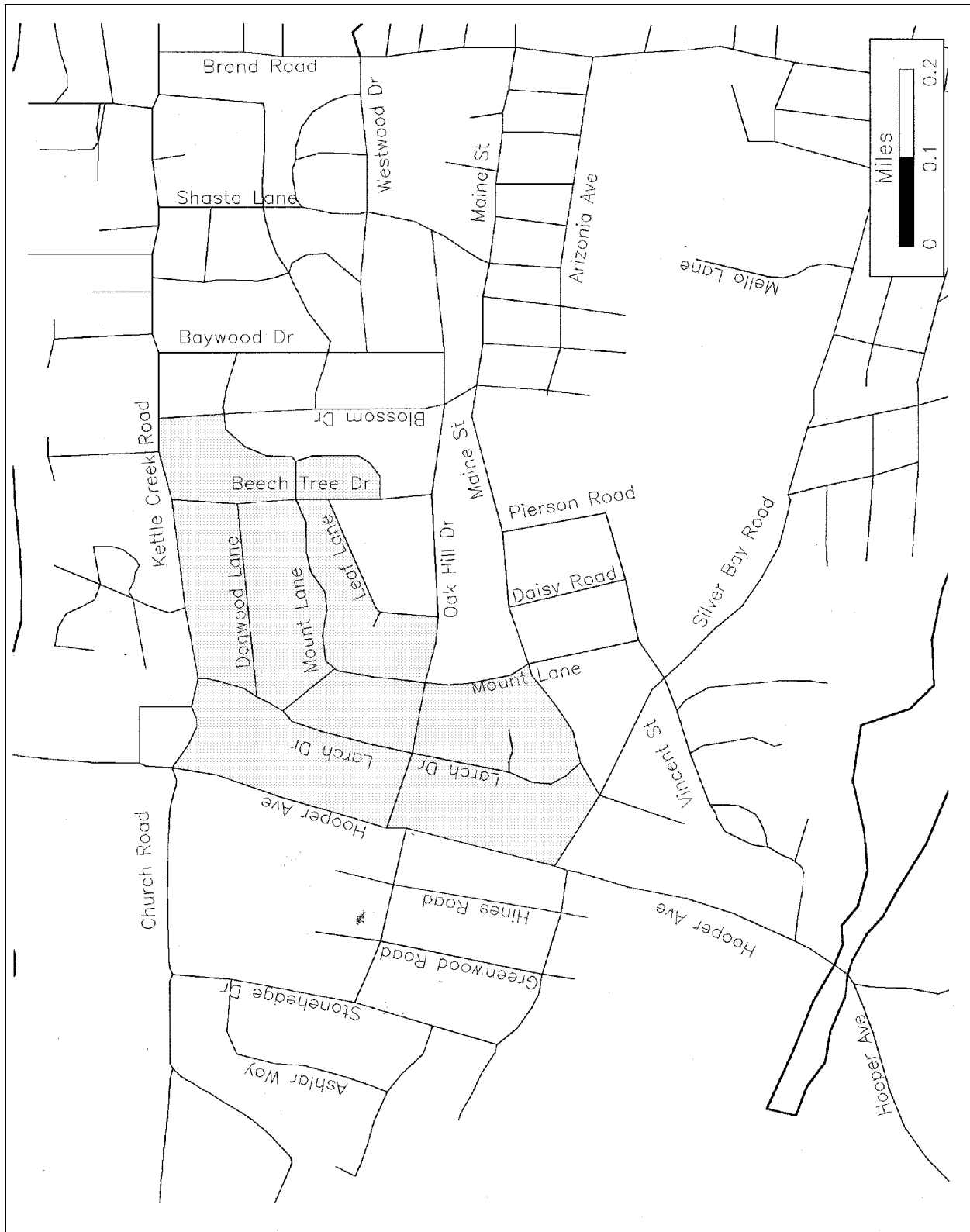


Figure 5 - Silverton Private Well Contamination Study Area.

