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Center for International Development

Local Environmental Management Project

Draft Comprehensive Report

Independent Appraisal of the Borsodszirák Wellhead Protection Area Located Near Sajószentpéter, Hungary

Volume I of II

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Draft Comprehensive Report

Volume I of II

Local Environmental Management (LEM) Project
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Research Triangle Institute

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Executive Summary

This comprehensive report presents the findings of an independent environmental appraisal within the Borsodszirák wellhead protection area located near Sajószentpéter, Hungary. This study was conducted by the Local Environmental Management (LEM) appraisal team. The Sajószentpéter survey is part of LEM's 3-year technical assistance and training project designed to support local governments in Poland and Hungary in the strengthening of their ability to manage local problems. Through a series of field visits and consultations with national and local officials, Sajószentpéter was chosen to participate in the LEM project because of its location in the Sajó River area and its demonstrated commitment to assessing the impact of nearby hazardous waste sites on sources of drinking water. The municipality wishes to address the potential risks posed by hazardous waste sites now, rather than delaying action until water supplies become polluted beyond remediation.

Survey Scope

The original scope of the survey was to assess the potential impact of the Epres-tanya hazardous waste landfill on the quality of groundwater pumped from the nearby Borsodszirák wellfields. The scope of the survey was subsequently broadened to include an independent appraisal, based largely on existing data, of the hydrogeology, groundwater chemistry, and potential contamination risk within the wellhead protection area. During the course of the survey, it was concluded that organic chemicals may also pose a risk to the two wellfields. The survey team, therefore, collected composite groundwater samples from the two wellfields and analyzed them for organic compounds and analytes. The results of these analyses are reported in "Final Analytical Results of Composite Groundwater Samples Collected from the Borsodszirák Wellfields Operated by the North-Hungarian Regional Waterworks" (July 1993).

Key Findings

The Pleistocene gravel aquifer used as a primary source of drinking water within the Borsodszirák wellhead protection area is highly vulnerable to pollution. The defined limits of the wellhead protection area appear adequate as a basis for protection; however, additional monitoring wells would be needed to fully characterize the groundwater flow and chemistry within the area. A comprehensive groundwater monitoring plan is recommended for the Borsodszirák wellhead protection area. The plan should incorporate sampling and analysis protocols, sampling frequency, existing and proposed monitoring well locations, data management and reporting, and provisions for quality assurance and quality control.

Groundwater quality within the wellhead protection area has been affected by pollutants, according to existing inorganic and organic chemical data obtained from monitoring wells and water

supply wells. Notable differences exist in water quality between the wellfields in Waterworks I and I/A. The groundwater derived from wells in Waterworks I appears to show the effects of dilution by surface water as a result of artificial groundwater recharge at the wellfield. Inorganic constituents are typically below the Hungarian limit values for drinking water. Small concentrations of organic compounds (chlorinated solvents) were detected in the composite water sample collected from Waterworks I by the Sajószentpéter survey team. In contrast, water from wells in Waterworks I/A typically exceeded the Hungarian drinking water limit values for several inorganic constituents. A composite sample collected from these wells by the survey team indicated detectable concentrations of some organic compounds (notably pesticides). The organic constituents in the two samples were not measured in concentrations considered to present an imminent threat to the drinking water supply.

The exact source(s) of the groundwater contamination within the Borsodszirák wellhead protection area can not be determined on the basis of the available information. Several potential contamination sources were identified during the assessment, such as the unregulated landfill at Epres-tanya and landfill No. 18, located between the two waterworks. The potential risks of groundwater contamination from the Epres-tanya landfill are considered to be greater than those defined by prior investigators. More complete characterizations of the wastes within the Epres-tanya landfill and landfill No. 18 are needed. Additional assessment of other waste disposal areas identified within the wellhead protection area also may be needed in the future.

Workshop

This is a draft report (working report) written by members of the LEM appraisal team focusing on the Sajószentpéter area. The preceding summary report, in both its English and Hungarian versions, was previously prepared (August 1993) for discussion at the LEM Project Workshop to be held in Miskolc, Hungary, on September 20-22, 1993. This draft of the comprehensive report has been made available as a basis for discussion at the workshop.

The conclusions and recommendations in this report are based on results of the LEM appraisal. Information presented in the comprehensive report is subject to change as this appraisal continues. Comments, suggestions, and proposed revisions received at the workshop will be evaluated and included in the final version of the comprehensive report. Recommendations for additional technical assistance, training, and modifications in project direction made by the workshop participants may also be included in the final report.

1.0 Background Information

Local Environmental Management (LEM) is a project of the U.S. Agency for International Development (U.S. AID) - Washington, based on a contract between Research Triangle Institute (RTI) and U.S. AID/Bureau for Europe (EUR) Environment and Natural Resources Division (ENR). The contract is for three years, beginning in July 1992 and ending in July 1995. RTI and U.S. AID/EUR/ENR agreed to focus LEM on specific municipal government environmental projects in Poland and Hungary.

1.1 LEM Project Overview

LEM undertook preliminary field trips to Hungary in September and November 1992, which confirmed the need for and importance of working with local environmental projects. These field trips also verified the need to focus on three or four municipalities and to determine criteria for establishing the project focus and choosing specific municipalities to be included in LEM.

The purpose of the LEM project in Hungary is to:

1. demonstrate the extent to which local governments can effectively manage their environmental problems if given adequate and consistent support,

2. assist project municipalities in producing reliable and technically acceptable proposals for the funding of environmental projects for presentation to national and international funding agencies, and

3. make available to other municipalities the replicable details resulting from the first two activities.

A subordinate purpose of the project is to act as liaison by matching municipal requests for technical assistance not supplied by LEM with various U.S. AID-supported projects which may be able to provide information, data, or assistance.

In its initial phase, the LEM project established a set of basic criteria to use in the selection of participating municipalities in Hungary:

- willingness of the community and its leaders to allocate existing financial and administrative resources to solve local environmental problems and to investigate methods of improving financial capacity to pay for solutions;

- ability of local government to demonstrate adequate expertise in the administration and management of the municipality;
- a cooperative approach to the implementation of suggestions for general management, administrative, and financial improvement;
- one of the projects should focus on the Sajó River area in Borsod-Abaúj-Zemplén County; and
- at least one project should involve a municipality with a population under 25,000.

The overall strategy was to implement project activity in four municipalities in Hungary:

Municipality	Population	Project Description
Gyor	140,000	Solid Waste Collection/Disposal
Ozd	47,000	Solid Waste Collection/Disposal
Edeleny	14,000	Solid Waste Collection/Disposal
Sajószentpéter	14,000	Hazardous Waste Site Assessment

Through a series of field visits and consultations with national and local officials, Sajószentpéter was chosen as one of four LEM municipalities in Hungary because of its demonstrated commitment to investigating the impact of nearby hazardous waste sites on sources of potable water. This report covers only the Sajószentpéter project.

1.2 Sajószentpéter Survey Objectives

Sajószentpéter, located in Borsod-Abaúj-Zemplén County in northern Hungary, is adjacent to an industrial complex near Kazincbarika and Berente (Figure 1) that includes a power plant, chemical factories, coal mines, and an ore-sintering plant. As a result, the municipality is faced with environmental problems stemming from the number of known, as well as unknown, hazardous waste dump sites that have the potential to pollute groundwater. One such buried site, referred to as the Epres-tanya landfill (Figure 2), was known to contain industrial waste. The risk

potential of this landfill was discovered when a high metal content in the crops grown nearby prompted the discontinuation of cultivation.

Because this site is near the drinking water sources for Sajószentpéter (Waterworks I and I/A and their wellfields), several studies of the area had already been commissioned. The last one was completed in January 1993. Although these studies revealed specific environmental problems with the site, none have been comprehensive enough to reveal the full extent of the risk to the municipal water supply. The municipality wishes to address the potential risks posed by hazardous waste sites now, rather than delaying action until water supplies become polluted beyond remediation.

In response to a request for technical assistance, the LEM project sent a survey team of two RTI researchers to Sajószentpéter in May 1993. The research team had both theoretical and practical expertise in appraisal and analysis of hazardous waste sites and hydrogeology. The initial objectives of the Sajószentpéter survey included: 1) review of previous studies of the Epres-tanya site, 2) field reconnaissance of the area, and 3) development of a more extensive site monitoring plan for the hazardous wastes at this site and other possible sites.

1.3 Survey Location and Scope

The original scope of the Sajószentpéter survey was to assess the potential impact of the Epres-tanya hazardous waste landfill on the quality of groundwater pumped from the nearby Borsodszirák wellfields, Waterworks I and I/A (Figure 2). The scope of the survey was subsequently broadened to include an independent appraisal, based largely on existing data, of the hydrogeology, groundwater chemistry, and potential risk within the wellhead protection area of the Borsodszirák wellfields. Permission to modify the scope of the Sajószentpéter survey to incorporate the groundwater sampling and analysis effort and the appraisal of the wellhead protection area was obtained from the LEM Project Managers and the U.S. AID.

The Borsodszirák wellhead protection area is understood to be within a legally defined boundary, which is based in part on hydrogeologic conditions. The wellhead protection area encompasses a large area (approximately 30 km^2), hydraulically upgradient of the Borsodszirák wellfields (Figure 3). During the course of LEM's survey, there were some indications of past and current usage of organic chemicals within the area of influence of the wellfields. The survey

team collected composite groundwater samples from the two wellfields and analyzed them for organic compounds and metallic analytes. The analytical results of composite wellfield samples were reported in "Final Analytical Results of Composite Groundwater Samples Collected from the Borsodszirák Wellfields Operated by the North-Hungarian Regional Waterworks" (July 1993).

1.4 Conditions Within the Borsodszirák Wellhead Protection Area

The survey team limited its appraisal to available groundwater data from existing monitoring wells and water supply wells within the Borsodszirák wellhead protection area. Approximate locations of monitoring wells are indicated in Figure 4, along with some of the known waste disposal areas and key land features in the vicinity of the waterworks. Water level and chemical data were not available for all of the identified monitoring wells.

The Borsodszirák wellfields include a total of 41 supply wells in Waterworks I and 5 active supply wells in Waterworks I/A. Together these wellfields produced an average of about 10300 m^3/day of drinking water in 1992. This drinking water, along with groundwater provided by other systems operated by the North-Hungarian Regional Waterworks (ÉRV) for Borsod-Abaúj-Zemplén County, serves an estimated total population of about 74300 inhabitants.

The alluvial basin that supplies groundwater as a source of drinking water to the ÉRV in the vicinity of Sajószentpéter is composed of a highly productive, complex gravel aquifer system of Pleistocene age. Groundwater flow within the basin is dynamic as a function of variable recharge from rainfall, surface water/groundwater interactions, and anthropogenic effects to the system such as dewatering for coal mines, and groundwater withdrawals from and artificial recharge to the Borsodszirák wellfields.

The Pleistocene gravel aquifer tapped by the Borsodszirák wellfield is composed of a heterogeneous mixture of sand and gravel that occurs at a relatively shallow depth below the surface in the study area (near the land surface in some areas and at depths of up to 8 m). The hydraulic conductivity of the aquifer, as reported by (Hydrology Planning Company of Eastern Hungary, KEVITERV, 1987), ranges from approximately 10 to over 100 m/day.

1.5 Team Profile

The Sajószentpéter survey team consisted of two RTI researchers from the United States. They were Mr. W. Joseph Alexander, a research hydrogeologist, and Mr. Robert S. Wright, an environmental scientist. The survey team arrived in Budapest on May 9 and met with the LEM Resident Project Manager before traveling to Borsod-Abaúj-Zemplén County on May 10, 1993. In Miskolc, the survey team met with members of various local, county, and regional offices, as well as the Directors of the North-Hungarian Regional Environmental Inspectorate (ÉKF) and the Ecological Institute for Sustainable Development. The team then traveled to Sajószentpéter where Mr. Alexander worked until May 19 and Mr. Wright worked until June 1, 1993.

As survey team leader, Mr. Alexander provided expertise in the appraisal of the hydrogeology and potential groundwater contamination. Mr. Alexander directed the site reconnaissances and initial information gathering efforts in Hungary. He also supervised RTI's independent technical appraisal and report preparation activities.

Mr. Wright contributed technical expertise in hazardous waste site assessment and assisted with the procurement of organizational and technical data from local government officials, regional authorities, and industrial firms while in Hungary. Mr. Wright supervised the collection of water samples and developed the databases on which the groundwater chemistry and risk assessment activities were largely based.

Mr. István Samu, the Mayor of Sajószentpéter, recommended the study area and guided the survey team in field data collection efforts and location of technical information. The Ecological Institute for Sustainable Development, directed by Dr. Ivan Gyulai, provided the survey team with technical, logistical, and translation assistance and with office services. Mr. István Pintér, Mr. Nagy Deszö and Mr. Csaba Losonci were among those providing this assistance. Many other individuals contributed to the Sajószentpéter survey team's understanding of the local environmental conditions and available sources of information. Much of this information was gained by review of available documents and through the process of interviewing. Details related to these sources of information are provided in Section 2.0.

This comprehensive report was prepared by the Sajószentpéter appraisal team consisting of W. J. Alexander, R. S. Wright, J. W. Reynolds, M. T. Siedlecki, S. K. Liddle, R. J. Curry, W.D. Wheaton, and J. M. Lloyd. Review comments were also provided by W. A. Sommers and

A. S. Wyatt. Report services were provided by R. S. Thomas, with editorial assistance from E. MacDonald.

1.6 Organization of the Comprehensive Report

The comprehensive report is an independent technical appraisal of the Borsodszirák wellhead protection area. The appraisal team have focused their evaluation on three key technical subject areas throughout the report:

1. hydrogeology
2. groundwater chemistry
3. qualitative assessment of the risk potential to the groundwater.

This report is subject to change as new information becomes available and as the appraisal team's survey continues. The appraisal is based largely on previous studies, available groundwater monitoring data, interview sessions conducted in Hungary by the survey team, and the use of available analysis techniques.

Section 2 of the report presents the previous studies and available data used by the appraisal team along with references cited. Section 3 describes the pre-survey activities, field activities by the survey team, and subsequent technical activities conducted by the appraisal team. A variety of scientific methods used in the survey are discussed in Section 3. Regional information about the geographic setting, water resources, and hydrogeologic framework are presented in Section 4.

Section 5 presents the results of the independent appraisal and follows the three key technical areas of hydrogeology (Section 5.1), groundwater chemistry (Section 5.2), and risk potential (Section 5.3). The hydrogeology appraisal primarily focuses on an independent evaluation of the groundwater flow and travel time estimates. The groundwater chemistry appraisal relies on available inorganic water quality data provided to the survey team and on organic data obtained by the survey team. The relative risk potential within the Borsodszirák wellhead protection area, as presented in Section 5.3, relies heavily on interpretations of the hydrogeology, the groundwater chemistry, and the use of established predictive models.

Section 6 presents the conclusions of the appraisal. Specific recommendations, categorized by short- and long-term activities, are provided in Section 7. Appendices to this comprehensive

report provide the tables and figures cited (Appendix A and B, respectively), and relevant supporting documentation.

2.0 Previous Studies, Groundwater Monitoring Data, and Other Technical Information

LEM's appraisal of the Borsodszirák wellhead protection area and analysis of the Epres-tanya hazardous waste site are based, in part, on English translations of several reports and regulations. The LEM survey team obtained these documents prior to or during its visit to the Borsodszirák wellhead protection area in May 1993. These documents are listed in the following subsections:

2.1 Reports Concerning the Borsodszirák Wellhead Protection Area

1. Szlabóczky, P., "Determination of the Hydrogeological Protective Profile of Waterworks Borsodszirák I and I/A (Technical Description)," Report, Hydrology Planning Company of Eastern Hungary, (KEVITERV), Plan No. 5-3925-86, Miskolc, 1987.

2. Regional Environmental Protection and Water Authorities of Northern Hungary (É-KÖVIZIG), "Forming and Confinement of the Borsodszirák I and I/A Waterworks Hydrogeologically Protective Area," Regulation, Reference No. 20.521-4/1989, Miskolc, 1989.

3. Regional Environmental Protection and Water Authorities of Northern Hungary (É-KÖVIZIG), "Decision on Obligations Concerning the Hydrogeologically Protective Area of Borsodszirák I - I/A Waterworks," Regulation, Reference No. 26037/1990, Miskolc, 1990.

2.2 Reports Concerning the Epres-tanya Hazardous Waste Site

1. Kalina, E. and O. Haszpra, "Professional Advice about the Hazardous Waste Dumping Site's Condition at Epres-Tanya," Report, Technical University of Budapest (TUB), Faculty of Civil Engineering, Institute of Water Engineering, Dean's Permission No. 241, 604/91, Budapest, 1992.

2. Haszpra, O., E. Kalina, and L. Szépkuti, "Supplementary Professional Advice on the Danger of Polluting Ground-Water by the Hazardous Waste Deposit Situated in Epres-Tanya," Report, Technical University of Budapest (TUB), Innovation Park, Kft., Budapest, 1993.

3. Kútfúro-Javító Földtani Szolgáltató es Vallalkozási (KÚTFÖ), Kft., "Epres-Tanya - Dumping Field Examination. Geological - Technical Data of Waste Examination Bores," Report, Karzincbarcika, 1992.

4. Kelemen, J., "The Analysis of Wastes of BVK Origin Dumped at the Sand-Pit on the Agricultural Field of Borsodszirák Cooperative - Farm at Dusnokpuszta," Report, Regional Water Administration and Environmental Authority of Northern Hungary (É-KÖVIZIG) Water Quality Measuring Service (KVMSZ), Miskolc, 1990.

5. Regional Environmental Protection and Water Authorities of Northern Hungary (É-KÖVIZIG), "Permission to Establish Observation Wells at Epres-Tanya Dumping Field of BVK," Regulation, Reference No. 22.163/1992, Miskolc, 1991.

6. Regional Environmental Inspectorate of Northern Hungary (ÉKF), "Observation System of the Dumping Fields of BVK at Epres-Tanya," Letter from István Gavaller to KÚTFÖ, Kft., Reference No. 12348-2/1991, Miskolc, 1991.

2.3 Additional Reports and References Cited

1. Hungarian Office of Standardization (MSZH), "Drinking Water. Physical and Chemical Quality Criteria," Standard, Reference No. MSZ 450/1-1989, Budapest, 1989.

2. U.S. Environmental Protection Agency, 1990. "Hazard Ranking System," Federal Register, Volume 55, No. 241, Pages 51532-51667, Friday, December 14, 1990.

3. U.S. Environmental Protection Agency, 1991. Guidance for Performing Preliminary Assessments Under CERCLA, Office of Solid Waste and Emergency Response, Publication No. 9345. 0-01A, September 1991.

4. Blandford, T.N. and P.S. Huyakorn, 1990. WHPA: A Modular Semi-Analytical Model for the Delineation of Wellhead Protection Areas, Office of Ground-Water, U.S. EPA.

5. Fitchko, J., 1989. Criteria for Contaminated Soil/Sediment Cleanup. Pudvan Publishing Company, Northbrook, Illinois, USA, ISBN 0-934165-26-9, 74 pages.

6. Jambrik, Rozalia, 1987, A dusnokpusztai barnaszénterület, Földtani és hidrogeológiai viszonyainak áltekintése, BÁNYSZAT, Volume 120, Number 2.

7. Sharp-Hansen, S., C. Travers, P. Hummel, T. Allison, 1990. A Subtitle D Landfill Application Manual for the Multimedia Exposure Assessment Model (MULTIMED). Environmental Research Laboratory, Office of Research & Development, U.S. EPA.

2.4 Summary of Monitoring Well Information and Groundwater Quality Data

Monitoring wells that are known to exist within the Borsodszirák wellhead protection area are shown in Figure 4. Pertinent information about well locations, construction, and monitoring data was provided by several organizations, as indicated below.

1. North-Hungarian Regional Waterworks (ÉRV)
   - Nine groundwater monitoring wells (E-1 through E-6 and TSZ-1 through TSZ-3);
   - Egységes Országos Vetület (EOV) coordinates for wells E-1 through E-6;
   - Groundwater level data for wells E-1 through E-6 from early 1990 to early 1993;
   - Groundwater quality data (e.g., conductivity, ammonium ion, and sodium) for wells E-1 through E-6 and TSZ-1 through TSZ-3 from early 1990 to early 1993; and
   - Drinking water quality data for individual wells and composite samples in Waterworks I from middle 1989 through late 1992 and in Waterworks I/A from late 1980 through late 1992.
2. Tiszai Erömü Rt. (formerly Borsodi Höerömü Vállalat [BHV])
   - Three groundwater monitoring wells (H-1 through H-3);
   - Well diagrams for wells H-1 through H-3;
   - EOV coordinates for wells H-1 through H-3;
   - Groundwater level data for wells H-1 through H-3 from mid-1988 through early-1993; and
   - Groundwater quality data for wells H-1 through H-3 from mid-1988 through early-1993.
3. Borsodchem Rt. (Formerly Borsodi Vegyi Kombinát [BVK])
   - Seven groundwater monitoring wells (V-1 through V-3 and ET-101 through ET-104);
   - Well diagrams for wells V-1 through V-3 and ET-101 through ET-104;
   - EOV coordinates for wells V-1 through V-3 and ET-101 through ET-104;
   - Groundwater level data for wells V-1 through V-3 from late-1991 through early-1993;
   - Groundwater quality data for wells V-1 through V-3 from early-1992 through early-1993.

- Groundwater level data for wells ET-101 through ET-104 from early 1992 through early 1993; and
- Groundwater quality data for wells ET-101 through ET-104 from early 1992 through early 1993.

2.5 Other Technical Information Gained from Field Interviews

Date	Person Interviewed	Types of Technical Information Gained
10 May 93	István Samu, Mayor of Sajószentpéter	His goals for the survey and a general discussion of the Epres-tanya landfill and the Borsodszirák wellhead protection area.
10 May 93	István Gavallér, Director of North-Hungarian Regional Environmental Inspectorate	A general discussion of the structure of environmental regulations and regulatory authorities.
11 May 93	István Samu, Mayor of Sajószentpéter	Field trip to Epres-tanya landfill and other hazardous waste sites in the wellhead protection area.
11 May 93	Chief of Borsodszirák Waterworks	Tour of Waterworks
12 May 93	László Vilimi and Béla Hernádi of North-Hungarian Regional Waterworks (ÉRV)	Discussion of ÉRV groundwater monitoring network, the data that have been collected, and hydrogeological conditions in the wellhead protection area
13 May 93	Dr. István Ávéd of Tiszai Erömü Rt., Kazincbarcika Power Plant	Discussion of their groundwater monitoring network, the data that have been collected, and the power plant's fly ash pile.
14 May 93	László F. Kovács, László Szentmiklóssy, and Judit Fukete-Nagyné Török of Borsodchem Rt.	Discussion of the LEM project, Borsodchem's work to correct environmental problems, their groundwater monitoring network, and the data that have been collected.

17 May 93	Csaba Nemeth of East-Hungarian Hydrological Planning Company (KEVITERV)	Discussion of the 1987 KEVITERV report on hydrogeological conditions in the wellhead protection area.
17 May 93	László Vilimi of ÉRV	Discussion of proposed groundwater sample collection for organic analysis at Borsodszirák Waterworks.
18 May 93	István Samu, Mayor of Sajószentpéter	Discussion of the survey team's preliminary conclusions and recommendations concerning the wellhead protection area.
18 May 93	Chief of Borsodszirák Waterworks	Discussion of proposed groundwater sample collection for organic analysis and inspection of new composite sampling ports.
19 May 93	Gábor Mezei and Istvánné Markó of Kútfúró-Javító Földtani Szolgáltató és Vállalkozási (KÚTFÖ) Kft.	Discussion of soil and waste measurements and drilling techniques at Epres tanya landfill.
19 May 93	Dr. Rozália Jambrik and Dr. Imre Szabó of the University of Miskolc, Department of Hydrogeology and Engineering Geology	Discussion of hydrogeological conditions in the wellhead protection area and a computer model for groundwater flow in the area.
21 May 93	Erzsebet Szatmeri and Ernö Pál of the Borsod-Abaúj-Zemplén County Environmental Office	Discussion of regulations concerning new and existing landfills.
24 May 93	Ernö Kiss, Attila F. Marton, and Eszter Szövényi of the Hungarian Ministry for Environmental and Regional Policy	Discussion of the survey team's preliminary conclusions.
25 May 93	Dr. Ottó Haszpra and Dr. Ernö Kalina of the Technical University of Budapest, Institute of Water Engineering	Discussion of their 1992 and 1993 reports on the Epres-tanya landfill.

27 Ma 93	László Vilimi of ÉRV	Discussion of final preparations for groundwater sample collection for organic analysis at Borsodszirák Waterworks.

3.0 Survey Methodology

This section describes the pre-survey activities of the LEM project members, field activities by the survey team, and subsequent technical activities by the appraisal team.

3.1 Pre-Survey Activities of LEM Project Members

In 1992, LEM project members and AID officials undertook two extensive field trips to Borsod-Abaúj-Zemplén County. The first field trip was in September 1992, and the second field trip was in November 1992. During the first field trip, environmental problems in the county were assessed, and a strategy was developed to provide environmental management assistance to local governments in the county. Local governments and industries, regional authorities and hazardous waste sites were visited. The second field trip provided an opportunity to revisit local governments and regional authorities that had responded favorably during the first field trip. Specific municipalities and specific environmental problems were selected for participation in the LEM project. Sajószentpéter and the Epres-tanya hazardous waste landfill were among the sites selected.

In January 1993, specific individuals were selected to conduct the Sajószenpéter survey, based on the technical expertise that would be needed for the survey. Several reports concerning the Epres-tanya landfill and environmental problems in Sajószenpéter and the Sajó River valley were translated into English. The survey team reviewed these reports and developed a plan for conducting the survey and for evaluating the potential hazards associated with the Epres-tanya landfill.

The technical and management assistance that could potentially be given to Sajószenpéter consisted of the following five steps:

1. Independent analysis of previous studies of the Epres-tanya landfill;
2. Development of a more extensive site monitoring plan for the hazardous wastes at this site and other possible sites;
3. Institution of a data collection system based on the monitoring system arising from the plan;

4. Analysis of data collected and preparation of a report of suggested additional monitoring and/or proposed remedial action; and
5. Development of a complete remediation/finance plan to resolve the hazardous waste effects and to protect Sajószentpéter's water supply.

The survey team that visited Sajószentpéter in May - June 1993 addressed the first three steps. It was anticipated that other LEM project members would provide assistance on the last two steps at a later date.

3.2 Field Activities of Sajószentpéter Survey Team Members

The Sajószentpéter survey team was in Hungary from 10 May through 2 June 1993. Upon their arrival in Miskolc, they attended a meeting of local, county and regional officials. After introductions had been completed, the survey team explained the purpose, goals, and schedule of the survey to the officials as a group. Subsequently, the survey team had a detailed discussion with István Samu, Polgármester (Mayor) of Sajószentpéter. Mayor Samu explained that his goals for the survey are:

1. to know the situation clearly;
2. to determine who is responsible; and
3. to decide what is to be done.

He explained that his main concern was protecting the drinking water quality at the Borsodszirák Waterworks and that the hazards associated with the Epres-tanya landfill were a secondary concern.

Based on this discussion and subsequent findings by the survey team in the field, the scope of work (terms of reference) for the survey was broadened to include an independent analysis, based largely upon existing data, of the groundwater chemistry and flow conditions in the Borsodszirák wellhead protection area, the hydrogeological protective area of the Borsodszirák Waterworks. Permission to broaden the scope of the survey was obtained from LEM project leaders and U.S. AID. The area is understood, for the purposes of the survey, to be within a legally-defined boundary based on hydrogeological conditions. It has an area of approximately 30 km^2 and is hydraulically upgradient of the wellfields.

The survey team conducted several field evaluations to investigate the Borsodszirák Waterworks, the wellhead protection area, and potential sources of groundwater contamination in the area. The field evaluations focused on the potential sources of contamination, the geological and hydrogeological conditions around the potential sources, and the relationship between the potential sources and the waterworks. Photographs were taken to document the conditions around the potential sources of contamination.

The survey team required geological, hydrogeological, and groundwater chemistry information for the wellhead protection area and potential contamination sources in the area. The team identified organizations and individuals in local agencies, industries, and universities who were knowledgeable in these subjects. Appointments were made for information-gathering interviews. The team prepared a set of questions prior to each interview. In some cases, the questions were typed and were translated into Hungarian in order to facilitate communications during the interview. Considerable amounts of technical information and groundwater monitoring data were given to the survey team as a result of the interviews, as described in Section 2.5. The organizations and individuals were cooperative and willing to share their knowledge with the survey team.

During the course of its investigations, the survey team discovered that a fairly extensive groundwater monitoring network already existed in the wellhead protection area. Groundwater samples have been routinely collected from monitoring wells and analyzed for their inorganic components (such as heavy metals). Organic components have not been analyzed in the past because of the lack of instrumentation for such analyses. However, the survey team found some indications that potentially hazardous organic compounds were used in the surrounding industrial area. It was suspected that these compounds could have been disposed in some portions of the alluvial basin. For example, the team observed the application of pesticides on crops in the area immediately surrounding Borsodszirák Waterworks I/A during one of the field evaluations.

The survey team recommended that composite groundwater samples be collected from the waterworks and be analyzed for specific organic and inorganic components. The primary objective of the sampling and analysis task was to independently establish whether or not hazardous organic compounds are currently present in the wellfields on the basis of the composite groundwater samples. Organic compounds are typically more mobile in groundwater than heavy metals and may be a greater hazard to the drinking water quality than heavy metals. These

results would help to establish the need for a comprehensive groundwater monitoring program. Permission was obtained from the North Hungarian Regional Waterworks (ÉRV) to collect composite groundwater samples from the waterworks for analysis in the United States. The survey team developed a preliminary sampling and analysis plan for this effort.

The composite groundwater samples were collected from the waterworks on 1 June 1993 and were transported to the United States on the following day. The details of the sampling and analysis procedures and the analytical results are provided in another report, which is titled "Final Analytical Results of Composite Groundwater Samples Collected from the Borsodszirák Wellfields," dated July 1993.

3.3 Technical Evaluation Activities

The following subsections describe the general methodology used by the appraisal team to analyze available data.

3.3.1 Geographic Information System Analysis. The base maps used in this report (Appendix B) were developed using geographic information system (GIS) techniques with spatial information derived from numerous Hungarian paper map sources. The map sources varied in their levels of accuracy due to reductions, enlargements, and physical condition. The maps included in this report, therefore, meet the objectives of this survey but do not follow generally accepted cartographic accuracy standards.

The base features (roads, railroads, rivers, and municipal boundaries) were derived from a single source consisting of six adjacent, uniformly scaled (1:10000) topographic maps. The topographic maps were apparently produced in the mid to late 1960s. These maps required some adjustment along the borders to match adjacent maps. A common coordinate system was used so that other features could be added to the base map, including the location of the ÉRV waterworks, monitoring wells, the Epres-tanya landfill, the fly ash disposal area, other landfills and disposal areas, and the wellhead protection area boundary. EOV coordinates for the monitoring wells could not be used because the appraisal team did not have any appropriately-scaled paper maps in this coordinate system.

3.3.2 Database Construction. Data concerning groundwater quality, groundwater levels, and drinking water quality were obtained in several different media (i.e., computer data files, computer printouts and typed tables). The ÉRV computer data file BSZIRAK.TXT served as the basis for a single database that would contain all the data. First, it was converted from a text file into an Excel ™ spreadsheet file. Second, the data from Borsodchem Rt. and Tiszai Erömü Rt. were entered manually into the file. Yearly average values were calculated and figures illustrating the data were prepared.

The data were analyzed to determine the portion of the data that best represented the wellhead protection area. The most complete set of groundwater quality and groundwater level data is the 1992 data. These data do not appear to be significantly different from data for other years. The most complete and representative set of drinking water quality data is that of 1991. These data were the primary focus of the groundwater chemistry appraisal, although other data were investigated as the need arose.

3.3.3 Hydrogeologic Evaluation. The hydrogeologic evaluation performed for this project involved the review of available geologic and hydrogeologic reports applicable to the area. Initially, the general geology and hydrogeology of the area were evaluated. A summary of this regional information is presented in Section 4.3.

The most significant and comprehensive hydrogeologic study of the area was performed by Keletmagyarországi Vízügyi Tervezö Vállalat (KEVITERV). Their report entitled "Determination of the Hydrogeological Protective Profile of Water Works Borsodszirák I and I/A (Technical Description)" is dated July 1987. The KEVITERV report described the installation of three monitoring wells (V-series), determination of hydraulic conductivity for the gravel aquifer, sample collection, regional hydrogeology and local groundwater movement, water quality, and potential contamination sources for the water-supply system. Evaluations for the LEM appraisal focused on the more subjective aspects of the report for which confirming data were available, such as reproduction of groundwater streamline maps and water level maps. In addition, evaluations were performed using more recent available data, such as water level maps and hydrographs.

3.3.4 Water Chemistry Analysis. Groundwater chemistry was evaluated using analytical data collected during 1992. As part of the evaluation, the annual mean concentrations of major and minor inorganic constituents were compared to the applicable limit values established by Hungary for drinking water. A series of figures were developed to illustrate the areas in which groundwater was characterized by constituent concentrations in excess of the applicable limit values. This enabled the determination of areas that have the potential to impact groundwater quality upgradient of the waterworks.

Water quality at Waterworks I and I/A was evaluated using data collected during 1992 for composite and individual water samples. If data were not available for 1992, the data generated during 1991 were used.

3.3.5 Hazard Ranking System. In 1980, the United States Congress passed the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), which is commonly known as "Superfund". This law established a program to identify sites where hazardous substances have been, or might be, released into the environment; to ensure that these sites are cleaned up by responsible parties or by the government; to evaluate damages to natural resources; and to create a claims procedure for parties who have cleaned up sites or who spent money to restore natural resources.

The U.S. Environmental Protection Agency (EPA) developed the Hazard Ranking System (HRS) in response to the CERCLA requirement to identify sites where hazardous substances have been, or might be, released into the environment. HRS is used to answer three basic questions about the sites:

1. What hazardous wastes are present at the site and what are their quantities and properties?
2. What is the probability that hazardous wastes have been released into the environment?
3. What people or other potential targets may be affected by the release?

HRS is a mathematical procedure for determining the potential hazard from one site relative to other sites. Each site is given a numerical HRS score, which quantifies the magnitude of the hazard from the site. Any site with a HRS score greater than 28.5 could be placed on EPA's National Priority List (NPL). The NPL includes those sites that appear to have the most serious

threat to public health and the environment. Sites on the NPL must be studied in greater detail. NPL sites have high priority for long-term evaluation and remedial response. EPA must decide whether it will require that the responsible groups clean the site or whether it will clean the site itself. Other U.S. or state regulations may require the cleaning of sites with HRS scores that are less than 28.5.

3.3.6 Multimedia Exposure Assessment Model (MULTIMED). The U.S. EPA's Multimedia Exposure Assessment Model (MULTIMED) was used to characterize the potential for migration for contaminants from potential waste disposal areas to potential receptors. Specifically, MULTIMED was used to estimate the effects of the disposal of organic chemicals at the Epres-tanya landfill on the Borsodszirák Waterworks I. Chemical, aquifer, and source-specific variables were defined for the area, and analytical and semi-analytical solution techniques were used to assess the localized contaminant fate and transport.

For this appraisal, best estimates of the aquifer parameters and source characteristics were entered in the model. Three different contaminants were modeled by varying chemical distribution coefficients. In addition, three values for fractional organic carbon content in the aquifer were modeled for each chemical to account for variations in this aquifer parameter. Contaminant pulse durations of 22 years (with a 40 year simulation period) and 50 years (with a 100 year simulation period) were modeled. The MULTIMED modeling process and results are described in detail in Section 5 of this report.

4.0 Regional Information

The following sections include information on the geographic setting of the site, description of the water resources for the region, and the hydrogeologic framework for the area. This information provides a foundation for the assessment of the wellhead protection area.

4.1 Geographic Setting

The Borsodszirák wellfield protection area is located in a broad alluvial valley near the confluence of the Sajó and Bódva Rivers; this area is part of a larger region referred to as the Sajó-Hernad valley. The Sajó River flows in an east-west direction from upland areas referred to as the Ózd-Borsodi coal basin. At Kazincbarcika, the Sajó River turns to the southeast where it is joined by the Bódva River. The Bódva River flows from north to south from a mountainous area (Szendroi. Aggteleki, Rudabanyi, and Tornai) and the upper Bódva basin. Both the Sajó and Bódva rivers have relatively narrow floodplains in the upland regions, but a broad, flat floodplain has developed at their confluence.

4.2 Water Resources

Water resources for a large region of northern Hungary, including the study area, are provided by the North-Hungarian Regional Waterworks (ÉRV). In 1990, ÉRV provided water to 340,000 individuals in 100 settlements and 11 towns, and to 31 industrial consumers. The ÉRV is divided into 7 regional water supply units. The survey area is served by the Regional Water Supply System of Borsod County (BRV), a subdivision of ÉRV. BRV's principal consumers include the cities of Kazincbarcika and Ózd as well as numerous smaller villages and industrial plants in the county.

Groundwater supplied by the BRV serves approximately 74300 inhabitants, some of which are served by other waterworks of the BRV. This survey focused on the wellhead protection area for the Borsodszirák Waterworks I and I/A (Figure 3), which produced an average of 10236 m^3/d in 1992. The boundary of this wellhead protection area was determined based on geographic and hydrogeologic factors.

Waterworks I is located on the southwest bank of the Bódva River (Figure 5). This wellfield, developed in the 1950s, now consists of 41 closely spaced production wells that extract groundwater from the Pleistocene gravel aquifer. The total production rate for this waterworks in 1992 was approximately 9320 m^3/d; however, pumping rates for each individual production well were not available. The gravel aquifer at Waterworks I is enriched by artificial recharge. This is accomplished by pumping water directly from the Bódva River into 19 infiltration ponds (or sieves). Approximately 80 percent of the groundwater pumped from the aquifer at Waterworks I is derived from the infiltration ponds.

Waterworks I/A is located approximately 2 km south of Waterworks I (Figure 6). Waterworks I/A includes 7 production wells, but only wells 1, 2, 3, 5 and 7 are currently operational. Therefore, its production (1992 average approximately 916 m^3/d) is significantly lower than Waterworks I. The production wells in Waterworks I/A also pump groundwater from the Pleistocene gravel aquifer. Individual production rates are not available and there is no artificial recharge of the aquifer at this location.

Initially, water collected from the wellfields was not chemically treated. Groundwater is now pumped into raw water manifolds where it is chlorinated and discharged into distribution lines for drinking water supply.

4.3 Hydrogeologic Framework

Three primary hydrostratigraphic units underlie the Sajó-Bódva River valley. The base of the hydrogeologic system in the study area consists of interlayers of Miocene clay and sand with localized seams of coal and lignite. Marl and tufa, with some thin interlayers of sand and localized intrusions of andesitic, dacitic, and/or rhyolitic rock, are present in the Miocene units in some areas. Only monitoring wells V-3 and ET-103 are known to terminate in the Miocene sediments. Little is known about the regional flow of groundwater in the Miocene strata.

The water supply for the region is obtained from a Pleistocene alluvial sand and gravel aquifer. This aquifer fills the valley region at varying thicknesses and is bounded by the surrounding uplands. Gravel was mined from this aquifer in some localities for construction materials, and ponds have developed where the excavations extend below the water table. The aquifer has been studied for water supply purposes, and its hydraulic characteristics are relatively

well-documented. The thickness of the Pleistocene aquifer varies from 5 to 12 meters (Figure 7). The aquifer is thicker in the central areas of the valley where incised alluvial channels have been filled, and thinner near the upland boundaries. The hydraulic conductivity (K) distribution for the aquifer has been estimated by KEVITERV from grain size analyses and a limited number of aquifer tests. The distribution of K for the area, as determined by KEVITERV, is presented in Figure 8.

Water level maps for the gravel aquifer were produced in October 1986 and March 1987 in a technical report produced by KEVITERV (Figures 9 and 10, respectively). These figures indicate that groundwater flow is from the highland areas into the alluvial valley, continuing in a southerly direction in the alluvial valley.

Overlying the gravel aquifer is a layer of Holocene sand, muddy clay-sands, and mud. This layer varies from 1 to 8 meters in thickness (Figure 11). These sediments have most likely been extensively reworked due to the meandering of the rivers and associated tributaries present in the valley. Due to the discontinuity of the overlying silt and clay layer, the gravel aquifer is not considered to be confined.

The Pleistocene gravel aquifer is overlain by a layer of lower-permeability sediments (hydraulic conductivity in the range of 1 to 2 m/day). This layer is not continuous in the study area, due to redistribution of the sediments by rivers and streams in the area, and due to mining for gravel deposits. It was observed that some of the excavations for the gravel deposits extend below the water table. Where these excavations were not backfilled, ponds have formed.

A northeast-southwest trending fault zone traverses both of the river valleys in the upland areas west and north of the study area. This fault zone crosses the Sajó valley approximately 10 km west of Kazinbarcika and crosses the Bódva River approximately 23 km north of the Sajó-Bódva confluence. Several warm springs and wells (>25 °C) are present along this fault zone. An additional northeast-southwest trending fault zone is present approximately 35 to 50 km to the east of the study area. It is reported that northeast-southwest trending fault zones are present in the deeper units in the study area (Jambrik, 1987; KEVITERV, 1987).

5.0 Results of Independent Appraisal

The independent appraisal focused primarily on three environmental aspects associated with the wellhead protection area. These include an evaluation of the hydrogeology of the area, an evaluation of the groundwater quality in the aquifer, and the qualitative assessment of a landfill located within the wellhead protection area. The results of the evaluation of these aspects are discussed in the following sections.

5.1 Hydrogeologic Evaluation

The technical report prepared by KEVITERV was reviewed as described in Section 3.4. There is little reason to question the validity of the empirical data on hydraulic conductivity estimation, aquifer and groundwater elevations, and unit thicknesses presented in the report. However, some of the most important factors to consider in an assessment of groundwater contamination are groundwater flow direction and velocity. These factors are assessed by subjective interpretation of water level data and hydrographs. The survey team then developed independent interpretations of the same data as KEVITERV and then compared them with the KEVITERV interpretation.

5.1.1 Evaluation of Water Level Data. Water level maps produced by KEVITERV for October 1986 and March 1987 were evaluated (Figures 9 and 10, respectively). Figure 9 (October 1986) apparently depicts water level conditions in the Pleistocene gravel aquifer when the waterworks were not operational. It is apparent that Waterworks I was not operational during this time. However, the positions of the isopleths near Waterworks I/A are similar in Figures 9 and 10, suggesting that Waterworks I/A may have been operational at this time. Figure 9 indicates a water level depression in the vicinity of a gravel excavation pit immediately southeast of the Epres-tanya landfill as an area of discharge, reportedly due to a high rate of evaporation from the pit. However, it was determined that a well present at the farmer's cooperative at "Bartók Béla" was in use at the time of water level measurement. It is unlikely that evaporation from the gravel pit and pumping from a single well could result in such a depression of the water level surface. However, required data are not available which would confirm or refute this

assertion. The duration of time between cessation of operation of Waterworks I, and water level measurements is not known. Incomplete recovery of the aquifer after cessation of Waterworks I pumping, in combination with a high evaporation rate, may be responsible for the orientation of the water level surface in this area.

Figure 10 is a water level map for the Pleistocene gravel aquifer during operation of the Borsodszirák Waterworks I and I/A in March 1987. Figure 10 indicates that the groundwater flow is affected by withdrawal of groundwater from the Borsodszirák wellfields, especially Waterworks I. In order to provide an alternate interpretation of the March 1987 water level data, an additional water level map was produced using the same water level data (Figure 12). Considering the subjective nature of manual contouring methods, Figures 10 and 12 are quite similar. Therefore, the characterization of the groundwater flow regime during this time period is consistent, and the KEVITERV March 1987 water level map appears to be a valid basis for determining groundwater streamlines.

During the 1993 survey by LEM, existing groundwater level data were collected from organizations responsible for numerous monitoring wells in the study area. Water level data for March 1992 were used to produce a water level map for the study area (Figure 13). Changes in the groundwater flow regime in the study area between March 1987 and March 1992 are small. A more definitive area of recharge is evident in the vicinity of the Tiszai Erömú flyash deposit. Little difference can be seen in the areas of Waterworks I and I/A. Variations are probably a result of climatic conditions, water extraction rates for the Borsodszirák wellfields, and infiltration rates at the Tiszai Erömú flyash deposit.

Long-term water level data for monitoring wells in the study area were not available. Short-term water level trends were available for a limited number of wells. Hydrographs for 1992 for the V-series wells are presented in Figure 14. The V-series wells are located near the flash deposit of the Tiszai Erömú as shown in Figure 4. Figure 14 indicates an anomalous decrease in the water level for well V-2 to below that of V-3, which is terminated in the deeper Miocene units. The reason for this abrupt change in the water level for well V-2 is unknown but may be attributed to damage or clogging of the well screen or improper water level measurement.

Hydrographs from 1990 to early 1993 for the E-series wells are presented in Figures 15 and 16. Hydrographs for the ET-series wells (referring to the Epres-tanya landfill) from early 1992 to early 1993 are presented in Figure 17. Hydrographs for the H-series wells for late 1991

to early 1993 are presented in Figure 18. None of these hydrographs indicate significant trends in the water levels over the relatively short duration of the hydrographs.

Little is known about the hydrogeologic characteristics of the water-bearing units of the Miocene sediments underlying the Pleistocene gravel aquifer. Only two wells (V-3 and ET-103) are known to terminate in these Miocene units. Due to the lack of multiple, closely-spaced wells terminating at various depths in the Pleistocene and Miocene aquifers, determination of vertical flow information was not possible.

5.1.2 Evaluation of Groundwater Travel Times. The LEM appraisal team estimated groundwater travel times from several potential point sources to Waterworks I and compared them to estimates calculated by KEVITERV. In addition, a semi-analytical model was used to estimate the groundwater travel times from a sensitive area. These topics are described in the following sections.

5.1.2.1 Velocity Calculation Along Groundwater Streamlines. KEVITERV produced a map indicating estimated groundwater streamlines and estimated groundwater travel times from potential point sources selected by KEVITERV (Figure 19). This map is based on the March 1987 water level data presented in Figure 10. For reference, the potential point sources selected by KEVITERV were assigned identification letters A to P (excluding O). Figure 20 presents the LEM appraisal team's interpretation of the groundwater streamlines and travel times based on the same water level distribution used in Figure 10.

A comparison of Figures 19 and 20 indicates that the estimated streamlines are in general agreement, with the exception of those from potential point-sources N and P. The shorter streamlines from N and P to Waterworks I shown in Figure 20 are based on the assumption that groundwater would flow perpendicular to groundwater level isopleths.

Figure 19 presents groundwater travel times (in years) estimated by KEVITERV for migration from the potential point sources to Waterworks I. These travel times were evaluated

for this appraisal by summation of integrated travel times for segments of each groundwater streamline. Linear groundwater velocity along each section was calculated using Darcy's Law:

$v_t = (K \bullet I)/n_e$; where:

v_t = linear groundwater velocity;
K = hydraulic conductivity;
I = hydraulic gradient;
n_e = effective porosity.

The hydraulic gradient was determined for each segment using the revised March 1987 water level map (Figure 12). Hydraulic conductivity values were estimated for each section using Figure 8. A hydraulic conductivity value of 25 meters/day was assumed for distant reaches of the streamlines not quantified on Figure 8.

A comparison of Figures 19 and 20 indicates some differences in the estimated travel times. Values for the parameters selected by KEVITERV for calculating these travel times are unknown.

A comparison of the travel times calculated by KEVITERV and those calculated during the LEM appraisal is presented in Table 1. Table 1 indicates that the majority of travel times calculated for this appraisal are shorter than those calculated by KEVITERV. However, many were in near agreement; in fact, the recalculated travel times are significantly longer for potential point sources D and H. These discrepancies may be attributed to differing interpretations of the hydraulic gradient or hydraulic conductivity selected for the distant reaches of the streamline. The recalculated estimated travel times are significantly shorter for potential point sources L, N, and P, because of the more direct estimated streamlines from the potential point sources to the wellfield. Point source L corresponds to the Epres-tanya landfill. Additional assessment of the migration of contamination from this point is presented in Section 5.3.4. As discussed in the KEVITERV report, these travel times estimate only of groundwater flow velocity, and not contaminant migration. The estimations do not take into consideration dispersion, mixing, retardation by sorption, or diffusion.

5.1.2.2 Particle Tracking Assessment. A semi-analytical particle tracking model was used to compute estimated groundwater travel times in the vicinity of the Borsodszirák Waterworks I. The semi-analytical component of the GPTRAC (General Particle Tracking) Module of the U.S. EPA Wellhead Protection Area (WHPA) Model was used for this comparison

(Blandford and Huyakorn, 1990). This model calculates 5-year and 10-year capture zone areas and calculates particle pathlines using an analytical velocity computation.

Assumptions

The model assumes presence of a homogeneous aquifer, with steady-state, two-dimensional groundwater flow. Wells in the model are assumed to be fully penetrating. A uniform gradient and flow direction must be specified in the model inputs. The model simulates groundwater flow velocity only and does not consider migration of reactive compounds in the groundwater.

Input Parameters

An aquifer transmissivity value of 400 m^2/d was assumed for the aquifer, based on a hydraulic conductivity value of 40 m/d (Figure 8) and an aquifer thickness of 10 m (Figure 7). An aquifer porosity of 25 percent was assumed for the aquifer. The groundwater flow vector was represented by an hydraulic gradient of 0.0016 flowing north 50° east, based on 1992 water level measurements obtained from the Epres-tanya - Waterworks I areas. A total of ten wells (five production and five recharge) were simulated. The five production wells were evenly distributed throughout the simulated Waterworks I plant with a pumping rate of 1865 m^3/d assigned for each well. The five recharge wells were added to simulate the effects of the enriching of the aquifer at Waterworks I by use of infiltration ponds or "sieves." Recharge wells were placed 50 feet east of each corresponding production well with a recharge rate of 1492 m^3/d (representing 80 percent of withdrawal rates). The model was used to determine 5-year and 10-year capture zones for the production wells at Waterworks I.

Results

The model generated a series of flow lines which designate the capture zones for each production well. Figure 21 indicates the 5-year capture zone for Waterworks I and Figure 22 indicates the 10-year capture zone for Waterworks I. These figures suggest that non-reactive, mobile contaminants released from the vicinity of the Epres-tanya landfill would be intercepted by Waterworks I at approximately 10 years, assuming a uniform groundwater flow direction and steady, continuous introduction of non-reactive contaminants into the aquifer. Though the model

does not represent the actual flow conditions and contaminant migration, it is useful for identifying and evaluating potential areas of concern in the vicinity of the waterworks.

5.2 Groundwater Chemistry

To evaluate groundwater chemistry, mean groundwater quality concentrations were derived for selected chemical constituents in 19 monitoring wells located within the wellhead protection area. Tables 2 and 3 present the annual mean concentration for each constituent monitored during 1992. Mean concentration values were used for this evaluation due to the availability of monitoring data for 1992 for each of the 19 monitoring wells. In addition, the mean concentration, rather than an individual concentration, was used to decrease uncertainties associated with differences in groundwater sample collection schedules, sample collection methodologies, sample handling, and chemical analyses. The data used to derive Tables 2 and 3 are contained in Appendix C.

Monitoring well sites were selected to provide water quality data relative to specific areas within the wellhead protection area. This information, obtained from various sources, was compiled to gain a more extensive survey of groundwater quality. Monitoring well designations and specific monitoring purposes are listed in Table 4.

The list of analyzed constituents may not be the same for each monitoring well, due in part to analytical differences. For example, the different organizations, involved in sample collection and analysis, may have requested analysis of different constituents, thereby resulting in minor gaps in the data. Furthermore, varying analytical instrumentation most likely resulted in differences in the method detection limits. This was especially apparent in the evaluation of the minor ion constituents. Finally, some organizations used the value of zero to indicate a measurement below the detection limit; whereas, others used the detection limit itself to indicate the same type of measurement. If the detection limit was reported, values below this limit are presented in the tables as "less than the detection limit."

Each of the mean concentrations was compared to the applicable limit values for drinking water as established by Hungary (Hungarian National Standards for Drinking Water, Physical and Chemical Quality Criteria [MSZ 450/1-1989]). In most cases, the "tolerable" limit value was used; however, in the case of sodium, the "adequate" limit value was used. These limit values

are included on Tables 2 and 3. In cases for which Hungary has not established a limit value, the public health authorities of Hungary allow for individual limit values to be set on the basis of available toxicological data and international regulations. In these cases, the U.S. EPA maximum contaminant levels (MCLs) for contaminants in drinking water were consulted. Specifically, the U.S. EPA MCLs were consulted for nickel concentrations.

5.2.1 Evaluation of Major Ion Constituents in Groundwater. Table 2 presents the mean concentration data for 1992 for sodium, chloride, ammonium, nitrate, sulfate, and conductivity. Monitoring wells V-3 and ET-103 represent groundwater chemistry in the Miocene aquifer; the other monitoring wells represent groundwater chemistry in the Pleistocene gravel aquifer.

The mean concentration for each of the constituents was compared to the drinking water limit value. These comparisons of major ions in Pleistocene aquifer groundwater to drinking water standards are presented on Figures 23 to 28. The monitoring wells screened in the Miocene aquifer were not included on these figures to avoid misrepresentation.

The area of each circle shown in the figures is proportional to the ratio of the mean concentration divided by the limit value established by Hungary for drinking water. For example, a ratio of 2.5 indicates that the ion concentration in groundwater is 2.5 times greater than the applicable standard. To aid in comparison between figures, a minimum and maximum size was defined for the circles. The minimum size corresponds to a ratio of 0.5 and the maximum size corresponds to a ratio of 3. In order to make high concentration areas easy to recognize, the circle was shaded a dark gray if the mean concentration exceeded the limit value. Otherwise, the circle was shaded a light gray. The mean concentration for each monitoring well is included for each circle.

5.2.1.1 Sodium. Based on the 1992 mean sodium data, the limit value of 200 milligrams per liter (mg/L) for sodium in drinking water was not exceeded in groundwater collected from the Miocene aquifer. The limit value was only exceeded in samples collected from one monitoring well screened in the Pleistocene gravel aquifer (Figure 23). Monitoring well ET-104 indicated a mean concentration of 440 mg/L. This well monitors groundwater chemistry

near the Epres-tanya landfill. This mean concentration exceeded the limit value by a factor of 2.2.

5.2.1.2 Chloride. The limit value of 100 mg/L for chloride in drinking water was not exceeded in groundwater collected from the Miocene aquifer. However, the limit value was exceeded in eight monitoring wells screened in the Pleistocene gravel aquifer. As shown on Figure 24, high mean concentrations of chloride were observed in monitoring well E-6, and in the areas of the Epres-tanya landfill, the manure storage pile, and Waterworks I. Note that in well ET-101, the mean chloride concentration (247 mg/L) was 2.5 times greater than the limit value, and in monitoring well ET-104, the mean concentration (840 mg/L) was 8.4 times greater than the limit value.

5.2.1.3 Ammonium. The limit value of 0.2 mg/L for ammonium was exceeded in one of the two monitoring wells providing water quality data for the Miocene aquifer. The 1992 mean ammonium concentration was 3.53 mg/L in monitoring well ET-103, which exceeds the limit value by a factor of 17.7. Because Figure 25 represents water quality chemistry in only the Pleistocene aquifer, this high concentration of ammonium does not appear on the figure.

As shown on Figure 25, the limit value for ammonium was exceeded in 11 of the 17 monitoring wells screened in the Pleistocene gravel aquifer. The ammonium limit value was exceeded in the areas of the Epres-tanya landfill, the manure storage pile, and the interior and perimeter of the fly ash pile.

Because of the constraint on the maximum size of the circle used to illustrate high concentrations of ammonium, the exact magnitude of the exceedences cannot be shown in Figure 25. Table 5 presents the mean ammonium concentration and the ratios of the mean ammonium concentration to the limit value for the wells that are characterized by high concentrations. The limit value is exceeded by a factor of more than 15 in six of the wells. It is exceeded by a factor of more than 100 in monitoring well ET-104, which is near the Epres-tanya landfill and the nearby cattle feedlot.

5.2.1.4 Nitrate. The limit value of 40 mg/L for nitrate in drinking water was not exceeded in groundwater collected from the Miocene aquifer. The limit value was exceeded in

one of the monitoring wells screened in the Pleistocene gravel aquifer. Monitoring well E-4, which is in the area of the Waterworks I, was characterized by a mean nitrate concentration of 60.8 mg/L (Figure 26).

5.2.1.5 Sulfate. The limit value of 300 mg/L for sulfate in drinking water was not exceeded in groundwater collected from the Miocene aquifer. However, the limit value was exceeded in 10 of the monitoring wells screened in the Pleistocene gravel aquifer. As shown on Figure 27, high concentrations of sulfate were observed in the areas of the Epres-tanya landfill, the interior and perimeter of the fly ash pile, and the Waterworks I and I/A. These areas of high sulfate concentration may be part of a single larger area of high concentration that stretches from the fly ash pile to the waterworks. Sulfate was not measured in the TSZ-series monitoring wells.

5.2.1.6 Conductivity. Conductivity is a measure of the total amount of ionic constituents in groundwater. Hungary defines the "tolerable" limit value for conductivity in drinking water as 1600 µS/cm. The limit value was not exceeded in groundwater collected from the Miocene aquifer. However, the limit value was exceeded in 7 monitoring wells screened in the Pleistocene gravel aquifer (Figure 28). High conductivity was observed in the areas of the fly ash pile, the Epres-tanya landfill, and the manure pile. The greatest mean concentration of conductivity for 1992 was 3515 µS/cm, which was observed in monitoring well ET-104. This value exceeded the limit value by a factor of 2.2.

5.2.2 Evaluation of Major Ion Constituents in Drinking Water. The previous section (5.2.1) evaluated major ion constituents in groundwater samples from monitoring wells in the Borsodszirák wellhead protection area. Evaluation of the groundwater chemistry in the wellhead protection area provides an indication of the quality of the groundwater that will reach Waterworks I and I/A. If the drinking water limit values are exceeded in groundwater collected from within the wellhead protection area, the potential exists for adverse impacts to drinking water quality.

This section evaluates drinking water quality by reviewing the analytical data for chloride, nitrate, ammonium, sulfate, and conductivity for composite and individual water samples collected from Waterworks I and I/A (Appendix C). Sodium concentrations were not available

for composite water samples. Data for Waterworks I were available from January 1990 through November 1992. Data for Waterworks I/A were available from November 1980 through October 1991. Where results of composite water analyses were not complete for 1992, data generated during 1991 were used.

5.2.2.1 Sodium. Sodium concentrations in composite water samples from Waterworks I and I/A were not available; however, sodium concentrations in individual water supply wells were available and were used to evaluate water quality at the waterworks.

The mean sodium concentration for individual water supply wells in Waterworks I was 31.8 mg/L in November 1992. The mean concentration is less than the drinking water limit value of 200 mg/L. The limit value was exceeded in only one of the individual water supply wells in Waterworks I in November 1992 (285 mg/L in water supply well No. 10A).

Sodium concentrations in individual water supply wells in Waterworks I/A did not exceed the limit value in 1992. Sodium concentrations were consistently less than 120 mg/L in water samples collected from individual water supply wells. Sodium concentrations in individual water supply wells in Waterworks I/A were plotted from 1991 to early 1993 (Figure 29). Note that a concentration gradient is apparent along the length of the wellfield, with higher values noted to the southwest.

5.2.2.2 Chloride. The mean chloride concentration for composite water samples collected from Waterworks I during 1992 was 49 mg/L. This concentration is below the drinking water limit value of 100 mg/L. The limit value was not exceeded in any one of the composite samples collected during 1992.

Chloride concentrations in composite water samples collected from Waterworks I/A were incomplete for 1992; therefore, the 1991 data were used. The mean chloride concentration for composite water samples collected from Waterworks I/A during 1991 was 163 mg/L. This mean concentration value exceeded the limit value, as did the majority of the individual composite samples collected from Waterworks I/A during 1991. Review of the database indicated that chloride concentrations in composite water samples consistently exceeded the limit value from the initiation of data collection in 1988 through 1991. The mean chloride concentration for this period was 158 mg/L.

Figure 30 illustrates the chloride concentration in individual water supply wells in Waterworks I/A for the period from 1988 through 1992. Note that a concentration gradient exists along the length of the wellfield.

The fact that the drinking water limit value for chloride in composite water samples was exceeded in water samples from Waterworks I/A, and not in Waterworks I, may be an indication of the effects of dilution in Waterworks I as a result of artificial recharge. The water collected from Waterworks I is approximately 20 percent groundwater and approximately 80 percent infiltrated river water. It is hypothesized that the river water is characterized by lower concentrations of chloride than the groundwater, and the mixing of the two may result in an overall lower chloride concentration. Dilution is not a factor in composite water samples collected from Waterworks I/A. As a consequence, the high chloride concentrations most likely reflect actual groundwater chemistry conditions in the vicinity of the wellfield.

5.2.2.3 Ammonium. Although ammonium concentrations in groundwater samples collected from the wellhead protection area during 1992 frequently exceeded the drinking water limit value, the limit value of 0.2 mg/L was exceeded in only one individual composite water sample collected from Waterworks I during 1992. Ammonium was measured at 0.33 mg/L in a composite water sample collected in January 1992. The mean ammonium concentration for 1992 was 0.06 mg/L.

The 1992 data for composite water samples collected from Waterworks I/A were not available; therefore, the 1991 data were used. The mean ammonium concentration for 1991 was 0.03 mg/L.

Figures 31 and 32 present ammonium concentrations in drinking water collected from individual water supply wells from Waterworks I/A. The ammonium data were divided between two figures for clarification purposes. As shown on Figure 31, the limit value is exceeded on occasion in water supply wells 1 and 6. In contrast, the ammonium limit value is not exceeded in water supply wells 2, 3, and 5 (Figure 32).

5.2.2.4 Nitrate. The limit value of 40 mg/L for nitrate in drinking water was not exceeded in composite water samples collected from Waterworks I during 1992. Nitrate

concentrations were consistently less than 20 mg/L during 1992. The mean nitrate concentration was 12.8 mg/L.

Monitoring well E-4 had a mean nitrate concentration of 60.8 mg/L during 1992 (Figure 26). Yet, almost all the nitrate concentrations for individual wells in Waterworks I were less than 20 mg/L during 1992. Water supply well 12 was the sole exception, with a value of 30 mg/L for October 1992. It appears that the higher nitrate concentrations in the groundwater near Waterworks I are being diluted by river water containing lower nitrate concentrations.

The 1992 data for composite water samples collected from Waterworks I/A were not available; therefore, the 1991 data were used. Nitrate concentrations in Waterworks I/A were equal to or less than 30 mg/L, and the limit value was not exceeded during 1991. The mean nitrate concentration was 25.2 mg/L.

Figure 33 presents nitrate concentrations for individual water supply wells in Waterworks I/A. Note that the limit value was exceeded in individual water supply wells 1, 3, 5, and 6. The limit value was consistently exceeded in water supply well 5. As with sodium and chloride, a concentration gradient was observed along the wellfield.

5.2.2.5 Sulfate. As shown on Figure 27, sulfate concentrations in groundwater samples collected from the wellhead protection area during 1992 frequently exceeded the drinking water limit value of 300 mg/L. However, despite the high concentrations of sulfate observed in the groundwater, the limit value was not exceeded in composite water samples collected from Waterworks I during 1992. The maximum sulfate concentration was 132 mg/L, which was measured in October 1992. The mean sulfate concentration was 105 mg/L.

The 1992 data for composite water samples collected from Waterworks I/A were not available; therefore, the 1991 data were used. The limit value was consistently exceeded in composite water samples collected from Waterworks I/A during 1991 (Figures 34 and 35). The mean sulfate concentration for the composite water samples was 479 mg/L. Sulfate concentrations in individual composite samples ranged from 178 mg/L in July 1991 to 762 mg/L in October 1991.

