Public Health Assessment for

KELLOGG-DEERING WELL FIELD

NORWALK, FAIRFIELD COUNTY, CONNECTICUT

CERCLIS NO. CTD980670814

JUNE 2, 1993

U.S. DEPARTMENT OF HEALTH & HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry

THE ATSDR HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104 (i) (6) (F) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure or tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR shall use appropriate data, risks assessments, risk evaluations and studies available from the Administrator of EPA."

In accordance with the CERCLA section cited, this Health Assessment has been conducted using available data. Additional Health Assessments may be conducted for this site as more information becomes available.

The conclusions and recommendations presented in this Health Assessment are the result of site specific analyses and are not to be cited or quoted for other evaluations or Health Assessments.

PUBLIC HEALTH ASSESSMENT

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CERCLIS NO. CTD980670814

Prepared by

Connecticut Department of Health Services
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry
U.S. Department of Health and Human Services

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6), and in accordance with our implementing regulations 42 C.F.R. Part 90). In preparing this document ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30 day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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SUMMARY

The Kellogg-Deering Well Field Superfund Site in Norwalk, Connecticut, is approximately 140 acres of light industrial, commercial, and residential properties, including a 10-acre municipal well field. Historic disposal practices of volatile organic compounds (VOCs), predominantly trichloroethylene (TCE), by a 1945 manufacturing facility has resulted in contamination of subsurface soils and ground water, the greatest contamination occurring within the bedrock aquifer directly under the manufacturing facility. Contaminants have migrated to the Kellogg-Deering well field approximately one half mile southwest of the source area. Residents within the site, employees of companies located on or near the Elinco/Pitney Bowes/Matheis Court Complex, and customers supplied water from the Norwalk First Taxing District (NFTD) are included in the receptor population at risk from exposure to contaminants identified within this site. Exposure may have occurred and may still be occurring via ingestion of contaminated ground water, inhalation of vapors or aerosols generated from domestic or industrial uses of ground water, skin contact from bathing, showering in contaminated ground water, and inhalation of vapors from contaminated air spaces. A packed tower air stripper has been installed at the well field to remove VOCs from the public water supply. The Environmental Protection Agency has divided this site into three Operable Units. The site is the subject of two Remedial Investigations and Feasibility Studies (RI/FS's) and two Records of Decision (ROD's) to date.

ATSDR and CT DOHS find that this site represents an indeterminate public health hazard. Current data available do not indicate that humans are being or have been exposed to contamination that would be expected to cause adverse health effects, however, sufficient information concerning the extent and duration of exposure to contaminated groundwater prior to 1975 is not available. ATSDR's Health Activities Recommendation Panel recommends that community health education occur because past exposure to site contaminants may have occurred; however, the duration and levels of exposure are not known. The community health education will be based on information presented in this public health assessment regarding the public health implications of this site. The CT DOHS will perform the education. This public health assessment is an update to the ATSDR preliminary health assessment of October 23, 1986.

BACKGROUND

A. Site Description and History

The Kellogg-Deering Well Field Superfund Site is approximately 140 acres of light industrial, commercial and residential properties which includes a municipal well field of approximately 10 acres. The site is in the north central section of Norwalk, CT, between Interstate Route 95 and State Highway 15 and along the U.S. Highway 7 extension.

The well field portion of the site lies along the western bank of the Norwalk River in Southwestern Fairfield County. It is bordered on the east by the Norwalk River, to the north by residences along Broad Street, to the west along Lakeview Avenue, and to the south by both wooded acreage and residences in the vicinity of East Lakeview Drive and Nutmeg Place. The well field was acquired by the Norwalk First Taxing District (NFTD) over a period of several years (1935-1964) and contains four independent wells. The first well, Layne 1, was installed in 1955. The others, Deering 1, Deering 2, and Layne 2 were installed in 1965, 1966 and 1975, respectively. The primary source of public water supply to the NFTD is surface water from four surface water reservoirs. The NFTD utilizes surface water reservoirs, ground water wells, and interconnections with the Second District Water Department and the Bridgeport Hydraulic Company to obtain adequate amounts of water for its customers. Surface reservoir water is blended with Kellogg-Deering Well Field water depending upon reservoir storage and distribution system location. The blending ratios have ranged from 1 part well field water with 2.5 to 7 parts of reservoir water. Records of the actual distribution, both current and historic, have not been obtainable by this investigator. The NFTD water supply serves approximately 45,000 people.(5)

In 1975, sampling data from CT DOHS showed TCE in ground water at the Kellogg-Deering Well Field. We do not have sufficient information to determine the extent or duration of human exposure to VOCs found in this public water supply prior to 1975 since testing of this water supply for VOCs prior to 1975 did not occur.

Between 1975 and 1980 the Connecticut Department of Environmental Protection (CT DEP) performed several inspections and sampling events within the area that later became the Kellogg-Deering Well Field Superfund site and initiated investigations of several local industries in attempts to identify the source(s) of contamination. By 1980, the investigation was expanded to include efforts of the United States Environmental Protection Agency (EPA).

In 1981, an experimental redwood slat aerator was installed at the Layne 2 well of the Kellogg-Deering Well Field to reduce the contaminant levels of VOCs from ground water drawn at the Layne 2 well of this public drinking water supply. This redwood slat aerator was designed to reduce VOC contamination from the drawn water by 65%.

The Kellogg-Deering Well Field was placed on the National Priorities List (NPL) in 1984, allowing federal Superfund monies to be spent on evaluation and cleanup of the contamination migrating into the well field. For the purposes of EPA's study and cleanup, the boundaries of the Kellogg-Deering Well Field Superfund Site were defined as the well field and all areas that contribute to the contamination of the well field (see Appendix A-Figure 1). This presently considers the Elinco/Pitney Bowes/Matheis Court Complex as the source area and the migrating plume of contamination as the areas of contributing contamination.

Between 1984 and 1986, a Remedial Investigation (RI) was conducted by EPA in conjunction with a Feasibility Study (FS) of treatment options for the water at the Kellogg-Deering Well Field. These two studies are known as the Initial Remedial Investigation and Feasibility Study (IRI/FS).

The results of sampling during the IRI/FS showed the presence of several contaminants in ground water beneath much of the study area. The study determined that these contaminants were migrating in ground water from the east side of the Norwalk River to the Kellogg-Deering Well Field.

EPA issued a Record of Decision (ROD) in 1986. Also, on October 23, 1986, the ATSDR issued a Preliminary Health Assessment for the site. The ROD required the implementation of a water treatment system for the Kellogg-Deering Well Field, upgraded from that of the existing redwood slat aerator. A packed tower air stripper was installed at the Kellogg-Deering Well Field, effective April 1987.

Also in 1987, EPA began another field investigation known as the Supplemental Remedial Investigation and Feasibility Study (SRI/FS). This supplemental investigation focused on identifying the source(s) of contamination. This second study better defined the area of ground water contamination found during the IRI/FS, identified soil and soil gas contamination sources, and provided preliminary analysis of indoor air quality in buildings located above the major soil and ground water contamination source area. As part of the SRI/FS, EPA prepared a risk assessment for the Kellogg-Deering Well Field Superfund Site.

In 1989, a second Record of Decision (as supported by the SRI/FS) was released. Clearly defined by this decision document was the separation of three distinct areas of activities, described as Operable Units. Operable Unit 1, as addressed in the IRI/FS and IROD, is the Kellogg-Deering Well Field, containing the four production wells, Layne 1, Layne 2, Deering 1, and Deering 2. Operable Unit 2 is defined as the source area. This area is characterized by ground water TCE concentrations greater than 6,600 ug/L and consists of an area that includes most of the Elinco/Pitney Bowes/Matheis Court Complex of 272 and 282 Main Avenue, along with an adjacent area extending approximately 400 feet west and about 500 feet southeast of the complex. TCE concentrations as high as 430 mg/L have been found in this area. Operable Unit 3

is defined as the downgradient area, consisting of the remainder of the TCE ground water plume in excess of 5 ug/L, the Safe Drinking Water Act Maximum Contaminant Level (MCL) for TCE. The downgradient area extends westward to the Norwalk River and, where influenced by the pumping of the Kellogg-Deering wells, under and beyond the Norwalk River. Operable Unit 3 will be further defined as EPA continues its investigation of the downgradient area. (1)

Detection of VOCs in ground water at the Kellogg-Deering Well Field led to the initiation of ground water monitoring designed to locate the source(s) of this contamination. The studies have identified the Elinco/Pitney Bowes/Matheis Court complex of 272 and 282 Main Avenue as a major source area of ground water and soil contamination contributing to contamination of the Kellogg-Deering Well Field and the aquifer supplying the well field. An air stripper is currently operating at the complex under order by the Department of Environmental Protection.

Beginning in 1945, Zell Products Corporation constructed and occupied three buildings in what is now known as the source area complex. Metal cosmetic and handbag frames were produced. For more than 20 years processes including metal plating and solvent cleaning were carried out at all of the three buildings. Sections of the three buildings were constructed with depressed floors for spillage collection of waste materials which were reportedly disposed of in open earth trenches below the depressions.

The Zell 1 building was occupied by the Pitney Bowes Corporation in 1969. The depressed floor was filled and capped. The building is presently used as office, warehouse, and research and development space.

The Zell 2 building was occupied by Pitney Bowes in 1974, at which time the depressed floor was filled and capped. The building is presently used as engineering office space.

The third building, the Elinco building, was taken over by the Elinco Corporation in the mid-1970's. A plywood floor has been built over the depressed floor and this area is presently used as a parts inventory storage space for Elinco's fractional horsepower motor business.

B. Site Visit

On August 14, 1990, a site visit was conducted by Susan Yurasevecz of the Connecticut Department of Health Services, Division of Environmental Epidemiology and Occupational Health. Susan Yurasevecz established contact with the Norwalk City Health Department (NCHD) and the Norwalk First Taxing District Water Department (NFTD) during this site visit.

Susan Yurasevecz conducted interviews with personnel at NCHD and NFTD and searched files at NCHD to compile information (current and historic) on the

populations served by community water, populations utilizing private wells, public concerns regarding site activities, community concern for health implications, and monitoring strategies for ensuring the quality of public water.

During a physical inspection of the site, Susan Yurasevecz made the following observations. These observations are listed in order of observance and do not present an order of significance.

