United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

EPA/ROD/R02-87/045
September 1987

EPA

Superfund Record of Decision:

Montgomery Township,NJ

TECHNICAL REPORT DATA

(Please read Instructions on the reverse before completing)

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15. SUPPLEMENTARY NOTES		

16. ABSTRACT

The Montgomery Township Housing Development (MTHD) is a 72-acre tract of land located in Somerset County, New Jersey. The housing development consists of 71 home sites. The original potable water source for each home was a private well drawing from the underlying aquifer. In 1978, the Borough of Rocky Hill, which is located near the site, sampled ground water from the Borough well and found it to be contaminated with trichloroethylene (TCE). Testing continued through 1983, and repeated evidence of TCE contamination prompted the New Jersey Department of Environmental Protection (NJDEP) to sample the MTHD well. Results indicated the presence of TCE and other volatile organics in that and other surrounding wells. In 1981, 20 homes in the MTHD were connected to the Elizabethtown Water Company water mains. To date, 38 residences have hooked up. Due to the similarity of contaminants and the proximity of the MTHD and Rocky Hill Municipal Well Superfund sites, a combined RI/FS is being performed. This ROD focuses only on an alternate water supply for MTHD. The primary contaminant of concern is TCE, with secondary contaminants being other volatile organics.

The selected first operable unit remedial action is to extend the Elizabethtown Water Company distribution system to currently or potentially affected residents of MTHD. The estimated capital cost of the alternative is $319,000, with no annual O&M.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN ENDED TERMS	c. COSATI Field/Group
Record of Decision Montgomery Township, NJ First Remedial Action Contaminated Media: gw Key contaminants: TCE, VOCs		
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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION II

DATE: September 16, 1987

SUBJECT: Record of Decision for Montgomery Township Housing Development

FROM: Stephen D. Luftig, Director
Emergency & Remedial Response Division

Stephen D. Luftig

TO: Christopher J. Daggett
Regional Administrator

Attached for your approval is the Record of Decision (ROD) for the Montgomery Township Housing Development site in Montgomery Township, Somerset County, New Jersey.

The selected remedy is a first operable unit for the site which involves the provision of an alternate water supply for residents with impacted or potentially threatened private wells. The remedial investigation is continuing to identify the contaminant source as well as the full extent of groundwater contamination. These are intended to be addressed in the next operable unit for the site and will be the subject of a subsequent ROD. The cost for extending the water main and providing the residential connections is approximately $320,000.

A public meeting to discuss the recommended alternative was held on July 29, 1987. There was general agreement by the public with the alternate water supply remedy. However, a few residents indicated a preference to continue using their own wells, questioning the quality of the public supply, while others expressed an interest in maintaining their wells for non-potable purposes.

The ROD has been reviewed by the appropiate program offices within Region II and the State of New Jersey, and their input and comments are reflected in this document. In addition a letter from Commissioner Dewling of the Department of Environmental Protection concurring with the selected remedy is attached.

If you have any questions, I would be happy to discuss them at your convenience.

Attachments

DECLARATION STATEMENT

RECORD OF DECISION

Montgomery Township Housing Development

SITE NAME AND LOCATION

Montgomery Township Housing Development, Montgomery Township, Somerset County, New Jersey

STATEMENT OF PURPOSE

This decision document presents the selected remedial action for the Montgomery Township Housing Development site, developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300, November 20, 1985.

STATEMENT OF BASIS

I am basing my decision primarily on the following documents, which are contained in the administrative record and characterize the area and evaluate the relative merits of remedial alternatives for the Montgomery Township site:

- Draft Operable Unit Remedial Investigation Report, Montgomery Township Housing Development, prepared by Woodward-Clyde Consultants, July 1987
- Draft Operable Unit Feasibility Study Report, Montgomery Township Housing Development, prepared by Woodward-Clyde Consultants, July 1987
- Proposed Remedial Action Plan, Montgomery Township Housing Development, July 1987
- The attached Decision Summary for the Montgomery Township Housing Development site
- The attached Responsiveness Summary for the site, which incorporates public comments received
- Staff summaries and recommendations

DESCRIPTION OF SELECTED REMEDY (Alternate Water Supply Operable Unit)

The remedial alternative presented in this document is the first operable unit of a permanent remedy for the Montgomery Township site. It will provide a permanent and reliable solution for the prevention of health risks to area residents associated with exposure to contaminated groundwater. The alternative selected involves extension of the Elizabethtown Water Company Distribution System which presently services a portion of the development. Service connections would be provided to all residents currently utilizing contaminated or potentially threatened wells.

Implementation of this alternative will necessitate the sealing of affected individual wells. The contaminant plume and source or sources of contamination will be addressed in a subsequent Record of Decision.

DECLARATIONS

Consistent with the Comprehensive Environmental Response Compensation, and Liability Act, as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan, 40 CFR Part 300, I have determined that the selected remedy is protective of human health and the environment, attains federal and state requirements that are applicable or relevant and appropriate for this action, and is cost-effective.

The State of New Jersey has been consulted and agrees with the selected remedy, as is documented in the attached letter of concurrence.

I have also determined that the actions being taken at the Montgomery Township Housing Development site are appropriate when balanced against the availability of Superfund monies for use at other sites.

September 29, 1987
Date

Christopher J. Daggett
Regional Administrator

Decision Summary

Montgomery Township Housing Development Site

SITE LOCATION AND DESCRIPTION

Montgomery Township Housing Development (MTHD) is a 72-acre tract of land in Montgomery Township, Somerset County, New Jersey. The development is located east of Route 206, north of Route 518, west of the Millstone River, and south of Beden Brook and Montgomery Road (see Figure 1, shaded area).

Properties along Montgomery Road, the northern border of the site, are wooded or agricultural lots. An industrial research facility is also located in this area. To the southwest are two shopping centers and an office center. The Borough of Rocky Hill (population 960) which is primarily residential, is located to the south. The homes on the end of Cleveland Circle are bordered to the east by the Millstone River, which parallels the Delaware and Raritan Canal.

The housing development consists of 71 home sites, each of approximately one acre. The homes are situated on Montgomery Road, Sycamore Lane, Robin Drive, Oxford Circle, and Cleveland Circle. The original potable water source for each home was a private well drawing from the aquifer in the Brunswick formation.

In 1986, the study area was expanded to include six additional residences beyond the boundaries of the MTHD. Ground water investigations have included the wells of residences along Canal Road, east of the Delaware and Raritan Canal, north of Montgomery Road, and along Route 206, as well as some commercial establishments along Routes 206 and 518.

The MTHD site lies within the Piedmont Physiographic Province and is underlain by bedrock of the Brunswick Formation covered with a relatively thin (up to about 30 feet thick) layer of unconsolidated sediments. The Brunswick Formation contains the principal aquifer in the region. Ground water exists in a number of water-bearing zones which are generally under unconfined to semi-confined conditions. Intersecting vertical fractures have resulted from jointing and provide the principal means of storage and movement of ground water in the formation.

The ground water in the Brunswick Formation is extensively pumped for domestic and industrial use. More than 90 wells are known to exist within a one mile radius from the center of the study area. The total reported yields of the permitted water supply wells is on the order of 2,000 gallons per minute (GPM).

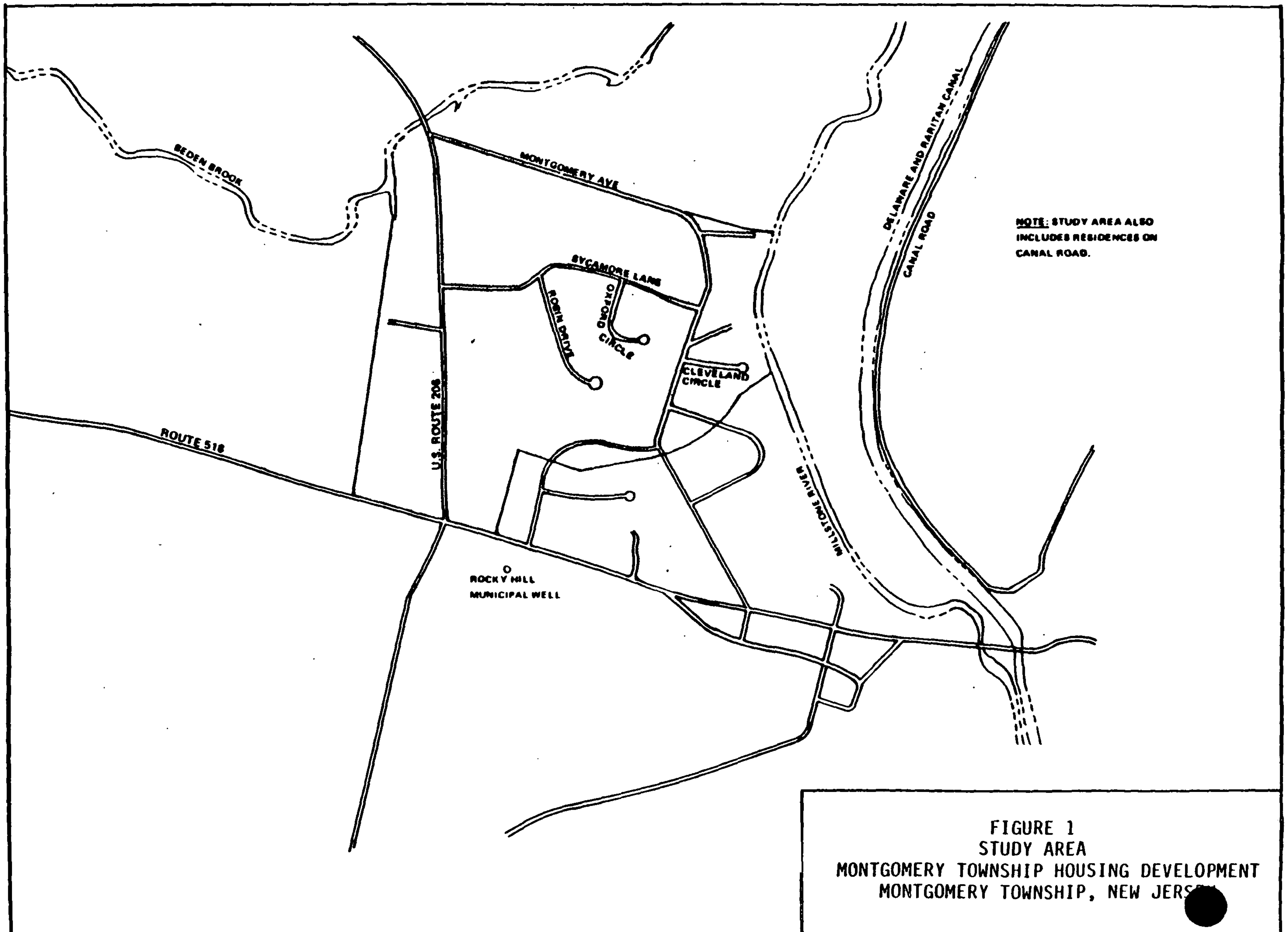


FIGURE 1
STUDY AREA
MONTGOMERY TOWNSHIP HOUSING DEVELOPMENT
MONTGOMERY TOWNSHIP, NEW JERS[illegible]

Site History

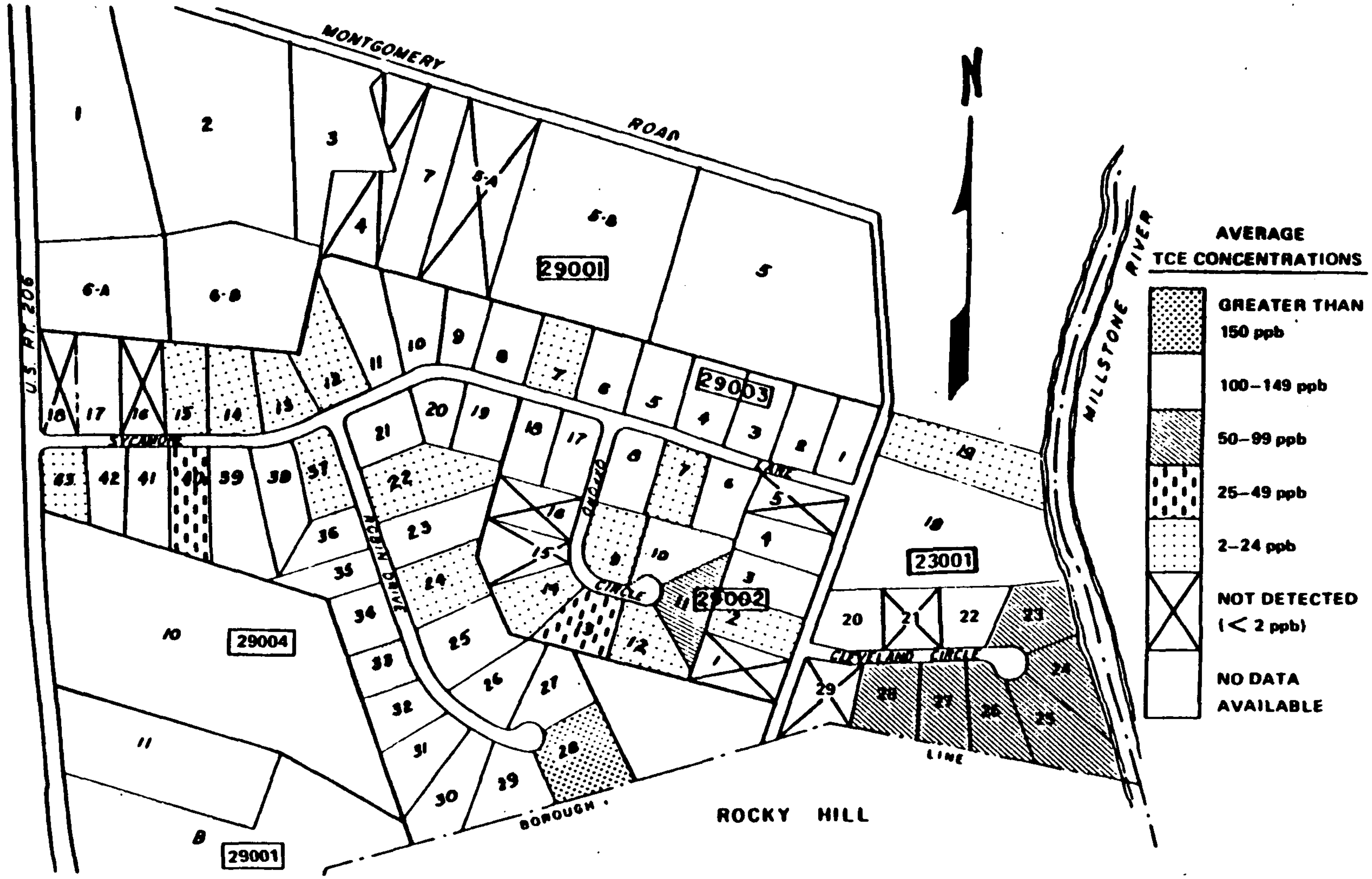
Tax records and accompanying maps indicate that the housing development site was privately owned and had been used for farming until 1961. There was no knowledge of any underground tanks or landfill areas on the property at that time. Tri-State Development Corporation purchased the land in 1961 and began construction of 71 homes. The potable water source for all homes was originally individual private wells. All homes utilize septic systems.

In 1978, a study by Rutgers University of the Rocky Hill Borough well revealed trichloroethene (TCE) contamination levels of approximately 25 micrograms per liter (ug/l). Continued testing of this water supply from 1978 to 1983 detected concentrations of TCE ranging from about 50 to 200 ug/l.

Concern over ground water contamination in Rocky Hill led the New Jersey Department of Environmental Protection (NJDEP) to conduct initial sampling of commercial and domestic wells in Montgomery Township from December 1979 to January 1980. Other investigations performed prior to 1984 included sampling from private wells, industrial water supply wells, soils, surface waters and septic tanks. Further environmental investigations continue through the present. Results indicate that approximately half of the private wells in the development are contaminated with TCE and other halogenated hydrocarbons, while the remaining are threatened.

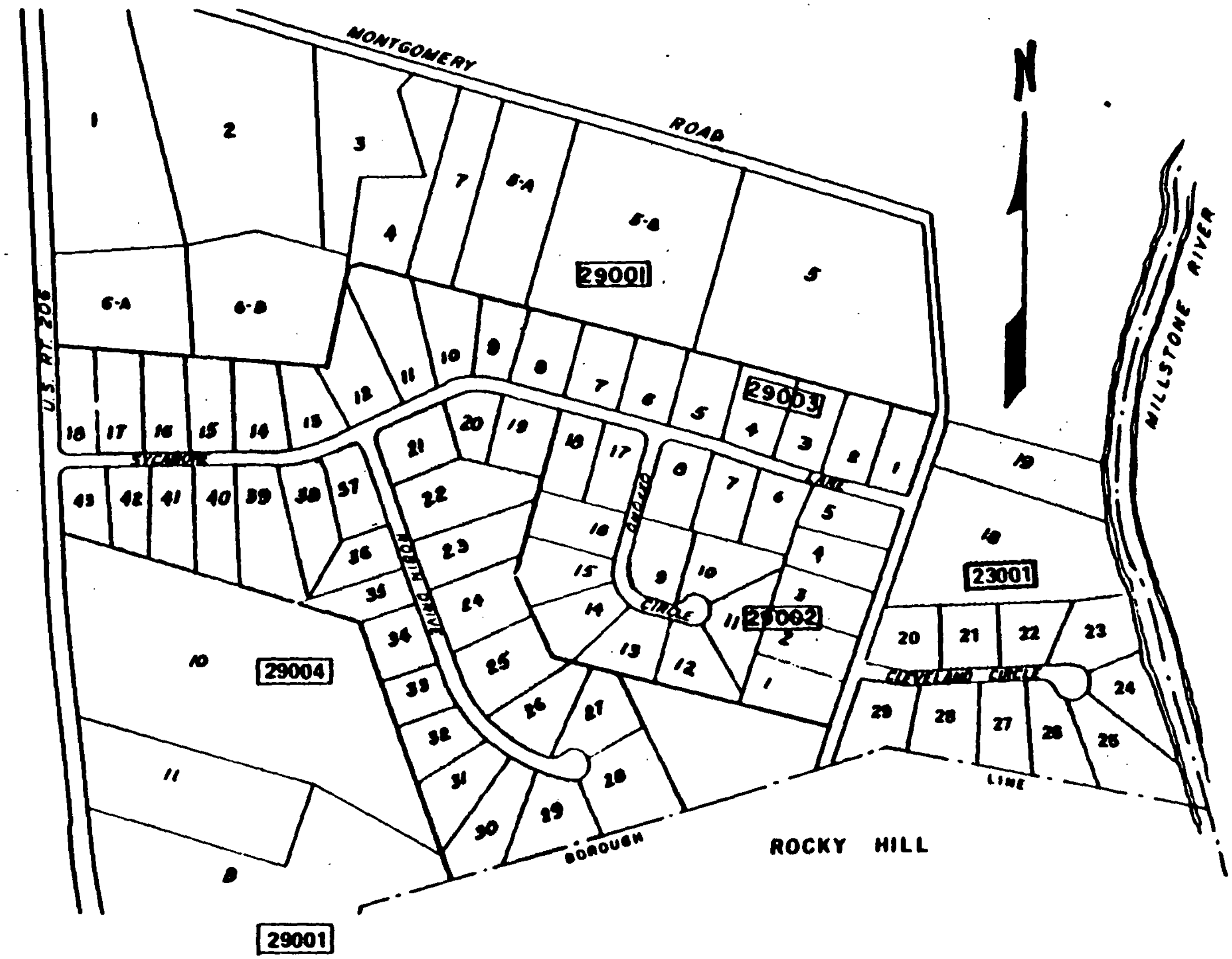
Figure 2 summarizes the results of investigations prior to the initiation of the remedial investigation and feasibility study (RI/FS) for the MTHD and the related Rocky Hill Municipal Well (RHMW) site. Data shown are mean averages of TCE concentrations found in domestic wells between 1979 and 1984. Residences at the ends of Robin Drive, Oxford Circle and Cleveland Circle were found to have the highest TCE concentrations, whereas lower TCE concentrations were found in wells along Sycamore Lane. TCE was not detected in any domestic wells on the northern part of Montgomery Road, where it runs east-west. However, the data were insufficient to adequately delineate a plume of contaminated ground water. In general, TCE concentrations in individual wells did not appear to vary significantly with time.

On August 21, 1980, Montgomery Township passed an ordinance authorizing the water line extensions into the Sycamore Lane area and assessment to the area homeowners for cost. In March 1981, Elizabethtown Water Company water mains were installed in the Montgomery Township Housing Development, and residents were advised not to use well water. Initially, 20 homes elected to hook up to the new water lines. To date, 38 residences have hooked up. Residences connected to the Elizabethtown water supply are shown in Figure 3.



SOURCE:
MONTGOMERY TOWNSHIP TAX MAP,
1984 RAMP BY JACA AND NUS

FIGURE 2
AVERAGE TCE CONCENTRATIONS
1979-1985
MONTGOMERY TOWNSHIP HOUSING DEVELOPMENT



SOURCE:
C. SEARFOSS, HEALTH OFFICER,
MONTGOMERY TOWNSHIP.

LEGEND:
PUBLIC WATER CONNECTIONS

FIGURE 3
RESIDENTS CONNECTED TO PUBLIC WATER
AS OF JUNE, 1987
MONTGOMERY, NEW JERSEY

REMEDIAL ACTIONS

In 1984, the NJDEP entered into a Cooperative Agreement with the United States Environmental Protection Agency (EPA) under which it would perform the RI/FS for the Montgomery Township Housing Development and the Rocky Hill Municipal Well sites. Because of the proximity of the two sites and the similarity of contaminants found, the RI/FS for the two sites is being performed under one cooperative agreement. However, the MTHD/RHMW RI/FS is not the subject of this Record of Decision (ROD). This ROD relates to a discrete phase of the main study, the provision of an alternate water supply for the residents of the MTHD.

In January 1986, NJDEP's Division of Water Resources placed a restriction on future well drilling for water supply in the area.

Phase 1 of the MTHD/RHMW remedial investigation was completed in January 1987. This phase involved a geohydrologic investigation which included a geophysical survey, permeability test, water level survey, and a pumping test. The objective of Phase 1 was to charactarize and determine the boundaries of the ground water contaminant plume.

Scope of Groundwater Investigation

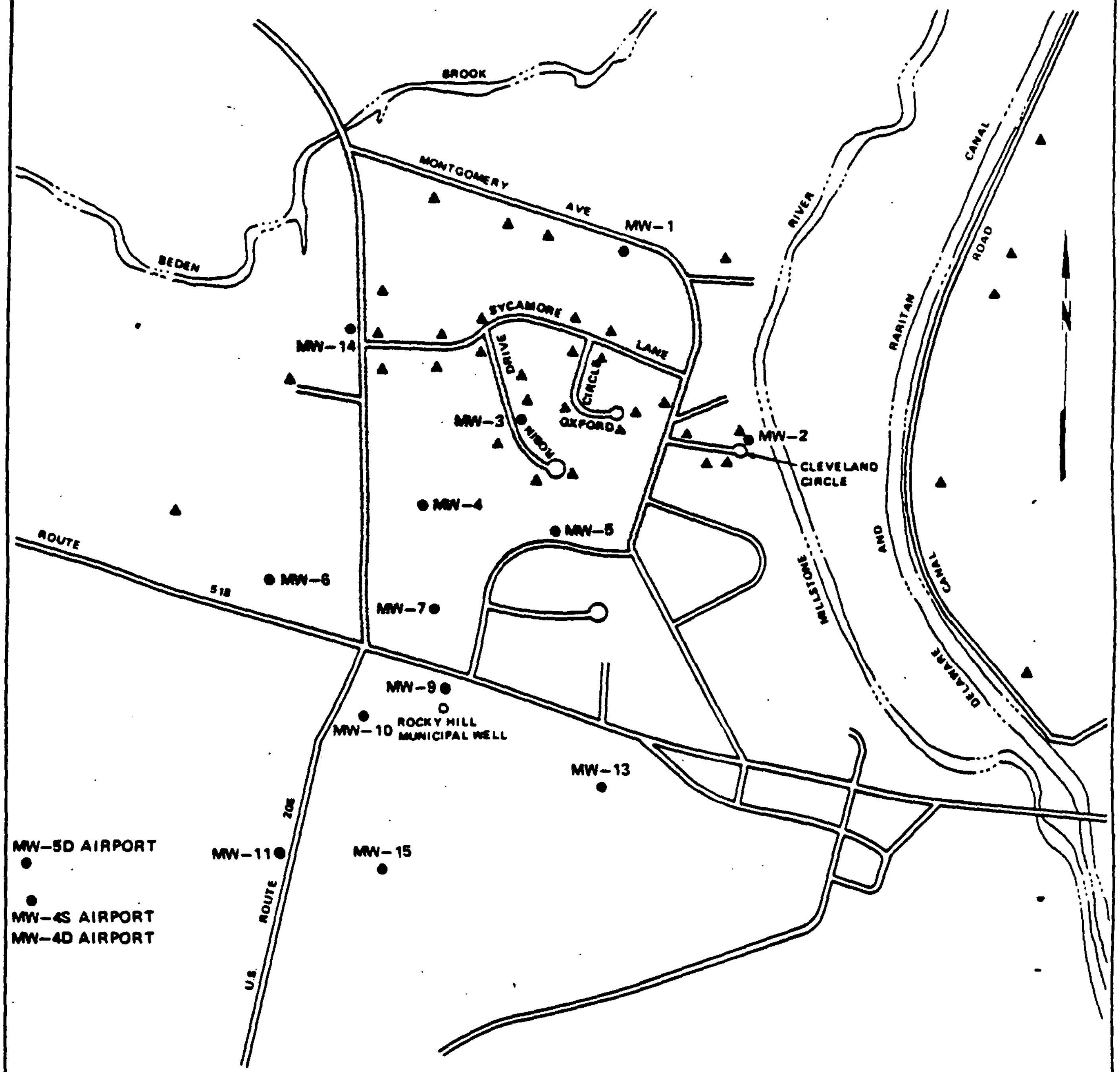
Twenty-six monitoring wells were installed in 13 clusters in the MTHD/RHMW site area. Each cluster consists of one shallow and one deep well. Wells were sampled in late November and early December of 1986. Six wells were dry at the time of sampling and, therefore, could not be sampled.

Thirty-five domestic wells were sampled in and around the MTHD. These wells were included due to their proximity to previously identified areas of contamination. Locations of all domestic and monitoring wells are included in Figure 4.

Summary of Results

Results of the RI indicate that the MTHD/RHMW sites are underlain by a fractured-bedrock aquifer, which consists of an upper unconfined section and a lower semi-confined section which are hydraulically connected. A downward hydraulic gradient exists between the two.

Deep ground water flow is generally toward the northeast and is largely controlled by the vertical fractures. Shallow ground water follows topographic features and discharges into surface water bodies (i.e. Millstone River).



NOTE:

STUDY AREA ALSO INCLUDES RESIDENCE ON CANAL ROAD.

0 1000 2000 3000 FT

SCALE

LEGEND

STUDY AREA

▲ DOMESTIC WELL SAMPLED DURING STUDY

MW-15 ● MONITORING WELL SAMPLED DURING STUDY

FIGURE 4
DOMESTIC AND MONITORING
WELL LOCATIONS

Ground water samples from the 23 monitoring wells were collected and analyzed in late 1986. The most common organic contaminant found in these samples was trichloroethene (TCE) at levels ranging up to 650 parts per billion. Other priority pollutant organic compounds identified included: trans-1,2-dichloroethene, tetrachloroethene, chloroform, diethylphthalate, chlordane and phenols. Table 1 lists TCE concentrations detected in monitoring wells sampled during the first phase of the RI/FS.