5.2.2.6 Conductivity. The tolerable limit value of 1600 µS/cm was not exceeded in composite water samples collected from Waterworks I during 1992. The mean conductivity value for 1992 was 619 µS/cm.

The 1992 data for composite water samples collected from Waterworks I/A were not available; therefore, the 1991 data were used. The mean conductivity value for 1991 was 1361 µS/cm. The limit value was not exceeded in composite water samples collected from Waterworks I/A during 1991. However, the limit value was exceeded at times prior to 1991 (Figure 36).

5.2.3 Evaluation of Minor Ion Constituents in Groundwater. The mean concentrations for the minor ion constituents in the Pleistocene gravel aquifer and the Miocene aquifer were calculated using the 1992 monitoring data. As noted earlier, some organizations used the value of zero to indicate a measurement below the detection limit and others used the detection limit to indicate a minimum concentration. In addition, the low concentrations of the minor ion constituents in groundwater, combined with possible analytical interferences, resulted in fluctuating detection limits. Interpretations were based on the most reliable data.

The mean concentrations for mercury, cadmium, arsenic, chromium, lead, copper, zinc, and nickel are presented in Table 3. The mean concentration for each of the constituents, except for nickel, was compared to the tolerable limit value for drinking water. Figures 37 through 41 present the mean concentration for chromium, lead, copper, zinc and nickel. Note that the figures do not depict the ratios of mean concentrations to limit values as was the case for the major ion constituents. The figures also do not depict data below the detection limit.

5.2.3.1 Mercury. Mercury concentrations in groundwater collected by ÉRV from the E-series, H-series, and V-3 monitoring wells in 1992 were consistently below the Hungarian limit value of 1.0 microgram per liter (µg/L) in 1992. The mean mercury concentration was calculated for these monitoring wells (Table 3). Mercury concentrations were reported by Borsodchem Rt. as less than the method detection limit of 1 µg/L for the ET-series, V-1, and V-2 monitoring wells.

5.2.3.2 Cadmium. Cadmium concentrations in groundwater collected from the wellhead protection area in 1992 were equal to or were less than the Hungarian limit value of 5.0 µg/L. As shown in Table 3, ÉRV reported cadmium concentrations as zero µg/L; whereas, Tiszai Erömü Rt. and Borsodchem Rt. reported cadmium concentrations as less than or equal to 5 µg/L. In either case, the limit value was not exceeded during 1992 groundwater monitoring.

5.2.3.3 Arsenic. Arsenic concentrations in groundwater collected from the E-series, the H-series, and V-3 monitoring wells in 1992 were reported as zero µg/L by ÉRV. Arsenic concentrations in the ET-series monitoring wells were reported as less than the method detection limit by Borsodchem Rt. Their method detection limit for these wells varied from 10 µg/L to 100 µg/L during the 1992 monitoring year. The variable detection limit may be a function of sample dilution to circumvent possible analytical interferences from other constituents. Since the method detection limit was, in some cases, greater than the limit value of 50 µg/L, it cannot be concluded that arsenic concentrations in the ET-series monitoring wells are above or below the limit value.

Borsodchem Rt. reported arsenic concentrations of 250 µg/L in monitoring well V-1 and 180 µg/L in monitoring well V-2 during March 1992. Subsequent measurements in both monitoring wells were reported as less than the detection limit. The detection limit for these wells varied from 50 µg/L to 100 µg/L, and as a consequence, it cannot be concluded that arsenic concentrations in monitoring wells V-1 and V-2 are above or below the limit values.

Arsenic was the only minor ion constituent to have a maximum concentration in monitoring wells other than the ET-series wells. Maximum arsenic concentrations were observed in the V-series wells, which monitor groundwater chemistry in the vicinity of the fly ash pile.

5.2.3.4 Chromium. With the exception of monitoring well E-5, chromium concentrations in 1992 were consistently less than the method detection limit in the E-series, the H-series, and V-3 monitoring wells (Table 3). A chromium concentration of 9 µg/L was measured in monitoring well E-5 in August 1992. This concentration is less than the Hungarian drinking water limit value of 50 µg/L. Chromium was not measured at concentrations exceeding the method detection limit in monitoring well E-5 for the remaining 1992 samples.

The mean chromium concentrations were calculated using the 1992 monitoring data. As shown on Table 3, the mean chromium concentrations in monitoring wells V-1, V-2, ET-101, ET-102, ET-103, and ET-104 were consistently less than the drinking water limit value. The maximum mean chromium concentration (26.6 µg/L) was observed in monitoring well ET-101. Chromium concentrations in ET-101 ranged from less than the detection limit of 5 µg/L to 160 µg/L. This latter concentration was measured in March 1992. It was the only occurrence of chromium to exceed the drinking water limit.

5.2.3.5 Lead. Lead concentrations in groundwater collected by ÉRV from the E-series, the H-series, and V-3 monitoring wells in 1992 were consistently less than the Hungarian limit value of 50 µg/L. The maximum lead concentration measured by ÉRV was 33 µg/L in monitoring well E-5 in February 1992. All other 1992 lead measurements in monitoring well E-5 were less than the detection limit. Lead concentrations in the other E-series, H-series, and V-3 monitoring wells were either less than 10 µg/L or below the method detection limit.

Lead concentrations in the V-1 and V-2 monitoring wells, as measured by Borsodchem Rt. in 1992, were less than the limit value of 50 µg/L. The mean concentration value was 14.5 µg/L in monitoring well V-2 and 13.0 µg/L in monitoring well V-3. Higher concentrations of lead were measured by Borsodchem Rt. in the ET-series monitoring wells. Mean lead concentrations ranged from 11.1 mg/L to 25.4 mg/L in monitoring well ET-104. Individual concentrations ranged from less than the detection limit to a maximum value of 80 µg/L. The maximum value was measured in groundwater collected from monitoring well ET-103 in July 1992. This measurement was the only lead concentration to exceed the drinking water limit value.

5.2.3.6 Copper. The 1992 mean copper concentrations did not exceed the Hungarian drinking water limit value of 1000 µg/L (Table 3). Mean copper concentrations ranged from 1.0 µg/L in monitoring well ET-102 to 10.7 µg/L in monitoring well ET-101.

5.2.3.7 Zinc. The 1992 mean zinc concentrations did not exceed the drinking water limit value of 1000 µg/L. The maximum mean zinc concentration was observed in monitoring well ET-101 at a value of 166.7 µg/L.

5.2.3.8 Nickel. The 1992 mean nickel concentrations ranged from less than the detection limit value in several monitoring wells to 24.3 µg/L in monitoring well ET-101. Because Hungary does not assign a drinking water limit value for nickel, guidelines established by the U.S. EPA were consulted. The U.S. EPA established the maximum contaminant level for nickel in drinking water at 1000 µg/L. Mean nickel concentrations in groundwater did not exceed this value.

5.3 Analysis of Epres-tanya Landfill

5.3.1 Results of Previous Studies. During the period from approximately 1971 to approximately 1976, industrial, construction, and solid household wastes were deposited in an abandoned gravel pit in the vicinity of Epres-tanya. Afterwards, these wastes were covered with soil. The nearby agricultural cooperative grew grass and crops, such as sugar beets, in this soil. In 1990, the North Hungarian Regional Water Administration and Environmental Authority (É-KÖVIZIG) was informed that hazardous wastes had been deposited in the landfill, which was within the Borsodszirák wellhead protection area. É-KÖVIZIG conducted a preliminary investigation of the landfill and found high levels of metals in the soil and wastes within the landfill. High levels of lead were found in the sugar beets growing there. Based on maps, aerial photographs, and excavations, the total amount of waste was estimated at 50,000 cubic meters.

In 1991, É-KÖVIZIG ordered Borsodchem Rt., as the legal successor to Borsod Chemical Works (BVK), to conduct additional geological and hydrogeological investigations of the Epres-tanya landfill. The Technical University of Budapest (TUB) prepared reports in 1992 and 1993 concerning this hazardous waste landfill. These reports were based on data presented in the 1987 KEVITERV report and the 1992 KÚTFÖ report and on groundwater quality data collected by ÉRV and Borsodchem Rt. In general terms, the conclusions and recommendations of the TUB reports are as follows:

1. The soil samples collected during construction of monitoring well ET-104 were determined to be excessively contaminated with mercury and cadmium compared to the limit values for natural soil. The soil from well ET-103 was moderately contaminated, but this contamination may have occurred naturally. The soil from wells ET-101 and ET-102 was not contaminated.

2. The amount of mercury and cadmium that is dissolved in groundwater decreases rapidly with distance from the site due to adsorptive bonding with soil. This distance is not more than 30 to 50 meters from the site. The concentrations of other contaminants do not decrease with distance, but fluctuate with distance. The Epres-tanya site does not contaminate its surroundings very heavily with these other materials.

3. Because the soil contamination by mercury and cadmium has spread only 30 to 50 meters in 15 to 20 years, the speed of its expansion is negligible and no remedial intervention is required.

4. The site does not jeopardize groundwater quality or the drinking water quality at Borsodszirák Waterworks I and I/A.

5. Buildings should not be constructed within 50 meters of the site. Artificial changes in the groundwater levels and in the local contaminant leaching rate should be avoided.

6. Remedial interventions around the site may increase the rate at which loosely-adsorbed toxic materials would leach into the groundwater and endanger the region of the site.

7. Borsodchem Rt. should buy the specified area around the site. It should plant shallow-rooted plants, rather than vegetables, in this area. These plants will reduce water infiltration to the waste at deeper levels.

8. Groundwater samples should be collected from wells ET-101 through ET-104 at least once in two years. The samples should be subjected to chemical analysis.

9. Methodical exploration for heavy metals and for the bottom level of the wastes in the site is not recommended due to the danger to the lower layers associated with the exploration. In any case, it is the contamination infiltrating the groundwater rather than the contamination remaining in the site that causes the real danger to the environment. Therefore, samples should be taken from the area surrounding the site rather than from the site itself.

10. The intervention schedule that was specified by É-KÖVIZIG would have been met if the 1992 TUB recommendations had been accepted.

11. The groundwater flow directions given in the 1987 KEVITERV report are still acceptable. They were used in the 1992 TUB report. Although the groundwater flow direction in the very close vicinity of the site is fluctuating, this fluctuation does not influence the effect of the site on Waterworks I and I/A.

12. The locations of the monitoring wells take into account the flow from the site to the waterworks. A larger number of monitoring wells are needed because they would create a more reliable monitoring network. Five additional monitoring wells should be established at the site.

13. Firm conclusions cannot be drawn from the analysis of the single groundwater sample collected by KÚTFÖ in 1992. However, the 1992 TUB report also used data from the 1987 KEVITERV report and data collected by ÉRV. Additionally, the 1993 TUB report presents new data for the site collected by Borsodchem in an appendix. In these data, the mercury, cadmium and arsenic concentrations are below the instrument's detection limit. A single mercury concentration is 1.6 times the limit value. However, one cannot conclude that the groundwater for this sample originated at the site because the other 11 values are below the limit value.

14. It is necessary to extend the groundwater quality analyses to non-heavy metal components, which have been found to exceed Hungarian Standard No. MSZ 450 (i.e., drinking water criteria) at the site. It is mandatory to make a complex investigation of the pollution sources in the whole region that have an effect on the waterworks.

15. The TUB report agrees with the intention of The Regional Environmental Inspectorate of Northern Hungary (ÉKF) to improve safety and suggests a simple, cost-effective solution to prevent the leakage of toxic materials from the site. The spraying of lime milk and calcium hydroxide on the surface of the site twice a year promotes the precipitation of certain heavy metals and ions in the waste.

5.3.2 Analysis of Soil and Waste Measurements. Table 6 summarizes the soil and waste measurements that have been made at the Epres-tanya landfill. The individual soil and waste measurements are listed in Appendix D. These data came from two sources, the 1992 KÚTFÖ report and the 1990 É-KÖVIZIG report. Both reports presented data specific to the metals concentrations in the soil. The following appraisal discusses how well the quantity and spatial distribution of wastes at the site have been characterized by these two reports. It also makes recommendations about additional work that is needed to characterize the waste composition.

The 1992 KÚTFÖ soil measurement data were obtained from two waste examination borings (ET-F1 and ET-F2) within the boundary of the site and from the four monitoring well borings (ET-101 through ET-104) outside of the boundary of the site. The borings extended to a depth of approximately 10 meters, except for well ET-103, which extended to a depth of

approximately 40 meters. Eight to ten samples were obtained from multiple depths in each borehole and were sent to the Borsodchem Rt. laboratory for analysis. The data given in Table 6 are the mean concentrations for the samples between 0 and approximately 10 meters depth. These data are illustrated in Figure 42.

The 1990 É-KÖVIZIG waste measurement data were obtained from five different excavations at the site. Samples were taken in soil-waste layers that were found from 20 to 30 centimeters below the surface and that were between 2 and 2.5 meters thick. Several samples were taken from each excavation. For easier identification, the aim was to take samples from different layers of waste that could be easily distinguished by color and condition. In this way, 17 samples were taken. These samples were not random, but rather represent various "hot spots" within the waste layers. A visual survey of the excavations showed that a mixture of industrial-production wastes (e.g., granular polyvinyl chloride and other, visually unrecognizable wastes) and wastes from other activities (e.g., construction debris or paint) had been dumped there. The data given in Table 6 are the mean, minimum and maximum concentrations for the 17 samples collected at the site by É-KÖVIZIG.

The KÚTFÖ soil measurements data for the ET-101 through ET-104 samples are uniform to a large degree. The only unusual values are for mercury in the ET-104 samples and for cadmium in the ET-103 samples. A maximum mercury concentration of approximately 10 mg/kg was found at a depth of 2.6 meters in the ET-104 samples. The mean mercury concentrations in the other three samples were less than or equal to 0.06 mg/kg. Cadmium concentrations ranged between 3.6 and 6.1 mg/kg at depths from 0.1 to 1.9 meters in the ET-103 samples. The mean cadmium concentrations in the other three samples were less than or equal to 0.6 mg/kg.

The KÚTFÖ soil measurements data indicate that the mean mercury, copper, chromium, nickel and lead concentrations for the ET-F2 samples are within the range of the mean concentrations for the ET-101 through ET-104 samples. In other words, the ET-F2 samples taken from inside the boundary of the site are not very different from the four sets of samples taken from outside the boundary of the site. The ET-F2 samples may represent the soil in the site, rather than the wastes in the site. Borsodchem Rt. did not analyze the ET-F2 samples for arsenic and cadmium as had been done for the ET-101 through ET-104 samples.

Although the KÚTFÖ report gives only the mercury concentrations for the ET-F1 samples, some of these values (e.g., 44 mg/kg at 0.5 to 1.0 meters depth) are much greater than

the mercury concentrations for the other five sets of samples. The mean mercury concentration (i.e., 8.5 mg/kg) is approximately five times greater than the mean concentration for the next-highest set of samples. It would appear that the ET-F1 samples were collected from the wastes in the site rather than from the soil in the site.

These conclusions are supported by KÚTFÖ's description of the ET-F1 and ET-F2 borings. A description of the geological layers that KÚTFÖ observed in the borings is given in Appendix D. In the ET-F1 boring, a soil and waste mixture was observed between 0.5 and 6 meters depth. The percentage of wastes in the ET-F1 samples in this depth range varied between 3 and 46 percent. In contrast, the description of the ET-F2 samples does not mention any wastes. In addition, the drilling records for the ET-101 through ET-104 borings do not mention any waste material in the samples.

It would seem that only a limited amount of information is given in the KÚTFÖ report about the waste composition in the site, although the report gives more information about the soil composition in and around the site. It is important to distinguish what is known about the waste in the site from what is known about the soil in the site.

In 1979, the Scientific Branch of the Greater London Council (GLC) suggested guidelines for soil contamination to be used during site assessments in London, England (Fitchko, 1989). These guidelines establish soil concentration ranges for "uncontaminated," "slight contamination," "contaminated," "heavy contamination," and "unusually heavy contamination," which is any level above the "heavy" range. These guidelines are given in Table 6.

The KÚTFÖ soil measurements data can be compared to the GLC guidelines to assess the extent of soil contamination in and around the Epres-tanya landfill. In general, most of the data fall in the "uncontaminated" range. The mean mercury concentration for the ET-F1 sample is in the "contaminated" range and the maximum value for this sample (44 mg/kg) is in the "heavy contamination" range. The mean mercury concentration for the ET-104 sample is in the "slight contamination" range and the maximum value for this sample (10.4 mg/kg) is at the lower edge of the "heavy contamination" range. Finally, the mean cadmium concentration for sample ET-103 sample is in the "slight contamination" range and the maximum value for this sample (6.1 mg/kg) is in the "contaminated" range.

If the KÚTFÖ soil measurement data were the only data available, one might conclude that there was some slight to heavy mercury contamination inside and outside the boundaries of

the site and that there was some slight to moderate cadmium contamination outside the site. However, the waste measurements data in the É-KÖVIZIG report present a very different picture of the Epres-tanya landfill. Individual É-KÖVIZIG waste measurement data are given in Appendix D. The extent of the contamination for the mean and maximum concentrations of the 17 É-KÖVIZIG samples are shown below:

Chemical Element	Mean Value	Maximum Value
Arsenic (As)	Contaminated	Unusually Heavy
Cadmium (Cd)	Heavy Contaminated	Unusually Heavy
Mercury (Hg)	Unusually Heavy	Unusually Heavy
Lead (Pb)	Unusually Heavy	Unusually Heavy
Zinc (Zn)	Uncontaminated	Slight Contamination

The É-KÖVIZIG waste measurements suggest that the Epres-tanya landfill may be significantly contaminated by arsenic, cadmium, lead and mercury. However, the É-KÖVIZIG samples are from wastes, rather than soil. These samples were not selected randomly and, therefore, the mean values are not representative of the site in a statistical sense. Yet, these "hot spot" samples give a warning that there may be substantial amounts of metallic contaminants at the Epres-tanya landfill. A methodical exploration of the site would be required to obtain a realistic estimate of the amount of the contamination and the spatial distribution of the contamination within the site. Such an estimate is needed for a realistic assessment of hazards at the landfill.

If the responsible authorities decide that a methodical exploration of the site is necessary, then a larger number of waste exploration borings must be made within the boundaries of the site. These bores should be drilled for the purpose of characterizing the amount and spatial distribution of the wastes in the site, rather than for characterizing the soil contamination in the site. KÚTFÖ appears to have followed good professional techniques in drilling the borings and then sealing them after the soil samples were removed. Additional borings made using the same techniques should not endanger the aquifer which underlies the site.

These additional waste examination borings could also be used to determine the non-metallic wastes in the site. Nonmetallic inorganic wastes (such as sodium and ammonium ions) and organic wastes (such as spent cleaning solvents) could be present in the site. If present, these wastes may have greater groundwater mobility, and may be a greater threat to Borsodszirák

Waterworks I and I/A than are the metallic wastes that are in the site. The magnitude of the threat cannot be realistically estimated until the amount, composition, and spatial distribution of the metallic and nonmetallic wastes are more accurately known.

5.3.3 Analysis of Groundwater Quality Measurements. In 1991, the Regional Environmental Protection and Water Authorities of Northern Hungary (É-KÖVIZIG) and the Regional Environmental Inspectorate of Northern Hungary (ÉKF) ordered the establishment of four groundwater monitoring wells in the vicinity of the Epres-tanya landfill. These wells are designed as ET-101 through ET-104. Tables 2 and 3 summarize 1992 mean groundwater quality concentrations for selected wells in the Borsodszirák wellhead protection area. These tables also list the limit values in Hungarian National Standard No. MSZ 450/1-1989 for these chemical ions and elements in drinking water. This analysis compares measurements in the four wells with measurements in other wells and with the limit values.

One possible way to assess the effect of the Epres-tanya landfill on groundwater is to look at the location of the maximum mean concentrations in the wellhead protection area. In general, many of the maximum mean concentrations are associated with the Epres-tanya landfill. Maximum ammonium (NH_4), chloride (Cl), and sodium (Na) concentrations are found in well ET-104. The maximum mean concentration for lead (Pb) is found in well ET-103. Finally, well ET-101 has the maximum mean concentration for chromium (Cr), copper (Cu), zinc (Zn), and nickel (Ni).

The many maximum mean concentrations associated with the Epres-tanya landfill could lead to the conclusion that the site has a major impact on groundwater quality in the area. However, it is possible that the concentrations may be greater in other places that have never been monitored. Also, the mean concentrations at the landfill may be the greatest in the area without posing an immediate health hazard.

Another way to assess the potential hazards associated with the landfill is to compare the mean concentrations to the MSZ 450 drinking water limit values. The fact that groundwater exceeds a drinking water limit value is not cause for alarm by itself, but it may become important if contaminated groundwater is captured by pumping at the waterworks. In the following analysis, the ratio of the 1992 mean concentration to the limit value is used as the assessment

tool. For example, if a ratio is determined to be 2.5, the concentration of the ion of interest is 2.5 times greater than the drinking water limit value.

5.3.3.1 Sodium. The ratio of mean concentration to limit value for well ET-104 is 2.2, but the ratios for the other Epres-tanya wells are 1.0 or less. All other monitoring wells in the wellhead protection area have ratios that are 1.0 or less. These data suggest that significant amounts of sodium are leaching into the groundwater at Epres-tanya. However, due to the placement and number of monitoring wells, it is not certain whether the source of the sodium is the landfill or the nearby cattle feedlot.

5.3.3.2 Chloride. The ratio is 8.4 for well ET-104, 2.5 for well ET-101, and 1.8 for well ET-102. Other monitoring wells (E-4, H-2, TSZ-1, and TSZ-2) also have ratios greater than 1.0. These data suggest that significant amounts of chloride are leaching into the groundwater at Epres-tanya as well as at other locations in the wellhead protection area.

5.3.3.3 Ammonium. The ratio is 108 for well ET-104, 17.6 for well ET-103, 2.4 for well ET-101, and 1.2 for well ET-102. Six other monitoring wells located in the wellhead protection area also have ratios that are greater than 1.0. These data suggest widespread ammonium contamination in the wellhead protection area. Epres-tanya appears to be a major ammonium source in the area. However, the data do not allow one to specify whether the landfill or the nearby cattle feedlot is the source of this contamination.

5.3.3.4 Nitrate. The ratio is less than 1.0 for all four Epres-tanya monitoring wells. There appears to be no direct source of nitrate pollution near Epres-tanya. However, ammonium ions will be converted into nitrate ions by the action of soil bacteria.

5.3.3.5 Sulfate. The ratio is greater than 1.0 for all four Epres-tanya monitoring wells and many other monitoring wells in the wellhead protection area. The data can be interpreted to indicate a broad band of sulfate contamination extending from the flyash pile to the Borsodszirák waterworks. The lack of monitoring wells at locations between the measured

sulfate "hot spots" in the area, however, does not allow one to determine that Epres-tanya is a significant source of sulfate contamination in groundwater.

5.3.3.6 Conductivity. The ratio for well ET-104 is 2.2 and is approximately 1.0 or less for the remaining monitoring wells at Epres-tanya. Four other wells in the wellhead protection area have ratios that are slightly above 1.0. Conductivity shows a strong linear correlation with total dissolved salts for data that were obtained for the Tiszai Erömü Rt. and Borsodchem Rt. monitoring wells. The high conductivity values in well ET-104 suggest that there is a significant source of total dissolved salts at Epres-tanya. These salts may be the sodium, chloride, and ammonium ions discussed above or other ions that are not being measured currently in the Epres-tanya monitoring wells. These data do not allow one to determine whether the source of the total dissolved salts is the landfill or the nearby cattle feedlot.

5.3.3.7 Lead. The lead ratios are less than 1.0 for all Epres-tanya monitoring wells and for all other monitoring wells in the wellhead protection area. In general, these data indicate that groundwater lead concentrations are not a cause for concern. However, closer inspection of these data suggests that groundwater lead concentrations at Epres-tanya are above background levels. The 1992 lead concentrations for the ÉRV E-series monitoring wells are used as indicators of background levels. For these wells, 83 percent of the samples had a reported lead concentration of 0 µg/L; 15 percent of the samples had concentrations between 5 and 10 µg/L; and only 1 percent of the samples had concentrations greater than 10 µg/L. In contrast, only 19 percent of the samples from the ET-series monitoring wells had a reported lead concentrations of less than 5 µg/L. Thirty percent of these samples had concentrations between 5 and 10 µg/L, and 51 percent of these samples had concentrations greater than 10 µg/L. These data lead to the conclusion that groundwater lead concentrations are greater in the ET-series monitoring wells than those in the E-series monitoring wells. It appears that lead is leaching from the Epres-tanya landfill and is being released into the environment, although the amount that is released does not appear to be significant in the existing monitoring wells.

5.3.3.8 Arsenic, Cadmium and Mercury. Little can be said about groundwater concentrations for these metals because the analytical detection limits for the Epres-tanya wells

were equal to or greater than the limit values. These data do not allow one to determine whether these metals are leaching from the landfill into the groundwater. Instrumentation with lower analytical detection limits is required to determine if groundwater concentrations for these three metals are above background levels at Epres-tanya.

5.3.3.9 Summary. In summary, these groundwater quality measurements data for the four monitoring wells at Epres-tanya suggest possible leaching of significant amounts of sodium, chloride, and ammonium ions from the vicinity of the Epres-tanya landfill. However, an animal feedlot located nearby could also be a source of these ions. Therefore, the source cannot be identified based on available data. The conductivity data which correlates well with the total dissolved salts data, also significantly exceeds the MSZ 20 drinking water limit value in well ET-104. The data do not show that significant problems exist for nitrate and sulfate ions or for metals. Lead concentrations are below the limit value, but are above background levels found in the E-series wells. These data suggest a release of lead from the landfill into groundwater, although the amount of the release does not appear to be significant. Analytical limitations do not permit a conclusive assessment of the arsenic, cadmium and mercury concentrations in the Epres-tanya monitoring wells. Additionally, the absence of an observed and significant problem does not mean that such a problem will not be discovered in the future or that a problem does not exist in some unmonitored areas around the landfill.

5.3.4 Analysis of Potential Groundwater Risks. Since it was determined that the landfill in the vicinity of Epres-tanya may be a potential source of heavy metals contamination, the migration of contaminants from the landfill to the Borsodszirák Waterworks was assessed. It was determined during the assessment of the hydrogeology of the wellhead protection area that 10 to 16 years would be required for groundwater to migrate from the Epres-tanya landfill to Waterworks I. The U.S. Environmental Protection Agency's Hazard Ranking System (HRS) and Multimedia Exposure Assessment Model (MULTIMED) were used during the appraisal in order to further evaluate the potential risks associated with the landfill.

5.3.4.1 Hazard Ranking System (HRS). A quantitative approach called the Hazard Ranking System (HRS) was used to estimate the magnitude of these hazards. A general description of HRS is given in Section 3.3.5.1.

The overall HRS score for a site is calculated from four subordinate pathway scores for exposure to contaminated soil, contaminated groundwater, contaminated surface water, and contaminated air. The following analysis calculates a HRS score using only the contaminated groundwater migration pathway calculations. These calculations are described in more detail in Appendix E.

Epres-tanya Landfill

Overall HRS site scores for the Epres-tanya landfill are calculated separately for arsenic, cadmium, lead and mercury. These four elements were identified as contaminants at the site based on the soil and waste measurements. Normally, the chemical compound producing the highest score would be used to determine the hazards associated with a particular site.

The groundwater exposure pathway score is calculated by multiplying together three values which quantify (a) the probability of waste release into the environment; (b) the hazardous waste characteristics; and (c) the human population and other potential targets that may be exposed to the waste.

The hazardous waste characteristics value is composed of three components evaluating the waste's quantity in the site, its toxicity, and its mobility in groundwater. HRS allows the waste quantity component to be calculated by one of four different methods. In this analysis, two methods, the measured area of the landfill and É-KOVIZIG's estimated volume of the waste, were used to calculate independent waste quantity components and independent overall HRS site scores. Normally, the volume method (if it is available) would be used instead of the area method. However, it is not clear how É-KOVIZIG obtained its volume estimate. Therefore, calculations using both methods are presented to emphasize the need to have the best possible estimate of the amount, composition, and spatial distribution of wastes in the Epres-tanya landfill.

A summary of the HRS calculations for the Epres-tanya landfill is given below:

Element	Area Method	Volume Method	Area Method
Arsenic	42.3	8.5	24.4
Cadmium	50.0	42.3	50.0
Lead	11.4	5.7	10.9
Mercury	8.5	4.2	8.1

The overall HRS site scores for arsenic and cadmium are above the threshold value using the area method. Both methods of waste quantity calculation produce an overall HRS site score above the threshold value for cadmium. The lead and mercury scores are below the threshold value for both methods. However, the two methods produce significantly different arsenic scores. This difference illustrates that it is important to have the best possible estimate of the wastes in this site.

This analysis leads to the conclusion that there is a significant potential hazard from arsenic and cadmium in the Epres-tanya site. Although lead and mercury were also found in the site, they are not a significant potential hazard because of their very low mobility in groundwater. This conclusion is based on the assumption that HRS is legally applicable to hazardous waste sites in Hungary, which is clearly not true. A legally-enforceable analysis of the hazards associated with the Epres-tanya site must await the development of a Hungarian hazard ranking system or risk assessment model.

This analysis did not consider any organic or nonmetallic inorganic contaminants in the Epres-tanya site. Such contaminants may be more mobile in groundwater than metals are and may be a greater hazard to public health and the environment. If further investigations of the Epres-tanya site discover these contaminants, the potential hazards associated with the site should be reassessed.

Landfill No. 18

The 1987 KEVITERV Report identified an abandoned sandpit (Source No. 18) as a potential contamination source in the Borsodzirák wellhead protection area. This sandpit has been back-filled and crops are now planted above it. It is located approximately 700 meters (or

half the distance of the Epres-tanya landfill) from Waterworks I. The survey team found evidence of municipal and industrial wastes on the surface above this sandpit and concluded that it had been used as an illegal landfill. No information exists concerning the wastes that are buried there.

The overall HRS site scores calculated for this landfill are shown below. They provide a very rough and tentative estimate of the hazards associated with the wastes that may be buried there:

	Arsenic	Cadmium	Lead	Mercury
Area Method:	24.4	50.0	10.9	8.1

It is assumed for the purpose of these calculations that the waste composition is the same as in the Epres-tanya landfill. The waste quantity component is calculated from the area of the landfill. These calculations should be compared to the threshold value of 28.5 that indicates sites having the most serious threat to public health and the environment.

For landfill No. 18, the overall HRS site score for cadmium is above the threshold value. The scores for arsenic, lead, and mercury are below the threshold value. The area of this landfill is approximately one-half that of the Epres-tanya landfill. However, this landfill is much closer to the Waterworks than is the Epres-tanya landfill. These two differences tend to balance each other. The HRS calculations lead to the conclusion that landfill No. 18 may be a significant potential hazard to Waterworks I if significant amounts of industrial wastes are buried there.

5.3.4.2 Multimedia Exposure Assessment Model. The U.S Environmental Protection Agency's (U.S. EPA) Multimedia Exposure Assessment Model (MULTIMED) is used to simulate the movement of contaminants in groundwater from a potential source to an identified downgradient receptor. MULTIMED simulates contaminant migration in groundwater for assessment of potential landfill sites in the United States. Currently, only the ground-water module is used because the surface water and air modules have not been sufficiently tested (Sharp-Hansen et al., 1990). MULTIMED can be used to determine a dilution attenuation factor (DAF) for use in determining the degree that the concentration of a contaminant is expected to decrease as it migrates from a source to a potential receptor.

MULTIMED was used in the LEM appraisal to characterize the potential for migration of contaminatnts from gravel pits located in the survey area. Specifically, simulations were performed in an attempt to approximate the migration rate of certain types of compounds from the Epres-tanya landfill, located in the survey area upgradient from Waterworks I.

Limitations

The MULTIMED model is limited to less complex scenarios as a result of certain assumptions required to obtain solutions to the analytical and semi-analytical equations used in the model. The model does not take into consideration the shape of the landfill, complex well pumping scenarios, multiple aquifers, fracture flow, or chemical reactions between contaminants. It is, however, useful in determining the relative risk associated with a specific waste disposal facility with regard to contaminant migration to potential receptors. As in all models, MULTIMED is limited in that certain variables must be estimated due to lack of site-specific parameters.

MULTIMED Variables Used

Three types of variables are required for the MULTIMED simulations: source-specific, chemical-specific, and aquifer-specific. In addition, the total duration of the simulations as well as the time steps must be specified.

The Epres-tanya landfill was given dimensions of 300 m by 120 m for the simulations. Since the landfill is not an engineered facility equipped with a low-permeability cover, the infiltration rate (in the landfill area) and the recharge rate (outside of the landfill area) were assumed to be identical and given values of 0.122 m/yr. This is based on a net recharge rate estimated to be 20 percent of the mean annual precipitation for the area (6.0 cm/yr). The source decay constant was unknown and was set at zero to provide conservative transport estimations.

Since specific chemicals and source concentrations were unknown, an initial concentration of 1.0 mg/L was specified in the model. Dividing 1.0 by the simulated concentration at the receptor point results in a DAF which can be used to estimate the contaminant concentration at a potential receptor if an actual initial concentration at the source is known. Conversely, the DAF can also be used to estimate the concentration at a potential source based on chemical analysis of groundwater collected from one or more receptors.

Aquifer-specific variables were relatively well-defined in the modeled area. An aquifer thickness of 10 m, a porosity of 0.25, a bulk density of 1.85 g/cc, and a hydraulic conductivity of 20100 m/yr were defined for the sand and gravel aquifer. A groundwater temperature of 18.5 °C was entered (based on a mean air temperature of 15.5 °C) and a pH of 6.8 was assigned for the aquifer. A hydraulic gradient of 0.0014 was entered into the model. The distance from the potential source to the receptor was entered as 1500 m. The receptor was assumed to be directly downgradient from the source. Longitudinal (α_L), transverse (α_T), and vertical (α_V) dispersivity values of 150 m, 50 m, and 0.84 m, respectively, were entered based on the following equation (Sharp-Hansen et. al, 1990):

$$\alpha_L = 0.1\ x_r;$$

$$\alpha_T = \alpha_L/3.0;$$

$$\alpha_V = 0.056\ \alpha_L;$$

where x_r = distance to the receptor well.

Two parameters critical for determination of contaminant migration rates in the model were arbitrarily selected for the simulations: the distribution coefficient for the chemical released (K_{oc}), and the fractional organic carbon content of the aquifer (f_{oc}). The combination of these parameters is especially important for determining the effects of sorption of organic compounds in the aquifer. Simulations were performed for three normalized distribution coefficients (chemicals) and three fractional organic carbon values for the aquifer (nine simulations total for each source pulse duration).

Normalized distribution coefficients of 30, 120, and 1500 ml/g were simulated. These numbers were selected in order to simulate a range of chemicals with varying mobility. Typically, chemicals with lower K_{oc} values are more mobile in the subsurface.

Actual measurements of the fractional organic carbon content of the aquifer were unavailable. Therefore, simulations were performed using values of 0.001, 0.0006, and 0.0002. To maintain conservative migration estimates, biodegradation, decay, and hydrolysis rates were not considered.

The model can be used for steady state simulations or transient simulations. For this survey, transient simulations modeling two source pulse durations were performed. A source pulse duration of 22 years was selected. Receptor concentrations were monitored for a 40-year

period, divided into twenty 2-year intervals. Nine simulations were performed using a source pulse deviation of 22 years.

A longer (50-year) pulse duration was also simulated. Receptor concentrations were monitored for a 100-year period, divided into twenty 5-year intervals. Nine simulations were performed using a source pulse duration of 50 years. These simulations provide more long-term estimations of contaminant concentrations at the receptor point assuming a longer contribution of contaminants to the groundwater system. A total of 18 MULTIMED simulations were performed for this appraisal.

Results

The receptor point concentrations computed during the simulations are presented in Figures 43 through 48. Each figure includes a table indicating the concentration at the simulated receptor at 2-year or 5-year intervals for three different K_{oc} values. The receptor point concentration is based on an initial source concentration of 1.0 mg/L. Concentration vs. time for the receptor is illustrated in a graph located below the table. In general, the results indicate that the concentration of organic matter in the aquifer and the distribution coefficient of the contaminant control of the rate of movement of contamination in the aquifer. For example, an organic with a high K_{oc} moves more rapidly through an aquifer with a low fractional organic carbon content.

Figures 43, 44, and 45 present the results of simulations with a 22-year pulse duration for f_{oc} values of 0.0002, 0.0006, and 0.001, respectively. Since the Epres-tanya site reportedly began receiving wastes in 1971, these simulations represent an immediate (1993) cessation (remediation) of the waste source, and indicate the concentration at the receptor point up to 40 years after waste was introduced into the groundwater system. The simulations indicate that concentrations of a chemical with a K_{oc} of 1500 would not peak at the receptor point even after 40 years. For chemicals with K_{oc} values of 30 and 120 mL/g, a peak concentration was attained after 26 to 30 years.

Figures 46, 47, and 48 present the results of simulations with a 50-year pulse duration for f_{oc} values of 0.0002, 0.0006, and 0.001, respectively. These figures indicate that chemicals with K_{oc} values of 30 and 120 mL/g essentially achieve steady-state concentrations of the receptor point until approximately 55 years when a rapid decrease in concentration is evident due to

termination of the source. A maximum concentration was observed for a chemical with a K_{oc} of 1500 only in an aquifer with an organic carbon content of 0.0002. Summaries of the model results and the variables used for each simulation are presented in Appendix F.

These results can be more specifically applied to the assessment of a waste site if more detailed site-specific information are available. For example, using Figure 44, if 1.0 mg/L of a chemical with a K_{oc} of approximately 120 (such as toluene) is released into an aquifer with a fractional organic carbon content of 0.0006 from a 36000 m^2 disposal pit in a 22-year pulse, it would reach its maximum concentration at a receptor located 1500 meters downgradient in 28 years at a concentration of 1.10E-2 mg/L. Dividing 1.0 by 1.10E-2 results in a DAF of 90.9. Therefore, if the concentration of toluene in groundwater detected at a waste disposal pit is 350 mg/L, the expected concentration at a receptor can be estimated by dividing 350 by the DAF, indicating that the concentration in the receptor well would be approximately 3.8 mg/L after 28 years.

In another example, using Figure 47, if a monitoring well located immediately adjacent to disposal pit indicated presence of 500 mg/L of a chemical with a K_{oc} of 1500 (e.g., 1,2,4-trichlorobenzene), and the aquifer was determined to have a fractional organic carbon content of 0.0006, the concentration of this compound in a receptor monitoring well located 1500 meters downgradient would be approximately 0.0372 mg/L after 30 years. This is determined by dividing 1.0 by 7.44E-5 to obtain a DAF, and multiplying the DAF by 500.

Use of the MULTIMED model can be extremely helpful in determining the potential impacts of a waste disposal pit on a potential receptor. It can also be used to determine appropriate engineering requirements for potential future waste management units, or to determine if hydrogeologic conditions are acceptable for construction of a waste management unit.

6.0 Conclusions

The Pleistocene aquifer beneath the Borsodzirák wellhead protection area is highly vulnerable to contamination due to its shallow depth, discontinuous cover, and high permeability. The hydrogeology of the basin is well understood; however, less is known about the groundwater chemistry of the basin. Groundwater contamination, as indicated by the exceedance of Hungarian groundwater limit value for specific indicator parameters, has been documented in the wellhead protection area. The specific sources of this contamination cannot be confirmed on the basis of the information available to date, although there are some indications of potential sources.

The existing monitoring network that was available for our review at the time of this appraisal provided valuable data indicating potential contamination from a variety of sources. However, the existing network is not sufficient to fully characterize the groundwater chemistry or the horizontal or vertical groundwater flow within the Borsodszirák wellhead protection area. While most monitoring wells have provided useful data, individual monitoring wells observed in the network do not appear to be adequate to yield reliable and representative information. For example, well casings were unlocked in many instances, biological activity was observed in some wells, and the well casing diameters are significantly larger than needed for appropriate groundwater monitoring.

There are some indications that groundwater sampling and analysis techniques are not consistent among the various investigators within the Borsodszirák wellhead protection area. With the exception of the sampling and analysis plan developed specifically for the composite organic sampling recently performed by the survey team, no unified groundwater monitoring plan is known to have been developed or adopted for use by the different investigators within the area. In addition, there is no central repository for hydrogeologic or groundwater chemistry data reported within the Borsodszirák wellhead protection area. A central data repository would be needed before an adequate evaluation of potential effects of land-based activities within the wellhead protection area could be made.

A number of analytical and manual interpolation methods were used to evaluate the available hydrogeologic and groundwater chemistry data available for the wellhead protection area. The results of the analytical methods are in agreement with each other and support the

conclusions drawn and recommendations made in this independent appraisal. Overall, the groundwater data evaluated for this survey appear to be reasonable and are considered to be consistent. The few data anomalies noted do not alter the conclusions.

The conclusions presented here are based on findings and results presented in the preceding sections of this report. Conclusions are presented separately for hydrogeology, groundwater chemistry, and risk potential.

6.1 Hydrogeology

1. The report prepared in 1987 by the Hydrology Planning Company of Eastern Hungary (KEVITERV) was determined to be a valid assessment of the local hydrogeology. It provided a useful framework on which many of the following hydrogeologic conclusions are based.

2. The wellhead protection area, as it is defined by KEVITERV, is partially based on KEVITERV's calculations of a stream parabola (capture zone), which was based primarily on the location and withdrawal rates of Waterworks I/A. The current withdrawal rates for Waterworks I/A are significantly lower than those of Waterworks I, and are presently lower than the rate used to calculate the stream parabola. Therefore, the stream parabola determined by KEVITERV is probably a conservative and adequate identification of vulnerable groundwater areas. We concur with the delineation of the wellhead protection area based on the information provided by KEVITERV.

3. The Pleistocene gravel aquifer is considered to be highly vulnerable to pollution sources due to the discontinuous nature of the overlying sediments. Potential threats identified in the wellhead protection area include the Epres-tanya landfill, other unregulated and uncharacterized landfills, agricultural activities, and a flyash deposit.

4. Groundwater travel times from potential contamination point sources identified in the wellhead protection area may be different from those previously calculated by KEVITERV, based on our calculations of groundwater flow velocity. Shorter streamlines and consequent travel times were estimated from some areas in the wellhead protection area (for example, Epres-tanya) to Borsodszirák Waterworks I.

5. Based on short-term hydrographs for a limited number of monitoring wells in the wellhead protection area, it does not appear that the gravel aquifer is being overdrafted by groundwater withdrawals.

6. Little is known about the groundwater flow in the underlying Miocene aquifer in the wellhead protection area. Extensive northeast-southwest faulting has been identified in these units. This faulting could conceivably serve as conduits for contaminant migration between the upper Pleistocene and lower Miocene aquifers.

6.2 Groundwater Chemistry

1. For groundwater collected from the Pleistocene gravel aquifer in 1992, the following five major ion constituents had mean concentrations above the drinking water limit values of the Hungarian National Standard MSZ 450/1-1989 in at least one of the 17 monitoring wells for which data were available:

- sodium (exceeded in 1 monitoring well),
- chloride (exceeded in 8 monitoring wells),
- ammonium (exceeded in 11 monitoring wells),
- nitrate (exceeded in 1 monitoring well), and
- sulfate (exceeded in 10 monitoring wells).

The conductivity limit value was also exceeded in 7 monitoring wells.

2. The maximum exceedences for sodium, chloride, and ammonium in groundwater collected from the Pleistocene gravel aquifer were observed in the ET-series monitoring wells that surround the Epres-tanya landfill. This suggests possible leaching of significant amounts of these constituents from the landfill or the nearby animal feedlot. The data do not show that significant leaching is occurring for lead, nitrate, or sulfate ions.

3. For sulfate, exceedences in groundwater collected from the Pleistocene gravel aquifer appear to be widespread, and have affected the areas around the Epres-tanya landfill, the flyash pile, and Waterworks I and I/A. For ammonium, exceedences in groundwater also appear

widespread, and were observed to affect the areas around the Epres-tanya landfill, the flyash pile, the manure pile, and Waterworks I/A. Finally, chloride exceedences also seem widespread, and have affected the areas around the Epres-tanya landfill, the manure pile, and Waterworks I.

4. The widespread occurrence of sulfate, ammonium, and chloride make determination of specific sources of these constituents difficult with the available data. This is especially apparent in the area of the Epres-tanya landfill. Constituents impacting groundwater in the area of the landfill could be originating from sources other than the landfill, for example, the adjacent animal feedlot.

5. In general, the highest mean concentrations of minor ion constituents were observed in the area of the Epres-tanya landfill.

6. The mean concentration value for ammonium exceeded the Hungarian limit value in one of the two groundwater monitoring wells screened in the Miocene aquifer. The exceedence was observed in well ET-103 in the Epres-tanya landfill area.

7. Groundwater data for the Miocene aquifer are limited and additional monitoring wells would be needed to fully characterize its chemistry.

8. Evaluation of water quality data from Waterworks I and I/A indicates that the chemistry varies between the two wellfields. The water derived from Waterworks I appears to show the effects of dilution by recharge from the Bódva River, and the inorganic constituents, are typically below the Hungarian drinking water limit values. Water samples collected from Waterworks I/A were consistently characterized by greater concentrations of the major ion constituents, with more frequent exceedences of the Hungarian limit values.

9. The concentrations of several major ions (sodium, chloride, nitrate) present in the composite water samples collected from Waterworks I/A are distributed as a gradient along the length of the wellfield. The highest concentrations were detected in the well located at the far southwest end of the wellfield, with concentrations decreasing to the southeast. This gradient is

most likely due to the fact that the area directly upgradient of wells characterized by lower concentrations is within the higher gradient capture zone of Waterworks I. The southernmost (higher concentrations wells) are located outside the primary capture zone for Waterworks I, and pump undiluted groundwater from potential source areas further upgradient.

10. Analysis of composite water samples collected by the survey team in June 1993, confirm ÉRV's previous analyses for metallic constituents. Drinking water quality at Waterworks I and I/A has not been adversely affected by metallic constituents. Small concentrations of organic constituents were measured in the composite water samples. The organic constituents included 1,1,2-trichloroethane, 1,1-dichloroethane, and toluene in water collected from Waterworks I, and toluene and pesticides in water collected from Waterworks I/A. The organic constituents were not measured in concentrations considered to present an imminent threat to the drinking water supply.

6.3 Potential for Risk

1. Little information has been documented regarding the type of waste disposed of within the abandoned gravel quarries in the Borsodszirák wellhead protection area. It appears that it may have been a common practice for multiple industries to dispose of waste in a single quarry. Heavy metals and unspecified industrial wastes are thought to have been disposed of in some quarries (e.g., Epres-tanya) during the period from 1971 through 1976. Domestic waste disposal was also thought to be common in the abandoned quarries.

2. The abandoned gravel quarries, containing waste deposited during the past 15 to 20 years, are believed to serve as direct sources for contaminants entering the Pleistocene gravel aquifer.

3. The potential risks represented by the Epres-tanya landfill are interpreted to be greater than those reported by the Technical University of Budapest.

4. Groundwater flow from the Epres-tanya landfill appears to be in a northeasterly direction. Various groundwater flow techniques have been used to estimate travel times from the Epres-tanya landfill to Waterworks I. Our estimates (10 to 16 years) are shorter than the value estimated by KEVITERV (49 years). If shorter estimates are correct, highly mobile constituents, if present in the waste at Epres-tanya, have already had sufficient time to migrate downgradient to Wellfield I. This is supported by semi-analytical transport modeling activities that assert that highly mobile organic compounds (i.e., compounds with low distribution coefficients), if present and released from the Epres-tanya site, are likely to have already reached Waterworks I.

5. There has not been a sufficiently extensive characterization of the hazardous wastes within the Epres-tanya landfill. There is no information about organic or nonmetallic inorganic wastes in the landfill. To a consequence, organic or nonmetallic inorganic contaminants were not considered in our analysis of the Epres-tanya landfill based on the U.S. Environmental Protection Agency Hazard Ranking System (HRS). Such contaminants may be more mobile in groundwater than metals and may present a greater risk to public health and the environment.

6. There are indications that high concentrations of metals are present within the wastes at Epres-tanya. There is a significant potential risk to groundwater from arsenic and cadmium in the Epres-tanya landfill, based on HRS scores of 42.3 and 50, respectively. Both scores are above the threshold value of 28.5, which indicates the most serious risks to the public health and the environment. Although lead and mercury were also found in the landfill, they are not a significant potential risk because of their very low mobility in groundwater.

7. The distance from landfill No. 18 to the Borsodszirák Waterworks I is approximately one-half the distance from the Epres-tanya landfill to Waterworks I. There is little information about the wastes in landfill No. 18. The suspected wastes in landfill No. 18 may be a significant potential risk to the waterworks if significant amounts of industrial wastes are buried there.

8. Other potential sources of groundwater pollution exist in the alluvial basin, including contaminants that may enter from the Bódva and Sajó rivers, local canals and drainage ditches

that are located near industrial facilities, industrial lagoons and ponds, mine waste piles, and animal waste storage areas. The full effect of these potential pollution sources (and the unknown wastes that they contain) on the groundwater quality within the Borsodszirák wellhead protection area cannot be fully assessed on the basis of the information that the survey team has collected to date.

6.4 Summary of Risk

Table 7 indicates potential point sources of groundwater contamination within the Borsodszirák wellhead protection area. The sources are ranked in order of relative risk to the wellfields. Comments and specific recommendations are also made in Table 7. The potential point sources in order of relative risk potential are:

1. The Epres-tanya landfill
2. Landfill No. 18
3. The animal feedlot
4. The three unlined lagoons on the west side of the fly ash pile
5. The fly ash pile
6. The manure storage pile.

Table 8 presents potential non-point sources of groundwater contamination within the Borsodszirák wellhead protection area. These non-point sources, in order of relative risk potential, are:

1. The Bodva River
2. Farming practices
3. The tributary to the Sajó River
4. The communities of Dusnokpustza and Borsodszirák
5. The coal mining area in the northwest portion of the wellhead protection area.

Although there are many potential point and non-point sources of contamination in the wellhead protection area, the drinking water that is obtained from the two waterworks is currently considered to be suitable for drinking. This status could change, however, if concentrated plumes of contamination enter the wellfield. This is why additional, carefully planned groundwater monitoring is needed. The boundary of the wellhead protection area appears to be appropriately defined; however, the boundary itself does not provide protection. It will always be important to monitor activities within the area that could lead to contamination.

The problems encountered in the Borsodsirák wellhead protection area are not unique, and technology is available to remediate serious groundwater contamination situations that may be encountered in future, site-specific investigations. There is also ample wellhead treatment technology that could be employed, if needed, to remediate the groundwater at the point of distribution in the waterworks. Frequent regular monitoring will ensure that any serious groundwater contamination problems that develop in the future are discovered promptly and can be corrected before adversely impacting the drinking water quality.

7.0 Short-Term and Long-Term Recommendations

The following recommendations are made by the appraisal team on the basis of available data and our independent evaluation of the hydrogeology and groundwater chemistry of the Borsodszirák wellhead protection area. The recommendations are divided into two categories: short-term activities (that should be considered within the time frame of a few months) and long-term activities (that could be implemented over several years).

7.1 Short-Term Activities

The short-term activities could probably be accomplished in a few months primarily by Hungarian organizations with some assistance by the survey team. The short-term activities will provide additional data, particularly on the organic compounds identified in the composite groundwater sample collected from Waterworks I, that will further aid in an understanding of the distribution of groundwater contamination. Specific activities to make existing monitoring wells more useful in a monitoring program are also suggested.

1. The Borsodszirák wellfields (Waterworks I and I/A) should be resampled for confirmation of the organic sample results obtained by the survey team in June 1993. The samples should be collected in accordance with the sampling and analysis plan developed for composite sampling (refer to July 1993 LEM report of composite sampling). It may be necessary to sample individual supply wells within the wellfield for organics and then develop a plan that will allow potentially contaminated wellwater to be diverted and/or treated. Existing laboratories in Hungary that can analyze organics in groundwater should be identified or such analytical capabilities should be developed.

2. Samples from the Bódva River should be collected at the intake to Waterworks I and analyzed for organic and inorganic compounds. These results should then be compared with available groundwater quality results from Waterworks I for evaluation of potential trends.

3. Samples should be collected from selected E-, ET-, V-, H-, TM-, TSZ-, and TT- series monitoring wells and analyzed for the organic constituents found in composite water from Waterworks I and I/A.

4. The TM- and TT-series wells should be thoroughly developed to remove drilling fluids and prepared for use as groundwater monitoring points. Analysis of groundwater from these wells for both inorganic and organic constituents could provide needed information concerning potential contamination from the flyash area.

5. Monitoring well V-2 should be examined for potential screen collapse or screen clogging. Consideration should then be given to remediating or replacing this monitoring well, if necessary.

6. It does not appear that groundwater level measurements have been obtained in the TSZ-series wells. Groundwater levels should be obtained from these wells at the time of sampling to aid in the interpretation of groundwater flow within the Borsodszirák wellhead protection area.

7. During the September workshop, the role of the LEM program in aiding Sajószentpéter should be decided. For example, should LEM assist in the development of a monitoring plan, or aid in preparing proposals to request funds for additional assessments, and/or technical review of future data collection efforts?

7.2 Long-Term Activities

The long-term activities recommended in this report may require implementation over the course of several years due to the high costs typically associated with groundwater monitoring and subsurface assessments. The workshop will need to address several fundamental issues, including the determination of the regional authority in charge of the groundwater monitoring assessments and related data within the wellhead protection area, the source(s) of potential funding, and the role of LEM in providing further assistance.

1. Consideration should be given to the establishment of a regional authority to coordinate the collection, evaluation, and decision making concerning the Borsodszirák wellhead protection area. Local and regional government authorities, industry, university researchers, and other interested parties should share information concerning groundwater quality in the Borsodszirák wellhead protection area.

2. Consideration should be given to evaluating land use activities that have the potential to result in groundwater contamination within the Borsodszirák wellhead protection area.

3. A regional repository should be considered for all groundwater monitoring data in the Borsodszirák wellhead protection area. A repository of groundwater data would enable the following activities:

a. Evaluation of monitoring results at least annually to monitor changes that may affect the groundwater quality at the Borsodszirák Waterworks.

b. Establishment of consistent monitoring protocols with respect to well construction, sampling procedures, chemical analysis methods (detection limits, analytical procedures, sample handling, quality assurance/quality control, etc.), and data reporting conventions.

c. Establishment of monitoring schedules to be followed by participating institutions.

d. Publication of an annual report of water quality and water supply issues in the Borsodszirák wellhead protection area.

4. The 1993 annual average groundwater chemistry should be evaluated for the E-, ET-, V-, H-, TM-, TSZ-, and TT- series wells to further document concentration trends of sodium, nitrate, ammonium, sulfate, chloride, conductivity, and heavy metals.

5. Additional sampling should be conducted to evaluate the presence of and risks posed by organic contaminants in composite water from Waterworks I and I/A.

6. The vertical variations of groundwater chemistry in the aquifers should be evaluated.

7. A comprehensive groundwater monitoring plan should be developed for the Borsodszirák wellhead protection area. The plan should establish and include the following elements:

a. Sample collection protocols for use by all data collectors.

b. Monitoring well construction and protection criteria for all wells in the Borsodszirák wellhead protection area monitoring network.

c. Frequency for collecting water level measurements and evaluating the flow regime in the aquifers.

d. Frequency for collecting of groundwater samples. The sampling frequency for each well should consider the proximity to potential contamination source(s), the history of contamination over a specified number of previous samplings (for example, over the last year of record), and the contribution of groundwater from the vicinity of the monitoring well to the Waterworks.

e. Constituents to be monitored in the Borsodszirák wellhead protection area and appropriate analytical techniques for quantification.

8. Additional monitoring wells should be considered within the Borsodszirák wellhead protection area and integrated into the monitoring plan. A monitoring authority should be designated for each well or group of wells. The following areas (shown on Figure 49) are suggested for placement of new monitoring wells:

Area A. Southeast of the Epres-tanya landfill, to further evaluate potential risks to Waterworks I/A.

Area B. Between Waterworks I and I/A, north of well E-2, to further evaluate water quality and potential risks to Waterworks I and I/A.

Area C. Southwest of TSZ - series wells, between the manure pile and Waterworks I, to further evaluate nitrate and ammonium concentrations in that area of the Pleistocene aquifer.

Area D. Northeast of well E-5 and north of Waterworks I, to evaluate groundwater quality north of the Waterworks I wellfield.

Area E. Around illegal landfill No. 18 (as described in the KEVITERV report), to evaluate potential groundwater contamination from this landfill.

Area F. East of Dusnokpuszta, to provide regional groundwater quality information for the center of the Borsodszirák wellhead protection area.

Area G. Between well TM-17 and Waterworks I/A, to provide regional groundwater quality information for the southern portion of the Borsodszirák wellhead protection area.

Area H. Additional wells around Epres-tanya, to further evaluate the extent of contamination seen in well ET-104. If significant contamination is noted in the Pleistocene gravel aquifer in this area, wells should also be installed to assess the vertical variations of groundwater chemistry. Extreme care should be taken in all drilling activities within the Borsodszirák wellhead protection area to ensure that contamination is not carried between the Pleistocene and the Miocene aquifers.

9. Additional soil and waste examination borings should be conducted within the boundaries of the Epres-tanya landfill and within illegal landfill No. 18. The soils, waste, and groundwater should be analyzed for metals, nonmetallic inorganics, and organic compounds.

10. The potential risks associated with the Epres-tanya landfill should be re-evaluated based on new information obtained from the additional borings and monitoring wells suggested above. Potential remediation alternatives should be evaluated.

11. A groundwater flow/solute transport model was developed at the Department of Hydrogeology and Engineering Geology at the University of Miskolc for an ammonia assessment for the Borsodchem Rt. This model should be evaluated to determine its applicability in assessing transport of other contaminants within the Borsodszirák wellhead protection area. A groundwater model would eventually be needed to evaluate effects of potential groundwater remediation alternatives.

12. The potential for overdraft of the Pleistocene gravel aquifer should be assessed including consideration of:

a. Installation of piezometers and/or monitoring wells in the upgradient areas of the Borsodszirák wellhead protection area to monitor water levels over the larger basin.

b. Evaluation of potential dewatering effects of the Waterworks.

c. Evaluation of future/proposed activities that might contribute to dewatering or impact water quality (e.g., coal mining of highland areas).

13. Consideration should be given to installing deep, nested piezometers in the areas southwest and northeast of Waterworks 1 to monitor potential vertical gradients, and recharge/discharge relationships between the Pleistocene gravel aquifer and the underlying faulted Miocene formations.

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Center for International Development

Local Environmental Management Project

Draft Comprehensive Report

Independent Appraisal of the Borsodszirák Wellhead Protection Area Located Near Sajószentpéter, Hungary

Volume II of II
Appendices

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Appendix A. Tables

Table 1. Comparison of Estimated Travel Times from Potential Point Sources to Waterworks I

Point-Source I.D.	Estimated Travel Time to Waterworks I (Years)	
	LEM Appraisal	KEVITERV
A (South of Múcsony)	112	142
B (Unidentified Area)*	41	54
C (Fly ash Deposit)	49	59
D (Megyei Waterworks)	305	86
E (Unidentified Area)*	51	60
F (SE End of Slurry Deposit)	69	70
G (Dúsnokpuszta)	18	32
H (Finke)	83	40
I (Unidentified Area)*	7	8
J (Borsodszirák)	6	14
K (Manure Stockpile)	3	5
L (Epres-tanya Landfill)	16	49
M (Abandoned Gravel Pit)	19	33.7
N (Borsodszirák)	7	87
P (Unidentified Area)*	4	63

* Unidentified areas are those locations for which travel times were calculated in the KEVITERV report but for which specific potential point sources were not identified.

Table 2. Major Ion Constituents in Groundwater (Annual Mean Concentrations, 1992)

Monitoring Well	Concentrations (mg/L)					Conductivity (µS/cm)
	Sodium	Chloride	Ammonium	Nitrate	Sulfate	
E-1	19	75	0.07	8.1	455	1381
E-2	14	54	0.21	0.6	393	996
E-3	21	34	0.07	10.6	117	595
E-4	72	132	0.04	60.8	369	1279
E-5	14	33	0.06	9.1	167	607
E-6	56	193	0.07	36.6	289	1395
TSZ-1	---	165	3.75	3.9	---	1362
TSZ-2	---	195	3.56	2.0	---	1681
TSZ-3	---	68	1.16	2.0	---	1206
H-1	98	75	5.67	8.5	527	1448
H-2	131	222	0.18	8.5	494	1798
H-3	42	96	0.51	1.5	231	851
V-1	111	55	3.74	17.1	761	1960
V-2	81	56	4.28	5.7	565	1672
V-3 *	19	26	0.03	6.5	40	306
ET-101	79	247	0.47	11.6	407	1660
ET-102	88	185	0.23	13.1	466	1667
ET-103 *	38	50	3.53	7.7	133	684
ET-104	440	840	21.58	9.0	472	3515
Limit Value [1]	200	100	0.2	40	300	1600

* Monitoring wells V-3 and ET-103 are screened in the Miocene aquifer.
[1] Based on MSZ 450/1-1989.

Table 3. Minor Ion Constituents in Groundwater (Annual Mean Concentrations, 1992)

Monitoring Well	Responsible Organization	Concentrations (µg/L)							
		Total Mercury	Cadmium	Arsenic	Chromium	Lead [1]	Copper	Zinc	Nickel
E-1	ERV	0.11	0	0	0	1.25 (0 - 10)	2.2	6.3	0
E-2	ERV	0.16	0	0	0	0.58 (0 - 7)	2.7	12.8	0
E-3	ERV	0.10	0	0	0	1.0 (0 - 6)	1.8	0.9	0
E-4	ERV	0.23	0	0	0	1.25 (0 - 5)	3.2	8.3	3.6
E-5	ERV	0.10	0	0	0.8	2.75 (0 - 33)	2.3	3.5	0
E-6	ERV	0.25	0	0	0	1.25 (0 - 5)	2.1	6.6	0
H-1	ERV	0.27	0	0	0	1.0 (0 - 7)	4.2	5.3	0
H-2	ERV	0.20	0	0	0	1.4 (0 - 6)	2.8	6.3	0
H-3	ERV	0.27	0	0	0	0.8 (0 - 8)	1.7	9.0	0
V-1	BHV	< 1	< 5	250 [2] (< DL)	5.0	15 (< 5 - 40)	6.9	< 50	7.8
V-2	BHV	< 1	< 5	180 [2] (< DL)	5.8	14.5 (< 5 - 27)	4.3	40.0	11.9
V-3	ERV	0.16	0	0	0	1.4 (0 - 6)	1.4	3.4	0
ET-101	BHV	< 1	< 5	< DL	26.6 (< 5 - 160)	18.5 (< 5 - 31)	10.7	166.7	24.3
ET-102	BHV	< 1	5 (< 5)	< DL	5.1	13.6 (< 5 - 42)	1.0	10.4	10
ET-103	BHV	< 1	< 5	< DL	1.5	25.4 (< 5 - 80)	4.9	34.3	4.0
ET-104	BHV	< 1	< 5	< DL	13.7	11.1 (< 5 - 16)	3.8	24.9	16.0
Limit Values		1.0	5.0	50	50	50	1000	1000	--- [3]

[1] The mean concentration is presented along with the range in concentration values for the 1992 monitoring results.
[2] The maximum concentration is presented. The detection limit varied due to possible interferences. Concentrations were less than the detection limit (< DL).
[3] A limit value for nickel in drinking water has not been established by Hungary. (The U.S. EPA uses a MCL of 1000 µg/L.)

Table 4. Monitoring Well Designation and Monitoring Purpose Borsodszirák Wellhead Protection Area

Designation	Source of Information	Monitoring Purpose
E-series	ÉRV	Regional water quality data. Provides information related to the waterworks and the wellhead protection area.
TSZ-series	ÉRV	Manure storage pile.
H-series	Tiszai Erömü Rt.	Perimeter of fly ash pile located at Berente.
V-series	Borsodchem Rt.	Interior of fly ash pile located at Berente.
ET-series	Borsodchem Rt.	Epres-tanya landfill.