- **The construction of US Highway 7 within site boundaries was in progress and has clearly altered site terrain.**

- **Vegetation and wildlife does exist in Deering Pond and the Norwalk River. Turtles, frogs, small fish, and various plant life were observed in these waters. Surface waters of the Kellogg-Deering Well Field Superfund Site have not been polluted beyond the capacity to support such life forms. It is not known if other life forms have been affected.**

- **Highly dense residential areas exist within and about the Kellogg-Deering Well Field Superfund Site. See the Demographics, Land Use and Natural Resource Use section of this public health assessment for more information.**

- **Signs of restricted access for, or observable notification to, occupants within this site, alerting the population at risk of the potential impact from soil and ground water contamination within this site, were not observed.**

- **A retirement community borders the north side of the Elinco/Pitney Bowes/Matheis Court Complex (identified as the source of contamination).**

- **The Elinco/Pitney Bowes/Matheis Court Complex was within a condensed grouping of other commercial and residential properties.**

- **The Elinco/Pitney Bowes/Matheis Court complex was lower in elevation than several of the surrounding residential and business properties. A unit designed to strip VOCs from contaminated ground water was observed. The stripper was located on the northeast parking lot, approximately 50 feet from Zell Building 2, and approximately 100 feet from nearby residential properties.**

- **A visit to the well field identified the existence of an air stripping water treatment tower located on the Kellogg-Deering Well Field property. This treatment tower is approximately 100-200 feet from local residents.**

Jennifer Kertanis from the State of Connecticut Department of Health Services conducted a follow-up site visit on March 12, 1992. Jennifer was joined by a representative from the Norwalk City Health Department. Similar observations to those made on an earlier site visit were made. Construction of Highway 7 appeared to be near completion in the area of the site. Some of the buildings at the source area appeared to be vacant.

C. Demographics, Land Use and Natural Resource Use

Demographics

The Kellogg-Deering Well Field Superfund Site is located within the Standard Metropolitan Statistical Area (SMSA) of Norwalk, in Fairfield County, Connecticut, with a population of approximately 126,000 people. An estimated 500 to 600 people live within 1/4 mile of the well field and approximately 800 to 900 people live within 1/4 mile of the study area.(1) (See Appendix A for area map--Figure 2) The site contains many commercial and light industrial businesses with various histories of operation. The work force population for this site is unknown.

The median household income for Norwalk during 1979 was $27,000 ($12,000 per capita). Four percent of the 1387 families live below the poverty level.

The majority of the Norwalk population is Caucasian (89%). The second largest population (9%) consists of African-Americans. Of adults ages 25 and older, 78% have received high school education, 33% graduated from college.

Census tract 0434 is the area most closely associated with on-site contamination issues. Approximately two thirds of the site is contained within approximately three quarters of this tract. Characteristics of this tract, as compared with the Standard Metropolitan Statistical Area of Norwalk and the State of Connecticut are as follows:

Characteristic	Tract 0434	Norwalk	Connecticut
Married	39%	58%	56%
Single	26%	28%	28%
Male	47%	48%	48%
Female	53%	52%	52%
Under 18	22%	27%	26%
65 and over	14%	10%	12%
Caucasian	77%	89%	90%
African-American	19%	9%	7%
Median Age	30 yrs	34 yrs	32 yrs

Contamination of this site has affected a municipal well field and, as such, demographics of this site should be extended to include the population within and about the site boundaries and the approximate 45,000 customers serviced by the public water system.

Land Use

Within one half mile of the source area, described as the Elinco/Pitney Bowes/Matheis Court Complex, are several concentrated areas of residential and commercial properties. A small retirement community is located within a few feet of the northwest border of the complex. To the north, buffered by a wooded area with a small surface pond, is a residential area of apartment buildings and condominiums.

To the southwest and within a quarter mile from the source area is a small residential community of multiple family homes, surrounded in part, by several light industrial business properties.

To the west of these multi-family homes, and bordering several of the light industrial business properties is the construction area of U.S. Highway 7. This construction project passes through Deering Pond, continues along the east bank of the Norwalk River and exits the site boundary southeast of the Kellogg-Deering Well Field.

A residential area of single family homes begins at the west bank of the Norwalk River. This area expands to the west as the housing classification shifts from suburban to rural.

Immediately east, across the Norwalk River, is the Connecticut Light and Power (CL&P) landfill owned by Northeast Utilities.

Three schools exist within one mile of the site; the West Rocks Middle School, the Central Catholic School, and the Briggs Center for Vocational Arts. Within two miles of the site are the Tracey Elementary School, the Saint Phillips School, the Jefferson School, the Kendall School, the Ponus Ridge Middle School, and the Silvermine Elementary School. Thirteen schools in total are within the NFTD public water system. The 1980 count for students enrolled in schools mentioned above by name is approximately 4280.

Many activities occur both within and near the site. Local business activity creates a flow of external populations which frequent the area for commercial purposes. Local business activity, commercial and light industrial, also creates a population of workers who frequent the site as a source of steady employment. Construction of U.S. Highway 7 has brought an additional population of working personnel to the site.

Both domestic and recreational activity is associated with the residential community located within and about this site. It is evident from visual observation that several children live and play on property located within the site boundaries.

Natural Resource Use

Information identifying private wells within or near this site was not readily available during the public health assessment process. Customer records of the Norwalk First Taxing District would need to be obtained and compared with records at the town Assessors office to identify those town residents that are not purchasing public water. As a result, identifying those at risk of drinking or using contaminated water from the use of private wells was not posible. However, a private well user survey was recommended and conducted in 1992 by the local health department to address this concern. No private well water users were identified within or near the study are at the time of the survey.

The Norwalk River is designated by the State of Connecticut as a Class B river (1). Class B waters are suitable for all recreational uses (fishing, boating, and swimming) and can receive certain treated waste waters from industrial processes. Restrictions from the Norwalk River is not evident. Although fishing and swimming were not observed on the river, these recreational activities may be occurring.

Wildlife does exist in Deering Pond, Kellogg Pond, and the Norwalk River. Turtles, frogs, and small fish were observed. The well field area and nearby surface waters are known habitats for unidentified species of waterfowl and an undetermined variety of fish.(1) It is not known what effects, if any, contamination within this site may have presented to the fishing activities downstream of the Norwalk River and the Norwalk Harbor.

No agricultural uses of land or land resources have been identified for the Kellogg-Deering Well Field Superfund site.

D. Health Outcome Data

Records were received from Connecticut's Tumor Registry for the period 1964-1985 (20 years). These records included data on the occurrences of liver, kidney, and bladder cancer, and leukemia (cancer of blood forming organs) in the city of Norwalk and the state of Connecticut. Cancer data were also collected for the census tract most closely associated with the site boundary. Census tract data in the Tumor Registry exist from 1985 to the present. These years have been included in the public health assessment data.

CT DOHS contacted representatives of The Norwalk City Health Department to access data of adverse health effects reported with the occurrence of contaminants in the

ground water of the Kellogg-Deering Well Field Superfund site. No additional data were available.

COMMUNITY HEALTH CONCERNS

Community interest in the Kellogg-Deering Well Field Superfund site began in 1975 when contamination of the Kellogg-Deering Well Field was first discovered. By 1984, the Connecticut Citizen's Action Group (CCAG) began to organize a group of Norwalk citizens, called the Waterforce, to express concerns about the well field contamination. The following concerns were those expressed by interested parties of the Norwalk community during public meetings held in accordance with EPA Superfund regulatory procedures or during the public comment period.

1. Technical oversight in the implementation of remedial activity.

2. Potential health effects from cumulative exposure to solvents, such as TCE, in drinking water.

3. Effectiveness of a proposed use of activated carbon filters in removing solvent type contaminants from drinking water.

4. An immediate remedy was necessary at the site.

5. TCE spills upstream of Deering Pond could have migrated to the pond and settled in the pond bottom.

6. Need for a more detailed description of the specific sampling methods used during site investigations and the reliability of such methods

7. What is being done to stop companies from continuing to pollute ground water.

8. The length of time necessary for EPA to conduct its studies of the site.

9. The quality of municipally supplied water from the period of contaminant discovery (1975) until implementation of aeration techniques (stated as 1987).

10. The alleged failure of the NFTD to properly notify its customers of the initial contamination problem and "keeping secrets" with future contamination issues.

11. Why contaminants listed by NFTD were not listed in the RI/FS produced by EPA.

12. How the construction of Route 7, the alleged use of junk cars as fill, CT DOT's oil storage at the construction site, suspected illegal dumping near the well field,

chemical spills from trucks passing on the new highway and the use of salt on the highway would affect the integrity of ground water supplying the Kellogg-Deering Well Field.

13. The safety of water provided by the NFTD, believing it to be unsafe for drinking. One resident was angry that he was forced to consume "carcinogenic" water as long as the carcinogen was within recommended levels of safety.

14. The full history of waste disposal and the filling in of Deering Pond had not been adequately addressed by EPA's investigation and constant monitoring of the site is necessary even after clean up.

15. Chemical contamination is suspect due to a repeated history of aquatic plants dying in Deering Pond and for skin irritation from pond water exposure to those people attempting the annual replanting.

16. What levels of contaminants are in household drinking water and what levels are considered unsafe for drinking?

The community health concerns expressed by the public are addressed in the Public Health Implications section.

ENVIRONMENTAL CONTAMINATION AND OTHER HAZARDS

The Kellogg-Deering Well Field Superfund Site is addressed by EPA site remediation activities in the realm of three Operable Units. Remedial Investigations, Feasibility Studies, and Records of Decision are addressed as Operable Units. Operable Unit 1 includes the Kellogg-Deering Well Field and has been defined as the well water treatment and distribution systems. Operable Unit 2 is defined as the source area of contamination reaching the well field. Operable Unit 3 is the downgradient area. Operable Unit 3 is still being investigated by EPA and will include the contamination not covered by the source area. The operable unit scheme was designed to assist in remedial actions and not to define geographical locations.

This public health assessment will refer to contamination in three geographic areas: the "Kellogg-Deering Well Field", the "Source Area" and the "Downgradient Area". The Source Area includes the Elinco/Pitney Bowes/Matheis Court Complex which was identified as the major source of pollution contaminating the well field. The Downgradient Area includes the area around the well field and source area. While these areas may parallel the Operable Units, as defined by EPA, this approach allows the public health assessment to deal more with geographical locations.

Though several contaminants exist within this site, TCE is detected most frequently and at the highest concentration. **The data and information discussed in this section are from EPA's Remedial Investigations.** EPA considers TCE to be the predominant contaminant of concern and TCE contamination has driven the remedial activities of the site. Other contaminants have been identified, however, and need to be considered for public health implications. In light of the metal plating and solvent cleaning activities confirmed within this site, contamination of soils and ground water within this site by metals and semivolatiles (polynuclear aromatic hydrocarbons) is possible.