Several priority-pollutant metals were found in the first round of monitoring well samples. Analyses of ground water have been compared to drinking water standards to assist in summarizing the data. With the exception of MW-3D, chromium is the only priority-pollutant metal present in concentrations exceeding the National Primary Drinking Water Regulations (NPDWR). In general, there is no apparent correlation between the contamination levels of organic compounds and priority-pollutant metals identified in the monitoring well samples.

Thirty-five domestic wells were also included in the first round of sampling in June 1986. Again, the principal contaminant detected was TCE, concentrations of which ranged from below detectable levels to 340 ug/l. A total of 17 of the 35 wells sampled were found to contain more than 4 ug/l TCE, and nine of those wells contained more than 50 ug/l. Table 2 lists TCE concentrations for those residences which are not currently connected to public water. (Note: The 340 ug/l maximum concentration mentioned above was detected in the well of a residence already connected to the municipal water supply and so is not listed in Table 2.) Results from this round of analysis are consistent with previous investigations as also shown in Table 2. The areas of highest TCE contamination found earlier (the end of Oxford Circle, near the end of Robin Drive and Cleveland Circle) are approximately the same as measured in this study.

Other priority-pollutant organic compounds of concern which were detected include 1,1-dichloroethane, diethylphthalate and bromodichloromethane.

Priority-pollutant metals (inorganics) were detected in a number of the domestic wells. The occurrence of inorganic contamination is sporadic and does not appear to be related to the occurrence of organic contamination. The wells do not appear to have any consistent relationship with each other relative to metal concentrations.

Table 1
TCE CONTENTS OF MONITORING WELLS

Well	TCE Concentration 11/18/86-11/21/86, 12/3/86-12/4/86 (ug/1)
MW-ID	ND
MW-IS	ND
MW-2D	34
MW-2S	ND
MW-3D	ND
MW-3D dup.	13
MW-3S	320
MW-4D	240
MW-4D airport	ND
MW-4S airport	ND
MW-5D	ND
MW-5D airport	ND
MW-6D	ND
MW-7D	650
MW-7S	650
MW-9D	6.3
MW-9D dup.	6.3
MW-10D	ND
MW-11D	ND
MW-11S	ND
MW-13D	ND
MW-13S	ND
MW-14D	ND
MW-14S	ND
MW-15D	ND

ND: Not Detected at detection limit of 5 ug/l.

TABLE 2
MONTGOMERY RESIDENTS NOT CONNECTED TO
PUBLIC WATER AS OF 7 MAY 1987

Block	Lot	TCE Concentration ug/l June 1986 Sampling Date	TCE Concentration ug/l Average 1979-1986
23001	20	1.9	1.9
23001	27	60	73
23001	28	140	85
29002	1		1.6
29002	3		
29002	4	58	58
29002	5		ND
29002	6		
29002	7		9.9
29002	8	18	18
29002	12	64	35
29002	13		39
29002	14	72	23
29002	15		ND
29002	16	3.9	ND
29002	17		3.9
29002	18		
29002	19		
29002	24	46	29
29002	28	ND	237
29002	37	2.5	11
29002	40	40/44 (duplicates)	41
29002	43	35	31
29003	2		
29003	3		
29003	4		
29003	5	3.8	3.8
29003	6		
29003	7		
29003	8	ND	6.7
29003	10		
29003	11		
29003	12	32	13
29003	13		
29003	18	ND	ND
29001	2	ND	ND
29001	3	ND	
29001	5A	ND	ND
29001	6A	ND	

Contaminant Plume

A summary of ground water TCE concentrations obtained during the Round 1 sampling program is illustrated in Figure 5. Although other organic contaminants have been detected in monitoring and domestic wells, TCE is considered the main contaminant of concern in this discussion because it is the consistently predominant site contaminant.

Observed TCE contamination appears to extend from the RHMW approximately northward to Sycamore Lane, and from Route 206 eastward to the Millstone River. It is not known at this time whether the plume continues east of the Millstone River, but the absence of contamination in the Canal Road wells indicates that it extends no farther east than Canal Road. Figure 6 delineates an approximation of the TCE contaminant plume based on mean averages of all available historical and recent data on ground water quality. Other organic contaminants frequently encountered during Round I sampling are found throughout the TCE plume, but they occur more sporadically across the site.

The plume appears to have been in a steady state condition for at least the last eight years (1979 to 1987). This may be due to two conditions: (1) the source or sources of contamination have been constant since 1979 or prior, or (2) the source or sources of contamination are no longer present but the rate of contaminant migration is so slow that the plume has not yet been appreciably dispersed.

Based on the inferred direction of ground water flow and the observed plume of TCE contamination, a region potentially threatened by ground water contamination may be outlined (Figure 7).

CURRENT SITE STATUS

Because of the potential health risks associated with the exposure to contaminated ground water via ingestion, inhalation or dermal (skin) absorption, an "operable unit", or discrete phase, of the Montgomery Township RI/FS was identified for more immediate action. This operable unit involved the evaluation of the need for, and implementation of, an alternate water supply for those residences continuing to draw water from the contaminated aquifer. This action is based on data accumulated prior to and during the first phase of the MTHD/RHMW RI/FS. It is this action which is the subject of this ROD.

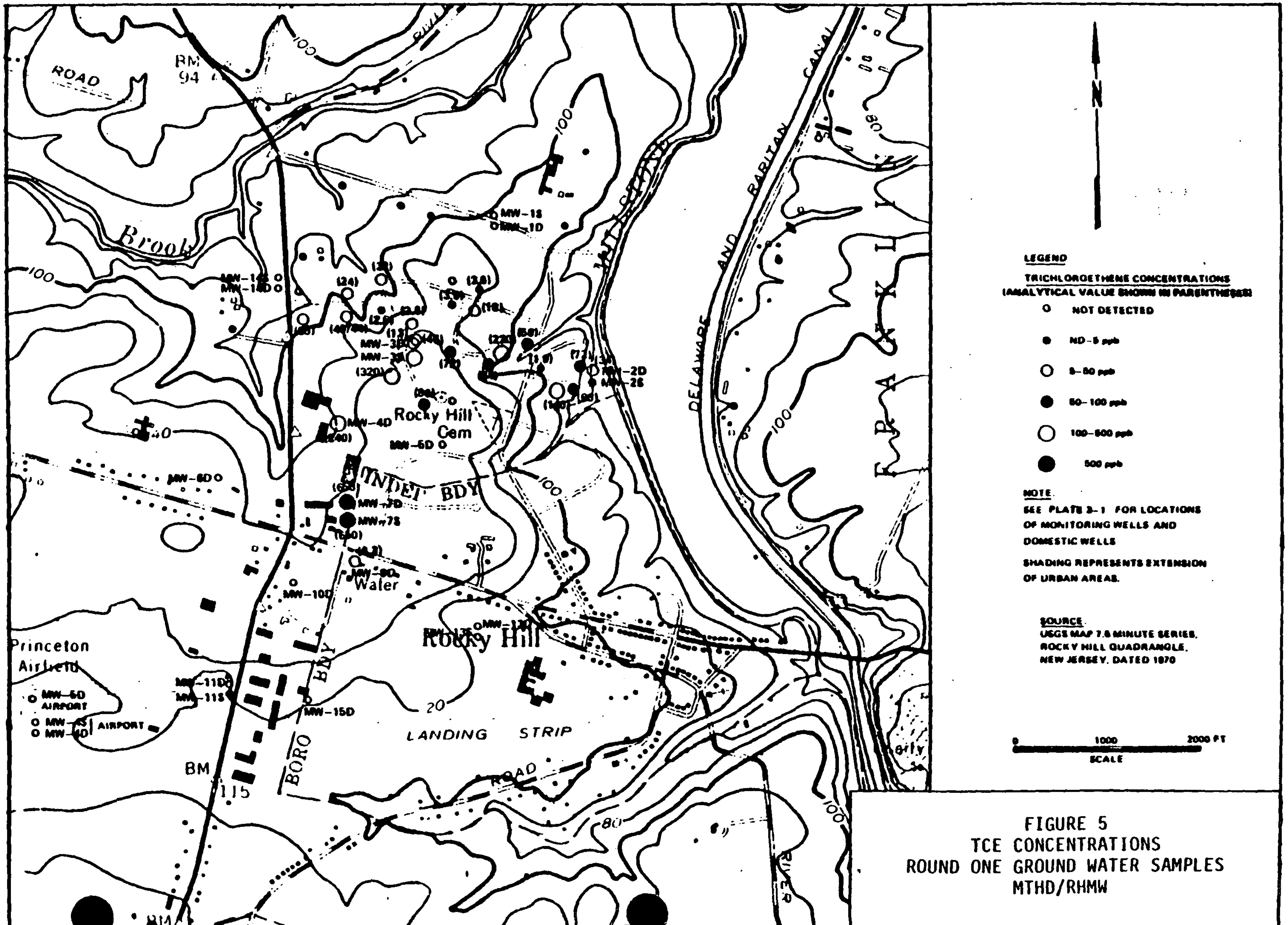


FIGURE 5
TCE CONCENTRATIONS
ROUND ONE GROUND WATER SAMPLES
MTHD/RHMW

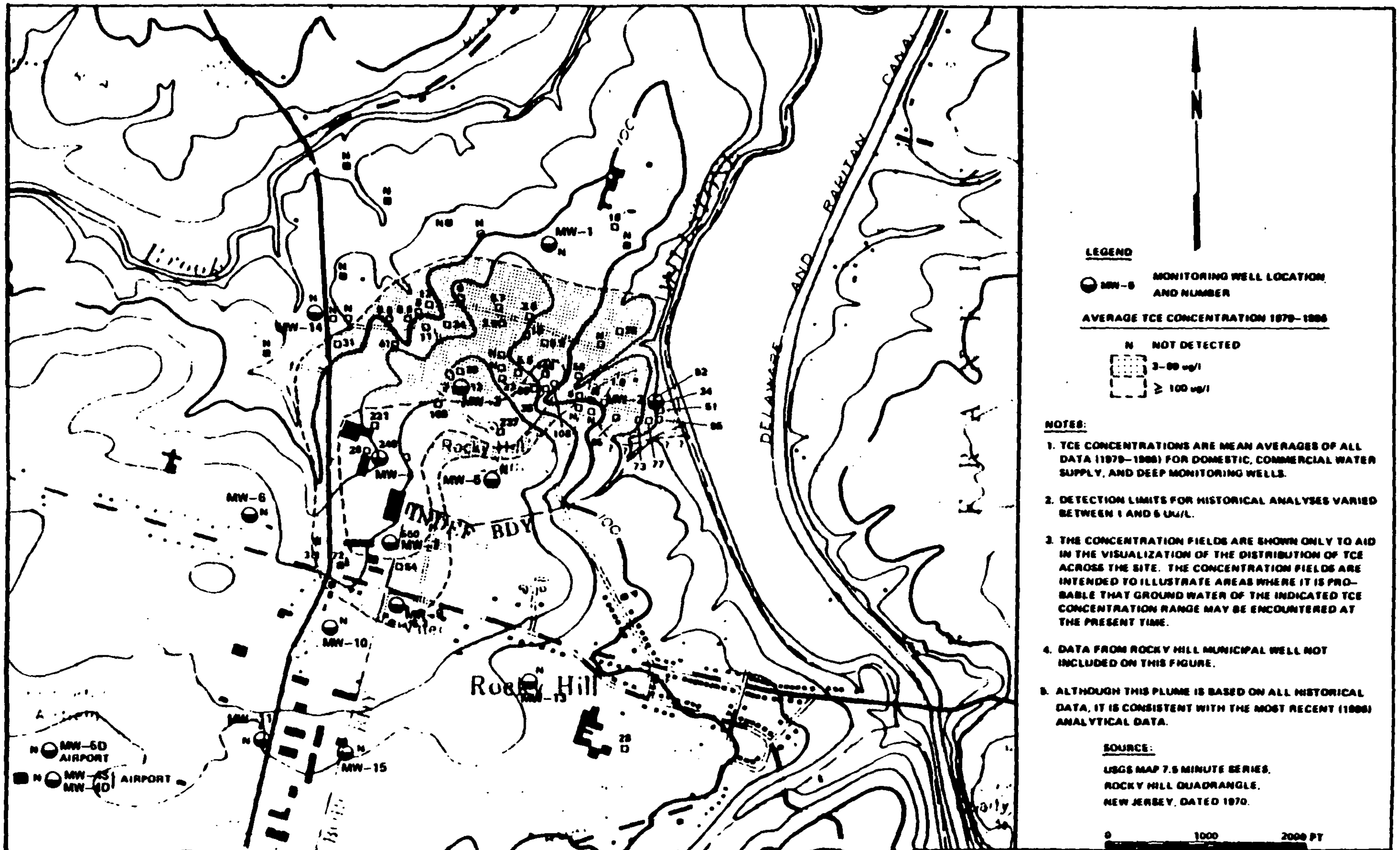


FIGURE 6
AVERAGE TCE CONCENTRATION IN DEEP MONITORING AND WATER SUPPLY WELLS
MONTGOMERY TOWNSHIP, NEW JERSEY

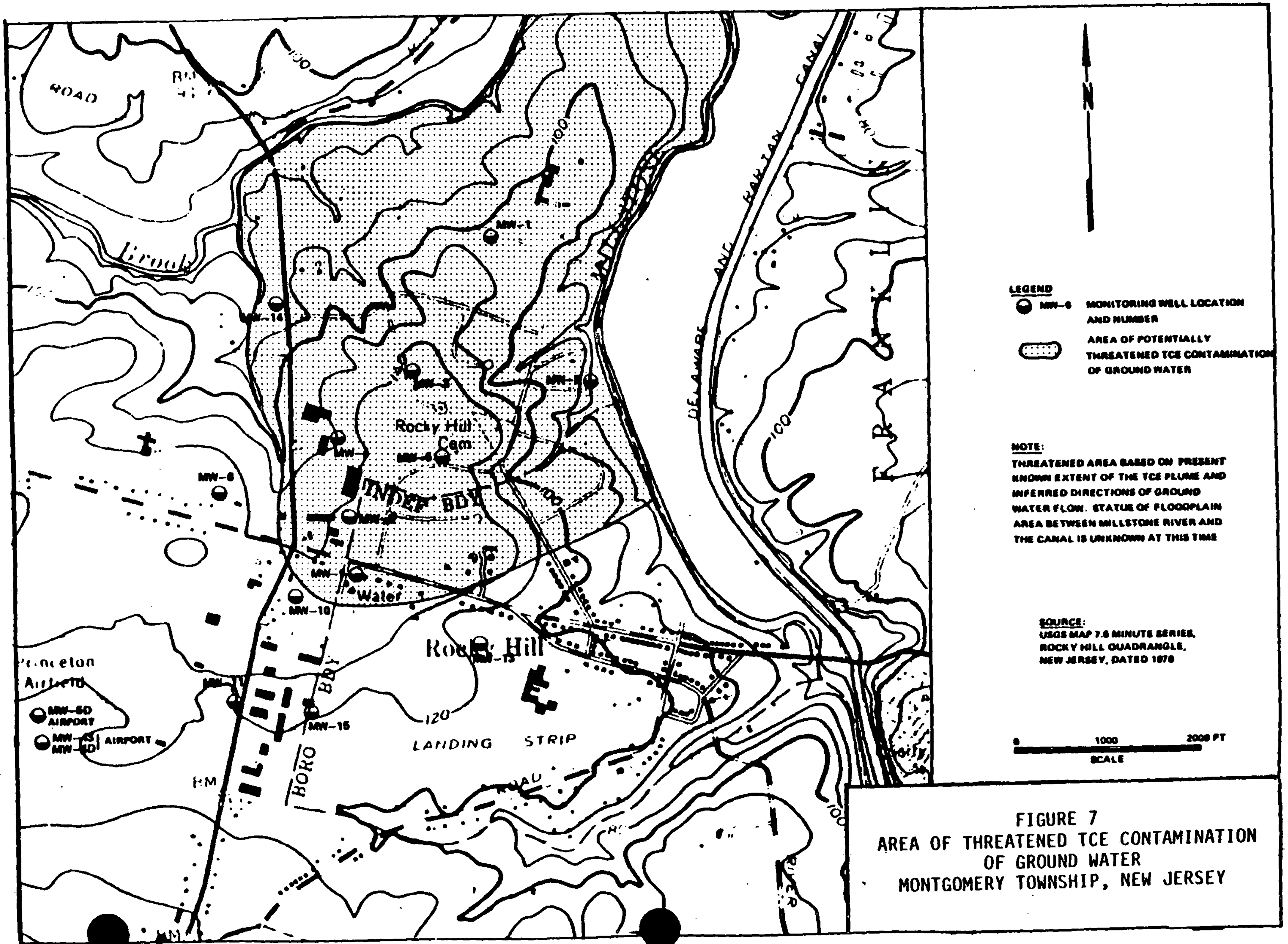


FIGURE 7
AREA OF THREATENED TCE CONTAMINATION
OF GROUND WATER
MONTGOMERY TOWNSHIP, NEW JERSEY

The second phase of the MTHD/RHMW RI/FS is ongoing and includes the installation of additional monitoring wells to better define the contaminant plume north of Route 518 and along the eastern boundary of the site along the Millstone River. Soil borings and septic tank samples have been collected during this phase to assist in identification of the source or sources of contamination. Possible remediation of the aquifer will also be evaluated in a subsequent feasibility study.

Risk Assessment

The primary potential human health impact at the MTHD is the exposure of residents to contaminated ground water. In order to evaluate this public impact, a health assessment, which evaluates risks to users as a result of the exposure, was conducted. This assessment provides a quantitative estimate of risk levels under existing conditions -- that is, in the absence of remedial action. This serves as a baseline against which the need for remedial action is evaluated. Potential increases or decreases in risks associated with each remedial alternative considered are qualitatively compared to this baseline.

Development of a list of indicator chemicals is the first stage in the characterization of risk. Factors considered include: maximum and mean concentrations of contaminants and their comparison to standards, frequency of occurrence in ground water samples, and carcinogenicity. Ten compounds were ultimately selected and are listed in Table 3. Trichloroethene is considered the main contaminant of concern based on the above factors. Acute inhalation exposure to TCE causes central nervous system depression. TCE is classified as a probable human carcinogen.

Potential exposure pathways to humans from the use of contaminated ground water include:

- ingestion of ground water
- inhalation of volatile chemicals released during water use
- direct dermal contact with contaminated water

Persons at risk of exposure to the contaminants in ground water include those still using contaminated or threatened private potable wells in the MTHD. Census data indicate that approximately 120 persons still use such wells.

Table 3
COMPARISON OF SITE DATA WITH WATER QUALITY CRITERIA

Substance	Water Quality Criteria	Monitor Well Data Max.	Monitor Well Data Mean	Monitor Well Data No. Detected	Private Well Data Max.	Private Well Data Mean	Private Well Data No. Detected
Trichloroethene	1	650	240	(8)	340	67	(20)
Tetrachloroethene	1	43	18	(5)	26	6.4	(7)
Chlordane	0.5	1.3	1.3	(1)	0.76	0.76	(1)
Arsenic	50	93	14	(11)	39	11	(12)
Barium	1000	1980	256	(24)	300	180	(35)
Beryllium	NA	14	4.1	(15)	ND	ND	(0)
Chromium	50	355	46	(15)	117	14	(32)
Lead	50	736	62	(15)	2170	116	(29)
Nickel	NA	293	103	(6)	71	18	(30)
Silver	50	36	15	(7)	180	21	(22)

NOTES:
1) All levels are expressed in ug/l and are compiled from RI/FS data.
2) Criteria were developed in the RI/FS by a review of water quality guidelines and regulations.
3) Mean values are calculated for the number of samples with detectable levels of contaminants. (shown above as "No. Detected")
4) Private well data includes six residences with public water as their primary water source.
5) Blank contamination was present in some chromium, lead, nickel, and silver sample analyses. This table uses all sample results, and includes some data that were negated due to blank contamination.

Based on assumptions involving the estimated human dosage from exposure and the fact that TCE, the primary contaminant of concern, readily volatilizes into the atmosphere, the largest dosage of the organic compounds has been estimated to be due to inhalation, followed by ingestion and dermal absorption.

ENFORCEMENT ANALYSIS

Several industrial and commercial establishments within the site area are believed to be potential sources of contamination. To date, however, evidence connecting CERCLA potentially responsible parties (PRPs) to the contamination of the study area has not been fully developed. Accordingly, PRP identification is an objective of the ongoing MTHD/RHMW RI. A more detailed discussion of potential sources will be included in a subsequent Record of Decision that addresses the MTHD/RHMW sites.

COMMUNITY RELATIONS

Community relations activities for the MTHD site were initiated by the NJDEP in 1985 with the development of a Community Relations Plan.

A public meeting was held in January 1986 to present NJDEP's plans for the RI/FS for the MTHD/RHMW sites.

On July 10, 1987, the RI/FS report for Phase 1 was made available at five public information repositories to initiate a 30-day public comment period. This period extended through August 14, 1987. On July 29, 1987, a public meeting was held to present the results of Phase 1 of the MTHD/RHMW RI and water supply alternatives including the preferred alternative to affected residents of the MTHD.

A high level of concern exists among the affected MTHD residents. Several issues were raised by residents during the course of the remedial investigation, as well as at the most recent public meeting. A responsiveness summary, which addresses the comments and questions raised, is attached to this ROD.

EVALUATION OF ALTERNATIVES

This section describes remedial alternatives for the MTHD that have been developed in order to meet the objectives of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA); and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR §300.68.

Three alternatives were specifically developed to address the health risk to those MTHD residents continuing to utilize contaminated or threatened private wells. These alternatives, as well as a no-action alternative, were identified and evaluated according to specific criteria required by CERCLA. The following evaluation criteria were applied to each alternative:

1)	Effectiveness:	-Protection of human health and the environment -Reduction of toxicity, mobility, and volume
2)	Implementability:	-Technical feasibility -Administrative feasibility -Availability of resources
3)	Cost Effectiveness:	-Capital -Operation and Maintenance

Table 4 provides a breakdown of all factors considered in the evaluation of alternatives for remedial action. Of these factors, only those relevant to the evaluation of remedial alternatives for the MTHD operable unit were considered.

CERCLA requires that the recommended remedial alternative be protective of human health and the environment, be cost effective, and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. The proposed remedy must also attain legally applicable or relevant and appropriate standards, requirements, criteria, or limitations (ARARs) and other to be considered guidanances and advisories that have been identified for the site by various federal and state agencies to protect public health and the environment.

ARARs and other to be considered criteria, advisories, and guidances used in the evaluation of alternatives include:

- ° New Jersey Maximum Contaminant Levels - NJMCLs
- ° Federal Maximum Contaminant Levels - MCLs

Drinking Water Health Advisories and reference levels for carcinogens have been included as requirements that are not enforceable but are still considered in the analysis of remedial alternatives. Table 3 lists ARARs, advisories, or State criteria, whichever is more stringent, for compounds of concern at the MTHD site. ARARs, advisories, or criteria for TCE have been exceeded at this site.

Initially, alternatives were considered and screened to narrow the list of potential alternatives for further detailed analysis. The three primary criteria listed above are identified by CERCLA for use in justifying the elimination of an alternative from further evaluation.

Table 4. EVALUATION FACTORS FOR REMEDY SELECTION

EFFECTIVENESS		IMPLEMENTABILITY			COST
Protectiveness	Reduction of Toxicity, Mobility, or Volume	Technical Feasibility	Administrative Feasibility	Availability	Capital and O&M
Reduction of existing risks Compliance with some ARARs Compliance with some criteria, advisories, and guidances Protection of community and workers during remedial actions Time until protection is achieved	Immediate or short-term reduction in toxicity, mobility, or volume	Ability to construct technology Short-term reliability of technology Compliance with some ARARs (primarily action-specific)	Ability to obtain approvals from other agencies Likelihood of favorable community response Need for coordination with other agencies Compliance with some location-specific ARARs Need to respond to other sites (§104)	Availability of treatment, storage, and disposal services and capacity Availability of necessary equipment and specialists	Development and construction costs Operating costs to implement remedial action Other capital and short-term costs required to complete remedial action
Magnitude of residual risk Long-term reliability Compliance with some ARARs or TBCs Likelihood of future exposure to residuals Potential need for replacement	Permanent and significant reduction in toxicity, mobility, or volume	Ease of undertaking additional remedial action, if necessary Ability to monitor effectiveness of remedy Ability to perform operation & maintenance functions			Operation and maintenance costs, for as long as necessary Costs of 5-year reviews Potential future remedial action costs

Those alternatives whose costs far exceed the costs of other alternatives considered and which do not provide substantially greater protection or technical reliability were screened from further consideration. Alternatives not considered appropriate for implementation and a brief discussion of reason for their exclusion are provided in Table 5.

The following text discusses each alternative considered with regard to the three major categories: effectiveness, implementability, and cost. The evaluation criteria not discussed in detail are either the same for all of the alternatives, or considered not relevant to this evaluation. Table 6 lists those four alternatives retained for more detailed analysis, and summarizes the specific criteria considered below.

Alternative 1: No-Action

As required by the NCP, a no-action alternative has been evaluated. Under this alternative, residents currently using contaminated or threatened private wells would continue using water drawn from the contaminated aquifer. A ground water monitoring program would be implemented to allow periodic reassessment of potential health impacts resulting from continued use.

For costing purposes, the assumed timespan of long-term ground water monitoring is 30 years. Residential well water would be sampled and analyzed semi-annually for priority pollutant compounds.

A detailed risk characterization associated with the no-action alternative has been performed as part of the RI/FS. Except for beryllium and nickel, maximum concentrations of the contaminants of concern (listed in Table 3) exceed the site-specific criteria, as cited. In addition, mean concentrations of trichloroethene, tetrachloroethene, arsenic, barium, and lead exceed the criteria cited. Human exposure to these contaminants in ground water may lead to adverse health effects.

Therefore, the no-action alternative is not appropriate because it would not provide protection to human health and the environment.

Annual cost for monitoring would be approximately $29,000 (see Table 6).

Alternative 2: Temporary Drinking Water

The use of a temporary drinking water source for potable water (i.e. bottled water) is a potential alternative to be implemented until such time that a permanent alternative water supply can be provided for the MTHD residents or the contaminant plume has been remediated. A range of two to twelve years has been estimated as the length of time that MTHD residents will need to use a temporary drinking water source.

Table 5
SCREENED ALTERNATIVES

Alternative	Reason Screened
Temporary water provided by taps on Elizabethtown Water Company mains	- Not as easily implementable as bottled water alternative - Engineering and construction time required before taps would be available for use - Use of bottled water can begin immediately
Individual Well Treatment Air Stripping with Granular Activated Carbon Adsorption	- High cost of implementation without benefit of greater degree of treatment than extension of Elizabethtown supply or installation of a community well
Individual Well Treatment Granular Activated Carbon Adsorption	- Excessively high operation and maintenance costs (specifically for carbon replacement) will be required to ensure the effective operation of this alternative. - Methylene chloride, a possible ground water contaminant, is not effectively removed by this technology

Table 6

REMEDIAL ALTERNATIVES
MONTGOMERY TOWNSHIP HOUSING DEVELOPMENT

	Remedial Alternative	Capital Cost	Annual O&M Cost	Present Worth Cost	Time To Implement (yr)	Comments
1-	No Action	-	29,000	273,000		-Does not address public health concerns; cost reflects 30 years of semi-annual well monitoring.
2-	Temporary Drinking Water	-	59,000	556,000	0-6 mo.	-Risks due to inhalation and dermal contact would remain.
3-	Extension of Elizabethtown Water Co. Supply System	319,000	-	319,000	1-2 yrs	-Addresses public health concerns -Meets ARARs -Technically feasibile and environmentally sound
4-	New Community Well with Treatment	699,000	31,000	991,000	2-4 yrs	-Will meet NJ ground water criteria -Potential releases of off-gas (treatment may need to be provided) -Time allowed for property acquisition prior to implementation

*An individual well water treatment alternative was considered and rejected due to inordinate cost.