Table 5. Calculated Ratios of Ammonium Concentration to the Limit Value*

Monitoring Well	Mean Concentration (mg/L)	Ratio
E-2	0.21	1.05
TSZ-1	3.75	18.75
TSZ-2	3.56	17.80
TSZ-3	1.16	5.80
H-1	5.67	28.35
H-3	0.51	2.55
V-1	3.74	18.70
V-2	4.28	21.40
ET-101	0.47	2.35
ET-102	0.23	1.15
ET-104	21.58	107.90

The limit value is 0.2 mg/L based on MSZ 450/1-1989.

Table 6. Summary of Soil and Waste Measurements at Epres-tanya Landfill and Greater London Council Guidelines for Contaminated Soils

SAMPLE NO. MINTA SZ.	MEASUREMENT MERET	As (mg/kg)	Cd (mg/kg)	Cr (mg/kg)	Cu (mg/kg)	Hg (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Zn (mg/kg)
ET-F1	MEAN(0 to 10m)	no data	no data	no data	no data	8.47	no data	no data	no data
ET-F2	MEAN(0 to 10m)	no data	no data	1.30	3.29	0.18	5.36	10.63	no data
ET-101	MEAN(0 to 10m)	0.93	0.57	1.51	8.49	0.05	5.75	6.05	no data
ET-102	MEAN(0 to 10m)	1.60	0.50	2.39	7.52	0.06	9.24	8.40	no data
ET-103	MEAN(0 to 10m)	0.73	1.93	1.96	7.24	0.06	8.95	11.79	no data
ET-104	MEAN(0 to 10m)	3.18	0.50	2.02	8.01	1.60	8.17	7.09	no data
EKOVIZIG	MEAN	70	26	no data	no data	71	no data	50148	125
EKOVIZIG	MINIMUM	0.73	0.50	no data	no data	0.05	no data	6.05	20
EKOVIZIG	MAXIMUM	800	270	no data	no data	360	no data	235000	410
GLC GUIDE.	UNCONTAMINATED	0 to 30	0 to 1	0 to 100	0 to 100	0 to 1	0 to 20	0 to 500	0 to 250
GLC GUIDE.	SLIGHT CONTAM.	30 to 50	1 to 3	100 to 200	100 to 200	1 to 3	20 to 50	500 to 1000	250 to 500
GLC GUIDE.	CONTAMINATED	50 to 100	3 to 10	200 to 500	200 to 500	3 to 10	50 to 200	1000 to 2000	500 to 2000
GLC GUIDE.	HEAVY CONTAM.	100 to 500	10 to 50	500 to 2500	500 to 2500	10 to 50	200 to 1000	2000 to 1 %	2000 to 1 %

Table 7. Potential Point Sources of Groundwater Contamination within the Borsodszirák Wellhead Protection Area (Ranked in Order of Decreasing Risk)

Potential Point Source Area Within Borsodzirák Wellhead Protection Area and Relative Ranking of Risk	Estimated Groundwater Travel Time to Waterworks I (Years; based on Figure 20)	Monitoring Well System (Number of Wells)	Exceedances Above Hungarian Groundwater Limit Values (based on mean 1992 data)	Comments Regarding Potential Risk to the Drinking Water Quality of the Wellfields, and Specific Recommendations
Epres-tanya landfill (Point 1 on Figure 20) **Relative Ranking of Risk:** No. 1	10 to 16	ET-series wells (4 wells). Well ET-103 monitors the Miocene aquifer the other three wells monitor the Pleistocene gravel aquifer.	Sodium (ET-104) Chloride (ET -101, 102, 104) Ammonium (all 4 ET-series wells) Sulfate (ET-101, 102, 104) Conductivity (ET-101, 102, 104)	**Comments:** The ET-series monitoring wells have some of the highest concentrations of minor ion constituents (chromium, lead, copper, mercury, zinc, and nickel) measured in the Borsodszirák wellhead protection area. There is no information about organic or nonmetallic wastes in the landfill. Arsenic and cadmium represent a significant potential risk to the groundwater resources. **Recommendations:** Additional monitoring wells should be installed downgradient of the landfill and sampled for inorganic and organic constituents. Additional soil and waste characterization borings should be conducted within the landfill. A remedial action plan should be developed. Crops should not be grown on the landfill and the area should be fenced off.
Illegal Landfill No. 18 (Figure 4) **Relative Ranking of Risk:** No. 2	8	None exist	Not known at present	**Comments:** Landfill is directly upgradient of Waterworks I; little is known about the disposal history; and no subsurface data has been obtained. The landfill was previously a gravel quarry which probably intersected the water table. There is evidence of industrial waste materials on the ground surface. **Recommendations:** A carefully directed subsurface investigation should be planned and conducted for this landfill including soil and waste characterization borings. Additional monitoring wells should be installed between this landfill and Waterworks I and sampled for inorganic and organic constituents. Crops should not be grown on the landfill.

Table 7. Potential Point Sources of Groundwater Contamination within the Borsodszirak Wellhead Protection Area (Ranked in Order of Decreasing Risk) cont.

Potential Point Source Area Within Borsodzirák Wellhead Protection Area and Relative Ranking of Risk	Estimated Groundwater Travel Time to Waterworks I (Years; based on Figure 20)	Monitoring Well System (Number of Wells)	Exceedances Above Hungarian Groundwater Limit Values (based on mean 1992 data)	Comments Regarding Potential Risk to the Drinking Water Quality of the Wellfields, and Specific Recommendations
Animal feedlot (Near Point L on Figure 20) **Relative Ranking of Risk:** No. 3	Estimated to be similar to that of Epres-tanya (10 to 16 years)	None specifically for this facility although the existing domestic supply well(s) could be used in a monitoring program.	Not known at present	**Comments:** No industrial wastes appear to be associated with this processing facility. There is a possibility that some of the major ion constituents observed in the adjacent Epres-tanya landfill monitoring wells (sulfate, ammonia, and/or chloride) could have originated from the animal feedlot. There is also the possibility that waste constituents from the Epres-tanya landfill could migrate to the active domestic well used to water the cattle. **Recommendations:** The domestic well at the animal feedlot should be sampled and analyzed for the same constituents as wells monitoring the Epres-tanya landfill.
Three currently unused and unlined lagoons on west side of fly ash pile (extreme northwest corner of the wellhead protection area) **Relative Ranking of Risk:** No. 4	Estimated to be similar to that of the fly ash disposal pile (approximately 50 years)	Two new monitoring wells (TT-4 and TT-11) installed in March 1993 appear to monitor these three lagoons.	Not known at present.	**Comments:** Groundwater chemistry data, other than initial purged samples for inorganic analysis, were not available from these two new monitoring wells at the time of this appraisal. Information obtained during LEM's survey suggests that these lagoons were excavated into the fly ash pile which had been previously excavated below the original ground surface. The original contents of the lagoons are apparently not known. Although the lagoons are the greatest distance from the waterworks, they could pose a significant risk to the quality of groundwater within the wellhead protection area if organic compounds were disposed in unlined lagoons. **Recommendations:** The new wells should be sampled for organic compounds.

Table 7. Potential Point Sources of Groundwater Contamination within the Borsodszirák Wellhead Protection Area (Ranked in Order of Decreasing Risk) cont.

Potential Point Source Area Within Borsodzirák Wellhead Protection Area and Relative Ranking of Risk	Estimated Groundwater Travel Time to Waterworks I (Years; based on Figure 20)	Monitoring Well System (Number of Wells)	Exceedances Above Hungarian Groundwater Limit Values (based on mean 1992 data)	Comments Regarding Potential Risk to the Drinking Water Quality of the Wellfields, and Specific Recommendations
Fly Ash Disposal Pile (Point C on Figure 20) **Relative Ranking of Risks:** No. 5	49	V-series wells (3) monitor the interior of the fly ash pile and the H-series wells (3) monitor the perimeter of the fly ash pile. A new series of monitoring wells monitors the eastern perimeter of the fly ash pile (TM-series wells) and several new wells monitor the interior of the fly ash pile (TT-series).	Sulfate (V-1, V-2, and H-1). Ammonium (V-1, V-2, H-1, and H-3) Conductivity (V-1 and V-2)	**Comments:** With the exception of some initial purged samples analyzed for inorganic constituents, groundwater chemistry data were not available from the new monitoring wells (TM- and TT-series wells) at the time of this appraisal. Monitoring wells V-1 and V-2 are in the center of the fly ash pile and have some high concentrations of minor ion constituents (arsenic, lead, chromium, copper, nickel, and zinc). Though not as high as the minor ion constituents detected in the wells that monitor the Epres-tanya landfill, it is apparent that the groundwater chemistry in the vicinity of the fly ash pile has being affected by the ongoing disposal operation. **Recommendations:** Continue sampling, analysis, and evaluation of existing and new monitoring wells.
Manure Storage Pile (Point K on Figure 20) **Relative Ranking of Risk:** No. 6	3	TSZ-series wells (3 wells)	Chloride (TSZ-1, TSZ-2) Ammonium (TSZ-1, TSZ-2, and TSZ-3) Conductivity (TSZ-2)	**Comments:** No industrial wastes appear to be associated with this storage facility. There is some potential for inorganic constituents (chloride, ammonia, and conductivity) to reach Waterworks I directly through the groundwater pathway or by discharge into the Bodva River which is used to artificially recharge the wellfield through infiltration ponds. **Recommendations:** Continue groundwater monitoring of TSZ-series wells. Additional monitoring wells should be considered between the manure pile and Waterworks I. These wells should be sampled for inorganic constituents.

Table 8. Potential Non-Point Sources of Groundwater Contamination within the Borsodszirák Wellhead Protection Area (Ranked in Order of Decreasing Risk)

Potential Non-Point Source Area Within Borsodzirák Wellhead Protection Area and Relative Ranking of Risk	Types of Contamination that Could Contribute to Wellfields	Wellfield Likely to be Impacted by Non-Point Source	Comments Regarding Risk Potential	Recommendations
Bodva River **Relative Ranking of Risk:** No. 1	Inorganic and/or organic contamination from spills and/or contaminated groundwater discharge upstream of Waterworks I. There was also an unconfirmed report of a phenol spill in the Bodva River.	Waterworks I. The Bodva River is used as a direct source of artificial recharge to the wellfield through the setting pond and the infiltration sieves.	The Bodva River contributes approximately 80 percent of the water pumped by Waterworks I. If contaminants enter the river they have a direct path to the aquifer and therefore the drinking water supply. On the other hand, the apparent effects of dilution on the groundwater quality have been observed by the appraisal team relative to Waterworks I. If the river remains uncontaminated this recharge could actually enhance the quality of the groundwater.	Routinely monitor the Bodva River for inorganic constituents and organic compounds at the intake to the wellfield. Evaluate other potential sources of contamination upstream of the intake to Waterworks I. Evaluate specific protection measures and contingency plans in the event of a major upstream spill.
Farming practices (application of pesticides, fertilizers, animal feed lots, etc.) **Relative Ranking of Risk:** No. 2	Pesticides, nitrate, and ammonium. Application of the pesticide "Betanel-Tandem" was observed by the survey team in May 1993. It was reported that the following have been used by the cooperative or individuals: Norton, Acenit, Fusilades, Satox, Latdok, Sabet, Olitref, and Fendona.	Primarily Waterworks I/A. Data from composite sample indicates some contamination already exists in the groundwater in this area. In addition, there are also significant agricultural areas adjacent to Waterworks I to the southwest.	Pesticides have already been detected in Waterworks I/A. The observed application of pesticides appears to be in the immediate vicinity of the wellhead (within 60 meters). Based on our observation of the thin protective layer overlying the aquifer in the nearby abandoned gravel quarry to the south of Waterworks I/A, there is very little separation of the aquifer from the overlying farming practices.	Resample Waterworks I/A and nearby monitoring wells for pesticides. Consider the need for other monitoring wells. Review farming practices in the wellhead protection area. Consider set-backs of pesticide applications near wellheads.

Table 8. Potential Point Sources of Groundwater Contamination within the Borsodszirak Wellhead Protection Area (Ranked in Order of Decreasing Risk) cont.

Potential Non-Point Source Area Within Borsodzirák Wellhead Protection Area and Relative Ranking of Risk	Types of Contamination that Could Contribute to Wellfields	Wellfield Likely to be Impacted by Non-Point Source	Comments Regarding Risk Potential	Recommendations
Tributary to the Sajó River (Szuha patak) **Relative Ranking of Risk:** No. 3	This tributary originates at the fly ash disposal pile. It appears, on the basis of available water level data, that the tributary may be influent (recharge the aquifer). The fly ash operation could contribute inorganic constituents to the groundwater via this tributary.	Groundwater from this area of the wellhead protection area could migrate toward Waterworks I or I/A.	There are a number of recently installed monitoring wells (TM-series) that appear to monitor the groundwater in the immediate vicinity of this tributary. Monitoring data from these wells were not available at the time of this appraisal.	The groundwater chemistry data obtained from the new TM-series wells should be evaluated. Based on these results it may be necessary to consider other monitoring well locations in this portion of the wellhead protection area. The water quality of the tributary should also be monitored periodically.
Communities within the Wellhead Protection Area (e.g., Dusnokpustza and Borsodszirák) **Relative Ranking of Risk:** No. 4	There was a report of elevated mercury in a well in Dusnokpustza. There was an unconfirmed report of a phenol spill in Borsodszirák. Domestic activities could contribute localized sources of contamination to the aquifer through open or improperly abandoned wells. Spills of petroleum products would also be more likely to occur within these more populated areas.	Both communities appear to be upgradient of Waterworks I.	There is no confirmed risk that has been documented in these communities at this time. The potential risk of contaminating the aquifer in these communities, relative to known point sources, is thought to be minor.	Review activities within these communities that could lead to potential groundwater contamination (petroleum storage tanks, commercial or industrial operations, type of sewage treatment systems in use, etc.)

Table 8. Potential Point Sources of Groundwater Contamination within the Borsodszirak Wellhead Protection Area (Ranked in Order of Decreasing Risk) cont.

Potential Non-Point Source Area Within Borsodzirák Wellhead Protection Area and Relative Ranking of Risk	Types of Contamination that Could Contribute to Wellfields	Wellfield Likely to be Impacted by Non-Point Source	Comments Regarding Risk Potential	Recommendations
Coal Mining Area in Northwest Portion of Wellhead Protection Area **Relative Ranking of Risk:** No. 5	Potential inorganic contamination associated with lignite coal mining (e.g., trace metals, high conductivity). There was an unconfirmed report that some coal mining operations used underground shafts in the past to dispose of drummed industrial waste. Operations could pose a potential threat to the Miocene aquifer.	The mining operations appear to be upgradient of Waterworks I and could affect water quality of the Miocene aquifer.	There is no confirmed risk that has been documented related to the mining operations at this time. The potential risk of contaminating the aquifer from this remote operation is considered to be minor.	Review mining operations and past waste disposal practices. Assess impacts of potential future mining endeavors planned within the wellhead protection area.

Appendix B. Figures

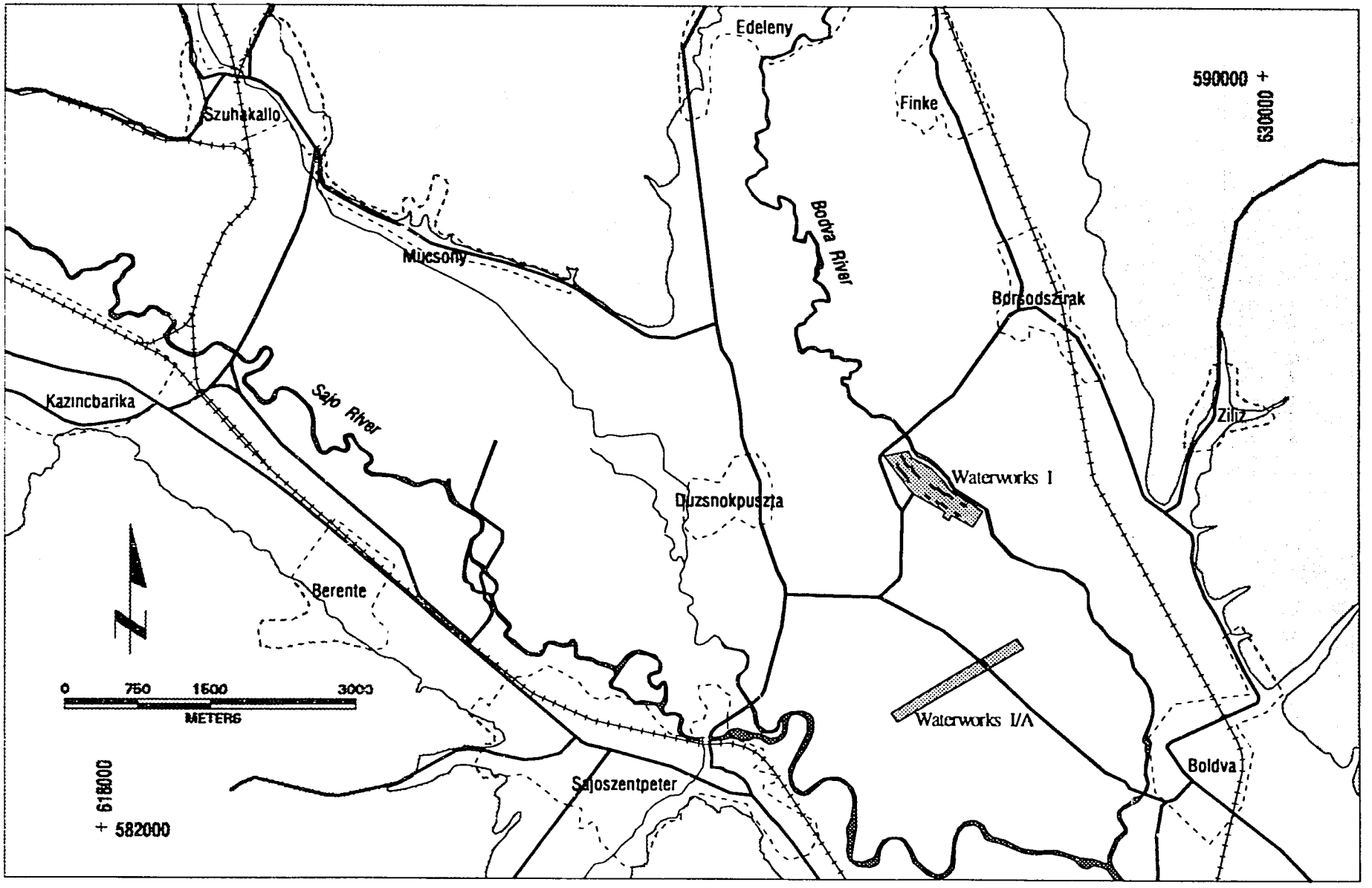


Figure 1. Study Area Indicating Location of Borsodszirak Wellfields

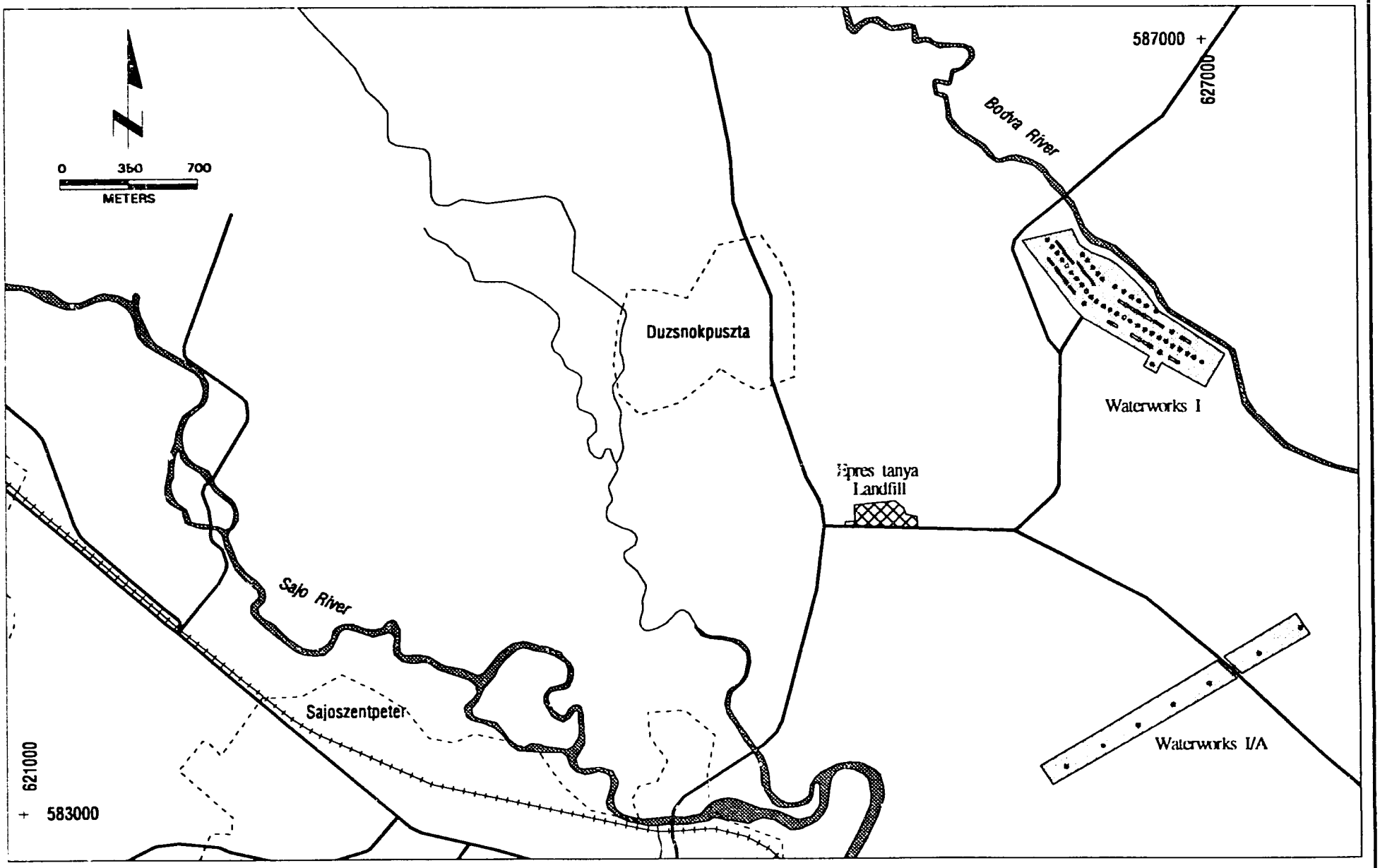


Figure 2. Location of Epres tanya Landfill

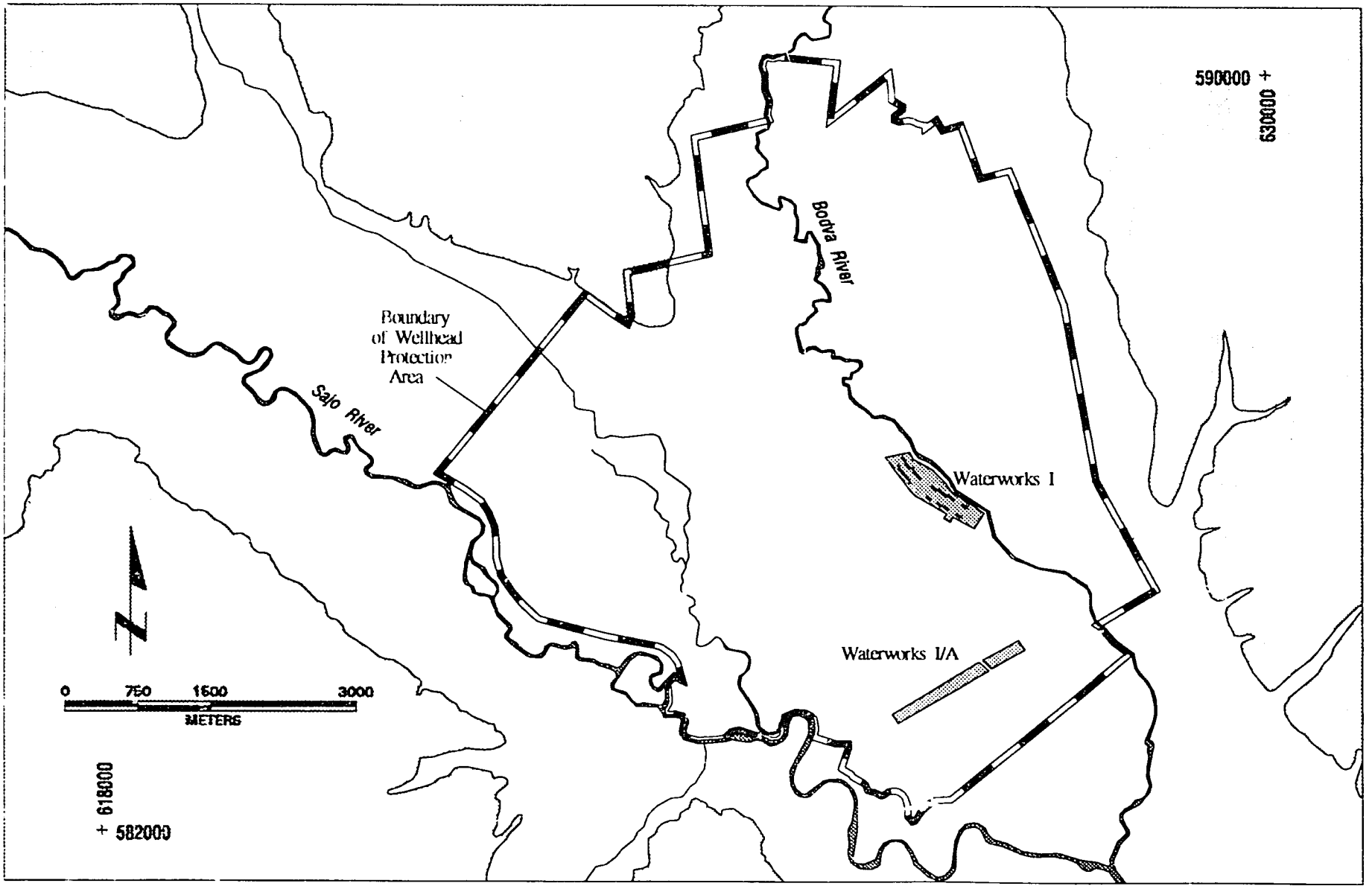


Figure 3. Location of Borsodszirak Wellhead Protection Area

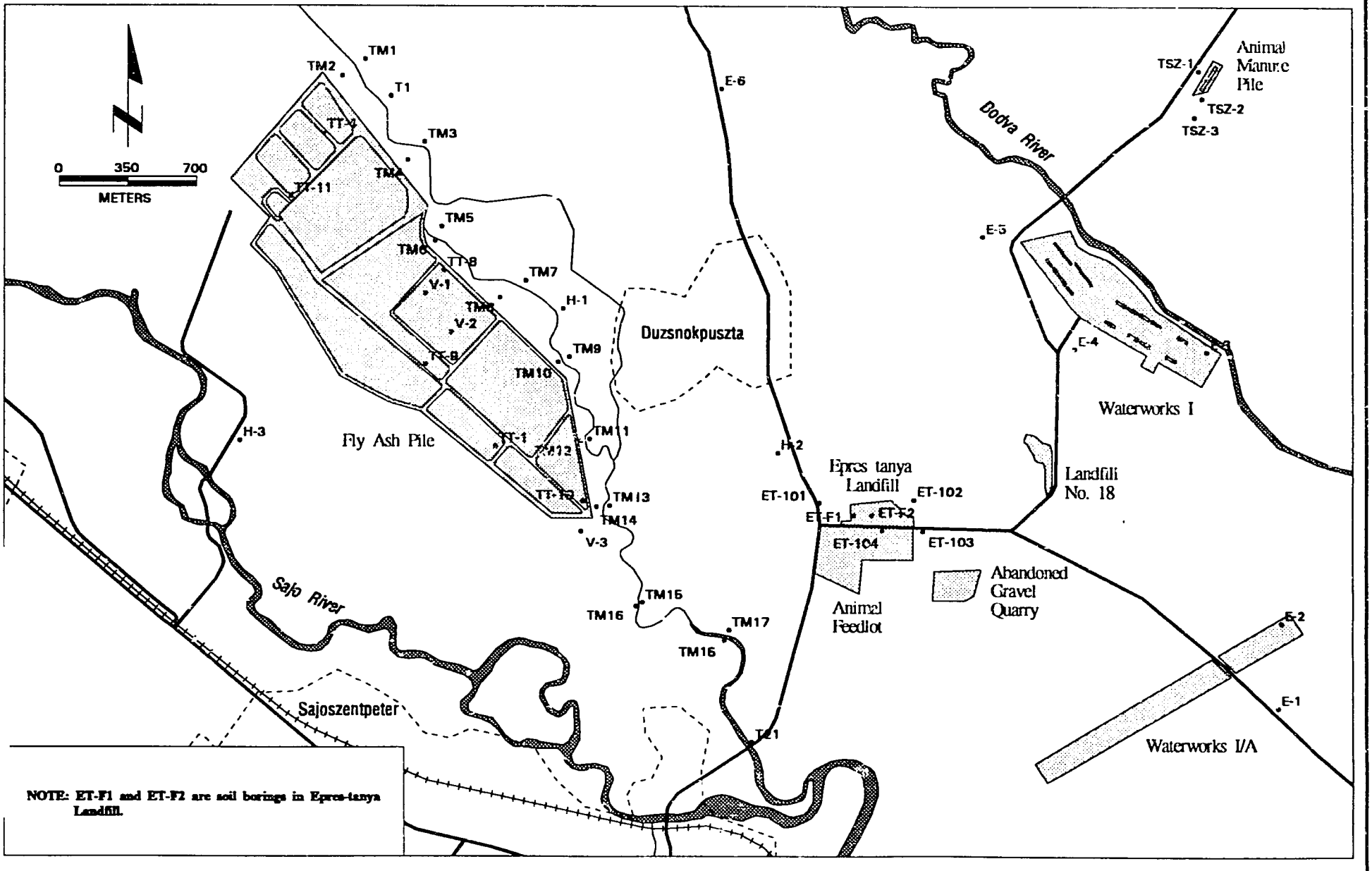


Figure 4. Location of Monitoring Wells and Known Disposal Areas in Vicinity of Waterworks

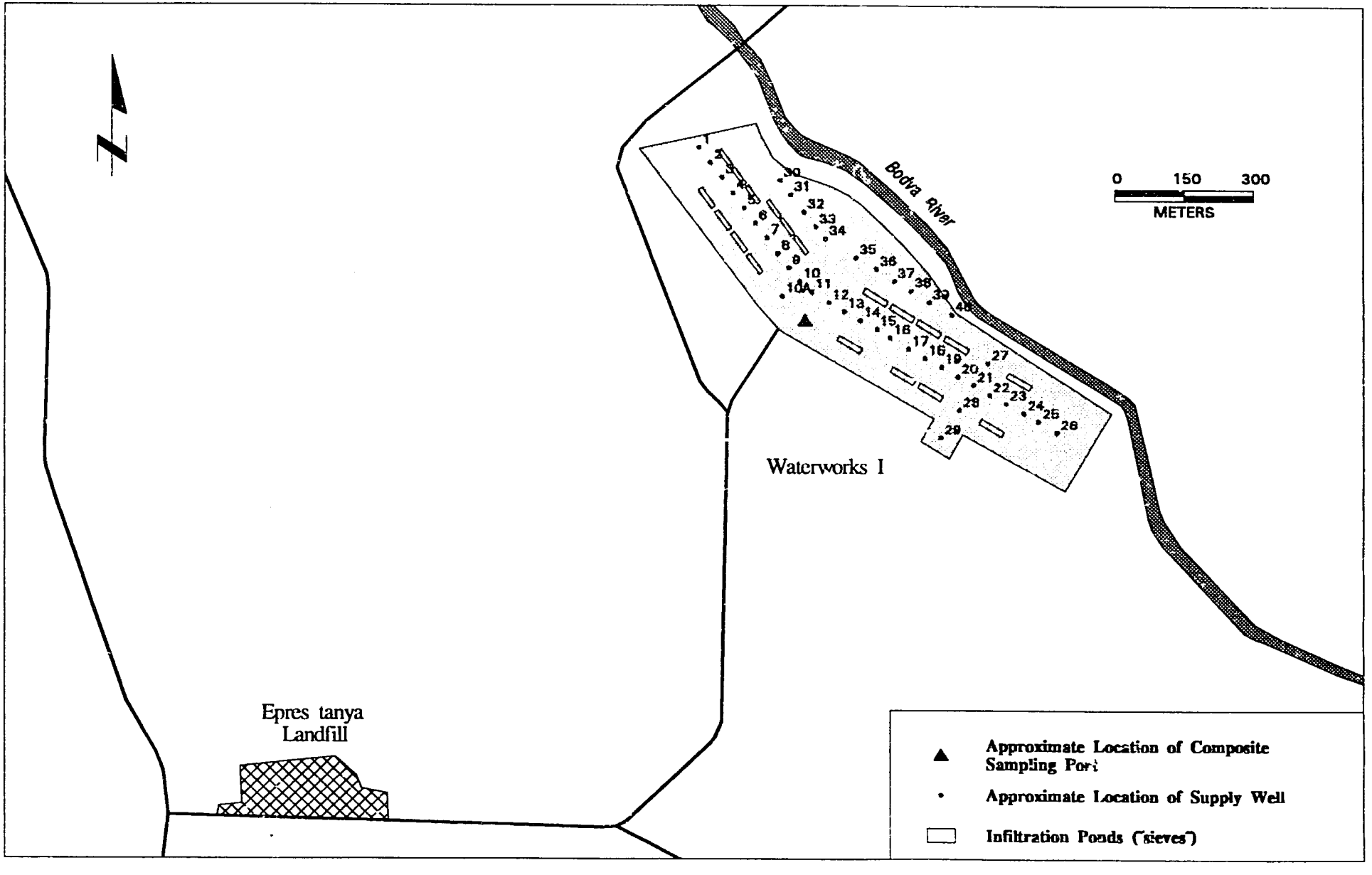


Figure 5. Layout of Supply Wells at Waterworks I

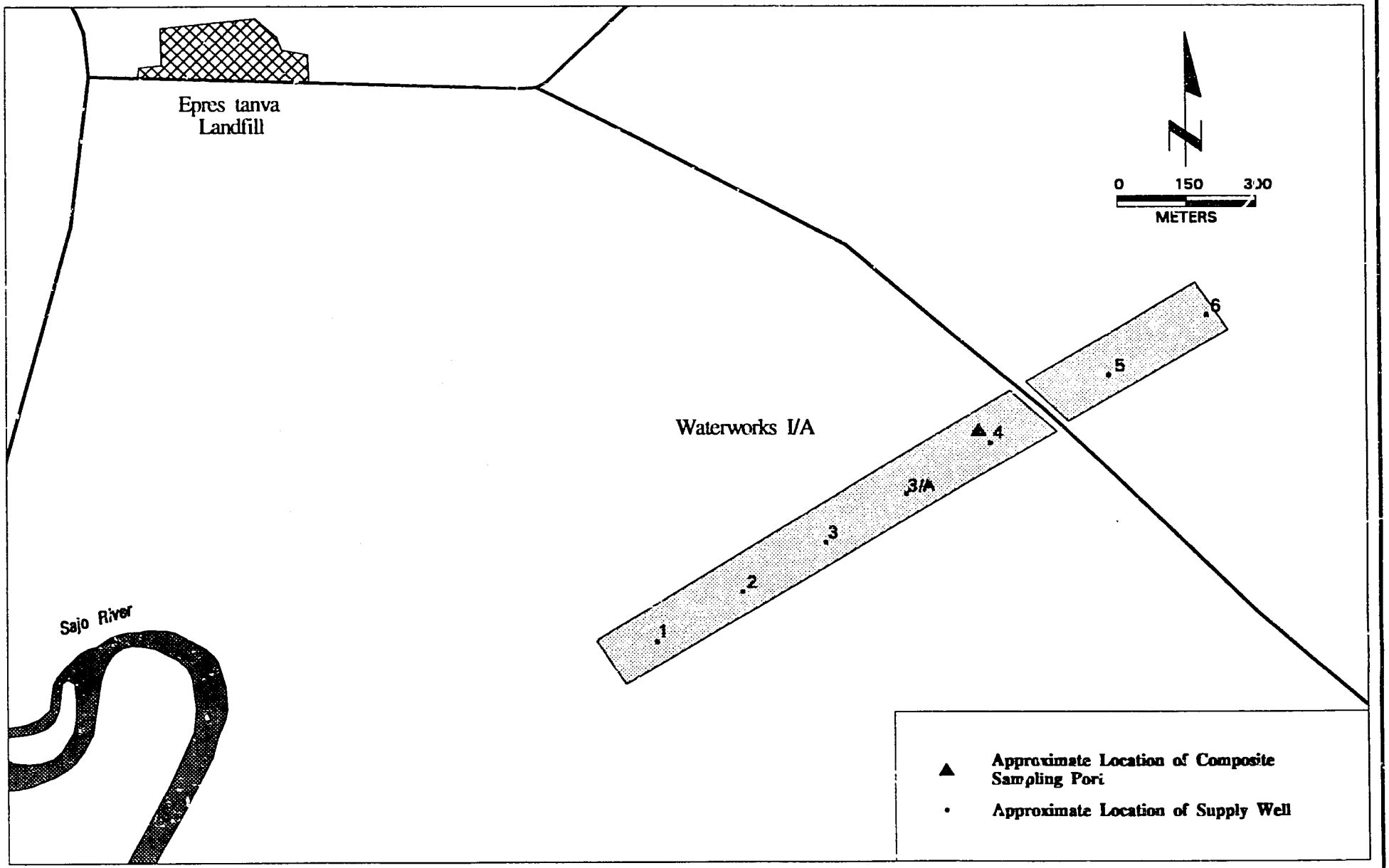
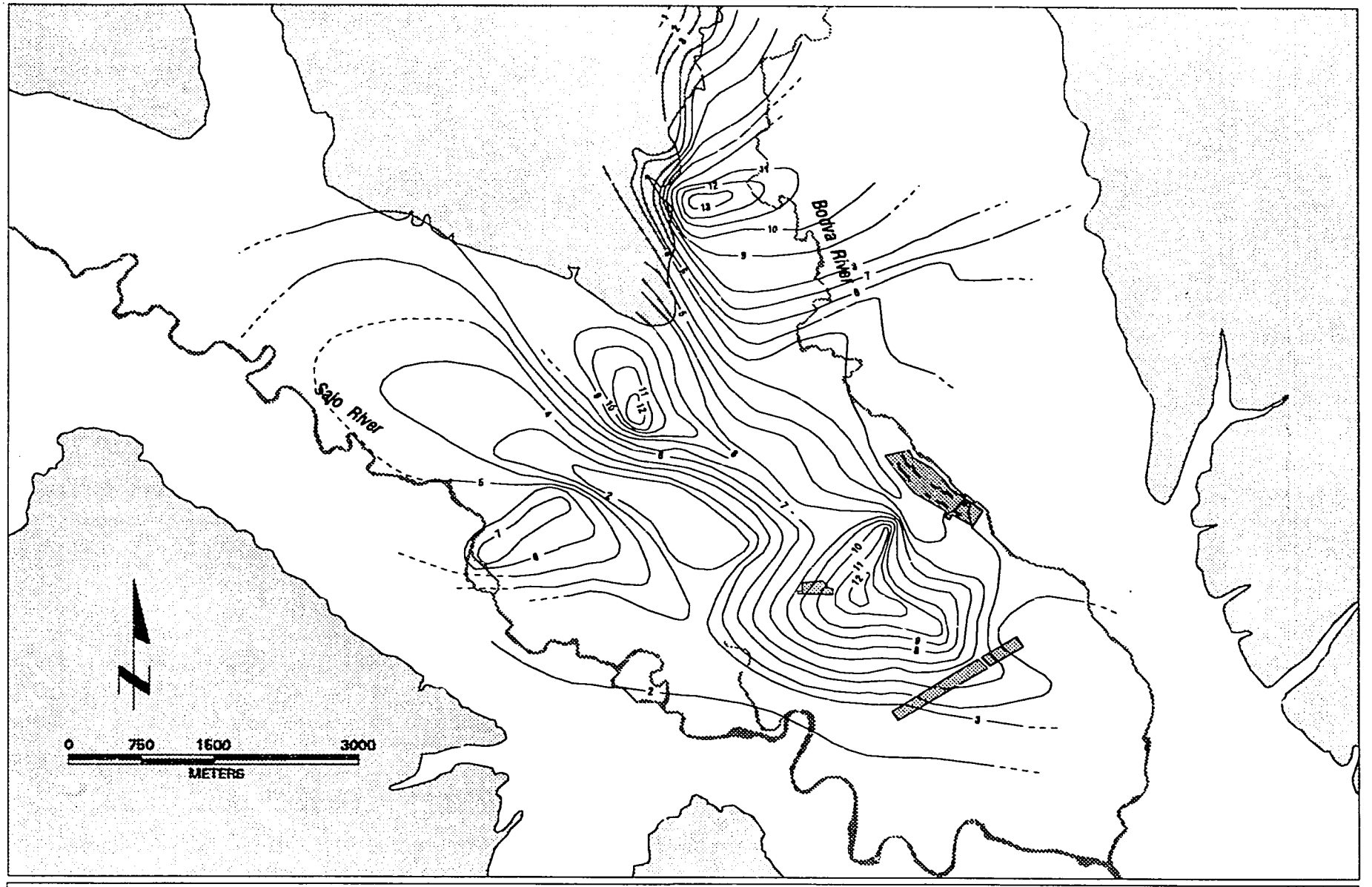


Figure 6. Layout of Supply Wells at Waterworks I/A

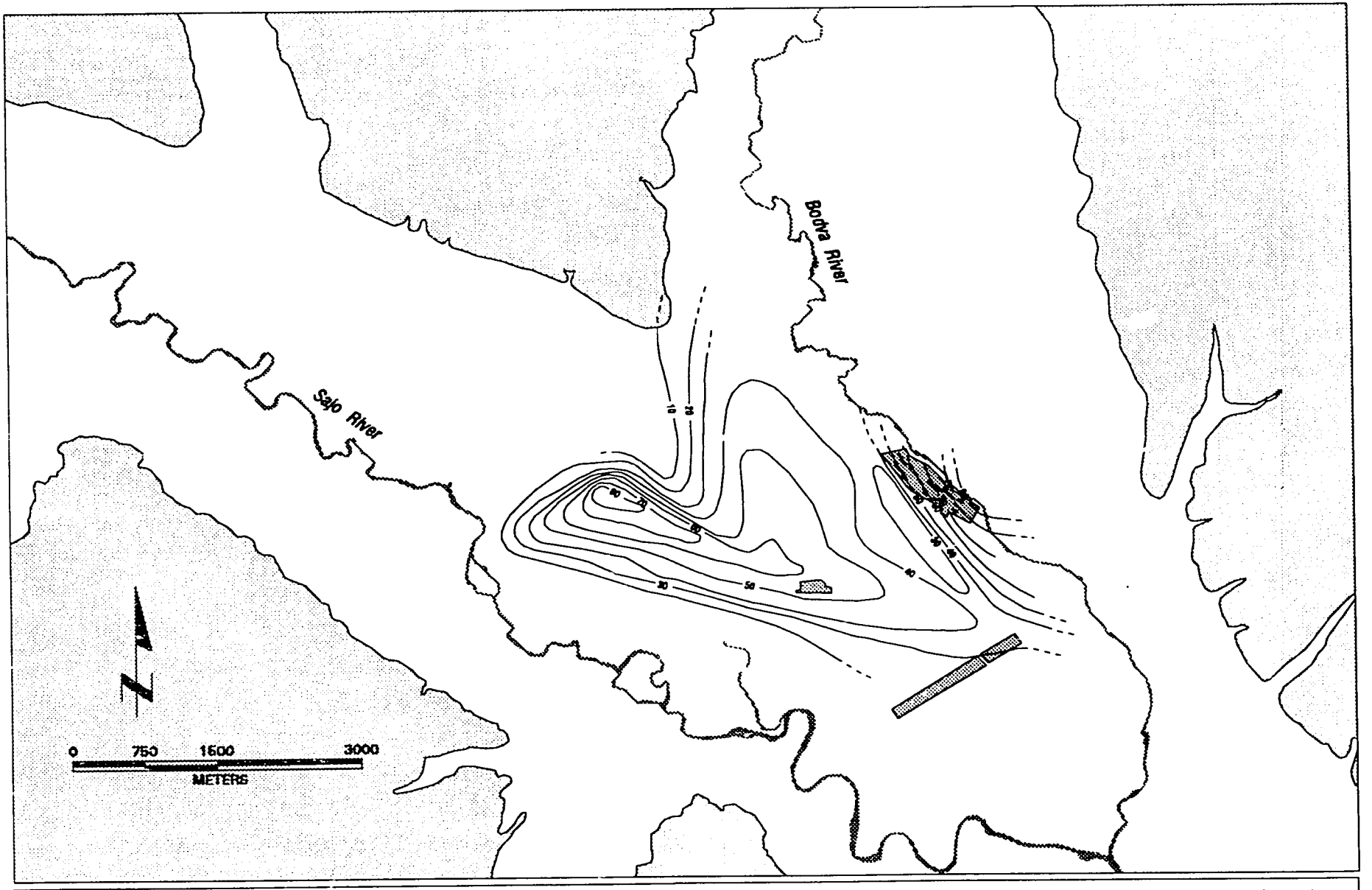


From Keviterv Technical Report, July 1987, project 5 – 3925 – 86. Detail Plan 3.5.

Boundary of Alluvial Valley

— s — Lines of Equal Aquifer Thickness, in Meters.

Figure 7. Thickness of Pleistocene Gravel Aquifer

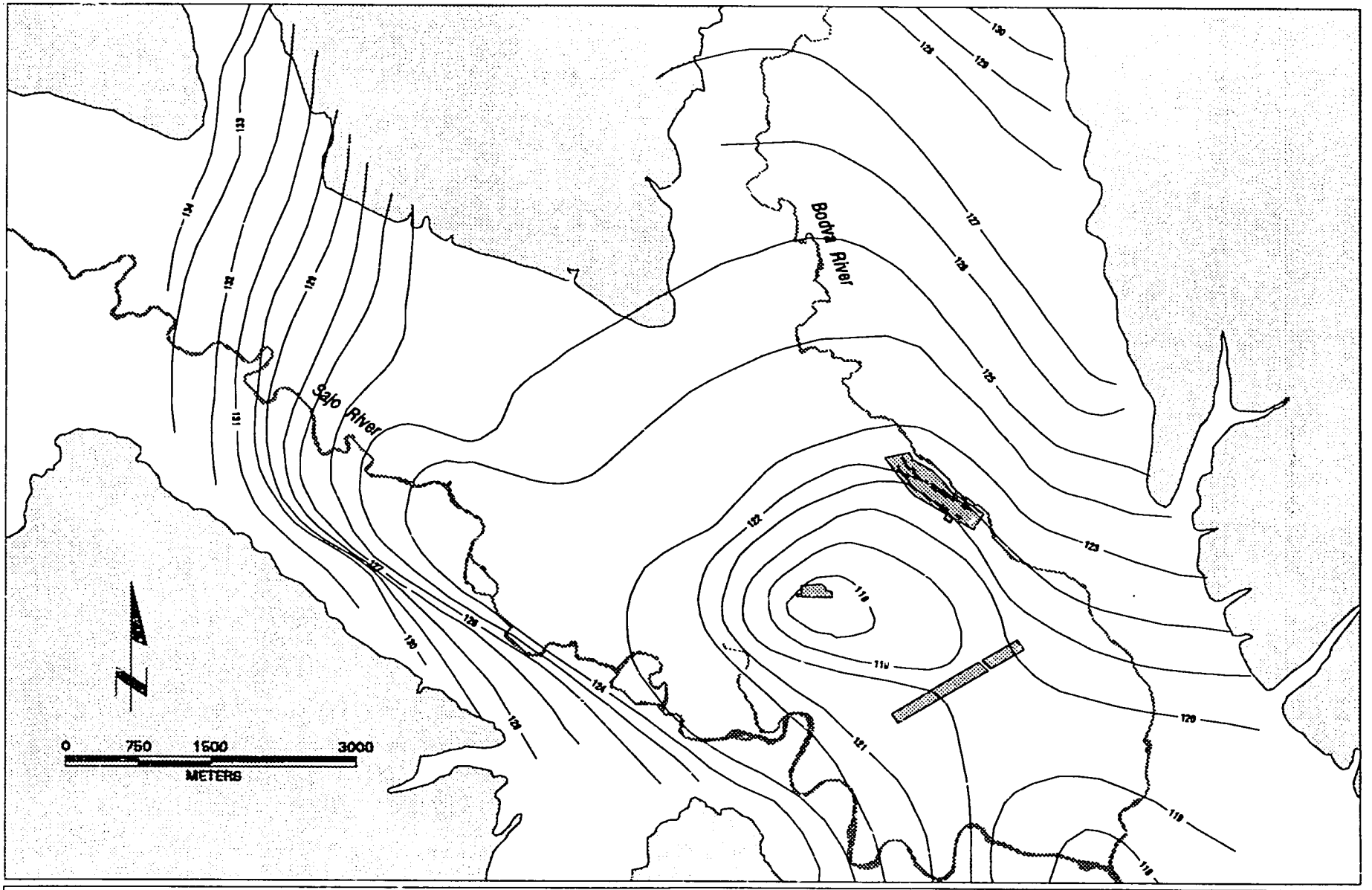


From Keviterv Technical Report, July 1987, project 5 – 3925 – 86. Detail Plan 3.6.

Boundary of Alluvial Valley

— 50 — Lines of Equal Hydraulic Conductivity, (Meters/Day).

Figure 8. Hydraulic Conductivity of Gravel Aquifer

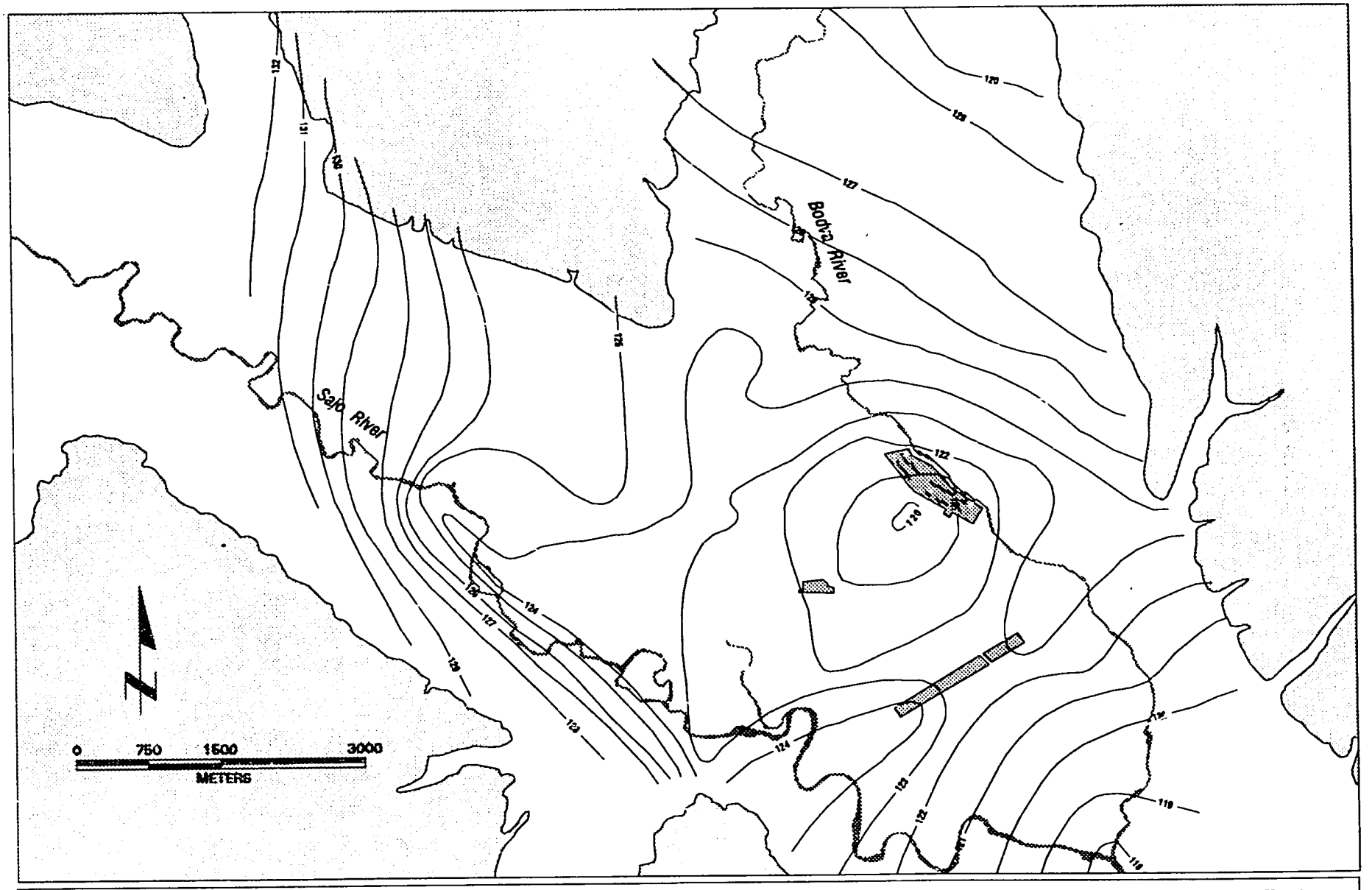


From Keviterv Technical Report, July 1987, project 5 – 3925 – 86. Detail Plan 3.7.

Boundary of Alluvial Valley

Figure 9. Water Level in Gravel Aquifer, October 1986 (Waterworks I and I/A Not Operating)

—— 110 —— Lines of Equal Groundwater Elevation, in Meters Above Mean Baltic Sea Level.

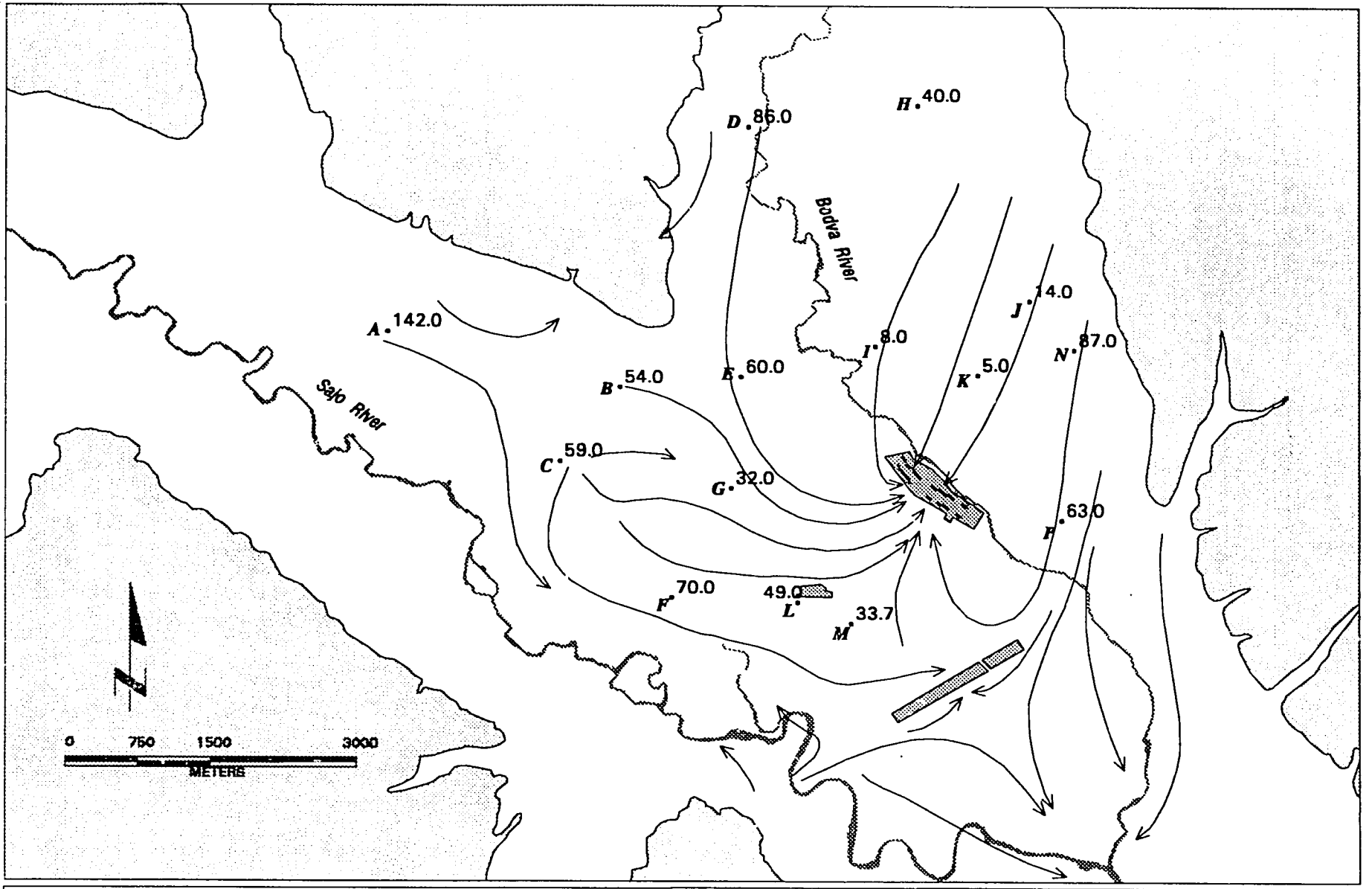


From Keviterv Technical Report, July 1987, project 5 – 3925 – 86. Detail Plan 3.7.

Boundary of Alluvial Valley

Figure 10. Water Level in Gravel Aquifer, March 1987 (Waterworks I and I/A Operating)

— 110 — Lines of Equal Groundwater Elevation, in Meters Above Mean Baltic Sea Level.



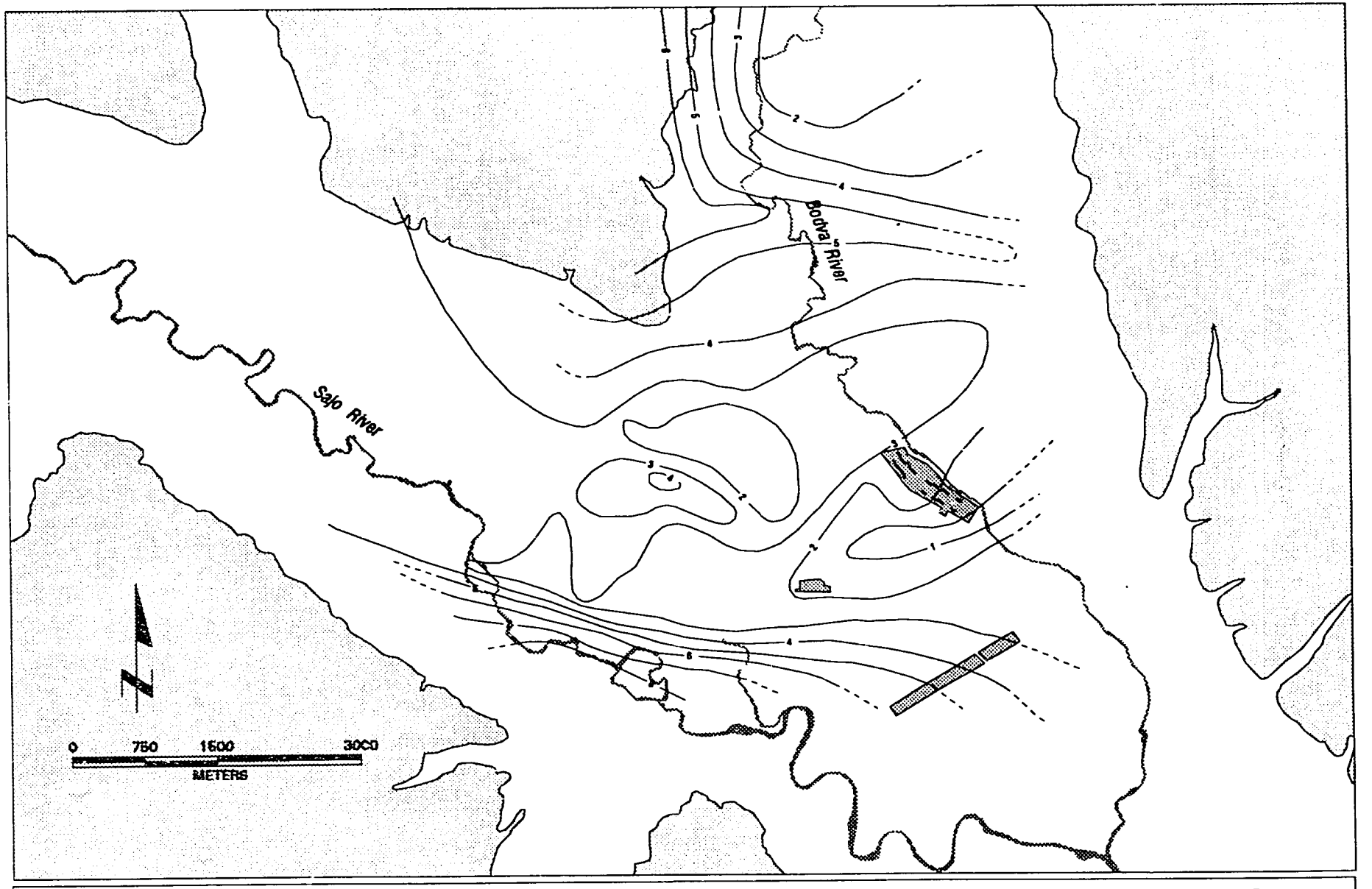
From Keviterv Technical Report, July 1987, Project 5 – 3925 – 86. Detail Plan 3.8.