*Public Health Assessment: Dover Township Municipal Landfill*

**Appendix E: Response Summary**



*Public Health Assessment: Dover Township Municipal Landfill*

## Appendix E

### Summary of Public Comments and Responses Dover Township Municipal Landfill and Silverton Private Well Contamination Investigation

This summary presents the comments received from interested parties on the public comment draft of the Public Health Assessment for the Dover Township Municipal Landfill and the Silverton Private Well Contamination Investigation, 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:*

*“It might be prudent to consider expanding the final impact assessment of the site via groundwater profiling off-site encircling the landfill. ‘Groundwater profiling is a relatively new technique that allows samples of water or soil to be obtained at discrete depth intervals during advancement of a probe through the soil or aquifer, thus allowing many samples to be taken per depth profile. This allows the determination of parameters at small depth intervals, so that the vertical distribution of parameters becomes known in detail’ (Ciba, OUII FS, 90/1/99). Well depths ranging from shallow to the bottom of the Kirkwood aquifer, would allow the parameter noted in the NJDEP Groundwater Impact Area Report of the areal extent of the Zone II extension of Pleasant Plains GWIA in 9/89. ‘The GWIA extends to the bottom of the Cohansey/Kirkwood Aquifer System, which is a total depth of Approximately 235 ft.’ ... the groundwater profiling assessment should extend in an Easterly direction toward Silverton and Southeasterly toward the Ocean County College.”*

##### Response:

Approval of the technologies and approaches used for on- and off-site contaminant delineation by Dover Township and its contractor is the responsibility of the New Jersey Department of Environmental Protection. The NJDHSS and the ATSDR have reviewed existing information regarding groundwater contamination associated with the Dover Township Municipal Landfill for the Public Health Assessment, and have conducted analyses of private wells in areas potentially affected by the site as part of the exposure investigation. In addition, monitoring wells around the site have been split-sampled by NJDHSS, both before and since the installation of new monitoring wells by the contractor for Dover Township. Results of these analyses are being compiled in a separate document. The new monitoring wells are intended to provide a more geographically extensive view of groundwater quality in the off-site areas down-gradient of the landfill.

*Public Health Assessment: Dover Township Municipal Landfill*

Based on available information, the Public Health Assessment concluded that there are currently no completed human exposure pathways through use of private wells in the area of the landfill.

**Commenter B:**

*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) acceleration and completion of the on-going Remedial Investigation; (2) Continued follow-up and delineation of the Dover Township Municipal Landfill groundwater contamination plume; (3) Development of periodic Progress Reports and Health Care Provider Updates.*

Response:

These recommended actions are in progress. The first two activities are being conducted by Dover Township and its contractor, with oversight from the New Jersey Department of Environmental Protection. The NJDHSS and the ATSDR will continue to prepare and distribute periodic Progress Reports and Health Care Provider Updates as necessary.

**Commenter C:**

*Comment 1:*

*“Testimony was given by the ‘independent waste contractor’ Nicholas Fernicola that between 1500 & 2000 drums off UCC chemicals were deposited in the DTML. This was verified in 1971 by a UCC representative, yet you indicated in your public presentation 8/3/99 that a “few” drums were deposited in the DTML. I strongly object to the term “a few”.*

Response 1:

The exact number of drums from Union Carbide that were deposited in the Dover Township Municipal Landfill is not known, but the Draft Public Health Assessment states, “Of the 5,000 to 6,000 drums removed by the waste removal contractor, approximately 4,500 were reportedly accounted for on the nearby Reich Farm property.” This implies that between 500 and 1,500 drums were deposited in the landfill; the upper part of this range is consistent with the figures presented in the comment.