Maps contained in Appendix A show the approximate site boundary, historic sampling/investigation areas, and a hydrogeologic cross section identifying the depth of monitoring wells.

A. On-Site Contamination

In 1975, TCE was discovered in ground water at the Kellogg-Deering Well Field. We do not have sufficient information to determine the extent or duration of human exposure to VOCs found in this public water supply prior to 1975 since testing of this water supply for VOCs prior to 1975 did not occur. If records of ground water use and total pumpage from the system prior to 1975 do exist, they were not obtainable. These records would be valuable for the estimation of human exposure to VOCs in combination with information gained in ground water sampling activities. Ground water modeling may also assist in giving a more accurate estimation of exposure.

The conclusions of a 1982-1983 hydrogeology and ground water quality study contracted by the Connecticut Light and Power Company (CL&P) indicated the CL&P landfill was not contributing VOC contamination to the ground water.(11)

Kellogg-Deering Well Field

Ground Water - Public Water Supply Distribution

Operable Unit 1 consists of the Kellogg-Deering Well Field and has been defined as the well water treatment and distribution systems. Contaminants in ground water drawn from the well field were detected for the first time by a CT DOHS water sample taken in 1975. Information identifying contaminants and the respective concentration of these contaminants occurring prior to, during, and subsequent to the initial detection date is severely limited by the lack of recorded data. Information on contaminants detected at the Kellogg-Deering Well Field between the initial detection date of 1975 and the implementation date of the redwood slat aerator at the Layne 2 well in 1981 is contained in Table 1. This information was compiled from random sampling data recorded at the Department of Health Services, Water Supply Section. Detection of contaminants other than TCE at sampling points within Kellogg-Deering Well Field supply water sources was sparse. These occurrences have been summarized in the Other Contaminants

section of this table. Sampling points are presented as Layne 1 (L1), Layne 2 (L2), Deering 1 (D1), Deering 2 (D2), and System Distribution Points (Dist). These sampling points are located within the NFTD water system. Sampling data from the supply wells indicate concentrations of contaminants from the Kellogg-Deering Well Field. Sampling data from the distribution points may include Kellogg-Deering Well Field supply water admixed with varying ratios of water from the surface water reservoirs. Distribution sampling points identified on the original laboratory report could not be identified to a point location within the water distribution system.

TABLE 1
Contamination at the Well Field
Ground Water TCE Concentrations (ppb)
1975-1981
(Ranges Detected)

Location	1975	1976	1977	1978	1979	1980
L1	0.75	-	-	5-14	-	67-200
L2	-	9-10	-	11-130	34-57	19
D1	-	-	-	63	15-76	ND-25
D2	-	2-14	-	5-14	9-18	6-33
D1 & D2	-	-	-	-	23	-
L2 & D2	-	-	-	-	65	-
Dist.	-	-	-	-	6-20	-

Other Contaminants Detected in Public Water Supply (ppb)

Compound	1975	1976	1977	1978	1979	1980	Comparison Value
Carbon Tetrachloride	-	tr-2	-	-	tr	-	5/0.3 (b,c)
Methyl Ethyl Ketone	-	-	-	-	tr-24	-	1000 (a)
Methylene Chloride	-	1-2	-	-	-	-	25/5 (a,c)
Tetrachloroethylene	-	tr	-	tr-2	tr-5	tr-26	5/0.7 (a,c)
1,1,1-Trichloroethane	-	.75-1	-	tr-2	1-7	tr	200 (a)

- The Connecticut state action level for TCE in ground water is 5 ppb--CREG is 3 ppb
- ND = not detected
- tr = trace amounts found below available detection limits

(a) Connecticut Action Level
(b) EPA Maximum Contaminant Level (MCL)
(c) Cancer Risk Evaluation Guide (CREG)

A redwood slat aerator was installed at the Layne 2 well by the NFTD in 1981. The redwood slat aerator was designed to treat contaminated ground water from the Layne 2 well at an efficiency rate of a 65% reduction in the levels of VOCs. Contaminants detected at the Kellogg-Deering Well Field between 1981 and 1987 are presented in Table 2. Sampling points are presented as Layne 1 (L1), Layne 2 (L2), Deering 1 (D1), Deering 2 (D2), and System Distribution Points (Dist). These sampling points are located within the NFTD water system. Sampling data from the supply wells indicate concentrations of contaminants from the Kellogg-Deering Well Field. Sampling data from the distribution points may include Kellogg-Deering Well Field supply water admixed with varying ratios of water from the surface water reservoirs. Distribution sampling points identified on original laboratory reports could not be identified to a point location within the water distribution system. Detection of contaminants other than TCE at sampling points within Kellogg-Deering Well Field supply water sources was sparse. These occurrences have been summarized in the Other Contaminants section of this table.

TABLE 2
Contamination at the Well Field
Ground Water TCE Concentrations (ppb)
1981-1987
(Ranges Detected)

Location	1981	1982	1983	1984	1985	1986	1987
L1	2-328	44-193	76-118	38-68	70-94	87-144	59-63
L2 (R)	6-152	15-92	9-10	10-137	23-102	31-163	55-94
L2 (A)	12-26	ND-12	17	6-24	8-366	tr-43	17-43
D1	6-360	6-17	7-38	8-25	-	5-40	13.7
D2	9-166	9-60	ND-28	5-21	5-14	9-16	10-24
D1&2	-	-	-	2-9	4-6	6-43	10-21
Dist.	-	-	-	-	-	6-14	-

TABLE 2 (CONTINUED)
Other Contaminants Detected in Public Water Supply (ppb)
(Ranges Detected)

Compound	1981	1982	1983	1984	1985	1986	1987	CV
Carbon Tetrachloride	ND-1	-	-	-	-	-	-	5/0.3 (b,d)
1,1 Dichloroethane	ND-4	-	ND-3	1-20	-	2	2	5 (c)
t-1,2-DCE	4-15	-	ND-11	1-11	-	2-43	2-45	200 (e)
Tetrachloroethylene	1-3	-	ND-3	-	-	tr-12	5	5/0.7 (a,d)
1,1,1-Trichloroethane	1-5	-	-	-	-	1	15	200 (a)

- The Connecticut action level for TCE is 5 ppb--CREG is 3 ppb
- (R) indicates raw sample (A) indicates aerated sample, others not known
- ND = not detected
- tr = trace amounts
- These data are a compilation of random sampling activities.
- Sample locations listed as 'D1&2' represent composites from both sources.
- All detectable concentrations have been rounded to whole numbers
- CV = Comparison value
- t-1,2-DCE = Trans-1,2-dichloroethylene

(a) Connecticut Action Level
(b) EPA Maximum Contaminant Level (MCL)
(c) Adopted from Massachusetts Guidelines (for the purpose of this public health assessment only)
(d) Cancer Risk Evaluation Guide (CREG)
(e) Reference Dose Media Evaluation Guide, calculated from EPA's reference dose (RMEG)
(f) EPA Lifetime Health Advisory (LTHA)

A more technically advanced packed tower air stripper, with a higher efficiency rate, was installed by the NFTD at the Kellogg-Deering Well Field in 1987. There was conflicting information on the start up date of this air stripper. Data collected by and stored with the CT DOHS Water Supply Section indicate the system became effective as of April 21, 1987. Data on the quality of ground water collected from the Kellogg-Deering Well Field from the period of April 21, 1987 to December of 1988 are contained in Table 3.

TABLE 3
Contamination at the Well Field
Ground Water TCE Concentrations (ppb)
(Ranges Detected)

Location	1987	1988
L1 (Raw)	-	-
L2 (Raw)	56-92	36-77
D1 (Raw)	-	ND
D2 (Raw)	11-12	5-9
D1&2 (Raw Mix)	10-21	ND-38
L2/D2 (Dist)	4	-
L2/D1&2	-	31-54
Packed Tower Air Stripper	BDL-1	ND

- The Connecticut state action level for TCE in ground water is 5 ppb--Cancer Risk Evaluation Guide (CREG) is 3 ppb.
- Sampling locations listed together represent composites of both sources.
- All water drawn from the Kellogg-Deering wells is run through the packed tower air stripper prior to treatment.
- ND = not detected
- BDL = below detection limits

Surface Water and Sediments - River and Pond

Table 4 is a compilation of data obtained from historical sampling activities of the Norwalk River. Additional sampling of the Deering Pond is presented in Table 5. EPA conducted additional toxicity testing of the Norwalk River and Deering Pond in 1990 in response to community concerns. The results do not indicate that these waterways have been significantly affected by Kellogg-Deering related contaminants.

TABLE 4
Contamination at the Well Field
Surface Water Concentrations (ppb)
(Ranges Detected)

Compound	1986	1987	1988	1989	CV
TCE	ND-8	ND-7	ND-15	ND	5/3 (a,c)
1,1,1,-Trichloroethane	-	ND-2	ND	ND	200 (a)
t-1,2-Dichloroethylene	-	ND	ND	ND-2	200 (d)
PCE	-	ND-2	ND	ND	5/0.7 (a,c)
Total Xylenes	ND-8	-	-	-	10,000 (b)
Methylene Chloride	ND-9	-	-	-	25/5 (a,c)

- ND = not detected
- CV = Comparison Value
- tr = trace amounts
- These data are a compilation of random sampling activities.
- All detectable concentrations have been rounded to whole numbers

(a) Connecticut Action Level
(b) EPA Maximum Contaminant Level
(c) Cancer Risk Evaluation Guide (CREG)
(d) Reference Dose Media Evaluation Guide, calculated from EPA's reference dose (RMEG)

TABLE 5
Contamination of the Downgradient Area
Surface Water Concentrations (ppb)
(Ranges Detected)

Compound	Surface Water	Comparison Value	Cancer Class
Trichloroethylene	ND-180	5/3 (a,c)	B2
Tetrachloroethylene	ND-2	5/0.7 (a,c)	B2
1,1,1-Trichloroethane	ND-2	200 (a)	D
Toluene	ND-150	1000 (a)	D
t-1,2-Dichloroethylene	ND-2	200 (d)	D
Methylene Chloride	ND-660,000	25/5 (a,c)	B2
Chloroform	ND-240	5/6 (e,c)	B2
Carbon Tetrachloride	ND-67,000	5/0.3 (b,c)	B2

ND = not detected
(a) Connecticut Action Level
(b) EPA Maximum Contaminant Level (MCL)
(c) Cancer Risk Evaluation Guide (CREG)
(d) Reference Dose Media Evaluation Guide, calculated from EPA's reference dose (RMEG)
(e) Adopted from Massachusetts Guidelines (for purposes of this public health assessment)

Investigations prior to the IRI/FS have been conducted in the Norwalk River within Operable Unit 1 (due to local point source spills). Several VOCs, including methylene chloride and carbon tetrachloride, were detected in surface waters at elevated concentration as seen in Table 5. These contaminants were related to specific discharge events and were not detected in ground water. Surface water/sediment samples were taken by EPA at three locations along the Norwalk River and at one location along a small stream flowing along the western edge of the Kellogg-Deering Well Field.