Boundary of Alluvial Valley

Figure 11. Gravel Aquifer Groundwater Streamlines and Estimated Travel Times from Potential Points Sources, March 1987

→ **Groundwater Flow Direction**

25.0 • *F* **Potential Point Source and Estimated Travel Time to Wellfield I (years).**

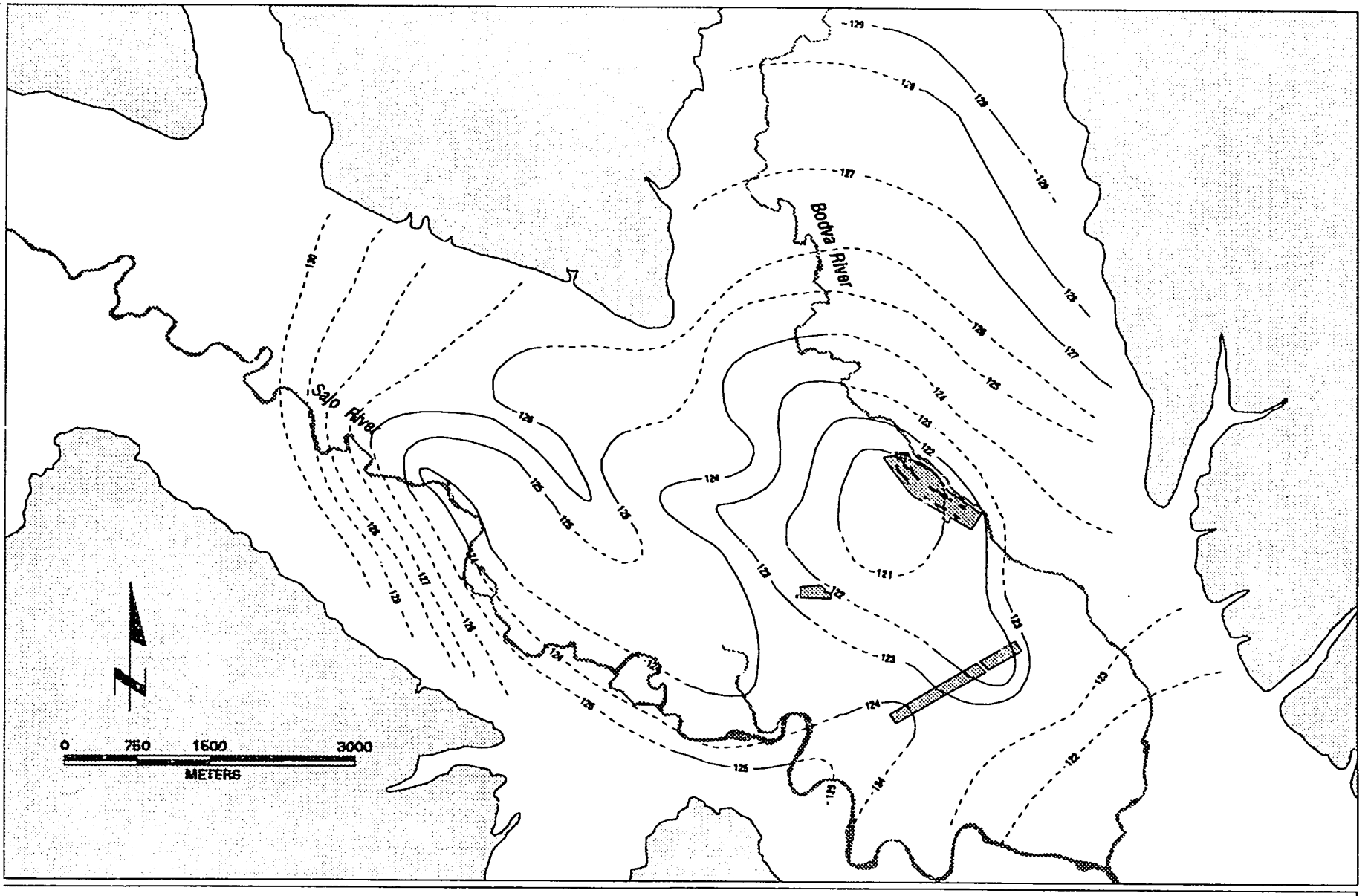


From Keviterv Technical Report, July 1987, project 5 – 3925 – 86. Detail Plan 3.3.

Boundary of Alluvial Valley

— 5 — Lines of Equal Sediment Thickness, in Meters.

Figure 12. Thickness of Holocene Cover Sediments

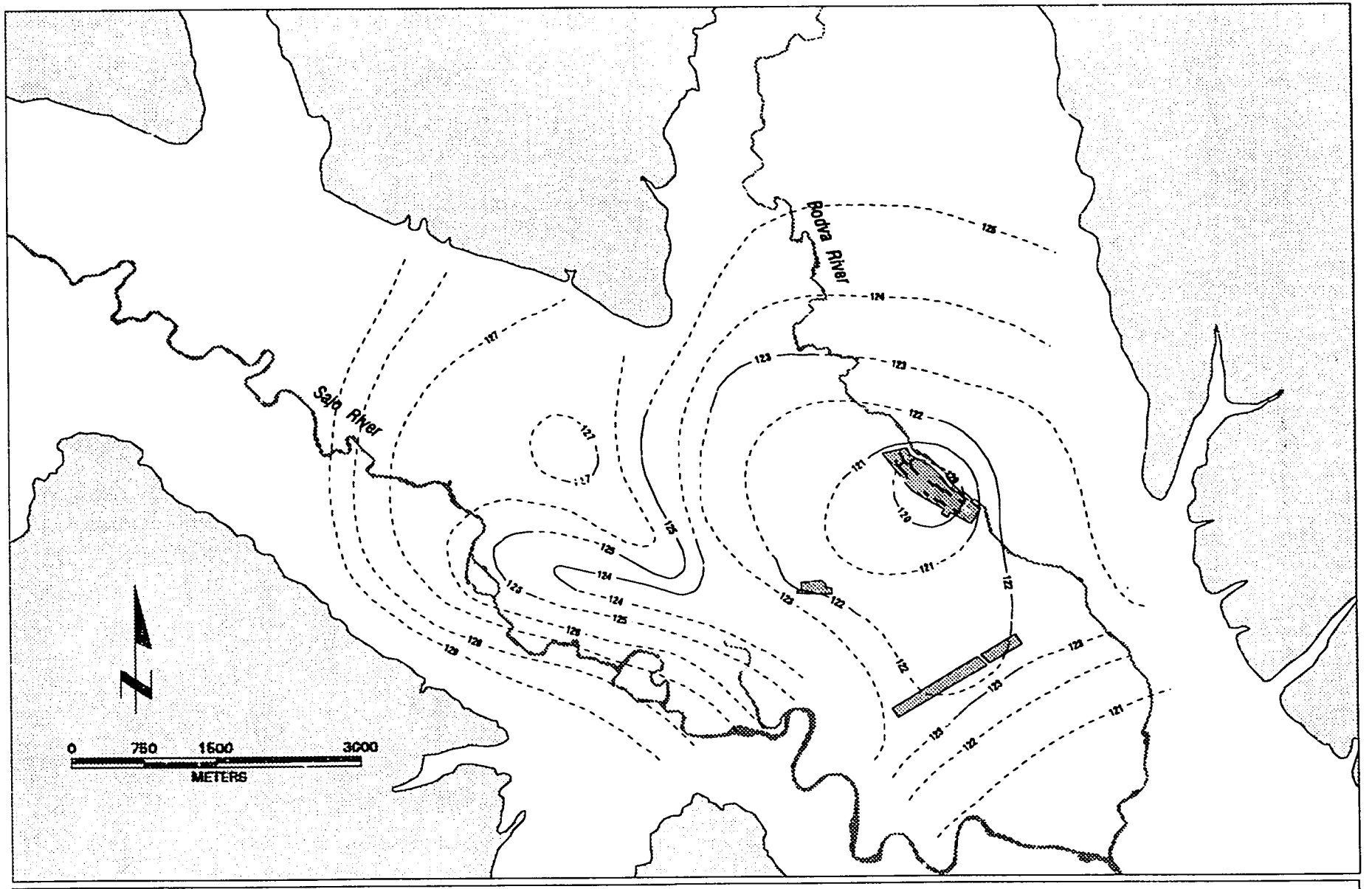


Water level map prepared by LEM appraisal team based on the water level measurements obtained by Keviterv in 1987 to produce Figure 12.

Boundary of Alluvial Valley

Figure 13. Water Level for Gravel Aquifer, March 1987

Lines of Equal Groundwater Elevation, in Meters above Mean Baltic Sea Level, Dashed where inferred.



Water level map prepared by LEM appraisal team based on the water level measurements obtained from several sources during 1993 reconnaissance.

Figure 14. Water Level for Gravel Aquifer, March 1992

— 120 - - - Lines of Equal Groundwater Elevation, in Meters above Mean Baltic Sea Level, Dashed where inferred.

Boundary of Alluvial Valley

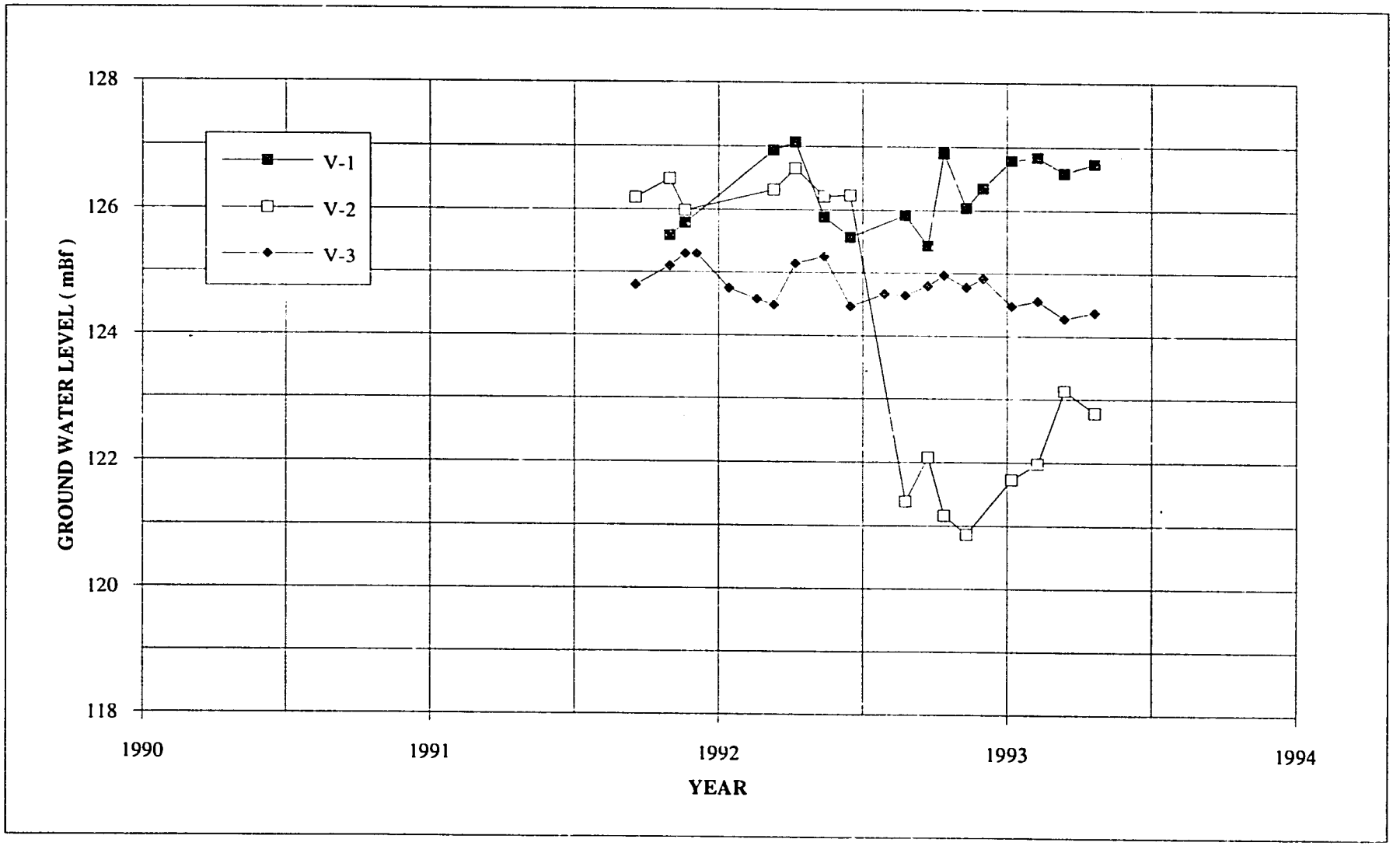


Figure 15. Hydrographs for V-Series Wells (1991 - 1993)

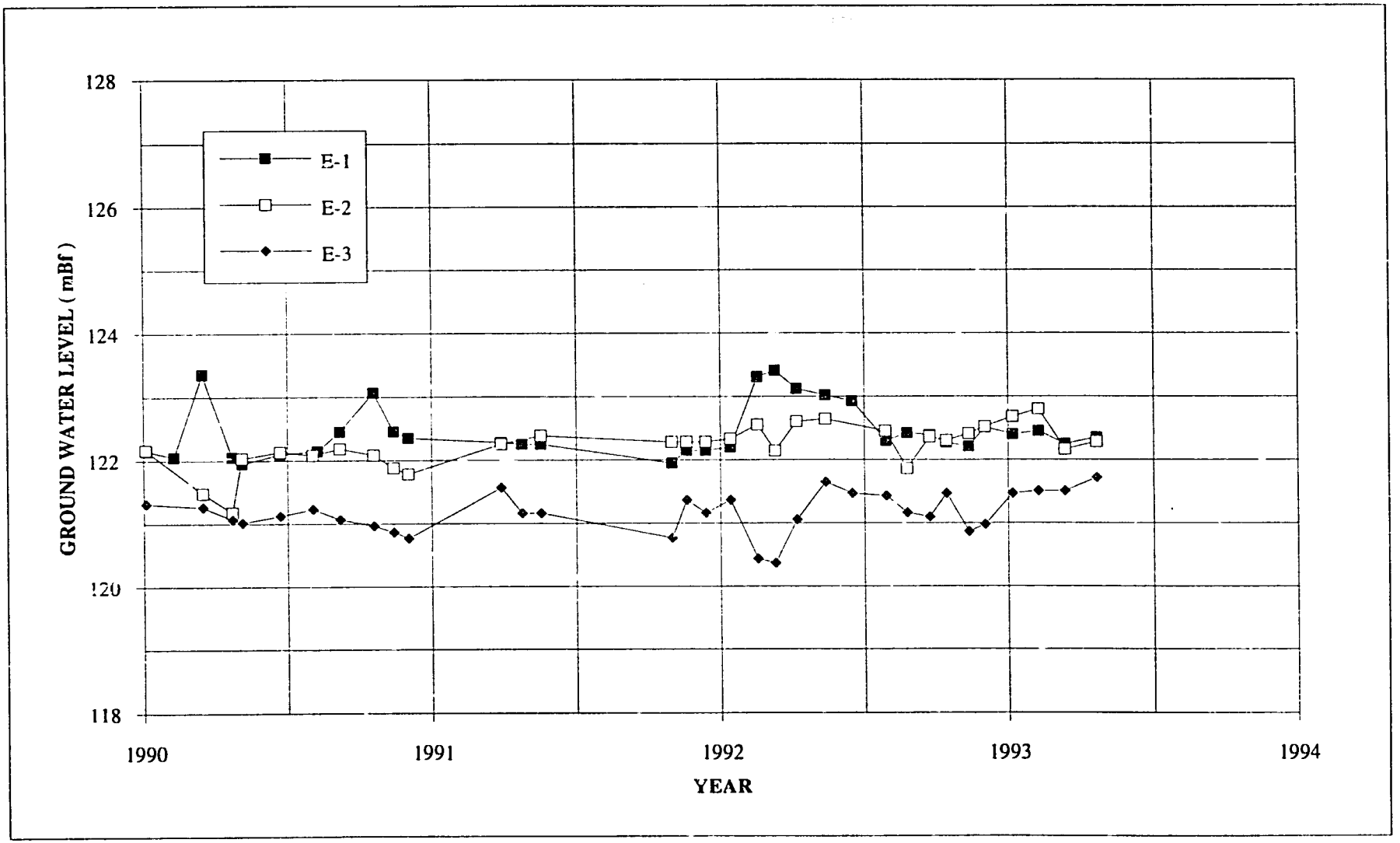


Figure 16. Hydrographs for E-Series (Wells E-1, E-2 & E-3, 1990 - 1993)

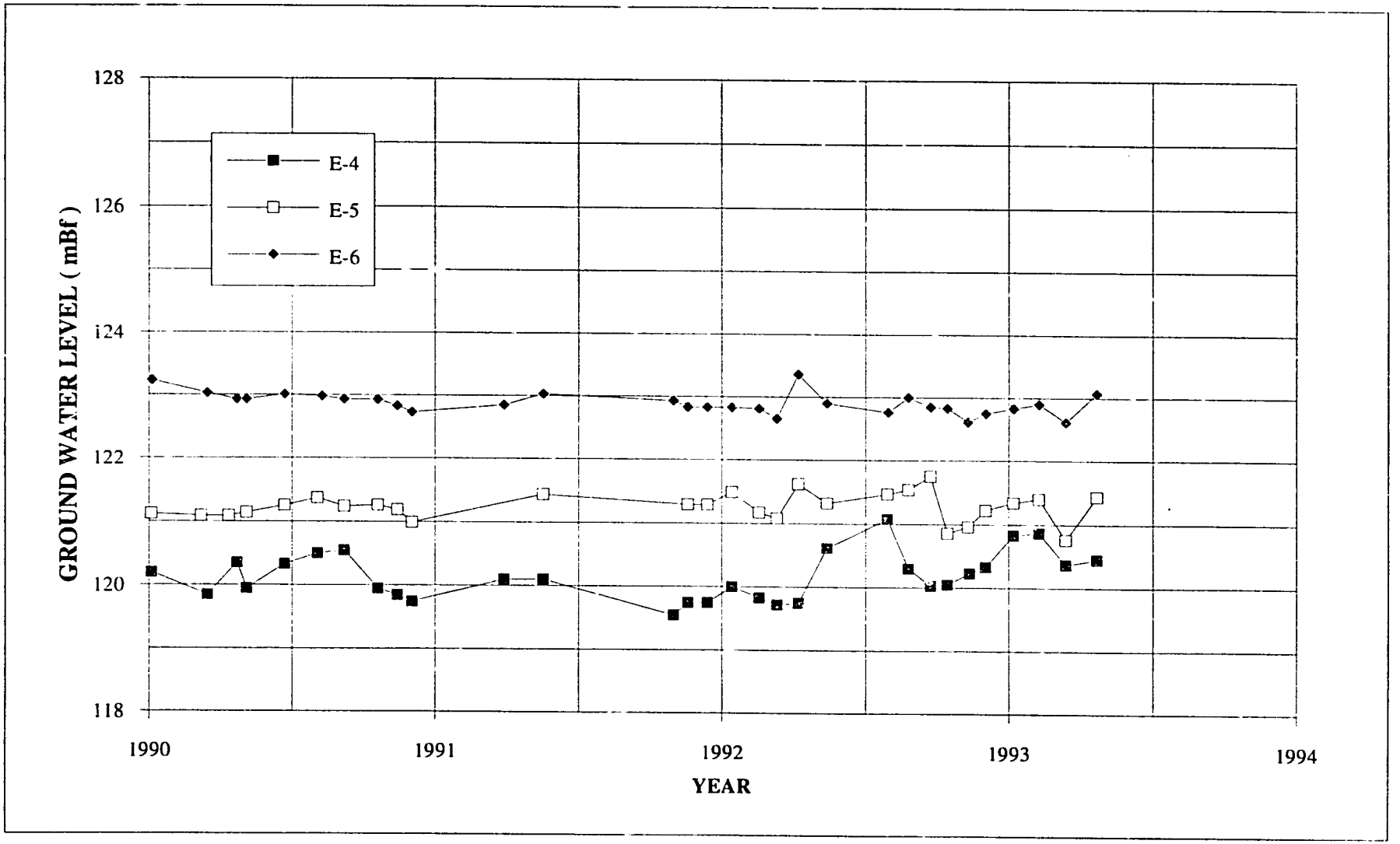


Figure 17. Hydrographs for E-Series (Wells E-4, E-5 & E-6, 1990 - 1993)

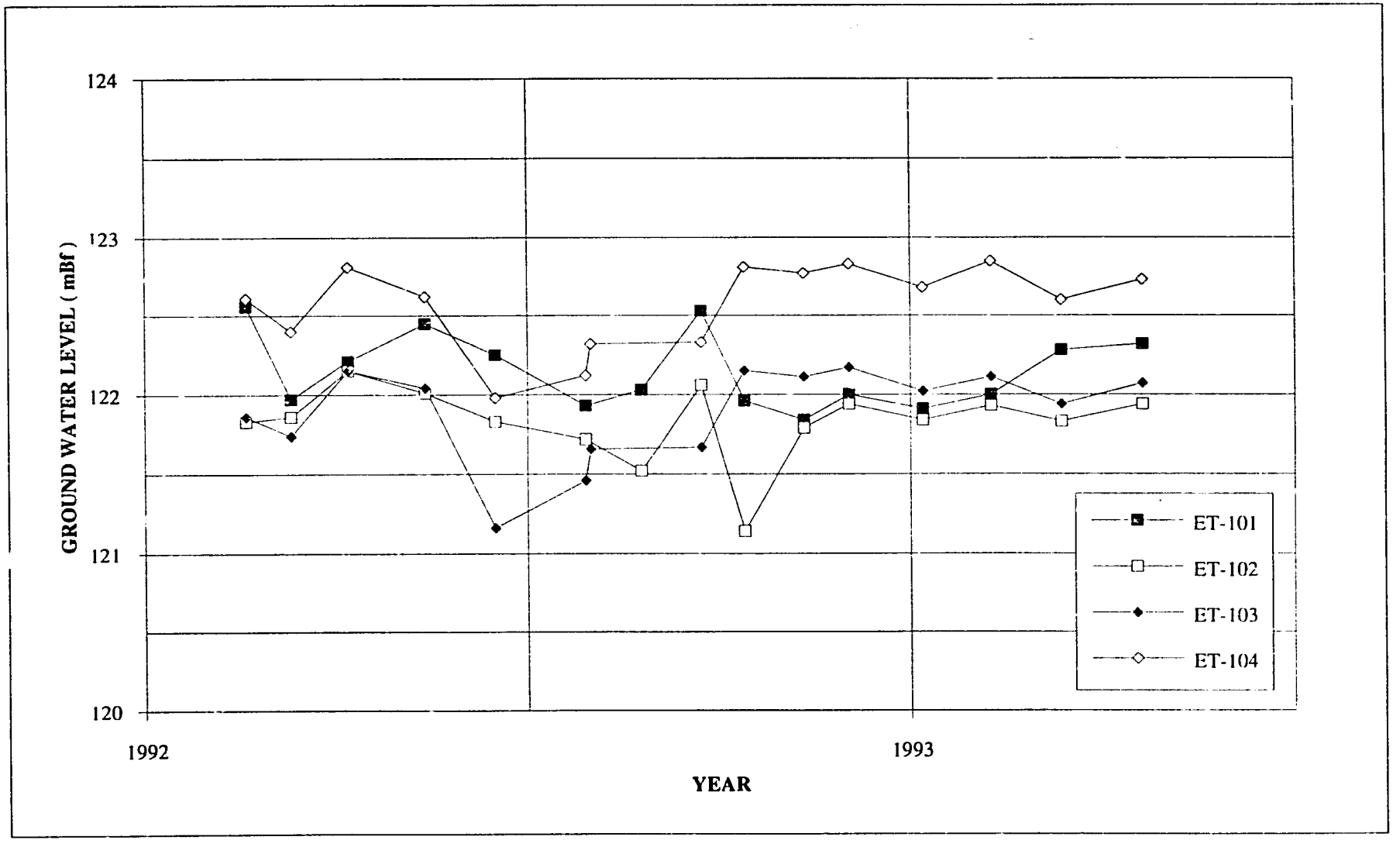


Figure 18. Hydrographs for ET-Series Wells (1992 - 1993)

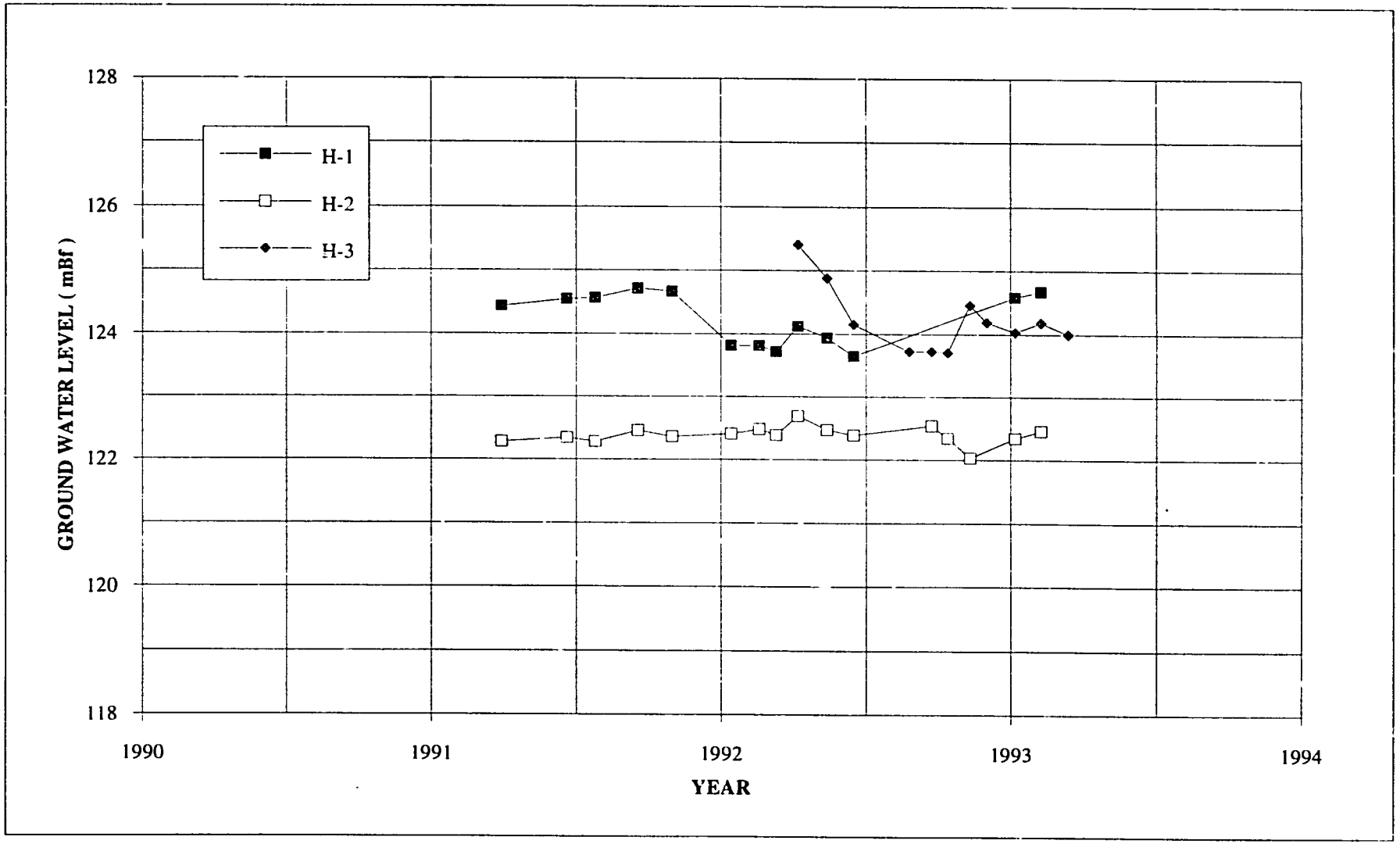
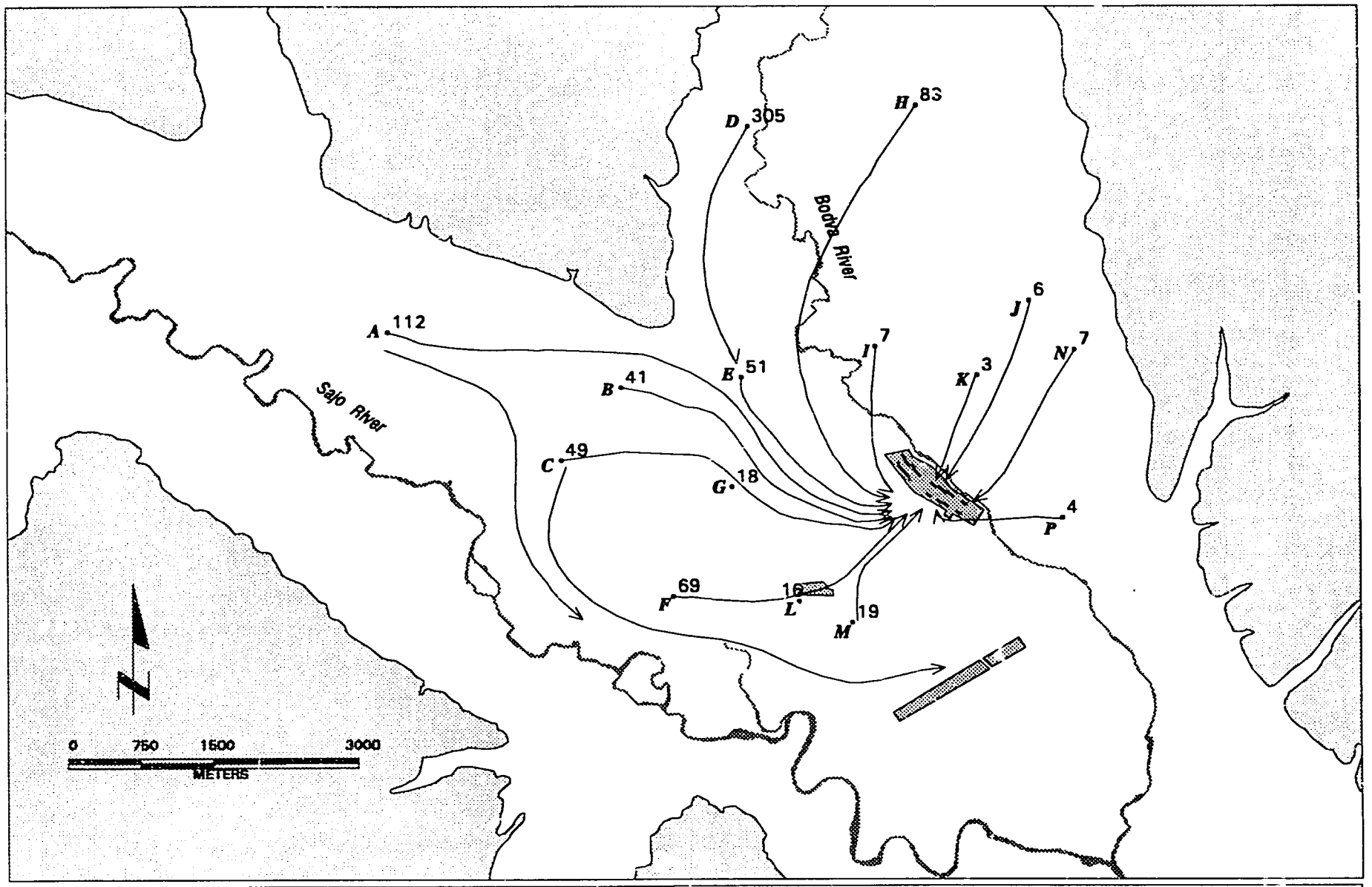


Figure 19. Hydrographs for H-Series Wells (1991 - 1993)



Streamlines were prepared by LEM appraisal team based on Detail Plan 3.8, Keviterv Technical Report, July 1987, Project 5 – 3925 – 86.

Boundary of Alluvial Valley

Figure 20. Revised Estimation of Gravel Aquifer Streamlines and Estimated Travel Times from Potential Points Sources, March 1987

→ **Groundwater Flow Direction**

100 • *F* **Potential Point Source and Estimated Travel Time to Welifield I (years).**

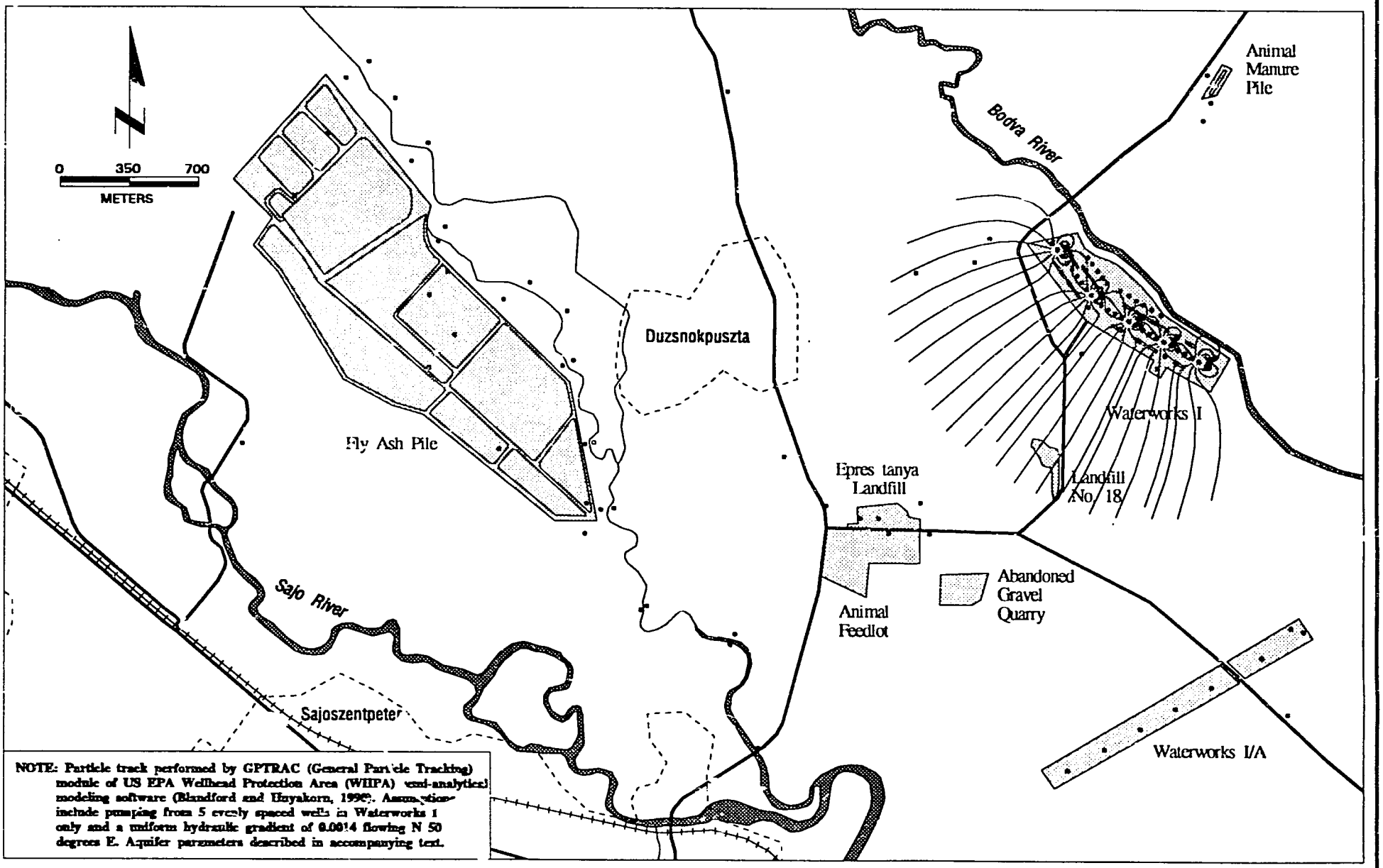


Figure 21. 5 Year Capture Zone for Waterworks I

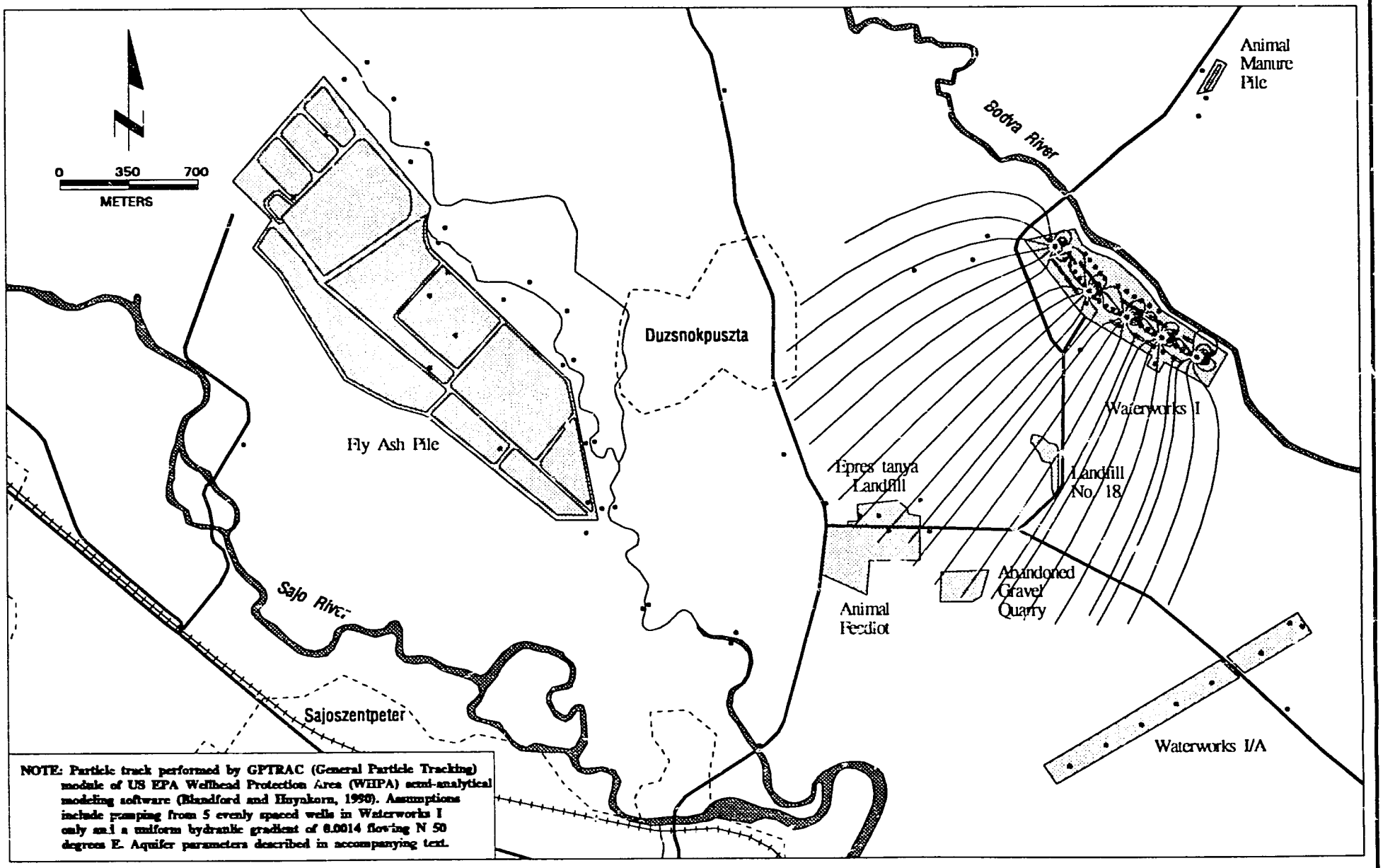


Figure 22. 10 Year Capture Zone for Waterworks I

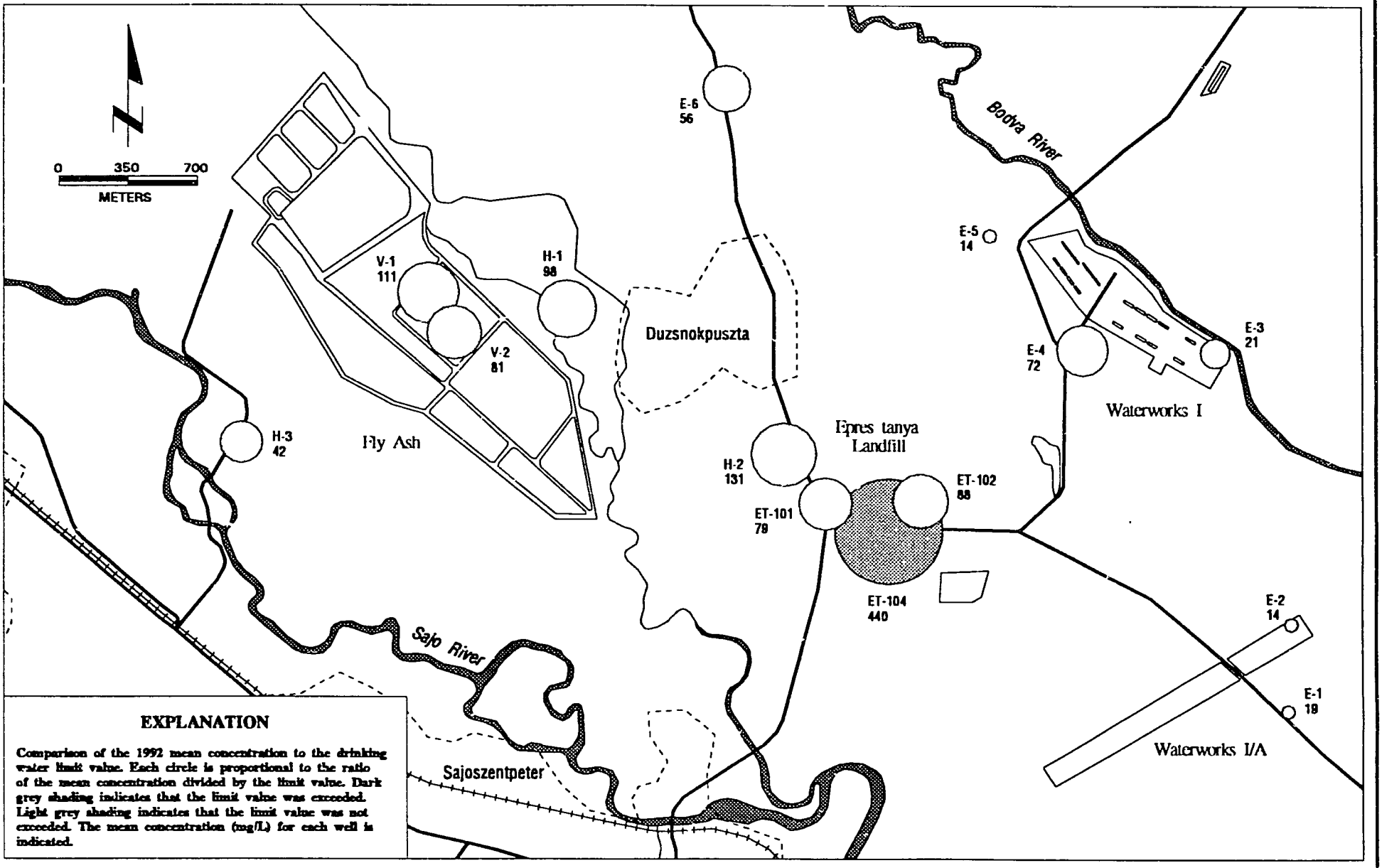


Figure 23. Sodium Concentrations at Selected Monitoring Wells

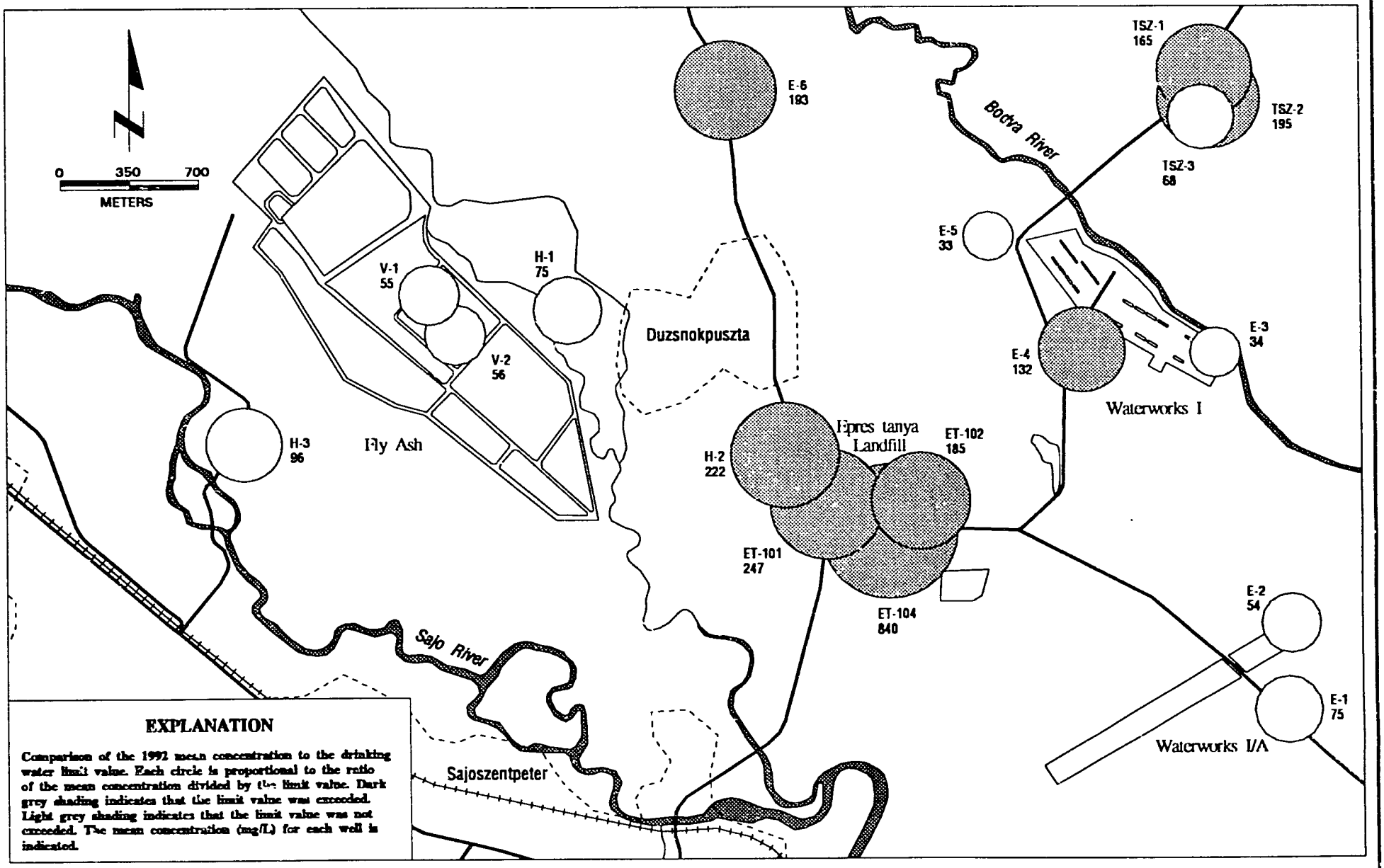


Figure 24. Chloride Concentrations at Selected Monitoring Wells

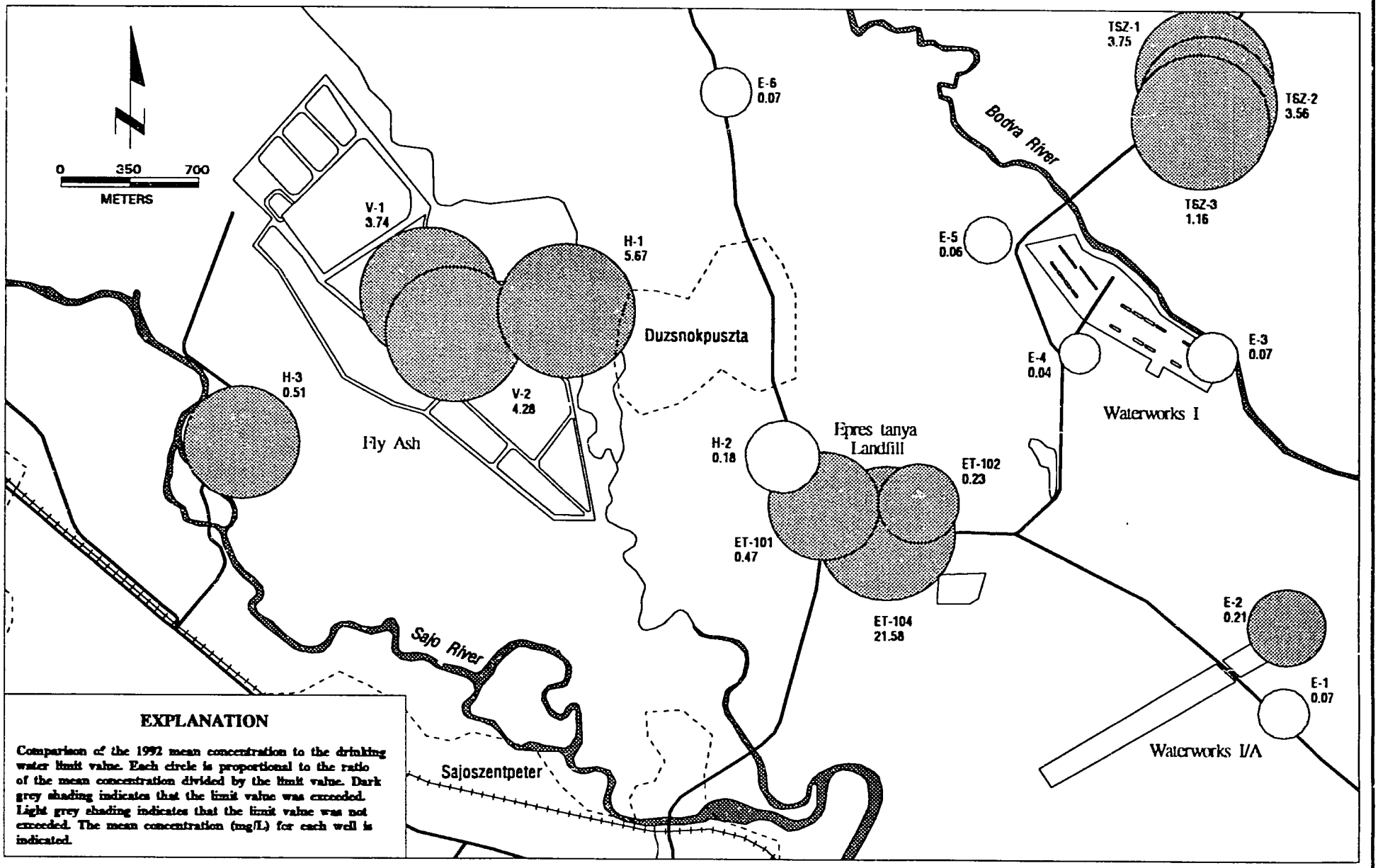


Figure 25. Ammonium Concentrations at Selected Monitoring Wells

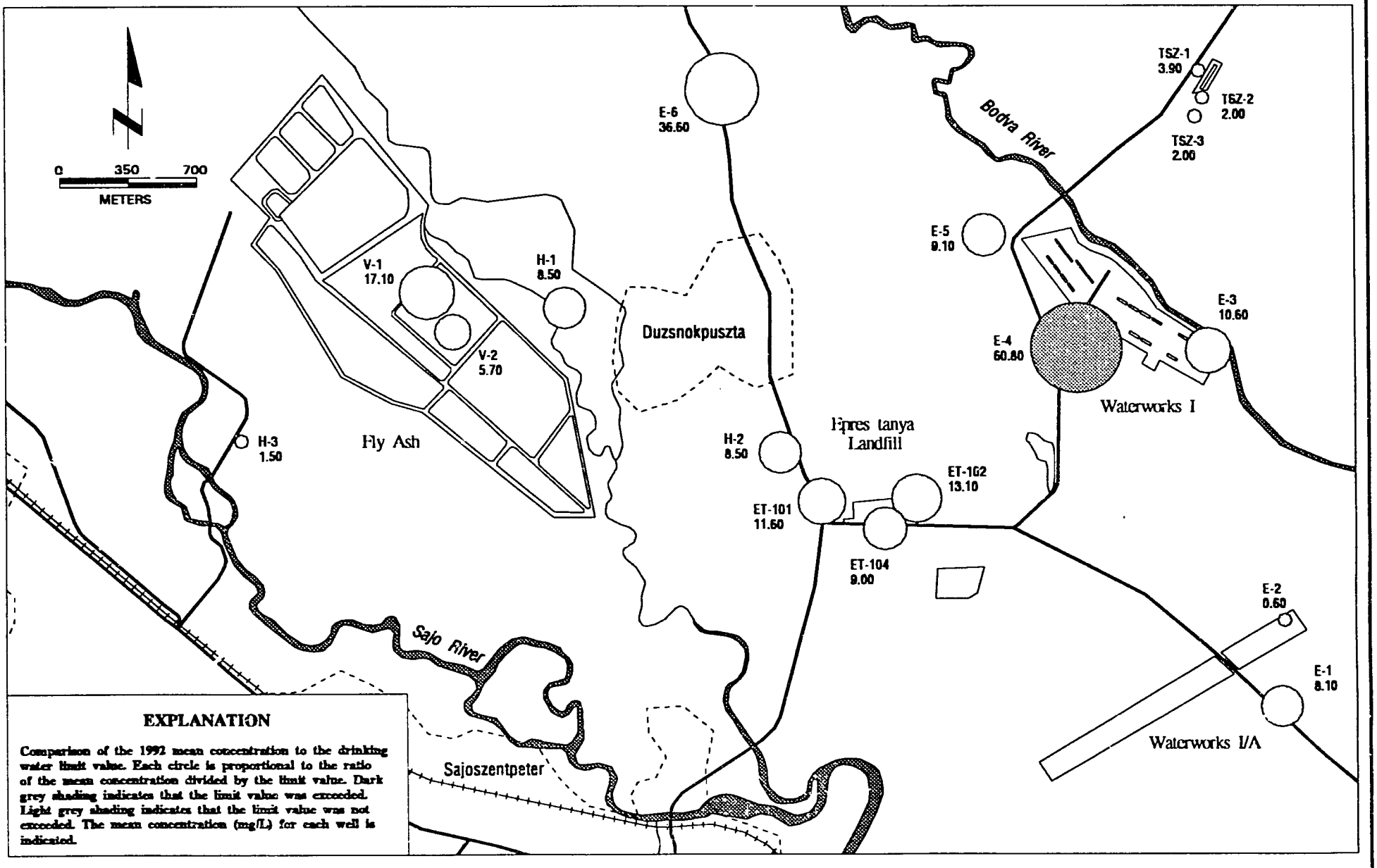


Figure 26. Nitrate Concentrations at Selected Monitoring Wells

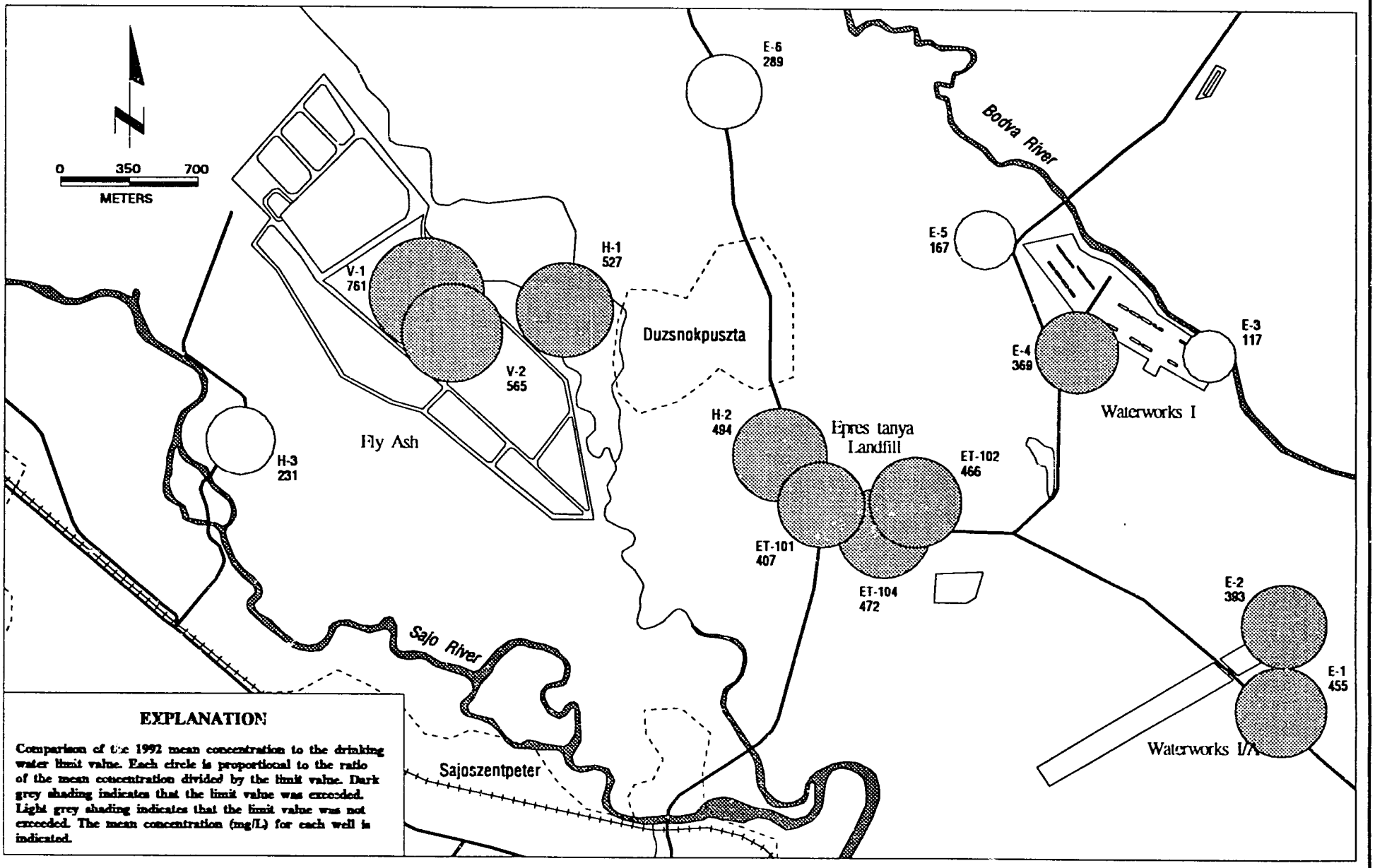


Figure 27. Sulfate Concentrations at Selected Monitoring Wells

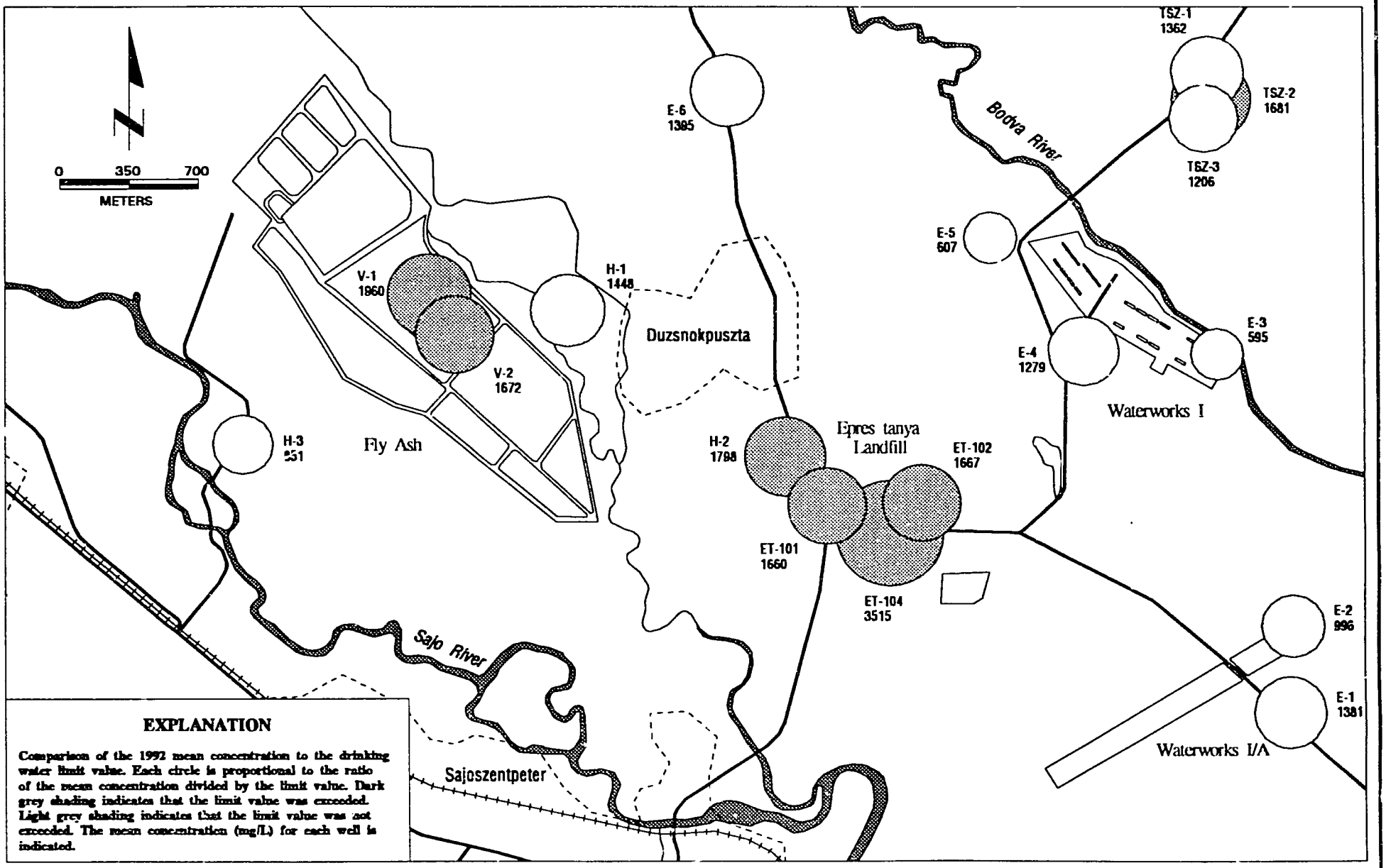


Figure 28. Conductivity at Selected Monitoring Wells

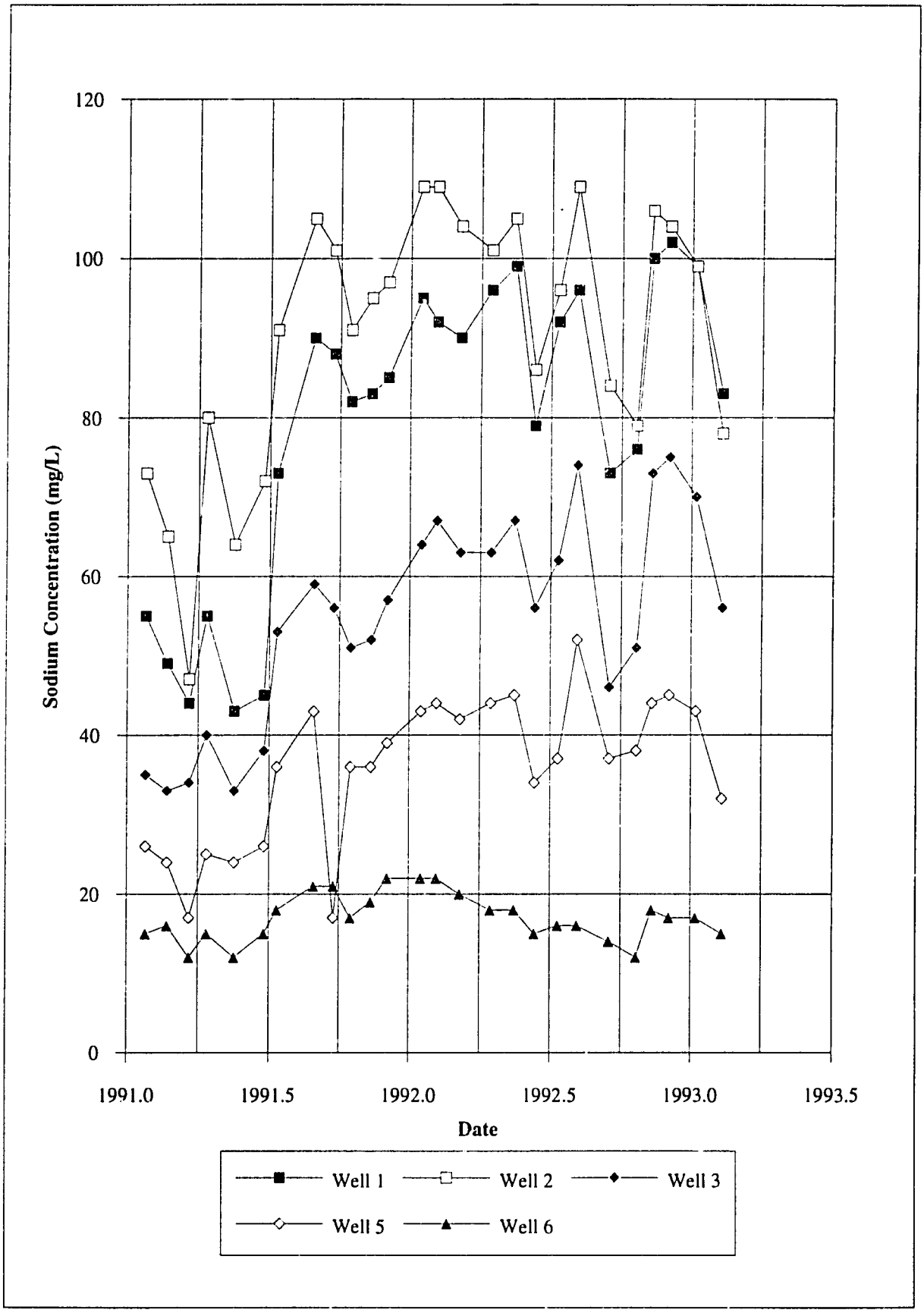


Figure 29. Waterworks I/A Sodium Concentrations (1991 - Early 1993)