*Alternatives 3 and 4 include sealing of abandoned wells.

*Present-worth costs are calculated using an interest rate of 10% and a project duration of 30 years.

Bottled water can be supplied through delivery to each of the 39 affected homes. The average daily demand for each residence was established for drinking and cooking purposes only. Temporary supply to meet all domestic water needs is impractical since a majority of bottled-water vendors supply five or six gallon storage containers mounted on a free-standing dispenser (i.e., bulk storage and dispensing facilities for purchased water would be required for each residence). Therefore, under Alternative 2, all other domestic water needs (i.e., sanitary, bathing, washing, etc.) would continue to be met through the existing contaminated well supplies.

Based on an assumed domestic water demand of one gallon per day per person, the estimated demand for drinking and cooking purposes would be met using bottled water with free-standing cold water cooler/dispensers. Water would be delivered in 11 five-gallon containers to each home every three weeks. It is estimated that each water delivery for 39 residences would consist of 2,145 gallons of water, or 429 five-gallon bottles.

The provision of a temporary water supply to meet drinking and cooking needs would reduce health risks resulting from the ingestion of contaminated well water. However, risks associated with airborne and dermal exposure would continue. The magnitude of the health risk from inhalation and dermal absorption is expected to be comparatively small for a two-year implementation period and would increase proportionately with increased time of exposure.

Supplying temporary drinking and cooking water from a local bottled water company is easily and immediately implementable. The annual cost of supplying 39 residences with bottled water includes an annual rental charge of $6,000 for the free-standing dispensers, and a water charge of $53,000 for a total of $59,000 per year. Implementation of this alternative necessitates future action.

Alternative 3: Elizabethtown Water Company Service Connections and Water-Main Extension (Public Water Supply)

Elizabethtown Water Company is currently supplying water to 38 of the 77 residences in the MTHD study area.

The Elizabethtown Water Company's existing water distribution system for the MTHD is shown in Figure 8. Addressing the problem of the contaminated residential wells by replacement with a public water supply would require the extension of the Elizabethtown water supply service system.

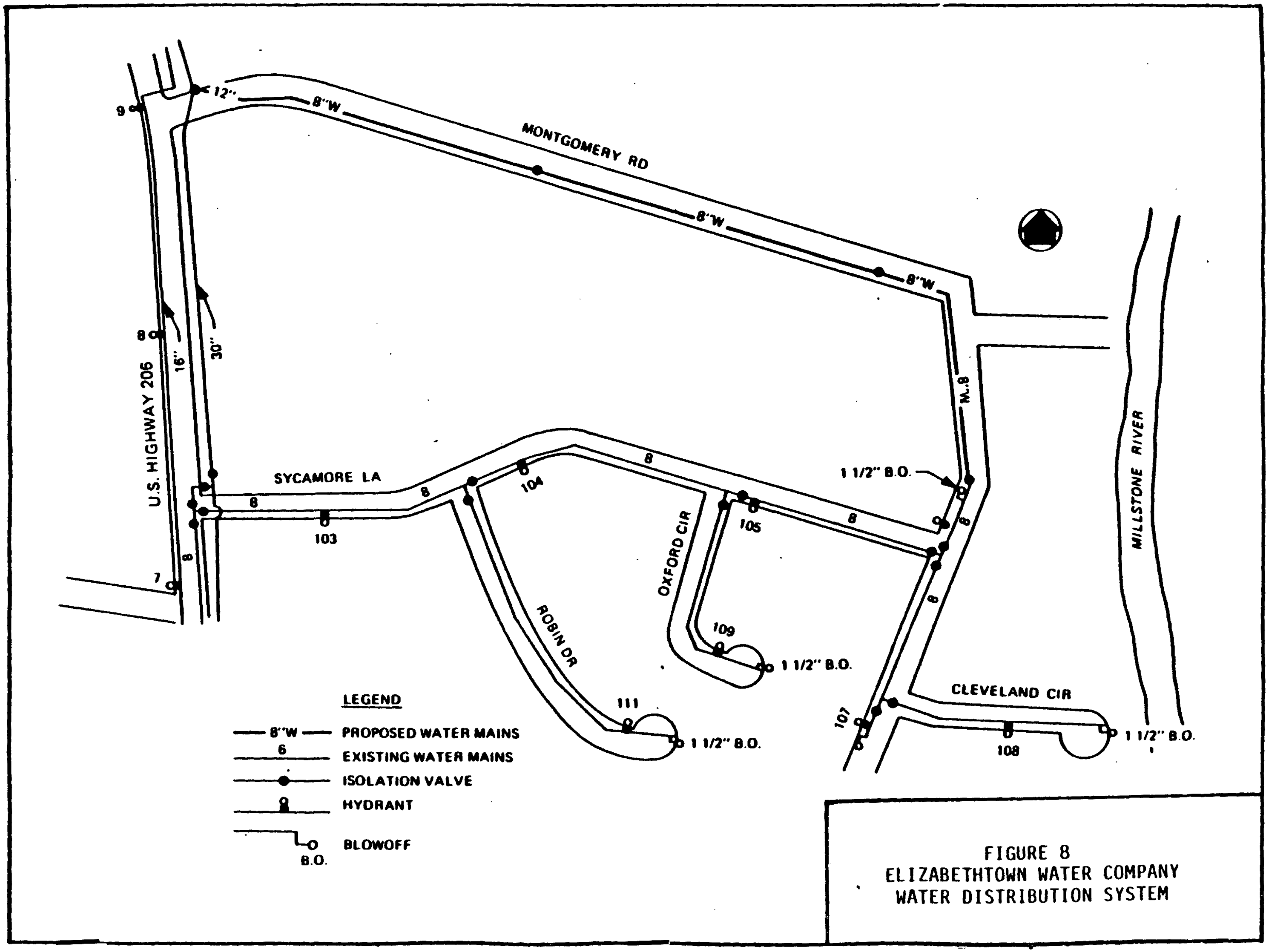


FIGURE 8
ELIZABETHTOWN WATER COMPANY
WATER DISTRIBUTION SYSTEM

The facilities to extend the Elizabethtown water system, also shown in Figure 8, include approximately 4,000 feet of water main and 39 service connections. The location of water mains and appurtenances for the water service would be finalized during the design phase.

The implementation of this alternative would necessitate abandonment and sealing of the individual residential wells in accordance with State of New Jersey Standard Specifications for Sealing of Abandoned Wells.

Extension of the existing system is a technically feasible and readily implementable alternative and the most cost-effective alternative considered. The capital cost for expanding the Elizabethtown water company system is estimated at $319,000. The physical expansion of these facilities could be implemented in six to nine months including design, approval, and construction of the system. Six additional months are necessary for administrative purposes, such as securing contracts.

Implementation of this alternative would completely eliminate risk due to exposure to contaminated ground water of residents using the aquifer for dringking water. It is a viable alternative and represents a permanent solution for providing a drinking water source that meets all criteria for the protection of human health. The Elizabethtown water supply is a reliable water source. The NJDEP Division of Water Resources has confirmed that this water company is in compliance with the Safe Drinking Water Act (SDWA) requirements. The water supply is monitored regularly for a list of compounds, as mandated by the SDWA.

<u>Alternative 4 New Centralized Community Well with Well Water Treatment</u>

Under this alternative a new community well would be installed on a purchased parcel of land within the MTHD or the surrounding area. A treatment system of sufficient capacity to meet the combined water demand of the 39 residential households would be constructed to treat the well water to a level that meets applicable criteria. The treatment facility components, shown in Figure 9, are described below.

The community well treatment system would be comprised of an air stripping system, in conjunction with a ground water activated carbon absorption system. Contaminated water would be brought into contact with air to vaporize the volatile compounds, which would then be removed with the exhaust air. The water would then be pumped through activated carbon cartridges for removal of those contaminants that are not removed by air stripping.

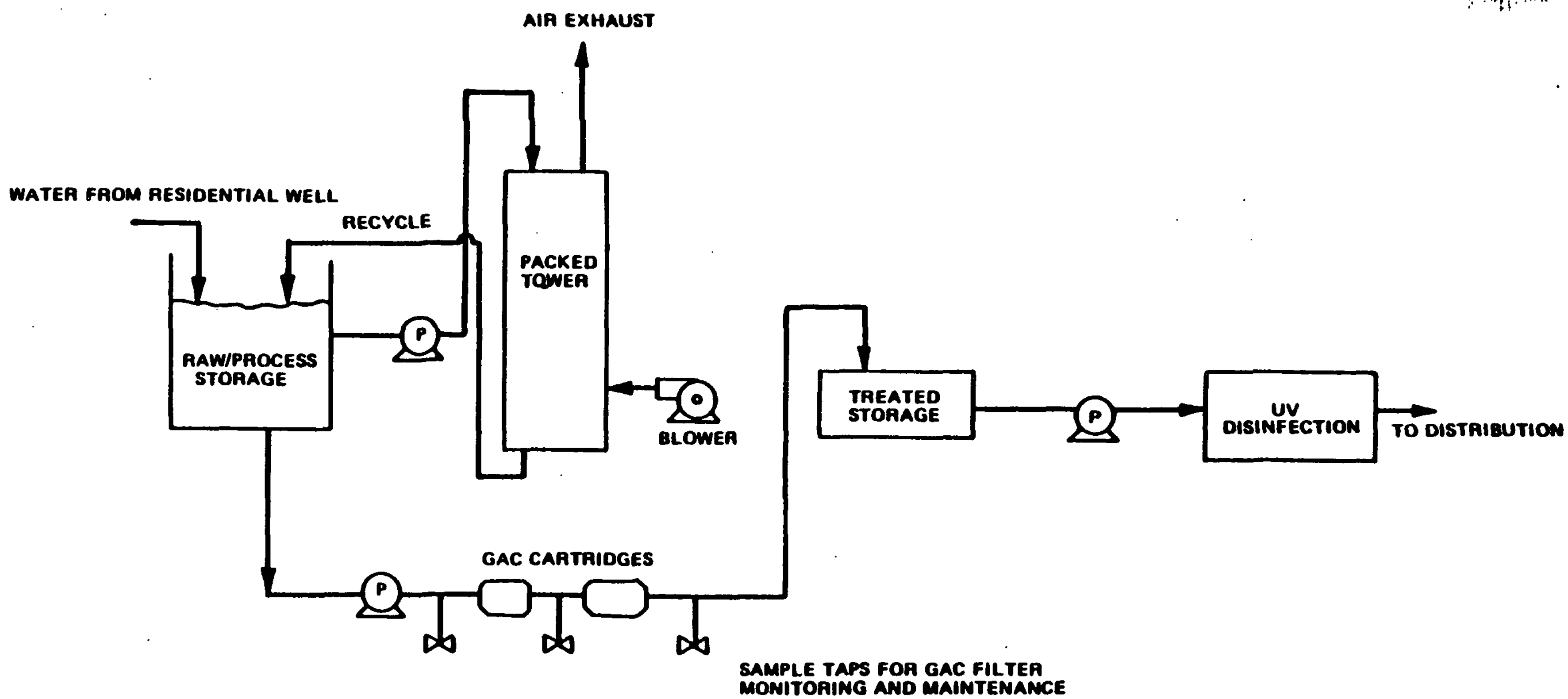


FIGURE 9
INDIVIDUAL WELL TREATMENT
AIR STRIPPING WITH
GRANULAR ACTIVATED CARBON ADSORPTI

Raw and treated water storage would be required to provide a buffer for fluctuating demand throughout the day. The community well system would require a distribution network system to collect and transport the water to the individual residences. Distribution pumps with recycle and distribution piping would be used for this purpose. Disinfection would be provided by chlorination to ensure residual disinfection throughout the distribution system. A standby generator would be included in case of power failure.

Like Alternative 3, the implementation of this alternative would result in the abandonment and sealing of the individual residential wells in accordance with State of New Jersey Standard Specification for Sealing of Abandoned Wells.

The reliability of the selected treatment is based on the existing water quality and contaminants presently identified. Possible future variations of contaminant levels or newly identified contaminant parameters could adversely affect reliability, and may require the upgrading of the treatment system.

Based on the individual contaminant levels found in the ground water to date, the water treatment systems described for Alternative 4 would meet all federal and state requirements for organics. However, pilot testing would be required to determine whether standards for metals would be met. If not, an appropriate treatment system for metals removal, based upon levels detected in the well, may need to be designed and evaluated. Continued monitoring of contaminant levels would be necessary to ensure that water quality meets appropriate requirements.

Air emissions for any of the treatment systems considered would be evaluated and treated to meet any ARARs.

Design and construction of the planned treatment system could be implemented within twelve months. Implementation of the centralized treatment system would also require time for property acquisition and associated contracts.

From an administrative standpoint, this alternative would not be as easily implemented as the other alternatives discussed herein. The establishment of the facility could take from a few months to over a year, based upon the cooperation of the residents, and the proposed owner (town or county). The time required to complete any necessary pilot studies, studies, design, construction and start-up of the treatment system would be likely longer than that for Alternative 3, especially since additional land would have to be acquired.

The capital cost for this alternative, $699,000, is the highest of all considered alternatives. Annual costs of operation and maintenance include costs for carbon disposal and replacement (see Table 6).

SELECTED REMEDY

After review and evaluation of the remedial alternatives discussed in the feasibility study and consideration of the evaluation criteria under each alternative, EPA and NJDEP presented Alternative 3 to the public as the preferred alternative for the MTHD site. During the public meeting held on July 29, 1987, concern was expressed regarding the quality of the Elizabethtown water supply. However, EPA and NJDEP have confirmed that this water supply is consistently in compliance with state and federal water quality standards.

Alternative 3 represents the first operable unit of a permanent remedy for the MTHD/RHMW sites. Identification of sources of contamination and possible remediation of the ground water plume will be addressed in a subsequent Record of Decision for the MTHD/RHMW sites.

The extension of the Elizabethtown water supply system best meets all evaluation criteria, as previously described here. Specifically, this alternative will best meet the objectives of CERCLA in that it is protective of human health, is cost effective, will provide a permanent solution to potential exposure to ground water contaminants by residents of the MTHD, and attains ARARs or criteria.

Implementation of Alternative 3 will effectively remove the risk of exposure to contaminants, and thus also remove potential health risks of those MTHD residents currently using the contaminated water supply.

Alternative 3 represents the most cost effective of all alternatives considered. In addition, Alternative 3 represents a permanent solution to the problem of potential exposure of MTHD residents to contaminated ground water. Administratively, Alternative 3 is the most easily implementable, when viewed over the long term, as compared to the other alternatives (see Table 5). It is also technically feasible.

Implementation of Alternative 3 is consistent with all ARARs and criteria. Specifically, the Safe Drinking Water Act (SDWA), as amended in 1984, established the basis for the development of the New Jersey Maximum Contaminant Levels and the Federal Maximum Contaminant Levels which were used as ARARs and criteria for the MTHD site. Implementation of an extension of the Elizabethtown water distribution system would meet these criteria and so ensure compliance with the SDWA.

Montgomery Township Housing Development
Montgomery Township
Somerset County, New Jersey

Responsiveness Summary

This community relations Responsiveness Summary is divided into the following sections:

Section I — Overview - This section discusses the New Jersey Department of Environmental Protection's (DEP) and the United States Environmental Protection Agency's (EPA) preferred alternative for remedial action, and likely public reaction to this alternative.

Section II — Background on Community Involvement and Concerns - This section provides a brief history of community interest and concerns raised during remedial planning activities at the Montgomery Township Housing Development (MTHD) site.

Section III — Summary of Major Comments Received During the Public Comment Period and the DEP/EPA Responses to the Comments - Both written and oral comments are categorized by relevant topics. DEP/EPA responses to these major comments are also provided.

Section IV — Remaining Concerns - This section describes remaining community concerns that DEP/EPA should be aware of in conducting the remedial design and remedial action at the MTHD site.

In addition to the above sections, Attachment A (included as part of this Responsiveness Summary) identifies the community relations activities conducted by DEP and EPA during remedial response activities at the MTHD site.

I. OVERVIEW

The alternative selected in the Record of Decision (ROD), which addresses the private potable well contamination in the MTHD, involves supplying a public water supply system to those residents whose wells are threatened or contaminated and permanently sealing the wells. The existing Elizabethtown Water Company water distribution system will be extended to replace use of these private wells.

Judging from the comments received during the public comment period, the residents and Montgomery Township officials appreciate DEP/EPA's efforts to mitigate the MTHD contamination but are concerned about the quality of the Elizabethtown Water Company supply. Several residents also expressed reservations regarding the sealing of private wells. Additionally, the Township and a number of residents felt that a marked inequity exists with respect to payments and reimbursements from the New Jersey Spill Compensation Fund and the Comprehensive Environmental Response Compensation and Liability Act (CERCLA or Superfund) for past actions taken to provide a safe water supply to residents.

These concerns have been addressed both in the July 29, 1987 public meeting and within this Responsiveness Summary. It is hoped that these efforts will result in increased community support for the water hookup program.

II. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS

Community interest in the MTHD evolved as information on the contamination became available. The contamination was first discovered in the Borough of Rocky Hill during a 1978-1979 water quality study being conducted by Rutgers University. Soon afterward, the problem was also recognized in the MTHD and by 1980, a citizens' committee had formed within the community to address the problem. The committee gathered information, produced newsletters and a petition for clean water, coordinated meetings, and helped to organize a sampling plan. Interest in the organized committee waned over the next three years but community interest continued.

The major concerns expressed at the January 14, 1986 public meeting and throughout the RI/FS process, and how DEP/EPA addressed these concerns are described below:

1) Concern was expressed regarding property damage related to site activities.

Response: DEP/EPA made assurances that any damage would be repaired (including any necessary landscaping) and that this would be ensured through Access Agreements.

2) A number of residents complained that they had not received first round sampling results for their wells. A few residents who later received sampling results were confused as to their content and meaning.

Response: Those residents who called before results had been approved through the DEP Quality Assurance program were told that results would be transmitted, when finalized, through the municipal health officer. They were also told to contact DEP by a specified date if they had not received them. Further follow-up contacts were made by DEP's Bureau of Community Relations to the DEP Bureau of Safe Drinking Water, the Montgomery Township Department of Health and the Franklin Township Health Department (some samples were also taken in Franklin Township) to ensure that the proper information was sent. Follow-up calls were made by DEP to clarify and explain results to residents with questions.

3) Concern was expressed regarding both payments for past actions and the possibility of mandatory hookups to the Elizabethtown Water Company supply.

Response: See Section 3, "Concern Regarding Hookup to Elizabethtown Water Company Supply" and "Reimbursement for Past Actions" for detailed responses to these concerns.

III. SUMMARY OF PUBLIC COMMENTS DURING THE JULY 15 - AUGUST 14, 1987 COMMENT PERIOD

Concern Regarding Hookup to Elizabethtown Water Company Supply

1) An inquiry was made as to whether the Elizabethtown Water Company supply is periodically tested and if it is known to contain the contaminants of concern. Several comments were made regarding the poor quality of the Elizabethtown water sources, specifically the Delaware and Raritan Canal and whether those sources are tested. A resident stated that the Elizabethtown Water Company, when asked, could not guarantee their supply was of better quality than her home-filtered water. A request was made for "proof" that the Elizabethtown water quality would be maintained.

Response: The water that Elizabethtown Water Company supplies to its customers is sampled on a regular basis to assure that State and Federal drinking water quality requirements are met. This supply has consistantly been in compliance with these requirements and sample results for recent analyses are included in the MTHD Operable Unit Remedial Investigation/Feasibility Study (RI/FS) for private potable wells (hereinafter referred to as the "MTHD RI/FS report"). This sampling includes the following:

-- Hazardous Contaminants (including trichloroethene and methylene chloride) as specified in the New Jersey Safe Drinking Water Act (commonly known as "A-280") - on a six month interval.

-- Volatile Organic Scan (including trichloroethene) - on a monthly basis. (This is done voluntarily by Eliabethtown, it is not a State requirement.)

-- Organic Pesticides - required to sample once every three years.

-- Trihalomethanes - voluntarily on a monthly basis. State requires quarterly sampling.

-- Inorganics (including lead and chromium) - required on a one year interval.

-- Coliform Bacteria - ten samples per day. Requirment varies by population served.

-- Turbidity - required on a daily basis

-- Radionucleids - required once every four years.

While regular sampling indicates that the public water supply is of good drinking quality, sampling of the ground water entering homes in the MTHD have consistently shown evidence of contamination. Levels of trichloroethene have been found in private wells in concentrations of 340 parts per billion (ppb), well over the present drinking water quality requirements of 5 ppb.

In contrast to the assurances provided regarding the public water supply quality, few similar assurances exist regarding the effectiveness of a home-filter unit.

2) A representative of Security and Safety Systems (a distributor of residential water filter systems) suggested that the FS include a listing of chemicals that are likely to be regulated under "A-280" in the future (according to a report issued by Congressman Christopher Smith).

Response: The MTHD RI/FS report has included in its analyses, chemicals which are likely to be regulated for drinking water supplies in the near future. DEP/EPA consider the inclusion of any more preliminary findings to be premature at this time. In March 1987, the New Jersey Drinking Water Quality Institute, which consists of members of the government, research and private sectors, released new recommended maximum contaminant levels for drinking water regulated under the New Jersey Safe Drinking Water Act. Once adopted in a regulation, Elizabethtown Water Company will be required to meet these levels. In the meantime, it can be noted that based on recent data, the Elizabethtown Water supply currently meets these proposed levels.

3) One resident noted that with hookup to the Elizabethtown system, there is no control over costs, as there is with a private well.

Response: Elizabethtown Water Company rates are regulated by the New Jersey Board of Public Utilities (BPU). If a rate increase is deemed necessary by Elizabethtown, they must file a rate-case petition. The BPU has 10 months in which to act on the request. During this time, the BPU forwards the petition to the New Jersey Department of the Public Advocate, the agency charged with defending the public's point of view. In addition, a public hearing, which is announced in local newspapers, is held by the BPU.

4) A resident submitted a written comment which expressed concerns about the health effects of trihalomethanes (THMs) that are created through chlorination of a public water supply (See Attachment B).

Response: Trihalomethanes (THMs) are a class of chemicals consisting of three halogens (either chlorine, bromine or iodine) around a methane base. Common THMs are chloroform, bromodichloromethane, dibromochloromethane and tribromomethane. These compounds are largely formed when selected organic materials in the water are combined with chlorine, which is introduced to kill harmful microorganisms. The recommended chlorination practice is to add a minimum of 1 parts per million (ppm) chlorine to the water and maintain a residual amount of at least 0.2 ppm as the water enters the distribution system.

Potential risks from THMs are being addressed by EPA, by requiring that total average THMs are below 100 ppb in drinking water. This requirement is similar to the 5 ppb requirement for tricholorethene. This level is currently being reviewed by a subcommittee of the New Jersey Drinking Water Quality Institute, as well as by EPA. If levels below 100 ppb are determined to be appropriate, new regulations would be issued accordingly.

In response to the concern regarding THMs, Elizabethtown Water Company carefully regulates the amount of chlorine used for disinfection. As a result, THM levels are consistently below 20 ppb, which are the lowest levels of any major New Jersey water company.

The choice currently being made by the concerned resident is to start with water from a severly contaminated aquifer and take on the responsibilities and associated risks of treating the water to potable levels. DEP/EPA feel that a more prudent action may be to start with water from an approved potable source and make the choice to treat the water in some personally acceptable manner. In this way the consequences of a home treatment system failure would not be one of drinking contaminated water.

Well Sealing and Hookups

1) A resident expressed concern that the "bad" wells had not been sealed which he felt affected the movement of contaminated ground water through the community. Another resident questioned why his well should be sealed if it's clean. Furthermore, because some residents have residential filters, there was resistance to a mandatory hookup. There was also an allegation made that the public water supply alternative had already been selected. A resident questioned why DEP was discussing leaving a few private wells unsealed for monitoring purposes.

Response: It is DEP/EPA's responsibility to protect residents from the fluctuations of contaminants in ground water and to ensure that future homeowners do not drink contaminated water. As the MTHD RI/FS report indicates, contaminant levels can change with time and location. Sealing of the private wells provides a uniform solution and assurance that present or future public health will not be threatened by this supply. The MTHD RI/FS attempts to specifically focus attention on the fact that several residents are using contaminated water, and provide a program to correct this situation. Sealing of the newly closed wells was included in some of the alternatives (including the selected alternative). Reasons for permanently sealing the wells include:

-- An unsealed well could provide a conduit for further vertical migration of contamination either from the surface or, from subsurface layers.

-- State law stipulates that abandoned wells must be sealed.

-- Incidential contact with contaminated water could occur with these unsecured wells.

-- A new homeowner could unknowingly reconnect the well and start drinking contaminated water.

-- Improper plumbing could lead to a cross connection between the well and the public water supply, resulting in contamination of the public water supply.

The decision to seal these 39 wells at this time was based on the ease with which this could be carried out under this program. Sealing of other abandoned wells in the site area are not being addressed here, but will be included within the main study.

Private wells which have not yet been sealed have probably not exerted a great deal of influence on movement of contamination through the aquifer in the short-term, although there is certainly some effect on ground water flow. Sealing of the wells is nonetheless desireable regardless of these facts.

Wells left unsealed for monitoring purposes only would allow us to track the flow and levels of contamination and to predict and avoid any unforeseen public health or environmental threats.

With respect to residential filters; because the design and maintenance of individual household filters are critical to their performance, DEP/EPA cannot readily ensure the reliability of the treated supply.

The public water supply alternative, or any other alternative, had not been selected prior to the issuance of the ROD and this Responsiveness Summary which incorporates public comments. Statements made at the July 29, 1987 public meeting regarding the public water supply alternative were based on DEP/EPA's preferred alternative as recommended to the public.

2) A resident asked if the wells could be uncapped once sealed if the aquifer were ever again deemed potable.

Response: A well is sealed by removing the pump and filling the well with a cement slurry. This is an irreversible process and is done to assure that the aquifer is not used while it is contaminated. As a result, the well could not be reused at a future date.

Other Proposed Alternatives

1) A resident suggested that we explore the possibility of the MTHD connecting to the Rocky Hill Municipal Well which is being treated to meet drinking water quality standards. The Township Health Officer questioned whether the Rocky Hill treatment system was adequate for heavy metals.

Response: The most efficient way to provide water to the MTHD from the Rocky Hill Municipal Wellfield would be to disconnect the tie-in to Elizabethtown water at the intersection of Route 206 and Sycamore Lane, and connect to a Rocky Hill municipal water main on Montgomery Road. It should be noted here that as with Elizabethtown water, Rocky Hill water is regularly tested for both organic and inorganic contaminants. The following concerns were raised when DEP/EPA considered this suggestion:

a) The Borough of Rocky Hill must first agree to such a connection.
b) An adequate supply must be available from the existing facility.
c) Limitations may exist because of franchises held by Elizabethtown Water Company.
d) Billing and water line maintenance would have to be addressed in some manner.

Subsequent contact with Mayor Raymond Whitlock of Rocky Hill indicated that he did not initially object to DEP/EPA's exploring the possibility of such a program. He noted however that actual approval would have to be gained from the city council when details of the plan were fully developed.