The Source Area

Levels of TCE and PCE have been identified at the source area in ground water, subsurface soil, subsurface soil gas, and indoor air. These contaminants and the range of contamination levels are discussed in the following text and charts.

Ground Water - Monitoring Wells

Operable Unit 2 is defined as the source area. In this area, TCE has been detected most frequently and at concentrations high enough to suggest proximity to an undissolved source of TCE. Concentrations do not indicate a DNAPL source throughout the entire source area. (DNAPL - dense non-aqueous phase liquid).(2) TCE and tetrachloroethylene (PCE) have been designated by EPA as indicator compounds for chemical contamination within Operable Unit 2 of this site. It is important to recognize that although TCE and PCE are considered by EPA to be the predominant contaminants of concern within Operable Unit 2, many other contaminants have been identified within the site and need to be considered for public health implications. In light of the metal plating and solvent cleaning activities confirmed within this site, contamination of soils and ground water within this site by metals and semivolatiles (polynuclear aromatic hydrocarbons) is possible. Table 6 contains ground water sampling data from the source area.

TABLE 6
Contamination of the Source Area
Ground Water Concentrations (ppb)

Compound	Range	Comparison Value	Cancer Class*
4-Methyl-2-pentanone	990 - 990	-	-
Benzene	2 - 65	1/1 ppb (a,e)	A
Toluene	4 - 14,000	1,000 ppb (a)	D
Ethylbenzene	2 - 5,800	700 ppb (c)	D
1,1,1-Trichloroethane	2 - 2,000	200 ppb (c)	-
1,1-Dichloroethane	6 - 14	5 ppb (d)	-
1,2-Dichloroethane	3 - 17	1/0.4 ppb (a,e)	B2
Tetrachloroethylene	6 - 68,000	5/0.7 ppb (a,e)	C
TCE	7 - 430,000	5/3 ppb (b,a)	B2
t-1,2-DCE	10 - 4,800	200 ppb (f)	D
1,1-Dichloroethylene	20 - 28	7/0.6 ppb (b,e)	C
Vinyl Chloride	4 - 10	2/0.2 ppb (a,g)	A
Chloroform	10 - 10	5/6 ppb (d,e)	B2
Methylene Chloride	5 - 16	25/5 ppb (a,e)	B2

t-1,2-DCE = Trans-1,2-dichloroethylene
(a) Connecticut Action Level
(b) EPA Maximum Contaminant Level (MCL)
(c) EPA Lifetime Health Advisory (LTHA)
(d) Adopted from Massachusetts Guidelines
(e) Cancer Risk Evaluation Guide (CREG)
(f) Reference Dose Media Evaluation Guide, calculated from EPA's reference dose (RMEG)
(g) ATSDR Environmental Media Evaluation Guide (EMEG)
* Definition of EPA Cancer Classification is contained in Appendix B.

Soil - Subsurface

Table 7 contains subsurface soil sampling data from the source area. Sampling data were collected at the Elinco/Pitney Bowes/Matheis Court complex, the Shell gas station across Main Street, and at Wesco, across from Polanksy Street. Soils at the gas station contained polynuclear aromatic hydrocarbons (PAHs) and lead. Soils at Wesco contained low concentrations of PCE. Soil analyses for residential areas within this site could not be distinguished from the summaries of all soil analyses.

TABLE 7
Contamination of the Source Area
Subsurface Soil Concentrations (ppb)

Compound	Range	Comparison Value Water*	Cancer Class**
Benzene	307-307	1 (a)	A
Toluene	1 - 1,785	1,000 (a)	D
Ethylbenzene	2 - 917	700 (c)	D
PCE	3 - 8,688	5 (a)	C
TCE	7 - 3,903	5 (b)	B2
Methylene chloride	3 - 100	5 (b)	B2
Bis(2-ethylhexyl)phthalate	400 - 3,000	10 (d)	-
Di-n-butyl phthalate	28 - 71	-	-
Acenaphthylene	110 - 450	-	-
Anthracene	180 - 570	-	D
Benzo(a)anthracene	110 - 4,800	0.1 (b)	
Benzo(b)fluoranthene	86 - 3,700	0.2 (b)	B2
Benzo(k)fluoranthene	24 - 3,100	0.2 (b)	B2
Benzo(g,h,i) perylene	24 - 3,100	-	B2
Benzo(a)pyrene	57 - 4,000	0.2 (b)	B2
Benzo(k)fluoranthene	24 - 3,100	0.2 (b)	D
Chrysene	67 - 4,000	0.3 (b)	B2
Dibenzo(a,h)anthracene	170 - 170	-	B2
Fluoranthene	100 - 4,700	-	B2
Fluorene	350 - 350	-	-
Indeno(1,2,3-cd)pyrene	420 - 2,800	0.3 (b)	D
Naphthalene	300 - 300	-	B2
2-Methylnaphthalene	55 - 55	-	D
Phenanthrene	49 - 2,400	-	-
Pyrene	90 - 4,760	-	D
Benzoic Acid	1,800 - 1,800	-	-
Dibenzofuran	240 - 240	-	-
Alpha Chlordane	39 - 39	0.5 (b)	B2
Gamma Chlordane	48 - 48	0.5 (b)	B2
Lead	ND - 796	0.5 (b)	B2
Aluminum	108 - 57500	-	-
Tin	ND - 29	-	-
Cyanide	ND - 17	-	-
Chromium	ND - 237	100 (b)	D
Cobalt	ND - 713	-	-
Silver	ND - 71	100 (c)	
Titanium	1900 - 7394	-	-
Cadmium	ND - 20	5 (b)	D

(a) Connecticut Action Level
(b) EPA Maximum Contaminant Level
(c) EPA Health Advisory; Lifetime Adult
(d) Adopted from Massachusetts Guidelines

* A major goal of the CT DEP in soil remediation is to eliminate actual and potential sources of pollution to the waters of the state. State action levels for water are listed in the following table as reference criteria, used for developing cleanup strategies in soil by the CT DEP. These action levels are not action levels for exposure to contaminated soil.

** Definition of EPA Cancer Classification is contained in Appendix B.

Soil - Subsurface Soil Gas Analysis

Soil gas analysis data were collected for the Elinco/Pitney Bowes/Matheis Court complex only. Soil gas analyses do not exist for other areas of the Kellogg-Deering Well Field Superfund site. Table 8 outlines the range of soil gas contamination. The Occupational Safety and Health Administration's (OSHA) Permissible Exposure Limits (PEL) are included for comparison due to their applicability in evaluating indoor air contamination.

TABLE 8
Contamination of the Source Area

Soil Gas Analysis (mg/m3)

Compound	Range	PEL (mg/m3)	Cancer Class
Ethylbenzene	12 - 12	435	D
1,1,1-TCA	14 - 50	1900	D
PCE	115-5,640	170	C
TCE	22-14,890	270	B2

PEL = Permissible Exposure Limit as a time weighted average.

Indoor Air

Indoor air sampling was done at the Elinco/Pitney Bowes/Matheis Complex. Several samples were taken within each of the three complex buildings. Table 9 summarizes the indoor air concentrations for TCE and PCE. OSHA's PEL levels are included for comparison.

TABLE 9
Contamination of the Source Area

Indoor Air Concentration (mg/m3)

Location	January 11, 1989		January 12, 1989	
	TCE	PCE	TCE	PCE
Zell Building 1	.020-.260	BDL-.008	.050-.295	.013-.018
Zell Building 2	.023-.052	BDL-.011	.021-.044	.004-.009
Elinco Building	.396-.584	.011-.016	.281-.764	.020-.045

• The permissible exposure limit (PEL) is 170 mg/m3 - PCE and 270 mg/m3 - TCE

Downgradient Area

Table 10 lists concentrations of various pollutants found in the Kellogg-Deering Well Field Superfund site study area defined by EPA as Operable Unit 3 (or the downgradient area) and further demonstrates that contamination is not confined to the well field (Operable Unit 1) nor is it confined to the source area (Operable Unit 2). This information suggests that additional characterization of Operable Unit 3 is necessary to assess the extent of contamination.

Ground Water - Monitoring Wells

TABLE 10
Contaminant of Downgradient Area

Ground Water Concentrations (ppb)
(Ranges Detected)

Compound	Ground water Value	Comparison	Cancer Class
TCE	ND - 2,870	5/3 (a,c)	B2
PCE	ND - 42	5/0.7 (a,c)	B2
1,1,1-TCA	ND - 17	200 (a)	D
Toluene	ND	1000 (a)	D
t-1,2-DCE	ND - 300	200 (d)	D
Methylene Chloride	ND - 2.6	25/5 (a,c)	B2
Chloroform	ND - 27	5/6 (a,e)	B2
Carbon Tetrachloride	ND	5/0.3 (b)	B2

- ND = not detected

(a) Connecticut Action Level
(b) EPA Maximum Contaminant Level
(c) Cancer Risk Evaluation Guide (CREG)
(d) Reference Dose Media Evaluation Guide, calculated from EPA's reference dose (RMEG)
(e) Adopted from Massachusetts Guidelines

As part of this public health assessment, the EPA Toxic Chemical Release Inventory and the CT DEP Water Compliance, Leachate and Wastewater Discharge Sources Inventory were researched. A search through the EPA Toxic Chemical Release Inventory (TRI) has identified an industrial company in Muller Industrial Park as being an air emissions

point source in 1988 for 1,2,4-trichlorobenzene. This source was not reported in 1987 or 1989. TRI information shows that on-site disposal did not occur between 1987 - 1989. Information from the CT DEP Water Compliance Unit, Leachate and Wastewater Discharge Sources Inventory shows that there was an oil leak at Muller Industrial Park and a former construction material dumpsite on the west bank of Deering Pond.

B. Off-Site Contamination

The Kellogg-Deering Superfund Site is defined as the extent of contamination affecting the Kellogg-Deering Well Field. The site is being addressed in three operable units for purposes of remediation activities. Operable Unit 3, the downgradient area including contamination not covered by the source area, is still being investigated and defined by EPA. Because Operable Unit 3 is considered part of the site and is still being defined, it is not appropriate to consider what may be called "Off-Site" at this time.