*Comment 2:*

*“Your use of the terms ‘DTML Silverton Road Groundwater Investigation’ and ‘Silverton Private Well Contamination Investigation’ is very confusing. I’m hoping that it was an honest mistake and not meant to be purposefully misleading. May I suggest a change - to ‘DTML/Silverton Road Private Well and Groundwater Contamination Investigation’ and ‘Private Well - Silverton Section of Dover Township Contamination Investigation.’ With the change you acknowledge our well contamination (Silverton Road) & the GWIA.”*

Response 2:

The NJDHSS and ATSDR used the names given to the two investigations by those who performed the work. The Draft Public Health Assessment presents information on private well contamination in both areas (see pages 6, 7, 9, 10, 15 and 16). In the Conclusions section, both areas were considered public health hazards due to past exposures through use of private wells (page 15 of the Draft Public Health Assessment).

*Comment 3:*

*“There are at present irrigation wells in the GWIA, specifically in the Senior development Holiday City on Church Rd. Have these ever been tested for the contaminants found in the GWIA. Therefore, I don’t know how you came up with the estimated exposed population (p.9) of 23. The number is not even accurate as to the # of houses and occupants on Silverton Rd.”*

Response 3:

The number 23 was estimated from the documentation of nine residences with contaminated groundwater in 1987, and with a standard assumption of 2.5 occupants per residence. The NJDHSS and the ATSDR are not aware of tests conducted on irrigation wells that may exist in Holiday City. The ongoing groundwater investigation by Dover Township and its contractor (with oversight from the NJDEP) is intended to define the current extent of potential groundwater contamination associated with the landfill.

*Comment 4:*

*“I also hope you have consulted DEP files containing monitoring well toxicological results taken prior to 1987. We had received copies of these dating back to the 70's. They indicate the presence of contaminants present in the DTML, yet no reference is made to the presence of these chemicals prior to 1987 & their discovery in the Silverton Road private wells. Complaints were made to the Dover Twp. Health Dept. as early as 1980. The only reason our contamination was recognized in 1987 (another fact which deserves mention) is that the Ocean County Water Ordinance went into effect 6/87 requiring all wells be tested for volatiles etc. on new construction or resales. At that time the house next to mine was nearing completion & in accordance with this regulation had its well tested, was deemed contaminated with volatile organic compounds, and the houses on either side & down were tested. Those of us that had contaminated wells were pulling water from the Cohansey aquifer.”*

Response 4:

The NJDHSS and the ATSDR reviewed the NJDEP files regarding on-site monitoring wells for the DTML. As noted in the Draft Public Health Assessment (page 7) and in the comment above, data documenting private well contamination was first collected in 1987. A discussion of the completed human exposure pathway associated with the DTML groundwater plume is discussed in the Draft Public Health Assessment on page 9. While no private well testing was documented prior to that time, the Draft Public Health Assessment (page 9) acknowledges that “...wells may have been contaminated with benzene as early as 1973, or with PCE by 1977.” On page 15, the NJDHSS and the ATSDR concluded that, “...there remains uncertainty as to the duration and levels of exposure that residences may have experienced before their wells were tested.”

*Comment 5:*

*“Since the DTML has never been remediated (i.e. fixed), even though your agency uses the word remediation when it is only being monitored - again a very misleading mix of terms - your presentation and report seems to ‘whitewash’ the problem. Have our residents been questioned or interviewed regarding health problems? I have not & my well was one of the very contaminated ones - yet you say you are ‘continuing to investigate.’ Perhaps the word Remedial does not belong as it implies a remedy - NOT a study which it is.”*

Response 5:

The New Jersey Department of Environmental Protection (NJDEP) is the State agency that is overseeing the remedial activities at the Dover Township Municipal Landfill. A “Remedial Investigation/Feasibility Study” generally includes delineation of contaminants which may be on the site and an evaluation of measures to control migration of contaminants off the site or eliminate contamination. These activities eventually lead to the design and implementation of specific engineering controls and/or treatment technologies to clean up or stabilize the site in the long term so that it will not pose a threat to the environment and public health. The NJDHSS and the ATSDR have the responsibility to evaluate how and to what degree human exposure to contaminants at the Dover Township Municipal Landfill occurred. To answer this question, the NJDHSS reviewed all available information regarding private wells in the area, and conducted additional sampling of private wells in areas potentially affected by the landfill. All these data and information were considered in the determination that the DTML represented a public health hazard in the past because of contaminated private wells. The NJDHSS is presently conducting an epidemiologic study which is evaluating this (and other) exposure pathways in the analysis of childhood cancer in Dover Township.