Both Mayor Whitlock and the Rocky Hill Borough Water Superintendent agreed that the system would probably be capable of handling the additional demand at the current usage rates. However, it was noted that significant portions of Rocky Hill are as yet undeveloped and any commitment to supply MTHD with water would impact future development plans.

According to the Board of Public Utilities, although Elizabethtown Water Company maintains a franchise to supply water in the area, alternative supply sources can be developed. The MTHD water mains, however, are under the control of Elizabethtown Water. If an agency other than Elizabethtown Water were to use these mains, they would have to assume control of the distribution system. Such an arrangement, which could be fairly simple or fairly complex (and expensive), could only be determined following a thorough review of the contract documents between Montgomery Township and Elizabethtown Water. It should be noted that the likely outcome of this review is that control can be shifted with only minor efforts.

Billing and water system maintenance could be handled by either Montgomery Township, Rocky Hill Borough, or Elizabethtown water under a variety of procedures. As compared to the other groups, Montgomery Township would probably be inappropriate for this task, since they do not customarily perform these functions. Rocky Hill would probably be capable of performing these functions, though they would have to act in the function of a utility with regard to sampling and accounting. Likewise they would have to assume added maintenance tasks. The complications would be minimized if Elizabethtown Water were to retain billing and maintenance responsibilities, and operate under a bulk sale agreement with Rocky Hill.

In summary, water can possibly be obtained from Rocky Hill Wellfield only for the present time. The optimal mechanism by which this would be done is by Elizabethtown Water buying water in bulk from Rocky Hill and distributing it to the housing development. Other methods would face several potential obstacles. Because the Elizabethtown water supply is of good drinking water quality, is the readily available water supply, and is a more reliable, long term water supply, an alternative supply is not warranted under this program. It is recommended that any discussion between Elizabethtown Water Company, Rocky Hill, and Montgomery Township be pursued further outside the realm of this program.

2) A proposal was made by a Township Committeeman to combine the alternative to connect to available water mains with the home air-stripping alternative, applying the latter to the four residences on Montgomery Road who do not have available mains. This would avoid the substantial costs involved in providing a water main to connect these four residences to the Elizabethtown supply. He further suggested that the savings may be applicable to the remaining homes thereby allowing households to continue using private wells with filter systems.

Response: This hybrid alternative is described in Attachment C. The cost estimates for this alternative are $266,000 capital costs and $11,000 for annual costs. The net present cost of this alternative is $369,696 (@ 10% for 30 years) compared to complete public water supply connection costs of $319,000. (See Item 2 in"Costs of Alternatives" for discussion of possible tax impacts). Since the accuracy of the cost estimate is limited, DEP/EPA do not consider the difference in estimated system costs of less than 30% to be significant. Therefore, a comparison is made based on technical parameters only.

Because of the relative ease of implementation and relative permanence of the remedy, the public water connection alternative is the selected alternative.

3) The Security and Safety Systems representative also requested that other new technologies be evaluated in the final MTHD FS report. Information he has submitted to DEP/EPA is included in Attachment D. These technologies may be applicable as an exclusive alternative, or as a means of providing water prior to the implementation of other remedial programs.

Response: Attachment D is a proposal for a carbon adsorption home filtration unit. The use of this unit in remediating the potable well contamination was considered, and the following points were noted:

a) The unit only addresses water ingestion and does not address inhalation threats associated with bathing. The RI/FS has identified this as a significant threat.

b) Though the unit is capable of removing trichloroethene, which is the major contaminant, it does not address other less prevalent potential problems, including biological buildup and contamination by methylene chloride and metals. (It should be noted that the activated carbon units discussed in the MTHD RI/FS also do not address methylene chloride and metals, though the public water connection alternative does address this point.)

c) The only information regarding trichloroethene removal is a calculation of total loading for a 34 ppb influent in a family unit. No data is presented for a concentration closer to the levels found on site (160 ppb or 0.16 mg/l average). If the total loading value presented of 102.1 mg is used, approximately a two month unit life would be expected as an average. (102.1 mg $\div$ 0.16 mg/l $\div$ 12 l/day = 53 days). This is significantly below the one year figure presented in the proposal. This factor results in a potential for proposed costs to be underestimated, since both filter replacement and analysis would be performed more frequently.

The proposed home filtration system (for drinking and cooking uses) is not recommended as part of this program. At best, the proposed unit would be only as protective as the bottled water alternative, and this alternative was eliminated from consideration in the FS because it failed to effectively limit inhalation risks. Those factors listed in points b) and c) above could be addressed with added monitoring and maintainance, but with resultant increased costs.

Reimbursement for Past Actions

1) Township officials expressed concern over the inequities of reimbursements to residents (See Attachment E). A number of residents have not been paid for hookups to the Elizabethtown supply or for assessments for the installation of a water line. The Health Officer further stated that the Township Committee would probably take these apparent inequities into consideration when addressing their plans to pass an ordinance condemning the wells. The Township Committeeman suggested that the cost of the existing water mains be factored into the alternatives.

   One resident stated that the starting point for the cleanup program should be 1979 when the contamination was first discovered and cleanup costs should include any cleanup actions taken from that date.

Response: Several claims related to MTHD have been filed under a State program intended to remediate a variety of problems at hazardous waste sites (New Jersey Spill Compensation and Control Act, otherwise kncwn as Spill Fund). These claims are currently being handled on an individual basis, with roughly half already processed. The law governing this program is explicit in defining filing requirements and the approval of claims is entirely dependent on the limitations of this law.

As a matter of EPA policy, Superfund is not used for reimbursement programs under the conditions addressed at MTHD. The fact that the obligation of municipal funds occurred prior to the enactment of the Superfund law passed December 11, 1980, raises an issue regarding State credits under CERCLA. Under section 104(c)(5) of CERCLA (Attachment F), the State is eligible for a credit for response actions that occurred before December 11, 1980 taken by a political subdivision. This granting of credit could conceivably be passed on to Montgomery Township. EPA and DEP are currently discussing the applicability and mechanics of such a program and will continue to pursue it to resolution.

Costs of Alternatives

1) There was general consensus among residents and officials that some of the estimated costs for the alternatives may be inaccurate and highly inflated.

Response: The costs presented are higher than may have been anticipated for the following reasons:

a) Contamination levels used for system design are the average site contaminants found in recent private and monitoring well samples (160 ppb). Due to the highly variable nature of the ground water sample results, it is necessary to use these levels to safely size treatment systems.

b) Analysis procedures required under this program are both more expensive and more frequent than those customarily seen by residents. As an example, the monitoring for individual activated carbon units is on a 30-day schedule at a cost of $750 per sampling event. Due to the highly variable nature of the contamination, a frequent sampling program is necessary.

c) Miscellaneous items such as bacterial buildup and winterizing of outdoor equipment are also addressed in the alternatives, resulting in increased cost estimates.

Further details of the cost elements are discussed in the body of the RI/FS report.

2) A resident suggested that we factor into our cost analysis the 66% State or Federal tax on the 4,000-foot water line.

Response: The additional project costs resulting from Elizabethtown Water potentially being taxed for the value of the new main have not been incorporated. This is because of the liklihood that these costs would be addressed outside of this program. The table below shows the potential impact of this tax.

Alternative	Capital Cost	Annual Cost	Present Worth (Rounded)
Bottled Water	-	59,000	556,200
Public Water	458,425	-	458,400
Home Air Stripping	1,255,000	105,000	2,244,800
Home Carbon	559,000	378,000	4,122,400
New Community Well (Assumes Well Operated by Township)	699,000	31,000	991,200
Hybrid System	266,000	11,000	369,700

The only shift in ranking of systems occurs between the complete public water connection and the hybrid system, but the resulting variation is still within the accuracies of the estimate (30%).

Responsible Parties

1) The Township Committeeman asked if DEP/EPA is focusing in on a responsible party and if so, will they be responsible for the costs incurred?

Response: A prime objective in any Superfund remedial action is identification of a responsible party or parties. The Superfund law mandates that any or all identified responsbile parties pay all costs associated with the cleanup process (including costs of the RI/FS). Should a responsible party choose not to pay the incurred costs, the law allows EPA to sue that party for up to three times the cleanup costs.

DEP/EPA are continuing to narrow the list of potential responsible parties through the more comprehensive, ongoing RI/FS being conducted for both the Rocky Hill Municipal Wellfield and MTHD sites.

Decision Process

1) A resident asked what the mechanism was for selecting the remedial alternative. After being told that the Regional Administrator makes the final decision, he asked why a referendum could not be held instead of a "czar" making the decision.

Response: The Superfund community relations program is very specific in its requirements for citizen input into the cleanup process in order to meet the mandates of the law. As is evident in the ROD and this Responsiveness Summary, the mechanism for selecting the remedial action alternative is relatively complex. The Superfund law and the accompanying regulations listed in the National Contingency Plan clearly outline the process by which a Superfund cleanup is conducted, including the alternative selection process.

Public input does indeed play an important role in this process. The public's concerns are solicited throughout the RI/FS process. These concerns are addressed in the Responsiveness Summary and are presented to the Regional Administrator prior to final selection of a remedial alternative.

The ROD is based on months of research, data gathering, analyses, and alternative reviews by a number of geologists, hydrogeologists, engineers, toxicologists, attorneys, etc. and each document of the RI/FS and ROD goes through several drafts before reaching the Regional Administrator.

Thus, the ROD actually represents the concerted efforts of DEP, EPA and the affected communities.

Aquifer Contamination

1) A resident had not heard prior to this public meeting that metals contamination was a concern. She asked what levels of heavy metals contamination were found.

Response: The metals contamination found randomly in the area is not necessarily part of the groundwater plume. Of the 35 private wells recently sampled for inorganics, the following materials were found in excess of standards:

Chromium (50 ppb drinking water standard) - in one well at 117 ppb.

Lead (50 ppb drinking water standard) - in four wells at levels of 91, 143, 740, and 2,170 ppb.

2) A resident asked how many wells have gone "bad" since the study started in the area.

Response: A comparison of 1986 data with previous data for changes in trichloroethene detection was made. Of 29 homes that had both a 1986 sample and a sample prior to 1986, four homes showed a newly detected presence of trichloroethene while one home where trichlorothene was previously detected, was clean. The four homes with recent detections were on Sycamore Lane and Montgomery Road, along the northern edges of the identified plume.

3) A resident asked what are the odds that the aquifer will be clean in ten years.

Response: Because the source is not yet known, it is impossible to predict whether, or how long it will be until all of the contaminants have traveled through the aquifer. The source may, in fact, no longer be discharging contaminants. The more comprehensive, ongoing RI/FS will address the contamination of the aquifer as a whole. The present MTHD RI/FS addresses only the private potable wells.

IV. REMAINING PUBLIC CONCERNS

The community will be awaiting the results of the more comprehensive RI/FS for MTHD and RHMW. This will address their concerns regarding the identification of responsible parties and the long-term cleanup of the aquifer.

DEP/EPA are confident that the July 29, 1987 public meeting regarding the MTHD RI/FS and this Responsiveness Summary will help to foster further public acceptance of the public water supply hookup and private well sealing decision.

ATTACHMENT A

Summary of

Community Relations Activities

COMMUNITY RELATIONS ACTIVITIES CONDUCTED
AT
MONTGOMERY TOWNSHIP HOUSING DEVELOPMENT

Community Relations activities conducted at the MTHD site to date include the following:

-- A Community Relations Plan was prepared (June, 1985).

-- Municipal officials were contacted to advise them of a contract award to conduct the RI/FS for the MTHD and the Rocky Hill Municipal Wellfield sites (August, 1985).

-- An informational flyer was distributed to homes in the MTHD regarding the RI/FS and planned activities (November, 1985).

-- DEP held a briefing for municipal officials (November 14, 1985).

-- Notices were sent to those listed on the Contacts list of the Community Relations Plan and press releases were sent to the media announcing the January 14, 1986 and July 29, 1987 public meetings (December 1985 & July 1987).

-- A public meeting was held at the Montgomery Township Municipal Building to discuss the initiation of the RI/FS. Approximately 35 people attended including citizens, local officials and media representatives (January 14, 1986).

-- The Operable Unit MTHD RI/FS report was placed in repository for public review and comment at four locations: the Montgomery Township Municipal Building, the Mary Jacobs Library in Rocky Hill, the Somerset County Library Main Branch and DEP in Trenton. The public comment period was from July 15, 1987 to August 14, 1987.

-- A public meeting was held at the Montgomery Township Municipal Building to discuss the completion of the Operable Unit RI/FS for Private Potable Wells. Approximately 35 people attended including citizens, local officials and media representatives (July 29, 1987).

-- Telephone contact and written correspondence was maintained between DEP and municipal officials and the press (ongoing throughout RI/FS).

ATTACHMENT B

Letter from Resident

Regarding Trihalomethanes

RECEIVED

AUG 13 1987

State of New Jersey
Department of Environmental Protection
Division of Water Resources
Office of the Director

AUG 26 1987

1 REC'D

August 11, 1987

Jan Gajewski

167 Montgomery Road

Skillman, NJ 08558

Jeffrey Folmer, Senior Area Coordinator

NJ Department of Environmental Protection

401 East State Street

Trenton, NJ 08625

Dear Sir:

As a resident of Montgomery Road I wish to voice my concern over the mandatory hookup to Elizabethtown public water proposed by the New Jersey Department of Environmental Protection for homes in the Montgomery Road Sycamore Lane area.

Through its past actions the NJDEP has made available to residents in the area an alternative to private well water in the form of Elizabethtown public water. Each resident has made a conscious decision as to the best source of water. I am one of several residents who has chosen activated charcoal filtered private well water. This source of water has been shown to contain no detectable organic contaminants per analysis of Princeton Testing Laboratory, P.O. Box 3108, Princeton, NJ 08540. In mandating hookup to Elizabethtown public water the State will be forcing me to ingest chlorine disinfected water against my better judgement. Recent epidemiologic studies, such as the one enclosed, have demonstrated health risks which have resulted from drinking chlorinated water which meets present standards. Numerous researchers have documented the increased mutagenicity of chlorinated water via standard Ames tests. Present studies of chlorinated water are quite reminiscent of asbestos research during the 1950's. In mandating public water the State is assuming a custodial role with all the responsibilities which this implies. I urge the New Jersey Department of Environmental Protection to consider the long term consequences of its decision.

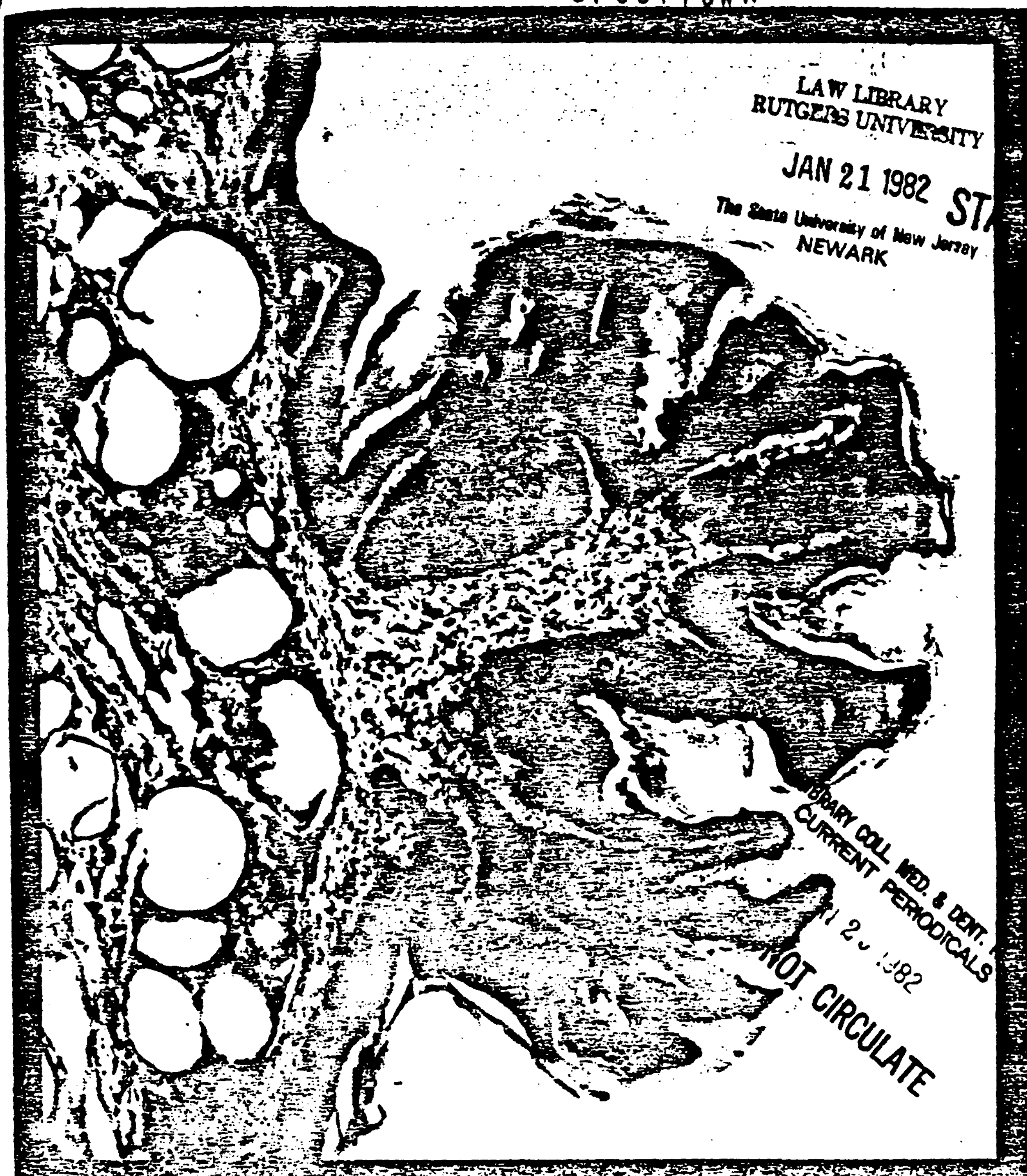
Sincerely

Jan Gajewski

JNCI

Journal of the National Cancer Institute

December 1981
Volume 67
Number 6



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES Public Health Service National Institutes of Health

JNCI

Journal of the National Cancer Institute

October 1981
Volume 67
Number 4

THE JOURNAL of the National Cancer Institute solicits manuscripts on original observations in laboratory and clinical research from all scientists. A manuscript is considered for publication with the understanding that it has not been published previously and is submitted exclusively to the Journal. Opinions expressed by the authors are not necessarily those of the publisher or its editors.

THE JOURNAL is published monthly (two volumes a year). The Secretary of Health and Human Services has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department.

A MONOGRAPH SERIES covering proceedings of scientific meetings pertaining to cancer is also published. These books may be purchased from the Superintendent of Documents. Series subscriptions are not available and monographs are not included in a subscription to the Journal.

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JNCI (NIH Publication No 82-13)

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES   Public Health Service   National Institutes of Health

Epidemiologic Study of Drinking Water Chlorination and Wisconsin Female Cancer Mortality [1, 2]

Theresa B. Young, [3] Marty S. Kanarek, [3] and Anastasios A. Tsiatis [4, 5]

ABSTRACT—The association between gastrointestinal, urinary tract, brain, lung, and breast cancer mortality and drinking water trihalomethane exposure, as estimated by average daily chlorine dosage of water source 20 years past, was investigated for Wisconsin white females by use of a death certificate-based case-control study design. A total of 8,029 cancer deaths and 8,029 controls (noncancer deaths) matched on county of residence, year of death, and age were taken from mortality records of 28 counties for the years 1972-77. Data on characteristics and treatment of municipal water supplied to the residences of cases and controls were obtained from questionnaires sent to the water superintendents of the 202 waterworks associated with the sample. By the use of logistic regression analysis, odds ratios for site-specific cancer death associated with high, medium, and low chlorine-dosed water as compared to unchlorinated water exposure were determined; the control variables were urbanicity, marital status, and occupation. With the exception of cancer of the colon, no anatomic cancer site was significantly associated with any chlorine dose exposure category. For colon cancer, odds ratios of 1.51 [95% confidence interval (CI) = 1.06-2.14], 1.53 (95% CI = 1.08-2.00), and 1.53 (95% CI = 1.11-2.11) were obtained for high-, medium-, and low-dose chlorination, respectively ($P \leq 0.02$). For colon cancer cases and controls exposed to water sources affected by rural runoff, odds ratios of 3.30 (95% CI = 1.45-7.48), 3.60 (95% CI = 1.57-8.26), and 2.74 (95% CI = 1.10-6.88) were observed for high, medium, and low chlorine dosages 20 years past ($P \leq 0.025$).—JNCI 1981; 67:1191-1198.

Acute chloroform exposure has been known to cause necrosis of liver, kidney, and central nervous system tissue since the 1940's, which dates to the era of chloroform anesthesia (*1*). Due to its toxic effects, chloroform was banned from use in medicinal preparations, and occupational standards were established (*2*). Widespread exposure to low levels of chloroform and other trihalomethanes[6] became apparent, however, when nationwide water surveys found these compounds to be pervasive in municipal water supplies disinfected with chlorine (*3*). Chloroform concentrations were found to greatly exceed those of any organic contaminant, including industrial pollutants. With repeated findings that chloroform is carcinogenic under bioassay conditions in rodents (*4*) and that other trihalomethanes are mutagenic (*2*), the chronic, low-dose exposure of a large proportion of the population to trihalomethanes via chlorinated drinking water assumed additional importance and necessitated assessment of human cancer risk.

A number of epidemiologic studies have been conducted which examine the relationship between drinking water variables that crudely reflect THM exposure and cancer mortality or incidence (*5-10*). Significantly higher cancer mortality rates for various anatomic sites (gastrointestinal, urinary tract, lung) have been found in geographic areas supplied with chlorinated surface water (*6, 7*), prechlorinated water (*8*), and water with recently measured high THM levels (*9*). In a case-control study of seven New York counties, excess gastrointestinal, urinary tract, and lung cancer deaths were associated with presumed use of both chlorinated surface and chlorinated ground water (*10*).

In general, these studies have been considered inconclusive as a result of the lack of concurrence of the anatomic cancer sites associated with higher risk. However, many of these studies were preliminary in intent and were not designed to assess THM exposure per se. From the consideration that an oncogenic effect appears to be associated with probable exposure to trihalomethanes, further investigation incorporating more exposure specificity was a major aim of this study.

Trihalomethanes are thought to result from a haloform-type reaction of chlorine with naturally occurring organics in water (*11*). Whereas trihalomethanes are rarely detectable in unchlorinated water, THM concentration in chlorinated water is a function of the amount of chlorine added, concentration of organic precursor, pH, water temperature, and water purification procedures (*12-15*). Historical data for most of these parameters were available from Wisconsin waterworks records. Consequently, the case-control study

ABBREVIATIONS USED: CI = confidence interval; ICDA = International Classification of Diseases adapted for use in the United States (8th revision); THM = trihalomethane.

[1] Received December 2, 1980; revised June 19, 1981; accepted July 21, 1981.

[2] Supported by Environmental Protection Agency contract C2769NAEX and by grants from the University of Wisconsin Graduate School and from the Wisconsin Clinical Cancer Center, Cancer Control Program.

[3] Department of Preventive Medicine, University of Wisconsin, 504 North Walnut St., Madison, Wis. 53706.

[4] Department of Biostatistics, Harvard School of Public Health, and Sidney Farber Cancer Institute, Boston, Mass. 02215.

[5] We thank Dr. Ray Nashold (Director of Health Statistics, Wisconsin Department of Health and Social Services) for providing the mortality data used in this study and Mr. Kevin Kessler (Bureau of Water Quality, Wisconsin Department of Natural Resources) for assisting in the gathering of exposure data.

[6] $CH(R)_3$ where R represents chlorine, bromine, or iodine or combinations thereof; the major trihalomethanes in drinking water are chloroform, bromodichloromethane, dibromochloromethane, and tribromomethane (bromoform).

reported here examines the risk of site-specific female cancer death associated with THM exposure, as estimated by chlorine dose of water supply 20 years past and other water factors known to affect THM levels.

METHODS

Study design.—A death certificate-based case-control study design was used in which the characteristics of water supplied to the last residence of the cases (female cancer deaths) are compared to the characteristics of water supplied to the controls (female noncancer deaths). Inherent in this design were the assumptions that cases and controls were exposed to the water supply associated with the "usual place of residence" recorded on the death certificate for 15-20 years before death and that this water source provided most of the water consumed daily. These tenets were maximized by the imposition of two sample restrictions. First, males were eliminated from the sample. For this cohort of decedents (death years 1972-77), males were likely to have experienced more residential mobility before their last residence. Furthermore, males of this era were more likely to have been employed outside the home than were females and thus to have had significant exposure to water other than the home supply on a daily basis. Second, only counties with 10-year population increases due to immigration of 10% or less over the past two decades with both chlorinated and unchlorinated water supplies were considered as sources of cases and controls.

Sample of cases and controls.—Cases were defined as all white female deaths that occurred 1972-77 within the 28 study counties due to malignant neoplasms of the following sites: esophagus, stomach, colon, rectum, liver and intrahepatic bile ducts, pancreas, urinary bladder, kidney, lung, breast, and brain (*see* table 1 for ICDA codes). Due to the lack of racial heterogeneity in most of Wisconsin, only white female deaths were included. Gastrointestinal and urinary tract cancer sites were chosen on the basis of experimental animal studies and clinical reports, which suggest kidney and liver as target organs and ecological studies that link treated water with gastrointestinal and urinary cancer mortality (*1, 4, 5*). Lung cancer in females has been linked to treated water in both ecological and case-control studies (*9, 10*). In addition, the lung is a biologically plausible target organ, since it is a major excretory route of ingested chloroform (*16*) and a site of considerable enzymatic metabolism of toxic compounds (*17*). Brain cancer is included on the basis of the relationship with THM exposure found in the ecological study by Cantor et al. (*9*) and of the clinical findings that link chloroform exposure to brain lesions (*1*). Breast cancer was originally included as a control site, because most currently held risk factors for this site are of a genetic or hormonal nature, and environmental factors have not been implicated. Findings from metabolic and animal studies, however, give no justification for precluding breast as target tissue. To the contrary, mammary tumors seen in mice exposed to chloroform (*4*) and findings from a metabolic study suggestive of a positive relationship between amount of adipose tissue and ingested chloroform retention (*16*) posed some biological rationale for investigation of this site.

All deaths meeting the case criteria were taken from computer tapes of abstracted death certificates provided by the Wisconsin Department of Health and Social Services, Bureau of Health Statistics. A noncancer death was then matched to each case on the basis of sex, race, year of death, county of residence, and nearest birth date (day, mo, yr).

The sample distribution by cause of death is presented in table 1. Several points are worthy of note. For most controls (71%), the cause of death was categorized as circulatory system disorders. There is some indication from animal studies that chloroform can induce heart and blood vessel lesions (*1, 4*). This possibility would tend to reduce differences in mortality associated with THM exposure. Similarly, since chloroform exposure is associated with liver and kidney necrosis in humans and experimental animals, control deaths due to liver and kidney disorders may also tend to reduce a relationship between cancer death and THM exposure.

A small percentage (1%) of the controls died due to infective and parasitic diseases. Some of these deaths may be related to waterborne infectious agents present in unchlorinated water. A positive relationship with unchlorinated water for these controls would thus have the effect of overestimating a positive relationship between cancer death and chlorinated water. Due to small numbers of relevant controls, however, the potential effect would be slight.