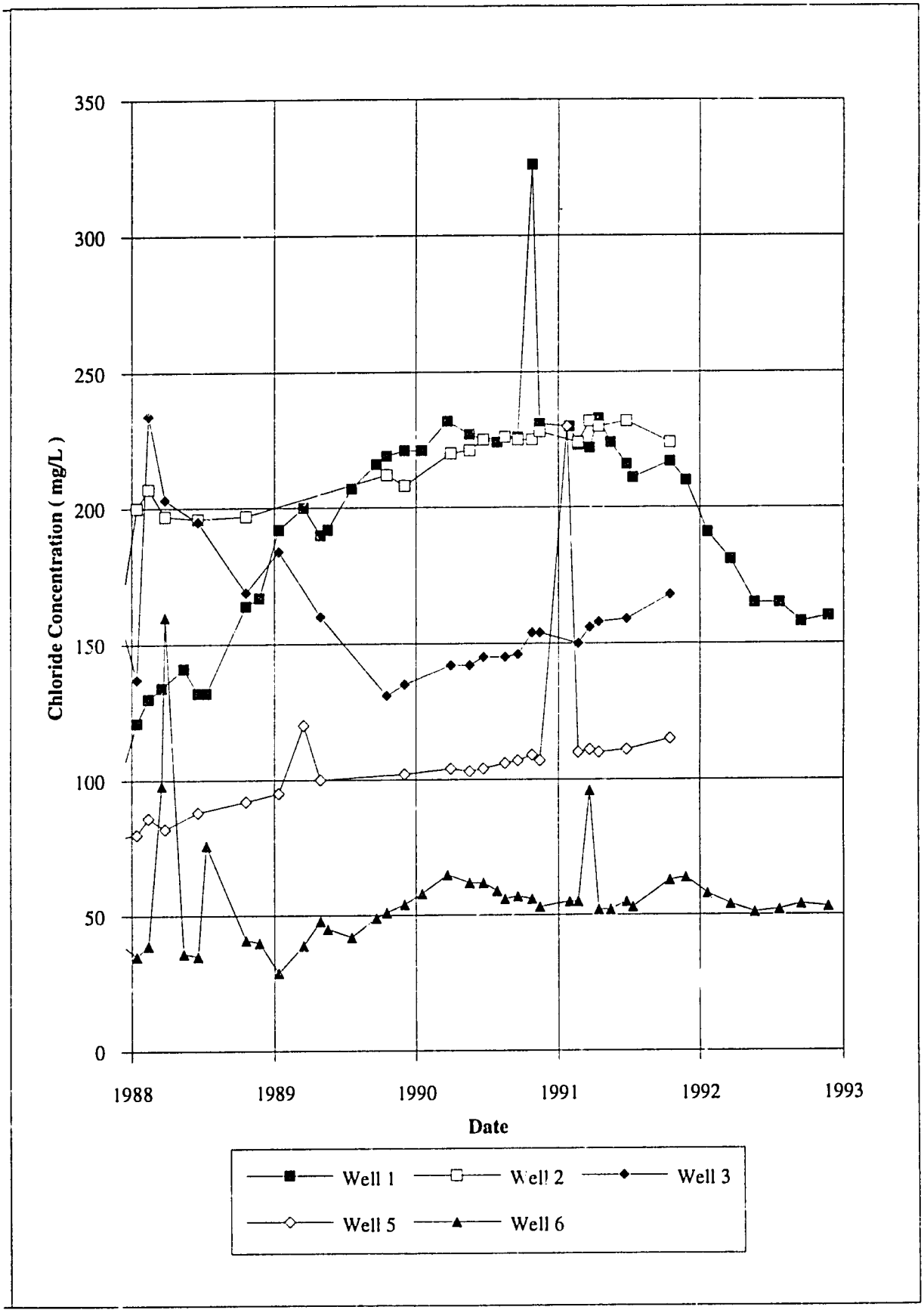


Figure 30. Waterworks I/A Chloride Concentrations (1988 - 1993)

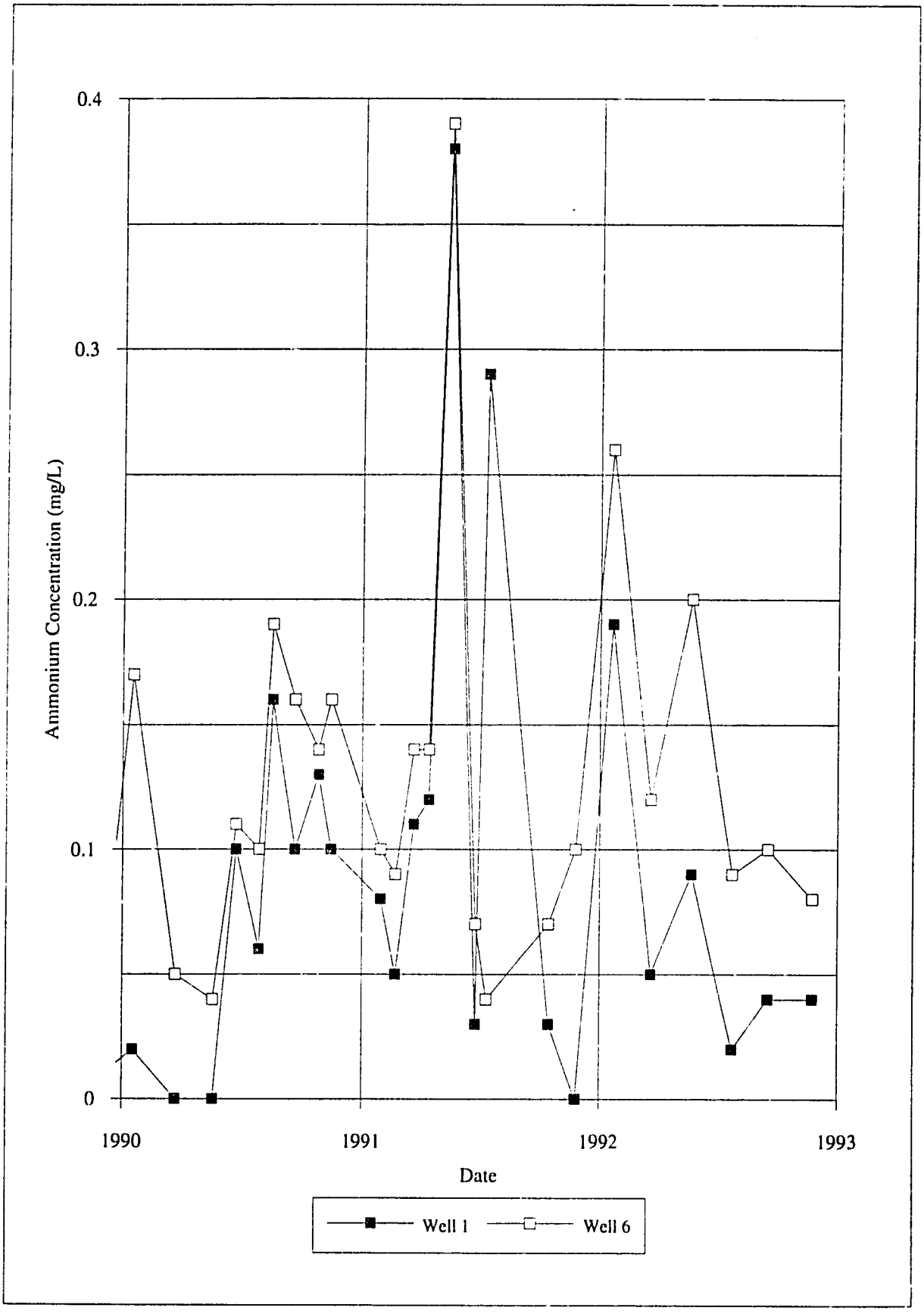


Figure 31. Waterworks I/A Ammonium Concentrations (Wells 1 & 6, 1990 - Late 1992)

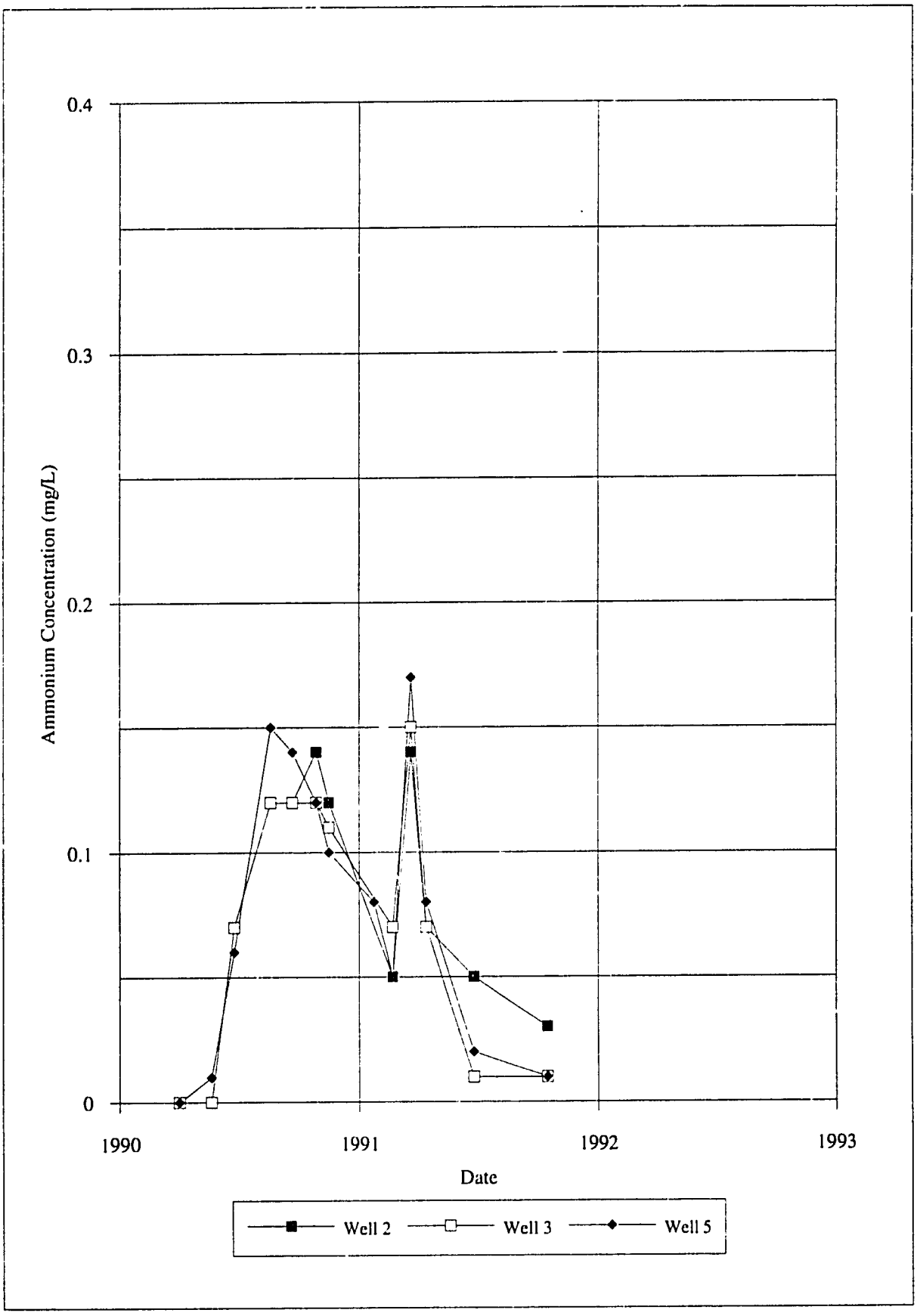


Figure 32. Waterworks I/A Ammonium Concentrations (Wells 2, 3, & 5, 1990 - Late 1991)

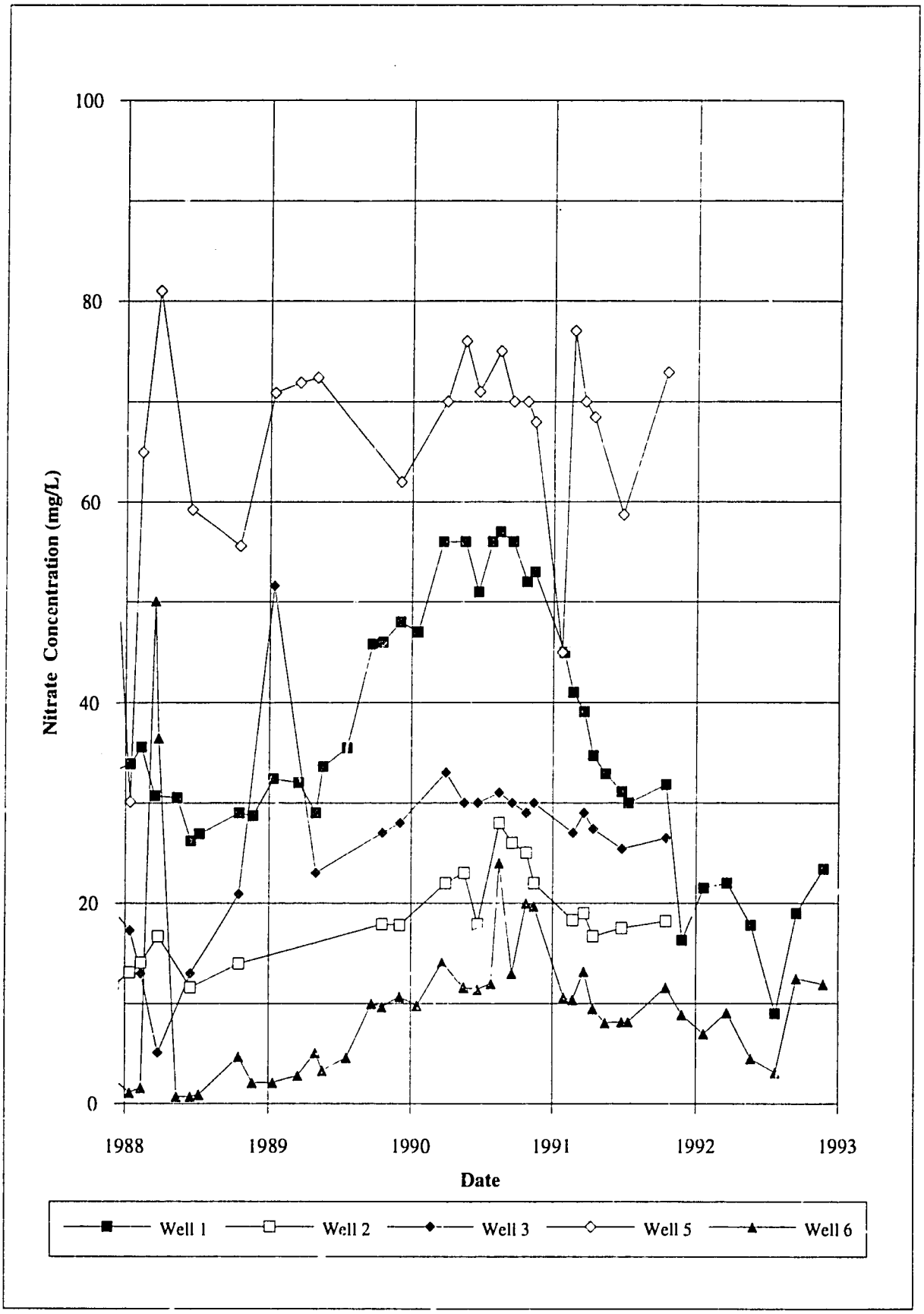


Figure 33. Waterworks I/A Nitrate Concentrations (1988 - 1993)

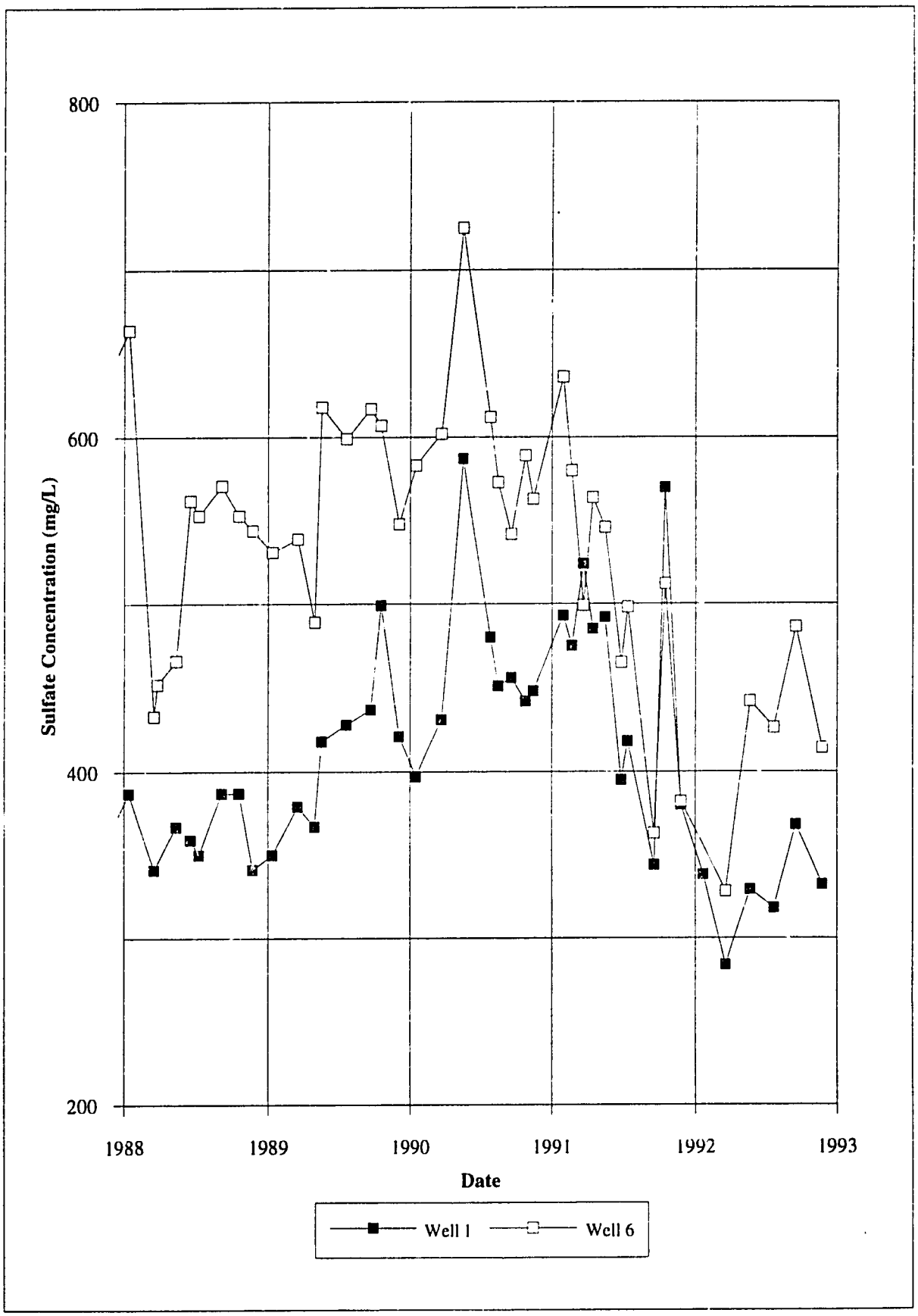


Figure 34. Waterworks I/A Sulfate Concentrations (Wells 1 & 6, 1988 - 1993)

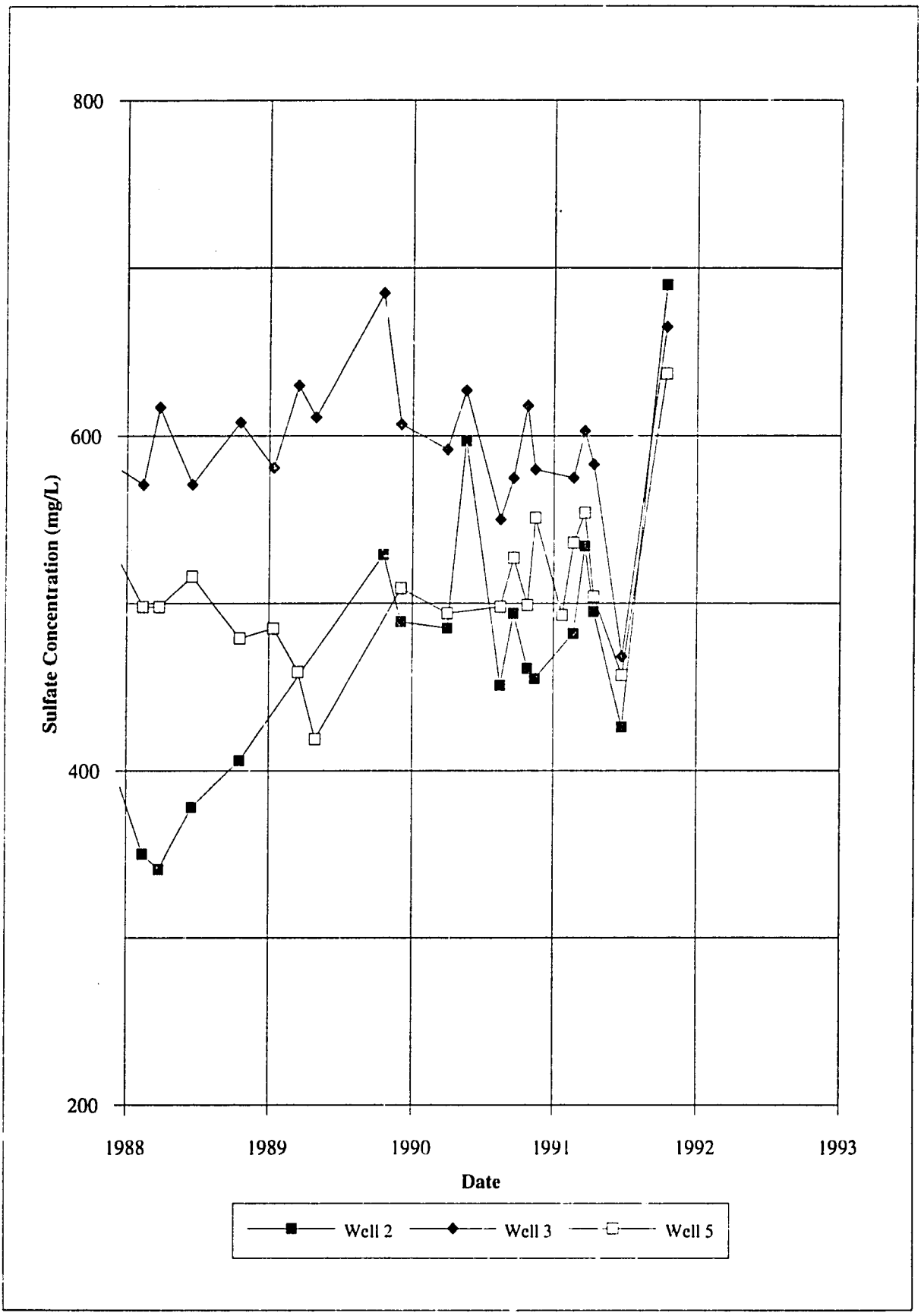


Figure 35. Waterworks I/A Sulfate Concentrations (Wells 2, 3, & 5, 1988 - 1993)

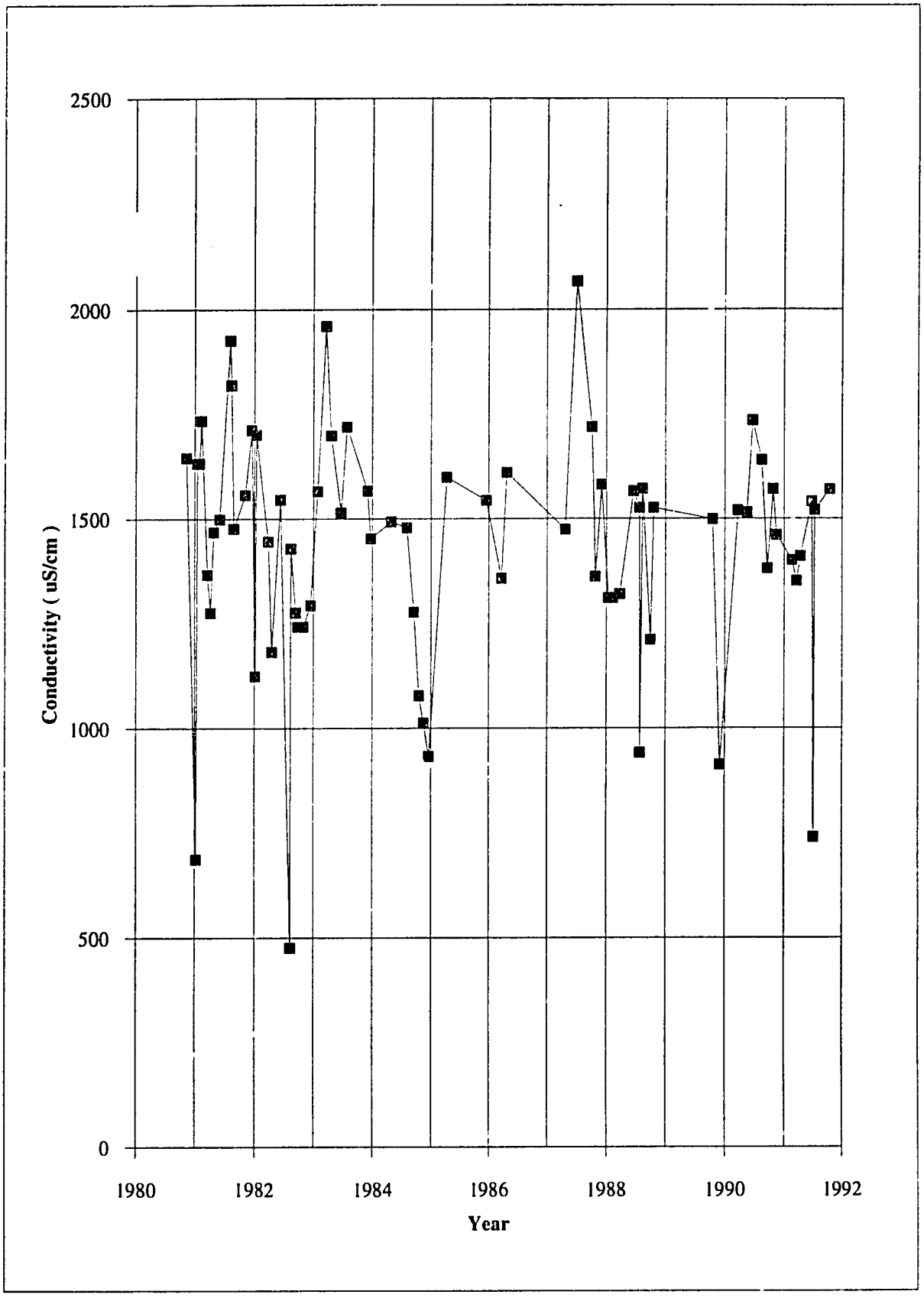


Figure 36. Waterworks I/A Composite Conductivity Values (1980 - Late 1991)

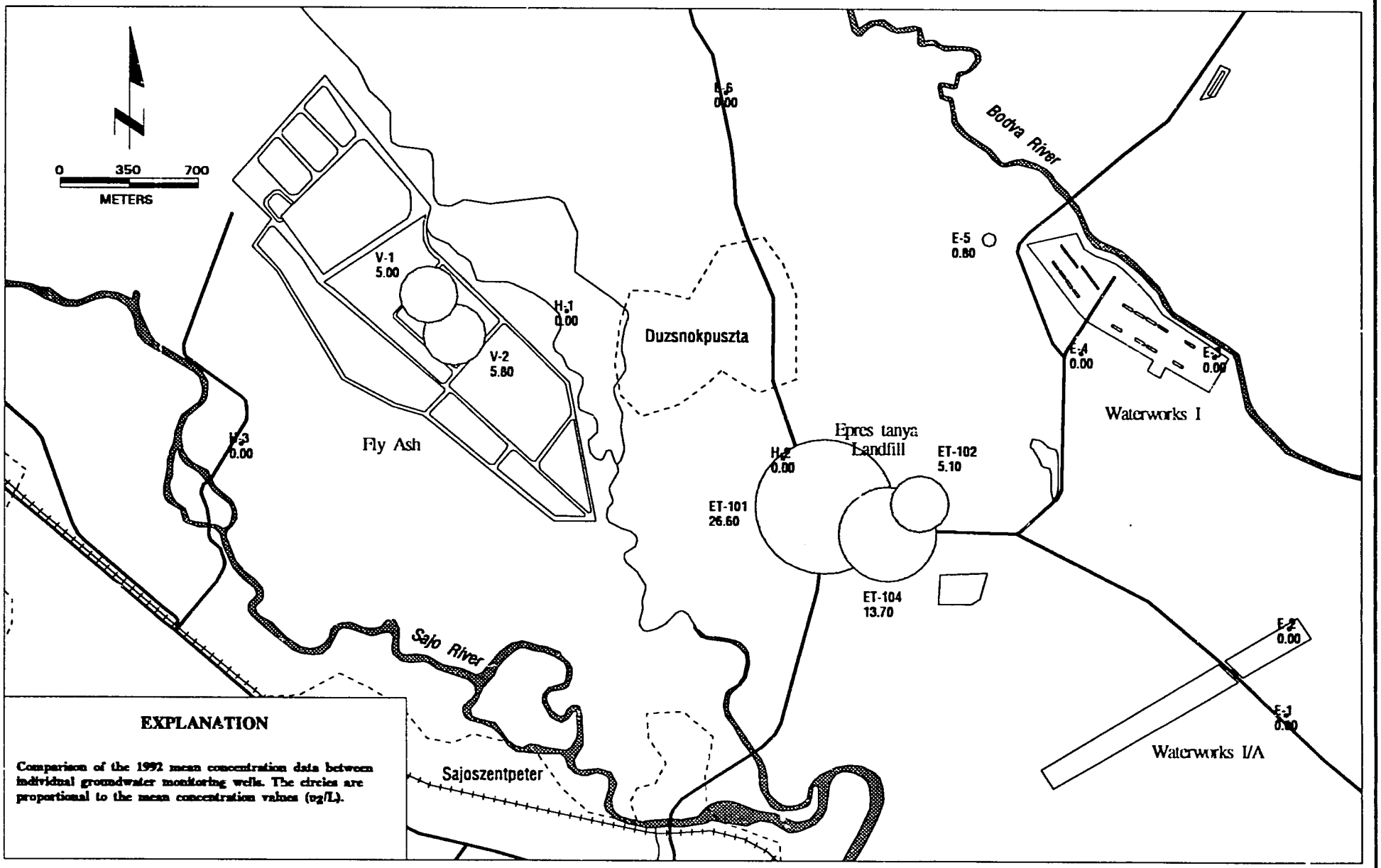


Figure 37. Chromium Concentrations at Selected Monitoring Wells

125

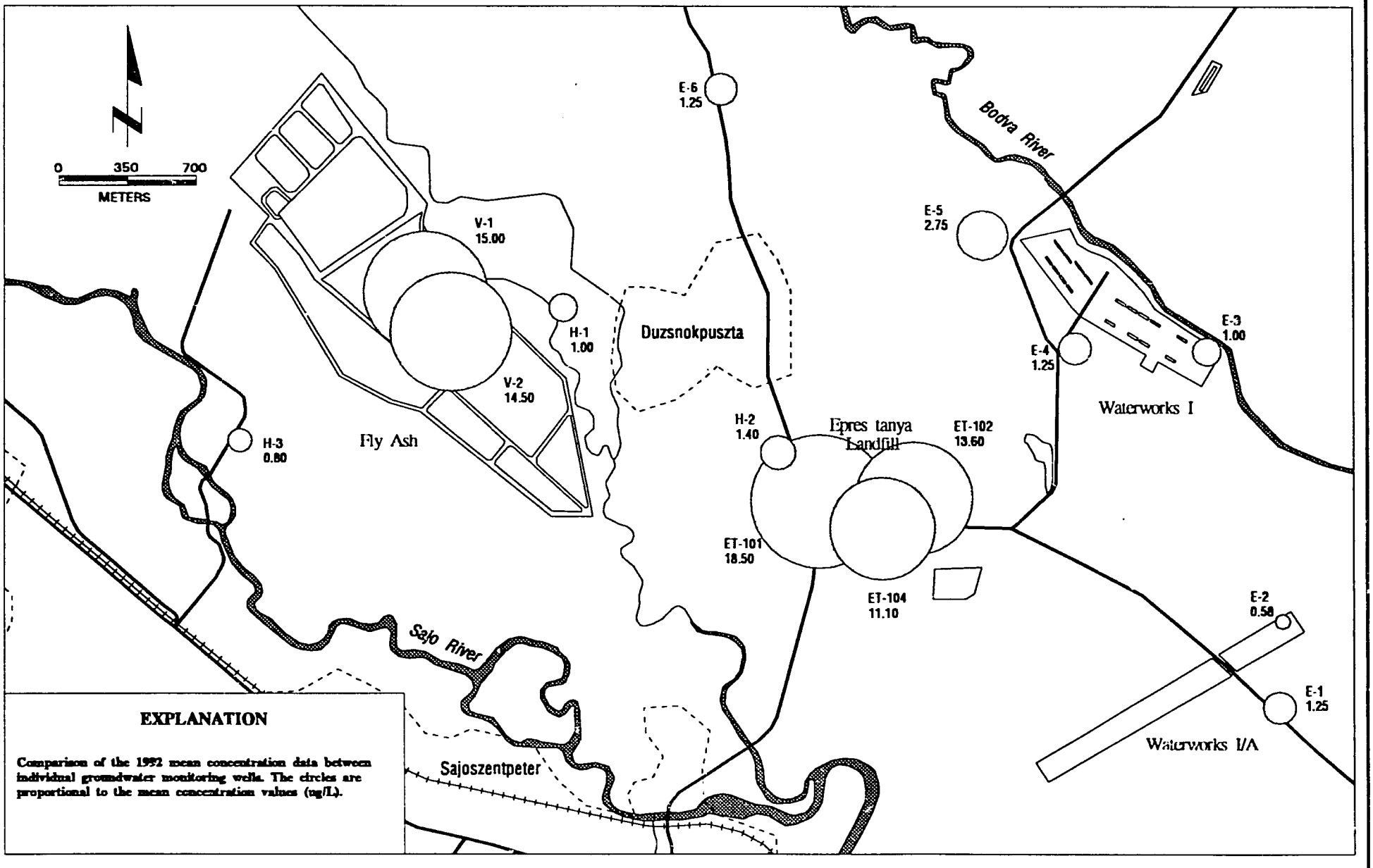


Figure 38. Lead Concentrations at Selected Monitoring Wells

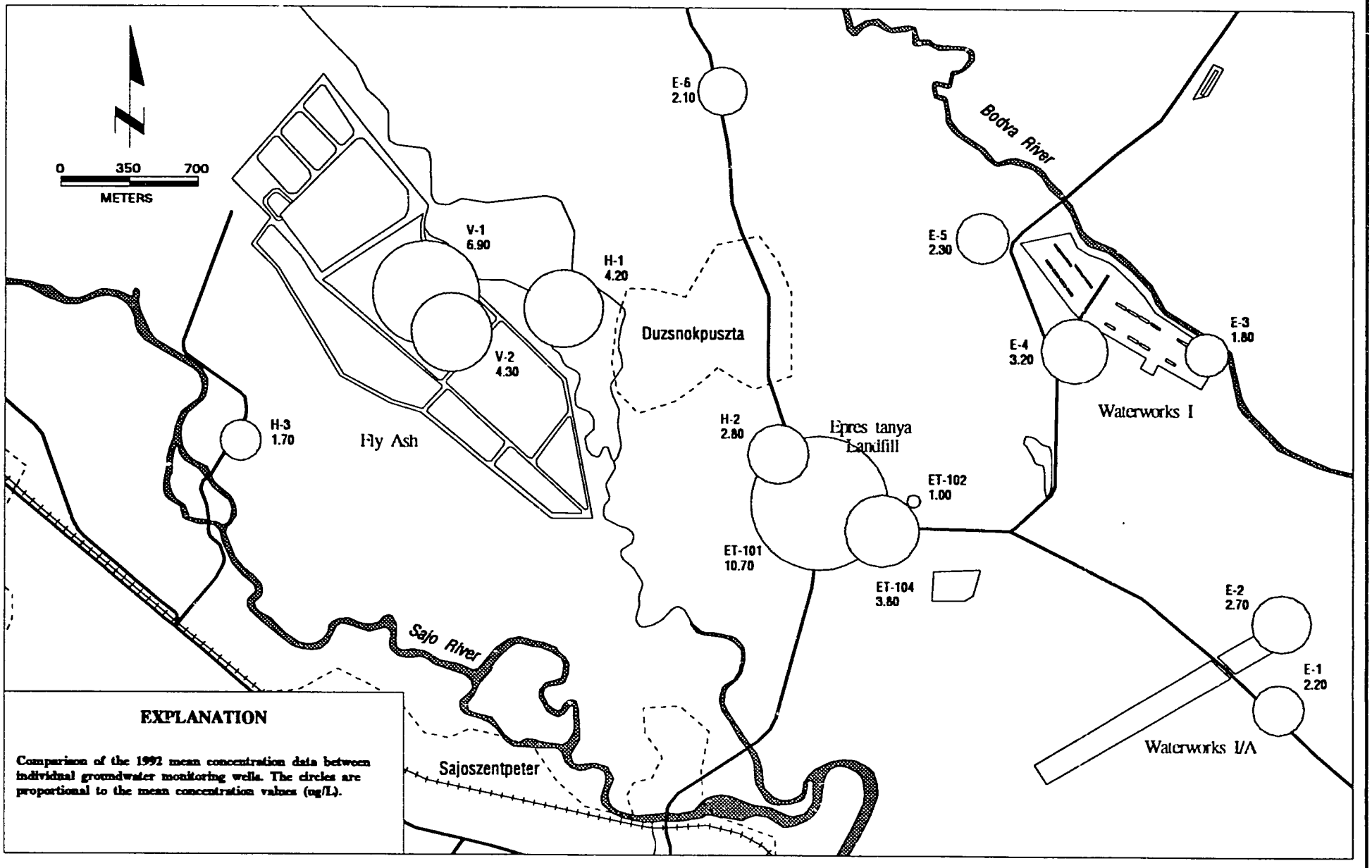


Figure 39. Copper Concentrations at Selected Monitoring Wells

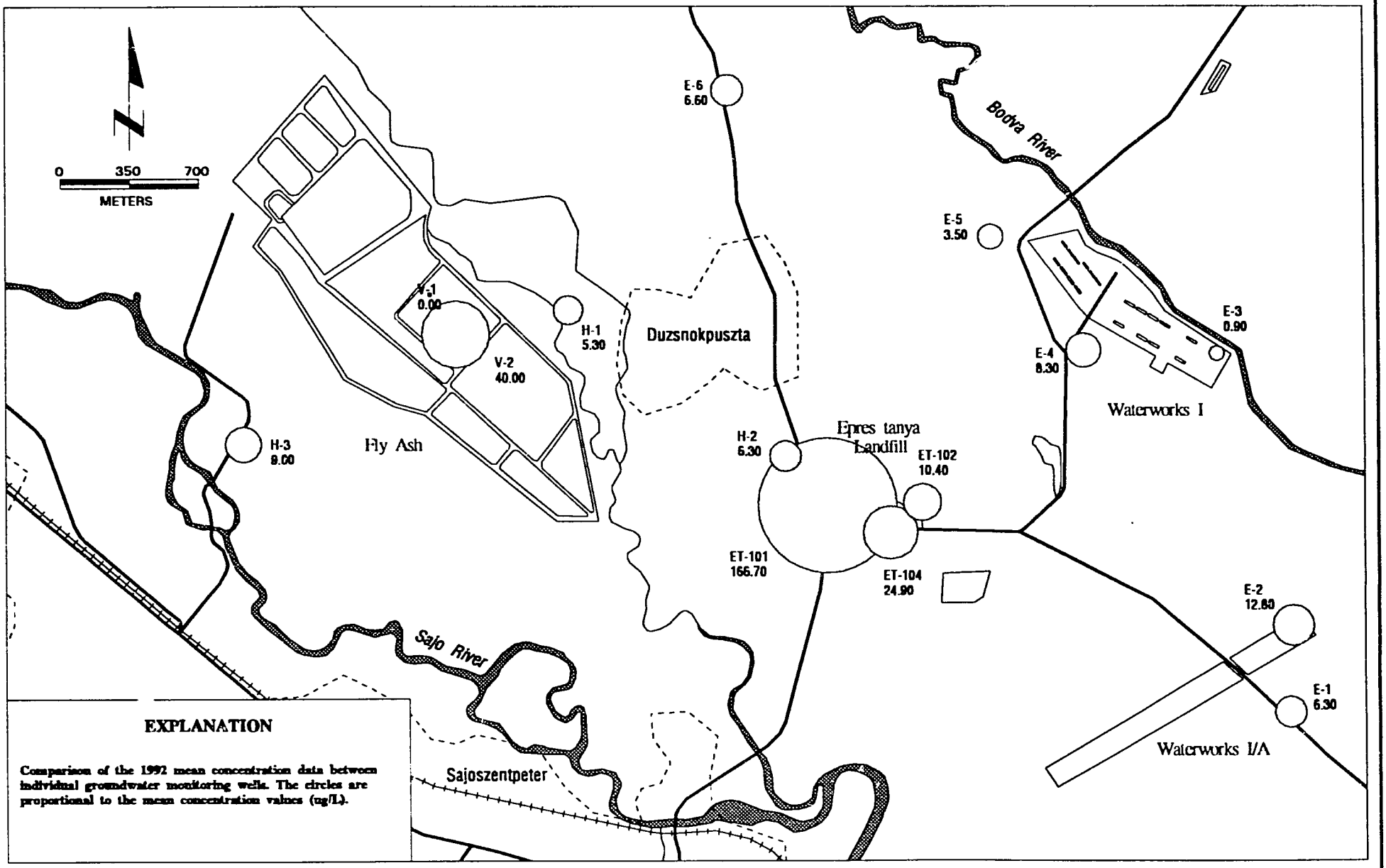


Figure 40. Zinc Concentrations at Selected Monitoring Wells

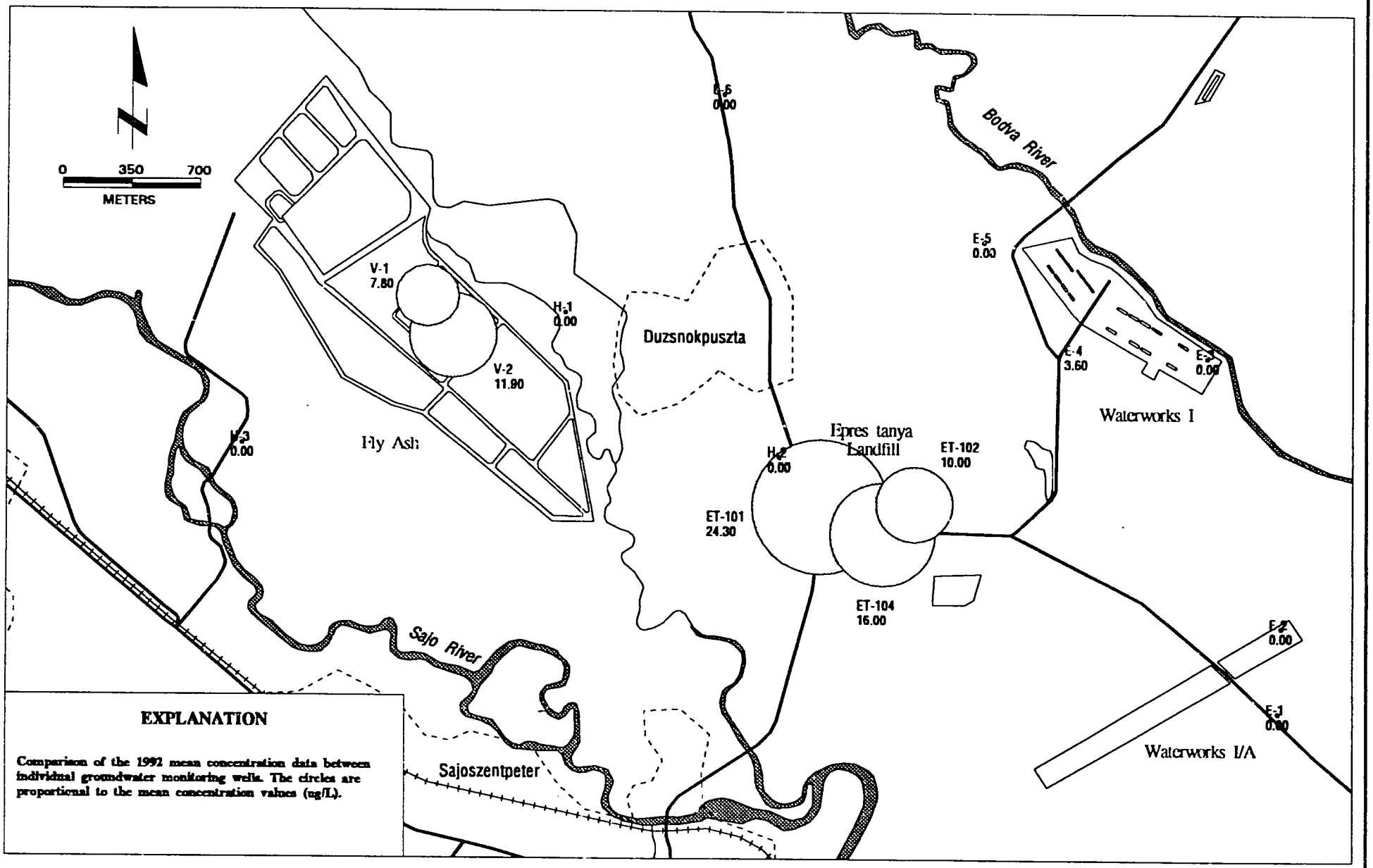


Figure 41. Nickel Concentrations at Selected Monitoring Wells

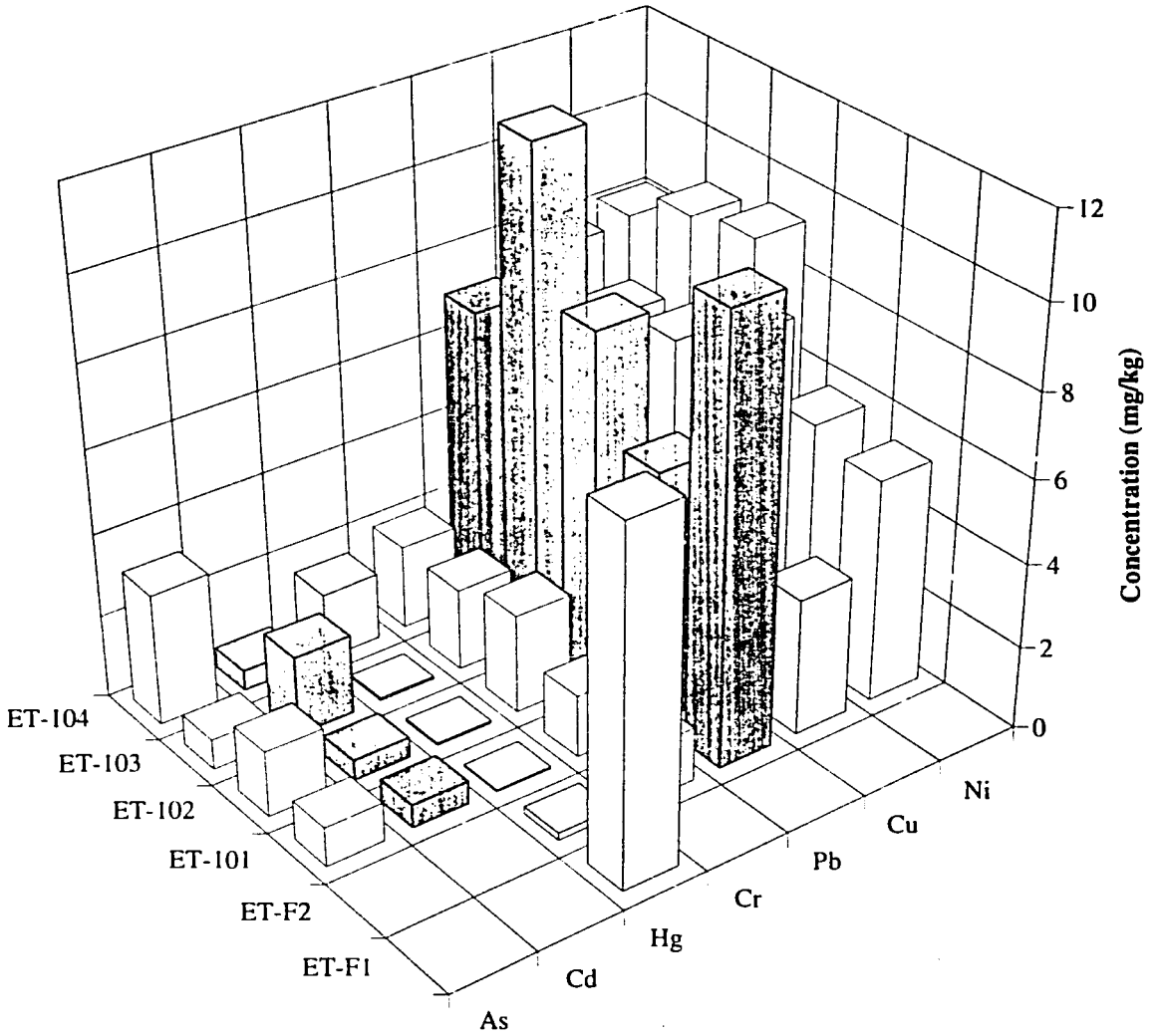


Figure 42. Mean Metals Concentrations in KÚTFÖ Soil Samples at Epres-Tanya Landfill

Time (years)	Concentration at Receptor (mg/L)		
	Koc=30	Koc=120	Koc=1500
2	1.53E-08	1.74E-09	3.38E-16
4	6.24E-05	2.24E-05	1.42E-12
6	7.99E-04	4.28E-04	9.54E-09
8	2.48E-03	1.64E-03	7.33E-07
10	4.45E-03	3.34E-03	9.45E-06
12	6.16E-03	5.04E-03	5.00E-05
14	7.43E-03	6.46E-03	1.60E-04
16	8.30E-03	7.53E-03	3.71E-04
18	8.87E-03	8.29E-03	6.99E-04
20	9.23E-03	8.81E-03	1.14E-03
22	9.45E-03	9.16E-03	1.67E-03
24	9.59E-03	9.38E-03	2.27E-03
26	9.61E-03	9.51E-03	2.91E-03
28	8.92E-03	9.20E-03	3.56E-03
30	7.27E-03	8.05E-03	4.19E-03
32	5.32E-03	6.39E-03	4.79E-03
34	3.62E-03	4.71E-03	5.33E-03
36	2.36E-03	3.31E-03	5.75E-03
38	1.49E-03	2.25E-03	6.02E-03
40	9.24E-04	1.50E-03	6.13E-03

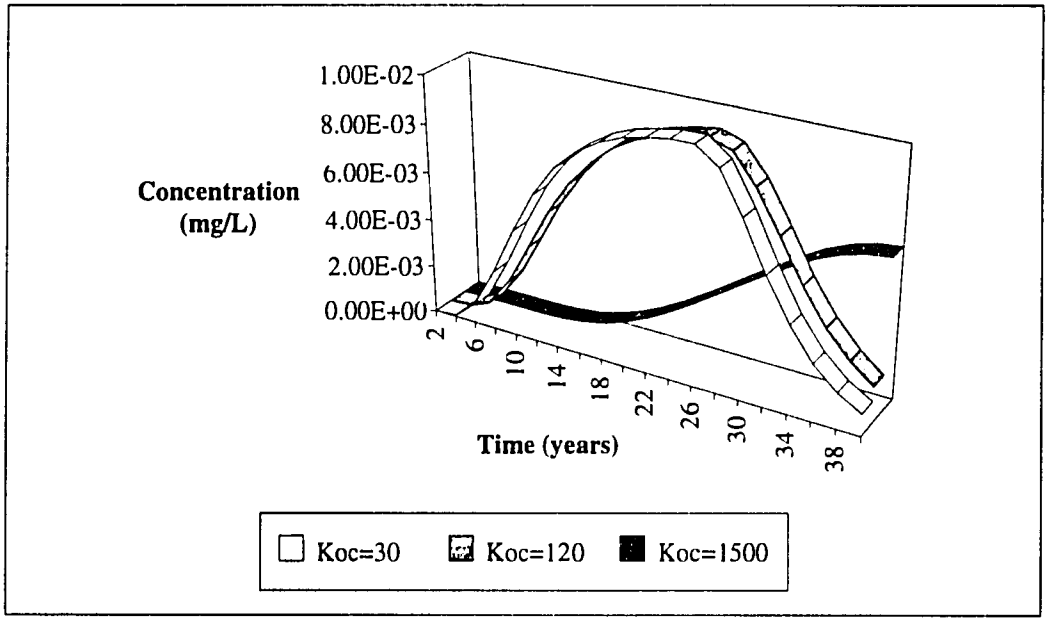


Figure 43. Results of Multimed Analysis
(Aquifer Fractional Carbon = 0.0002, Pulse Duration = 22 Years)

Time (years)	Concentration at Receptor (mg/L)		
	Koc=30	Koc=120	Koc=1500
2	3.59E-09	5.08E-12	3.38E-16
4	3.16E-05	1.36E-06	3.38E-16
6	5.28E-04	7.41E-05	3.38E-16
8	1.89E-03	4.89E-04	9.22E-15
10	3.69E-03	1.40E-03	5.15E-12
12	5.41E-03	2.65E-03	3.43E-10
14	6.79E-03	4.01E-03	6.78E-09
16	7.80E-03	5.27E-03	6.27E-08
18	8.50E-03	6.35E-03	3.49E-07
20	8.96E-03	7.23E-03	1.37E-06
22	9.27E-03	7.91E-03	4.14E-06
24	9.46E-03	8.42E-03	1.03E-05
26	9.56E-03	8.80E-03	2.22E-05
28	9.14E-03	9.01E-03	4.26E-05
30	7.83E-03	8.80E-03	7.44E-05
32	6.06E-03	8.03E-03	1.21E-04
34	4.36E-03	6.89E-03	1.83E-04
36	2.99E-03	5.61E-03	2.65E-04
38	1.99E-03	4.40E-03	3.67E-04
40	1.29E-03	3.35E-03	4.90E-04

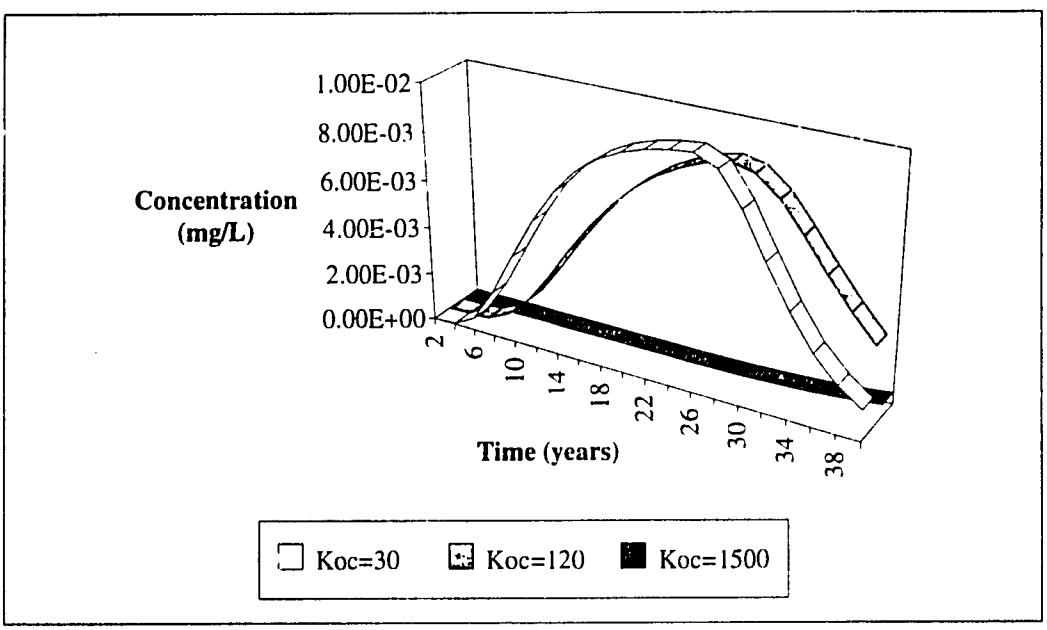


Figure 44. Results of Multimed Analysis
(Aquifer Fractional Carbon = 0.0006, Pulse Duration = 22 Years)

Time (years)	Concentration at Receptor (mg/L)		
	Koc=30	Koc=120	Koc=1500
2	8.40E-10	1.44E-14	3.38E-16
4	1.58E-05	7.80E-08	3.38E-16
6	3.46E-04	1.19E-05	3.38E-16
8	1.42E-03	1.33E-04	3.38E-16
10	3.02E-03	5.29E-04	3.38E-16
12	4.69E-03	1.26E-03	1.71E-15
14	6.13E-03	2.23E-03	2.01E-13
16	7.25E-03	3.32E-03	7.10E-12
18	8.07E-03	4.41E-03	1.13E-10
20	8.64E-03	5.41E-03	1.02E-09
22	9.03E-03	6.28E-03	6.17E-09
24	9.30E-03	7.02E-03	2.75E-08
26	9.45E-03	7.63E-03	9.66E-08
28	9.24E-03	8.10E-03	2.83E-07
30	8.24E-03	8.36E-03	7.14E-07
32	6.69E-03	8.27E-03	1.60E-06
34	5.05E-03	7.78E-03	3.24E-06
36	3.63E-03	6.98E-03	6.06E-06
38	2.52E-03	6.03E-03	1.06E-05
40	1.71E-03	5.05E-03	1.74E-05

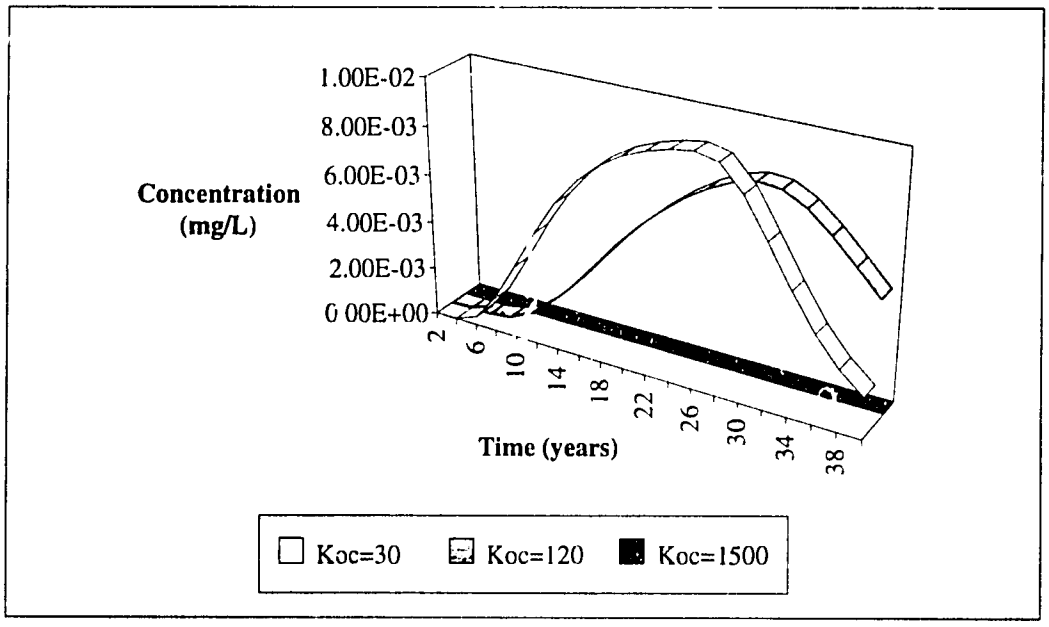


Figure 45. Resuits of Multimed Analysis
(Aquifer Fractional Carbon = 0.001, Pulse Duration = 22 Years)

Time (years)	Concentration at Receptor (mg/L)		
	Koc=30	Koc=120	Koc=1500
5	2.97E-04	1.35E-04	2.85E-10
10	4.45E-03	3.34E-03	9.45E-06
15	7.91E-03	7.04E-03	2.51E-04
20	9.23E-03	8.81E-03	1.14E-03
25	9.64E-03	9.46E-03	2.59E-03
30	9.75E-03	9.69E-03	4.19E-03
35	9.78E-03	9.76E-03	5.65E-03
40	9.79E-03	9.79E-03	6.83E-03
45	9.80E-03	9.79E-03	7.73E-03
50	9.80E-03	9.80E-03	8.38E-03
55	9.50E-03	9.66E-03	8.83E-03
60	5.35E-03	6.46E-03	9.14E-03
65	1.89E-03	2.76E-03	9.11E-03
70	5.68E-04	9.88E-04	8.37E-03
75	1.62E-04	3.34E-04	7.02E-03
80	4.56E-05	1.08E-04	5.48E-03
85	1.28E-05	3.51E-05	4.06E-03
90	3.58E-06	1.13E-05	2.91E-03
95	1.01E-06	3.66E-06	2.03E-03
100	2.86E-07	1.19E-06	1.40E-03

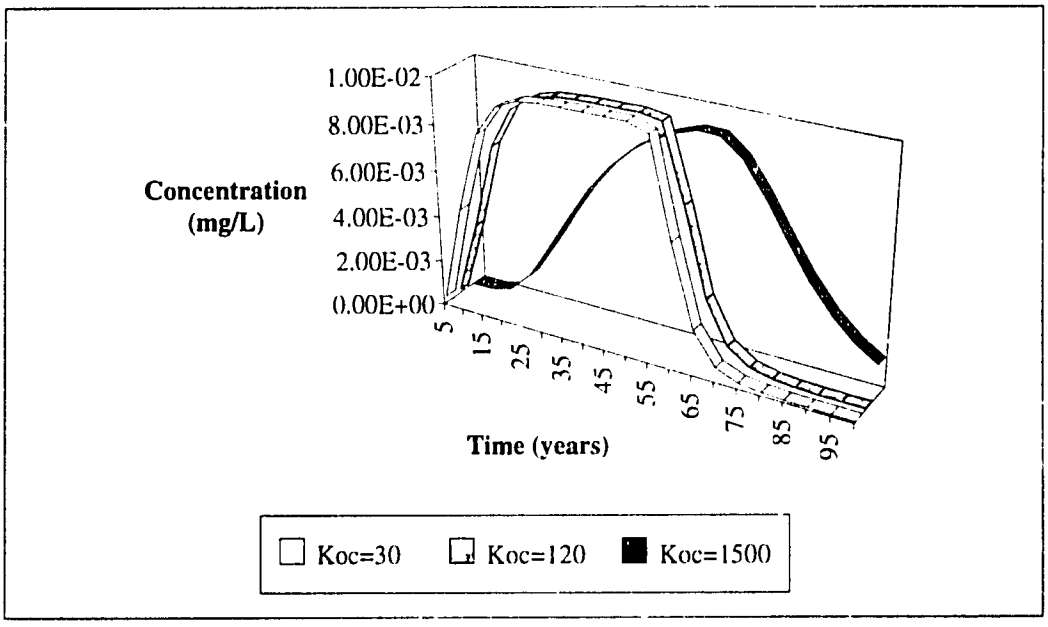


Figure 46. Results of Multimed Analysis
(Aquifer Fractional Carbon = 0.0002, Pulse Duration = 50 Years)