**Commenter D:**

*Comment 1:*

*“According to the draft PHA, between 500 and 1500 drums of Union Carbide plastics manufacturing wastes appear to have been disposed at DTML. This is between 11% and 33% the volume disposed at the Reich Farm site. Yet, comparable contaminants (styrene, SAN trimer, other TICs) have not been reported in groundwater monitoring wells at DTML.”*

Response 1:

Since the draft PHA was released for comment in August 1999, styrene-acrylonitrile trimer (SAN) has been identified in several monitoring wells at the Dover Township Municipal Landfill. These new data will be discussed in the revised final version of the Draft Public Health Assessment.

*Comment 2:*

*“It would appear that several million tons of wastes were placed in DTML 1956-1981. What proportion of these wastes came from industrial sources? Which other industries besides Union Carbide contributed to these wastes?”*

Response 2:

The NJDHSS and the ATSDR, on page 4 of the Draft Public Health Assessment, note that according to NJDEP records, the DTML received approximately 960 tons of waste per week at its peak of operations, and that this waste came from numerous sources. The Draft Public Health Assessment documented the presence of Union Carbide wastes because of the importance of these wastes at the Reich Farm site. Additional information related to industrial or municipal wastes may be available from Dover Township or the New Jersey Department of Environmental Protection.

*Comment 3:*

*“Six monitoring wells were installed at DTML in 1978 and they have been monitored quarterly. Yet, the monitoring well data in the draft PHA only span the time frame 1987-1989. Why is there no inclusion of earlier monitoring data?”*

Response 3:

The NJDHSS and the ATSDR cited VOC data reported in 1982. Prior to that date, sampling of monitoring wells did not include specific VOC parameters relevant to the exposure pathway. Data from monitoring wells during the period 1987 to 1989 were summarized in a table to illustrate groundwater conditions at that time, because that is the period that impact to private wells on Silverton Road was documented, and thus most accurately reflects the contaminant profile being considered.

*Comment 4:*

*“According to the draft PHA, groundwater migrates eastward from DTML at approximately 1.6 feet per day. At this rate of migration, contaminants first deposited in DTML in 1971 barely could have reached the Silverton private wells in early 1982.”*

Response 4:

The Draft Public Health Assessment reports NJDEP’s estimate that groundwater moved at approximately 1.6 feet/day. As stated on page 16, the NJDHSS and the ATSDR concluded that, “There was insufficient information available ... to address the community’s concern that groundwater contamination in the Silverton Private Well Contamination Investigation area was associated with the [Dover Township Municipal Landfill].”

*Comment 5:*

*“The use of equivalent lettering (wells A-I along Silverton Road and wells A-T in the Silverton community itself) in Tables 2 and 3 and accordant discussions is confusing.*

Response 5:

The titles of Tables 2 and 3 denote the specific investigation from which the data are summarized.

Comment 6:

*“Some additional private wells appear to be denoted on Figure 4, but are neither described in the text nor accompanied by sampling data.”*

Response 6:

Figure 4 shows areas where private wells were sampled during the exposure investigation conducted by the NJDHSS and the ATSDR in 1997. The address locations of these wells were considered to be confidential information in this context. The exposure investigation sampled wells near the Dover Township Municipal Landfill and other sites in Dover Township. Those wells pertinent to the Dover Township Municipal Landfill exposure assessment were discussed in the Draft Public Health Assessment. A separate, detailed summary of the overall exposure investigation (including private well, soil and sediment sampling) is found in a separate report by the NJDHSS and the ATSDR.