Exposure data.—Water source for each decedent was assigned on the basis of the water facility, if any, that served the population within the boundaries of the city, village, or town listed on the death certificate as the usual place of residence. Residences not served by private or municipal waterworks were considered to have individual wells. In addition, residences served by waterworks constructed more recently than 1970 were considered to have an individual well water source, since the exposure of interest would have been before the operation of these waterworks. Water treatment and characteristics for each of the 202 different water sources that had served the sample were then gathered and linked to the decedents.

Type of water source (surface or ground), depth of ground source in feet, and use of purification procedures (coagulation, sedimentation, and filtration) were obtained from the 1970 Wisconsin Waterworks Survey report (based on data for 1960-65). More detailed information on prechlorination and/or postchlorination dosages used over the past 20 years (average daily dose in ppm) and the occurrence of several environmental factors influencing organic content of raw water (rural runoff, industrial discharge, air pollution, and water with taste or color) were ascertained from a mail-back questionnaire sent to each water supe

TABLE 1.—*Sample distribution by cause of death*[a]

Cause of death	ICDA code[b]	No. of deaths	Percent of deaths
Cancer, site of malignant neoplasm			
Esophagus	150	97	1
Stomach	151	457	6
Colon	153	1,601	20
Rectum	154	393	5
Liver, gallbladder, and bile ducts	155, 156	372	5
Pancreas	157	701	9
Urinary bladder	188	230	3
Kidney	189	245	3
Brain	191	214	3
Lung and bronchus	162	975	12
Breast	174	2,695	33
Small intestine[c]	152	26	0
Other digestive[c]	159	23	0
Total		8,029	100
Noncancer diseases			
Infective and parasitic diseases	1–136	72	1
Endocrine, nutritional, and metabolic diseases	240–279	364	5
Diseases of the blood and blood-forming organs	280–289	38	0
Mental disorders	290–315	56	1
Diseases of the nervous system and sense organs	320–389	146	2
Diseases of the circulatory system	390–458	5,695	71
Diseases of the respiratory system	460–519	440	6
Diseases of the digestive system	520–569	197	2
Diseases of the liver	570–573	272	3
Diseases of the gallbladder and pancreas	574–576	28	0
Diseases of the genitourinary tract	580–629	112	1
Diseases of the skin	680–709	10	0
Diseases of the musculoskeletal system	710–738	58	1
Other		541	7
Total		8,029	100

[a] Wisconsin female deaths, 1972–77.
[b] According to (*18*).
[c] These sites were not analyzed due to insufficient sample size.

tendent. For six nonresponders, monthly water reports on file at the Wisconsin Department of Natural Resources were searched, and data on average current chlorination dosages were obtained. For this sample of deaths, 14% were not served by a waterworks and were assumed to have individual wells. Since Wisconsin private wells are very unlikely to be chlorinated, decedents not served by a water facility were assigned a chlorine dosage of zero.

Confounding factors.—Urban residence is associated with higher cancer mortality (*19*) and with exposure to chlorinated water. Consequently, the community of the decedent's residence was ranked on the basis of the 1960 U.S. census into one of six population size categories (*see* table 2).

The occupations listed on the death certificates were used to construct site-specific high-risk occupation variables. For each anatomic cancer site subsample analyzed, if the case or control had worked at any occupation considered a high risk for the particular cancer site, a score of 1 was assigned; otherwise, the score was zero. The following occupation categories represented in the Wisconsin death certificate coding were considered (*20*, *21*):

Cancer site	Risk occupation or industry
Bladder	Dyers, shoemakers, hairdressers, painters, printers, printer's apprentices, and textile workers
Kidney	Dyers
Pancreas	Metal production workers
Liver and biliary passages	Chemical workers
Lung and gastrointestinal tract	Asbestos workers

Unfortunately, some specific high-risk occupations (e.g., rubber worker) could not be discerned from death certificate coding. However, since only females were studied, the chance of significant confounding due to high-risk occupation in chlorinated areas was slight. As seen in table 2, the proportion of females employed in any of these high-risk categories was small, as expected for this generation of female decedents. Only 0.56% of the sample had an occupation designated high cancer risk by the above criteria, whereas 63% of this sample were classified as "homemakers" on the basis of occupation listed on the death certificate.

Cancer rates, particularly breast and colon cancer rates, are higher among unmarried females (*22-24*). It is possible that fewer unmarried females reside in the more rural areas, and thus the exposure of unmarried females to chlorinated water (associated with more urban areas) is more likely. This potential confounder was avoided because marital status as indicated on the death certificate was used as a control variable. A descriptive summary of the sample of 16,058 deaths is given in table 2.

TABLE 2.—*Descriptive summary of cases and controls*[a]

Selected factors	No. of deaths	Percent of deaths
Marital status = married	6,900	43
Occupation		
Homemaker	10,086	63
High cancer risk	90	<1
Residence served by a water facility	13,840	86
Residence supplied with chlorinated water	12,460	78
Urbanicity of residence, population[b]		
≤2,500	2,922	18
2,501–5,000	756	5
5,001–10,000	1,217	8
10,001–20,000	1,139	7
20,001–50,000	2,596	16
>50,000	7,428	46

[a] Sample consisted of 16,058 Wisconsin female deaths, 1972–77.
[b] Population category was from the 1960 U.S. census.

TABLE 3.—*Distribution of sample by chlorine dose categories*[a]

Category (chlorine dose)	Sample, n = 16,058: No. of deaths	Sample, n = 16,058: Percent of deaths	Waterworks, No. reporting, n = 202
None	3,598	22.40	95
Low (0.01–0.99 ppm)	1,340	8.34	56
Medium (1.00–1.70 ppm)[b]	8,603	53.57	26
High (1.71–7.00 ppm)	2,517	15.67	25

[a] Wisconsin female deaths, 1972–77.
[b] The numerous recipients of Milwaukee city water contributed heavily to this category. The chosen cut-points, however, maximized water source variability (No. of waterworks) within each category and provided reasonable dosage ranges.

DATA ANALYSIS

For analysis with each individual decedent as the unit of observation, each case or control was assigned the appropriate value for 1) water variables, based on the water source for the residence, and 2) control variables, based on death certificate and census data. Cut-points for high, medium, and low average daily chlorine dose categories were established, which created exposure categories of reasonable dosage ranges and of adequate numbers of waterworks and decedents. The distribution by sample decedents and by waterworks is given in table 3.

The site-specific cancer risk associated with water supply was estimated by the analysis of several statistical models in which logistic regression was performed separately on each cancer site subsample and the corresponding set of matched controls (*see* appendix). The distinct advantage of this technique lay in its ability to account for factors that may confound the association of interest and to allow for the influence of factors related to the strength of the association (*25*). Thus when variables for potential confounders were included in the logistic regression model, the estimated value of the regression coefficient for si[illegible]ecifi cancer death in relation to chlorine dose [illegible]irec estimate of the log odds ratio associated with th exposure) is considered to be adjusted for the othe variables in the model (*26*).

A computer program capable of multinominal logistic regression was used which computed maximum likelihood estimates of the regression coefficients. Log likelihood ratios which approximate a χ^2 distribution were used to assess the significance of the resultant odds ratios (*27*). Standard errors of the parameter estimates, computed by the program from the inverted matrix of the second derivatives of the log-likelihood function, were used to construct 95% confidence intervals (*27, 28*).

RESULTS

Analysis of Site-Specific Cancer Risk of Chlorinated Water

Table 4 presents the results from the analysis of the basic model which estimates the relative risk of site-specific cancer death for exposure 20 years past to high, medium, and low chlorine doses as compared to no chlorination, while urbanicity, marital status, and site-specific high risk occupation are controlled for. Only colon cancer death showed a significant ($P \leq 0.05$) association with chlorine dose. No other cancer site risk was found to even approach significance, [illegible] the exception of brain cancer death in areas [illegible]igh chlorine-dosed water ($P = 0.09$).

For these two sites, chlorine dose 10 years past was also used as the exposure variable to allow for a shorter latent period. Positive odds ratios for colon cancer were found for the more recent chlorine dose, but they were not significant ($P = 0.09$). (*See* table 5.)

For brain cancer death, odds ratios for categories of total chlorine dose 10 years past were similar to those of the 20 years-past variable, and they were of no

TABLE 4.—*Odds ratios of site-specific cancer death associated with chlorinated water exposure 20 years past*[a]

Cancer site (No. of deaths)	High: No. of deaths	High: Odds ratio	High: P	High: (95% CI)	Medium: No. of deaths	Medium: Odds ratio	Medium: P	Medium: (95% CI)	Low: No. of deaths	Low: Odds ratio	Low: P	Low: (95% CI)	None: No. of deaths
Esophagus (194)	28	1.03	0.90	(0.15–7.00)	118	1.24	0.80	(0.19–8.33)	15	0.70	0.70	(0.12–4.16)	33
Stomach (914)	150	1.81	0.10	(0.90–3.63)	447	1.69	0.13	(0.84–3.40)	102	1.30	0.37	(0.72–2.37)	215
Colon (3,202)	510	1.51	0.02	(1.06–2.14)	1,618	1.53	0.015	(1.08–2.00)	356	1.53	0.015	(1.11–2.11)	718
Rectum (786)	105	1.39	0.40	(0.67–2.86)	411	1.16	0.70	(0.58–2.32)	91	1.13	0.70	(0.61–2.08)	179
Liver (744)	119	1.09	0.80	(0.51–2.34)	367	1.23	0.60	(0.57–2.64)	83	0.99	0.90	(1.51–1.91)	175
Pancreas (1,402)	242	1.06	0.80	(0.16–1.82)	692	1.05	0.80	(0.62–1.80)	140	1.26	0.40	(0.77–2.08)	328
Kidney (490)	80	1.04	0.90	(0.54–1.99)	203	0.92	0.80	(0.58–2.03)	25	1.22	0.70	(0.45–3.31)	182
Bladder (460)	82	1.04	0.90	(0.43–2.50)	224	1.[illegible]5	0.90	(0.42–2.54)	54	1.36	0.50	(0.60–3.09)	100
Lung (1,950)	326	0.85	0.50	(0.54–1.36)	1,044	0.90	0.40	(0.50–1.29)	177	0.75	0.20	(0.48–1.18)	403
Brain (428)	68	2.48	0.09	(0.83–7.37)	218	2.15	0.16	(0.72–5.92)	26	1.81	0.30	(0.59–5.54)	116
Breast[b] (2,718)	373	1.36	0.30	(0.84–1.87)	1,440	1.23	0.27	(0.83–1.83)	315	1.21	0.31	(0.84–1.73)	590

[a] Ratios are relative to no chlorination; control variables we[illegible]banicity, marital status, and site-specific high-risk oc[illegible]on. Wisconsin female deaths 1972–77.
[b] Due to size limitations of the computer program availab[illegible]nly 3 yr (1976–78) of breast cancer mortality were analyzed.

TABLE 5.—*Odds ratios of colon and brain cancer death associated with chlorinated water exposure 10 years past*[a]

Cancer site (No. of deaths)	Chlorine dose category												
	High				Medium				Low				None:
	No. of deaths	Odds ratio	*P*	(95% CI)	No. of deaths	Odds ratio	*P*	(95% CI)	No. of deaths	Odds ratio	*P*	(95% CI)	No. of deaths
Colon (3,202)	483	1.20	0.30	(0.84–1.71)	1,680	1.24	0.20	(0.88–1.76)	393	1.31	0.09	(0.97–1.76)	646
Brain (428)	68	2.39	0.11	(0.78–7.32)	225	2.03	0.20	(0.66–6.26)	28	1.76	0.30	(0.58–5.36)	107

[a] Ratios are relative to no chlorination; control variables were urbanicity and marital status; Wisconsin female deaths 1972–77.

greater significance. Since the histologic tumor types are not reflected in the ICDA coding of underlying cause of death, it is possible that the brain cancer death category is too diverse. In the report of a recent study of risk factors for childhood brain tumors, the authors suggest that the etiology of brain tumors may differ for children, inasmuch as the distribution of histologic tumor types differs (*29*). Thus more specificity might be achieved by stratifying the brain cancer subsample by age group.

Exploratory Analyses of Colon Cancer Risk and Water Exposure

While the basic model employs a known predictor of final THM level, it fails to account for amounts of organic precursor or water purification. Consequently, exploratory models were investigated which allow for the influence of water variables expected to modify THM levels.

The impact of rural runoff was examined first, since THM precursors are thought to be of natural origin and since a relationship between rural runoff and THM concentration has been demonstrated (*15*). Addition of this explanatory variable to the regression equation specified by the basic model has the effect of stratification, whereby the odds ratios that result are summary odds ratios for the subsets of "rural runoff" and "no rural runoff." A problem arises, however, in that rural runoff is an unmeasured variable for the proportion of the sample served by individual wells (13.3% of the subsample of colon cancer cases and matched controls). The possibility of contamination of individual wells by rural runoff cannot be dismissed, since individuals not served by a water facility are more likely to have been located in the more rural agricultural areas. And, while the impact of rural runoff on THM formation would be nil (since the water is not chlorinated), the possibility of other carcinogens introduced through rural runoff contamination must be considered. For these reasons, the cases and controls not served by a water facility were dropped from the analysis at this point.

As seen in table 6, the inclusion of the rural runoff variable in the regression equation led to odds ratios suggestive of a dose-response relationship. To pursue the influence of rural runoff further, an interaction variable was created (cancer death × rural runoff), such that a multiplicative effect of chlorine dose and rural runoff could be assessed. The significance of this variable ($P=0.001$) indicated that the relationship between colon cancer cases and chlorine dose category was significantly different for those exposed to rural runoff. The sample was then stratified on the rural runoff variable, and the basic model was applied. The results showed that for those individuals exposed to water supplies not affected by rural runoff, colon cancer death was not significantly related to chlorine-

TABLE 6.—*Influence of organic precursor indicator variables on the odds ratio of colon cancer death and chlorinated water exposure 20 years past*[a]

Model (No. of deaths)	Chlorine dose category												
	High				Medium				Low				None:
	No. of deaths	Odds ratio	*P*	(95% CI)	No. of deaths	Odds ratio	*P*	(95% CI)	No. of deaths	Odds ratio	*P*	(95% CI)	No. of deaths
Controlled for rural runoff (2,776)	510	1.58	0.03	(1.06–2.40)	1,618	1.56	0.03	(1.05–2.34)	356	1.44	0.03	(1.01–2.07)	292
Stratified for rural runoff													
Not exposed (766)	27	1.37	0.40	(0.60–3.12)	205	1.28	0.40	(0.73–2.25)	278	1.35	0.13	(0.91–2.00)	256
Exposed (2,010)	483	3.30	0.003	(1.45–7.48)	1,413	3.60	0.002	(1.57–8.26)	78	2.74	0.025	(1.10–6.88)	36
Controlled for water source depth and purification	483	3.43	0.003	(1.48–7.96)	1,413	3.68	0.003	(1.56–8.70)	75	2.94	0.015	(1.20–7.24)	36

[a] Sample included municipal water recipients only. Ratios are relative to no chlorination; control variables were urbanicity and marital status; Wisconsin female deaths 1972–77.

dosed water. For the subsample exposed to rural runoff, odds ratios of 3.30, 3.60, and 2.74 were found ($P \leq 0.003$) for the high-, medium-, and low-dose categories, respectively. Variables for water source depth and purification were then added to the basic model. As seen in the table, these variables somewhat increased the odds ratios.

For completeness, the entire sample was analyzed under this model, with private well users coded zero for chlorination, rural runoff, and water purification and assigned to the less than 250-foot well-depth category. Neither the odds ratios nor the significance levels differed appreciably.

In the comparison of the results of various models, the risk of colon cancer associated with any dose category of chlorinated water is over twice as great for water affected by rural runoff. In contrast, odds ratios are fairly constant over chlorine dose categories under any particular model. Thus it appears that organic precursor content of chlorinated water is more important in regard to dose-response considerations.

DISCUSSION

The major finding of this investigation is that death due to colon cancer for females is significantly associated with exposure to water that was disinfected with low, medium, or high daily chlorine doses for at least 20 years. The validity of the models used in this investigation must be scrutinized to generalize the study results or to infer risk in a meaningful way.

Misclassification error, a major problem in retrospective studies where past exposure must be traced or estimated, is of compounded concern in death certificate case-control studies, where the effect is also vulnerable. The potential for exposure misclassification arises from unknown water exposure histories, other than that source associated with the residence recorded on the death certificate, and from the ability of the exposure variables used to differentiate among high, medium, and low THM exposure by the cases and controls. For the first limitation, migration from areas of low THM water concentration to areas of high THM concentration and the converse have the effect of damping a measurable relationship. Such effects were researched by Polissar (*30*), who showed quantitative loss in sensitivity of cancer risk estimates to be proportional to the latent period and size of the geographic area that encompasses the exposure. The long latent period assumed for colon cancer and the rather small geographic boundaries of waterworks thus tend to reduce the degree of risk discernible in this study. However, Polissar points out that since mobility is age-dependent, diseases with a higher incidence among older age groups are more likely to occur near the location of the environmental "cause."

Since the measure of effect in this study is mortality rather than incidence, migration during the interval between cancer diagnosis and death must also be considered. For females, the 5-year survival rate for colon cancer is approximately 46% (*31*). During this period, the cancer diagnosis may influence a decision to migrate and possibly introduce bias. If there is a trend toward migration to more urban areas (which tend to chlorinate) for proximity to medical care as an example, a spurious association between chlorine-treated water and cancer death would result. Three aspects of this study presumably minimize this possibility. First, only counties with low migration rates were considered as sample sources. However, this does not preclude intracounty migration. Next, migration due to cancer diagnosis would be less likely for married females, since (for this cohort of decedents) the spouse's occupational status would weigh against a move requiring a job change late in life. Finally, urbanicity was always included as a control variable in the analysis.

A second major source of exposure misclassification lies in the use of water variables as surrogates for ingested trihalomethanes. While chlorine dose and organic contamination may adequately reflect the THM level of water at the time of treatment, several factors not measured in this study may be of greater importance in the determination of an individual's ingested THM dose. Differences in THM concentrations at home water taps due to continued THM formation along the water distribution system, the amount of water ingested daily from the home water tap, significant ingestion from water sources other than the one supplied to the home, and past use of chloroform-containing cough syrups or other preparations may account for considerable dose variation among individuals with the same water supply. Use of surrogates has been reported to result in loss of power and underestimation of the true relative risk proportional to the strength of the association (*31*).

Another shortcoming due to the death certificate-based study design is the uncertainty of accurate effect classification. A recent study of death certificate accuracy showed that malignant neoplasms were underreported by approximately 10%, and vascular diseases overreported by 10% (*33*). From the assumption that misclassification with respect to exposure is independent of misclassification of effect, the net result is again power reduction, with a measured relative risk in the same direction as that of the true relative risk, but reduced in magnitude, according to Gladen and Rogan (*32*).

The major sources of misclassification error in this study are not likely to explain the significant findings for colon cancer. Also, there is evidence that misclassification has the effect of both underestimating the true risk and obscuring a dose-response relationship. However, in view of the lack of evidence for a dose-response relationship, possible confounding factors are of greater concern. While it would have been unlikely for unknown colon cancer risk factors to be correlated with the amount of chlorine added to the water supply, it is possible for such factors to be associated with living in an area supplied with chlorinated water

Exposures to other environmental contaminants, lifestyle factors, and ethnic susceptibilities are all sources of possible contribution to risk error through confounding. In summary, the findings of this investigation must be considered inconclusive, due to the possible underestimation of risk associated with misclassification error and possible spurious contribution to the study findings from unknown colon cancer risk factors.

The results of this investigation do not significantly implicate any other gastrointestinal, urinary tract, lung, brain, or breast cancer risk for Wisconsin females. Two points in this regard must be noted. First, in view of the decreased power and probable underestimation of risk inherent in the study design used, it is not possible to generalize the Wisconsin results by summarily dismissing exposure association with other sites. Second, carcinogenic organotropism is exceedingly complex; a variety of exposure and coexposure conditions that vary by geographic area may impact on the nature and magnitude of measurable population effects. There is, for example, evidence that activation of chloroform, tissue binding, and subsequent lesions are affected by a variety of compounds and conditions [such as DDT, benzo[*a*]pyrene, polybrominated biphenyls, chlordecone (Kepone), and protein deficiency] to which the population is differentially exposed (*34-37*).

While we stress both the modest risk and the preliminary nature of this study and similar studies (*5*), the excess colon cancer mortality associated with chlorinated water is provocative. At present, there are few clues to the etiology of this major cancer. The high rate of colon cancer among the more economically developed nations has focused attention on the high-fat, low-fiber diet of these nations in contrast to the diet of nations with lower rates. Evidence from epidemiologic studies examining these possible diet risk factors, however, has been largely inconclusive; a recent editorial by Graham et al. (*38*) stressed the need to pursue new colon cancer hypotheses. As several authors have noted (*39, 40*), there are a number of potentially important correlates of industrial development in addition to high-fat diet. Those factors of special relevance to the findings of this investigation include water chlorination and environmental dispersion of the industrial spillage, leachates, and refuse of advanced nations. Clearly, drinking water exposure deserves attention in future epidemiologic studies of colon cancer.

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APPENDIX: LOGISTIC MODEL: ESTIMATION OF ODDS RATIO OF CANCER DEATH AND CHLORINE LEVEL EXPOSURE

$$\text{Log}\left[\frac{P(x \text{ chlorine dose})}{P(\text{no chlorination})}\right] = \alpha + \beta D + \gamma V + \sigma C + \lambda W;$$

$$\text{log odds cases} = \frac{P(x \text{ chlorine dose} \mid D=1, V, C, W)}{P(\text{no chlorination} \mid D=1, V, C, W)};$$

$$\text{log odds controls} = \frac{P(x \text{ chlorine dose} \mid D=0, V, C, W)}{P(\text{no chlorination} \mid D=0, V, C, W)};$$

$$\text{log odds ratio} = \frac{\text{log odds cases}}{\text{log odds controls}} = [\alpha + \beta(1) + \gamma V + \sigma C + \lambda W] - [\alpha + \beta(0) + \gamma V + \sigma C + \lambda W];$$

$$\text{log odds ratio} = \beta,$$

where x = high, medium, or low dose; D = cancer death (yes = 1, no = 0); V = matching variables, age in years, percent county chlorine exposure; C = control variables—1) marital status (married = 1, not married = 0), 2) high-risk occupation (yes = 1, no = 0), and 3) urbanicity (<2,500 = 1, 2,501-5,000 = 2, 5,001-10,000 = 3, 10,001-20,000 = 4, 20,001-50,000 = 5, >50,000 = 6); and W = explanatory water variables—1) rural runoff (yes = 1, no = 0), 2) purification (yes = 1, no = 0), and 3) source depth (surface source = 1, wells <250 feet = 2, wells 251-500 feet = 3, wells >500 feet = 4).

ATTACHMENT C

Description of Hybrid Alternative

(This alternative has been identified as Alternative 5

in keeping with the RI/FS numbering system.)

ALTERNATIVE DESCRIPTION

Alternative 5

This alternative is a hybrid of alternatives 2 and 3A. Elizabethtown Water Company's supply system will be hooked-up to homes on streets where the company's distribution lines are already in place, including homes on Sycamore Lane, Robin Drive, Oxford Circle, and Cleveland Circle. The four homes on Montgomery Road will remain on their wells, however a well treatment system, such as that described in Alternative 3A with air-stripping and activated carbon adsorption, will be provided for each of these homes.

ALTERNATIVE EVALUATION

Public Health Evaluation

Alternative 5. For the 35 residents who will be hooked-up to the Elizabethtown Water Company supply system, health effects will be the same as those described for Alternative 2, in that ARARs will be met or exceeded based on available data. The individual well treatment system proposed for each of the four remaining residents will meet the ARARs for the organic contaminants provided the system is well monitored and maintained. There is no guarantee, however, that heavy metals will be removed to a level that will meet the ARARs.

Environmental Assessment

Alternative 5. Although the off-gas from the air-stripping column will contain the stripped volatile organics, concentrations from these units is expected to be minimal when dispersed to the open air, therefore the environmental impact of the off-gas from the four columns is minimal. Activated carbon replacement will be handled by the vendor, and disposal or regeneration will be conducted off-site.

Assessment of Technical Feasibility

Alternative 5. Extension of the Elizabethtown Water Company supply system can be easily implemented since, for this alternative, the water mains are already in place. Installation of individual well treatment for the four residents on Montgomery Road will be implemented using well established technologies. Like Alternative 4, the reliability of the treatment systems is based on existing water quality and contaminants identified. Possible future variations of contaminant levels or newly identified contaminant parameters could adversely affect the reliability.

The capital cost for this alternative is $266,000, as presented in Table 5-3. The annual O&M cost, associated with sampling and maintenance of the individual well treatment systems, is $11,000.

TABLE 5-5. CAPITAL AND O&M COSTS "HYBIRD" ELIZABETHTOWN WATER - INDIVIDUAL TREATMENT SYSTEMS - ALTERNATIVE 5

Cost Item	Cost, $ *
Extention of Elizabethtown Water	
Valves (4)	11,000
Well Sealing	35,000
Service Connections	46,000
Pavement Repair	5,000
Subtotal	97,000
Engineering and Contingencies (25%)	24,000
Subtotal	121,000
Individual Well Treatment - 4 residences (See Table I-1 for details)	102,000
- Analytical (startup)	2,000
- Engineering & Contingencies (40%)	41,000
Subtotal	145,000
TOTAL CAPITAL COST	$266,000
Annual O&M For Well Treatment	
- 4 Residences (See Table I-1 for details)	$11,000

Does not include tax impacts.

ATTACHMENT D

Letter from Security & Safety Systems Representative

Regarding Activated Carbon Adsorption

Security & Safety Systems

RESIDENTIAL
COMMERCIAL · RECREATIONAL

AUG 10 1987

74 RICHMOND DRIVE
SKILLMAN, NJ 08558

(201) 874-5018

• "WIRELESS" PERIMETER ALARMS
• SATELLITE DISHES
• HALON FIRE EXTINGUISHERS
• WATER TREATMENT SYSTEMS

July 31,1987

Mr. Douglas E. Seely
Senior Project Scientist
Metcalf and Eddy, Inc.
P.O. Box 4043
Woburn, Mass. 01888-4043

Dear Douglas:

This letter is in response to our discussion following the documentation and presention of the Montgomery Township Remedial Investigation/Feasibility Study of 39 private contaminated wells.

Enclosed per your request are copies of the results of extensive EPA 601 & 604 protocol testing and information reflecting over $ 10 million of product development and reseach. The technical feasibility and economic viability of the methods we recommend are well documented in detailed EPA reports, major Educational Institutional Studies, Private Industry research, Independent Laboratory testing, and by many Environmental Engineering Consultants.

This information scientifically substantiates the superior performance capabilities of solid carbon block filtration over less sophisticated activated granular carbon filters. Clearly, the two most important state-of-the-art breakthroughs are:

1. The ability of SOLID CARBON BLOCK technology to remove over 100+ of the EPA 128 priority pollutants. (No other filter technology can effectively remove more than 40 of the 83 toxic chemicals required by the EPA under the 1986 Safe Water Act guidelines)

2. Solid Carbon Block construction provides a major safety advantage because EVERY DROP OF WATER passes through the carbon and is filtered. (Granular activated Carbon filter dependability is often plagued with channeling and frequently deteriorates rapidly in use with no indication that they are performing poorly and/or are no longer effective)

Other outstanding performance benefits of SOLID CARBON BLOCK point-of-use filtration include:

* Highest water quality remedial technology available!
* Major drinking water problems are solved immediately!
* Less expensive and healthier than bottled water!
* Convenient because safe water is always available!
* Eliminates costly and unnecessary filtration at public water processing plants!
* Removes the unpleasant smell, taste and harmfull side affects of Chlorination at the point-of-use!
* Filters can be easily replaced on a controlled basis!
* Eliminates individual Risk in sitiuations of common water contamination!