C. Quality Assurance and Quality Control

Data generation in the attempt to characterize the scope of chemical contamination within the Kellogg-Deering Well Field Superfund site, began in 1975 and has continued to the present (1991). Several agencies and laboratories have been involved in the generation of data over the years. Quality assurance guidelines have been met with the generation of many data sets used in this assessment despite the fact that the laboratories involved may have used different methodologies and laboratory practices. In preparing this public health assessment, ATSDR relies on the information provided in the referenced documents and assumes that adequate quality assurance and quality control measures were followed with regard to chain of custody, laboratory procedures, and data reporting. The validity of the analysis and conclusions drawn for this public health assessment are determined in part by the completeness and reliability of the referenced information.

D. Physical and Other Hazards

No physical hazards were noted.

PATHWAY ANALYSES

To determine whether people within or nearby this site have been, are, or may be exposed to contaminants within or migrating from this site, ATSDR evaluates the environmental and human components that lead to human exposure. This pathways analysis consists of five elements: a source of contamination, transport through an environmental media, a point of exposure, a route of human exposure, and an exposed

population. ATSDR categorizes an exposure pathway as a completed or potential exposure pathway if the exposure pathway cannot be eliminated. A completed pathway exists if all five elements are present and indicate that exposure to a contaminant has occurred in the past, is currently occurring, or will occur in the future. Potential pathways, however, exist if at least one of five elements is missing, but could exist. Potential pathways indicate that exposure to a contaminant could have occurred in the past, could be occurring now, or could occur in the future. An exposure pathway can be eliminated if at least one of the five elements is missing and will never be present. As discussed in the Site Description and History subsection, disposal practices of past industrial waste activity at the Elinco/Pitney Bowes/Matheis Court complex (formerly Zell Manufacturing, Inc.) have resulted in contamination of subsurface soil, ground water, a municipal well field, and indoor air.

The population potentially affected by contaminants from this site include residents within and about the site who may be using contaminated ground water, employees within the site who may also be exposed to contaminated ground water, and employees working in buildings which have concentrated levels of volatilized contaminants from soil and ground water. Customers of the Norwalk First Taxing District Water Supply Company (NFTDWSC) that were probably exposed to contaminants via ingestion and inhalation of and skin contact with the public water supply prior to the implementation of the air stripper at the well field are also included in the population potentially affected by site contaminants.

The following subsections discuss the environmental and human exposure pathways that exist for this site. The only currently identified completed exposure pathway is because of past exposure to contaminants found in the wells operated by the NFTDWSC--the remaining pathways discussed below are considered to be potential exposures.

Ground Water Pathway

Ground water within the Kellogg-Deering site has been contaminated. Ground water is found in both the bedrock and overburden material and flows west-southwest. The depth of the water table ranges from 0-37 feet.

A relatively large bedrock fracture zone exists. These fractures are capable of transmitting contaminated ground water. Monitoring data indicates that contaminated groundwater is following fracture patterns deep into bedrock. The Norwalk River is not a barrier to groundwater flow. Contaminated groundwater is flowing beneath the River and reaching the well field on the southern edge of the River.

Private Water Supply

A private well user survey was conducted in 1992 by the local health department to identify the use of private well water within or near the site. No private well use was identified at the time of the survey. However, we can not eliminate the potential for private well use prior to the survey.

Public Water Supply

Contamination of the well field was first identified in 1975. The first well was installed in 1955 and the source of contamination may have originated as early as 1945. There is no water quality data available from 1955-1975. During this time, customers of the Norwalk First Taxing District water supply company were exposed to undetermined amounts of contaminants via ingestion of water used for drinking and cooking, inhalation of vapors from showering or bathing and dermal absorption from bathing.

In 1981, a redwood slat aerator was installed at the well field and in 1987 an upgraded air stripper was installed. Water sampling indicates that the air stripper has been very effective in removing site related contaminants from the water drawn at the well field. Customers of the Norwalk First Taxing District are not currently being exposed to contamination through the use of the public water supply.

Surface Water and Surface Water Sediment Pathway

Claims have been made by wetlands restoration personnel that surface waters and surface water sediments of Deering Pond have been adversely impacted by chemical contamination. Workers reported severe dermal reactions from being in the pond water and disturbing pond water sediments. Surface water and sediment sampling as well as toxicity testing indicate that Kellogg-Deering related contaminants have not adversely affected these waters. Hydrogeology also indicates that contaminated ground water is travelling below the Norwalk River and is not intercepting the River's banks (CT DEP Files).

Food Pathway

While claims have been made about possible contamination of surface water and sediments, existing data on surface water and sediments do not indicate that contamination has occurred. The major contaminant of concern, TCE, is not known to bioaccumulate in fish. Additional toxicity testing for the Norwalk River and Deering Pond was conducted in 1990. These results indicate that these waterways have not been significantly affected by Kellogg-Deering related contaminants.

Air Pathway

Soil gas samples from around the source area indicate that contaminants below land surface are making their way to the land surface and volatilizing into the atmosphere. The potential for this is minimized, however, by the fact that nearly the entire source area is paved or covered by buildings.

Ambient Air

Residents may be exposed to emissions from the neighboring air stripper at the Source area and at the Well Field.

Indoor Air

An addendum to the supplemental remedial investigation and feasibility study shows that indoor air concentrations of TCE and PCE reached levels of 143 ppb (764 ug/m3) and 7 ppb (45 ug/m3), respectively.

Those people working in buildings located on the Elinco/Pitney Bowes/Matheis Court Complex may be exposed via inhalation, to contaminants volatilizing from soil and ground water into the air and concentrating in confined spaces (basements, small rooms or closets).

The limitations of the information available to characterize environmental contamination and past, present, and future human exposure pathways include, the available data on ambient air near the two air strippers at the source area and the well field and the identification of those people using private well water prior to the survey.

PUBLIC HEALTH IMPLICATIONS

As discussed in the Environmental Contamination and Other Hazards and Pathways Analysis sections, any one with access to ground water within the approximate boundaries of this site could be exposed to unacceptable concentrations of VOCs, primarily trichloroethylene (TCE) if access to ground water through the installation of private wells occurred. People outside site boundaries may also be at risk as transport of contaminants in ground water through migration patterns in bedrock fractures cannot effectively be identified or contained.

A. Toxicological Evaluation

Introduction

In this section we will discuss the possible adverse health effects in persons exposed to site contaminants and evaluate state and local health data resources. To evaluate health effects, ATSDR has developed a Minimal Risk Level (MRL) for contaminants commonly found at hazardous waste sites. The MRL is an estimate of daily human exposure to a contaminant below which non-cancer, adverse health effects are unlikely to occur. MLRs are developed for each route of exposure such as ingestion, inhalation, and dermal absorption and for the length of exposure, such as acute (less than 14 days), intermediate (15 to 364 days), and chronic (greater than 364 days). ATSDR also develops Toxicological Profiles on chemicals commonly found at hazardous waste sites. The chemical-specific profiles provide information on health effects, environmental transport, human exposure, and regulatory status. **The ATSDR Toxicological Profiles are used in this section to discuss the toxicological implications of the contaminants of concern at this site.**

TCE

TCE exposure has occurred through ingestion of contaminated ground water, inhalation of vapors from showering or bathing with contaminated ground water, and dermal absorption from showering and bathing in contaminated ground water. TCE exposure also occurred from inhalation of vapors from within the industrial buildings. Whether the concentrations of exposure were high enough to be associated with non-carcinogenic adverse health effects can not be assessed. It appears that ground water from the Kellogg-Deering Well Field may have been diluted enough by the mixing process of adding other water sources, that contamination did not occur in concentrations high enough to elicit a toxicologic, non-carcinogenic effect. A private well user survey did not identify any private wells within or near the site. This survey was conducted at a point in time and does not eliminate the possibility of private wells existing prior to the survey.

TCE exposure may also have occurred from inhalation of vapors concentrating in indoor air, and inhalation of vapors in ambient air.

Because exposure to TCE may have occurred through multiple exposure pathways, ATSDR's MRLs, which were developed for single routes of exposure, should be used with caution. Since little or no research information is available on dermal absorption of TCE, ATSDR does not have MRLs for dermal exposure. ATSDR also lacks a chronic MRL for inhalation and ingestion (ATSDR Toxicological Profile for Trichloroethylene).

Animal studies have shown that ingesting or breathing TCE can produce nervous system changes; liver and kidney damage; effects on the blood; cancer of the liver, kidney, lung, and male sex organs. In addition, animal studies have shown that leukemia, a cancer of the tissues that form white blood cells, is possible. Studies also have shown effects on unborn and newborn animals; at present, insufficient information exists to determine whether these effects can occur in humans.

Occupational studies of workers exposed to TCE have not detected TCE-induced cancer. Since site data and information do not exist to quantify human exposure from TCE (i.e, concentration and duration), we cannot determine the excess lifetime cancer risk from past inhalation or ingestion exposure.

PCE

PCE exposure has occurred through ingestion of contaminated ground water, inhalation of vapors from showering or bathing with contaminated ground water, and dermal absorption from showering and bathing in contaminated ground water. Whether the concentrations of exposure were high enough to be associated with non-carcinogenic adverse health effects can not be assessed. It appears that ground water from the Kellogg-Deering Well Field may have been diluted enough by the mixing process of adding other water sources, that contamination did not occur in concentrations high enough to elicit a toxicologic, non-carcinogenic effect. If there are homes within the site that are using private water sources, this may not be the case.

PCE exposure may also have occurred from inhalation of vapors concentrating in indoor air, and inhalation of vapors in ambient air. Because exposure to PCE may have occurred through multiple exposure pathways, ATSDR's MRLs, which were developed for single routes of exposure, should be used with caution. Since little or no research information is available on dermal absorption of PCE, ATSDR does not have MRLs for dermal exposure. ATSDR also lacks a chronic MRL for inhalation (ATSDR Toxicological Profile for Tetrachloroethylene).

Animal studies have shown that ingesting PCE can produce nervous system changes; liver and kidney damage; and cancer of the liver. Breathing PCE can produce nervous system changes; liver and kidney damage, and cancer of the liver in animals. In addition, animal studies have shown that leukemia, a cancer of the tissues that form white blood cells, is possible. Studies also have shown effects on unborn and newborn animals; although, at present, insufficient information exists to determine whether these effects can occur in humans.