Comments 7 through 10:

*“In addition, many of the Silverton private well contaminants (in 1982) are significantly more concentrated than DTML groundwater contaminants (in 1987-1989). Benzene, for example was 4.3 ppb in MW2, while 609 ppb in private well O. Other constituents, such as TCE, chloroform, carbon tetrachloride and 1,1,2,2-tetrachloroethane, were not reported in DTML monitoring wells, but were found in hundreds of ppb in Silverton private wells.” ... “These two previous points indicate a separate source of contamination for the Silverton private wells. Given that so many contaminants are involved, it is not likely that this source could have been a single underground storage tank – one postulate put forward in the draft PHA. What other potential sources of these chemicals have existed along Larch Drive, Mount Lane or Beech Tree Drive in the Silverton area?” ... “Have drums or contaminated soil been found in the Silverton area?” ... “Is it possible that multiple sources of contamination, for example from illegal dumping of liquid wastes directly into sandy soil, could have occurred in the area of these three roads? Such multiple sources are suggested by the variation in contaminants in area wells. For example, in 1982 whereas well A had benzene and chlorobenzene < 1 ppb and 1,2-dichloroethane at 217 ppb, well O had benzene at 609 ppb, chlorobenzene at 364 ppb and no detectable 1,2-dichloroethane.”*

Response 7 through 10:

See response 4. Investigation by the NJDEP did not identify a specific source of the Silverton Private Well Contamination Investigation area (page 7 of the Draft Public Health Assessment). The NJDHSS and the ATSDR stated on page 10 of the PHA that the community’s concern regarding association of the DTML and the Silverton Private Well Contamination case could not be addressed based upon available information. However because of the community’s concern and the existence of a completed pathway, the exposures were evaluated in the Public Health Assessment.

Comment 11:

*“In this regard, it would be helpful to emplace private wells A-T on Figure 5.*

Response 11:

The boundary that includes wells A - T are shaded on Figure 5. The shading, however, did not copy well in the printed copies of the Draft Public Health Assessment. The final version of the Public Health Assessment will be corrected.

Comment 12:

*“Although Silverton area residents were put on public water shortly after the discovery of profound contamination of their private wells, in that many of these contaminants are volatile, it is not clear whether additional exposures have occurred through inhalation. Do any area residents have basements? Have air samples been taken in those homes with profound contamination of their private wells (especially well A, C, G, L, N, and O).*

Response 12:

Because many of the contaminants reported from the Silverton Road private wells and Silverton area private wells are volatile, exposure through private well use would have occurred through ingestion and inhalation. In addition, some degree of exposure would have occurred through dermal absorption during contact with water (such as bathing or showering). These routes of exposure are noted in the discussions and exposure pathway tables on pages 9 and 10. Since the wells have not been used for many years, air sampling at present would not provide information on these past exposure pathways.

Comment 13:

*“In addition to some organics, lead (Pb) and arsenic were found elevated in DTML wells. Were these inorganics tested for in Silverton private wells in 1982?”*

Response 13:

Only volatile organic chemical data were available for review from the Silverton Private Wells Contamination Investigation.

Comment 14:

*“Have either ATSDR or NJDHSS assessed potential carcinogenic risk from ingestion of well water containing the following carcinogens: TCE (185 ppb), 1,1,2,2-tetrachloroethane (350 ppb), benzene (609 ppb), chloroform (2,295 ppb), carbon tetrachloride (1,140 ppb) and 1,2-dichloropropane (86 ppb). Would an annual risk to a 10 kg child of  $7.4 \times 10^{-4}$  from this exposure be alarming?”*

Response 14:

The Draft Public Health Assessment discusses the potential for non-carcinogenic and carcinogenic risk from estimated exposures to contaminated private wells in the Silverton area on pages 12 and 13. The Public Health Assessment suggests a “low increased risk” ( $10^{-4}$ , according to definitions used by ATSDR)



of cancer for both adults and children for this exposure pathway. In the judgment of the NJDHSS and the ATSDR, this exposure and risk constituted a public health hazard.