Time (years)	Concentration at Receptor (mg/L)		
	Koc=30	Koc=120	Koc=1500
5	1.76E-04	1.53E-05	3.38E-16
10	3.69E-03	1.40E-03	5.15E-12
15	7.34E-03	4.66E-03	2.22E-08
20	8.96E-03	7.23E-03	1.37E-06
25	9.53E-03	8.63E-03	1.54E-05
30	9.71E-03	9.29E-03	7.44E-05
35	9.77E-03	9.58E-03	2.22E-04
40	9.79E-03	9.71E-03	4.90E-04
45	9.80E-03	9.76E-03	8.88E-04
50	9.80E-03	9.78E-03	1.40E-03
55	9.62E-03	9.78E-03	2.00E-03
60	6.11E-03	8.40E-03	2.66E-03
65	2.46E-03	5.14E-03	3.34E-03
70	8.35E-04	2.57E-03	4.01E-03
75	2.66E-04	1.17E-03	4.65E-03
80	8.29E-05	5.10E-04	5.20E-03
85	2.58E-05	2.17E-04	5.62E-03
90	7.94E-06	9.16E-05	5.87E-03
95	2.46E-06	3.87E-05	5.93E-03
100	7.68E-07	1.62E-05	5.83E-03

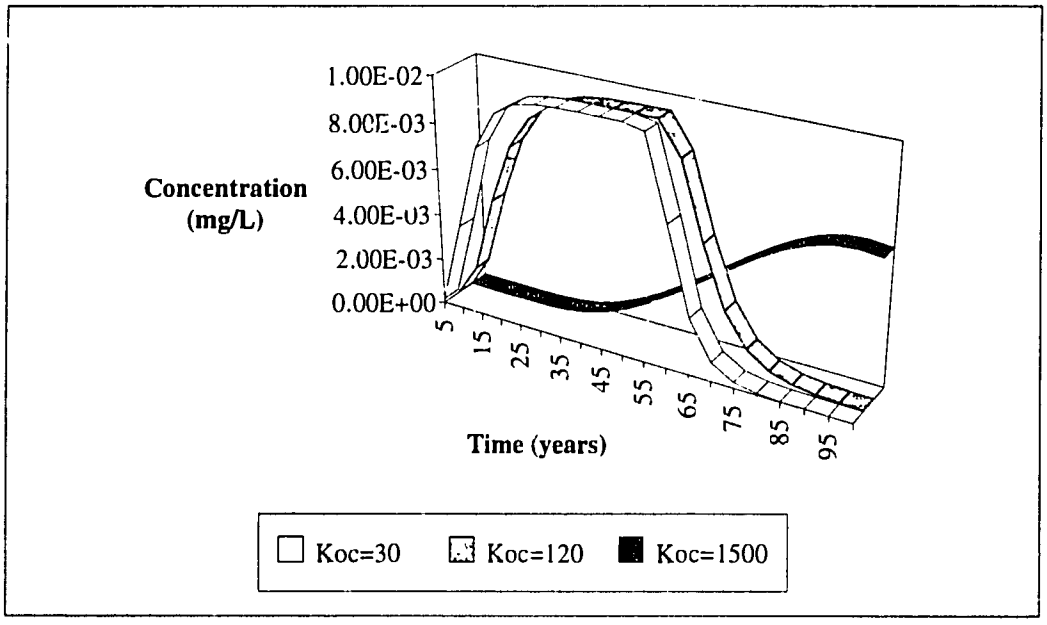


Figure 47. Results of Multimed Analysis (Aquifer Fractional Carbon = 0.0006, Pulse Duration = 50 Years)

Time (years)	Concentration at Receptor (mg/L)		
	Koc=30	Koc=120	Koc=1500
5	1.04E-04	1.62E-06	3.38E-16
10	3.02E-03	5.29E-04	3.38E-16
15	6.73E-03	2.77E-03	1.35E-12
20	8.64E-03	5.41E-03	1.02E-09
25	9.39E-03	7.34E-03	5.29E-08
30	9.66E-03	8.50E-03	7.14E-07
35	9.75E-03	9.13E-03	4.48E-06
40	9.78E-03	9.46E-03	1.74E-05
45	9.79E-03	9.63E-03	4.92E-05
50	9.80E-03	9.71E-03	1.11E-04
55	9.69E-03	9.75E-03	2.15E-04
60	6.78E-03	9.25E-03	3.66E-04
65	3.06E-03	7.01E-03	5.70E-04
70	1.15E-03	4.38E-03	8.26E-04
75	4.08E-04	2.46E-03	1.13E-03
80	1.38E-04	1.30E-03	1.47E-03
85	4.66E-05	6.65E-04	1.85E-03
90	1.57E-05	3.38E-04	2.24E-03
95	5.29E-06	1.67E-04	2.63E-03
100	1.79E-06	8.26E-05	2.99E-03

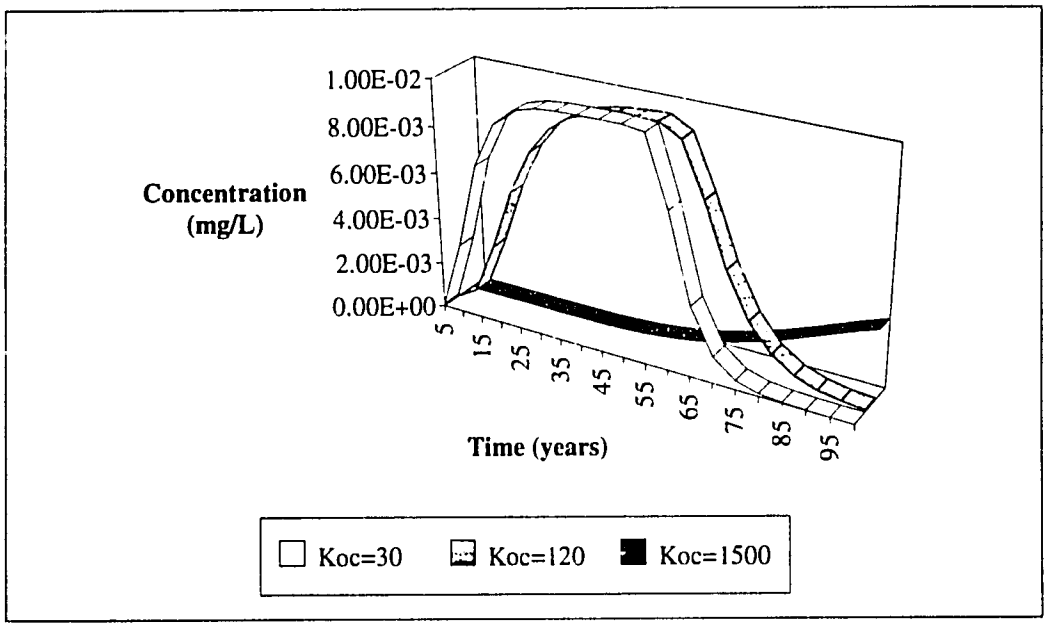


Figure 48. Results of Multimed Analysis
(Aquifer Fractional Carbon = 0.001, Pulse Duration = 50 Years)

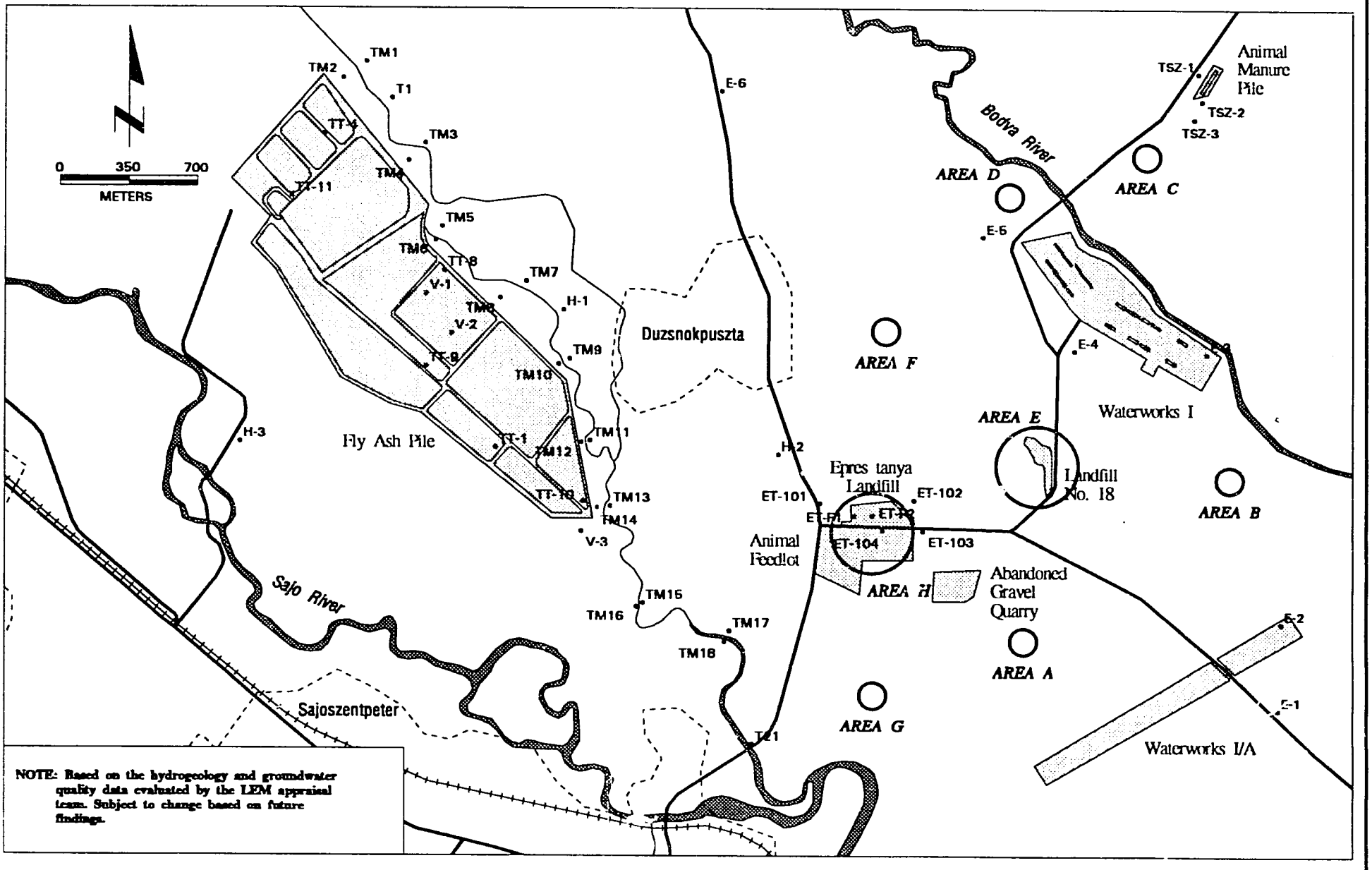


Figure 49. Preliminary Recommendations for Additional Monitoring Wells

Appendix C. Database of Major and Minor Ionic Constituents

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	TSZ-1	1990	9	6	1990.68	1.9	4.4	122	1190	273
ERV	TSZ-1	1990	10	18	1990.80	0.5	4.1	124	1310	242
ERV	TSZ-1	1990	11	13	1990.87	2.3	5.4	119	1049	270
ERV	TSZ-1	1990	12	14	1990.96	2	4.7	124	1030	265
ERV	TSZ-1	1991	1	29	1991.08	0	4.7	128	1180	246
ERV	TSZ-1	1991	2	25	1991.15	0	----	125	1160	217
ERV	TSZ-1	1991	3	21	1991.22	16.1	3.2	79	680	119
ERV	TSZ-1	1991	4	29	1991.33	7.9	3.9	138	1210	127
ERV	TSZ-1	1991	5	16	1991.38	0.3	3.9	138	1170	144
ERV	TSZ-1	1991	6	24	1991.48	1.1	5.1	139	1340	198
ERV	TSZ-1	1991	7	10	1991.53	0.9	4.5	139	1270	192
ERV	TSZ-1	1991	8	8	1991.61	6.5	5.7	135	1340	203
ERV	TSZ-1	1991	9	11	1991.70	0.2	3.6	140	1040	XXX
ERV	TSZ-1	1991	10	31	1991.83	7.1	1.51	146	1120	194
ERV	TSZ-1	1991	11	12	1991.87	3.7	3.3	152	1120	208
ERV	TSZ-1	1991	12	12	1991.95	4.2	1.6	148	1115	201
ERV	TSZ-1	1992	1	22	1992.06	7.7	3.27	196	1500	199
ERV	TSZ-1	1992	2	18	1992.13	0.9	4.3	178	1420	XXX
ERV	TSZ-1	1992	3	17	1992.21	0.3	6.6	143	1200	XXX
ERV	TSZ-1	1992	4	22	1992.31	0.1	4.4	206	1580	XXX
ERV	TSZ-1	1992	6	11	1992.45	1.9	1	152	1380	XXX
ERV	TSZ-1	1992	7	27	1992.57	1.8	3.9	155	1050	XXX
ERV	TSZ-1	1992	8	17	1992.63	5.7	5	158	----	XXX
ERV	TSZ-1	1992	9	14	1992.71	6.7	3.6	154	1400	XXX
ERV	TSZ-1	1992	10	7	1992.77	6.2	3	154	1370	XXX
ERV	TSZ-1	1992	11	24	1992.90	5.5	3.2	162	1350	XXX
ERV	TSZ-1	1992	12	11	1992.95	5.9	3	160	1370	XXX
ERV	TSZ-1	1993	1	15	1993.04	5.1	****	166	1660	XXX
ERV	TSZ-1	1993	2	15	1993.12	0.3	7.6	206	1970	XXX
ERV	TSZ-1	1993	3	25	1993.24	0.6	1.5	202	1910	XXX
ERV	TSZ-1	1993	4	23	1993.31	0.5	1.9	204	2000	XXX
ERV	TSZ-2	1990	9	6	1990.68	0.7	3.4	134	1360	235
ERV	TSZ-2	1990	10	18	1990.80	2.7	4.7	122	1330	223
ERV	TSZ-2	1990	11	13	1990.87	1.9	4.8	141	1194	251
ERV	TSZ-2	1990	12	14	1990.96	1.4	4.3	155	1205	231
ERV	TSZ-2	1991	1	29	1991.08	0	4.2	153	1380	267
ERV	TSZ-2	1991	2	25	1991.15	0	4.9	156	1365	197
ERV	TSZ-2	1991	3	21	1991.22	1.2	2.6	140	1380	218
ERV	TSZ-2	1991	4	29	1991.33	2.1	3.32	152	1390	231
ERV	TSZ-2	1991	5	16	1991.38	0.6	3.7	153	1320	249
ERV	TSZ-2	1991	6	24	1991.48	0.9	3.5	67	1680	129
ERV	TSZ-2	1991	7	10	1991.53	0.7	3.3	67	1520	149
ERV	TSZ-2	1991	8	8	1991.61	1.5	4.9	174	1520	155
ERV	TSZ-2	1991	9	11	1991.70	0.1	4	181	1300	XXX
ERV	TSZ-2	1991	10	31	1991.83	1.4	0.45	168	1230	174

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	TSZ-2	1991	11	12	1991.87	0.9	2.5	173	1200	153
ERV	TSZ-2	1991	12	12	1991.95	1.1	0.9	170	1220	161
ERV	TSZ-2	1992	1	22	1992.06	1.9	3.62	195	1500	179
ERV	TSZ-2	1992	2	18	1992.13	0.5	4.8	213	1900	XXX
ERV	TSZ-2	1992	3	17	1992.21	0.2	6	205	1460	XXX
ERV	TSZ-2	1992	4	22	1992.31	0.5	5.4	151	1610	XXX
ERV	TSZ-2	1992	6	11	1992.45	1.4	1.1	232	1740	XXX
ERV	TSZ-2	1992	7	27	1992.57	1	2.7	195	2140	XXX
ERV	TSZ-2	1992	8	17	1992.63	5.6	4.4	200	1700	XXX
ERV	TSZ-2	1992	9	14	1992.71	2.8	3.4	191	1590	XXX
ERV	TSZ-2	1992	10	7	1992.77	2.2	2.8	190	1560	XXX
ERV	TSZ-2	1992	11	24	1992.90	3	2.6	190	1660	XXX
ERV	TSZ-2	1992	12	11	1992.95	3.3	2.3	187	1630	XXX
ERV	TSZ-2	1993	1	15	1993.04	3	****	190	1708	XXX
ERV	TSZ-2	1993	2	15	1993.12	0.2	6.6	208	1920	XXX
ERV	TSZ-2	1993	3	25	1993.24	0.3	0.7	200	1910	XXX
ERV	TSZ-2	1993	4	23	1993.31	0.4	1.2	205	1950	XXX
ERV	TSZ-3	1990	9	6	1990.68	0.8	0.37	44	980	268
ERV	TSZ-3	1990	10	18	1990.80	43	0.22	100	1290	375
ERV	TSZ-3	1990	11	13	1990.87	1.1	0.73	45	804	270
ERV	TSZ-3	1990	12	14	1990.96	1.1	0.6	55	790	249
ERV	TSZ-3	1991	1	29	1991.08	0	0.7	55	940	267
ERV	TSZ-3	1991	2	25	1991.15	0	0.98	65	975	257
ERV	TSZ-3	1991	3	21	1991.22	0.7	0.31	68	1020	266
ERV	TSZ-3	1991	4	29	1991.33	1.1	0.92	60	1010	274
ERV	TSZ-3	1991	5	16	1991.38	1.1	0.9	60	940	266
ERV	TSZ-3	1991	6	24	1991.48	2.6	0.28	59	1100	258
ERV	TSZ-3	1991	7	10	1991.53	2.2	0.2	59	1040	262
ERV	TSZ-3	1991	8	8	1991.61	2.5	0.37	58	1030	289
ERV	TSZ-3	1991	9	11	1991.70	0.4	0.2	67	880	XXX
ERV	TSZ-3	1991	10	31	1991.83	1.8	0.23	72	895	220
ERV	TSZ-3	1991	11	12	1991.87	1	0.2	65	825	244
ERV	TSZ-3	1991	12	12	1991.95	1.1	0.21	68	845	232
ERV	TSZ-3	1992	1	22	1992.06	1.8	0.21	60	800	222
ERV	TSZ-3	1992	2	18	1992.13	0.3	0.43	89	1500	XXX
ERV	TSZ-3	1992	3	17	1992.21	0.2	0.02	79	1020	XXX
ERV	TSZ-3	1992	4	22	1992.31	0.3	6.5	30	1400	XXX
ERV	TSZ-3	1992	6	11	1992.45	2.6	0.43	73	1070	XXX
ERV	TSZ-3	1992	7	27	1992.57	1.9	2.9	38	1420	XXX
ERV	TSZ-3	1992	8	17	1992.63	5.3	0.36	70	1125	XXX
ERV	TSZ-3	1992	9	14	1992.71	2.4	0.44	78	1070	XXX
ERV	TSZ-3	1992	10	7	1992.77	2.1	0.4	76	1090	XXX
ERV	TSZ-3	1992	11	24	1992.90	2.5	0.6	80	1660	XXX
ERV	TSZ-3	1992	12	11	1992.95	2.9	0.5	78	1110	XXX
ERV	TSZ-3	1993	1	15	1993.04	2.3	0.7	77	1178	XXX

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	TSZ-3	1993	2	15	1993.12	1.5	0.26	90	1350	XXX
ERV	TSZ-3	1993	3	25	1993.24	1.7	0.01	90	137	XXX
ERV	TSZ-3	1993	4	23	1993.31	1.7	0.1	87	1425	XXX
ERV	ET-101	1992	4	6	1992.27	XXX	XXX	XXX	1430	XXX
ERV	ET-101	1992	8	24	1992.65	XXX	XXX	XXX	XXX	XXX
ERV	ET-101	1992	10	13	1992.79	----	0.16	----	----	XXX
ERV	ET-101	1992	11	9	1992.86	----	0.3	----	----	XXX
ERV	ET-101	1992	12	1	1992.92	----	0.16	----	1440	XXX
ERV	ET-101	1993	1	6	1993.02	----	0.01	----	1380	XXX
ERV	ET-101	1993	2	8	1993.11	6.2	0.12	206	1880	372
ERV	ET-101	1993	3	11	1993.20	4.3	0.04	199	1810	650
ERV	ET-101	1993	4	20	1993.30	4.8	0.01	192	1880	489
ERV	ET-102	1993	2	8	1993.11	15.8	0.96	186	1840	430
ERV	ET-103	1993	2	8	1993.11	0.1	9.2	36	720	76
ERV	ET-104	1992	4	6	1992.27	XXX	XXX	XXX	3050	XXX
ERV	ET-104	1992	7	28	1992.58	XXX	XXX	XXX	1600	XXX
ERV	ET-104	1992	8	24	1992.65	XXX	XXX	XXX	690	XXX
ERV	ET-104	1992	10	13	1992.79	----	2.8	----	----	XXX
ERV	ET-104	1992	11	9	1992.86	----	0.2	----	----	XXX
ERV	ET-104	1992	12	1	1992.92	----	1.6	----	3950	XXX
ERV	ET-104	1993	1	6	1993.02	----	****	----	3350	XXX
ERV	ET-104	1993	2	8	1993.11	3.9	****	101	4280	290
ERV	ET-104	1993	3	11	1993.20	10.6	****	50	4300	552
ERV	ET-104	1993	4	20	1993.30	4.9	8.1	1160	4500	364
ERV	BVK-50	1991	1	24	1991.07	45	8.2	292	3480	883
ERV	E-1	1981	11	18	1981.88	3.2	0.04	72	1280	460
ERV	E-1	1990	1	4	1990.01	9.1	0.02	80	1350	XXX
ERV	E-1	1990	2	8	1990.11	16.9	0.1	79	1319	XXX
ERV	E-1	1990	3	14	1990.21	8.7	0.06	121	1488	578
ERV	E-1	1990	4	21	1990.31	1.9	0.04	81	1208	578
ERV	E-1	1990	5	3	1990.34	22	0	84	1345	576
ERV	E-1	1990	6	21	1990.47	26	0.03	81	1488	597
ERV	E-1	1990	7	19	1990.55	23	0.07	85	1274	585
ERV	E-1	1990	8	8	1990.61	XXX	XXX	XXX	XXX	XXX
ERV	E-1	1990	9	6	1990.68	19.5	0.09	82	1420	564
ERV	E-1	1990	10	18	1990.80	15.4	0.04	74	1300	513
ERV	E-1	1990	11	13	1990.87	17.6	0.14	79	1010	541
ERV	E-1	1990	12	1	1990.92	11.4	0.06	77	1270	657
ERV	E-1	1991	1	24	1991.07	8	0.07	79	1320	616
ERV	E-1	1991	2	21	1991.14	5.9	0.06	74	1280	598

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	E-1	1991	3	27	1991.24	14.9	0.09	72	1220	607
ERV	E-1	1991	4	23	1991.31	11.3	0.09	79	1340	643
ERV	E-1	1991	5	16	1991.38	10.2	0.18	76	1250	671
ERV	E-1	1991	6	18	1991.47	8.2	0.11	72	1520	445
ERV	E-1	1991	7	24	1991.57	----	----	----	1641	XXX
ERV	E-1	1991	8	27	1991.66	9.5	0.05	74	1450	441
ERV	E-1	1991	9	17	1991.71	8.7	0.02	74	1640	470
ERV	E-1	1991	10	18	1991.80	15.4	0.04	74	1300	513
ERV	E-1	1991	10	30	1991.83	3.2	0.04	67	1140	442
ERV	E-1	1991	11	13	1991.87	17.6	0.14	79	1310	541
ERV	E-1	1991	11	18	1991.88	3.2	0.04	72	1280	460
ERV	E-1	1991	12	12	1991.95	2.7	0.09	72	1320	322
ERV	E-1	1992	1	13	1992.04	4.8	0.1	75	1220	463
ERV	E-1	1992	2	17	1992.13	2.1	0.14	74	1345	361
ERV	E-1	1992	3	9	1992.19	3.5	0.07	74	1265	475
ERV	E-1	1992	4	6	1992.27	5.4	0.12	73	1380	440
ERV	E-1	1992	5	12	1992.37	4.2	0.08	72	1400	430
ERV	E-1	1992	6	15	1992.46	9.3	0.02	75	1450	459
ERV	E-1	1992	7	28	1992.58	16	0.07	78	1450	452
ERV	E-1	1992	8	24	1992.65	10.9	0.07	80	1600	462
ERV	E-1	1992	9	22	1992.73	11	0.06	75	1320	494
ERV	E-1	1992	10	13	1992.79	11	0.06	73	----	495
ERV	E-1	1992	11	11	1992.86	10	0.03	73	----	490
ERV	E-1	1992	12	1	1992.92	9.4	0.02	74	1380	437
ERV	E-1	1993	1	6	1993.02	9	0.06	72	1320	530
ERV	E-1	1993	2	8	1993.11	4.1	0.03	76	1880	500
ERV	E-1	1993	3	11	1993.20	4.2	0.01	80	1720	770
ERV	E-1	1993	4	20	1993.30	3.6	0.02	86	1860	660
ERV	E-2	1981	11	18	1981.88	0.5	0.23	47	970	422
ERV	E-2	1990	1	3	1990.01	1.9	0.22	45	1108	XXX
ERV	E-2	1990	2	1	1990.09	2.4	0.29	46	1108	XXX
ERV	E-2	1990	3	14	1990.21	3.8	0.11	49	1208	499
ERV	E-2	1990	4	21	1990.31	1.9	0.17	55	1208	485
ERV	E-2	1990	5	3	1990.34	0.8	0.16	49	1102	490
ERV	E-2	1990	6	21	1990.47	1.9	1.12	48	1234	558
ERV	E-2	1990	7	19	1990.55	2	0.19	47	1060	503
ERV	E-2	1990	8	2	1990.59	0.3	0.22	45	1115	XXX
ERV	E-2	1990	9	6	1990.68	2.2	0.22	43	1170	513
ERV	E-2	1990	10	18	1990.80	0.8	0.05	41	1010	513
ERV	E-2	1990	11	13	1990.87	3.6	0.28	41	1109	502
ERV	E-2	1990	12	1	1990.92	0.3	0.13	41	1025	555
ERV	E-2	1991	1	24	1991.07	0.3	0.19	47	1075	513
ERV	E-2	1991	2	21	1991.14	0.8	0.21	46	970	513
ERV	E-2	1991	3	27	1991.24	0.3	0.29	62	965	519
ERV	E-2	1991	4	23	1991.31	0.5	0.26	49	1020	521

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	E-2	1991	5	16	1991.38	1.4	0.31	49	980	532
ERV	E-2	1991	6	18	1991.47	1	0.24	48	1180	395
ERV	E-2	1991	7	24	1991.57	----	----	----	1282	XXX
ERV	E-2	1991	8	27	1991.66	1.9	0.24	47	1130	407
ERV	E-2	1991	9	17	1991.71	1.9	0.18	48	1120	402
ERV	E-2	1991	10	30	1991.83	0.5	0.21	47	875	364
ERV	E-2	1991	11	18	1991.88	0.5	0.23	47	970	422
ERV	E-2	1991	12	12	1991.95	0.7	0.17	45	980	308
ERV	E-2	1992	1	13	1992.04	0.8	0.26	48	895	369
ERV	E-2	1992	2	17	1992.13	0.4	0.12	47	970	333
ERV	E-2	1992	3	9	1992.19	0.5	0.11	48	920	436
ERV	E-2	1992	4	6	1992.27	0.5	0.11	45	1000	439
ERV	E-2	1992	5	12	1992.37	0.9	0.1	50	1000	440
ERV	E-2	1992	6	15	1992.46	0.6	0.13	46	1035	389
ERV	E-2	1992	7	27	1992.57	1.1	0.22	45	1030	331
ERV	E-2	1992	8	24	1992.65	0.5	0.25	45	1100	407
ERV	E-2	1992	9	22	1992.73	0.4	0.37	45	960	380
ERV	E-2	1992	10	3	1992.76	0.4	0.25	73	----	400
ERV	E-2	1992	10	13	1992.79	0.4	0.25	73	----	400
ERV	E-2	1992	11	11	1992.86	0.4	0.25	71	----	400
ERV	E-2	1992	12	1	1992.92	0.8	0.28	70	1050	384
ERV	E-2	1993	1	6	1993.02	0.9	0.25	43	970	430
ERV	E-2	1993	2	8	1993.11	0.1	0.19	42	1347	390
ERV	E-2	1993	3	11	1993.20	0.2	0.13	40	1230	556
ERV	E-2	1993	4	20	1993.30	2.3	0.14	40	1280	466
ERV	E-3	1981	11	18	1981.88	5.4	0.04	36	570	116
ERV	E-3	1990	1	3	1990.01	7.1	0.02	37	691	XXX
ERV	E-3	1990	2	1	1990.09	8.8	0.13	38	708	XXX
ERV	E-3	1990	3	14	1990.21	5.7	0	42	797	166
ERV	E-3	1990	4	21	1990.31	2.3	0.02	47	823	157
ERV	E-3	1990	5	3	1990.34	0	0.01	40	712	160
ERV	E-3	1990	6	21	1990.47	0.4	0.8	36	717	147
ERV	E-3	1990	7	19	1990.55	3.4	0.07	33	564	156
ERV	E-3	1990	8	2	1990.59	3.9	0.06	32	1120	XXX
ERV	E-3	1990	9	6	1990.68	0.5	0.07	41	820	169
ERV	E-3	1990	10	18	1990.80	0.2	0.18	42	1075	162
ERV	E-3	1990	11	13	1990.87	1.8	0.27	42	890	184
ERV	E-3	1990	12	1	1990.92	0.3	0.06	40	610	175
ERV	E-3	1991	1	24	1991.07	3.1	0.08	37	650	143
ERV	E-3	1991	3	27	1991.24	78.1	0.12	45	460	149
ERV	E-3	1991	4	23	1991.31	3.9	0.17	39	650	168
ERV	E-3	1991	5	16	1991.38	5.2	0.18	37	540	174
ERV	E-3	1991	6	18	1991.47	6.7	0.09	24	690	114
ERV	E-3	1991	7	24	1991.57	6.44	0.06	34	718	XXX
ERV	E-3	1991	8	27	1991.66	3.9	0.09	27	610	126

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	E-3	1991	9	17	1991.71	4.8	0.08	30	680	112
ERV	E-3	1991	10	30	1991.83	3.3	0.04	37	550	115
ERV	E-3	1991	11	18	1991.88	5.4	0.04	36	570	116
ERV	E-3	1991	12	12	1991.95	5.6	0.03	23	480	54
ERV	E-3	1992	1	13	1992.04	10.7	0.13	31	520	109
ERV	E-3	1992	2	17	1992.13	10.2	0.06	38	580	111
ERV	E-3	1992	3	9	1992.19	17.1	0.03	39	580	138
ERV	E-3	1992	4	6	1992.27	11.8	0.02	32	530	107
ERV	E-3	1992	5	12	1992.37	12.4	0.05	38	510	112
ERV	E-3	1992	6	15	1992.46	7.8	0.05	33	610	100
ERV	E-3	1992	7	28	1992.58	7.9	0.06	31	610	111
ERV	E-3	1992	8	24	1992.65	6.5	0.08	34	660	116
ERV	E-3	1992	9	22	1992.73	6.8	0.06	33	525	102
ERV	E-3	1992	10	13	1992.79	6.3	0.16	33	----	110
ERV	E-3	1992	11	11	1992.86	6	0.02	33	----	103
ERV	E-3	1992	12	1	1992.92	23.6	0.1	33	820	185
ERV	E-3	1993	1	6	1993.02	14.9	0.01	36	550	130
ERV	E-3	1993	2	8	1993.11	10.7	0.01	60	890	139
ERV	E-3	1993	3	11	1993.20	21	0.03	40	730	140
ERV	E-3	1993	4	20	1993.30	11	0.03	36	980	119
ERV	E-4	1981	11	18	1981.88	72	0.03	132	1320	436
ERV	E-4	1990	1	3	1990.01	68	0	114	1435	XXX
ERV	E-4	1990	2	1	1990.09	76	0	118	1456	XXX
ERV	E-4	1990	3	14	1990.21	87	0.06	121	797	460
ERV	E-4	1990	4	21	1990.31	82	0.01	115	1488	455
ERV	E-4	1990	5	3	1990.34	82	0	125	1430	451
ERV	E-4	1990	6	21	1990.47	70	0.07	116	1488	480
ERV	E-4	1990	7	19	1990.55	69	0.07	129	1389	471
ERV	E-4	1990	8	2	1990.59	83	0.14	128	1580	XXX
ERV	E-4	1990	9	6	1990.68	77	0.07	124	1440	452
ERV	E-4	1990	10	18	1990.80	74	0.05	128	1440	513
ERV	E-4	1990	11	13	1990.87	70	0.14	136	1320	413
ERV	E-4	1990	12	1	1990.92	73	0.04	124	1400	555
ERV	E-4	1991	1	24	1991.07	62	0.06	111	1370	513
ERV	E-4	1991	2	21	1991.14	77	0.06	116	1260	525
ERV	E-4	1991	3	27	1991.24	83.4	0.14	128	1350	529
ERV	E-4	1991	4	23	1991.31	64	0.1	134	1350	544
ERV	E-4	1991	5	16	1991.38	69.4	0.11	133	1320	546
ERV	E-4	1991	6	18	1991.47	68.5	0.11	141	1550	324
ERV	E-4	1991	7	24	1991.57	65.3	0.02	141.8	1641	XXX
ERV	E-4	1991	8	27	1991.66	70.9	0.04	147	1520	351
ERV	E-4	1991	9	17	1991.71	68	0.09	142	1410	349
ERV	E-4	1991	10	30	1991.83	65.4	0.04	137	1225	368
ERV	E-4	1991	11	18	1991.88	72	0.03	132	1320	436
ERV	E-4	1991	12	12	1991.95	66	0.04	135	1400	250

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Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	E-4	1992	1	13	1992.04	61.5	0.09	138	1210	325
ERV	E-4	1992	2	17	1992.13	68.8	0.03	123	1260	362
ERV	E-4	1992	3	9	1992.19	56.3	0.02	120	1180	405
ERV	E-4	1992	4	6	1992.27	59.6	0.01	125	1280	361
ERV	E-4	1992	5	12	1992.37	61	0.01	100	1260	360
ERV	E-4	1992	6	15	1992.46	69.6	0.04	115	1280	400
ERV	E-4	1992	7	28	1992.58	68	0.08	119	1350	382
ERV	E-4	1992	8	24	1992.65	60.3	0.07	126	1470	394
ERV	E-4	1992	9	22	1992.73	54.5	0.04	151	1230	360
ERV	E-4	1992	10	13	1992.79	51.4	0.1	153	----	376
ERV	E-4	1992	11	11	1992.86	56	0.02	156	XXX	XXX
ERV	E-4	1992	12	1	1992.92	63	0.01	154	1270	331
ERV	E-4	1993	1	6	1993.02	70	0.01	115	1180	380
ERV	E-4	1993	2	8	1993.11	73	0.02	120	1650	400
ERV	E-4	1993	3	11	1993.20	78	0.02	119	1470	506
ERV	E-4	1993	4	20	1993.30	74.7	0.01	123	1680	306
ERV	E-5	1981	11	18	1981.88	14.5	0.08	32	620	182
ERV	E-5	1990	1	3	1990.01	4.6	0	30	675	XXX
ERV	E-5	1990	2	1	1990.09	4.9	0.01	30	654	XXX
ERV	E-5	1990	3	6	1990.18	6.8	0.04	33	696	147
ERV	E-5	1990	4	11	1990.28	4.8	0	31	675	147
ERV	E-5	1990	5	3	1990.34	2.5	0	32	612	145
ERV	E-5	1990	6	21	1990.47	3.1	0.02	32	654	157
ERV	E-5	1990	7	19	1990.55	2.9	0.05	31	589	143
ERV	E-5	1990	8	2	1990.59	6.9	0.05	33	670	XXX
ERV	E-5	1990	9	6	1990.68	8.6	0.05	31	670	61
ERV	E-5	1990	10	18	1990.80	7.9	0.03	34	610	162
ERV	E-5	1990	11	13	1990.87	9	0.11	33	740	129
ERV	E-5	1990	12	1	1990.92	7.4	0	33	620	195
ERV	E-5	1991	1	24	1991.07	6.3	0.04	37	720	202
ERV	E-5	1991	2	21	1991.14	8.1	0.06	36	650	200
ERV	E-5	1991	3	27	1991.24	7.5	0.1	27	590	219
ERV	E-5	1991	4	23	1991.31	12.6	0.1	40	660	257
ERV	E-5	1991	5	16	1991.38	15.2	0.08	40	640	268
ERV	E-5	1991	6	18	1991.47	12.3	0.07	38	760	134
ERV	E-5	1991	7	24	1991.57	11.5	0.02	35	728	XXX
ERV	E-5	1991	8	27	1991.66	14	0.09	35	720	178
ERV	E-5	1991	9	17	1991.71	12.3	0.05	39	730	149
ERV	E-5	1991	10	30	1991.83	15.9	0.04	34	478	102
ERV	E-5	1991	11	18	1991.88	14.5	0.08	32	620	182
ERV	E-5	1991	12	12	1991.95	17	0.15	32	660	82
ERV	E-5	1992	1	13	1992.04	8.3	0.11	30	515	306
ERV	E-5	1992	2	17	1992.13	6.2	0.08	33	620	151
ERV	E-5	1992	3	9	1992.19	0.1	0.04	35	560	142
ERV	E-5	1992	4	6	1992.27	8.6	0.02	34	620	335

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	E-5	1992	5	12	1992.37	9.2	0.02	39	590	342
ERV	E-5	1992	6	15	1992.46	8.8	0.05	33	625	104
ERV	E-5	1992	7	28	1992.58	10.6	0.08	31	640	112
ERV	E-5	1992	8	24	1992.65	9.7	0.11	32	660	102
ERV	E-5	1992	9	22	1992.73	10.1	0.05	30	660	106
ERV	E-5	1992	10	13	1992.79	10	0.07	30	----	110
ERV	E-5	1992	11	9	1992.86	7	0.01	33	----	113
ERV	E-5	1992	12	1	1992.92	11.2	0.03	31	580	100
ERV	E-5	1993	1	6	1993.02	9.9	0.02	29	540	110
ERV	E-5	1993	2	8	1993.11	9	0.02	30	760	98
ERV	E-5	1993	3	11	1993.20	9.2	0.02	29	690	150
ERV	E-5	1993	4	20	1993.30	9.8	0.01	30	740	110
ERV	E-6	1981	11	18	1981.88	46.5	0.03	148	1200	304
ERV	E-6	1990	1	4	1990.01	36	0.02	112	1192	XXX
ERV	E-6	1990	2	8	1990.11	4.9	0.01	30	654	XXX
ERV	E-6	1990	3	14	1990.21	3.6	0.11	100	1203	318
ERV	E-6	1990	4	21	1990.31	53	0.01	94	1192	348
ERV	E-6	1990	5	3	1990.34	50	0	95	1113	361
ERV	E-6	1990	6	21	1990.47	50	1.52	109	1308	333
ERV	E-6	1990	7	19	1990.55	48	0.06	112	1194	325
ERV	E-6	1990	8	8	1990.61	51	0.11	113	1280	XXX
ERV	E-6	1990	9	6	1990.68	51	0.09	116	1230	310
ERV	E-6	1990	10	18	1990.80	47	0.11	106	1170	295
ERV	E-6	1990	11	13	1990.87	48	0.16	116	1010	311
ERV	E-6	1990	12	1	1990.92	50	0.1	119	1190	380
ERV	E-6	1991	1	24	1991.07	5.6	0.1	141	1240	369
ERV	E-6	1991	3	27	1991.24	31	0.13	157	1190	378
ERV	E-6	1991	4	23	1991.31	48.9	0.11	159	1230	307
ERV	E-6	1991	5	16	1991.38	47.1	0.23	159	1160	321
ERV	E-6	1991	6	18	1991.47	36	0.17	178	1350	268
ERV	E-6	1991	7	24	1991.57	49.3	0.08	146	1487	XXX
ERV	E-6	1991	8	27	1991.66	50.4	0.07	150	1370	274
ERV	E-6	1991	9	17	1991.71	51.2	0.06	148	1410	368
ERV	E-6	1991	10	30	1991.83	44.2	0.07	147	1060	301
ERV	E-6	1991	11	18	1991.88	46.5	0.03	148	1200	304
ERV	E-6	1991	12	12	1991.95	52	0.05	166	1300	196
ERV	E-6	1992	1	13	1992.04	33	0.09	195	1200	281
ERV	E-6	1992	2	17	1992.13	25	0.04	193	1310	289
ERV	E-6	1992	3	9	1992.19	33	0.08	195	1200	290
ERV	E-6	1992	4	6	1992.27	37.2	0	180	1310	119
ERV	E-6	1992	5	12	1992.37	38	0	185	1290	120
ERV	E-6	1992	6	15	1992.46	33.5	0.12	193	1510	315
ERV	E-6	1992	7	28	1992.58	36.4	0.07	200	1740	255
ERV	E-6	1992	7	29	1992.58	XXX	XXX	XXX	XXX	XXX
ERV	E-6	1992	8	24	1992.65	42.5	0.08	191	1630	354

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	E-6	1992	9	22	1992.73	39.8	0.05	200	1410	339
ERV	E-6	1992	10	13	1992.79	39.3	0.13	190	----	340
ERV	E-6	1992	11	9	1992.86	33	0.01	191	----	331
ERV	E-6	1992	12	1	1992.92	47.9	0.13	200	1350	438
ERV	E-6	1993	1	6	1993.02	46	0.03	160	1280	310
ERV	E-6	1993	2	8	1993.11	40	0.01	166	1780	216
ERV	E-6	1993	3	11	1993.20	40	0.03	163	1600	389
ERV	E-6	1993	4	20	1993.30	42.3	0.01	160	1730	260
ERV	H-1	1981	11	18	1981.88	1.8	3.75	65	1400	501
ERV	H-1	1990	3	6	1990.18	3.7	3.4	60	1604	930
ERV	H-1	1990	6	21	1990.47	----	8.1	61	1735	18
ERV	H-1	1991	3	27	1991.24	2.4	3.6	67	1335	910
ERV	H-1	1991	7	24	1991.57	----	----	----	----	XXX
ERV	H-1	1991	8	27	1991.66	3.3	4.04	75	1550	790
ERV	H-1	1991	10	30	1991.83	0.6	3.56	67	1260	478
ERV	H-1	1991	11	18	1991.88	1.8	3.75	65	1400	501
ERV	H-1	1991	12	3	1991.92	2.9	3.46	63	1340	342
ERV	H-1	1992	1	13	1992.04	0.8	3.45	62	1280	442
ERV	H-1	1992	2	17	1992.13	0.2	3.04	64	1370	369
ERV	H-1	1992	3	9	1992.19	1.8	3.5	64	1270	497
ERV	H-1	1992	4	6	1992.27	1.2	4.2	63	1360	262
ERV	H-1	1992	5	12	1992.37	1.3	4.1	66	1410	265
ERV	H-1	1992	6	15	1992.46	1	3.9	62	1440	465
ERV	H-1	1992	12	1	1992.92	0.3	4	75	1240	431
ERV	H-1	1993	1	6	1993.02	15	0.13	75	1370	770
ERV	H-1	1993	2	8	1993.11	16	0.26	64	1880	800
ERV	H-1	1993	3	11	1993.20	15	0.04	72	1690	65
ERV	H-1	1993	4	20	1993.30	15.6	0.03	70	1760	675
ERV	H-2	1981	11	18	1981.88	9.3	0.17	232	1400	501
ERV	H-2	1990	3	6	1990.18	25	0.16	244	1878	578
ERV	H-2	1990	6	21	1990.47	13.5	0.21	24	1920	587
ERV	H-2	1991	3	27	1991.24	17.3	0.18	229	1565	607
ERV	H-2	1991	7	24	1991.57	----	----	----	----	XXX
ERV	H-2	1991	10	30	1991.83	8.2	0.12	217	1280	435
ERV	H-2	1991	11	18	1991.88	9.3	0.17	232	1540	503
ERV	H-2	1991	12	3	1991.92	8.4	0.06	238	1680	296
ERV	H-2	1992	1	13	1992.04	7.6	0.06	250	1500	433
ERV	H-2	1992	2	17	1992.13	5.7	0.14	245	1820	399
ERV	H-2	1992	3	9	1992.19	6	0.1	250	1520	472
ERV	H-2	1992	4	6	1992.27	5.8	0.8	240	2500	460
ERV	H-2	1992	5	12	1992.37	5.7	0.7	238	2400	430
ERV	H-2	1992	6	15	1992.46	6.5	0.06	230	1720	459
ERV	H-2	1992	7	28	1992.58	7.7	0.06	225	1820	435
ERV	H-2	1992	8	24	1992.65	6.9	0.05	227	1800	438

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	H-2	1992	9	22	1992.73	7.5	0.07	220	1500	444
ERV	H-2	1992	10	13	1992.79	7.3	0.07	210	1470	450
ERV	H-2	1992	11	9	1992.86	7	0.01	213	1437	445
ERV	H-2	1992	12	1	1992.92	10.3	0.04	215	1600	421
ERV	H-2	1993	1	6	1993.02	6.1	0.15	210	1510	530
ERV	H-2	1993	2	8	1993.11	5.5	0	234	2070	470
ERV	H-2	1993	3	11	1993.20	5.8	0.01	228	2020	672
ERV	H-2	1993	4	20	1993.30	6.4	0.01	260	2280	466
ERV	V-2	1991	10	30	1991.83	1.7	2.84	57	1350	489
ERV	V-2	1993	2	8	1993.11	0.4	2.4	54	1960	900
ERV	V-3	1981	11	18	1981.88	0.8	0.03	22	375	60
ERV	V-3	1990	6	21	1990.47	0.1	0.19	12	307	29
ERV	V-3	1991	3	27	1991.24	0.3	0.21	19	328	69
ERV	V-3	1991	7	24	1991.57	----	----	----	----	XXX
ERV	V-3	1991	8	27	1991.66	0.8	0.49	25	580	114
ERV	V-3	1991	10	30	1991.83	0.4	5	62	1690	474
ERV	V-3	1991	11	18	1991.88	0.8	0.03	22	375	60
ERV	V-3	1991	12	3	1991.92	1.5	0.03	23	380	31
ERV	V-3	1992	1	13	1992.04	1.3	0.03	20	390	30
ERV	V-3	1992	2	17	1992.13	0.8	0.05	27	308	41
ERV	V-3	1992	3	9	1992.19	0.3	0.08	25	320	51
ERV	V 3	1992	4	6	1992.27	0.2	0.01	26	336	176
ERV	V-3	1992	5	12	1992.37	0.3	0.02	28	340	93
ERV	V-3	1992	6	15	1992.46	0.1	0.09	15	300	32
ERV	V-3	1992	7	28	1992.58	0.5	0.13	25	282	33
ERV	V-3	1992	8	24	1992.65	0.4	0.12	26	280	20
ERV	V-3	1992	9	22	1992.73	0	0.05	24	255	19
ERV	V-3	1992	10	13	1992.79	0	0.11	24	270	19
ERV	V-3	1992	11	9	1992.86	0	0.34	21	290	19
ERV	V-3	1992	12	1	1992.92	2.8	0.02	23	268	19
ERV	V-3	1993	1	6	1993.02	0.2	0.01	25	280	33
ERV	V-3	1993	2	8	1993.11	0.3	0.18	22	400	55
ERV	V-3	1993	3	11	1993.20	0	0.01	27	420	51
ERV	V-3	1993	4	20	1993.30	0.1	0.02	28	450	61
ERV	H-3	1981	11	18	1981.88	0.8	0.69	86	780	197
ERV	H-3	1991	10	30	1991.83	0.9	0	84	675	160
ERV	H-3	1991	11	18	1991.88	0.8	0.69	86	780	197
ERV	H-3	1991	12	3	1991.92	2.1	0.33	89	820	146
ERV	H-3	1992	1	13	1992.04	3.8	0.77	98	760	160
ERV	H-3	1992	3	9	1992.19	0.6	0.93	105	780	200
ERV	H-3	1992	4	6	1992.27	0.7	0.7	96	820	453
ERV	H-3	1992	5	12	1992.37	0.8	0.75	99	810	450
ERV	H-3	1992	6	15	1992.46	0.6	0.63	93	870	186

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
ERV	H-3	1992	7	28	1992.58	1.5	0.36	100	920	192
ERV	H-3	1992	8	24	1992.65	0	0.43	100	950	184
ERV	H-3	1992	9	22	1992.73	0.6	0.76	99	820	175
ERV	H-3	1992	10	13	1992.79	0.7	0.64	90	840	170
ERV	H-3	1992	11	9	1992.86	0.7	0.02	91	848	176
ERV	H-3	1992	12	1	1992.92	5.8	0.06	95	870	166
ERV	H-3	1993	1	6	1993.02	1.2	1.05	97	800	200
ERV	H-3	1993	2	8	1993.11	0.4	0.8	104	1020	159
ERV	H-3	1993	3	11	1993.20	1.5	0.92	125	992	225
ERV	H-3	1993	4	20	1993.30	0.7	1.05	105	1080	179
ERV	V-1	1993	2	8	1993.11	0.1	9.8	66	2225	100
BHV	H-1	1990	3	6	1990.18	XXX	XXX	199	1237	XXX
BHV	H-1	1991	3	28	1991.24	XXX	XXX	64	1668	842
BHV	H-1	1991	6	19	1991.47	14	2.80	71	1231	985
BHV	H-1	1991	7	24	1991.57	8.5	4.20	71	2066	660
BHV	H-1	1991	8	27	1991.66	6.4	3.30	74	1680	910
BHV	H-1	1991	9	17	1991.71	5.6	3.40	71	1596	705
BHV	H-1	1991	10	30	1991.83	4.8	5.90	57	1834	1090
BHV	H-1	1991	11	19	1991.89	5.3	6.90	64	1997	990
BHV	H-1	1991	12	3	1991.92	5.5	3.00	71	1900	XXX
BHV	H-1	1992	1	13	1992.04	14	4.00	71	1520	680
BHV	H-1	1992	2	18	1992.13	6	5.94	156	1455	438
BHV	H-1	1992	3	9	1992.19	7.2	3.80	66	1400	448
BHV	H-1	1992	4	6	1992.27	7.4	5.70	57	1464	592
BHV	H-1	1992	5	12	1992.37	8.1	7.50	57	1380	428
BHV	H-1	1992	6	15	1992.46	2.9	6.00	60	1400	450
BHV	H-1	1992	12	1	1992.92	14	6.75	57	1517	650
BHV	H-1	1993	1	6	1993.02	12.6	0.06	70	1670	810
BHV	H-1	1993	2	8	1993.11	16	0.26	64	XXX	680
BHV	H-2	1990	3	6	1990.18	XXX	XXX	241	1365	XXX
BHV	H-2	1991	3	28	1991.24	XXX	XXX	248	1898	402
BHV	H-2	1991	6	19	1991.47	23	0.00	234	1321	186
BHV	H-2	1991	7	24	1991.57	15.9	0.00	248	2200	372
BHV	H-2	1991	8	27	1991.66	11	0.00	248	1900	525
BHV	H-2	1991	9	17	1991.71	12	2.60	227	1800	460
BHV	H-2	1991	10	30	1991.83	4.7	1.20	220	1883	310
BHV	H-2	1991	11	19	1991.89	10.6	1.20	241	2371	600
BHV	H-2	1991	12	3	1991.92	9.2	0.00	255	2020	649
BHV	H-2	1992	1	13	1992.04	13	0.00	284	1800	500
BHV	H-2	1992	2	18	1992.13	7	0.00	191	1660	418
BHV	H-2	1992	3	9	1992.19	10.2	0.00	248	1750	448
BHV	H-2	1992	4	6	1992.27	7.4	0.08	241	1771	532
BHV	H-2	1992	5	12	1992.37	9.3	0.20	202	1680	432

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
BHV	H-2	1992	6	15	1992.46	5.9	0.00	234	1750	262
BHV	H-2	1992	7	28	1992.58	11.3	0.10	227	1800	860
BHV	H-2	1992	8	24	1992.65	16.2	0.08	220	1746	389
BHV	H-2	1992	9	22	1992.73	7.8	0.08	214	1939	600
BHV	H-2	1992	10	12	1992.78	7.7	0.12	190	1776	49[illegible]
BHV	H-2	1992	11	10	1992.86	4.8	1.45	200	1997	[illegible]
BHV	H-2	1992	12	1	1992.92	5.1	0.04	207	1910	600
BHV	H-2	1993	1	6	1993.02	4.5	0.14	206	1827	490
BHV	H-2	1993	2	8	1993.11	5.5	0.00	234	XXX	470
BHV	H-3	1990	1		1990.00	3.8	1.01	75	842	203
BHV	H-3	1990	2		1990.08	1.7	1.06	67	910	210
BHV	H-3	1990	3		1990.17	3.1	1.14	74	873	217
BHV	H-3	1990	4		1990.25	2.9	0.95	82	916	198
BHV	H-3	1990	5		1990.33	1.4	0.85	76	867	207
BHV	H-3	1990	6		1990.42	1.8	0.07	77	903	191
BHV	H-3	1990	7		1990.50	2.8	0.17	79	838	195
BHV	H-3	1990	8		1990.58	1.5	0.28	81	791	224
BHV	H-3	1990	9		1990.67	1.5	0.22	78	820	173
BHV	H-3	1990	10		1990.75	0	0.06	85	905	172
BHV	H-3	1991	2		1991.08	1.6	0.82	70	866	183
BHV	H-3	1991	4		1991.25	3.7	0.82	64	815	184
BHV	H-3	1991	5		1991.33	1.6	0.52	72	766	177
BHV	H-3	1991	6		1991.42	2.5	0.04	68	860	177
BHV	H-3	1991	7		1991.50	2.3	0.09	69	863	177
BHV	H-3	1991	8		1991.58	2.6	0.07	69	795	167
BHV	H-3	1991	9		1991.67	2.2	0.05	68	780	171
BHV	H-3	1991	10		1991.75	0.9	0.00	84	675	160
BHV	H-3	1991	11		1991.83	0	0.69	86	780	197
BHV	H-3	1991	12		1991.92	2.1	0.03	89	820	146
BHV	H-3	1992	1		1992.00	3.8	0.77	98	760	160
BHV	H-3	1992	4	6	1992.27	0.7	0.70	96	820	453
BHV	H-3	1992	5	12	1992.37	0.8	0.75	99	810	450
BHV	H-3	1992	6	15	1992.46	0.6	0.63	93	870	186
BHV	H-3	1992	7	28	1992.58	1.5	0.36	100	920	192
BHV	H-3	1992	8	24	1992.65	0	0.43	100	950	184
BHV	H-3	1992	9	22	1992.73	0.6	0.76	99	820	175
BHV	H-3	1992	10	12	1992.78	0.7	0.64	90	840	170
BHV	H-3	1992	11	10	1992.86	0.7	0.02	91	848	176
BHV	H-3	1992	12	1	1992.92	5.8	0.06	95	870	166
BHV	H-3	1993	1	6	1993.02	1.2	1.05	97	800	200
BHV	H-3	1993	2	8	1993.11	0.4	0.80	104	1020	159
BHV	H-3	1993	3	11	1993.20	1.5	0.92	125	992	225
BVK	V-1	1991	10	30	1991.83	4.8	10.70	71	2320	1500
BVK	V-1	1991	11	19	1991.89	5.3	11.70	57	2793	1320

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
BVK	V-1	1992	3	9	1992.19	7.2	1.60	50	1000	418
BVK	V-1	1992	4	6	1992.27	5.6	7.20	64	1834	576
BVK	V-1	1992	5	12	1992.37	8.1	9.20	53	1700	440
BVK	V-1	1992	6	15	1992.46	5.9	8.00	57	1900	274
BVK	V-1	1992	8	24	1992.65	18.7	1.40	50	2330	420
BVK	V-1	1992	9	22	1992.73	24.4	0.00	57	2285	650
BVK	V-1	1992	10	12	1992.78	8	4.60	57	2140	1225
BVK	V-1	1992	11	10	1992.86	36	1.45	54	2246	1400
BVK	V-1	1992	12	1	1992.92	40	0.24	55	2208	1450
BVK	V-1	1993	1	6	1993.02	13.7	5.10	56	2049	1200
BVK	V-1	1993	2	8	1993.11	0.15	9.94	57	2300	1182
BVK	V-1	1993	3	11	1993.20	0.5	12.20	55	2280	1276
BVK	V-1	1993	4	19	1993.30	0.5	18.70	56	1880	1062
BVK	V-2	1991	9	17	1991.71	5.6	2.60	50	1680	950
BVK	V-2	1991	10	30	1991.83	7.7	11.70	64	1966	1200
BVK	V-2	1991	11	19	1991.89	4.2	3.10	57	1715	600
BVK	V-2	1992	3	9	1992.19	8.2	7.30	50	1470	476
BVK	V-2	1992	4	6	1992.27	6.5	3.70	50	1446	440
BVK	V-2	1992	5	12	1992.37	9.3	2.10	46	1500	416
BVK	V-2	1992	6	15	1992.46	3.9	1.70	53	1600	196
BVK	V-2	1992	8	24	1992.65	10.4	3.00	78	1840	500
BVK	V-2	1992	9	22	1992.73	4.4	7.80	64	1824	615
BVK	V-2	1992	10	12	1992.78	2.1	5.00	56	1824	875
BVK	V-2	1992	11	10	1992.86	0.6	3.64	51	1872	1000
BVK	V-2	1993	1	6	1993.02	1.9	3.10	50	1679	940
BVK	V-2	1993	2	8	1993.11	0.2	2.79	52	2000	1120
BVK	V-2	1993	3	11	1993.20	4	2.50	40	2060	1113
BVK	V-2	1993	4	19	1993.30	1.9	8.80	50	1710	927
BVK	V-3	1991	9	17	1991.71	5.6	0.00	28	428	34
BVK	V-3	1991	10	30	1991.83	7.7	1.20	21	500	92
BVK	V-3	1991	11	19	1991.89	4.2	2.10	28	525	54
BVK	V-3	1991	12	3	1991.92	6.4	0.00	21	360	45.3
BVK	V-3	1992	1	13	1992.04	12	0.32	28	300	50
BVK	V-3	1992	2	18	1992.13	7	0.16	50	300	42
BVK	V-3	1992	3	9	1992.19	7.2	0.20	28	310	70
BVK	V-3	1992	4	6	1992.27	7.4	0.12	21	350	130
BVK	V-3	1992	5	12	1992.37	4.6	0.57	25	290	12
BVK	V-3	1992	6	15	1992.46	3.9	0.00	25	300	36
BVK	V-3	1992	7	28	1992.58	17.6	0.44	21	320	12
BVK	V-3	1992	8	24	1992.65	12.5	0.16	21	300	0
BVK	V-3	1992	9	22	1992.73	4.4	0.10	25	274	27
BVK	V-3	1992	10	12	1992.78	0	0.06	24	312	60
BVK	V-3	1992	11	10	1992.86	0.5	1.45	23	312	10
BVK	V-3	1992	12	1	1992.92	0.5	0.01	25	302	30

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
BVK	V-3	1993	1	6	1993.02	0.5	0.08	23	304	50
BVK	V-3	1993	2	8	1993.11	0.25	0.06	35	358	36
BVK	V-3	1993	3	11	1993.20	0.5	0.07	21	410	53
BVK	V-3	1993	4	19	1993.30	0.5	0.15	24	360	42
BVK	ET-101	1992	1	13	1992.04	17	0.06	355	1800	420
BVK	ET-101	1992	2	18	1992.13	13	0.22	319	1600	376
BVK	ET-101	1992	3	9	1992.19	12.3	3.20	284	1530	364
BVK	ET-101	1992	4	6	1992.27	18.5	0.10	262	1624	420
BVK	ET-101	1992	5	12	1992.37	15.1	0.00	216	1470	316
BVK	ET-101	1992	6	15	1992.46	7.8	0.00	255	1550	242
BVK	ET-101	1992	7	28	1992.58	15.1	0.40	248	1700	350
BVK	ET-101	1992	8	24	1992.65	27.5	0.22	220	1600	400
BVK	ET-101	1992	9	22	1992.73	4.4	0.00	202	1776	575
BVK	ET-101	1992	10	12	1992.78	3.6	0.16	197	1680	400
BVK	ET-101	1992	11	10	1992.86	4.8	1.09	196	1809	400
BVK	ET-101	1992	12	1	1992.92	0.5	0.13	212	1776	625
BVK	ET-101	1993	1	6	1993.02	6.8	0.09	205	1687	400
BVK	ET-101	1993	2	8	1993.11	5.8	0.09	209	1960	495
BVK	ET-101	1993	3	11	1993.20	4.1	0.15	190	1960	XXX
BVK	ET-101	1993	4	19	1993.30	4.2	0.04	191	1600	487
BVK	ET-102	1992	1	13	1992.04	14	0.44	213	1600	475
BVK	ET-102	1992	2	18	1992.13	11	0.00	206	1426	412
BVK	ET-102	1992	3	9	1992.19	13.3	0.30	213	1500	444
BVK	ET-102	1992	4	6	1992.27	12	0.00	184	1643	548
BVK	ET-102	1992	5	12	1992.37	11.6	0.00	142	1450	428
BVK	ET-102	1992	6	15	1992.46	10.8	0.00	184	1700	350
BVK	ET-102	1992	7	28	1992.58	13.8	0.06	184	1700	320
BVK	ET-102	1992	8	24	1992.65	21.2	0.40	177	1650	385
BVK	ET-102	1992	9	22	1992.73	8.8	0.00	175	1824	550
BVK	ET-102	1992	10	12	1992.78	8.6	0.00	180	1738	575
BVK	ET-102	1992	11	10	1992.86	18	1.09	178	1934	475
BVK	ET-102	1992	12	1	1992.92	14	0.51	179	1834	625
BVK	ET-102	1993	1	6	1993.02	9.9	0.01	173	1696	440
BVK	ET-102	1993	2	8	1993.11	15.1	0.46	182	2000	535
BVK	ET-102	1993	3	11	1993.20	16.1	0.05	180	1990	553
BVK	ET-102	1993	4	19	1993.30	16.3	0.01	180	1600	491
BVK	ET-103	1992	1	13	1992.04	11	0.72	71	570	84
BVK	ET-103	1992	2	18	1992.13	7	0.73	71	630	176
BVK	ET-103	1992	3	9	1992.19	8.2	0.80	57	730	192
BVK	ET-103	1992	4	6	1992.27	7.4	0.96	57	647	202
BVK	ET-103	1992	5	12	1992.37	5.8	1.10	50	580	118
BVK	ET-103	1992	6	15	1992.46	XXX	1.60	14	700	140
BVK	ET-103	1992	7	28	1992.58	17.6	5.30	57	700	122