Occupational studies of workers exposed to PCE have not detected PCE-induced cancer. Since site data and information do not exist to quantify exposure from PCE (i.e., concentration and duration), we cannot determine the excess lifetime cancer risk from past inhalation or ingestion exposures.

Methylene Chloride

Methylene chloride exposure may have occurred through dermal absorption from contact with contaminated surface waters or surface water sediments. If the surface waters or surface water sediments prove to be contaminated, exposure may also have occurred through the ingestion of fish and waterfowl caught from Deering Pond, Kellogg Pond, and the Norwalk River.

Because exposure to methylene chloride may have occurred through multiple exposure pathways, ATSDR's MRLs, which were developed for single routes of exposure, should be used with caution. Since little or no research information is available on dermal absorption of methylene chloride, ATSDR does not have MRLs for dermal exposure. ATSDR also lacks an acute MRL for ingestion (ATSDR Toxicological Profile for Methylene Chloride).

Limited or no data is available to assess the toxicity of dermal exposure to methylene chloride. Animal studies have shown that methylene chloride is absorbed through the skin.

Occupational studies of workers exposed to methylene chloride have not detected methylene chloride-induced cancer. Since site data and information do not exist to quantify human exposure from methylene chloride (i.e., concentration and duration), we cannot determine the excess lifetime cancer risk from past dermal exposures.

Carbon Tetrachloride

Carbon tetrachloride exposure may have occurred through dermal absorption from contact with contaminated surface waters or surface water sediments. If the surface waters or surface water sediments prove to be contaminated, exposure may also have occurred through the ingestion of fish and waterfowl caught from Deering Pond, Kellogg Pond, and the Norwalk River.

Because exposure to carbon tetrachloride may have occurred through multiple exposure pathways, ATSDR's MRLs, which were developed for single routes of exposure, should be used with caution. Since little or no research information is available on dermal absorption of carbon tetrachloride, ATSDR does not have MRLs for dermal exposure. ATSDR also lacks a chronic MRL for ingestion and inhalation (ATSDR Toxicological Profile for Carbon
Tetrachloride).

Limited data is available to assess the toxicity of dermal exposure to carbon

tetrachloride. Carbon tetrachloride is rapidly absorbed through the skin. In humans, direct dermal contact with carbon tetrachloride causes a mild burning sensation with mild reddening of the skin. Some individuals appear to be hypersensitive, developing marked swelling, itching, and blistering following dermal contact. Similar effects of carbon tetrachloride have been described in animal studies. Carbon tetrachloride can lead to systemic effects similar to those observed following oral and inhalation exposures; nervous system changes, liver and kidney damage, and gastrointestinal disturbances.

Studies in animals show that carbon tetrachloride taken by mouth can increase the frequency of liver tumors. Studies have not been performed to determine if breathing or dermal exposure to carbon tetrachloride causes tumors in animals. Studies do not exist to show that cancer will be produced in humans. Occupational studies of workers exposed to methylene chloride have not detected methylene chloride-induced cancer. Since site data and information do not exist to quantify human exposure from methylene chloride (i.e., concentration and duration), we cannot determine the excess lifetime cancer risk from past dermal exposures.

B. Health Outcome Data Evaluation

The contaminants of concern for this site can be placed in the category of VOCs. Various forms of cancer are postulated to be associated with overexposure to VOCs. The most common and the most frequently occurring cancers associated with VOC exposure include those of the liver, kidney, bladder and blood forming organs (ATSDR Toxicological Profiles). For this reason, liver, kidney, and bladder tumors and leukemia (cancer of blood forming organs) were used as parameters in exploring the possibility of adverse health effects from exposure to contaminants within this site. The occurrences of these four cancer types were assessed to identify the possible association between ground water contamination of the Kellogg-Deering Well Field Superfund Site and an increase in the occurrence of cancer in those people exposed to the contamination. Data were collected from the Connecticut Tumor Registry for the period of 1965-1974 and 1975-1984. These data were used to compare standard incidence ratios (the observed number of cancers divided by the expected number of cancers) in Norwalk to those of the whole state of Connecticut. The data were adjusted to account for age. There was no increase in the incidence of these four tumor types in any of the age categories for either 10 year period as compared with state data. In fact, the data show that local rates were lower than those of the state. The following chart represents the overall standard incidence ratios for the periods 1965-1974 and 1975-1984 and includes a 95% confidence interval. (A 95% confidence interval means we are 95% sure that given the chance this number is in error, the new number would be within the specified ranges.)

Overall Standard Incidence Ratio (SIR)

1965-1974	Observed	Expected	SIR	Upper 95%	Lower 95%
Leukemia	61	113.23	0.539	0.674	0.404
Liver	14	18.77	0.745	1.136	0.355
Bladder	137	170.72	0.802	0.937	0.668
Kidney	45	72.84	0.618	0.798	0.437
1975-1984					
Leukemia	98	132.75	0.738	0.885	0.952
Liver	21	27.20	0.772	1.102	0.442
Bladder	144	249.73	0.577	0.671	0.482
Kidney	53	100.39	0.528	0.670	0.386

Data were also obtained from the Connecticut Tumor Registry to look specifically at a smaller subsection, the census tract most closely associated with the site. The statistics do not show that cancer has developed as a result of exposure to contaminants within this site. However, statistics used to evaluate disease are not always sensitive enough to detect adverse health effects in small populations about a point source. Also, if the latency period has prevented cancer from manifesting during the years 1964-1988, this information would not be represented in this analysis.

To better understand the plausibility of acute or chronic systemic effects occurring from exposure to contaminants within this site, the Norwalk City Health Department was consulted. No reports of adverse health effects from workers or residents of the Kellogg-Deering Well Field Superfund site were recorded.

C. Community Health Concerns Evaluation

Community concerns regarding health issues at the site are addressed in this section. Citizens expressed their concerns during the public health assessment process and during a thirty day public comment period announced in July 1992. All of the comments received are summarized in the Community Health Concerns Section of this public health assessment. Many of the concerns expressed by the community were related to issues not within focus of the this public health assessment. These comments and concerns were brought to the attention of the appropriate agency.

We have addressed each of the community concerns about health as follows:

1. What are the potential health effects from cumulative exposure to solvents, such as TCE in drinking water?

Animal studies have shown that ingesting or breathing TCE can produce nervous system changes; liver and kidney damage; effects on the blood; and cancer of the liver, kidney, lung, and male sex organs. Insufficient information exists to determine whether these

effects can occur in humans. Occupational studies of workers exposed to TCE have not detected TCE induced cancer.

We do not have sufficient information to determine the extent and duration of exposure to VOC's in the public water supply prior to 1975. We do believe that the contaminated water was diluted enough by the mixing of other water sources that exposure did not occur in concentrations high enough to cause adverse, non-carcinogenic effects. Because of the potential association between TCE and certain cancers, the rates of leukemia, liver, bladder, and kidney cancers were evaluated for years 1965-1974 and 1975-1984. No increases above expected values were seen.

2. TCE spills upstream of Deering Pond could have migrated to the pond and settled in the pond bottom.

Surface water and sediment sampling in the Norwalk River and Deering Pond do not indicate that these waterways have been significantly affected by Kellogg-Deering related contaminants. If TCE spills occurred upstream of Deering Pond, it is possible that dilution and mixing significantly reduced the detectable levels of the TCE.

3. The quality of municipally supplied water from the period of contaminant discovery(1975) until implementation of aeration techniques(1987).

TCE concentrations were monitored at various locations within the water distribution system from 1975 to the present. In 1981 a redwood slat aerator was installed at the Layne 2 well. From 1975-1981, TCE concentrations within the distribution system ranged from non-detectable to 200 parts per billion. The highest concentrations occurred at individual public supply wells. Water is supplied to residents after this water is mixed with uncontaminated water from other sources. After 1981, the aerated water from the use of the aeration unit on the Layne 2 well significantly reduced the concentrations of TCE. In 1987 a packed tower air stripper was installed and water monitoring data indicates that TCE is being affectively removed from the water to below levels of public health concern.

4. Chemical contamination is suspect due to a repeated history of aquatic plants dying in Deering Pond and for skin irritation from pond water exposure to those people attempting the annual replanting.

Surface water and sediment sampling in the Norwalk River and Deering Pond during the Remedial Investigations do not indicate that these waterways have been significantly affected by Kellog-Deering related contaminants. If chemical spills occurred during the plantings, surface water sampling for the Remedial Investigations may not have detected these contaminants.

5. What levels of contaminants are in household drinking water (public water supplies) and what levels are considered unsafe for drinking?

TCE was not detected in public water treated by the packed tower air stripper. The CTDHS has set a limit of 5 ppb for TCE in drinking water. This is the level at which no adverse health effects are expected to occur from exposure.

CONCLUSIONS

1. From the information reviewed, this site is judged to be an indeterminate public health hazard. There is evidence showing that there was an exposure to the customers of the water supply however, available data of the health effects does not show a correlation between that exposure and adverse health effects within the exposed populations. In addition, sufficient information concerning the extent and duration of exposure to contaminated groundwater prior to 1975 is not available.

2. A private well user survey was conducted to determine whether anyone was currently drinking or using groundwater within and near the site. No private wells were identified, however, we do not know if private wells were used prior to the survey.

3. Information which has been obtained to identify the extent and duration of contaminant exposure from ingestion of the public water supply is not adequate to estimate qualitative or quantitative exposure to contaminants. One critical piece of information which would aid in the estimation of exposure is documentation of pumpage and distribution activity at the well field. Other information, if it exists, would be additional sampling data between the years 1975 and 1987.

4. Exposure to airborne contaminants is occurring within industrial buildings at the Elinco/Pitney Bowes/Matheis Court complex and may be occurring at concentrations above recommended safe exposure levels, however, monitoring data to date do not indicate concentrations above the PELs. The areas of airborne contaminants to be considered within this site include off-gassing from contaminated soil at the source area, concentration of contaminants in confined air spaces such as industrial and commercial buildings on site, and air emissions from the air strippers located at the well field and the source area.

5. Communication of Superfund site activities should occur for anyone living or working in the site area.

6. Evaluation of the health outcome data indicates the exposed population is not experiencing an increased incidence of the four cancer types investigated for this site. However, if the latency period has prevented cancer from manifesting during the year 1964-1988, this information would not be represented in this analysis.

RECOMMENDATIONS

1. An investigation should be conducted to ensure that no one within or near the site is using contaminated water from private ground water sources.

2. Air monitoring activities should be conducted on a routine basis to ensure that vapors from off-gassing of contaminated soils at the Elinco/Pitney Bowes/Matheis Court complex are not entering the industrial buildings and concentrating in indoor air at levels exceeding recommended exposure limits.