*Comment 15:*

*“Although cancer incidence statistics are quoted for Toms River and Dover Township as a whole (same verbiage as in the Reich Farm draft PHA), no statistics specific to the communities near DTML or for the Silverton area are given.”*

Response 15:

The NJDHSS and the ATSDR completed a report in 1997, “Childhood Cancer Incidence; A Review and Analysis of Cancer Registry Data, 1979 - 1995, for Dover Township (Ocean County), New Jersey.” The purpose of the report was to describe childhood cancer incidence in Dover Township as a whole, as well as in an aggregate of four census tracts within Dover Township considered to be the “Toms River” section of the Township (according to the U.S. Census Bureau). In Table 16 of the cancer incidence report, case counts for all childhood cancers combined, for the 1979 - 1995 period, are given for each census tract, and a map of the census tracts is given in Figure 1. In census tract 22, which includes the landfill, 0 cases were reported compared to 0.3 expected. In census tract 224 (the Silverton area east of Hooper Ave.), 8 cases occurred compared to 8.4 expected. In census tract 223 (to the south of Church Road), 2 cases were registered compared to 3.3 expected.

*Comment 16:*

*“Additionally, anecdotal evidence suggests a much higher incidence of autism in Brick Township. Is the Silverton area within Brick Township? Have either ATSDR or NJDHSS investigated whether or not the incidence of autism is higher in Silverton?”*

Response 16:

The Silverton area is a part of Dover Township. The NJDHSS and the ATSDR have not investigated the incidence of autism in Silverton.

*Comment 17:*

*“Why is the toxicology of PCE discussed, when it was found only once (in private well D on 9/9/87 near DTML) at 5.7 ppb. Other compounds not discussed (e.g., carbon tetrachloride and 1,1,2,2-tetrachloroethane) have posed a much higher risk to Silverton area residents and their risks would be useful information for the community?”*

Response 17:

On pages 12 and 13 of the Draft Public Health Assessment, the toxicology of carbon tetrachloride and the other chemicals noted in the comment is discussed. The NJDHSS and the ATSDR stated, “Of the chemicals found in the Silverton wells, the non-carcinogenic toxicity of carbon tetrachloride was of greatest concern.” The carcinogenic potential of carbon tetrachloride and other chemicals is also noted on page 13. Of the chemicals found in the Silverton Road and Silverton private wells, epidemiological data on leukemia

and childhood cancers is available for benzene, trichloroethylene (TCE) and tetrachloroethylene (PCE); therefore, a portion of the discussion (pages 13 and 14) focuses on these chemicals.

**Commenter E:**

*Comment 1:*

*“The PHA states in several places that the volatile organic compounds (VOCs) found in domestic wells along Silverton Road during 1987 and 1988 sampling events are similar to the contaminants found in the landfill monitoring wells. There is no analysis of concentration gradients, ground water flow or dispersion, nor is there any evaluation or delineation of ground water contaminants. The PHA then attributes the presence of these compounds in Silverton Road domestic wells to impacts from the DTML. This conclusion is unsupported by the scientific evidence. To evaluate the possibility of a connection between the DTML and the domestic wells, one needs to evaluate the individual compounds detected, their concentrations, and their spatial distribution.” The comment then argues that PCE in two of the private wells could not be attributed to the landfill since it has generally not been found in landfill monitoring wells. The comment makes a similar argument with respect to vinyl chloride. Regarding benzene, the comment argues that, although benzene is present in landfill monitoring wells and private wells on Silverton Road, it is unlikely that the landfill is the source because the wells and the landfill are too far apart. The comment continues, “Other potential sources of these VOCs, including septic tanks, degreaser and solvent use, gasoline, kerosene and heating oils in the area in and around Silverton Road have not been investigated by the NJDHSS, ATSDR or NJDEP.” The comment then discusses lead. “Similarly, the lead that has been detected in domestic wells along Silverton Road has not been shown to originate at the DTML. The June 1999 ground water sampling event at the DTML detected no lead concentrations above 25 ppb ... The high lead concentrations that have been sporadically detected in DTML monitoring wells reflect lead that is naturally occurring and is incorporated into the mineral structure of the aquifer matrix, and not truly a dissolved metal... There are many potential sources of lead in domestic wells. Many alloys used for solder in plumbing systems in residences contain lead. The pumps installed in wells can contain alloys that can contain lead. Finally, many supply wells were constructed with lead alloys and lead components in the pipe and/or screen. ...”*