Equally important, Security and Safety Systems is a full service company. We provide water quality testing and monitoring, use only the most effective state-of-the-art solid block carbon filter technology, utilize experienced and licensed trades people for installation and service. Our water treatment systems are backed with a manufacturing five Yr. warranty and 100% customer satisfaction guarantee.

WATER QUALITY TESTING is conducted by our firm through Aqua Associates Inc. and *AA LABS, Inc. Both firms are a N.J. State Certified water chemistry specialists.

Costs range from $ 45.00 to $ 75.00-$ 100.00+

SOLID CARBON BLOCK Water Treatment System point-of-use technology manufactured exclusively by the Amway Corporation is configured to meet the specific needs of each situation.

*	500 Gal. Family Model	cost	$ 295.00
	100 Gal. Compact Model	cost	$ 99.95

INSTALLATION & MAINTENANCE is provided by several local contractors (incl'd Jefferson Plumbing of Princeton). We replace the solid block filters on a scheduled and routine basis. This is done to insure proper working conditions and avoid the concern of neglect on the part of the system user. We accomplish this by registering each unit on a computer, periodic water meter readings, scheduled water testing cycles and/or any reasonable specific arrangements to comply with regulations.

*	Installation per unit	cost	$ 50.00
	Maintenance call	cost	$ 25.00

SECURITY & SAFETY SYSTEMS is an approved contractor with the state of New Jersey.

The following analysis reflects our order of magnitude estimate of the cost of both the short term and long term benefits of including solid block filtration in Alternative 1 in lieu of $ 130,000 for only 2 years of bottled water.

Equipment Investment*		
39 Family 500 Gal. Models	cost	$ 12,000
39 Compact 100 Gal. Models	cost	3,900
78 2nd year (annual) filter	replacements	780
Installation and Maintenance		
39 Family 500 Gal. Models		$ 3,000
39 Compact 100 Gal. Models		$ 2,000

* Equipment cost includes 5 year warranty

We look forward in assisting Woodward Clyde, Metcalf and Eddy, Inc., the N.J. DEP, the EPA, the township of Montgomery and the Elizebethtown Water Co. in their efforts to assure everyone who lives and works in Montgomery Township that their water can be healthier and better tasting that ever!

We offer our help in communicating and demonstrating the opportunity for your neighbors to be fully aware of and protected with the best state-of-the-art now available in the form of solid block carbon filtration systems.

We appreciate the opportunity to be considered in your evaluation of experienced contractors who can effectively, professionally, economically and immediately respond to the water treatment problems you are working hard to resolve !

Sincerely;

Warren Tunkel
President

cc:
Edward Putnam
Robert Gaibrois
Kevin M Psarianos
Charley Seafass
✓ Jeffrey Folmer

ΞR

ↄ

ƨ AMWAY Water Treatment

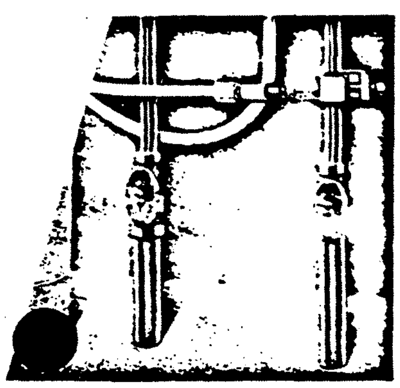
s Pesticides and Herbicides:
DT, DBCP, malathion, and a
ral contaminants.

ves Industrial Chemicals:
ɛxachloroethane, and many more
ıls.

ıoves Chlorine and THMs:
.nd its THM by-products out of the
ıre suspected cancer-causing agents.

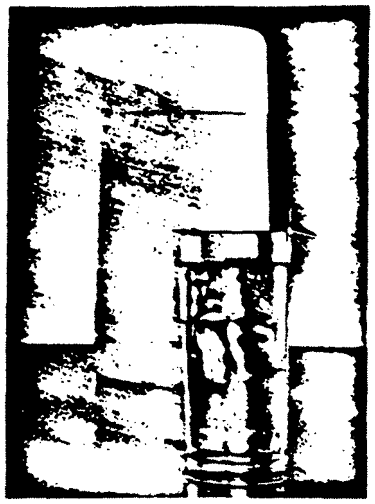
:emoves Other Contaminants:
ɔestos, precipitated heavy metals, sedi-
ıd scale.

Taste:
ı, juice, ice cubes, and soup have a better
ɪ no unusual odors.



Simple to Use:
Fits any standard water faucet or taps into your cold water line. Use on-the-counter or under-the-sink.

Simple to Install:
No special tools needed. Just follow the step-by-step instructions.

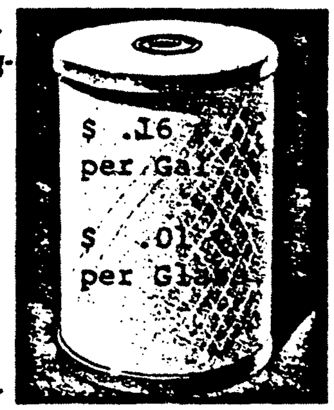


Large Capacity.
The average family can expect each filter cartridge to last about one year. It depends upon how much water you use and the quality of your water.

Replacement Filter Cartridge:
No need to send the entire unit back to the factory for a new filter. Simply remove the filter cartridge and insert a new one.

NEW "CONCENTRIC RING" FILTER DESIGN–EXCLUSIVELY AMWAY

In addition to the advantages already mentioned, Amway's unique "second generation" filter design provides *extra* benefits:



- **Five-stage filtration reduces sedimentary clogging, traps particles as small as 0.2 microns (1/300th the diameter of a human hair)**
- **Up to 25% greater initial flow rate**
- **Higher flow rate throughout filter life**
- **More even water distribution throughout filter**
- **New harder outer layer helps reduce accidental damage, increase durability.**
- **Improved carbon block matrix allows more effective removal of hard-to-absorb chemicals such as chloroform.**

The Best Service:
If you have any problems installing or using your System, simply call the toll-free Hot Line listed in your Owner's Manual.

The Amway Satisfaction Guarantee:
If, after a reasonable time, you decide you're not satisfied with your AMWAY Water Treatment System, you're entitled to a replacement, a full refund, or full credit toward the purchase of another AMWAY product.

PURE AND SIMPLE

DISTRIBUTED BY:
SECURITY & SAFETY SYSTEMS
74 RICHMOND DR.
SKILLMAN, N.J. 08558
(20... .8

Printed in U.S.A. T-SA-955-H 530587 SA-4616

"This gives me clearer, better smelling, better tasting water!"

Frank Nosek
Illinois

Frank Nosek gets tap water directly from the city, but it is often cloudy and brown. "Installing an AMWAY® Water Treatment System turned our water clearer, cleaner, and more appetizing. I really believe it encourages my family to drink more water."

Frank likes the AMWAY Water Treatment System. He's hooked it up to his kitchen tap and refrigerator cold water dispenser. "It doesn't take up a lot of room in our small kitchen, and it's movable if we move." Frank especially likes the fact that his AMWAY Water Treatment System gets results. "I tried one of those filters you put on the end of the faucet. It didn't work, even though I had to replace the filter every couple of months. With my AMWAY Water Treatment System, I only have to replace the filter once a year."

Frank believes that pollutants don't do your body any good. So when his Amway distributor showed Frank an Amway video, he quickly decided to buy. "I knew our water didn't *look* good. The video made me that much more aware of how many other things might be in our water. I realized the AMWAY Water Treatment System would help me take better care of my family and myself."

Call (201) 874-5018 Today!

"IT CHANGED OUR WELL WATER TO WONDERFUL WATER!"

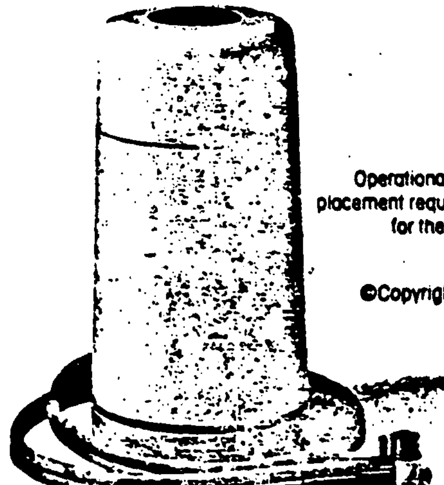
Ruth Marsh, Onsted, Michigan

"The AMWAY® Water Treatment System took the harsh taste out of our well water and gave it a nice, fresh-water taste," says Ruth Marsh. "I really notice the difference!"

The AMWAY Water Treatment System effectively removes more than 100 E.P.A. priority pollutants. It will improve the taste and smell of your water, while it effectively removes any chlorine, pesticides, industrial chemicals, and other contaminants which might be in your water. And it's small enough to fit under your sink or on your kitchen counter.

"I was hesitant to drink much water. I feel a lot more comfortable drinking it now with our AMWAY Water Treatment System," Ruth Marsh says.

If you want to assure good-tasting, clean water for your family, ask an Amway distributor to show you the easily installed AMWAY Water Treatment System.

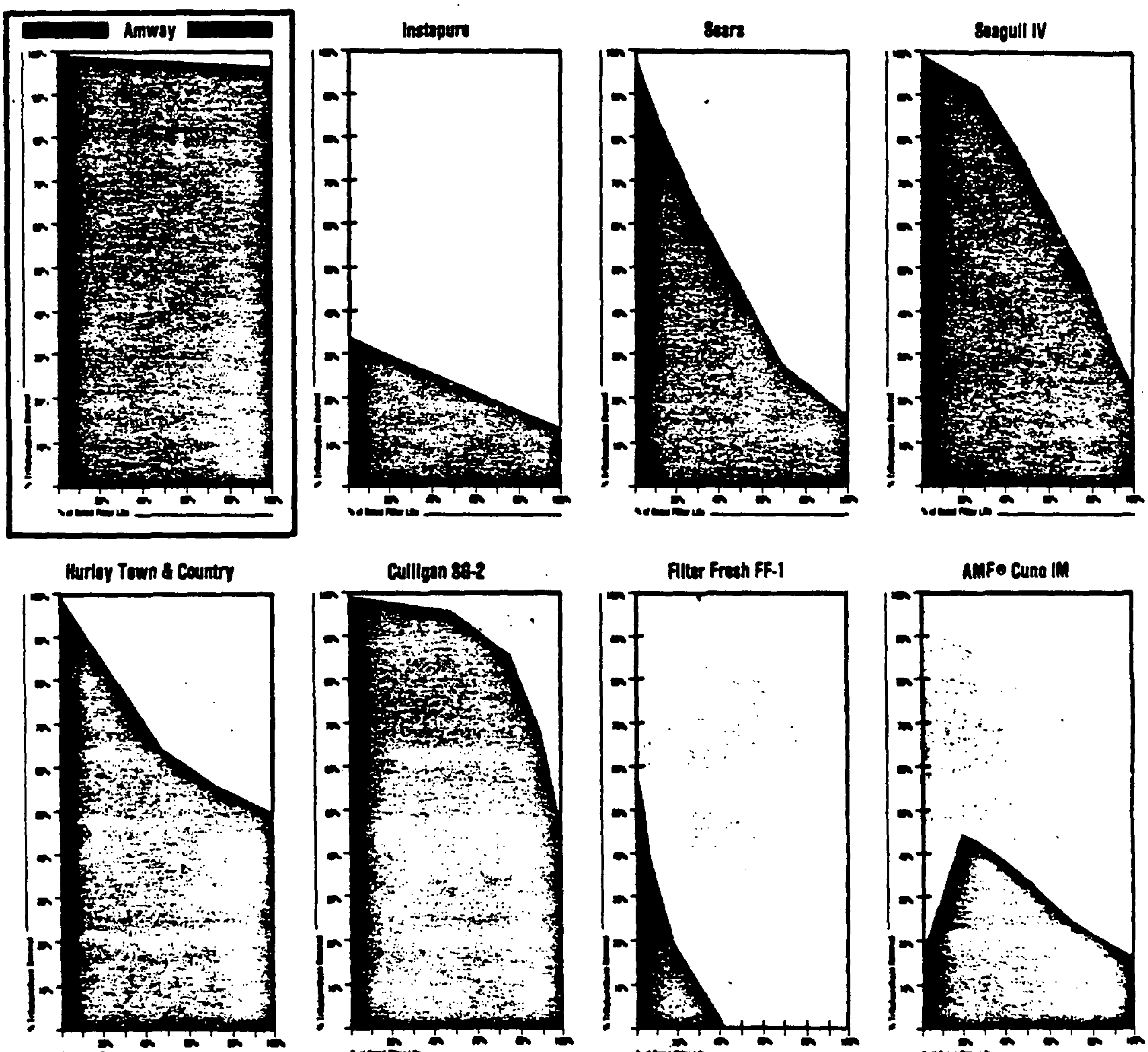


Operational, maintenance, and replacement requirements are essential for the product to perform as advertised.

Amway

The AMWAY® Water Treatment System Versus Competitive Units

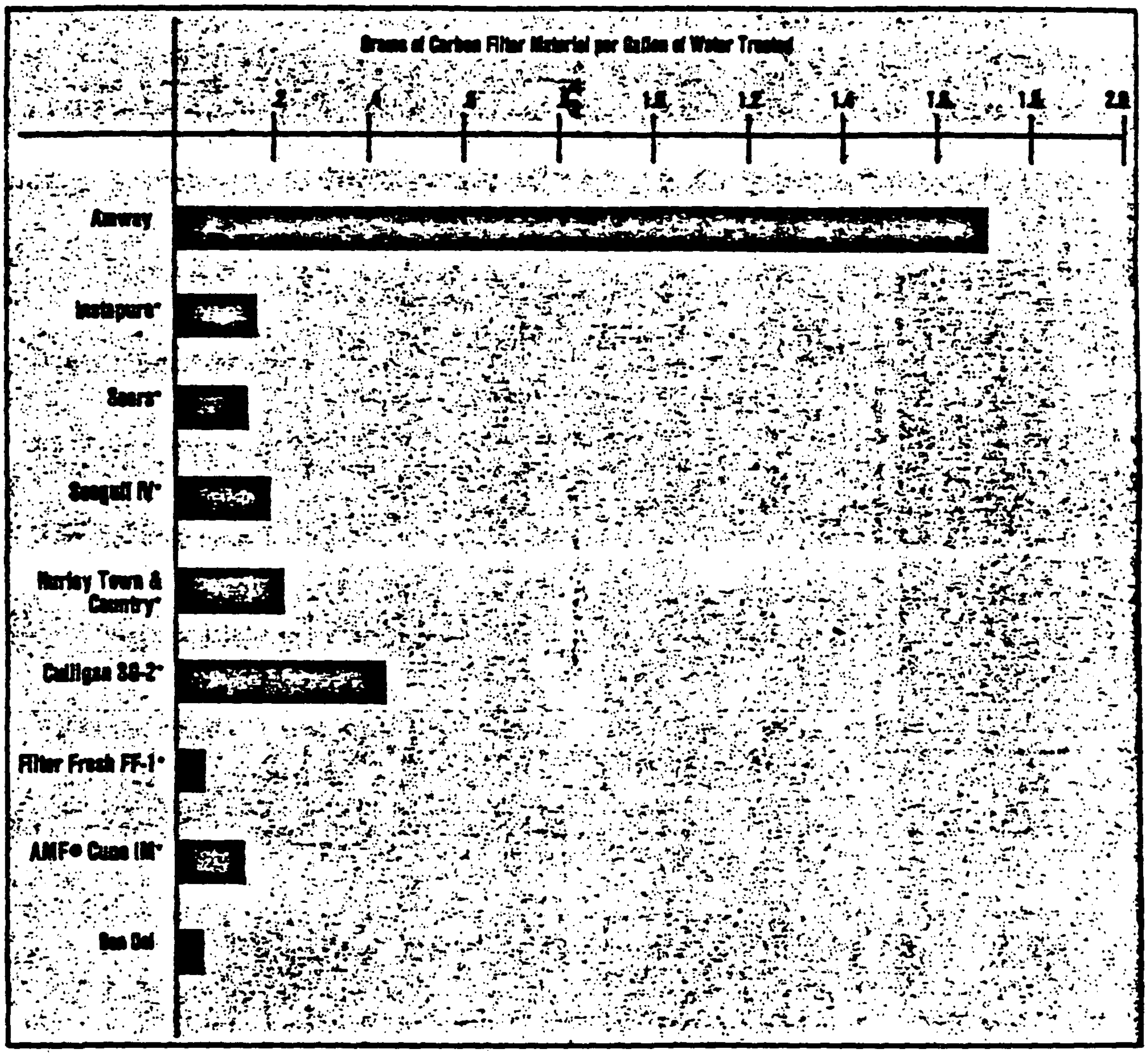
Comparison 1
One way to see how well a water filter works is to measure the Trihalomethanes (THMs) removed over the rated filter life of the unit. The graphs below show the superior capacity of the AMWAY Water Treatment System to several competitive water filters in removing THMs over the rated filter lives of the units depicted. Rated filter lives of the competitive units depicted below vary.



* The data on the AMWAY Water Treatment System was generated in Amway Laboratories using test protocols similar to EPA and NSF test protocols. The performance data on the competitive filters was obtained from available published data more fully described on the reverse side of this advertisement.

Comparison 2

In general, the more carbon a water filter has in relation to the amount of water it filters, the more efficient that filter will be over its rated life. The graph below shows the superior capacity of the AMWAY Water Treatment System to several competitive filters over the rated lives of filters.



* Information for AMWAY Water Treatment System was generated in Amway Laboratories as described on the reverse side.

Information on the competitive units was obtained from a report prepared for the Office of Drinking Water, U.S. Environmental Protection Agency, Washington, D.C., July 1, 1980. The Report is publicly available and is entitled "Development of Basic Data and Knowledge Regarding Organic Removal Capabilities of Commercially Available Home Water Treatment Units Utilizing Activated Carbon: Phase 1 and 2." The data for the competitive filters obtained from the Report was based on a series of studies. The graphs depict the average of the results of those studies.

CHEMICALS AND YOUR WATER

THE FACTS

Man's use of chemicals dramatically affects the quality of our water!

Pesticides and Herbicides

They protect crops and increase our food supply. But in the past, toxic chemicals like DDT and DBCP have mixed with irrigation water and permeated the soil. Many of these chemicals have been banned since 1975, but because of their resistance to decay, they continue to be found in sediments.

FACT: **Traces of pesticides thought to cause cancer have been reported in aquifers that serve the Miami, Florida area.**

FACT: **A 1974 study of dissolved residues of DDT and dieldrin in surface, subsurface, and finished drinking water in Iowa showed contamination in every major watershed in the state.**

Industrial Chemicals

They increase the efficiency of manufacturing and are used in the creation of products. More than 100,000 chemical compounds have been developed, and each year an estimated 500-1000 more are introduced. But chemicals like PCB, PBB, and dioxin have been disposed of in ponds, landfills, and lagoons. In the past, many of these chemical dumps were not properly lined and because these chemicals have been used for generations and because chemicals move slowly in the earth, the problems may have originated 20 or 30 years ago.

FACT: **A recent United States Environmental Protection Agency (EPA) survey of 176,647 industrial waste impoundments showed that 95% of the sites were not being monitored for groundwater contamination and that 70% of the impoundments were unlined.**

FACT: **In January 1980, 39 public wells—serving 400,000 people in 12 cities in the San Gabriel Valley, California—were closed because of high levels of trichloroethylene (TCE), an industrial solvent. Similar contamination and well closings have occurred in New York, New Jersey, Pennsylvania, Connecticut, Massachusetts, and Maine.**

Chlorine

It's used to eliminate bacteria in many municipal water systems. But recent studies show that chlorine reacts with organic material in water to form chemicals called Trihalomethanes (THMs).

FACT: **The EPA reports that THMs are not considered dangerous at low levels found in most municipal water systems. But THMs are suspected cancer-causing agents!**

FACT: **In 1980, the U.S. Government's Council on Environmental Quality reported that chlorine added to water *increased the risk* of urinary-tract and gastrointestinal cancer.**

Other Contaminants

What else is in the water? Asbestos; heavy metals like lead, cadmium, chromium, and zinc; sediments; dirt; and scale.

FACT: **Evidence suggests that asbestos is a significant contaminant in a number of water supplies in the United States. In Canada, chrysotile asbestos was identified as a major form present in drinking water. Age-standardized mortality rates for gastrointestinal cancers were calculated for 71 municipalities between 1966 and 1976. The results for two cities with the highest asbestos concentrations were compared with the weighted average for 52 localities where the concentration did not differ significantly from zero. Relatively higher mortality rates for stomach cancer were recorded in both sexes in one of the cities and in males in the other city. The death rate due to cancer of the large intestine also markedly increased for males in the first city.**

WHAT CAN YOU DO?

Once a groundwater supply is contaminated, it can take generations to clean it up. That's not immediate enough when the public's health is threatened.

And though government, industry, and municipalities are doing a better job, many of us want the best possible water *now*–not sometime off in the future.

It's up to each of us to take responsibility for the quality of our water. Individuals have been trying several alternatives to clean up the water they personally use. Various methods achieve various results.

TRADITIONAL METHODS OF TREATING WATER

Method	*Advantages*	*Disadvantages*
Spring water	• Generally free of chlorine and THMs.	• Threat of chemical contamination exists–spring water is only as safe as its source.
Bottled water	• Depends upon the source and treatment method used by the manufacturer.	• Could become expensive.
Well water	• May or may not contain chlorine and THMs–whether local authorities require chlorine treatment of water.	• Agricultural contamination and other toxic chemicals can infiltrate well water.
Distilled water	• Significantly reduced chlorine and THMs.	• Free of trace minerals that are essential to good health.
Boiled water	• May contain less chlorine and toxic chemicals than unboiled water.	• Cannot remove most toxic chemicals–it's hardly better than tap water.
Water Softeners	• Improve water for laundry and bathing.	• Do not remove toxic chemicals.

Filtered Water can be a good solution. How good depends upon the method used.

FILTERED WATER METHODS FOR TREATING WATER

Method	*Advantages*	*Disadvantages*
Reverse osmosis filter	• Removes chlorine, THMs, and many industrial compounds.	• Removes minerals, which are essential good health. • Some contaminants may concentrate certain units as they pass through the filter–increasing potential hazards. • Slow and wasteful–up to 20 gallons of water to get 1 gallon of treated water.
Granular activated charcoal filter	• Removes chlorine, THMs, and toxic chemicals. • Leaves minerals. • Most units have a pre-filter that removes rust and large particles.	• Performance can vary greatly depending on the quantity and quality of activated carbon and the design parameters of the unit such as flow rate, prevention of channeling, etc.
Pressed carbon block filter	• Removes chlorine, THMs, and toxic chemicals. • Leaves minerals. • Pre-filter takes out large particles and inner carbon block removes smaller particles. • An efficient system–because the filtering block is solid, every drop of water passes through the carbon and is filtered.	

Of all the methods for use on drinkable water, it's clear that a very effective system is *pressed carbon block filter.*

The AMWAY® Water Treatment System effectively removes impurities from water including over 100 EPA priority pollutants such as organic contaminants, pesticides and trihalomethanes.

Acenaphthene
Acenaphthylene
Aldrin
Anthracene
Benzene
Benzidine
Benzo[a]anthracene
Benzo[a]pyrene
Benzo[b]fluoranthene
Benzo[ghi]perylene
Benzo[k]fluoranthene
alpha-BHC
beta-BHC
delta-BHC
gamma-BHC (Lindane)
Bis (2-chloroethoxy) methane
Bis (2-chloroethyl) ether
Bis (2-chloroisopropyl) ether
Bromodichloromethane
Bromoform
4-Bromophenyl phenyl ether
Butyl Benzyl phthalate
Carbon tetrachloride
Chlordane (technical mix.)
para-Chloro-*meta*-cresol
Chlorobenzene
2-Chloroethyl vinyl ether
Chloroform
2-Chloronaphthalene
2-Chlorophenol
4-Chlorophenyl phenyl ether
Chrysene
4,4'-DDD
4,4'-DDE
4,4'-DDT
Di-*n*-butyl phthalate
Di-*n*-octyl phthalate
Dibenzo[a,h]anthracene
Dibromochloromethane
1,2-Dichlorobenzene
1,3-Dichlorobenzene
1,4-Dichlorobenzene
3,3'-Dichlorobenzidine
1,1-Dichloroethane
1,2-Dichloroethane
1,1-Dichloroethylene
trans-1,2-Dichloroethylene
2,4-Dichlorophenol
1,2-Dichloropropane
1,3-Dichloropropene (trans)
Dieldrin
Diethyl phthalate
Dimethyl phthalate
2,4-Dimethylphenol
4,6-Dinitro-*ortho*-cresol
2,4-Dinitrophenol
2,4-Dinitrotoluene
2,6-Dinitrotoluene
alpha-Endosulfan
beta-Endosulfan
Endosulfan Sulfate
Endrin
Endrin Aldehyde
Ethylbenzene
Fluoranthene
Fluorene
Heptachlor
Heptachlor epoxide
Hexachlorobenzene
Hexachlorobutadiene
Hexachlorocyclopentadiene
Hexachloroethane
Isophorone
Naphthalene
Nitrobenzene
2-Nitrophenol
4-Nitrophenol
N-Nitrosodi-*n*-propylamine
N-Nitrosodiphenylamine
PCB-1016 (Aroclor 1016)
PCB-1221 (Aroclor 1221)
PCB-1232 (Aroclor 1232)
PCB-1242 (Aroclor 1242)
PCB-1248 (Aroclor 1248)
PCB-1254 (Aroclor 1254)
PCB-1260 (Aroclor 1260)
Pentachlorophenol
Phenanthrene
Phenol
Pyrene
TCDD (2,3,7,8-Tetrachloro-dibenzo-*para*-dioxin)
1,1,2,2-Tetrachloroethane
1,1,2,2-Tetrachloroethene
Toluene
Toxaphene
1,2,4-Trichlorobenzene
1,1,1-Trichloroethane
1,1,2-Trichloroethane
Trichloroethylene
Trichlorofluoromethane
2,4,6-Trichlorophenol

AMWAY Water Treatment System Effectively Removes Precipitated Heavy Metals.

Certain metals do not dissolve in water—they are suspended in it. These metals are called "precipitated heavy metals." The AMWAY Water Treatment System effectively removes precipitated heavy metals. There are many different types and some are listed below. The System also removes over 99% of asbestos, sediment, and scale.