3. Data should be developed on a routine basis to ensure that the emissions from the air stripping facilities at the Elinco/Pitney Bowes/Matheis Court complex and at the Kellogg-Deering Well Field, are not exceeding recommended exposure limits.

4. Communications should be expanded to alert the populations within and near this site of the potential impact contaminants presently contained within subsurface soil and ground water within this site, may present if these contaminants migrate to areas where an exposure pathway can be considered complete. This would include alerting residents of the potential migration of contaminants to area surface waters, and the potential for contaminants to be released upon excavation of area soils particularly at the source area.

5. The local health department should establish a record regarding adverse health effects expressed by those people who feel they are or have been exposed to site contaminants.

Health Activities Recommendation Panel Recommendations

The information and data developed in the public health assessment for the Kellogg-Deering Well Field site, Norwalk, Connecticut, has been evaluated by ATSDR's Health Activities Recommendations Panel for appropriate follow-up with respect to health activities. Past exposure to site contaminants probable has occurred; however, the duration and levels of exposure are not known. The panel recommends that community health education be performed to inform and educate the population about their potential for exposure and assist in interpreting adverse health occurrences in their community. No further public health actions are indicated at this time. The Connecticut Department of Health Services will perform the community health education activities.

PUBLIC HEALTH ACTION PLAN

The Public Health Action Plan (PHAP) for the Kellog-Deering Well Field site contains a description of actions taken and to be taken by ATSDR and/or the CT DOHS at and near the site, following completion of this public health assessment. For those actions already taken at the site, please refer to the Background section of this public health

assessment. 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 past, present and/or future exposures to hazardous substances at or near the site. Included, is a commitment on the part of ATSDR and/or the CT DOSH to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by ATSDR and/or the CT DOSH are as follows:

Public Health Actions Taken:

1. A fact sheet developed for the general public outlining the history of the site, the extent of contamination, exposure potential and health concerns for the site has been disseminated to residents near and within the site.

2. This site has been referred to ATSDR's Dose Reconstruction Program for consideration to determine duration and levels of past exposure through the ingestion of contaminated public water supplies.

3. The Norwalk City Health Department, in cooperation with the CTDHS, conducted a survey of all residents near and within the site area to ensure that no residence is using contaminated water from a private ground water source.

Public Health Actions Planned:

The Norwalk City Health Department in cooperation with the State of Connecticut Department of Health Services will conduct the following public health actions:

1. Reports regarding adverse health effects, as communicated by residents near and within the site, will be documented and recorded in an organized manner.

2. ATSDR and CT DOHS will coordinate with the appropriate environmental agencies to develop plans to implement the recommendations contained in this public health assessment.

3. ATSDR will provide an annual follow-up to the PHAP, outlining the actions completed and those in progress. This report will be placed in repositories that contain copies of this public health assessment, and will be provided to persons who request it.

ATSDR will reevaluate and expand the Public Health Action Plan when needed. New environmental, toxicological, or health outcome data, or the results of implementing the above proposed actions may determine the need for additional actions at this site.

CERTIFICATION

The public health assessment for the Kellog-Deering Well Field site was prepared by the Connecticut Department of Health Services 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 initiated.

Gregory V. Ulirsch

Technical Project Officer, SPS, RPB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this public health assessment and concurs with its findings.

Division Director, DHAC, ATSDR

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References

1. Environmental Protection Agency Region 1, "Remedial Investigation Report: Kellogg-Deering Site, Norwalk, Connecticut", Boston, MA: Environmental Protection Agency Volume 1-2, 1986.

2. NUS Corporation, "Final Supplemental Remedial Investigation and Feasibility Study; Kellogg-Deering Superfund Site, Norwalk, Connecticut", Environmental Protection Agency Region 1: Volumes 1-4, 1989

3. Beveridge and Diamond, P.C., "Kellogg-Deering Superfund Site: Letter", Washington, D.C., 1989

4. Environmental Protection Agency, "Record of Decision, Declaration Statement, Kellogg-Deering Well Field Superfund Site, Operable Unit 2 - Source Control", Boston, MA: Environmental Protection Agency, 1989.

5. Environmental Protection Agency, "Record of Decision, Remedial Alternative Selection, Operable Unit 1", Boston, MA: Environmental Protection Agency, 1986.

6. Environmental Protection Agency Region 1, "Final Supplemental Remedial Investigation and Feasibility Study, Kellogg-Deering Superfund Site, Norwalk, CT; RI Addendum "Indoor Air Quality Survey", Boston, MA: Environmental Protection Agency, 1989.

7. Environmental Protection Agency Region 1, "Kellogg-Deering Well Field Site, The Norwalk First Taxing District Water Department, Respondent; Administrative Order", Boston, MA: Environmental Protection Agency, 1987

8. Environmental Protection Agency Region 1, "Risk Assessment: Kellogg-Deering Well Field Site, Norwalk, Connecticut", Boston, MA: Environmental Protection Agency, 1989.

9. Roald Haestad, Inc., "First District Water Department, Norwalk, CT; Comprehensive Water Supply Plan", Waterbury, CT: 1987

10. Norwalk First Taxing District Water Department, "Test Drilling - Test Pumping for Trichloroethylene, Source Evaluation, Kellogg-Deering Well Field, Norwalk, Connecticut", Norwalk, CT: Year?

11. Geraghty and Miller, Inc., "Hydrogeology and Ground Water Quality Study, 1982-1983, Connecticut Light and Power Company Landfill, Smith Well Field, Norwalk, Connecticut", Syosset, New York: 1983

12. HRP Associates, Inc., "Hydrogeologic and Engineering Report on the Extent of Contamination and Remedial Options Available for the Elinco Division of EDO Corporation, 272 Main Avenue, Norwalk, Connecticut", New Britain, CT: 1984.

13. Fuss and O'Neill, "Hydrogeologic Investigation, Bardanise Buildings, 272 Main Avenue, Norwalk, Connecticut, Manchester, CT: 1986.

14. Department of Health Services, "Kellogg-Deering Well Field Site, Norwalk, Connecticut: Memorandum", Atlanta, GA: Center for Disease Control, 1984

15. Norwalk Water Force/CCAG, "EPA Superfund, Kellogg-Deering Well Field: Letter", Norwalk, C: 1984.

16. Environmental Protection Agency Region 1, "Superfund Record of Communication", Boston, MA: Environmental Protection Agency, January 12, 1984.

17. Department of Environmental Protection, "Norwalk, CT - Dumping Violation on Desmond Property on Perry Avenue; Letter", Hartford, CT: State of Connecticut, 1981.

18. Department of Health and Human Services, "Health Assessment: SI-86-192 A&B, Kellogg-Deering Site, Norwalk, Connecticut; Letter", Atlanta, GA: Center for Disease Control, 1986.

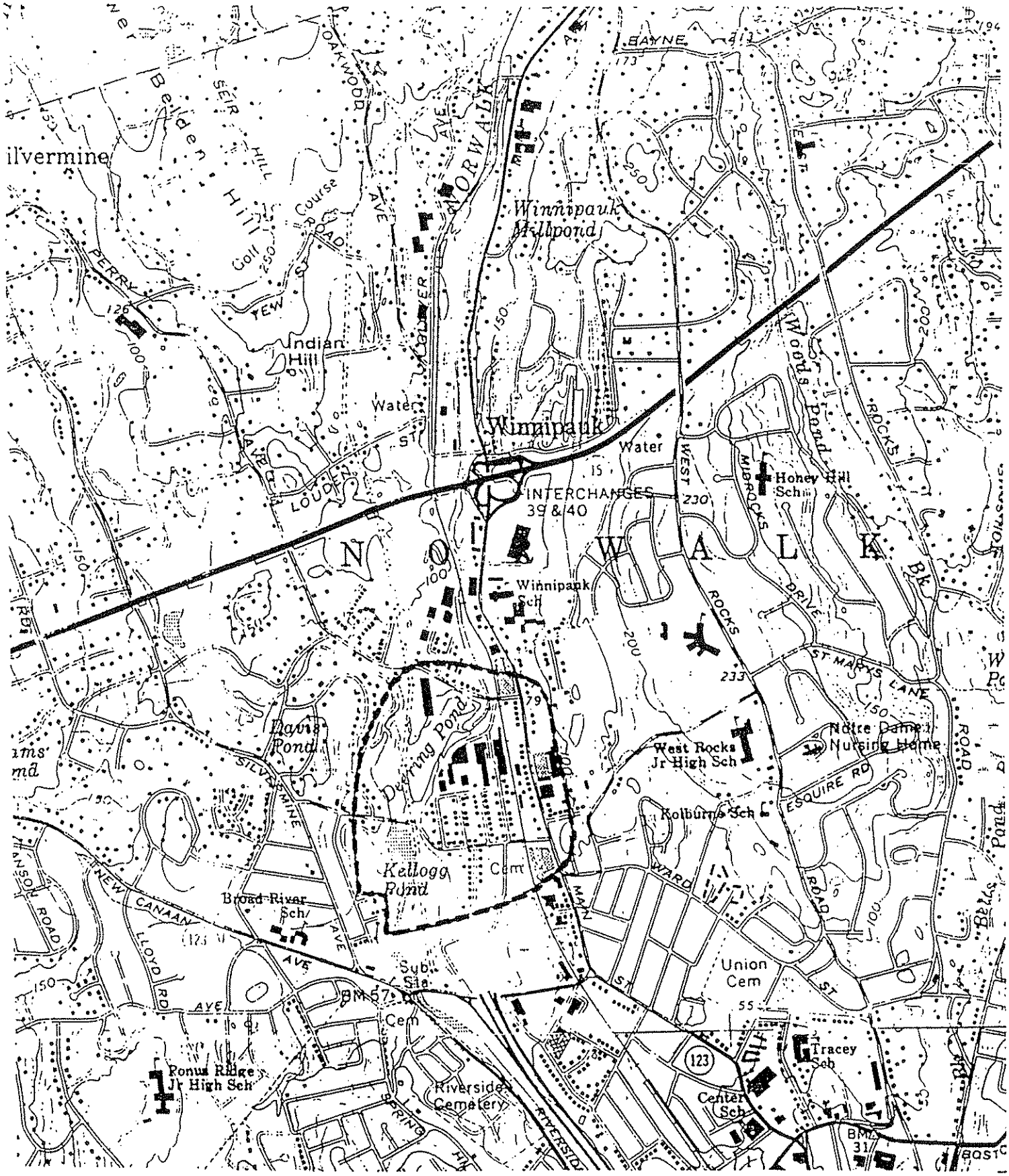
19. Department of Health Services, "Norwalk First Taxing District (NFTD), Deering Well Field Air Tower; Letter", Hartford, CT: State of Connecticut, 1988.