**Response 1:**

The Draft Public Health Assessment concluded that a completed human exposure pathway to Dover Township Municipal Landfill site-related contaminants occurred among users of contaminated private wells on Silverton Road. The association between these contaminated wells and the landfill was made by the NJDEP under the New Jersey Spill Fund (see references: NJDEP 1990, and Mack, 1990). In the judgment of the NJDHSS and the ATSDR, the similarity in the specific contaminant profiles of the monitoring wells and private wells along Silverton Road, particularly with respect to benzene, chlorobenzene and dichlorobenzenes, supports this conclusion. This conclusion does not preclude the possibility of other sources of contaminants in the area.

The NJDHSS has actively participated in recent (1999 and 2000) sampling activities at the Dover Township Municipal Landfill in cooperation with Dover Township and Dan Raviv Associates. These more recently collected monitoring well data are important to assess present conditions, but do not necessarily reflect those in the past. These data will be discussed in the revised (final) version of the Public Health

Assessment, and will be summarized in detail in a separate report.

The NJDHSS and the ATSDR recognize that lead may occur in private well or monitoring well samples for reasons presented in the comment. However, noting that lead was found in all six monitoring wells and in the private wells (apparently in association with other site-related contaminants), the Draft Public Health Assessment (page 9) stated, “This information suggests that lead in the private wells was site-related.” In addition, the NJDHSS and the ATSDR evaluated lead as a site-related contaminant of concern as presented in the NJDEP case documentation. Other sources of lead contamination of private wells have been observed in Dover Township; lead may be present either as a naturally occurring contaminant, or as the result of corrosion. It is not possible to determine to what degree, if any, these or other sources may have contributed to the documented levels of lead contamination. More recent sampling (1999) indicates that lead is not found in the groundwater in association with other contaminants, although as noted above, present day conditions may not accurately reflect those in the past. In its final version, the Public Health Assessment will be revised to reflect this uncertainty in the source of lead.

*Comment 2:*

*“Sampling of private domestic wells in the Silverton Area in 1982 revealed the presence of a suite of VOCs at concentrations ranging from less than 1 ppb to 1,000s of ppb ... The PHA indicates that the source of the contamination at the Silverton Area is not known. While the draft report states that ‘the NJDEP has not considered the private well contamination in the Silverton section of Dover Township to be related to the DTML’, it leaves open the question that the DTML could potentially be the source of this contamination. The PHA includes a statement that the Silverton Area private wells are located ‘to the east and down-gradient of the DTML’, which could be interpreted as implying that the DTML is viewed as a potential source of the contamination detected in Silverton area wells. This innuendo does little, but to imply that ‘DTML is the source’. There is no scientific basis whatsoever for this position and it should be deleted from the report in its entirety. ... The PHA report should state that, with all reasonable scientific certainty, the DTML is not the source of the high VOC levels that had been found in domestic wells in the Silverton area, as the NJDEP has already concluded. Carbon tetrachloride and TCE, both detected in Silverton Area private wells, have never been detected in DTML monitoring wells...” ... “The PHA makes no mention of other potential sources within the Silverton Area. However, there is information readily available in the files of the NJDEP and commercial databases regarding numerous spills, leaks and discharges at other contamination sites in immediate proximity to the Silverton Area. It appears that the PHA does not evaluate any of these sources to determine their relationship to the contaminated wells.*

*Response 2:*

In response to concerns expressed by the community that there was a connection between the Silverton area private well contamination in 1982 and the Dover Township Municipal Landfill, the Draft Public Health Assessment concludes (page 16), “There was insufficient information available to the NJDHSS and the ATSDR to address the community’s concern that groundwater contamination in the Silverton Private Well Contamination Investigation area was associated with the DTML.” The Draft Public Health Assessment also states (on pages 6 and 7) that the NJDEP and the Ocean County Health Department suspected the source “... to have originated from a leaking underground storage tank.” However, after investigation, no sources were identified by the NJDEP.