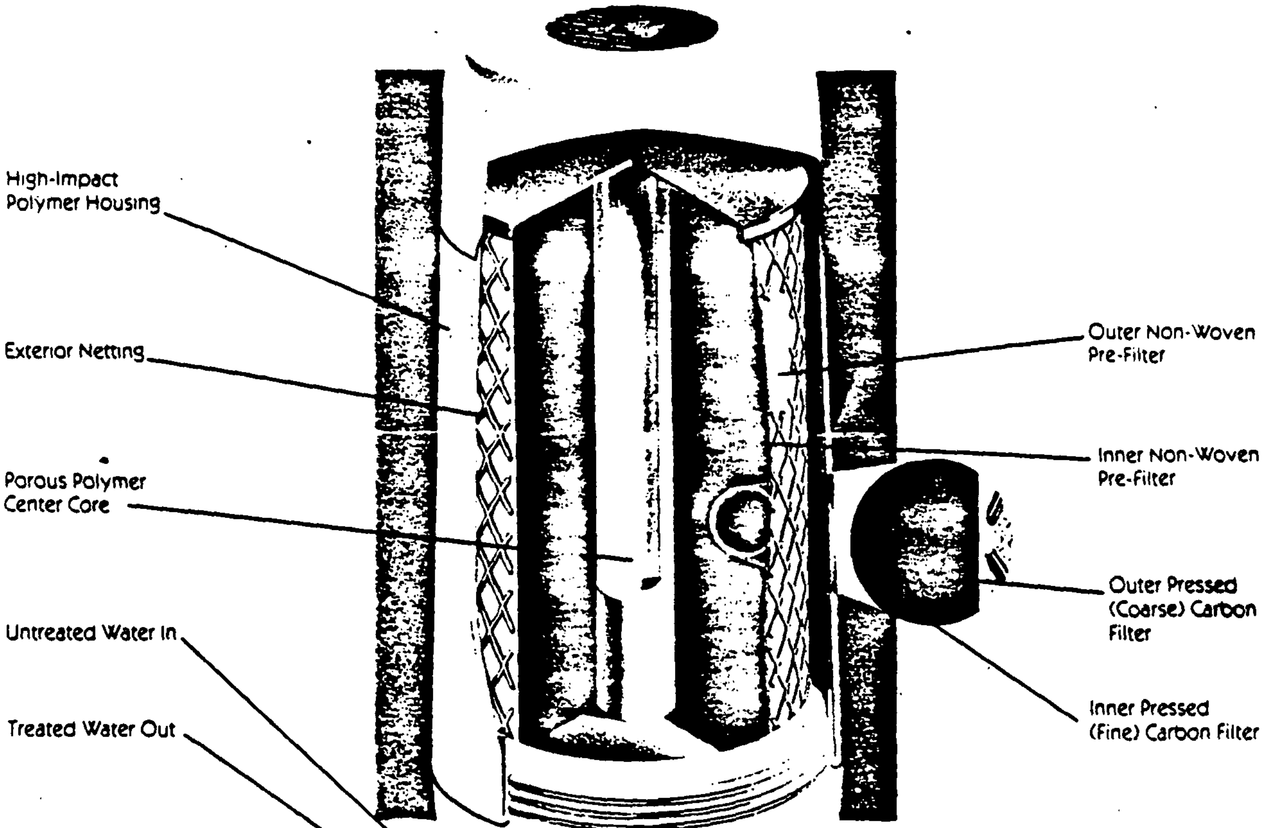
Iron Oxide	Lead Carbonate
Copper Oxide	Silver Chloride
Zinc Oxide	Chromium Oxide
Barium Sulfate	Manganese Oxide
Cadmium Oxide	Nickel Oxide

The AMWAY Water Treatment System effectively removes from water other non-priority pollutants including gasoline, kerosene, EDB, DBCP, aldicarb and 13 other organic compounds.

Alachlor
Aldicarb (Temik)
Atrazine
Chlorpyrifos
4,4'–Dibromo–1,1'–biphenyl (PBB)
1,2–Dibromo–3–chloropropane (DBCP)
1,2–Dibromoethane (EDB)
Guthion
Hydrocarbons**
Malathion
Methoxychlor
Parathion
Strychnine
TCDF (2,3,7,8–Tetrachloro–dibenzo furan)
1,2,3–Trichloropropane
Xylene

**Includes the components of gasoline, kerosene and diesel fuel.

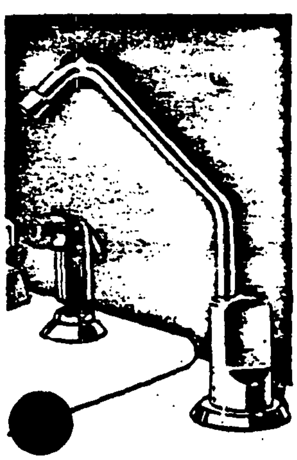
The cross-section of the AMWAY Water Treatment System gives you a closer look at the unit itself. The five-stage filter is an extremely effective way to treat water. And the durable, high-impact housing assures its quality for years to come. ***The AMWAY Water Treatment System is intended for use with cold, bacteriologically suitable (potable) drinking water only.***



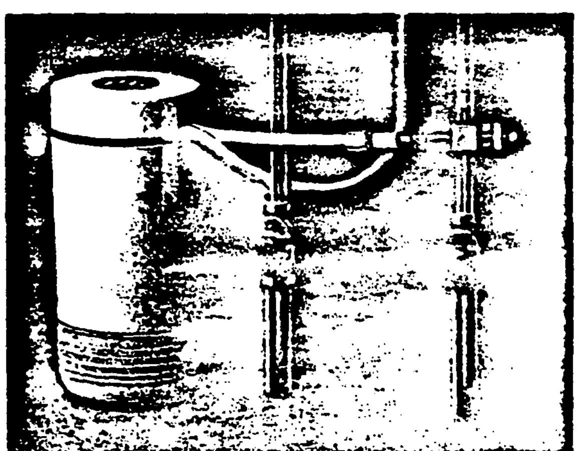
NEW CONCENTRIC RING FILTER DESIGN AND CARBON BLOCK MATRIX. . . Exclusively Amway

In addition to the advantages already mentioned, Amway's unique "second generation" filter provides extra benefits:

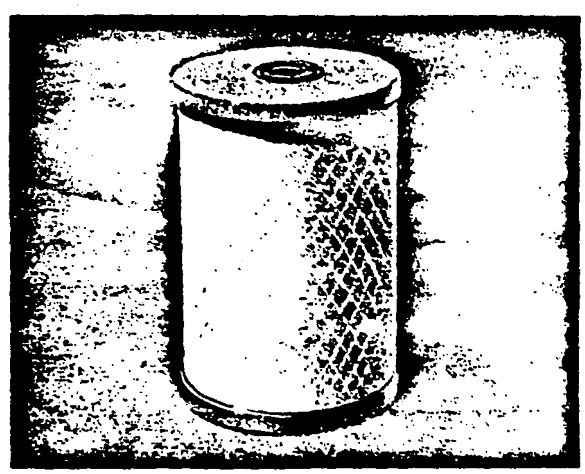
- Traps particles as small as 0.2 microns (1/300th the diamenter of a human hair) with less sedimentary clogging.
- More effective removal of hard-to-absorb chemicals such as chloroform.
- More durable construction reduces accidental damage.
- More even water distribution throughout filter.
- Up to 25% greater initial flow rate.
- Higher flow rate throughout filter life.



Auxiliary Faucet kit It includes a hole drilled into your countertop. : sink with the faucet All the tub- ere it's out of the way The filter



Any do-it-yourselfer can hook up the auxiliary faucet to the filter housing and cold water line Each auxiliary faucet kit includes a self-piercing saddle valve that makes adding your AMWAY Water Treatment System simple. Full instructions show how and where to add tubing, the valve, and the faucet connections.



You don't have to send your entire unit back to the factory for a new filter Simply remove the filter cartridge and insert a new one.
The average family can expect each filter cartridge to last about one year Of course, it depends upon how much water you actually use for cooking and drinking It also depends upon the quality of your water

THE AMWAY WATER TREATMENT SYSTEM!

Yes, you can do something about the contaminants in your water. Use the AMWAY Water Treatment System! Amway utilizes a pressed carbon block filter in this System—an extremely effective way to treat water. Look at the many advantages of the AMWAY [illegible]

Improves Taste:
Coffee, tea, juice, ice cubes, and soup have a better flavor and no unusual odors.

Effectively Removes Pesticides and Herbicides:
Filters chemicals like DDT, DBCP, malathion, and a host of other agricultural contaminants.

Effectively Removes Industrial Chemicals:
Filters PCB, PBB, Hexachloroethane, and many more industrial chemicals.

Effectively Removes Chlorine and THMs:
Takes chlorine and its THM by-products out of water—one of these (chloroform) is a suspected cancer-causing agent.

Effectively Removes Other Contaminants:
Filters asbestos, precipitated heavy metals, sediment, dirt, and scale.

Simple to Use:
Fits any standard water faucet or taps into your cold water line. Use on-the-counter or under-the-sink [illegible]

Simple to Install:
No special tools needed. Just follow the step-by-step instructions.

Large Capacity:
The average family can expect each filter cartridge to last about one year.

It depends upon how much water you use and the quality of your water.

Replaceable Filter Cartridge:
No need to send the entire unit back to the factory for a new filter. Simply remove the filter cartridge and insert a new one.

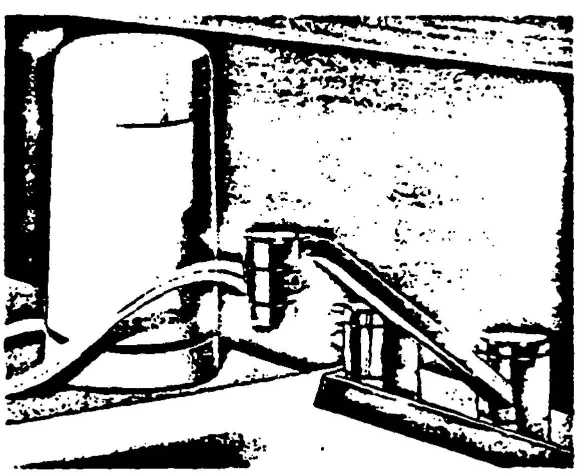
The Best Service
If you have any problems installing or using your System, simply call the toll-free, Hot Line listed in your Owner's Manual.

The Amway Customer Satisfaction Guarantee:

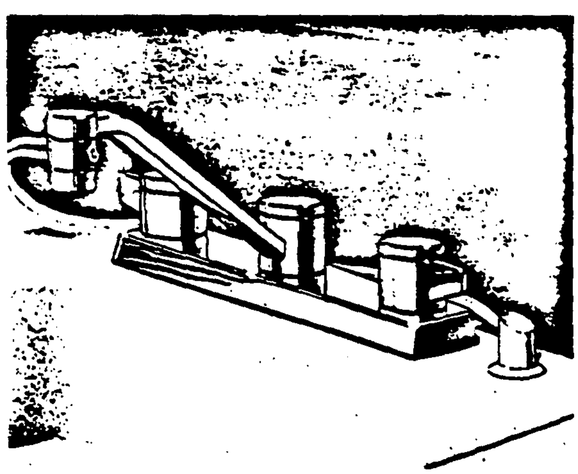
Anytime you buy an Amway Water Treatment product, you have the right to use it for 120 days from date of purchase to determine whether it is satisfactory and that you want to keep it. If you decide it is not satisfactory, return it to the Amway distributor from whom you purchased it. The distributor will offer you the choice of replacement without charge, or full credit toward the purchase of another Amway distributed product, or a refund of the full purchase price.

This guarantee does not apply to products which have been intentionally damaged or misused.

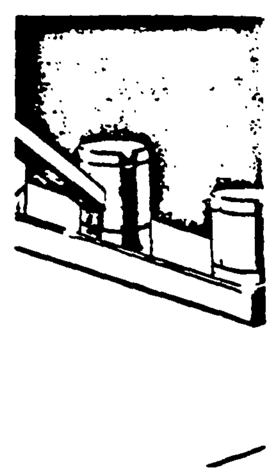
Amway Pledge of Fairness: if, after you have decided to keep the product, you find it does not give the services you expected, please contact your distributor or Amway Corporation. We will extend every effort to make a fair adjustment in accordance with the terms of the Satisfaction Guarantee.



The fastest, easiest way to put your new AMWAY Water Treatment System into service is by connecting it to an Existing Faucet. Merely set the filter housing on the countertop and connect the dual-line tubing and diverter to the kitchen faucet! Installation is that simple—and so is disconnecting and moving the unit should you want to use it elsewhere.



You can enjoy the convenience of installing your AMWAY Water Treatment System to an Existing Faucet, but store the housing under the sink. Your kit includes a countertop sleeve to pass the tubing from your faucet to the housing below the sink. Drill a one-inch hole in the countertop for the sleeve, or add it in place of your spray nozzle. The rest



For a more finished look, ask [illegible] handsome auxiliary faucet th[illegible] Or replace your spray nozz[illegible] ing is connected below the [illegible] housing sits neatly out of [illegible]

TABLE 4-1. TREATABILITY INDICATORS FOR CONTAMINANTS IN MONTGOMERY TOWNSHIP HOUSING DEVELOPMENT RESIDENTIAL WELLS

Contaminant	Henry's Law Constant @ 10°C[1]	Carbon Requirement Mg Contaminant Adsorbed/gm Carbon [2]
Trichloroethene	336	0.39
1,1,1-Trichloroethane	223	2.5
1,1-Dichloroethane	140	1.8
1,2-Dichloroethane	30.4	3.6
1,1-Dichloroethene	709	4.9
1,2-Dichloroethene	91.7[4]	3.0
Tetrachloroethene	564	50
Methylene Chloride	140[3]	1.3[5]
Ethylbenzene	350[3]	53
Carbon Tetrachloride	720	11
Toluene	154	26
Chloroform	97	2.6
1,2-Dichlorobenzene	37.1	129

(1) M.C. Kavanaugh, R. Trussel, 1980.
(2) EPA, carbon adsorption isotherms for toxic organics, EPA-600/8-80-023, April 1980, unless otherwise noted.
(3) Nyer, Groundwater Treatment Technology, (20°C).
(4) Metcalf & Eddy Data Base.
(5) Based on available data, this compound is not readily adsorbed onto activated carbon (Becker, 1978; Metcalf & Eddy, 1987; Calgon, 1987).

The Amway Water Treatment System

Distributor/Customer Information Packet

This document is to help understand the principles behind the Amway Water Treatment System and the claims documentation testing that was done.

The Amway Water Treatment System is a point of use water filter utilizing pressed carbon block technology. The pressed carbon block is made by compressing very finely divided activated carbon into a porous block. The water is forced through the submicron pore structure by water pressure.

The filter cartridge consists of three stages. The first is a synthetic, non-woven fabric that acts as a pre-filter. The next is the pressed carbon block where organic contaminants and sub-micron particulates are removed. The final stage is a sintered polyethylene core that acts as a support media for the carbon block.

Included in this packet are the following:

1. Claims platform
2. Product specifications
3. Qualifications for use
4. Abstracts of the test protocols and results for each claim
5. Amway Water Treatment System Brochure
6. Amway Water Treatment System Owners Manual

Claims Platform

1. Effectively removes impurities from water, including over 100 EPA priority pollutants such as organic contaminants, pesticides and trihalomethanes.
2. Effectively removes precipitated heavy metals, asbestos, sediment, dirt and scale.
3. Removes _Giardia lamblia_ cysts.
4. Removes chlorine.
5. Does not remove beneficial minerals and fluoride.
6. Improves water taste and odor.
7. Improves taste of coffee, tea, juices, ice cubes and soup.
8. Fits standard water faucets.
9. Easily replaceable filter cartridge.
10. Will treat enough drinking and cooking water for the average family for one year.

Specifications

1. Housing: Height -.13 1/2" nominal. Diameter - 6 31/32" nominal. Constructed of durable, high impact, Noryl plastic.
2. Filter block: Three-stage, pressed activated carbon block cartridge.
3. Materials: Water contact surfaces made with F.D.A.-approved materials.
4. Flow rate: 0.72 to 0.98 gallons per minute at 60 psi of water pressure with a new filter. (Flow rate will vary directly with water pressure and time filter has been in service.)
5. Filter life: The filter is designed to serve the average family for one year. Filter life will vary with the amount of use and the quality of the influent water.
6. Installation: The filter can either be installed on an existing faucet via a dual line diverter or plumbed in using a self piercing saddle valve and an auxiliary faucet.

Qualifications for Use

The following qualifications for use of the Amway Water Treatment System should be noted:

1. The Amway Water Treatment System is designed for use only with cold potable water.

2. DO NOT use with warm or hot water.

3. During normal operation, if the system has not been used for several hours, run water through the unit for one to two minutes prior to use.

4. The filter cartridge should be replaced at least once a year. In areas of very poor water quality, more frequent replacement may be needed. A drop in the flow rate is a good indication that the filter is filling up with contaminants and needs to be replaced. However, even if water flow rate is not affected, after a year of operation, the filter should still be replaced to assure adequate filtration of all contaminants.

Abstracts

The accompanying Abstracts are organized as follows:

1. Claim.
2. Introduction
3. Analytical Procedure
4. Results

Abstract:

1. Effectively removes impurities from water, including over 100 EPA priority pollutants such as organic contaminants, pesticides, and trihalomethanes.

Introduction:

This claim was documented in three sections: 1) Removal of Soluble, Organic EPA Priority Pollutants; 2) Removal of Insoluble, Organic EPA Priority Pollutants; and 3) Removal of Trihalomethanes. The filters were tested over their rated life, and to an additional 50% to insure a margin of safety.

Analytical Procedure - Soluble Organics:

The EPA organic priority pollutants were separated into two groups classified as soluble and insoluble. The definition of soluble was based on getting measurable quantities of the compounds into solution within the test constraints. Compounds not meeting this criteria were run under the insoluble protocol. The organic priority pollutants were added to water in a series of 200 gallon tanks and recirculated when not being pumped through the filter. The filters were tested in duplicate. The influent to, and effluent from, each of the filters was sampled at 1, 5, 50, and 150 gallons and then at 100 gallon intervals to measure the actual quantity of organic material getting to the filter. This provided an analysis from each tank of spiked water used throughout the test.

All samples were taken according to EPA protocols and were analyzed by EPA method 624 and 601 (purgeables) or 625 (base/neutrals and acids). The methods use GC/MS detection and quantitation. One modification to the methods was the use of the Tracor/Hall detector in place of the GC/MS for the purgeables.

Duplicate samples from two sample points were analyzed by an outside test agency for confirmation.

Results:

Listed below are the compounds tested, the detection limit for each compound, the measured average influent, the effluent at rated life and 50% beyond, and the calculated total loading on the filter. The measured average influent is an average of the influent concentrations determined at each sample point. The calculated total loading is the summation of the influent concentrations times the gallons of water passed at that concentration.

Compound	Detection Limit (ppb)	Measured Average Influent (ppb)	Effluent @ rated life(ppb)	Effluent @ 50% beyond(ppb)	Calculated Total Loading (mg)
Acenaphthene	0.1	52	<DL*	<DL	156.6
Chlorobenzene	0.1	8	<DL	<DL	22.9
1,2,4-Trichlorobenzene	0.1	81	<DL	<DL	245.7
1,2-Dichloroethane	0.1	11	<DL	<DL	33.5
1,1,1-Trichloroethane[1]	0.1	7	<DL	<DL	20.1
1,1,2,2-Tetrachloroethane[2]	0.1	7	<DL	<DL	21.7
Bis (2-Chloroethyl) ether	0.3	19	<DL	<DL	57.3
2-Chloronaphthalene	0.1	84	<DL	<DL	253.2
2,4,5-Trichlorophenol	0.1	96	<DL	<DL	290.8
para-chloro-meta-cresol	0.1	18	<DL	<DL	53.3
2-Chlorophenol	0.1	29	<DL	<DL	89.1
1,2-Dichlorobenzene	0.1	67	<DL	<DL	202.1
1,3-Dichlorobenzene	0.1	25	<DL	<DL	74.7
1,4-Dichlorobenzene	0.1	78	<DL	<DL	235.9
1,1-Dichloroethylene	0.1	1	<DL	<DL	2.8
1,2-*trans*-Dichloroethylene	0.1	11	<DL	<DL	34.1
2,4-Dichlorophenol	0.1	49	<DL	<DL	147.0
1,2-Dichloropropane	0.1	14	<DL	<DL	41.0
1,3-Dichloropropylene[3]	0.1	168	<DL	<DL	508.4
2,4-Dimethylphenol	0.1	5	<DL	<DL	16.0
2,4-Dinitrotoluene	0.1	93	<DL	<DL	280.0
2,6-Dinitrotoluene	1.0	111	<DL	<DL	334.0
Fluoranthene	0.1	34	<DL	<DL	102.05

Compound	Detection Limit (ppb)	Measured Average Influent (ppb)	Effluent @ rated life(ppb)	Effluent @ 50% beyond(ppb)	Calculated Total Loading (mg)
4-Chlorophenyl phenyl ether	0.2	56	<DL	<DL	170.8
4-Bromophenyl phenyl ether	0.1	33	<DL	<DL	100.3
Bis (2-Chloroisopropyl) ether	0.2	105	<DL	<DL	318.9
Bis (2-Chloroethoxy) methane	0.3	91	<DL	<DL	274.7
Bromoform	0.1	6	<DL	<DL	18.5
Trichlorofluoromethane	0.1	3	<DL	<DL	8.1
Dichlorobromomethane	0.1	31	<DL	<DL	93.4
Chlorodibromomethane[3]	0.1	168	<DL	<DL	508.4
Hexachlorobutadiene	0.1	20	<DL	<DL	61.0
Hexachlorocyclopentadiene	0.1	43	<DL	<DL	131.4
Isophorone	0.1	104	<DL	<DL	314.1
Naphthalene	0.1	55	<DL	<DL	167.7
Nitrobenzene	0.1	111	<DL	<DL	334.1
2-Nitrophenol	0.1	78	<DL	<DL	236.0
4-Nitrophenol	0.1	127	<DL	<DL	383.4
2,4-Dinitrophenol	0.2	32	<DL	<DL	96.6
4,6-Dinitro-*o*-cresol	0.2	77	<DL	<DL	233.6
n-Nitrosodiphenylamine	1.0	72	<DL	<DL	218.6
Pentachlorophenol	0.1	45	<DL	<DL	135.5
Phenol	0.1	31	<DL	<DL	94.1
Butyl benzyl phthalate	0.2	86	<DL	<DL	260.7
Di-*n*-octyl phthalate	0.1	12	<DL	<DL	37.4

Compound	Detection Limit (ppb)	Measured Average Influent (ppb)	Effluent @ rated life(ppb)	Effluent @ 50% beyond(ppb)	Calculated Total Loading (mg)
Di-n-butyl phthalate	0.2	51	1.3	1.5	155.0
Diethyl phthalate	1.0	65	<DL	<DL	195.7
Dimethyl phthalate	0.5	90	<DL	<DL	270.8
Acenaphthylene	0.2	58	<DL	<DL	174.1
Anthracene	0.1	8	<DL	<DL	23.4
Fluorene	0.1	50	<DL	<DL	152.0
Phenanthrene	0.3	18	<DL	<DL	55.7
Pyrene	0.1	20	<DL	<DL	59.3
Tetrachloroethylene2	0.1	7	<DL	<DL	21.7
Trichloroethylene	0.1	34	<DL	<DL	102.1
Dieldrin	0.2	144	<DL	<DL	435.3
Endrin	0.2	216	<DL	<DL	652.0
Heptachlor	0.1	85	<DL	<DL	256.1
Heptachlor epoxide	0.1	4	<DL	<DL	13.1
gamma-BHC (Lindane)	0.1	149	<DL	<DL	451.7
Hexachloroethane	0.1	44	<DL	<DL	133.1
1,1-Dichloroethane	0.1	13	<DL	<DL	40.1
1,1,2-Trichloroethane1	0.1	7	<DL	<DL	20.1
Chloroform	0.1	30	<DL	0.2	91.1
4,4-DDD	0.2	101	<DL	<DL	306.9

* Below Detection Limit

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1 1,1,1-trichloroethane and 1,1,2-trichloroethane: values are the sum of the two compounds due to chromatographic overlap.

2 1,1,2,2-tetrachloroethane and tetrachloroethylene: values are the sum of the two compounds due to chromatographic overlap.

3 1,3-dichloropropylene and chlorodibromomethane: values are the sum of the two compounds due to chromatographic overlap.

Analytical Procedure: Insoluble Organics

This test was performed by injecting the insoluble EPA organic priority pollutants, dissolved in a minimum of a methanol/acetone solvent mixture, into a moving stream of water with high pressure, liquid chromatography pumps. The water source was the municipal supply. The filters were tested in duplicate, with a separate pump for each filter. The injection was done continuously at a point just inside the filter housing. The effluent from each of the filters was sampled at 1, 5, 50 and 150 gallons and then at 100 gallon intervals.

All samples were taken according to EPA protocols and were analyzed by EPA method 624 (purgeables) or 625 (base/neutrals and acids). The methods use GC/MS detection and quantitation. Duplicate samples were analyzed by an outside test lab for confirmation using the same EPA protocols.

Results:

Listed below are the compounds tested, the detection limit for each compound, the calculated average influent, the effluent at rated life and 50% beyond, and the calculated total loading on the filter. The calculated average influent is the average concentration reaching the filter during the test. The calculated total loading is the total quanitity of each compound injected into each filter.

Compound	Detection Limit (ppb)	Calculated Average Influent (ppb)	Effluent @ rated life(ppb)	Effluent @ 50% beyond(ppb)	Calculated Total Loading (mg)
Acrolein	0.1	121	<DL*	<DL	336
Benzene	0.1	95	<DL	<DL	264
Carbon Tetrachloride	0.1	229	<DL	<DL	636
Bis (chloromethyl) ether	0.1	19	<DL	<DL	52
2-chloroethyl vinyl ether (mixed)	0.1	155	<DL	<DL	431
1,2-diphenyl-hydrazine	0.1	14	<DL	<DL	38
Ethylbenzene	0.1	156	<DL	<DL	433

Compound	Detection Limit (ppb)	Calculated Average Influent (ppb)	Effluent @ rated life(ppb)	Effluent @ 50% be-yond(ppb)	Calculated Total Loading (mg)
Dichlorodi-fluoromethane	0.1	36	<DL	<DL	100
n-Nitrosodi-n-propylamine	0.1	74	<DL	<DL	206
n-Nitrosodi-methylamine	0.1	145	<DL	<DL	403
1,2-Benzanthracene	0.1	18	<DL	<DL	50
3,4-Benzopyrene	0.1	94	<DL	<DL	260
3,4-Benzo-fluoranthene	0.1	71	<DL	<DL	197
11,12-Benzo-fluoranthene	0.1	70	<DL	<DL	195
Chrysene	0.1	72	<DL	<DL	201
1,12-Benzo-perylene	0.1	72	<DL	<DL	200
1,2:5,6-Dibenzo-anthracene	0.1	91	<DL	<DL	252
Toluene	0.1	145	<DL	<DL	404
Aldrin	0.1	68	<DL	<DL	190
Chlordane (technical mixture and metabolites)	0.1	15	<DL	<DL	43
4,4'-DDT	0.1	78	<DL	<DL	218
4,4'-DDE	0.1	160	<DL	<DL	445
alpha-Endosulfan	0.1	20	<DL	<DL	55
beta-Endosulfan	0.1	20	<DL	<DL	57
Endosulfan sulfate	0.1	29	<DL	<DL	80
alpha-BHC	0.1	38	<DL	<DL	105

Compound	Detection Limit (ppb)	Calculated Average Influent (ppb)	Effluent @ rated life (ppb)	Effluent @ 50% beyond (ppb)	Calculated Total Loading (mg)
beta-BHC	0.1	12	<DL	<DL	34
delta-BHC	0.1	20	<DL	<DL	56
PCB-1016 (Aroclor 1016)	0.1	64	<DL	<DL	179
PCB-1221 (Aroclor 1221)	0.1	51	<DL	<DL	143
PCB-1232 (Aroclor 1232)	0.1	27	<DL	<DL	75
PCB-1248 (Aroclor 1248)	0.1	79	<DL	<DL	220
PCB-1254 (Aroclor 1254)	0.1	65	<DL	<DL	181
PCB-1260 (Aroclor 1260)	0.1	119	<DL	<DL	330
Toxaphene	0.1	73	<DL	<DL	203
3,3'-Dichlorobenzidine	0.1	54	<DL	<DL	150
Chloroform	0.1	50	5.6	4.3	139

* Below Detection Limit

Analytical Procedures: Trihalomethanes

Trihalomethane removal was measured using Grand Rapids city water as the source. A short term test (4 weeks) and a long term test (6 months) were run on replicate filters being cycled each hour, with an 8 hour stagnation period each day and two days per week stagnation. Short term test had water on for 2.3 minutes per hour with the long term test cycling at 0.5 minutes per hour.