20. Agency for Toxic Substances and Disease Registry, "Preliminary Health Assessment for Kellogg-Deering Site, Norwalk, Connecticut, CERCLIS No. CTD98060314, October 23, 1986", Atlanta, GA: U.S. Public Health Service, 1988.

21. Environmental Protection Agency Region 1, "EPA Proposed Cleanup Plan for the Kellogg-Deering Superfund Site", Boston, MA: Environmental Protection Agency, 1989.

22. Environmental Protection Agency Region 1, "Kellogg-Deering Well Field, NPL Site Administrative Record: Index", Boston, MA: Environmental Protection Agency, 1986.

APPENDIX A



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Figures 2A

General Cross-Section Diagram from Line Looking Northwest

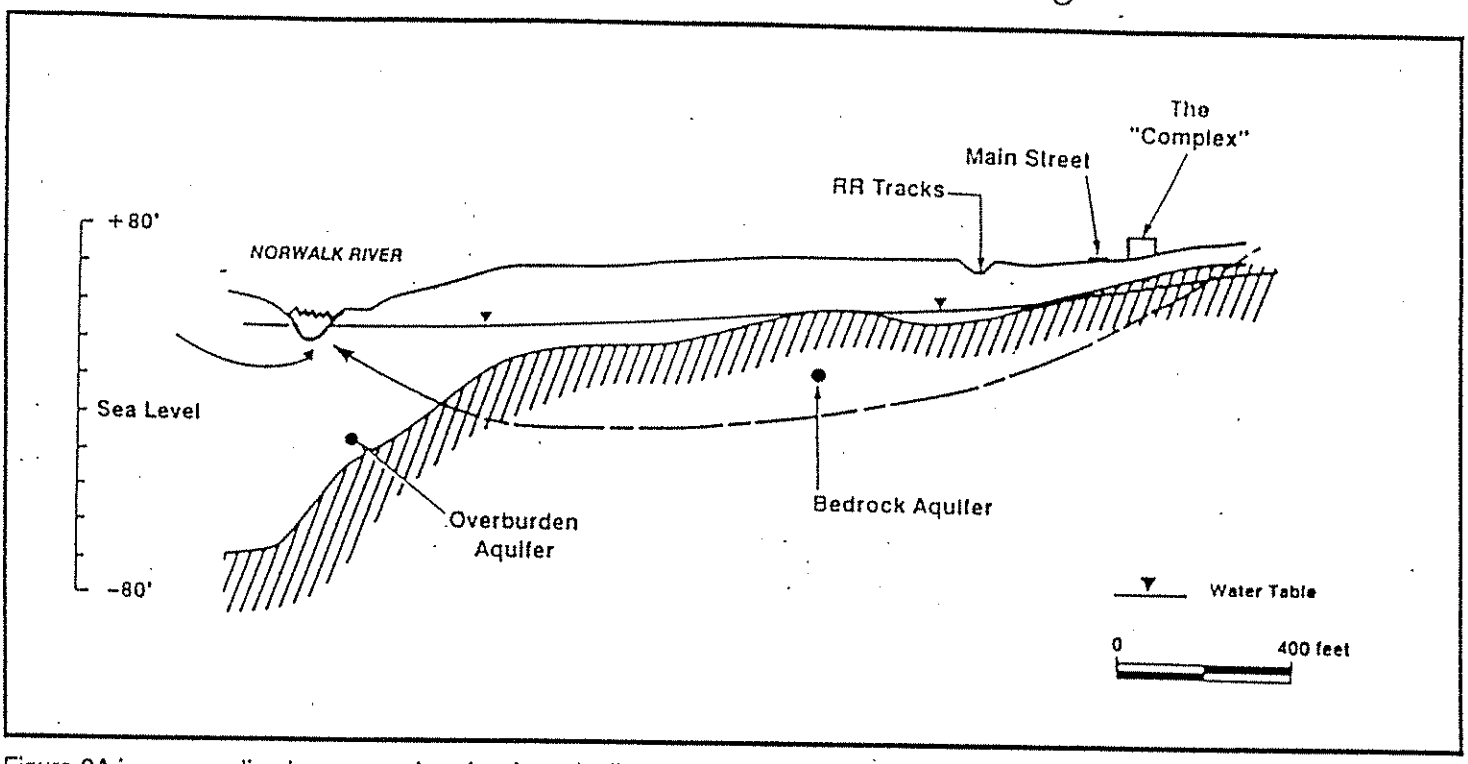

Figure 2A is a generalized cross-section view from the line in Figure 1. Figure 2A shows how groundwater would probably discharge to the Norwalk River if the Kellogg-Deering Wells did not exist.

Figure 2B

General Cross-Section Diagram from Line Looking Northwest

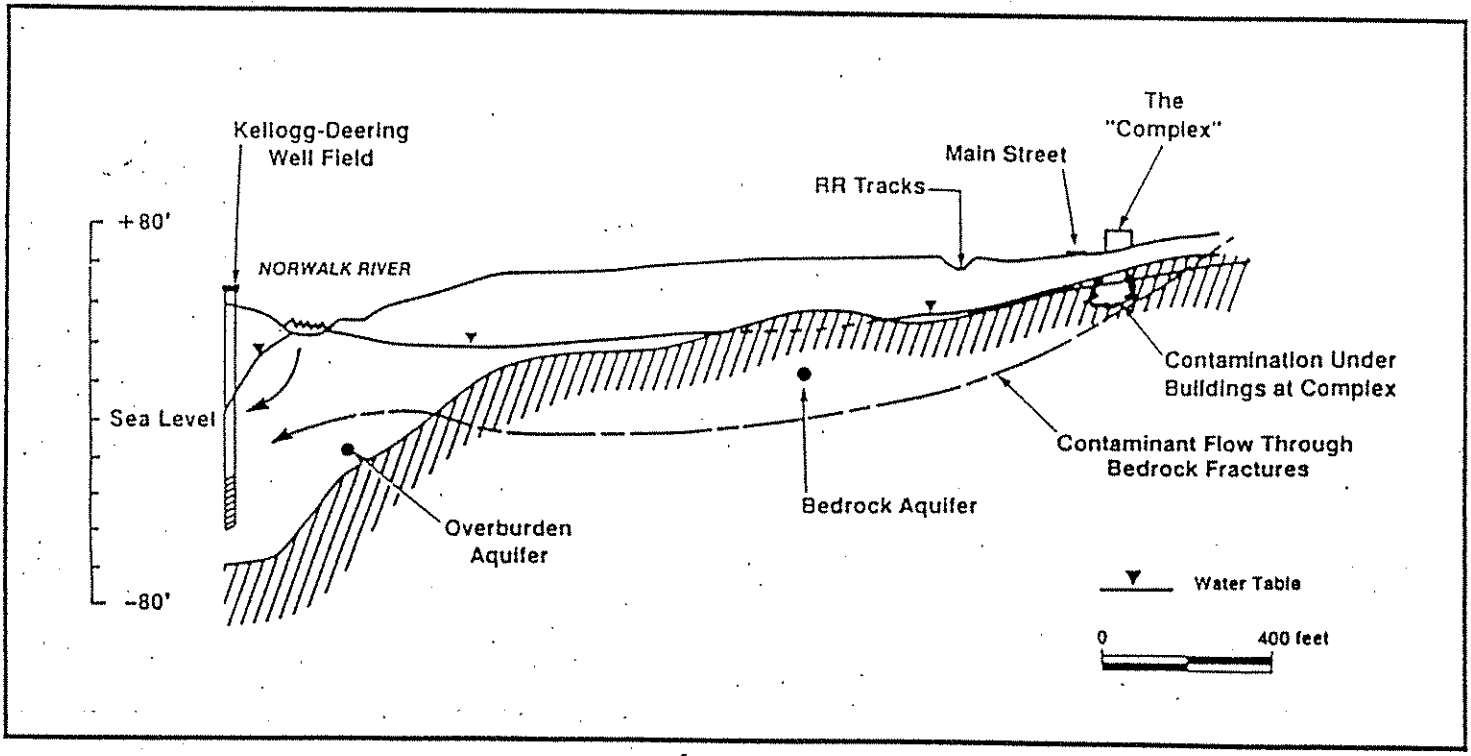

Figure 2B shows how operation of the Kellogg-Deering Wells changes the flow of groundwater at the site. Pumping at the well field causes groundwater to flow toward the wells underneath the River where it mixes with downward moving water from Norwalk River.

APPENDIX B

EPA CANCER CLASSIFICATION

Group A: Human Carcinogen

This group is used only when there is sufficient evidence from epidemiologic studies to support a causal association between exposure to the agents and cancer.

Group B: Probable Human Carcinogen

This group includes agents for which the weight of evidence of human carcinogenicity based on epidemiologic studies is "limited" and also includes agents for which the weight of evidence of carcinogenicity based on animal studies is "sufficient.: The group is divided into two subgroups. Usually, Group B1 is reserved for agents for which there is limited evidence of carcinogenicity from epidemiologic studies. It is reasonable, for practical purposes, to regard an agent for which there is "sufficient" evidence of carcinogenicity in animals as if it presented a carcinogenic risk to humans. Therefore, agents for which there is "sufficient" evidence from animal studies and for which there is :inadequate evidence: or "inadequate evidence" or "no data" from epidemiologic studies would usually be categorized under Group B2.

Group C: Possible Human Carcinogen

This group is used for agents with limited evidence of carcinogenicity in animals in the absence of human data. It includes a wide variety of evidence, e.g., (a) a malignant tumor response in single well-conducted experiment that does not meet conditions for sufficient evidence, (b) tumor responses of marginal statistical significance in studies having inadequate design or reporting, (c) benign but not malignant tumors with an agent showing no response in a variety of short-term tests for mutagenicity, and (d) responses of marginal statistical significance in a tissue known to have a high or variable background rate.

Group D: Not Classifiable as to Human Carcinogenicity

This group is generally used for agents with inadequate human and animal evidence of carcinogenicity or for which no data are available.

Group E: Evidence of Non-Carcinogenicity for Humans

This group is used for agents that show no evidence for carcinogenicity in at least two adequate animal tests in different species or in both adequate epidemiologic and animal studies.

The designation of an agent as being in Group E is based on the available evidence and should not be interpreted as a definitive conclusion that the agent will not be a carcinogen under any circumstances.