**Commenter F:**

*Comment 1:*

*“DTML ‘a public health hazard because of past exposures’ plus ‘no apparent public hazard at present.’ HOW CAN THIS ASSESSMENT BE SUPPORTED WHEN ON PG 4 PARA 4 THE REPORT STATES ‘THE CURRENT STATUS OF THE UCC-UNION CARBIDE DRUMS WHICH WERE DEPOSITED INTO THE DTML IS NOT KNOWN.’ 6500 drums and no status. May we bring our people/press in? TO A PERSON PRESENT AND CURRENT ARE THE SAME IN TIME, SPACE. CLEARLY, THE DRUMS ARE A PUBLIC HAZARD AND ANY ATTEMPT TO THINK OTHERWISE DEFIES LOGIC AND THE SCIENTIFIC APPROACH SPOKEN ABOUT BY THE PRESENTERS.”*

Response 1:

The NJDHSS and the ATSDR state that Union Carbide Corporation drums were deposited into the Dover Township Municipal Landfill in the Draft Public Health Assessment (page 4). The sentence identified above relates to uncertainty regarding the physical condition of the drums. The language in the Public Health Assessment has been modified to clarify this intent. Based on recent groundwater data collected since the release of the draft Public Health Assessment, the Union Carbide drums appear to constitute a source of groundwater contamination (based on the detection of styrene-acrylonitrile (SAN) trimer in monitoring wells close to the landfill). The NJDHSS and the ATSDR acknowledge the potential for a future exposure pathway through use of groundwater, depending on the fate and transport of contaminants away from the site (see page 15 of the Draft Public Health Assessment).

*Comment 2:*

*“WHY ARE THE CHILDREN AGES 6 UP OMITTED FROM THIS STUDY SEEMS IF CHILDHOOD CANCERS IS A CONCERN WHY ARE NOT THE CHILDREN INCLUDED THEIR NUMBERS, INCIDENCES, TYPES, DEATHS, CENSUS TRACTS AND TRENDS ... Page 5, para 2 WE EXPRESSED OUR CONCERN ABOUT CHILDREN CANCERS, THEIR NUMBERS, TRENDS, LOCATIONS, FOR TOMS RIVER, OCEAN COUNTY, OTHER COUNTIES WITHOUT OBTAINING THE INFORMATION WE SOUGHT”*

Response 2:

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 ATSDR 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 3:*

*“Page 17 the first para marked 2 - mention of Raviv 1997 etc. THIS study and conclusions must be made part of the Landfill report. In essence it states that their computer model and actions thru containment*

*Public Health Assessment: Dover Township Municipal Landfill*

*assure that the landfill is safe. THAT CLAY DEPOSIT below in the earth will prevent the pollution from finding their way into our current potable drinking water supply. To the reference of the computer model, my 30 plus years in this area - and the Y2K problems states that the person doing the program must have a crystal ball to foresee the future and how nature will affect the LANDFILL AND OUR DRINKING WATER. THE LANDFILL IS ACTUALLY A TOXIC MINEFIELD WAITING TO IMplode. NEW AND EXISTING WELL SHOULD BE MONITORED ON AT A 3 MONTH BASIS AND NOT 2 YEARS.*

Response 3:

The NJDHSS and the ATSDR reviewed two 1997 reports from Dan Raviv Associates, Inc., and referenced information from these reports in the Draft Public Health Assessment (see page 6). These reports were the “Preliminary Assessment” and the “Remedial Investigation Workplan.”