Samples were taken every 100 gallons according to EPA protocols and were analyzed by EPA test method 601.

Results:

Listed below are the average influent and effluent levels at the rated life and 50% beyond as well as percent removal.

Trihalomethanes (THM's) (Averages)

	Rated Life			Rated Life Plus 50%		
	Influent	Effluent	% Removal	Influent	Effluent	% Removal
Long Term	64.7 ppb	1.4 ppb	97.8	58.4 ppb	2.5 ppb	95.7
Short Term	59.5 ppb	.3 ppb	99.5	56.2 ppb	.3 ppb	99.5
	62.1	.85	98.6	57.3	1.4	97.6

The results show effective removal through the 750 gallon point.

Abstract:

2. Effectively removes precipitated heavy metals, asbestos, sediment, dirt and scale.

Introduction:

This claim was documented in three major tests: 1) Precipitated Heavy Metals Removal, 2) Particulate Removal, and 3) Asbestos Removal.

Analytical Procedure: Precipitated Heavy Metals Removal

In the Precipitated Heavy Metals study, water spiked with water-insoluble heavy metal compounds was pumped from a 200 gallon tank through duplicate filters. Samples were collected just prior to, and after the filter units every 100 gallons to evaluate the removal capabilities of the units over the rated life of the filter and to an additional 50% of rated life to insure a margin of safety.

The metal compounds were ground to pass a 250 um screen before being dispersed into the water. Agitation was able to keep a portion of the particulates in suspension so that a measureable quantity reached the filters. Removal is based on physical removal of the particulates. No claim is made for metals which are in solution prior to the filter.

Influent and effluent samples were passed through a 0.45 um filter. (Several sources, references 1-5, have defined insoluble as any material that will not pass through a 0.45 um membrane filter). Hydrochloric acid was used to bring the insoluble materials collected on the 0.45 um filter into solution prior to analysis by optimized atomic absorption.

Results:

Removal based on particulate filtration capability removes dependence on particular compound selectivity to the activated carbon. Any metal present as an insoluble particulate greater than 0.45 um diameter, will be effectively removed.

REFERENCES

1. Vogl, E.C. and Angino, E.E., Chemical Effects of Selected Trace-Metals from Sanitary Landfill Leachates on Ground Water Quality, Kansas Water Resources Research Institute, Manhattan, (Dec, 1981).

2. Schock, M.R., Response of Lead Solubility to Dissolved Carbonates in Drinking Water, J. AWWA, (Dec, 1980), Vol. 72, No. 12, pp. 695-704.

3. Tanaka, S., Darzi, M., and Winchester, J.W., Elemental Analysis of Soluble and Insoluble Fractions of Rain and Surface Waters by Particle-Induced X-Ray Emission, Environ. Science and Technology, (Mar, 1981), Vol. 15, No. 3, pp. 354-357.

4. Wangen, L.E. and Williams, J.M., Control by Alkaline Neutralization of Trace Elements in Acidic Coal Cleaning Waste Leachates, J. WPCF, (Sept, 1982), Vol. 54, No. 9, pp. 1302-1310.

5. Theis, T.L., Westrick, J.D., Hsu, C.L., and Marley, J.J., Field Investigation of Trace Metals in Ground Water from Fly Ash Disposal, J. WPCF, (Nov, 1978), Vol. 50, No. 111, pp. 2457-2469.

Analytical Procedure: Particulate Removal

The filter efficiency was tested for small spherical particles. A suspension of particles consisting of titanium dioxide (TiO_2) in a size range between 0.1-10 um in diameter in filtered, distilled water was passed through the filters. Samples were collected of the influent to, and effluent from, the filter at 3 and 5 gallons throughput. Samples were filtered and particulates collected on 0.2 um Nuclepore substrate filters. The filters were examined by computer controlled scanning electron microscopy (CCSEM). Particles were located, sized, analyzed by x-ray fluorescence (XRF), classified by type based on the analysis, counted and removal calculated based on titanium containing particles. This ensured that removal was based on a reduction of the challenging particulates. Testing was conducted at an outside test agency.

3 Gallon Test

Inlet		Outlet		Removal Efficiencies	
WT.%	Part/cm2	WT.%	Part/cm2	WT.%	Number %
97.8	1.5×10^7	0.0	0.0	100%	100%

5 Gallon Test

Inlet		Outlet		Removal Efficiencies	
WT.%	Part/cm2	WT.%	Part/cm2	WT.%	Number %
98.6	2.2×10^7	0.3	1.2×10^4	99.7%	99.9%

The filter block is at least 99.7% efficient in removing particulates down to and below 0.2 micrometers in diameter.

Analytical Procedure: Asbestos Removal

In order to accurately measure the removal efficiencies of the Amway filtration system for asbestos, a suspension of Chrysotile asbestos (particle size distribution of 0.1–10 um in diameter) in filtered, distilled water was passed through the filters. Replicate samples were collected at the three and five gallon points for both influent and effluent. Resulting samples were filtered onto 0.2 um Nuclepore® substrate filters. Each Nuclepore® filter was examined using computer controlled scanning electron microscopy (CCSEM). Testing was conducted at an outside test agency.

Results:

Particles were sized, analyzed by x-ray fluorescence (XRF), classified by type based on the XRF results, counted, and removal calculated on only asbestos fiber removal. Given below are the asbestos removals shown as both a weight percent and particle number percent removals:

3 Gallon Test

Inlet		Outlet		Removal Efficiency	
WT.%	Part/Cm2	WT.%	Part/Cm2	WT.%	Number %
58.8	1.9×10^5	0.3	5.0×10^1	99.5%	99.9%

5 Gallon Test

Inlet		Outlet		Removal Efficiency	
WT.%	Part/Cm2	WT.%	Part/Cm2	WT.%	Number %
68.1	3.1×10^5	0.0	0.0	100%	100%

The filter block is at least 99.5% effective in removing asbestos particles.

3. Removes *Giardia lamblia* cysts.

Introduction:

Giardia lamblia is an intestinal parasite that is known to populate mountainous areas of the United States but in the past few years, is showing up across the country.

Giardia causes severe intestinal distress and is very difficult to treat, in most water systems, since it is extremely resistant to normal chlorination and water treatment techniques.

Analytical Procedure:

Live *Giardia lamblia* cysts were introduced into replicate filters at the 0, 500 rate life and an additional 50% of rated life with 50,000 cysts per filter. A four liter effluent sample was collected from each filter after each spike, allowed to settle, and was concentrated to 1 ml and examined microscopically for cysts. Testing was done at an outside test agency.

Results:

Given below are the cyst counts introduced and recovered for each replicate:

Gallons	Cysts Introduced	Cysts Recovered	% Efficiency
0	50,800	0	100%
	50,800	0	100%
	50,800	0	100%
500	50,800	0	100%
	50,800	0	100%
	50,800	0	100%
750	50,800	0	100%
	50,800	0	100%
	50,800	0	100%

The Amway Water Treatment System removes *Giardia lamblia* cysts.

Abstract:

4. Removes Chlorine.

Introduction:

Chlorine removal was evaluated using replicate filters and was tested to 50% greater than rated filter life.

Analytical Procedure:

Free and total chlorine removal was measured using Grand Rapids city water as the source in a long term test (7 months). Each filter was run daily with an 8 hour stagnation period each day and a two day stagnation period each week. Influent and effluent samples were taken daily, after a six minute flush period.

Samples were analyzed using Hach DPD 14077 and 14076 test kits that measured to the nearest 0.1 ppm. Replicate samples were run for each filter.

Results:

Listed below are the average influent and effluent results for the long term test for both free and total chlorine.

Free Chlorine (Average)	Influent	Effluent	% Removal
Long term	.5 ppm	0 ppm	100%

Total Chlorine (Average)	Influent	Effluent	% Removal
Long term	.5 ppm	0 ppm	100%

Chlorine was not detectable, in the effluent, throughout the testing period.

Abstract:

5. Does not remove beneficial minerals and fluoride.

Introduction:

This claim has been documented in two parts:

1) Removal of Minerals and 2) Removal of Fluoride.

Analytical Procedure: Removal of Minerals

Amway Well Number 11 was the source of water for a long term (8 month) test of the water filter to a point 50% beyond the rated life. This is a well on the Amway complex. Each replicate filter was cycled on and off each hour for 16 hours with an eight hour stagnation period each day and a two day stagnation period each week.

Influent and effluent samples were taken bi-weekly after a six minute flush period. Hardness was measured with Disodium EDTA using ammonium chloride and ammonium hydroxide as a buffer and titrating to an Erichrome Black T end point.

Results:

Numbers given below are the average of all influent and effluent samples.

Influent	Effluent	% Removal
34.9 grains	34.9 grains	0%

Calcium : Magnesium Ratio 4:1

The minerals calcium and magnesium are not removed by the carbon block based on the above results.

Analytical Procedure: Removal of Fluoride

Grand Rapids city water was the source of a long term (7 months) fluoride removal test. Each replicate filter was cycled on and off each hour for 16 hours with an 8 hour stagnation period each day and a 2 day stagnation period each week.

Influent and effluent samples were taken weekly after a six minute flush period. Analysis was done by specific ion electrode.

Results:

Results below are the average of all data points for the test:

Influent	Effluent	% Reduction
0.95 ppm	0.91 ppm	4.2%

While there is a slight numerical reduction in fluoride, the levels are statistically the same at the 95% confidence level.

Abstract:

6. Improves water taste and odor.

7. Improves taste of coffee, tea, juices, ice cubes and soup.

Introduction:

These two claims will be covered in one abstract since they are both documented by the same panel tests.

Procedure:

Two panel tests were conducted on this product. The first was a panel test using Amway employee families and conducted by our Product Evaluation Laboratory. The second was conducted by an outside agency, in another state, using all non-Amway personnel. Tests were coordinated and the results tabulated by the Amway Product Evaluation Laboratory.

The questionnaires used contained numerous questions as to installation and function of the units as well as specific questions on water quality improvements, water taste and odor and improved taste of coffee, tea, juices, ice cubes and soup.

The panelists, in each study, were broken down by water source into two-thirds municipally treated water and one-third well water.

Results:

Given below are the averages for both panel tests and both claims:

Improves Water Taste and Odor

Panel Test	Improved Taste	Improved Odor
65 Amway Families	82%	59%
70 Outside, Non-Amway Families	69%	67%

Improves taste of coffee, tea, juices, ice cubes, and soup.

Panel Test	Improved Taste
65 Amway Families	70%
70 Outside, Non-Amway Families	63%

Abstract:

8. Fits standard water faucets

Introduction:

This claim can be documented by panel test results from both the Amway family and outside, non-Amway panel test as well as a survey of plumbing supply houses.

Procedure:

Two panel tests were conducted on the water treatment system. The first was a panel test using Amway employee families and conducted by our Product Evaluation Laboratory. The second was conducted by an outside agency, in another state, using all non-Amway personnel. The test was coordinated and the results tabulated by the Amway Product Evaluation Laboratory.

An initial installation questionnaire was a portion of both these panel tests. Questions on ease of installation and specific problems with installation were included for response.

The Water Treatment System, existing faucet option, comes with three adaptors for attaching the dual line diverter to a faucet. A survey was done of plumbing supply houses to determine what portion of faucets could be accommodated by the diverter itself and the three adaptors.

Results:

Results given below are a combination of both panel tests.

- 99.1% of all respondents said the adaptors fit their faucets.
- 1.8% of all respondents encountered problems with portable dishwashers. (As a result of this input, Amway offers the appropriate quick - connect adaptors for portable dishwashers as an extra item).
- 87.8% of all respondents found the water filter easy or very easy to install.

The survey of plumbing supply houses showed that 90% of the faucets being installed had threads that matched those on the dual-line diverter valve. Another 5% can be accommodated by three adaptors supplied with the installation kit. This gives a total of 95% of faucets that can be accommodated directly. The potential remaining 5% have two options. First, the auxiliary faucet kit can be used as this does not require attachment to an existing faucet. Second, if a consumer knows what type of faucet they have, a call to the Water Treatment Hotline will help identify the proper adaptor required.

Abstracts

9. Easily replaceable filter cartridge.

Introduction:

This claim was documented using laboratory personnel and a prototype filter housing.

Procedure:

Panelists were given a water filter with a cartridge already in place and a new filter with filter change instructions. Panelists were chosen based on an equal mix of male and female but all with limited knowledge of the Water Treatment System. They were asked to read the instructions and change the filter.

Results:

All panelists changed the filter in less than 15 minutes and found no major problems in doing so.

Abstract:

10. Will treat enough drinking water and cooking water for an average family for one year.

Introduction:

In order to evaluate the Amway Water Treatment System, some rated life needed to be established.

Results:

References (1, 2, 3) indicate that an average family uses a given quantity of water per year for cooking and drinking. All testing was conducted to 50% beyond this point in order to insure the recommended one year life.

Amway has also put in place a reminder system. Based upon registration post card information, contact will be made with the consumer 10 months after the filter installation to remind them that a filter change is due.

1. National Water Summary 1983 - Hydrologic Events and Issues. U.S. Geologic Survey Water Supply paper 2250.

2. Water Quality Association - Point of use Treatment for Compliance with Drinking Water Standards. May 5, 1983.

3. Statistical Abstract of The United States 1984, U.S. Department of Commerce, Bureau of the Census.

ATTACHMENT E

Written Comments

From Montgomery Township

AUG 19 1987

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August 12, 1987

Jeffrey Folmer
Senior Area Coordinator
Bureau of Community Relations
Division of Hazardous Site Mitigation
New Jersey Department of
Environmental Protection
C.N. 413, 6th Floor
401 East State Street
Trenton, NJ 08625

Re: Written Comments of Montgomery Township in Response to the Remedial Investigation/Feasibility Study and the Proposed Remedial Action Plan for the Montgomery Township Housing Development Superfund Site

Dear Mr. Folmer:

In response to the RI/FS and the PRAP for the well water contamination in and around the Sycamore Lane area of Montgomery Township which was the subject of a public meeting on July 29, 1987, Montgomery Township submits the following comments:

1. Montgomery Township continues to maintain the position that it has consistently espoused since the time the contamination was initially discovered with respect to the issue of reimbursement of costs for remedial measures to the citizens of the affected area. To reiterate this position, Montgomery Township contends that reimbursement for corrective measures must

be equitably achieved, treating each resident in the area in a similar fashion.

Needless to say, the residents in the area affected by the ground water pollution are not responsible for the problem. In response to the potential public health threat presented by the ground water pollution, the Township contracted for and provided public water to the areas affected at that time. Residents were encouraged to tie into the public water lines, but some chose to deal with the problem by the installation of individual well water treatment systems. Still others in the affected area, whose wells showed no sign of TCE contamination, chose to monitor their drinking water to ascertain the extent of the problem before deciding on an appropriate course of action.

Regardless of the corrective choices made, all area residents were assessed equally for the extension of the public water lines into the area. Logic dictates that these residents also share any reimbursement resulting from the correction of the problem equally.

2. Montgomery Township has already noted for the record its objection to the parameters originally used to determine eligibility for reimbursement from the Spill Compensation Fund, N.J.S.A. 58:10-23.11 et. seq. Officials of the Fund originally required both timely hook-up to the water line and timely filing of a claim for reimbursement to homeowners. Following the institution of several law suits on the subject, and negotiations

with various parties, a later date for claim filing was allowed, coupled with no date specified for hook-up to the public water system. However, neither the officials from the Spill Compensation Fund, nor any other representatives from the Department of Environmental Protection provided notice to the general public or the affected homeowners concerning the changes in the requirements necessary for reimbursement from the Spill Compensation Fund. As a result, some homeowners failed to take the action necessary to insure reimbursement from the Fund even though they had paid their fair share for the public water lines, while other area homeowners similarly situated from a public health standpoint were fully reimbursed. Montgomery Township believes the Spill Compensation Fund was created with the intent to fully compensate the victims of the same pollution incident equally. For this reason, we feel that any costs associated with the final resolution of the problem which will not be covered by Superfund should be allowed by way of claim submission to the Spill Compensation Fund.

3. With respect to Superfund payment of costs associated with remedial action, DEP has stated that Superfund will not cover past costs already incurred, but will cover any new costs associated with the recommended corrective action. If DEP's preferred alternative is chosen, Superfund would reimburse homeowners for extensions of the public water line and connection to the new or existing water mains. However, Superfund would not

reimburse homeowners for the water assessments already assessed to pay for the original public water lines in 1981.

The Township has two related comments concerning Superfund reimbursement. First, conceptually the assessment for public water can be viewed as a present cost, since payments for local improvements are generally annualized in equal payments over a ten-year period. Such is the case with the water lines installed and assessed for by the Township in 1981. In that sense, the assessment is on-going and, therefore, part of the current remedial costs presently being incurred by the affected homeowners. It is submitted that Superfund could reimburse for assessment costs if they are viewed in this matter.

Second, the Superfund legislation was enacted by Congress on December 11, 1980. However, the ordinance authorizing the water line extensions into the Sycamore Lane area and assessment to the area homeowners was passed by Montgomery Township on August 21, 1980, approximately four months prior to the enactment of Superfund. Arguably, remedial measures which pre-date enactment of Superfund, but which are also totally consistent with the recommended remedial action proposed by DEP and funded under Superfund, should likewise be included in the Superfund reimbursement. If the Township had acted less promptly and effectively to solve the public health problem presented by the ground water pollution, Superfund would unquestionably be reimbursing all the homeowners for all the costs associated with the clean-up. The area homeowners should not now be penalized for the diligence of the Township in attempting to solve the problem at the site seven years ago.

4. As follow-up to some of the comments which were made at the public meeting of July 29, 1987, Montgomery Township believes that the methodology employed in examination of the four proposed alternatives which led to the designation of the preferred alternative may have been too rigid in that possible combinations of the various alternatives, if considered, could possibly provide a satisfactory resolution to the health problem at the site in a more cost-effective manner. The extension of the water line along Montgomery Road from Route 206 to the border of Rocky Hill to serve only a few residences should be reexamined to see if it truly represents the best overall solution to the problem.

5. Finally, it appears obvious from the public meeting that the area residents are concerned with the water quality from the Elizabethtown Water Company distribution system. To date, DEP's emphasis has focused on the poor quality of the contaminated well water in the area. Any decision concerning a preferred alternative must consider the quality of the water which is being suggested as an alternative to the present source. In addition, DEP should be cognizant of, and sensitive to, public sentiment concerning this issue by addressing the area residents' misgivings about the quality of the Elizabethtown Public Water during the decision-making process.

On behalf of Montgomery Township, I would like to thank the Department for the opportunity to present these written comments concerning this most important issue. It is our hope that these comments will help the Department develop a fair and reasonable course of action to eliminate the problem at the site. The Township anticipates that such a course of action can and will be developed. To that end, Montgomery Township is eager to assist the Department whenever possible in its task.

MASON, GRIFFIN & PIERSON

By: ______________________.
David E. Tomlinson

cc: Peter N. Rayner, Township Administrator
Charles G. Searfoss, Health Officer

ATTACHMENT F

Excerpt from CERCLA

Regarding State Credit

exposure to a hazardous substance, pollutant, or contaminant and that a release may have occurred or be occurring, he may undertake such investigations, monitoring, surveys, testing, and other information gathering as he may deem necessary or appropriate to identify the existence and extent of the release or threat thereof, the source and nature of the hazardous substances, pollutants or contaminants involved, and the extent of danger to the public health or welfare or to the environment. In addition, the President may undertake such planning, legal, fiscal, economic, engineering, architectural, and other studies or investigations as he may deem necessary or appropriate to plan and direct response actions, to recover the costs thereof, and to enforce the provisions of this Act.

[104(b)(1) designated by PL 99-499]

(2) Coordination of investigations. — The President shall promptly notify the appropriate Federal and State natural resource trustees of potential damages to natural resources resulting from releases under investigation pursuant to this section and shall seek to coordinate the assessments, investigations, and planning under this section with such Federal and State trustees.

[104(b)(2) added by PL 99-499]

(c)(1) Unless (A) the President finds that (i) continued response actions are immediately required to prevent, limit, or mitigate an emergency, (ii) there is an immediate risk to public health or welfare or the environment, and (iii) such assistance will not otherwise be provided on a timely basis, or (B) the President has determined the appropriate remedial actions pursuant to paragraph (2) of this subsection and the State or States in which the source of the release is located have complied with the requirements of paragraph (3) of this subsection, or (C) continued response action is otherwise appropriate and consistent with the remedial action to be taken, obligations from the Fund, other than those authorized by subsection (b) of this section, shall not continue after $2,000,000 has been obligated for response actions or 12 months has elapsed from the date of initial response to a release or threatened release of hazardous substances.

[104(c)(1) amended by PL 99-499]

(2) The President shall consult with the affected State or States before determining any appropriate remedial action to be taken pursuant to the authority granted under subsection (a) of this section.

(3) The President shall not provide any remedial actions pursuant to this section unless the State in which the release occurs first enters into a contract or cooperative agreement with the President providing assurances deemed adequate by the President that (A) the State will assure all future maintenance of the removal and remedial actions provided for the expected life of such actions as determined by the President; (B) the State will assure the availability of a hazardous waste disposal facility acceptable to the President and in compliance with the requirements of subtitle C of the Solid Waste Disposal Act for any necessary offsite storage, destruction, treatment, or secure disposition of the hazardous substances; and (C) the State will pay or assure payment of (i) 10 per centum of the costs of the remedial action, including all future maintenance, or (ii) 50 percent (or such greater amount as the President may determine appropriate, taking into account the degree of responsibility of the State or political subdivision for the release) of any sums expended in response to a release at a facility, that was operated by the State or a political subdivision thereof, either directly or through a contractual relationship or otherwise, at the time of any disposal of hazardous substances therein. For the purpose of clause (ii) of this subparagraph, the term "facility" does not include navigable waters or the beds underlying those waters. The President shall grant the State a credit against the share of the costs for which it is responsible under this paragraph for any documented direct out-of-pocket non-Federal funds expended or obligated by the State or a political subdivision thereof after January 1, 1978, and before the date of enactment of this Act for cost-eligible response actions and claims for damages compensable under section 111 of this title relating to the specific release in question: *Provided, however*, That in no event shall the amount of the credit granted exceed the total response costs relating to the release. In the case of remedial action to be taken on land or water held by an Indian tribe, held by the United States in trust for Indians, held by a member of an Indian tribe (if such land or water is subject to a trust restriction on alienation), or otherwise within the borders of an Indian reservation, the requirements of this paragraph for assurances regarding future maintenance and cost-sharing shall not apply, and the President shall provide the assurance required by this paragraph regarding the availability of a hazardous waste disposal facility.

[104(c)(3) amended by PL 99-499]

(4) Selection of Remedial Action. — The President shall select remedial actions to carry out this section in accordance with section 121 of this Act (relating to cleanup standards).

[104(c)(4) revised by PL 99-499]

(5) State Credits.—

(A) Granting of credit. — The President shall grant a State a credit against the share of the costs, for which it is responsible under paragraph (3) with respect to a facility listed on the National Priorities List under the National Contingency Plan, for amounts expended by a State for remedial action at such facility pursuant to a contract or cooperative agreement with the President. The credit under this paragraph shall be limited to those

State expenses which the President determines to be reasonable, documented, direct out-of-pocket expenditures of non-Federal funds.

(B) Expenses before listing or agreement. — The credit under this paragraph shall include expenses for remedial action at a facility incurred before the listing of the facility on the National Priorities List or before a contract or cooperative agreement is entered into under subsection (d) for the facility if—

(i) after such expenses are incurred the facility is listed on such list and a contract or cooperative agreement is entered into for the facility, and

(ii) the President determines that such expenses would have been credited to the State under subparagraph (A) had the expenditures been made after listing of the facility on such list and after the date on which such contract or cooperative agreement is entered into.

(C) Response actions between 1978 and 1980. — The credit under this paragraph shall include funds expended or obligated by the State or a political subdivision thereof after January 1, 1978, and before December 11, 1980, for cost-eligible response actions and claims for damages compensable under section 111.

(D) State expenses after December 11, 1980, in excess of 10 percent of costs. — The credit under this paragraph shall include 90 percent of State expenses incurred at a facility owned, but not operated, by such State or by a political subdivision thereof. Such credit applies only to expenses incurred pursuant to a contract or cooperative agreement under subsection (d) and only to expenses incurred after December 11, 1980, but before the date of the enactment of this paragraph.

(E) Item-by-item approval. — In the case of expenditures made after the date of the enactment of this paragraph, the President may require prior approval of each item of expenditure as a condition of granting a credit under this paragraph.

(F) Use of credits. — Credits granted under this paragraph for funds expended with respect to a facility may be used by the State to reduce all or part of the share of costs otherwise required to be paid by the State under paragraph (3) in connection with remedial actions at such facility. If the amount of funds for which credit is allowed under this paragraph exceeds such share of costs for such facility, the State may use the amount of such excess to reduce all or part of the share of such costs at other facilities in that State. A credit shall not entitle the State to any direct payment.

[104(c)(5) — (9) added by PL 99-499]

(6) Operation and Maintenance. — For the purposes of paragraph (3) of this subsection, in the case of ground or surface water contamination, completed remedial action includes the completion of treatment or other measures, whether taken onsite or offsite, necessary to restore ground and surface water quality to a level that assures protection of human health and the environment. With respect to such measures, the operation of such measures for a period of up to 10 years after the construction or installation and commencement of operation shall be considered remedial action. Activities required to maintain the effectiveness of such measures following such period or the completion of remedial action, whichever is earlier, shall be considered operation or maintenance.

(7) Limitation on Source of Funds for O&M. — During any period after the availability of funds received by the Hazardous Substance Superfund established under subchapter A of chapter 98 of the Internal Revenue Code of 1954 from tax revenues or appropriations from general revenues, the Federal share of the payment of the cost of operation or maintenance pursuant to paragraph (3)(C)(i) or paragraph (6) of this subsection (relating to operation and maintenance) shall be from funds received by the Hazardous Substance Superfund from amounts recovered on behalf of such fund under this Act.

(8) Recontracting. — The President is authorized to undertake or continue whatever interim remedial actions the President determines to be appropriate to reduce risks to public health or the environment where the performance of a complete remedial action requires recontracting because of the discovery of sources, types, or quantities of hazardous substances not known at the time of entry into the original contract. The total cost of interim actions undertaken at a facility pursuant to this paragraph shall not exceed $2,000,000.

"(9) Siting. — Effective 3 years after the enactment of the Superfund Amendments and Reauthorization Act of 1986, the President shall not provide any remedial actions pursuant to this section unless the State in which the release occurs first enters into a contract or cooperative agreement with the President providing assurances deemed adequate by the President that the State will assure the availability of hazardous waste treatment or disposal facilities which—

(A) have adequate capacity for the destruction, treatment, or secure disposition of all hazardous wastes that are reasonably expected to be generated within the State during the 20-year period following the date of such contract or cooperative agreement and to be disposed of, treated, or destroyed,

(B) are within the State or outside the State in accordance with an interstate agreement or regional agreement or authority,