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
BVK	ET-103	1992	8		1992.58	XXX	XXX	XXX		XXX
BVK	ET-103	1992	9	22	1992.73	4.4	6.20	48	682	150
BVK	ET-103	1992	10	12	1992.78	2.6	6.40	46	778	96
BVK	ET-103	1992	11	10	1992.86	0.5	8.37	46	799	80
BVK	ET-103	1992	12	1	1992.92	12	6.68	40	730	100
BVK	ET-103	1993	1	6	1993.02	0.5	6.40	27	661	32
BVK	ET-103	1993	2	8	1993.11	0.5	6.30	34	725	55
BVK	ET-103	1993	3	11	1993.20	0.15	4.20	27	720	69
BVK	ET-103	1993	4	19	1993.30	4.7	3.00	28	580	35
BVK	ET-104	1992	1	13	1992.04	12	9.60	780	3260	470
BVK	ET-104	1992	2	18	1992.13	9	19.26	787	2900	388
BVK	ET-104	1992	3	9	1992.19	8.2	16.80	744	3020	444
BVK	ET-104	1992	4	6	1992.27	9.3	17.50	795	3151	480
BVK	ET-104	1992	5	12	1992.37	12.8	18.90	681	2960	408
BVK	ET-104	1992	6	15	1992.46	XXX	26.00	XXX	3600	225
BVK	ET-104	1992	7	28	1992.58	13.8	31.00	922	3800	375
BVK	ET-104	1992	8		1992.58	XXX	XXX	XXX		XXX
BVK	ET-104	1992	9	22	1992.73	6.7	31.00	980	3936	850
BVK	ET-104	1992	10	12	1992.78	10.3	30.00	850	3696	550
BVK	ET-104	1992	11	10	1992.86	2.3	14.90	933	4306	405
BVK	ET-104	1992	12	1	1992.92	5.1	22.40	926	4032	600
BVK	ET-104	1993	1	6	1993.02	2	27.00	890	3784	390
BVK	ET-104	1993	2	8	1993.11	3.6	22.40	1025	4500	462
BVK	ET-104	1993	3	11	1993.20	9.25	26.40	920	4560	513
BVK	ET-104	1993	4	19	1993.30	5.3	19.40	965	3740	389
BVK	E-6(?)	1990	3	29	1990.25				5733	
BVK	E-6(?)	1990	5	16	1990.38				6333	
BVK	E-6(?)	1990	9	28	1990.74				11375	
BVK	E-6(?)	1990	11	29	1990.91				10100	
BVK	H-1(?)	1990	3	29	1990.25				2912	
BVK	H-1(?)	1990	5	16	1990.38				3166	
BVK	H-1(?)	1990	9	28	1990.74				3731	
BVK	H-1(?)	1990	11	29	1990.91				3100	
BVK	H-2(?)	1990	3	29	1990.25				1147	
BVK	H-2(?)	1990	5	16	1990.38				1100	
BVK	H-2(?)	1990	9	28	1990.74				1110	
BVK	H-2(?)	1990	11	29	1990.91				826	
BHK	V-2(?)	1990	3	29	1990.25				892	
BHK	V-2(?)	1990	5	16	1990.38				900	
BHK	V-2(?)	1990	9	28	1990.74				819	
BHK	V-2(?)	1990	11	29	1990.91				430	

Table C-1. Groundwater Inorganics Data

Lab	Well ID	Year	Mo.	Day	Date	Nitrate NO3 mg/l	Ammonia NH4 mg/l	Chloride Cl mg/l	Conductivity f.vez uS/cm	Sulfate SO4 mg/l
BHK	V-3(?)	1990	3	29	1990.25				537	
BHK	V-3(?)	1990	5	16	1990.38				600	
BHK	V-3(?)	1990	9	28	1990.74				510	
BHK	V-3(?)	1990	11	29	1990.91				1012	

Table C-2. 1992 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	1992 MEAN	Ammonia mg/L	1992 MEAN	Chloride mg/L	1992 MEAN	Bicarbonate mg/L	1992 MEAN	Conductivity uS/cm	1992 MEAN
ERV	BS(I)-01	1992	4	6	1992.27	8.8	8.0	0.02	0.0	53	39.5	237	255.0	596	584.0
ERV	BS(I)-01	1992	10	27	1992.82	7.2		0.04		26		273		572	
ERV	BS(I)-02	1992	4	6	1992.27	13.5	10.9	0.03	0.0	25	31.0	213	249.5	353	513.5
ERV	BS(I)-02	1992	10	27	1992.82	8.2		0.04		37		286		674	
ERV	BS(I)-03	1992	4	6	1992.27	14.1	10.1	0.02	0.0	25	30.5	225	252.5	451	556.5
ERV	BS(I)-03	1992	10	27	1992.82	6.1		0.05		36		280		662	
ERV	BS(I)-04	1992	4	6	1992.27	15.2	11.0	0.02	0.0	25	30.5	213	228.5	349	461.5
ERV	BS(I)-04	1992	10	27	1992.82	6.7		0.06		36		244		574	
ERV	BS(I)-05	1992	4	6	1992.27	14.4	12.9	0.03	0.0	26	31.0	219	231.5	444	482.0
ERV	BS(I)-05	1992	10	27	1992.82	11.4		0.05		36		244		520	
ERV	BS(I)-06	1992	4	6	1992.27	17.6	12.7	0.03	0.0	25	30.5	213	228.5	421	492.5
ERV	BS(I)-06	1992	10	27	1992.82	7.8		0.04		36		244		564	
ERV	BS(I)-07	1992	4	6	1992.27	18.8	14.2	0.02	0.0	26	31.0	225	240.5	450	507.0
ERV	BS(I)-07	1992	10	27	1992.82	9.5		0.04		36		256		564	
ERV	BS(I)-08	1992	4	6	1992.27	15.3		0.01		26		237		505	
ERV	BS(I)-09	1992	4	6	1992.27	11.2	10.1	0	0.0	34	36.0	256	259.0	1029	774.5
ERV	BS(I)-09	1992	10	27	1992.82	8.9		0.03		38		262		520	
ERV	BS(I)-10	1992	4	6	1992.27	12.3	10.9	0.01	0.0	150	148.5	329	353.5	631	924.5
ERV	BS(I)-10	1992	10	27	1992.82	9.4		0.01		147		378		1218	
ERV	BS(I)-11	1992	1	20	1992.05	19.1	15.4	0.26	0.1	124	122.6	311	345.9	1303	1250.0
ERV	BS(I)-11	1992	3	18	1992.22	12.6		0.04		165		366		1372	
ERV	BS(I)-11	1992	4	6	1992.27	20		0		77		323		592	

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Table C-2. 1992 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	1992 MEAN	Ammonia mg/L	1992 MEAN	Chloride mg/L	1992 MEAN	Bicarbonate mg/L	1992 MEAN	Conductivity uS/cm	1992 MEAN
ERV	BS(I)-11	1992	5	19	1992.39	18.6		0.1		70		317		837	
ERV	BS(I)-11	1992	7	21	1992.56	7.2		0.02		44		286		901	
ERV	BS(I)-11	1992	9	15	1992.71	16.8		0.05		166		384		1696	
ERV	BS(I)-11	1992	10	27	1992.82	9.9		0.01		235		427		1562	
ERV	BS(I)-11	1992	11	23	1992.90	18.9		0.04		100		353		1737	
ERV	BS(I)-12	1992	4	6	1992.27	16.4	23.4	0.01	0.0	31	72.0	256	314.0	558	968.0
ERV	BS(I)-12	1992	10	27	1992.82	30.4		0		113		372		1378	
ERV	BS(I)-13	1992	4	6	1992.27	14.1	12.7	0	0.0	30	34.5	256	280.5	535	743.0
ERV	BS(I)-13	1992	10	27	1992.82	11.2		0		39		305		951	
ERV	BS(I)-14	1992	4	6	1992.27	17.6	14.2	0	0.0	29	34.0	237	249.5	361	500.0
ERV	BS(I)-14	1992	10	27	1992.82	10.7		0.02		39		262		639	
ERV	BS(I)-15	1992	4	6	1992.27	19.4	14.3	0	0.0	28	33.0	237	243.5	452	505.0
ERV	BS(I)-15	1992	10	27	1992.82	9.2		0		38		250		558	
ERV	BS(I)-16	1992	5	18	1992.38	13.2	13.4	0.06	0.0	28	31.0	256	243.5	601	635.0
ERV	BS(I)-16	1992	11	16	1992.88	13.6		0.03		34		231		669	
ERV	BS(I)-18	1992	5	18	1992.38	3.2		0.07		25		244		403	
ERV	BS(I)-19	1992	5	18	1992.38	11.7		0.06		27		250		456	
ERV	BS(I)-20	1992	5	18	1992.38	16.5		0.04		25		225		325	
ERV	BS(I)-21	1992	5	18	1992.38	12.9		0.05		32		213		448	
ERV	BS(I)-22	1992	5	18	1992.38	12.7	16.3	0.07	0.1	30	33.0	207	216.0	551	551.5
ERV	BS(I)-22	1992	11	16	1992.88	19.8		0.03		36		225		552	

Table C-2. 1992 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	1992 MEAN	Ammonia mg/L	1992 MEAN	Chloride mg/L	1992 MEAN	Bicarbonate mg/L	1992 MEAN	Conductivity uS/cm	1992 MEAN
ERV	BS(I)-23	1992	5	18	1992.38	15.9	17.1	0.04	0.0	31	33.0	274	252.5	460	546.0
ERV	BS(I)-23	1992	11	16	1992.88	18.3		0.02		35		231		632	
ERV	BS(I)-24	1992	5	18	1992.38	14.9	14.4	0.05	0.0	33	34.0	268	256.0	470	591.0
ERV	BS(I)-24	1992	11	16	1992.88	13.8		0.02		35		244		712	
ERV	BS(I)-25	1992	5	18	1992.38	6.4	5.8	0.07	0.1	35	36.5	268	271.0	379	576.5
ERV	BS(I)-25	1992	11	16	1992.88	5.2		0.05		38		274		774	
ERV	BS(I)-26	1992	5	18	1992.38	6.8		0.05		33		280		360	
ERV	BS(I)-27	1992	5	18	1992.38	7.9	10.8	0.06	0.0	28	35.5	213	243.5	391	493.0
ERV	BS(I)-27	1992	11	16	1992.88	13.7		0.03		43		274		595	
ERV	BS(I)-28	1992	11	16	1992.88	8.5		0.04		32		231		545	
ERV	BS(I)-30	1992	5	18	1992.38	10.9	7.8	0.03	0.0	26	28.5	237	237.0	316	614.5
ERV	BS(I)-30	1992	11	16	1992.88	4.6		0.03		31		237		913	
ERV	BS(I)-31	1992	5	18	1992.38	13.9		0.04		25		225		340	
ERV	BS(I)-32	1992	5	18	1992.38	4.6		0.05		37		256		495	
ERV	BS(I)-34	1992	5	18	1992.38	7.6	6.1	0.03	0.0	25	35.5	256	250.0	450	649.5
ERV	BS(I)-34	1992	11	16	1992.88	4.6		0.04		46		244		849	
ERV	BS(I)-35	1992	5	18	1992.38	2	3.9	0.12	0.1	33	37.0	250	253.0	568	633.5
ERV	BS(I)-35	1992	11	16	1992.88	5.8		0.07		41		256		699	
ERV	BS(I)-37	1992	5	18	1992.38	2.2		0.13		28		250		604	
ERV	BS(I)-38	1992	5	18	1992.38	3.9	3.6	0.13	0.1	29	30.5	262	256.0	516	634.0

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Table C-2. 1992 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	1992 MEAN	Ammonia mg/L	1992 MEAN	Chloride mg/L	1992 MEAN	Bicarbonate mg/L	1992 MEAN	Conductivity uS/cm	1992 MEAN
ERV	BS(I)-38	1992	11	16	1992.88	3.3		0.08		32		250		752	
ERV	BS(I)-39	1992	11	16	1992.88	3.6		0.12		30		256		794	
ERV	BS(I)-40	1992	5	18	1992.38	1.2	8.7	0.11	0.1	27	39.5	244	271.0	487	613.5
ERV	BS(I)-40	1992	11	16	1992.88	16.2		0.03		52		298		740	
ERV	BS(I)-Comp	1992	1	8	1992.02	17.6	12.8	0.05	0.06	45	49	127	256	666	619
ERV	BS(I)-Comp	1992	1	27	1992.07	15.4		0.33		52		274		718	
ERV	BS(I)-Comp	1992	2	6	1992.10	15.2		0.18		60		286		728	
ERV	BS(I)-Comp	1992	2	19	1992.14	14.9		0.04		52		280		769	
ERV	BS(I)-Comp	1992	3	5	1992.18	18.8		0.03		66		280		605	
ERV	BS(I)-Comp	1992	4	14	1992.29	11.9		0.04		39		243		311	
ERV	BS(I)-Comp	1992	5	7	1992.35	10.7		0		38		250		483	
ERV	BS(I)-Comp	1992	5	18	1992.38	13.3		0.12		35		256		448	
ERV	BS(I)-Comp	1992	6	3	1992.42	9.8		0.04		43		244		644	
ERV	BS(I)-Comp	1992	6	30	1992.50	14.1		0.08		47		265		563	
ERV	BS(I)-Comp	1992	7	9	1992.52	10.7		0.02		44		244		554	
ERV	BS(I)-Comp	1992	8	10	1992.61	9.2		0.01		45		256		646	
ERV	BS(I)-Comp	1992	9	10	1992.69	5.3		0.03		51		256		727	
ERV	BS(I)-Comp	1992	10	7	1992.77	7.7		0.02		42		256		629	
ERV	BS(I)-Comp	1992	10	27	1992.82	10.4		0		61		286		713	
ERV	BS(I)-Comp	1992	11	5	1992.85	17.2		0.01		55		274		607	
ERV	BS(I)-Comp	1992	11	16	1992.88	16.2		0.03		52		268		704	
ERV	BS(I/A)-1	1992	1	20	1992.05	21.5	18.8	0.19	0.07	191	170	225	334	1436	1327
ERV	BS(I/A)-1	1992	3	18	1992.22	22		0.05		181		366		1248	
ERV	BS(I/A)-1	1992	5	19	1992.39	17.8		0.09		165		353		1136	
ERV	BS(I/A)-1	1992	7	21	1992.56	9		0.02		165		353		1274	
ERV	BS(I/A)-1	1992	9	15	1992.71	19		0.04		158		359		1386	
ERV	BS(I/A)-1	1992	11	23	1992.90	23.4		0.04		160		347		1482	

Table C-2. 1992 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	1992 MEAN	Ammonia mg/L	1992 MEAN	Chloride mg/L	1992 MEAN	Bicarbonate mg/L	1992 MEAN	Conductivity uS/cm	1992 MEAN
ERV	BS(I/A)-6	1992	1	20	1992.05	7	8.0	0.26	0.14	58	54	256	257	1138	1095
ERV	BS(I/A)-6	1992	3	18	1992.22	9.1		0.12		54		268		869	
ERV	BS(I/A)-6	1992	5	19	1992.39	4.5		0.2		51		250		881	
ERV	BS(I/A)-6	1992	7	21	1992.56	3.1		0.09		52		262		1171	
ERV	BS(I/A)-6	1992	9	15	1992.71	12.5		0.1		54		256		1298	
ERV	BS(I/A)-6	1992	11	23	1992.90	11.9		0.08		53		250		1212	

Table C-3. 1988 - 1991 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	88-91 Mean	1991 Mean	Ammonia mg/L	88-91 Mean	1991 Mean	Chloride mg/L	88-91 Mean	1991 Mean	Bicarbonate mg/L	88-91 Mean	1991 Mean	Conductivity uS/cm	88-91 Mean	1991 Mean	Sulfate mg/L	88-91 Mean	1991 Mean
ERV	BS(I)-Comp	1990	1	11	1990.03	15.2	13.7		0	0.05		45	41		268	254		749	669		XXX	155	
ERV	BS(I)-Comp	1990	2	8	1990.11	15.2			0			45			256			717			XXX		
ERV	BS(I)-Comp	1990	3	20	1990.22	17.9			0			43			232			675			XXX		
ERV	BS(I)-Comp	1990	4	5	1990.26	13.1			0			43			238			696			XXX		
ERV	BS(I)-Comp	1990	5	10	1990.36	10.9			0.04			36			244			665			XXX		
ERV	BS(I)-Comp	1990	5	16	1990.38	11.7			0			37			250			665			166		
ERV	BS(I)-Comp	1990	5	21	1990.39	11.6			0			42			250			596			XXX		
ERV	BS(I)-Comp	1990	6	7	1990.44	11.1			0			34			238			617			XXX		
ERV	BS(I)-Comp	1990	6	18	1990.47	11.1			0.07			33			250			570			170		
ERV	BS(I)-Comp	1990	7	5	1990.51	12.4			0			38			250			679			XXX		
ERV	BS(I)-Comp	1990	8	8	1990.61	9.4			0.09			38			268			623			XXX		
ERV	BS(I)-Comp	1990	9	6	1990.68	5.6			0.08			39			232			590			XXX		
ERV	BS(I)-Comp	1990	9	18	1990.72	7.9			0.1			43			354			620			XXX		
ERV	BS(I)-Comp	1990	10	4	1990.76	7.6			0.09			44			262			505			XXX		
ERV	BS(I)-Comp	1990	11	7	1990.85	----			0.04			----			-----			----			166		
ERV	BS(I)-Comp	1990	11	8	1990.86	12.5			0.1			51			281			904			166		
ERV	BS(I)-Comp	1990	11	13	1990.87	11.2			0.07			46			256			909			165		
ERV	BS(I)-Comp	1990	11	26	1990.90	14.5			0.04			30			250			585			147		
ERV	BS(I)-Comp	1990	12	4	1990.93	18.3			0.02			36			262			807			XXX		
ERV	BS(I)-Comp	1990	12	6	1990.93	18.3			0.02			36			262			804			166		
ERV	BS(I)-Comp	1990	12	17	1990.96	12			0.01			36			238			550			162		
ERV	BS(I)-Comp	1991	1	10	1991.03	18		15.5	0.02		0.07	34		43	220		250	520		660	144		150
ERV	BS(I)-Comp	1991	2	7	1991.10	22.2			0.08			36			238			620			163		
ERV	BS(I)-Comp	1991	3	7	1991.19	13			0.07			34			226			660			167		
ERV	BS(I)-Comp	1991	4	11	1991.28	27.8			0.06			50			250			720			188		
ERV	BS(I)-Comp	1991	4	22	1991.31	10.6			0.04			44			238			600			164		
ERV	BS(I)-Comp	1991	5	9	1991.36	9.6			0.07			40			220			500			174		
ERV	BS(I)-Comp	1991	5	13	1991.37	8.7			0.17			43			226			620			214		
ERV	BS(I)-Comp	1991	6	19	1991.47	9.4			0.11			35			238			660			XXX		
ERV	BS(I)-Comp	1991	7	5	1991.51	8.3			0.04			50			262			740			208		
ERV	BS(I)-Comp	1991	9	5	1991.68	----			0.02			46			256			697			XXX		
ERV	BS(I)-Comp	1991	10	10	1991.78	27.3			0.02			48			286			687			122		
ERV	BS(I)-Comp	1991	11	11	1991.86	11.2			0.2			30			292			728			61		
ERV	BS(I)-Comp	1991	11	26	1991.90	28.8			0.04			55			274			707			133		
ERV	BS(I)-Comp	1991	12	5	1991.93	11.6			0.1			60			274			779			108		

Table C-3. 1988 - 1991 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	88-91 Mean	1991 Mean	Ammonia mg/L	88-91 Mean	1991 Mean	Chloride mg/L	88-91 Mean	1991 Mean	Bicarbonate mg/L	88-91 Mean	1991 Mean	Conductivity uS/cm	88-91 Mean	1991 Mean	Sulfate mg/L	88-91 Mean	1991 Mean
ERV	BS(I)-Comp	1991	12	9	1991.94	10.6			0.06			45			256			656			98		
ERV	BS(I/A)-Comp	1988	1	13	1988.04	30.7	30.7		0.08	0.12		145	158		323	321		1310	1401		XXX	499	
ERV	BS(I/A)-Comp	1988	2	11	1988.11	33.8			0.23			152			317			1310			479		
ERV	BS(I/A)-Comp	1988	3	24	1988.23	35.9			0.2			162			336			1319			461		
ERV	BS(I/A)-Comp	1988	6	16	1988.46	26.8			0.28			144			287			1565			498		
ERV	BS(I/A)-Comp	1988	7	21	1988.56	26.1			0.23			139			317			1525			XXX		
ERV	BS(I/A)-Comp	1988	7	25	1988.57	26.4			0.2			135			305			941			XXX		
ERV	BS(I/A)-Comp	1988	8	10	1988.61	28			0.69			143			310			1571			XXX		
ERV	BS(I/A)-Comp	1988	9	28	1988.74	23.2			----			99			281			1210			XXX		
ERV	BS(I/A)-Comp	1988	10	17	1988.80	29.6			0.28			144			317			1525			498		
ERV	BS(I/A)-Comp	1989	10	16	1989.79	32			0			166			336			1498			578		
ERV	BS(I/A)-Comp	1989	12	1	1989.92	31			0			162			329			913			529		
ERV	BS(I/A)-Comp	1990	3	20	1990.22	36			0			172			323			1519			XXX		
ERV	BS(I/A)-Comp	1990	5	16	1990.38	35			0			169			336			1514			548		
ERV	BS(I/A)-Comp	1990	6	20	1990.47	34			0.03			175			329			1735			XXX		
ERV	BS(I/A)-Comp	1990	8	15	1990.62	58			0.12			178			323			1640			573		
ERV	BS(I/A)-Comp	1990	9	18	1990.72	36			0.07			175			329			1380			XXX		
ERV	BS(I/A)-Comp	1990	10	24	1990.82	34			0.06			178			329			1570			480		
ERV	BS(I/A)-Comp	1990	11	13	1990.87	34			0.09			179			342			1460			495		
ERV	BS(I/A)-Comp	1991	2	21	1991.14	30		25.2	0.03		0.03	180		163	323		321	1400		1361	470		478
ERV	BS(I/A)-Comp	1991	3	19	1991.22	28.7			0.04			180			342			1350			509		
ERV	BS(I/A)-Comp	1991	4	12	1991.28	27.8			0.06			180			311			1410			504		
ERV	BS(I/A)-Comp	1991	6	24	1991.48	27.4			0.01			187			360			1540			455		
ERV	BS(I/A)-Comp	1991	7	5	1991.51	8.3			0.04			50			262			740			178		
ERV	BS(I/A)-Comp	1991	7	10	1991.53	25			0			180			329			1520			470		
ERV	BS(I/A)-Comp	1991	10	14	1991.79	29.1			0.02			185			317			1569			762		
ERV	BS(I/A)-1	1988	1	13	1988.04	33.9	38.4		0.21	0.10		121	199		317	335		1067	1375		387	426	
ERV	BS(I/A)-1	1988	2	11	1988.11	35.6			0.31			130			317			1154			XXX		
ERV	BS(I/A)-1	1988	3	15	1988.21	30.7			0.01			134			329			1135			341		
ERV	BS(I/A)-1	1988	5	11	1988.36	30.5			0			141			336			1130			367		
ERV	BS(I/A)-1	1988	6	16	1988.46	26.2			0.11			132			299			1380			359		
ERV	BS(I/A)-1	1988	7	7	1988.52	26.9			0.21			132			311			1403			350		
ERV	BS(I/A)-1	1988	9	5	1988.68	28.1			----			130			305			1397			387		

Table C-3. 1988 - 1991 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	88-91 Mean	1991 Mean	Ammonia mg/L	88-91 Mean	1991 Mean	Chloride mg/L	88-91 Mean	1991 Mean	Bicarbonate mg/L	88-91 Mean	1991 Mean	Conductivity uS/cm	88-91 Mean	1991 Mean	Sulfate mg/L	88-91 Mean	1991 Mean
ERV	BS(I/A)-1	1988	10	17	1988.80	29			0.27			164			287			1432			387		
ERV	BS(I/A)-1	1988	11	21	1988.89	28.7			0			167			293			1184			341		
ERV	BS(I/A)-1	1989	1	11	1989.03	32.4			0.21			192			275			647			350		
ERV	BS(I/A)-1	1989	3	13	1989.20	32			0.25			200			305			1361			379		
ERV	BS(I/A)-1	1989	4	27	1989.32	29			0.02			190			311			1398			367		
ERV	BS(I/A)-1	1989	5	15	1989.37	33.6			0.12			192			342			1387			418		
ERV	BS(I/A)-1	1989	7	17	1989.55	35.5			0			207			341			1424			428		
ERV	BS(I/A)-1	1989	9	20	1989.72	45.8			0			216			354			1498			437		
ERV	BS(I/A)-1	1989	10	16	1989.79	46			0			219			360			1528			499		
ERV	BS(I/A)-1	1989	12	1	1989.92	48			0.01			221			354			1561			421		
ERV	BS(I/A)-1	1990	1	16	1990.04	47			0.02			221			354			1509			397		
ERV	BS(I/A)-1	1990	3	20	1990.22	56			0			232			354			1625			431		
ERV	BS(I/A)-1	1990	5	16	1990.38	56			0			227			360			1572			587		
ERV	BS(I/A)-1	1990	6	20	1990.47	51			0.1			225			354			1762			XXX		
ERV	BS(I/A)-1	1990	7	25	1990.57	56			0.06			224			360			1718			480		
ERV	BS(I/A)-1	1990	8	15	1990.62	57			0.16			226			348			740			451		
ERV	BS(I/A)-1	1990	9	18	1990.72	56			0.1			226			342			1420			456		
ERV	BS(I/A)-1	1990	10	24	1990.82	52			0.13			326			354			1580			442		
ERV	BS(I/A)-1	1990	11	13	1990.87	53			0.1			231			360			1579			448		
ERV	BS(I/A)-1	1991	1	29	1991.08	45		32.8	0.08		0.12	230		215	348		344	1420		1392	493		458
ERV	BS(I/A)-1	1991	2	21	1991.14	41			0.05			223			354			1330			475		
ERV	BS(I/A)-1	1991	3	19	1991.22	39.1			0.11			222			360			1420			524		
ERV	BS(I/A)-1	1991	4	12	1991.28	34.7			0.12			233			342			1480			485		
ERV	BS(I/A)-1	1991	5	13	1991.37	32.9			0.38			224			341			1450			492		
ERV	BS(I/A)-1	1991	6	24	1991.48	31.1			0.03			216			226			1560			395		
ERV	BS(I/A)-1	1991	7	10	1991.53	30			0.29			211			378			1540			418		
ERV	BS(I/A)-1	1991	9	16	1991.71	25.6			0.14			164			-----			451			344		
ERV	BS(I/A)-1	1991	10	14	1991.79	31.8			0.03			217			372			1600			570		
ERV	BS(I/A)-1	1991	11	25	1991.90	16.3			0			210			372			1672			380		
ERV	BS(I/A)-2	1988	1	13	1988.04	13.1	18.9		0.14	0.10		200	217		317	324		1261	1519		XXX	474	
ERV	BS(I/A)-2	1988	2	11	1988.11	14.1			0.23			207			311			1276			350		
ERV	BS(I/A)-2	1988	3	24	1988.23	16.7			0.16			197			305			1280			341		
ERV	BS(I/A)-2	1988	6	16	1988.46	11.6			0.11			196			281			1530			378		
ERV	BS(I/A)-2	1988	10	17	1988.80	14			0.26			197			305			1548			406		

Table C-3. 1988 - 1991 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	88-91 Mean	1991 Mean	Ammonia mg/L	88-91 Mean	1991 Mean	Chloride mg/L	88-91 Mean	1991 Mean	Bicarbonate mg/L	88-91 Mean	1991 Mean	Conductivity uS/cm	88-91 Mean	1991 Mean	Sulfate mg/L	88-91 Mean	1991 Mean
ERV	BS(I/A)-2	1989	10	16	1989.79	17.9			0			212			341			1561			529		
ERV	BS(I/A)-2	1989	12	1	1989.92	17.8			0			208			329			1561			489		
ERV	BS(I/A)-2	1990	3	29	1990.25	22			0			220			336			1519			485		
ERV	BS(I/A)-2	1990	5	16	1990.38	23			0			221			348			1630			597		
ERV	BS(I/A)-2	1990	6	20	1990.47	17.9			0.07			225			354			1762			XXX		
ERV	BS(I/A)-2	1990	8	15	1990.62	28			0.12			226			336			1700			451		
ERV	BS(I/A)-2	1990	9	18	1990.72	26			0.12			225			354			1460			494		
ERV	BS(I/A)-2	1990	10	24	1990.82	25			0.14			225			336			1590			461		
ERV	BS(I/A)-2	1990	11	13	1990.87	22			0.12			228			335			1550			455		
ERV	BS(I/A)-2	1991	2	21	1991.14	18.3		17.9	0.05		0.07	224		228	336		312	1510		1526	482		525
ERV	BS(I/A)-2	1991	3	19	1991.22	19			0.14			232			336			1440			534		
ERV	BS(I/A)-2	1991	4	12	1991.28	16.7			0.07			230			323			1470			495		
ERV	BS(I/A)-2	1991	6	24	1991.48	17.5			0.05			232			226			1570			426		
ERV	BS(I/A)-2	1991	10	14	1991.79	18.2			0.03			224			341			1641			690		
ERV	BS(I/A)-3	1988	1	13	1988.04	17.3	25.6		0.22	0.08		137	162		348	341		1601	1543		XXX	596	
ERV	BS(I/A)-3	1988	2	11	1988.11	13			0.19			234			342			1618			571		
ERV	BS(I/A)-3	1988	3	24	1988.23	5.1			0			203			366			1618			617		
ERV	BS(I/A)-3	1988	6	16	1988.46	13			0.08			195			318			1888			571		
ERV	BS(I/A)-3	1988	10	17	1988.80	20.9			0.17			169			348			1761			608		
ERV	BS(I/A)-3	1989	1	11	1989.03	51.6			0.18			184			311			1478			581		
ERV	BS(I/A)-3	1989	3	13	1989.20	16			****			200			329			1604			630		
ERV	BS(I/A)-3	1989	4	27	1989.32	23			0			160			323			1583			611		
ERV	BS(I/A)-3	1989	10	16	1989.79	27			0.04			131			384			1580			685		
ERV	BS(I/A)-3	1989	12	1	1989.92	28			0			135			354			1013			607		
ERV	BS(I/A)-3	1990	3	29	1990.25	33			0			142			354			1519			592		
ERV	BS(I/A)-3	1990	5	16	1990.38	30			0			142			366			1540			627		
ERV	BS(I/A)-3	1990	6	20	1990.47	30			0.07			145			360			1677			XXX		
ERV	BS(I/A)-3	1990	8	15	1990.62	31			0.12			145			354			1650			550		
ERV	BS(I/A)-3	1990	9	18	1990.72	30			0.12			146			342			1410			575		
ERV	BS(I/A)-3	1990	10	24	1990.82	29			0.12			154			342			1550			618		
ERV	BS(I/A)-3	1990	11	13	1990.87	30			0.11			154			342			1540			580		
ERV	BS(I/A)-3	1991	2	21	1991.14	27		27.1	0.07		0.06	150		158	360		326	1450		1464	575		579
ERV	BS(I/A)-3	1991	3	19	1991.22	29			0.15			156			354			1350			603		
ERV	BS(I/A)-3	1991	4	12	1991.28	27.4			0.07			158			329			1420			583		

Table C-3. 1988 - 1991 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	88-91 Mean	1991 Mean	Ammonia mg/L	88-91 Mean	1991 Mean	Chloride mg/L	88-91 Mean	1991 Mean	Bicarbonate mg/L	88-91 Mean	1991 Mean	Conductivity uS/cm	88-91 Mean	1991 Mean	Sulfate mg/L	88-91 Mean	1991 Mean
ERV	BS(I/A)-3	1991	6	24	1991.48	25.4			0.01			159			226			1560			468		
ERV	BS(I/A)-3	1991	10	14	1991.79	26.5			0.01			168			359			1539			665		
ERV	BS(I/A)-4	1988	1	13	1988.04	23.2	22.6		0.37	0.50		79	130		354	318		1437	1600		XXX	611	
ERV	BS(I/A)-4	1988	2	11	1988.11	26.9			0.75			136			336			1607			590		
ERV	BS(I/A)-4	1988	3	24	1988.23	21.7			0.32			144			311			1445			627		
ERV	BS(I/A)-4	1988	10	17	1988.80	19.2			0.83			140			323			1692			627		
ERV	BS(I/A)-4	1989	1	11	1989.03	21.8			0.25			150			268			1817			601		
ERV	BS(I/A)-5	1988	1	13	1988.04	30.1	66.4		0.15	0.08		80	108		336	335		1290	1406		XXX	506	
ERV	BS(I/A)-5	1988	2	11	1988.11	65			0.08			86			323			1300			498		
ERV	BS(I/A)-5	1988	3	24	1988.23	81			0.01			82			348			1242			498		
ERV	BS(I/A)-5	1988	6	16	1988.46	59.2			0.03			88			305			1513			516		
ERV	BS(I/A)-5	1988	10	17	1988.80	55.6			0.11			92			336			1478			479		
ERV	BS(I/A)-5	1989	1	11	1989.03	70.9			0.21			95			281			1582			485		
ERV	BS(I/A)-5	1989	3	13	1989.20	71.9			0.19			120			317			1372			459		
ERV	BS(I/A)-5	1989	4	27	1989.32	72.4			0			100			311			1345			419		
ERV	BS(I/A)-5	1989	12	1	1989.92	62			0			102			329			1372			509		
ERV	BS(I/A)-5	1990	3	29	1990.25	70			0			104			336			1372			494		
ERV	BS(I/A)-5	1990	5	16	1990.38	76			0.01			103			342			1382			XXX		
ERV	BS(I/A)-5	1990	6	20	1990.47	71			0.06			104			358			1488			XXX		
ERV	BS(I/A)-5	1990	8	15	1990.62	75			0.15			106			336			1550			498		
ERV	BS(I/A)-5	1990	9	18	1990.72	70			0.14			107			354			1300			527		
ERV	BS(I/A)-5	1990	10	24	1990.82	70			0.12			109			348			1540			499		
ERV	BS(I/A)-5	1990	11	13	1990.87	68			0.1			107			354			1488			551		
ERV	BS(I/A)-5	1991	1	23	1991.06	45		65.4	0.08		0.07	230		131	348		343	1420		1388	493		530
ERV	BS(I/A)-5	1991	2	21	1991.14	77			0.05			110			342			1320			536		
ERV	BS(I/A)-5	1991	3	19	1991.22	70			0.17			111			342			1260			554		
ERV	BS(I/A)-5	1991	4	12	1991.28	68.5			0.08			110			329			1320			504		
ERV	BS(I/A)-5	1991	6	24	1991.48	58.7			0.02			111			342			1510			457		
ERV	BS(I/A)-5	1991	10	14	1991.79	72.9			0.01			115			353			1497			637		
ERV	BS(I/A)-6	1988	1	13	1988.04	1.1	12.0		1.28	0.37		35	59		220	242		1116	1191		664	548	
ERV	BS(I/A)-6	1988	2	11	1988.11	1.6			0.6			39			232			1125			XXX		
ERV	BS(I/A)-6	1988	3	15	1988.21	50.1			0.42			98			299			1251			433		

Table C-3. 1988 - 1991 Drinking Water Inorganics Data

Lab	Well No.	Year	Mo.	Day	Date	Nitrate mg/L	88-91 Mean	1991 Mean	Ammonia mg/L	88-91 Mean	1991 Mean	Chloride mg/L	88-91 Mean	1991 Mean	Bicarbonate mg/L	88-91 Mean	1991 Mean	Conductivity uS/cm	88-91 Mean	1991 Mean	Sulfate mg/L	88-91 Mean	1991 Mean
ERV	BS(I/A)-6	1988	3	24	1988.23	36.5			0.11			160			323			1319			452		
ERV	BS(I/A)-6	1988	5	11	1988.36	0.7			0.91			36			232			1116			466		
ERV	BS(I/A)-6	1988	6	16	1988.46	0.7			1.28			35			207			1282			562		
ERV	BS(I/A)-6	1988	7	7	1988.52	0.9			1.39			76			214			1294			553		
ERV	BS(I/A)-6	1988	9	5	1988.68	1.5			----			78			214			1298			571		
ERV	BS(I/A)-6	1988	10	17	1988.80	4.7			1.02			41			226			1247			553		
ERV	BS(I/A)-6	1988	11	21	1988.89	2.1			1.08			40			202			1155			544		
ERV	BS(I/A)-6	1989	1	11	1989.03	2.1			0.81			29			201			1247			531		
ERV	BS(I/A)-6	1989	3	13	1989.20	2.8			0.76			39			220			1171			539		
ERV	BS(I/A)-6	1989	4	27	1989.32	5.1			0.12			48			225			1161			489		
ERV	BS(I/A)-6	1989	5	15	1989.37	3.3			1.18			45			238			1139			618		
ERV	BS(I/A)-6	1989	7	17	1989.55	4.6			0			42			262			1203			599		
ERV	BS(I/A)-6	1989	9	20	1989.72	10			0.03			49			244			1171			617		
ERV	BS(I/A)-6	1989	10	16	1989.79	9.7			0.06			51			244			1203			607		
ERV	BS(I/A)-6	1989	12	1	1989.92	10.7			0.05			54			226			1182			548		
ERV	BS(I/A)-6	1990	1	16	1990.04	9.8			0.17			58			238			1224			583		
ERV	BS(I/A)-6	1990	3	20	1990.22	14.1			0.05			65			238			1287			602		
ERV	BS(I/A)-6	1990	5	16	1990.38	11.6			0.04			62			244			1261			725		
ERV	BS(I/A)-6	1990	6	20	1990.47	11.4			0.11			62			305			1324			XXX		
ERV	BS(I/A)-6	1990	7	25	1990.57	12			0.1			59			268			1279			612		
ERV	BS(I/A)-6	1990	8	15	1990.62	24			0.19			56			238			1350			573		
ERV	BS(I/A)-6	1990	9	18	1990.72	13			0.16			57			238			1140			542		
ERV	BS(I/A)-6	1990	10	24	1990.82	20			0.14			56			244			1460			589		
ERV	BS(I/A)-6	1990	11	13	1990.87	19.7			0.16			53			250			1304			563		
ERV	BS(I/A)-6	1991	1	29	1991.08	10.6		16.1	0.1		0.13	55		67	238		247	1100		1077	636		505
ERV	BS(I/A)-6	1991	2	21	1991.14	10.4			0.09			55			244			1130			580		
ERV	BS(I/A)-6	1991	3	19	1991.22	13.2			0.14			96			250			1080			499		
ERV	BS(I/A)-6	1991	4	12	1991.28	9.5			0.14			52			226			1090			564		
ERV	BS(I/A)-6	1991	5	13	1991.37	8.1			0.39			52			232			1080			546		
ERV	BS(I/A)-6	1991	6	24	1991.48	8.2			0.07			55			238			1230			465		
ERV	BS(I/A)-6	1991	7	10	1991.53	8.2			0.04			53			238			1170			498		
ERV	BS(I/A)-6	1991	9	16	1991.71	72.7			0.12			124			-----			410			363		
ERV	BS(I/A)-6	1991	10	14	1991.79	11.6			0.07			63			280			1251			512		
ERV	BS(I/A)-6	1991	11	25	1991.90	8.9			0.1			64			280			1231			382		

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Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
ERV	Sajo	1990	1	4	1990.01	------	----	0.5	------	----	----	----	----	----
ERV	Sajo	1990	2	1	1990.09	------	----	0.2	------	----	----	----	----	----
ERV	Sajo	1990	3	20	1990.22	25	0	0.2	0	3	4	0	0	23
ERV	Sajo	1990	4	11	1990.28	22	----	0.2	------	----	----	----	----	----
ERV	Sajo	1990	5	16	1990.38	19	----	0.2	------	----	----	----	----	----
ERV	Sajo	1990	6	10	1990.44	21	----	0.2	------	----	----	----	----	----
ERV	Sajo	1990	7	11	1990.53	21	----	0.2	------	----	----	----	----	----
ERV	Sajo	1990	8	15	1990.62	52	----	0.3	------	----	----	----	----	----
ERV	Sajo	1990	9	18	1990.72	56	----	0.1	------	----	----	----	----	----
ERV	Sajo	1990	10	28	1990.83	60	0	0.3	0	7	9	4	16	22
ERV	Sajo	1990	11	13	1990.87	38	0	0.1	0	3	2	7	0	17
ERV	Sajo	1990	11	30	1990.92	9	0	0	0	4	2	7	0	19
ERV	Sajo	1991	1	24	1991.07	22	0	0.3	0	6	2	0	0	26
ERV	Sajo	1991	2	21	1991.14	23	0	0.1	0	0	0	0	14	21
ERV	Sajo	1991	3	19	1991.22	6	0	0.2	0	0	4	0	12	18
ERV	Sajo	1991	4	11	1991.28	13	0	0.4	1	0	8	0	8	10
ERV	Sajo	1991	5	16	1991.38	9.6	0	0.6	0	0	2	10	10	8
ERV	Sajo	1991	6	24	1991.48	8.6	0	0.3	0	0	4	10	0	7
ERV	Sajo	1991	7	10	1991.53	38	0	0.4	0	0	5	0	5	0
ERV	Sajo	1991	8	28	1991.66	20	0	0.2	0	0	0	0	0	0
ERV	Sajo	1991	9	23	1991.73	41	0	0.6	0	0	6	0	0	7
ERV	Sajo	1991	10	15	1991.79	83	0	0.6	0	0	0	0	0	0
ERV	Sajo	1991	11	11	1991.86	12	0	0.2	0	0	4	0	0	38
ERV	Sajo	1991	12	2	1991.92	10	0	0.1	0	0	1	0	0	10
ERV	Sajo	1992	1	15	1992.04	33	0	0.1	0	0	3	0	12	15
ERV	Sajo	1992	2	5	1992.10	30	0	0.1	0	0	4	0	0	12
ERV	Sajo	1992	3	5	1992.18	34	0	0.1	0	0	5	0	0	10
ERV	Sajo	1992	4	14	1992.29	13	0	0.3	0	0	0	0	16	14
ERV	Sajo	1992	5	14	1992.37	19	0	0.2	0	0	8	0	0	35
ERV	Sajo	1992	6	10	1992.44	26	0	0	0	0	3	0	0	18
ERV	Sajo	1992	7	10	1992.53	41	0	0.3	1	0	1	11	0	6
ERV	Sajo	1992	8	4	1992.59	40	0	0.3	0	4	0	0	8	5
ERV	Sajo	1992	9	15	1992.71	47	0	0.2	0	0	2	0	0	5
ERV	Sajo	1992	10	20	1992.80	16	0	0.2	0	0	1	0	5	9
ERV	Sajo	1992	11	10	1992.86	39	0	0.2	0	0	0	0	9	9
ERV	Sajo	1992	12	2	1992.92	26	0	0.2	0	0	2	0	7	0
ERV	Sajo	1993	1	6	1993.02	60	0	0.2	0	0	4	10	0	12
ERV	Sajo	1993	2	10	1993.11	38	0	0.1	0	0	3	0	0	10
ERV	Sajo	1993	3	9	1993.19	19	0	0.1	0	0	4	0	0	7
ERV	ET-101	1992	10	12	1992.78	85	0	0.2	0	0	1	14	8	48
ERV	ET-101	1992	11	9	1992.86	105	0	0.4	0	0	1	0	7	46
ERV	ET-101	1992	12	1	1992.92	111	0	0.1	0	0	2	14	0	70
ERV	ET-101	1993	1	6	1993.02	107	0	0	0	0	3	0	0	32
ERV	ET-101	1993	2	8	1993.11	120	0	0.2	0	0	2	0	0	33
ERV	ET-101	1993	3	11	1993.20	136	0	0.1	0	0	2	0	0	27
ERV	ET-101	1993	4	19	1993.30	139	0	0.1	0	0	4	0	0	29

Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
ERV	ET-102	1993	2	8	1993.11	103	0	0.3	0	0	2	0	0	3
ERV	ET-103	1993	2	8	1993.11	31	7	0.3	0	0	2	0	0	10
ERV	ET-104	1992	10	12	1992.78	530	0	0.2	0	0	1	40	0	7
ERV	ET-104	1992	11	9	1992.86	636	0	0.2	0	0	0	12	0	5
ERV	ET-104	1992	12	1	1992.92	610	0	0.1	0	0	2	0	0	0
ERV	ET-104	1993	1	6	1993.02	540	0	0.4	0	0	3	0	6	6
ERV	ET-104	1993	2	8	1993.11	560	0	0.3	0	0	3	0	0	0
ERV	ET-104	1993	3	11	1993.20	665	0	1	0	0	3	0	0	0
ERV	ET-104	1993	4	19	1993.30	660	0	0.7	0	0	1	0	0	6
ERV	BVK-50	1991	1	24	1991.07	765	10	0.1	0	6	4	11	0	18
ERV	E-1	1990	1	4	1990.01	17	10	0.1	0.4	8	8	0	14	34
ERV	E-1	1990	2	1	1990.09	16	10	0	0	10	9	0	0	26
ERV	E-1	1990	3	6	1990.18	19	10	0.1	0.2	9	7	0	8	15
ERV	E-1	1990	4	11	1990.28	19	10	0.1	0	7	4	0	0	15
ERV	E-1	1990	5	3	1990.34	15	10	0.2	0	7	4	0	0	9
ERV	E-1	1990	6	21	1990.47	21	10	0.1	0	6	4	0	0	21
ERV	E-1	1990	7	19	1990.55	15	10	0.1	0	16	4	4	4	29
ERV	E-1	1990	9	12	1990.70	16	10	0.1	0	16	6	0	0	17
ERV	E-1	1990	10	18	1990.80	15	10	0	0	14	4	0	0	26
ERV	E-1	1990	11	3	1990.84	19	10	0	0	5	3	7	11	13
ERV	E-1	1990	11	30	1990.92	17	10	0.1	0	9	7	0	3	24
ERV	E-1	1991	1	24	1991.07	15	----	0	0	9	8	0	12	26
ERV	E-1	1991	2	21	1991.14	16	10	0.1	0	0	0	0	14	20
ERV	E-1	1991	3	27	1991.24	13	10	0.2	0	0	3	0	0	10
ERV	E-1	1991	4	23	1991.31	13	10	0.1	0	0	7	0	0	11
ERV	E-1	1991	5	16	1991.38	12	10	0.3	0	0	4	0	0	6
ERV	E-1	1991	6	18	1991.47	14	10	0.3	0	7	53	0	0	26
ERV	E-1	1991	7	24	1991.57	16	5	0.1	0	0	2	0	0	10
ERV	E-1	1991	8	27	1991.66	18	5	0.7	0	0	2	0	0	6
ERV	E-1	1991	9	16	1991.71	19	5	0.3	0	0	7	0	0	0
ERV	E-1	1991	10	30	1991.83	18	0	0.5	0	0	3	0	0	0
ERV	E-1	1991	11	18	1991.88	19	0	0.4	0	0	6	0	0	0
ERV	E-1	1991	12	3	1991.92	20	0	0.4	0	0	2	0	0	0
ERV	E-1	1992	1	13	1992.04	20	0	0.1	0	0	4	0	0	0
ERV	E-1	1992	2	17	1992.13	19	0	0.1	0	0	4	0	0	0
ERV	E-1	1992	3	9	1992.19	19	0	0.1	0	0	7	0	0	0
ERV	E-1	1992	4	6	1992.27	19	0	0.1	0	0	9	0	0	10
ERV	E-1	1992	5	12	1992.37	22	0	0.1	0	0	0	0	0	11
ERV	E-1	1992	6	15	1992.46	21	0	0	0	0	0	0	0	8
ERV	E-1	1992	7	28	1992.58	20	0	0.4	0	0	0	0	0	8
ERV	E-1	1992	8	24	1992.65	16	0	0.1	0	0	0	0	5	6
ERV	E-1	1992	9	22	1992.73	17	0	0.1	0	0	0	0	0	6

Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
ERV	E-1	1992	10	12	1992.78	13	0	0.1	0	0	0	0	10	9
ERV	E-1	1992	11	9	1992.86	20	0	0.1	0	0	1	0	0	10
ERV	E-1	1992	12	1	1992.92	20	0	0	0	0	1	0	0	8
ERV	E-1	1993	1	6	1993.02	19	0	0	0	0	0	0	0	5
ERV	E-1	1993	2	8	1993.11	19	0	0.2	0	0	0	0	5	6
ERV	E-1	1993	3	11	1993.20	19	0	0.1	0	0	0	0	0	0
ERV	E-1	1993	4	19	1993.30	22	0	0.1	0	0	0	0	0	0
ERV	E-2	1990	1	4	1990.01	14	10	0.1	0	8	8	0	10	32
ERV	E-2	1990	2	1	1990.09	13	10	0	0.8	8	9	0	0	23
ERV	E-2	1990	3	6	1990.18	15	10	0.3	0	13	8	0	4	26
ERV	E-2	1990	4	11	1990.28	15	10	0.2	0	7	3	0	0	18
ERV	E-2	1990	5	3	1990.34	14	10	0.2	0.1	6	3	7	0	6
ERV	E-2	1990	6	21	1990.47	17	10	0.1	0	4	6	0	8	8
ERV	E-2	1990	7	19	1990.55	12	10	0	0	12	6	8	0	36
ERV	E-2	1990	8	2	1990.59	15	10	0	0	4	2	12	0	22
ERV	E-2	1990	9	12	1990.70	13	10	0.1	0	8	5	0	0	14
ERV	E-2	1990	10	18	1990.80	11	10	0	0	14	4	32	0	21
ERV	E-2	1990	11	3	1990.84	15	10	0	0	8	5	7	8	17
ERV	E-2	1990	11	12	1990.87	12	10	0	0	6	3	4	0	21
ERV	E-2	1991	1	24	1991.07	12	10	0.1	0	6	2	0	0	14
ERV	E-2	1991	2	21	1991.14	13	10	0.1	0	0	0	0	19	12
ERV	E-2	1991	3	27	1991.24	10	10	0.1	0	0	2	0	0	0
ERV	E-2	1991	4	23	1991.31	10	10	0.2	0	0	3	0	0	9
ERV	E-2	1991	5	16	1991.38	10	10	0.4	0	0	3	0	11	6
ERV	E-2	1991	6	18	1991.47	12	10	0.3	0	0	11	0	0	10
ERV	E-2	1991	7	24	1991.57	13	5	0.2	0	0	0	0	0	7
ERV	E-2	1991	8	27	1991.66	15	5	0.2	0	0	1	0	0	7
ERV	E-2	1991	9	16	1991.71	17	5	0.4	0	0	7	0	0	5
ERV	E-2	1991	10	30	1991.83	14	0	0.5	0	0	1	15	0	8
ERV	E-2	1991	11	18	1991.88	14	0	0.4	0	0	4	0	6	8
ERV	E-2	1991	12	3	1991.92	16	0	0.4	0	0	1	0	0	0
ERV	E-2	1992	1	13	1992.04	16	0	0.1	0	0	3	0	0	7
ERV	E-2	1992	2	17	1992.13	15	0	0.2	0	0	2	0	0	5
ERV	E-2	1992	3	9	1992.19	14	0	0.3	0	0	5	0	7	0
ERV	E-2	1992	4	6	1992.27	14	0	0.1	0	0	18	0	0	38
ERV	E-2	1992	5	12	1992.37	16	0	0.1	0	0	0	0	0	23
ERV	E-2	1992	6	15	1992.46	15	0	0.1	0	0	3	0	0	36
ERV	E-2	1992	7	28	1992.58	16	0	0.4	0	0	0	0	0	12
ERV	E-2	1992	8	24	1992.65	10	0	0.1	0	0	0	0	0	9
ERV	E-2	1992	9	22	1992.73	11	0	0.1	0	0	0	0	0	7
ERV	E-2	1992	10	12	1992.78	10	0	0.2	0	0	0	0	0	6
ERV	E-2	1992	11	9	1992.86	14	0	0.1	0	0	0	0	0	5
ERV	E-2	1992	12	1	1992.92	14	0	0.1	0	0	1	0	0	5
ERV	E-2	1993	1	6	1993.02	15	0	0	0	0	4	0	0	14
ERV	E-2	1993	2	8	1993.11	15	0	0.1	0	0	5	0	6	16
ERV	E-2	1993	3	11	1993.20	14	0	0.2	0	0	0	0	0	7

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Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
ERV	E-2	1993	4	19	1993.30	15	0	0.1	0	0	2	0	0	9
ERV	E-3	1990	1	4	1990.01	23	10	0.1	0	2	3	0	18	26
ERV	E-3	1990	2	1	1990.09	29	10	0	1	2	7	0	2	16
ERV	E-3	1990	3	6	1990.18	31	10	0.3	0.2	4	2	0	0	18
ERV	E-3	1990	4	11	1990.28	32	10	0.2	0	2	3	0	0	6
ERV	E-3	1990	5	3	1990.34	28	10	0.3	0	2	3	2	0	3
ERV	E-3	1990	6	21	1990.47	32	10	0.1	0.6	2	6	0	8	6
ERV	E-3	1990	7	19	1990.55	17	10	0.1	0.2	8	4	8	0	11
ERV	E-3	1990	8	2	1990.59	18	10	0	0	2	2	4	0	7
ERV	E-3	1990	9	12	1990.70	28	10	0	0	0	5	0	0	12
ERV	E-3	1990	10	18	1990.80	29	10	0	0	11	3	0	0	12
ERV	E-3	1990	11	3	1990.84	32	10	0.1	0	3	3	7	2	10
ERV	E-3	1990	11	12	1990.87	25	10	0.1	0	3	3	0	9	17
ERV	E-3	1991	1	24	1991.07	23	10	0.1	0	0	2	0	0	8
ERV	E-3	1991	3	27	1991.24	11	10	0	1	0	3	0	0	0
ERV	E-3	1991	4	23	1991.31	16	10	0.2	0	0	4	0	0	6
ERV	E-3	1991	5	16	1991.38	12	10	0.2	0	0	2	0	0	0
ERV	E-3	1991	6	18	1991.47	12	10	0.2	0	0	4	0	0	5
ERV	E-3	1991	7	24	1991.57	15	5	0	0	0	0	0	0	6
ERV	E-3	1991	8	27	1991.66	17	5	0.2	0	0	1	0	0	7
ERV	E-3	1991	9	16	1991.71	27	5	0.2	0	0	5	0	0	0
ERV	E-3	1991	10	30	1991.83	26	0	0.4	0	0	1	16	0	0
ERV	E-3	1991	11	18	1991.88	21	0	0.2	0	0	4	0	5	5
ERV	E-3	1991	12	3	1991.92	15	0	0	0	0	2	0	0	0
ERV	E-3	1992	1	13	1992.04	20	0	0.1	0	0	2	0	0	0
ERV	E-3	1992	2	17	1992.13	22	0	0.1	0	0	3	0	0	0
ERV	E-3	1992	3	9	1992.19	22	0	0.1	0	0	4	0	6	0
ERV	E-3	1992	4	6	1992.27	19	0	0.2	0	0	6	0	0	5
ERV	E-3	1992	5	12	1992.37	21	0	0.1	0	0	2	0	0	0
ERV	E-3	1992	6	15	1992.46	25	0	0	0	0	0	0	0	0
ERV	E-3	1992	7	28	1992.58	23	0	0.1	0	0	2	0	0	6
ERV	E-3	1992	8	24	1992.65	18	0	0.1	0	0	0	0	0	0
ERV	E-3	1992	9	22	1992.73	20	0	0.1	0	0	0	0	0	0
ERV	E-3	1992	10	12	1992.78	17	0	0.2	0	0	0	0	0	0
ERV	E-3	1992	11	9	1992.86	22	0	0.1	0	0	1	0	6	0
ERV	E-3	1992	12	1	1992.92	22	0	0	0	0	2	0	0	0
ERV	E-3	1993	1	6	1993.02	21	0	0	0	0	4	0	0	0
ERV	E-3	1993	2	8	1993.11	29	0	0.1	0	0	3	0	0	0
ERV	E-3	1993	3	11	1993.20	21	0	0.1	0	0	1	0	0	0
ERV	E-3	1993	4	19	1993.30	22	0	0.1	0	0	1	0	0	0
ERV	E-4	1990	1	4	1990.01	62	10	0.3	0.4	10	4	0	18	33
ERV	E-4	1990	2	1	1990.09	62	10	0	1	8	7	0	4	27
ERV	E-4	1990	3	6	1990.18	63	10	0.4	0	9	4	4	6	15
ERV	E-4	1990	4	11	1990.28	22	10	0.2	0.2	4	4	0	0	13
ERV	E-4	1990	5	3	1990.34	58	10	0.2	0.2	5	3	2	0	6

Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
ERV	E-4	1990	6	21	1990.47	78	10	0.2	0.4	4	9	0	0	19
ERV	E-4	1990	7	19	1990.55	96	10	0.3	0.4	8	4	12	0	23
ERV	E-4	1990	8	2	1990.59	61	10	0	0	2	4	4	5	16
ERV	E-4	1990	9	12	1990.70	52	10	0.1	0.8	7	6	0	0	16
ERV	E-4	1990	10	18	1990.80	59	10	0	0	7	4	0	0	21
ERV	E-4	1990	11	3	1990.84	78	10	0	0	10	5	7	11	15
ERV	E-4	1990	11	12	1990.87	56	10	0	0	12	4	4	6	22
ERV	E-4	1991	1	24	1991.07	55	10	0.1	0	6	2	0	0	14
ERV	E-4	1991	2	21	1991.14	58	10	0.1	0	9	0	0	24	12
ERV	E-4	1991	3	27	1991.24	47	10	0	1	5	4	0	0	7
ERV	E-4	1991	4	23	1991.31	56	10	0.2	0	0	5	0	8	9
ERV	E-4	1991	5	16	1991.38	51	10	0.6	0	0	4	0	0	6
ERV	E-4	1991	6	18	1991.47	90	10	0.3	0	0	19	13	5	21
ERV	E-4	1991	7	24	1991.57	70	5	0	0	0	2	0	0	9
ERV	E-4	1991	8	27	1991.66	80	5	0.6	0	0	0	0	0	6
ERV	E-4	1991	9	16	1991.71	82	5	0.4	0	0	8	0	0	6
ERV	E-4	1991	10	30	1991.83	78	0	0.6	0	0	2	0	0	0
ERV	E-4	1991	11	18	1991.88	83	0	0.1	0	0	5	0	10	7
ERV	E-4	1991	12	3	1991.92	84	0	0.5	0	0	2	0	0	0
ERV	E-4	1992	1	13	1992.04	90	0	0.3	0	0	4	0	0	0
ERV	E-4	1992	2	17	1992.13	73	0	0.3	0	0	3	0	0	6
ERV	E-4	1992	3	9	1992.19	79	0	0.1	0	0	4	0	0	0
ERV	E-4	1992	4	6	1992.27	93	0	0.6	0	0	19	0	0	16
ERV	E-4	1992	5	12	1992.37	64	0	0.2	0	0	2	0	0	30
ERV	E-4	1992	6	15	1992.46	63	0	0	0	0	0	0	0	15
ERV	E-4	1992	7	28	1992.58	77	0	0.6	0	0	4	0	0	10
ERV	E-4	1992	8	24	1992.65	46	0	0.1	0	0	0	12	5	5
ERV	E-4	1992	9	22	1992.73	63	0	0.1	0	0	0	0	5	6
ERV	E-4	1992	10	12	1992.78	60	0	0.2	0	0	0	31	5	6
ERV	E-4	1992	11	9	1992.86	80	0	0.3	0	0	0	0	0	0
ERV	E-4	1992	12	1	1992.92	80	0	0	0	0	2	0	0	5
ERV	E-4	1993	1	6	1993.02	73	0	0	0	0	3	0	0	8(?)
ERV	E-4	1993	2	8	1993.11	66	0	0.2	0	0	4	0	3	7
ERV	E-4	1993	3	11	1993.20	75	0	0	0	0	2	0	0	0
ERV	E-4	1993	4	19	1993.30	75	0	0.1	0	0	1	16	0	5
ERV	E-5	1990	1	4	1990.01	15	10	0.1	0	8	4	0	24	15
ERV	E-5	1990	2	1	1990.09	15	10	0	0.8	4	7	0	0	13
ERV	E-5	1990	3	6	1990.18	16	10	0.4	0.8	4	4	0	4	9
ERV	E-5	1990	4	11	1990.28	17	10	0.2	0	3	3	0	0	6
ERV	E-5	1990	5	3	1990.34	14	10	0.2	0	4	3	2	3	2
ERV	E-5	1990	6	21	1990.47	20	10	0.1	0	3	3	0	0	8
ERV	E-5	1990	7	19	1990.55	14	10	0.2	0.2	4	4	8	0	9
ERV	E-5	1990	8	2	1990.59	15	10	0	0	5	2	0	0	5
ERV	E-5	1990	9	12	1990.70	16	10	0	0.5	0	2	0	0	9
ERV	E-5	1990	10	18	1990.80	14	10	0	0	0	2	4	0	7
ERV	E-5	1990	11	3	1990.84	19	10	0	0	5	2	4	15	8

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Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
ERV	E-5	1990	11	12	1990.87	14	10	0	0	6	3	0	0	21
ERV	E-5	1991	1	24	1991.07	16	10	0	0	0	2	11	12	8
ERV	E-5	1991	2	21	1991.14	18	10	0.1	0	0	0	0	19	8
ERV	E-5	1991	3	27	1991.24	11	10	0	0	0	1	0	0	0
ERV	E-5	1991	4	23	1991.31	13	10	0	0	0	2	0	6	6
ERV	E-5	1991	5	16	1991.38	12	10	0.2	0	0	1	0	5	0
ERV	E-5	1991	6	18	1991.47	13	10	0.2	0	0	2	0	5	5
ERV	E-5	1991	7	24	1991.57	16	5	0	0	0	0	15	0	6
ERV	E-5	1991	8	27	1991.66	18	5	0.6	0	0	0	0	0	6
ERV	E-5	1991	9	16	1991.71	19	5	0.1	0	0	3	17	0(?)	0
ERV	E-5	1991	10	30	1991.83	16	0	0.4	0	0	0	0	0	0
ERV	E-5	1991	11	18	1991.88	17	0	0.2	0	0	2	0	0	5
ERV	E-5	1991	12	3	1991.92	17	0	0.1	0	0	0	0	0	0
ERV	E-5	1992	1	13	1992.04	17	0	0.1	0	0	4	0	0	6
ERV	E-5	1992	2	17	1992.13	16	0	0.3	0	0	4	0	33	7
ERV	E-5	1992	3	9	1992.19	15	0	0.1	0	0	3	0	0	0
ERV	E-5	1992	4	6	1992.27	15	0	0.1	0	0	5	0	0	5
ERV	E-5	1992	5	12	1992.37	17	0	0.1	0	0	0	0	0	0
ERV	E-5	1992	6	15	1992.46	16	0	0	0	0	1	0	0	7
ERV	E-5	1992	7	28	1992.58	16	0	0.1	0	0	2	0	0	7
ERV	E-5	1992	8	24	1992.65	11	0	0.1	0	9	0	0	0	0
ERV	E-5	1992	9	22	1992.73	12	0	0.1	0	0	5	0	0	10
ERV	E-5	1992	10	12	1992.78	10	0	0.1	0	0	2	0	0	0
ERV	E-5	1992	11	9	1992.86	13	0	0.1	0	0	0	0	0	0
ERV	E-5	1992	12	1	1992.92	14	0	0	0	0	2	0	0	0
ERV	E-5	1993	1	6	1993.02	14	0	0	0	0	3	0	0	5
ERV	E-5	1993	2	8	1993.11	13	0	0.2	0	0	4	0	6	0
ERV	E-5	1993	3	11	1993.20	13	0	0.2	0	0	2	0	0	6
ERV	E-5	1993	4	19	1993.30	15	0	0.1	0	0	1	0	0	0
ERV	E-6	1990	1	4	1990.01	36	10	0.1	0.4	10	8	6	8	33
ERV	E-6	1990	2	1	1990.09	34	10	0	0	10	11	0	2	33
ERV	E-6	1990	3	6	1990.18	39.6	10	0.4	1	9	4	18	0	25
ERV	E-6	1990	4	11	1990.28	37	10	0.3	0	2	3	0	0	11
ERV	E-6	1990	5	3	1990.34	32	10	0.2	0.2	5	2	3	0	5
ERV	E-6	1990	6	21	1990.47	42	10	0.2	0.2	6	3	3	12	8
ERV	E-6	1990	7	19	1990.55	33	10	0.2	0	4	3	12	4	31
ERV	E-6	1990	8	2	1990.59	35	10	0	0.5	2	4	4	5	38
ERV	E-6	1990	9	12	1990.70	33	10	0.1	0	13	5	0	0	17
ERV	E-6	1990	10	18	1990.80	31	10	0	0.2	7	4	7	6	17
ERV	E-6	1990	11	3	1990.84	46	10	0	0	8	3	7	8	18
ERV	E-6	1991	1	24	1991.07	31	10	0.1	0	9	3	0	0	18
ERV	E-6	1991	3	27	1991.24	33	10	0.1	0	0	1	0	7	6
ERV	E-6	1991	4	23	1991.31	30	10	0.2	0	0	3	0	0	9
ERV	E-6	1991	5	16	1991.38	26	10	0.6	0	0	2	0	9	5
ERV	E-6	1991	6	18	1991.47	48	10	0.3	0	0	25	0	0	18
ERV	E-6	1991	7	24	1991.57	41	5	0	0	0	0	0	0	6

Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
ERV	E-6	1991	8	27	1991.66	50	5	0.7	0	0	3	0	8	6
ERV	E-6	1991	9	16	1991.71	51	5	0.2	0	0	5	0	0	0
ERV	E-6	1991	10	30	1991.83	48	0	0.6	0	0	1	0	0	0
ERV	E-6	1991	11	18	1991.88	46	0	0.1	0	0	4	0	16	9
ERV	E-6	1991	12	3	1991.92	50	0	0.2	0	0	0	0	0	0
ERV	E-6	1992	1	13	1992.04	58	0	0.1	0	0	3	0	5	5
ERV	E-6	1992	2	17	1992.13	52	0	0.3	0	0	3	0	0	5
ERV	E-6	1992	3	9	1992.19	56	0	0.1	0	0	6	0	0	0
ERV	E-6	1992	4	6	1992.27	58	0	0.1	0	0	9	0	0	10
ERV	E-6	1992	5	12	1992.37	61	0	0.1	0	0	0	0	0	13
ERV	E-6	1992	6	15	1992.46	58	0	0.1	0	0	0	0	0	11
ERV	E-6	1992	7	28	1992.58	64	0	1	0	0	1	0	0	11
ERV	E-6	1992	7	29	1992.58	------	----	0.8	------	----	----	----	----	----
ERV	E-6	1992	8	24	1992.65	36	0	0.1	0	0	0	0	5	0
ERV	E-6	1992	9	22	1992.73	49	0	0.1	0	0	0	0	0	10
ERV	E-6	1992	10	12	1992.78	48	0	0.3	0	0	2	0	0	7
ERV	E-6	1992	11	9	1992.86	65	0	0.1	0	0	0	0	5	0
ERV	E-6	1992	12	1	1992.92	69	0	0	0	0	1	0	0	7
ERV	E-6	1993	1	6	1993.02	55	0	0	0	0	2	0	0	6
ERV	E-6	1993	2	8	1993.11	54	0	0.2	0	0	1	0	0	5
ERV	E-6	1993	3	11	1993.20	65	0	0.2	0	0	1	0	0	0
ERV	E-6	1993	4	19	1993.30	63	0	0.2	0	0	1	0	0	0
ERV	H-1	1991	7	24	1991.57	107	5	0.5	0	0	3	0	0	9
ERV	H-1	1991	8	27	1991.66	120	5	0.6	0	0	5	0	0	9
ERV	H-1	1991	10	30	1991.83	110	0	0.6	0	0	3	10	0	0
ERV	H-1	1991	11	18	1991.88	110	0	0.5	0	0	6	0	0	6
ERV	H-1	1991	12	3	1991.92	106	0	0.4	0	0	4	0	0	0
ERV	H-1	1992	1	13	1992.04	117	0	0.2	0	0	3	0	0	0
ERV	H-1	1992	2	17	1992.13	100	0	0.5	0	0	3	0	0	5
ERV	H-1	1992	3	9	1992.19	99	0	0.2	0	0	8	0	0	0
ERV	H-1	1992	4	6	1992.27	99	0	0.2	0	0	13	0	0	9
ERV	H-1	1992	5	12	1992.37	106	0	0.2	0	0	0	0	0	8
ERV	H-1	1992	6	15	1992.46	95	0	0.2	0	0	0	0	0	15
ERV	H-1	1992	12	1	1992.92	115	0	0.4	0	0	3	0	7	0
ERV	H-1	1993	1	6	1993.02	109	0	0.1	0	0	5	0	7	27
ERV	H-1	1993	2	8	1993.11	113	0	0.4	0	7	6	0	22	41
ERV	H-1	1993	3	11	1993.20	114	0	0.4	0	0	6	0	10	21
ERV	H-1	1993	4	19	1993.30	114	0	0.5	0	0	3	0	18	20
ERV	H-2	1991	7	24	1991.57	131	5	0	0	0	3	0	0	10
ERV	H-2	1991	8	27	1991.66	145	5	0.3	0	0	3	0	6	11
ERV	H-2	1991	10	30	1991.83	135	0	0.6	0	0	2	0	0	8
ERV	H-2	1991	11	18	1991.88	147	0	0.2	0	0	7	0	14	12
ERV	H-2	1991	12	3	1991.92	154	0	0.3	0	0	3	0	0	0
ERV	H-2	1992	1	13	1992.04	165	0	0.2	0	0	4	0	0	0
ERV	H-2	1992	2	17	1992.13	164	0	0.4	0	0	3	0	0	9

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Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
ERV	H-2	1992	3	9	1992.19	164	0	0.1	0	0	8	0	0	0
ERV	H-2	1992	4	6	1992.27	163	0	0.1	0	0	11	0	0	10
ERV	H-2	1992	5	12	1992.37	177	0	0.1	0	0	1	0	0	10
ERV	H-2	1992	6	15	1992.46	152	0	0.1	0	0	0	0	0	17
ERV	H-2	1992	7	28	1992.58	142	0	1.2	0	0	1	0	0	8
ERV	H-2	1992	7	29	1992.58	------	----	0.7	------	----	----	----	----	----
ERV	H-2	1992	8	24	1992.65	111	0	0.2	0	0	0	0	0	7
ERV	H-2	1992	9	22	1992.73	158	0	0.1	0	0	0	0	6	9
ERV	H-2	1992	10	12	1992.78	125	0	0.2	0	0	1	0	5	5
ERV	H-2	1992	11	9	1992.86	143	0	0.1	0	0	0	0	6	0
ERV	H-2	1992	12	1	1992.92	148	0	0.1	0	0	4	0	0	0
ERV	H-2	1993	1	6	1993.02	146	0	0	0	0	3	0	0	7
ERV	H-2	1993	2	8	1993.11	154	0	0.2	0	0	4	0	0	8
ERV	H-2	1993	3	11	1993.20	169	0	0	0	0	3	0	9	0
ERV	H-2	1993	4	19	1993.30	163	0	0.1	0	0	1	0	0	5
ERV	V-2	1993	2	8	1993.11	76	0	0.4	0	0	3	0	0	7
ERV	V-3	1991	7	24	1991.57	84	5	0.3	0	0	0	0	0	6
ERV	V-3	1991	8	27	1991.66	25	5	0.2	0	0	0	0	0	6
ERV	V-3	1991	10	30	1991.83	135	20	0.1	0	0	6	0	0	0
ERV	V-3	1991	11	18	1991.88	22	0	0.1	0	0	1	0	9	13
ERV	V-3	1991	12	3	1991.92	21	0	0.2	0	0	0	0	0	58
ERV	V-3	1992	1	13	1992.04	23	0	0.3	0	0	0	0	0	0
ERV	V-3	1992	2	17	1992.13	22	0	0.5	0	0	0	0	0	6
ERV	V-3	1992	3	9	1992.19	21	0	0.1	0	0	1	0	5	0
ERV	V-3	1992	4	6	1992.27	23	0	0.1	0	0	12	0	0	27
ERV	V-3	1992	5	12	1992.37	25	0	0.1	0	0	0	0	0	0
ERV	V-3	1992	6	15	1992.46	23	0	0.1	0	0	0	0	0	8
ERV	V-3	1992	7	28	1992.58	22	0	0.2	0	0	1	0	0	0
ERV	V-3	1992	8	24	1992.65	20	0	0.1	0	0	0	0	0	0
ERV	V-3	1992	9	22	1992.73	20	0	0	0	0	3	0	0	0
ERV	V-3	1992	10	12	1992.78	16	0	0.1	0	0	0	0	6	0
ERV	V-3	1992	11	9	1992.86	21	0	0.2	0	0	0	0	6	0
ERV	V-3	1992	12	1	1992.92	22	0	0.1	0	0	0	0	0	0
ERV	V-3	1993	1	6	1993.02	22	0	0	0	0	1	0	0	0
ERV	V-3	1993	2	8	1993.11	24	0	0.1	0	0	1	0	0	0
ERV	V-3	1993	3	11	1993.20	22	0	0.3	0	0	1	0	0	0
ERV	V-3	1993	4	19	1993.30	22	0	0.3	0	0	2	0	0	0
ERV	H-3	1991	10	30	1991.83	40	10	0.5	0	0	0	0	0	0
ERV	H-3	1991	11	18	1991.88	41	0	0.2	0	0	2	0	0	8
ERV	H-3	1991	12	3	1991.92	44	0	0.5	0	0	2	0	0	7
ERV	H-3	1992	1	13	1992.04	47	0	0.4	0	0	1	0	0	0
ERV	H-3	1992	3	9	1992.19	45	0	0.2	0	0	4	0	0	0
ERV	H-3	1992	4	6	1992.27	44	0	0.3	0	0	9	0	0	19
ERV	H-3	1992	5	12	1992.37	47	0	0.1	0	0	0	0	0	12
ERV	H-3	1992	6	15	1992.46	38	0	0.1	0	0	0	0	0	15

Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
ERV	H-3	1992	7	28	1992.58	42	0	0.7	0	0	2	0	0	9
ERV	H-3	1992	8	24	1992.65	29	0	0.3	0	0	0	0	0	6
ERV	H-3	1992	9	22	1992.73	41	0	0.2	0	0	0	0	0	7
ERV	H-3	1992	10	12	1992.78	39	0	0.4	0	0	1	0	8	16
ERV	H-3	1992	11	9	1992.86	47	0	0.2	0	0	0	0	0	7
ERV	H-3	1992	12	1	1992.92	50	0	0.1	0	0	2	0	0	8
ERV	H-3	1993	1	6	1993.02	46	0	0.1	0	0	3	0	0	8
ERV	H-3	1993	2	8	1993.11	44	0	0.1	0	0	3	0	0	0
ERV	H-3	1993	3	11	1993.20	53	0	0.4	0	0	2	0	0	0
ERV	H-3	1993	4	19	1993.30	54	0	0.6	0	0	1	0	0	0
ERV	V-1	1993	2	8	1993.11	148	111	0.2	0	0	10	0	7	9
BHV	H-1	1988	6	19	1988.47	127	0	10.6	1.6	29	66	80	100	181
BHV	H-1	1988	11	29	1988.91	122	0	0	22	6	17	98	230	185
BHV	H-1	1989	2	21	1989.14	73	0	3.7	1.4	15	11	48	13	37
BHV	H-1	1989	5	30	1989.42	113	0	2	4	XXX	5	18	7	50
BHV	H-1	1989	8	9	1989.61	90	0	1	19	1.4	17.9	48	22	40
BHV	H-1	1989	11	1	1989.84	129	0	1	5	1.5	10	25	1	50
BHV	H-1	1990	3	6	1990.18	157	0	1.8	4	2	6	41	1	32
BHV	H-1	1991	3	28	1991.24	106	0	1	1.2	5	3.4	10	5	500
BHV	H-1	1991	6	19	1991.47	105	0	1.6	5	7	10	14	18	20
BHV	H-1	1991	7	24	1991.57	115	0	1	5	5	5	5	5	57
BHV	H-1	1991	8	27	1991.66	105	0	1	5	10	5	6	5	50
BHV	H-1	1991	9	17	1991.71	105	0	1	5	5	5	6	5	50
BHV	H-1	1991	10	30	1991.83	100	0	1	5	5	5	5	5	50
BHV	H-1	1991	11	19	1991.89	90	0	1	5	5	5	5	5	50
BHV	H-1	1991	12	3	1991.92	95	0	1	5	5	5	5	5	50
BHV	H-1	1992	1	13	1992.04	80	0	1	5	5	5	5	5	50
BHV	H-1	1992	2	18	1992.13	110	10	1	5	5	5	5	5	50
BHV	H-1	1992	3	9	1992.19	175	10	1	5	5	5	5	5	50
BHV	H-1	1992	4	6	1992.27	80	50	1	5	5	5	5	5	50
BHV	H-1	1992	5	12	1992.37	68	50	1	5	5	5	5	5	50
BHV	H-1	1992	6	15	1992.46	60	50	1	5	6	5	5	5	50
BHV	H-1	1992	12	1	1992.92	115	10	1	5	5	5	7	39	50
BHV	H-1	1993	1	6	1993.02	100	10	1	5	5	18	5	11	50
ERV	H-1	1993	2	8	1993.11	113	0	0.4	0	7	6	0	22	41
BHV	H-2	1988	6	19	1988.47	82	0	6.7	0.5	34	34	77	89	54
BHV	H-2	1988	11	29	1988.91	87	0	1.5	3	0	22	77	60	46
BHV	H-2	1989	2	21	1989.14	65	0	1	0.4	17	20	36	100	42
BHV	H-2	1989	5	30	1989.42	113	0	1	4	13	0	14	16	30
BHV	H-2	1989	8	9	1989.61	95	0	1	8	13	14.3	45.4	11	30
BHV	H-2	1989	11	1	1989.84	144	0	1	1	16	2	32	1	20
BHV	H-2	1990	3	6	1990.18	137	0	1.1	4	4	6	37	1	39
BHV	H-2	1991	3	28	1991.24	158	0	1	1.2	5.3	4.9	13	6.9	10
BHV	H-2	1991	6	19	1991.47	115	0	1	5	63	13	7.3	9.7	30

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Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
BHV	H-2	1991	7	24	1991.57	125	0	1	5	5	5	5	5	50
BHV	H-2	1991	8	27	1991.66	130	0	1	5	5	5	5	5	50
BHV	H-2	1991	9	17	1991.71	130	0	1.9	5	6	5	5	5	50
BHV	H-2	1991	10	30	1991.83	115	0	1	5	5	5	5	26	50
BHV	H-2	1991	11	19	1991.89	120	0	1	5	5	7.3	5.1	42	50
BHV	H-2	1991	12	3	1991.92	115	0	1	5	5	5	7	5	50
BHV	H-2	1992	1	13	1992.04	150	0	1	5	5	5	5	5	50
BHV	H-2	1992	2	18	1992.13	115	10	1	5	9	5	5	5	50
BHV	H-2	1992	3	9	1992.19	280	10	1	5	15	5	5	5	50
BHV	H-2	1992	4	6	1992.27	150	50	1	5	5	5	5	5	50
BHV	H-2	1992	5	12	1992.37	125	50	1	5	5	5	5	5	50
BHV	H-2	1992	6	15	1992.46	110	50	1	5	6	5	5	9	50
BHV	H-2	1992	7	28	1992.58	125	50	1	5	5	5	6	5	50
BHV	H-2	1992	8	24	1992.65	200	50	1	5	5	5	14	7	50
BHV	H-2	1992	9	22	1992.73	100	100	1	5	15	23	8	13	50
BHV	H-2	1992	10	12	1992.78	80	100	1	5	0.5	5	5	5	50
BHV	H-2	1992	11	10	1992.86	14	100	1	5	5	5	5	5	50
BHV	H-2	1992	12	1	1992.92	125	100	1	5	5	5	5	5	50
BHV	H-2	1993	1	6	1993.02	150	100	1	5	7	5	5	5	50
BHV	H-2	1993	2	8	1993.11	154	0	0.2	0	0	4	0	0	80
BHV	H-3	1988	10	0	1988.75		ND	ND	1.5		6.4		20	110
BHV	H-3	1988	11	0	1988.83		ND	ND	0.3		19.8		109	443
BHV	H-3	1988	12	0	1988.92		ND	ND	0.5		7.1		18	40
BHV	H-3	1989	1	0	1989.00		ND	ND	ND		6.8		15	48
BHV	H-3	1989	2	0	1989.08		ND	ND	ND		4.8		11	105
BHV	H-3	1989	3	0	1989.17		ND	ND	ND		6.3		20	105
BHV	H-3	1989	4	0	1989.25		ND	ND	ND		6.8		10	81
BHV	H-3	1989	5	0	1989.33		ND	ND	ND		8.5		13	200
BHV	H-3	1989	6	0	1989.42		ND	ND	ND		8.5		13	206
BHV	H-3	1989	7	0	1989.50		13	0.4	ND		7		15	166
BHV	H-3	1989	8	0	1989.58		3.8	0.3	ND		9.8		10	142
BHV	H-3	1989	9	0	1989.67		11	ND	0.42		13		16	170
BHV	H-3	1989	10	0	1989.75		2.5	0.6	ND		8.8		21	155
BHV	H-3	1989	11	0	1989.83		ND	ND	0.9		5.7		24	134
BHV	H-3	1989	12	0	1989.92		3	ND	0.6		5.5		15	105
BHV	H-3	1990	1	0	1990.00		153	ND	ND		ND		19	86
BHV	H-3	1990	2	0	1990.08		82	ND	ND		9.1		18	160
BHV	H-3	1990	3	0	1990.17		70	ND	ND		16		11	100
BHV	H-3	1990	4	0	1990.25		112	ND	ND		6.3		15	410
BHV	H-3	1990	5	0	1990.33		167	ND	ND		3		ND	120
BHV	H-3	1990	6	0	1990.42		9.7	ND	ND		3		22	220
BHV	H-3	1990	7	0	1990.50		4.6	ND	ND		3.5		9	120
BHV	H-3	1990	8	0	1990.58		---	ND	0.3		7		24	210
BHV	H-3	1990	9	0	1990.67		---	0.3	ND		3.5		15	87
BHV	H-3	1990	10	0	1990.75		---	6.3	1.3		7.4		117	86
BHV	H-3	1991	2	0	1991.08		17	0.3	ND		22		138	84

Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
BHV	H-3	1991	4	0	1991.25		2.7	1	ND		4		21	43
BHV	H-3	1991	5	0	1991.33		5.5	ND	1.7		29		7	56
BHV	H-3	1991	6	0	1991.42		2.7	0.3	ND		13.5		15	70
BHV	H-3	1991	7	0	1991.50		15.1	0.5	ND		10.5		7	38
BHV	H-3	1991	8	0	1991.58		7.9	0.4	ND		8.8		9	51
BHV	H-3	1991	9	0	1991.67		0.5	0.6	0.4		19.7		24	98
BHV	H-3	1991	10	0	1991.75	40	10	0.5	0		0		0	0
BHV	H-3	1991	11	0	1991.83	41	0	0.2	0		2		0	0
BHV	H-3	1991	12	0	1991.92	44	0	0.5	0		2		0	7
BHV	H-3	1992	1	0	1992.00	47	0	0.4	0		1		0	0
BHV	H-3	1992	4	6	1992.27		0	0.3	0		9		0	19
BHV	H-3	1992	5	12	1992.37		0	0.1	0		0		0	12
BHV	H-3	1992	6	15	1992.46		0	0.1	0		0		0	15
BHV	H-3	1992	7	28	1992.58		0	0.7	0		2		0	9
BHV	H-3	1992	8	24	1992.65		0	0.3	0		0		0	6
BHV	H-3	1992	9	22	1992.73		0	0.2	0		0		0	7
BHV	H-3	1992	10	12	1992.78		0	0.4	0		1		8	16
BHV	H-3	1992	11	9	1992.86		0	0.2	0		0		0	7
BHV	H-3	1992	12	1	1992.92		0	0.1	0		2		0	8
BHV	H-3	1993	1	6	1993.02		0	0.1	0		3		0	0
BHV	H-3	1993	2	3	1993.11		0	0.1	0		3		0	0
BHV	H-3	1993	3	11	1993.20		0	0.4	0		2		0	0
BVK	V-1	1991	10	30	1991.83	125	500	<1	<5	7.4	<5	6	6.3	<50
BVK	V-1	1991	11	19	1991.89	180	1000	<1	9.2	12.1	71	168	11	188
BVK	V-1	1992	3	9	1992.19	55	250	<1	<5	10	<5	8	9	<50
BVK	V-1	1992	4	6	1992.27	120	<50	<1	<5	11	7	28	<5	<50
BVK	V-1	1992	5	12	1992.37	110	<50	<1	<5	<5	12	8	8	<50
BVK	V-1	1992	6	15	1992.46	120	<50	<1	<5	5	22	5	8	<50
BVK	V-1	1992	8	24	1992.65	130	<50	<1	<5	9	7	7	40	<50
BVK	V-1	1992	9	22	1992.73	100	<100	<1	<5	5	7	8	8	<50
BVK	V-1	1992	10	12	1992.78	100	<100	<1	<5	5	<5	<5	6	<50
BVK	V-1	1992	11	10	1992.86	130	<100	<1	<5	<5	<5	<5	<5	<50
BVK	V-1	1992	12	1	1992.92	130	<100	<1	<5	<5	8	6	26	<50
BVK	V-1	1993	1	6	1993.02	135	<100	<0.5	<5	7	<5	<5	12	<50
BVK	V-1	1993	2	8	1993.11	130	200	<0.5	<5	9	9	<5	10	<50
BVK	V-1	1993	3	11	1993.20	125	40	<0.5	<5	5	7	<5	12	<50
BVK	V-1	1993	4	19	1993.30	135	40	<0.5	<5	7	15	20	33	<50
BVK	V-2	1991	9	17	1991.71	70	0	1.7	5	<5	<5	10	5.4	110
BVK	V-2	1991	10	30	1991.83	68	0	<1	<5	17	9.3	13.7	<5	<50
BVK	V-2	1991	11	19	1991.89	50	0	<1	<5	11	<5	21	<5	265
BVK	V-2	1992	3	9	1992.19	165	180	<1	<5	<5	<5	15	7	<50
BVK	V-2	1992	4	6	1992.27	75	<50	<1	<5	6	<5	19	<5	<50
BVK	V-2	1992	5	12	1992.37	70	<50	<1	<5	8	<5	11	<5	<50
BVK	V-2	1992	6	15	1992.46	70	<50	<1	<5	<5	<5	<5	7	<50
BVK	V-2	1992	8	24	1992.65	71.5	<50	<1	<5	14	6	16	27	140

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Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.old. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
BVK	V-2	1992	9	22	1992.73	64	<100	<1	<5	13	15	21	19	180
BVK	V-2	1992	10	12	1992.78	61	<100	<1	<5	<5	5	7	10	<50
BVK	V-2	1992	11	10	1992.86	70	<100	<1	<5	5	8	6	17	<50
BVK	V-2	1993	1	6	1993.02	68	<100	<1	<5	5	<5	6	7	<50
BVK	V-2	1993	2	8	1993.11	68.5	40	<0.5	<5	<5	<5	6	<5	<50
BVK	V-2	1993	3	11	1993.20	75	40	<0.5	<5	<5	<5	<5	11	<50
BVK	V-2	1993	4	19	1993.30	70.5	20	<0.5	<5	12	<5	<5	<5	<50
BVK	V-3	1991	9	17	1991.71	19.5	0	<1	<5	<5	<5	<5	<5	<50
BVK	V-3	1991	10	30	1991.83	18	0	<1	<5	8.5	<5	<5	<5	<50
BVK	V-3	1991	11	19	1991.89	17	0	<1	<6	<5	<5	12	<5	<50
BVK	V-3	1991	12	3	1991.92	10.5	0	1.2	<5	<5	<5	<5	<5	<50
BVK	V-3	1992	1	13	1992.04	18.5	0	<1	<5	11	<5	7.3	<5	<50
BVK	V-3	1992	2	18	1992.13	18	<10	<1	<5	6	<5	<5	20	<50
BVK	V-3	1992	3	9	1992.19	18.5	<10	<1	<5	<5	<5	<5	<5	<50
BVK	V-3	1992	4	6	1992.27	20	<50	<1	<5	<5	24	<5	6	<50
BVK	V-3	1992	5	12	1992.37	17	<50	<1	<5	<5	8	<5	<5	<50
BVK	V-3	1992	6	15	1992.46	15	<50	<1	<5	7	<5	<5	<5	<50
BVK	V-3	1992	7	28	1992.58	20	<50	<1	<5	<5	<5	<5	<5	<50
BVK	V-3	1992	8	24	1992.65	25	<50	<1	<5	<5	<5	<5	<5	<50
BVK	V-3	1992	9	22	1992.73	18	<100	<1	<5	<5	<5	8	<5	<50
BVK	V-3	1992	10	12	1992.78	15	<100	<1	<5	6	<5	<5	<5	<50
BVK	V-3	1992	11	10	1992.86	23	<100	<1	<5	<5	<5	<5	<5	<50
BVK	V-3	1992	12	1	1992.92	21	<100	<1	<5	<5	9	<5	<5	<50
BVK	V-3	1993	1	6	1993.02	24	<100	<1	<5	<5	<5	<5	<5	<50
BVK	V-3	1993	2	8	1993.11	21.5	<20	<0.5	<5	9	<5	<5	<5	<50
BVK	V-3	1993	3	11	1993.20	21.5	<20	<0.5	<5	8	<5	<5	<5	<50
BVK	V-3	1993	4	19	1993.30	22.5	<20	<0.5	<5	5	<5	<5	<5	<50
BVK	ET-101	1992	1	13	1992.04	80	0	<1	<5	<5	<5	10	22	347
BVK	ET-101	1992	2	18	1992.13	85	<10	<1	<5	28	12	29	9	109
BVK	ET-101	1992	3	9	1992.19	---	<10	<1	<5	160	24	79	19	210
BVK	ET-101	1992	4	6	1992.27	90	<50	<1	<5	29	30	72	9	351
BVK	ET-101	1992	5	12	1992.37	66	<50	<1	<5	16	19	14	25	253
BVK	ET-101	1992	6	15	1992.46	60	<50	<1	<5	7	<5	<5	<5	<50
BVK	ET-101	1992	7	28	1992.58	65	<50	<1	<5	22	8	25	31	340
BVK	ET-101	1992	8	24	1992.65	70	<50	<1	<5	<5	<5	10	14	80
BVK	ET-101	1992	9	22	1992.73	84	<100	<1	<5	15	13	15	19	120
BVK	ET-101	1992	10	12	1992.78	77.5	<100	<1	<5	8	8	8	18	60
BVK	ET-101	1992	11	10	1992.86	100	<100	<1	<5	27	14	25	28	130
BVK	ET-101	1992	12	1	1992.92	96	<100	<1	<5	7	<5	5	9	<50
BVK	ET-101	1993	1	6	1993.02	100	<100	<0.5	<5	6	<5	5	8	<50
BVK	ET-101	1993	2	8	1993.11	110	<20	<0.5	<5	11	12	8	<5	<50
BVK	ET-101	1993	3	11	1993.20	115	<20	<0.5	<5	<5	6	<5	9	50
BVK	ET-101	1993	4	19	1993.30	120	<20	<0.5	<5	14	7	9	7	50
BVK	ET-102	1992	1	13	1992.04	75	0	<1	<5	22	5.4	35	42	65

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Table C-4. Groundwater Minor Ionic Data

Lab	Well	Year	Mo.	Day	Date	Sodium Na mg/l	Arsenic As ug/l	Total Mercury Hg.cld. ug/l	Cadmium Cd ug/l	Chromium Cr ug/l	Copper Cu ug/l	Nickel Ni ug/l	Lead Pb ug/l	Zinc Zn ug/l
BVK	ET-102	1992	2	18	1992.13	70	<10	<1	<5	13	<5	17	6	<50
BVK	ET-102	1992	3	9	1992.19	150	<10	<1	<5	9	<5	14	9	<50
BVK	ET-102	1992	4	6	1992.27	80	<50	<1	<5	<5	<5	14	<5	<50
BVK	ET-102	1992	5	12	1992.37	66	<50	<1	<5	<5	<5	12	<5	<50
BVK	ET-102	1992	6	15	1992.46	70	<50	<1	5	12	6	8	12	<50
BVK	ET-102	1992	7	28	1992.58	75	<50	<1	<5	<5	<5	5	<5	60
BVK	ET-102	1992	8	24	1992.65	85	<50	<1	<5	<5	<5	7	18	<50
BVK	ET-102	1992	9	22	1992.73	100	<100	<1	<5	8	<5	8	12	<50
BVK	ET-102	1992	10	12	1992.78	60	<100	<1	<5	9	<5	<5	9	<50
BVK	ET-102	1992	11	10	1992.86	120	<100	<1	<5	<5	<5	<5	5	<50
BVK	ET-102	1992	12	1	1992.92	100	<100	<1	<5	8	<5	<5	9	<50
BVK	ET-102	1993	1	6	1993.02	100	<100	<1	<5	6	<5	<5	8	<50
BVK	ET-102	1993	2	8	1993.11	120	<20	0.8	<5	10	<5	5	<5	<50
BVK	ET-102	1993	3	11	1993.20	105	<20	<0.5	<5	<5	<5	<5	<5	<50
BVK	ET-102	1993	4	19	1993.30	100	<20	<0.5	<5	8	<5	<5	<5	<50
BVK	ET-103	1992	1	13	1992.04	40.5	0	<1	<5	<5	<5	6	26	84
BVK	ET-103	1992	2	18	1992.13	7.5	<10	<1	<5	6	<5	11	10	80
BVK	ET-103	1992	3	9	1992.19	55	<10	<1	<5	<5	<5	5	8	<50
BVK	ET-103	1992	4	6	1992.27	53	<50	<1	<5	<5	40	8	7	73
BVK	ET-103	1992	5	12	1992.37	41.5	<50	<1	<5	<5	8	9	36	<50
BVK	ET-103	1992	6	15	1992.46	45	<50	<1	<5	6	6	<5	23	60
BVK	ET-103	1992	7	28	1992.58	30	<50	<1	<5	<5	<5	<5	80	80
BVK	ET-103	1992	9	22	1992.73	39	<100	<1	<5	<5	<5	<5	<5	<50
BVK	ET-103	1992	10	12	1992.78	32	<100	<1	<5	5	<5	<5	<5	<50
BVK	ET-103	1992	11	10	1992.86	42	<100	<1	<5	<5	<5	<5	13	<50
BVK	ET-103	1992	12	1	1992.92	36	<100	<1	<5	<5	<5	5	<5	<50
BVK	ET-103	1993	1	6	1993.02	34	<100	<1	<5	<5	<5	<5	<5	<50
BVK	ET-103	1993	2	8	1993.11	33	<20	<0.5	<5	9	<5	<5	<5	<50
BVK	ET-103	1993	3	11	1993.20	30	<20	<0.5	<5	<5	<5	<5	<5	<50
BVK	ET-103	1993	4	19	1993.30	28	<20	<0.5	<5	7	<5	<5	<5	<50
BVK	ET-104	1992	1	13	1992.04	360	0	<1	<5	29	<5	39	8	58
BVK	ET-104	1992	2	18	1992.13	370	<10	<1	<5	20	<5	31	7	50
BVK	ET-104	1992	3	9	1992.19	760	<10	<1	<5	46	13	25	12	<50
BVK	ET-104	1992	4	6	1992.27	390	<50	<1	<5	<5	15	23	<5	66
BVK	ET-104	1992	5	12	1992.37	320	<50	<1	<5	19	14	13	16	<50
BVK	ET-104	1992	6	15	1992.46	405	<50	<1	<5	11	<5	19	9	<50
BVK	ET-104	1992	7	28	1992.58	430	<50	<1	<5	<9	<5	<15	13	100
BVK	ET-104	1992	9	22	1992.73	460	<100	<1	<5	10	<5	11	14	<50
BVK	ET-104	1992	10	12	1992.78	390	<100	<1	<5	6	<5	<5	<5	<50
BVK	ET-104	1992	11	10	1992.86	550	<100	<1	<5	10	<5	8	16	<50
BVK	ET-104	1992	12	1	1992.92	410	<100	<1	<5	<5	<5	7	5	<50
BVK	ET-104	1993	1	6	1993.02	600	<100	<0.5	<5	5	6	<5	<5	<50
BVK	ET-104	1993	2	8	1993.11	540	<20	<0.5	<5	12	<5	9	<5	<50
BVK	ET-104	1993	3	11	1993.20	535	<20	<0.5	<5	7	<5	<5	<5	<50
BVK	ET-104	1993	4	19	1993.30	490	<20	<0.5	<5	10	<5	9	<5	<50

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Appendix D. Lithologic Descriptions and Soil and Waste Measurements - Epres-tanya Landfill

Table D-1. Lithologic Descriptions - Epres-tanya Landfill

WELL NO. (KUT SZ)	DEPTH FROM	DEPTH TO	DESCRIPTION
ET-F1	0	0.5	LIGHTLY HUMIC SOIL
ET-F1	0.5	6	MIXED SOIL OF WASTE MATTER AND CLAY
ET-F1	6	7	CLAY WITH GRAVEL AND SMALL WASTE CONTENT
ET-F1	7	7.3	CLAY WITH SAND
ET-F1	7.3	7.7	CLAY WITH GRAVEL
ET-F1	7.7	8.5	CLAY
ET-F2	0	0.9	LIGHTLY HUMIC SOIL WITH CLAY
ET-F2	0.9	3.1	SAND
ET-F2	3.1	5.2	GRAVEL WITH SAND
ET-F2	5.2	6.9	GRAVEL WITH SAND
ET-F2	6.9	7.5	SILT WITH CLAY
ET-101	0	0.8	TOPSOIL WITH CLAY
ET-101	0.8	1.8	CLAY WITH SAND
ET-101	1.8	4.4	GRAVEL WITH CLAY
ET-101	4.4	6.8	SOIL WITH GRAVEL
ET-101	6.8	10.4	CLAY
ET-102	0	0.8	TOPSOIL WITH CLAY
ET-102	0.8	1.4	SOIL WITH CLAY
ET-102	1.4	6.5	SOIL WITH GRAVEL
ET-102	6.5	6.7	SAND
ET-102	7.7	10.1	SILT WITH CLAY
ET-103	0	0.9	TOPSOIL
ET-103	0.9	1.8	SOIL WITH CLAY
ET-103	1.8	2.4	SOIL WITH ???
ET-103	2.4	5.3	GRAVEL WITH CLAY
ET-103	5.3	5.6	CLAY
ET-103	5.6	16	SILT WITH CLAY
ET-103	16	32.5	SILT WITH SOIL
ET-103	32.5	41.1	CLAY
ET-104	0	1	TOPSOIL WITH CLAY
ET-104	1	2.2	SOIL WITH CLAY
ET-104	2.2	6.3	SOIL WITH GRAVEL
ET-104	6.3	9.8	SILT WITH CLAY
ET-104	9.8	10.4	SILT WITH SOIL

Table D-2. Soil and Waste Measurements - Epres-tanya Landfill

SAMPLE ID (MINTA SZ)	DEPTH (m)	Hg (mg/kg)	Cu (mg/kg)	Cr (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Cd (mg/kg)	As (mg/kg)	Zn (mg/kg)	Waste (%)
ET-101	0.15	0.0324	13.21	1.72	15.54	8.89	0.95	0.42	XXX	XXX
ET-101	0.75	0.0451	12.30	1.97	8.32	8.12	0.82	0.10	XXX	XXX
ET-101	1.40	0.0486	4.61	2.24	10.07	6.22	0.50	0.10	XXX	XXX
ET-101	2.35	0.0484	3.78	1.54	5.54	6.65	0.50	2.98	XXX	XXX
ET-101	3.05	0.0148	16.79	1.04	2.31	0.92	0.50	1.39	XXX	XXX
ET-101	4.45	0.0396	12.31	2.24	3.20	2.62	0.50	1.11	XXX	XXX
ET-101	5.45	0.0280	5.93	1.38	4.07	1.15	0.50	1.40	XXX	XXX
ET-101	6.40	0.0319	4.14	1.54	4.75	2.63	0.50	0.28	XXX	XXX
ET-101	7.40	0.0708	5.27	1.01	2.35	9.01	0.50	0.40	XXX	XXX
ET-101	8.30	0.0801	2.24	0.41	2.13	8.51	0.50	0.12	XXX	XXX
ET-101	10.25	0.0587	12.76	1.51	4.97	11.82	0.50	1.97	XXX	XXX
ET-101	MEAN	0.0453	8.49	1.51	5.75	6.05	0.57	0.93	XXX	XXX
ET-102	0.15	0.0537	6.89	1.99	7.14	12.57	0.50	0.07	XXX	XXX
ET-102	0.75	0.0559	4.49	2.99	7.71	9.32	0.50	3.09	XXX	XXX
ET-102	1.45	0.0636	3.33	2.55	6.50	5.86	0.50	1.85	XXX	XXX
ET-102	2.35	0.0259	2.49	1.57	2.54	2.11	0.50	0.59	XXX	XXX
ET-102	3.25	0.0407	6.61	1.84	3.36	1.79	0.50	1.51	XXX	XXX
ET-102	4.15	0.0153	1.92	0.88	1.82	2.75	0.50	0.37	XXX	XXX
ET-102	5.35	0.0257	9.46	4.16	5.55	3 64	0.50	2.72	XXX	XXX
ET-102	6.25	0.0268	2.57	1.83	2.49	1.77	0.50	0.11	XXX	XXX
ET-102	7.50	0.1169	15.84	2.62	20.92	18.51	0.50	2.06	XXX	XXX
ET-102	7.90	0.0875	14.48	2.79	21.64	15.64	0.50	4.42	XXX	XXX
ET-102	10.00	0.1004	14.66	3.08	22.01	18.41	0.50	0.79	XXX	XXX
ET-102	MEAN	0.0557	7.52	2.39	9.24	8.40	0.50	1.60	XXX	XXX

Table D-2. Soil and Waste Measurements - Epres-tanya Landfill

SAMPLE ID (MINTA SZ)	DEPTH (m)	Hg (mg/kg)	Cu (mg/kg)	Cr (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Cd (mg/kg)	As (mg/kg)	Zn (mg/kg)	Waste (%)
ET-103	0.10	0.0608	5.81	1.74	5.17	19.69	3.67	0.10	XXX	XXX
ET-103	0.50	0.0356	5.94	2.23	6.02	14.54	4.02	0.10	XXX	XXX
ET-103	1.00	0.0413	3.66	2.65	5.51	23.55	6.09	2.07	XXX	XXX
ET-103	1.40	0.1300	5.97	3.29	6.55	23.46	3.62	1.85	XXX	XXX
ET-103	1.90	0.0262	2.69	2.28	6.22	12.83	3.65	1.63	XXX	XXX
ET-103	2.45	0.0242	7.42	1.03	11.52	2.92	0.50	1.91	XXX	XXX
ET-103	3.00	0.0218	4.62	0.70	1.95	1.58	0.50	0.10	XXX	XXX
ET-103	4.15	0.0167	2.99	0.56	1.18	0.86	0.50	1.28	XXX	XXX
ET-103	5.10	0.0160	4.48	0.65	2.37	1.78	0.50	0.10	XXX	XXX
ET-103	6.05	0.0614	13.00	3.17	24.45	11.16	0.50	0.10	XXX	XXX
ET-103	7.00	0.1043	11.31	3.75	16.98	16.47	0.50	0.10	XXX	XXX
ET-103	7.95	0.1835	13.99	2.28	12.39	11.38	0.50	0.10	XXX	XXX
ET-103	10.25	0.1050	12.19	1.17	16.09	13.00	0.50	0.10	XXX	XXX
ET-103	15.15	0.0646	11.67	2.61	8.42	7.17	0.50	XXX	XXX	XXX
ET-103	16.05	0.1004	13.00	1.14	63.30	18.74	0.50	XXX	XXX	XXX
ET-103	20.05	0.0371	7.63	2.04	7.42	8.35	0.50	XXX	XXX	XXX
ET-103	25.15	0.1343	10.81	1.06	14.18	13.44	0.50	XXX	XXX	XXX
ET-103	30.05	0.0670	14.08	0.92	12.25	12.92	0.50	XXX	XXX	XXX
ET-103	35.25	0.0765	7.17	0.26	3.21	7.62	0.50	XXX	XXX	XXX
ET-103	40.15	0.4529	8.30	0.23	2.68	54.43	0.50	XXX	XXX	XXX
ET-103	MEAN	0.06	7.24	1.96	8.95	11.79	1.93	0.73	XXX	XXX

Table D-2. Soil and Waste Measurements - Epres-tanya Landfill

SAMPLE ID (MINTA SZ)	DEPTH (m)	Hg (mg/kg)	Cu (mg/kg)	Cr (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Cd (mg/kg)	As (mg/kg)	Zn (mg/kg)	Waste (%)
ET-104	0.15	0.1567	7.74	1.93	6.41	13.28	0.50	4.12	XXX	XXX
ET-104	0.45	0.2848	7.38	1.69	9.55	14.32	0.50	5.08	XXX	XXX
ET-104	1.05	0.1234	4.65	2.18	7.01	6.81	0.50	1.33	XXX	XXX
ET-104	1.60	0.0834	2.68	1.59	4.32	6.56	0.50	3.42	XXX	XXX
ET-104	2.00	8.0826	5.41	1.66	5.48	7.02	0.50	2.01	XXX	XXX
ET-104	2.55	10.4262	5.92	1.30	3.45	2.25	0.50	1.03	XXX	XXX
ET-104	3.10	0.8469	4.83	1.61	3.69	3.15	0.50	0.58	XXX	XXX
ET-104	3.95	0.4151	22.16	5.56	7.43	3.99	0.50	11.61	XXX	XXX
ET-104	5.15	0.0868	7.15	2.22	7.03	4.89	0.50	1.38	XXX	XXX
ET-104	5.75	0.1283	5.44	1.29	1.99	1.42	0.50	2.31	XXX	XXX
ET-104	7.15	0.0595	7.32	2.06	26.48	10.54	0.50	2.22	XXX	XXX
ET-104	8.00	0.0554	7.59	1.55	9.82	7.54	0.50	4.44	XXX	XXX
ET-104	9.95	0.0867	15.87	1.62	13.51	10.36	0.50	1.80	XXX	XXX
ET-104	MEAN	1.6028	8.01	2.02	8.17	7.09	0.50	3.18	XXX	XXX
ET-F1	0.25	2.6930	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
ET-F1	0.75	44.2780	XXX	XXX	XXX	XXX	XXX	XXX	XXX	45.02
ET-F1	1.75	13.7040	XXX	XXX	XXX	XXX	XXX	XXX	XXX	45.62
ET-F1	2.75	14.0970	XXX	XXX	XXX	XXX	XXX	XXX	XXX	21.76
ET-F1	3.65	13.1720	XXX	XXX	XXX	XXX	XXX	XXX	XXX	8.8
ET-F1	5.10	5.7810	XXX	XXX	XXX	XXX	XXX	XXX	XXX	4.23
ET-F1	6.05	4.7080	XXX	XXX	XXX	XXX	XXX	XXX	XXX	2.95
ET-F1	6.90	1.6960	XXX	XXX	XXX	XXX	XXX	XXX	XXX	3.26
ET-F1	7.15	0.1760	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
ET-F1	7.50	0.2030	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
ET-F1	7.95	1.0150	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
ET-F1	8.35	0.0690	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
ET-F1	MEAN	8.4660	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX

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Table D-2. Soil and Waste Measurements - Epres-tanya Landfill

SAMPLE ID (MINTA SZ)	DEPTH (m)	Hg (mg/kg)	Cu (mg/kg)	Cr (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Cd (mg/kg)	As (mg/kg)	Zn (mg/kg)	Waste (%)
ET-F2	0.20	1.7200	12.61	4.00	6.00	67.27	XXX	XXX	XXX	XXX
ET-F2	1.15	0.1040	3.24	1.80	5.30	10.45	XXX	XXX	XXX	XXX
ET-F2	2.05	0.1750	3.29	1.30	5.36	10.63	XXX	XXX	XXX	XXX
ET-F2	3.25	0.1000	XXX	1.12	XXX	5.99	XXX	XXX	XXX	XXX
ET-F2	4.15	0.0550	2.25	1.33	36.21	4.94	XXX	XXX	XXX	XXX
ET-F2	5.20	0.0400	1.55	0.54	3.09	4.28	XXX	XXX	XXX	XXX
ET-F2	6.25	0.0430	1.42	0.61	2.64	1.30	XXX	XXX	XXX	XXX
ET-F2	7.25	0.0660	6.68	1.33	10.61	1.26	XXX	XXX	XXX	XXX
ET-F2	MEAN	0.2879	4.43	1.50	9.89	13.27	XXX	XXX	XXX	XXX
EKOVIZIG-1	???	35	XXX	XXX	XXX	1280	6	16	410	XXX
EKOVIZIG-2	???	89	XXX	XXX	XXX	1190	8	350	370	XXX
EKOVIZIG-3	???	23	XXX	XXX	XXX	790	31	7	110	XXX
EKOVIZIG-4	???	23	XXX	XXX	XXX	500	2	800	60	XXX
EKOVIZIG-5	???	3	XXX	XXX	XXX	30	2	29	50	XXX
EKOVIZIG-6	???	45	XXX	XXX	XXX	2700	4	16	150	XXX
EKOVIZIG-7	???	14	XXX	XXX	XXX	1160	270	2	80	XXX
EKOVIZIG-8	???	3	XXX	XXX	XXX	110	3	4	250	XXX
EKOVIZIG-9	???	54	XXX	XXX	XXX	14700	3	1	30	XXX
EKOVIZIG-10	???	118	XXX	XXX	XXX	620	130	1	60	XXX
EKOVIZIG-11	???	13	XXX	XXX	XXX	1850	2	1	30	XXX
EKOVIZIG-12	???	113	XXX	XXX	XXX	690	7	3	90	XXX
EKOVIZIG-13	???	360	XXX	XXX	XXX	2330	3	7	240	XXX
EKOVIZIG-14	???	28	XXX	XXX	XXX	235000	15	1	20	XXX
EKOVIZIG-15	???	12	XXX	XXX	XXX	400	2	4	50	XXX
EKOVIZIG-16	???	17	XXX	XXX	XXX	1250	2	11	30	XXX
EKOVIZIG-17	???	98	XXX	XXX	XXX	200000	2	1	140	XXX
EKOVIZIG	MEAN	62	XXX	XXX	XXX	27329	29	74	128	XXX
EKOVIZIG	MINIMUM	3	XXX	XXX	XXX	30	2	1	20	XXX
EKOVIZIG	MAXIMUM	360	XXX	XXX	XXX	235000	270	800	410	XXX

Table D-2. Soil and Waste Measurements - Epres-tanya Landfill

SAMPLE ID (MINTA SZ)	DEPTH (m)	Hg (mg/kg)	Cu (mg/kg)	Cr (mg/kg)	Ni (mg/kg)	Pb (mg/kg)	Cd (mg/kg)	As (mg/kg)	Zn (mg/kg)	Waste (%)
ET-F1	MEAN	8.47								
ET-F2	MEAN	0.18	3.29	1.30	5.36	10.63				
ET-101	MEAN	0.05	8.49	1.51	5.75	6.05	0.57	0.93		
ET-102	MEAN	0.06	7.52	2.39	9.24	8.40	0.50	1.60		
ET-103	MEAN	0.06	7.24	1.96	8.95	11.79	1.93	0.73		
ET-104	MEAN	1.60	8.01	2.02	8.17	7.09	0.50	3.18		
EKOVIZIG	MEAN	71				50148	26	70	125	
EKOVIZIG	MINIMUM	0.05				6.05	0.50	0.73	20	
EKOVIZIG	MAXIMUM	360				235000	270	800	410	

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Appendix E. Hazard Ranking System (HRS) Calculations

The detailed calculations that are used to determine an overall HRS site score are described in the 14 December 1990 issue of the Federal Register (U.S. Environmental Protection Agency, 1990). This appendix documents the input data for these calculations as well as the intermediate and final results of the calculations.

As indicated in the body of this report, only the groundwater exposure pathway was considered in calculating the overall HRS site score. Individual scores were calculated for arsenic, cadmium, lead, and mercury at the Epres-tanya landfill and at landfill No. 18. Calculations are presented in Tables E-I and E-2 for Epres-tanya landfill and Table E-3 for landfill No. 18.

The groundwater exposure pathway score is calculated by multiplying together three values which quantify (a) the probability of waste release into the environment; (b) the hazardous waste characteristics; and (c) the human population and other potential targets that may be exposed to the waste. The likelihood of release value (a) is covered in items 1 through 3 of tables E-1 and E-2. The waste characteristics value (b) is covered in items 4 through 6. The targets value (c) is covered in items 7 through 11. The overall HRS site score is given at the bottom of the table.

The likelihood of release value is 550 for lead and is 410 for arsenic, cadmium, and mercury. These values are the same in all three tables. The lead value is higher because an actual contaminant release above background levels has been measured in the groundwater outside of the site's boundaries. An actual release has not been demonstrated for the other elements. Their probability of release values are mainly calculated from the facts that the sites do not have a liner preventing release of contaminants and that the waste is in direct contact with the aquifer. The value is influenced in a minor way by the monthly amount of precipitation, which was estimated from data for Debrecen.

The hazardous waste characteristics value is composed of three components that evaluate the toxicity of the waste, the mobility of the waste in groundwater, and the quantity of the waste in the site. The toxicity component for all four elements is set to the maximum value allowed because of the great toxicity of these elements. The groundwater mobility component varies greatly for these four elements because of differences in their solubilities in water and their distribution coefficients (K_d). K_d measures the tendency of a compound to be sorbed onto soil.

The ground water mobility components for the four elements are as follow:

- Arsenic 1×10^{-1}
- Cadmium 1×10^{0}
- Lead 2×10^{-5}
- Mercury 2×10^{-5}

A larger value means the element is more mobile. Thus, cadmium is the most mobile and lead and mercury are the least mobile elements. These groundwater mobility components have a large effect on the hazardous waste characteristics value, as shown in item 6 in the tables.

The groundwater mobility components that are used in these calculations are for ionic forms of the four elements. However, these ions may react with other materials in to form complex ions which may be more mobile in groundwater. For example, the highly-charged mercury ion (Hg^{2+}) may react with chloride salts to form the neutral complex $HgCl_2$ or the negative ion $HgCl^-_3$, both of which move through the soil more quickly than Hg^{2+}.[1] Although both mercury and chloride ions have been found in monitoring wells associated with the Epres-tanya landfill, these data do not allow one to determine if complexation reactions have occurred. Any future investigations of wastes at this landfill should look for complex ions. The hazard associated with the landfill may be higher if significant amounts of complex ions are present there.

The hazardous waste quantity component may be calculated using one of four different methods (area of landfill, volume of wastes in landfill, mass of hazardous waste, and mass and concentration of hazardous waste stream). In this analysis, the hazardous waste quantity component will be independently calculated by the area and volume methods, using the measured area of the site and the estimated volume of the waste in the site. Normally, the volume-derived calculation (if an estimate is available) is used instead of the area-derived calculation. However, since it is not clear how the volume estimate was obtained, we decided to present calculations using both methods. These calculations emphasize the need to have the best possible estimate of the amount, composition and spatial distribution of wastes in the Epres-tanya landfill.

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[1]M.D. Piwoni and J.W. Keeley, 1990. Basic Concepts of Contaminant Sorption at Hazardous Waste Sites. U.S. Environmental Protection Agency Publication No. EPA/540/4-90/053, 7 pp.

The area of the Epres-tanya landfill is approximately 37000 square meters, based on a map of the landfill in the 1992 report by the Technical University of Budapest. The volume of the waste in the Epres-tanya landfill was estimated to be 50000 cubic meters by É-KÖVIZIG (Gavallér, 1992). The area of landfill No. 18 is estimated to be approximately 18000 square meters, based on a 1963 topographic map of the Sajószentpéter area which shows the outline of the sandpit.

The choice of the method that is used to calculate the hazardous waste quantity component has a large effect on the waste characteristics value. The values for arsenic in the Epres-tanya landfill are used as an example. The arsenic value (item 6 in the tables) is 10 if the area method is used, but is only 2 if the volume method is used. The difference between these values demonstrates the importance of having a reliable estimate of the amount of waste in the Epres-tanya landfill.

The area of landfill No. 18 is approximately one-half the Epres-tanya landfill area. The smaller area produces a smaller waste characteristics value. Using the area method, the arsenic value for landfill No. 18 is 3; using the same method, the larger Epres-tanya site has a value of 10.

The target value is based on the size of the population potentially at risk and the distance between the source and the reception, in this case the waterworks. The target value for the Epres-tanya landfill is 1702 and is mainly due to the size of the human population drinking water from the Borsodszirák Waterworks I and I/A. Approximately 74,000 people obtain all or some of their water from the ÉRV distribution network, and these waterworks supply 47 percent of the water in the network. The distance from the Epres-tanya site to the waterworks is approximately 1.5 kilometers.

The target value for landfill No. 18 is 3276. This value is greater than the target value for the Epres-tanya landfill because this landfill is only approximately 700 meters from Waterworks I. If similar amounts of wastes were in both landfills, landfill No. 18 would be a greater hazard. Groundwater would carry the wastes more quickly to the waterworks.

The groundwater migration pathway scores for both sites are obtained by multiplying together the likelihood of release value, the waste characteristics value, and the target value and then dividing this product by 82500. The maximum allowable groundwater score is 100. The

overall HRS site scores for each element at the two landfills are calculated using the following equation:

$$HRS\ Score=\sqrt{(GroundwaterScore)^2/4}$$

The HRS site scores in the three tables are summarized below:

Element	HRS Site Score for Epres-tanya Landfill		HRS Site Score for Landfill No. 18
	Area Method	Volume Method	Area Method
Arsenic	42.3	8.5	24.4
Cadmium	50.0	42.3	50.0
Lead	11.4	5.7	10.9
Mercury	8.5	4.2	8.1

Table E-1. HRS Calculations for Epres-tanya Landfill

ITEM NO.	CALCULATIONS FOR EPRES TANYA LANDFILL (waste quantity estimated from area of landfill)	ARSENIC	CADMIUM	LEAD	MERCURY
1	OBSERVED RELEASE	0	0	550	0
2	POTENTIAL TO RELEASE				
2a	Containment Factor Value (no liner)	10	10	10	10
2b	Net Precipitation Factor Value	1	1	1	1
	Monthly Precipitation (Debrecen)	1.93	1.93	1.93	1.93
	Monthly Potential Evapotranspiration	1	1	1	1
	Net Precipitation	0.93	0.93	0.93	0.93
2c	Depth to Aquifer Factor Value (< 25 feet)	5	5	5	5
2d	Travel Time Factor Value (D to A < 10 ft)	35	35	35	35
2e	Potential to Release	410	410	410	410
3	LIKELIHOOD OF RELEASE TO AN AQUIFER	410	410	550	410
4	TOXICITY/MOBILITY FACTOR VALUE	100	10000	0.2	0.2
	Toxicity Factor Value	10000	10000	10000	10000
	Ground Water Mobility Factor Value	0.01	1	2.00E-05	2.00E-05
	Water Solubility (mg/L)	1.20E+03	2.00E+03	1.50E-01	7.70E-08
	Distribution Coefficient (Kd) (mL/g)	2.00E+02	6.50E+00	9.00E+02	1.00E+01
5	HAZARDOUS WASTE QUANTITY (Tier D)	100	100	100	100
	Calculated Area, (square feet)	401090	401090	401090	401090
	Hazardous Waste Quantity Value	118	118	118	118
6	WASTE CHARACTERISTICS FACTOR VALUE	10	32	2	2
	Waste Characteristics Product	10000	1000000	20	20
7	NEAREST WELL (0.87 miles to Waterworks I)	9	9	9	9
8a	Level I Concentrations	0	0	0	0
8b	Level II Concentrations	0	0	0	0
8c	Potential Contamination	1668.4	1668.4	1668.4	1668.4
	Population within Distance Category (0.5 to 1.0)	34681	34681	34681	34681
8d	POPULATION	1668.4	1668.4	1668.4	1668.4
9	RESOURCES (Commercial livestock watering)	5	5	5	5
10	WELLHEAD PROTECTION AREA	20	20	20	20
11	TARGETS FACTOR VALUE	1702.4	1702.4	1702.4	1702.4
12	AQUIFER SCORE	84.60	100.00	22.70	16.92
13	GROUND WATER MIGRATION PATHWAY SCORE	84.60	100.00	22.70	16.92
	OVERALL HAZARD RANKING SYSTEM SITE SCORE	**42.30**	**50.00**	**11.35**	**8.46**

Table E-2. Revised HRS Calculations for Epres-tanya Landfill

ITEM NO.	REVISED CALCULATIONS FOR EPRES TANYA (waste quantity estimated from volume of landfill)	ARSENIC	CADMIUM	LEAD	MERCURY
1	OBSERVED RELEASE	0	0	550	0
2	POTENTIAL TO RELEASE				
2a	Containment Factor Value (no liner)	10	10	10	10
2b	Net Precipitation Factor Value	1	1	1	1
	Monthly Precipitation (Debrecen)	1.93	1.93	1.93	1.93
	Monthly Potential Evapotranspiration	1	1	1	1
	Net Precipitation	0.93	0.93	0.93	0.93
2c	Depth to Aquifer Factor Value (< 25 feet)	5	5	5	5
2d	Travel Time Factor Value (D to A < 10 ft)	35	35	35	35
2e	Potential to Release	410	410	410	410
3	LIKELIHOOD OF RELEASE TO AN AQUIFER	410	410	550	410
4	TOXICITY/MOBILITY FACTOR VALUE	100	10000	0.2	0.2
	Toxicity Factor Value	10000	10000	10000	10000
	Ground Water Mobility Factor Value	0.01	[illegible]	2.00E-05	2.00E-05
	Water Solubility (mg/L)	1.20E+03	2.00E+03	1.50E-01	7.70E-08
	Distribution Coefficient (Kd) (mL/g)	2.00E+02	6.50E+00	9.00E+02	1.00E+01
5	HAZARDOUS WASTE QUANTITY (Tier D)	1	1	1	1
	EKOVIZIG's Estimated Volume (cubic yards)	65400	65401	65402	65403
	Hazardous Waste Quantity Value	26	26	26	26
6	WASTE CHARACTERISTICS FACTOR VALUE	2	10	1	1
	Waste Characteristics Product	100	10000	0.2	0.2
7	NEAREST WELL (0.87 miles to Waterworks I)	9	9	9	9
8a	Level I Concentrations	0	0	0	0
8b	Level II Concentrations	0	0	0	0
8c	Potential Contamination	1668.4	1668.4	1668.4	1668.4
	Population within Distance Category (0.5 to 1.0)	34681	34681	34681	34681
8d	POPULATION	1668.4	1668.4	1668.4	1668.4
9	RESOURCES (Commercial livestock watering)	5	5	5	5
10	WELLHEAD PROTECTION AREA	20	20	20	20
11	TARGETS FACTOR VALUE	1702.4	1702.4	1702.4	1702.4
12	AQUIFER SCORE	16.92	84.60	11.35	8.46
13	GROUND WATER MIGRATION PATHWAY SCORE	16.92	84.60	11.35	8.46
	OVERALL HAZARD RANKING SYSTEM SITE SCORE	**8.46**	**42.30**	**5.67**	**4.23**

Table E-3. HRS Calculations for Landfill No. 18

ITEM NO.	CALCULATIONS FOR LANDFILL NO. 18 (waste quantity estimated from area of landfill)	ARSENIC	CADMIUM	LEAD	MERCURY
1	OBSERVED RELEASE	0	0	550	0
2	POTENTIAL TO RELEASE				
2a	Containment Factor Value (no liner)	10	10	10	10
2b	Net Precipitation Factor Value	1	1	1	1
	Monthly Precipitation (Debrecen)	1.93	1.93	1.93	1.93
	Monthly Potential Evapotranspiration	1	1	1	1
	Net Precipitation	0.93	0.93	0.93	0.93
2c	Depth to Aquifer Factor Value (< 25 feet)	5	5	5	5
2d	Travel Time Factor Value (D to A < 10 ft)	35	35	35	35
2e	Potential to Release	410	410	410	410
3	LIKELIHOOD OF RELEASE TO AN AQUIFER	410	410	550	410
4	TOXICITY/MOBILITY FACTOR VALUE	100	10000	0.2	0.2
	Toxicity Factor Value	10000	10000	10000	10000
	Ground Water Mobility Factor Value	0.01	1	2.00E-05	2.00E-05
	Water Solubility (mg/L)	1.20E+03	2.00E+03	1.50E-01	7.70E-08
	Distribution Coefficient (Kd) (mL/g)	2.00E+02	6.50E+00	9.00E+02	1.00E+01
5	HAZARDOUS WASTE QUANTITY (Tier D)	1	1	1	1
	Calculated Area, (square feet)	196219	196220	196221	196222
	Hazardous Waste Quantity Value	58	58	58	58
6	WASTE CHARACTERISTICS FACTOR VALUE	3	10	1	1
	Waste Characteristics Product	100	10000	0.2	0.2
7	NEAREST WELL (0.42 miles to Waterworks I)	18	18	18	18
8a	Level I Concentrations	0	0	0	0
8b	Level II Concentrations	0	0	0	0
8c	Potential Contamination	3232.5	3232.5	3232.5	3232.5
	Population within Distance Category (0.25 to 0.50)	34681	34681	34681	34681
8d	POPULATION	3232.5	3232.5	3232.5	3232.5
9	RESOURCES (Commercial livestock watering)	5	5	5	5
10	WELLHEAD PROTECTION AREA	20	20	20	20
11	TARGETS FACTOR VALUE	3275.5	3275.5	3275.5	3275.5
12	AQUIFER SCORE	48.83	100.00	21.84	16.28
13	GROUND WATER MIGRATION PATHWAY SCORE	48.83	100.00	21.84	16.28
	OVERALL HAZARD RANKING SYSTEM SITE SCORE	**24.42**	**50.00**	**10.92**	**8.14**

Appendix F. MULTIMED Model Output Files

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

1

Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 1

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	30.0	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

1

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	50.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+1
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+1
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+1
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+1
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+0
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+0
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+0
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+0
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+0
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+0
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+0
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+0
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.200E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
1	0.500E+01	0.29726E-03
	0.100E+02	0.44505E-02
	0.150E+02	0.79108E-02
	0.200E+02	0.92291E-02
	0.250E+02	0.96352E-02
	0.300E+02	0.97520E-02
	0.350E+02	0.97848E-02
	0.400E+02	0.97940E-02
	0.450E+02	0.97965E-02
	0.500E+02	0.97973E-02
	0.550E+02	0.95002E-02
	0.600E+02	0.53471E-02
	0.650E+02	0.18868E-02
	0.700E+02	0.56848E-03
	0.750E+02	0.16235E-03
	0.800E+02	0.45580E-04
	0.850E+02	0.12757E-04
	0.900E+02	0.35801E-05
	0.950E+02	0.10097E-05
	0.100E+03	0.28649E-06

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

1

Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 2

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	120.	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	50.0	-999.	0.100E-08	-999.

Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+1
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+1
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+1
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+1
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+0
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+0
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+0
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-0[illegible]	0.100E+0
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+0
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+0
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+0
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+0
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.200E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+0[illegible]	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
2	0.500E+01	0.13528E-03
	0.100E+02	0.33419E-02
	0.150E+02	0.70372E-02
	0.200E+02	0.88093E-02
	0.250E+02	0.94634E-02
	0.300E+02	0.96895E-02
	0.350E+02	0.97625E-02
	0.400E+02	0.97863E-02
	0.450E+02	0.97939E-02
	0.500E+02	0.97964E-02
	0.550E+02	0.96616E-02
	0.600E+02	0.64555E-02
	0.650E+02	0.27603E-02
	0.700E+02	0.98822E-03
	0.750E+02	0.33410E-03
	0.800E+02	0.10804E-03
	0.850E+02	0.35097E-04
	0.900E+02	0.11303E-04
	0.950E+02	0.36627E-05
	0.100E+03	0.11916E-05

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

1

Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 3

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen — Saturated zone model

Run was — DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.150E+04	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	50.0	-999.	0.100E-08	-999.

Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.200E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
3	0.500E+01	0.28481E-09
	0.100E+02	0.94524E-05
	0.150E+02	0.25101E-03
	0.200E+02	0.11400E-02
	0.250E+02	0.25872E-02
	0.300E+02	0.41924E-02
	0.350E+02	0.56507E-02
	0.400E+02	0.68331E-02
	0.450E+02	0.77281E-02
	0.500E+02	0.83767E-02
	0.550E+02	0.88332E-02
	0.600E+02	0.91388E-02
	0.650E+02	0.91120E-02
	0.700E+02	0.83650E-02
	0.750E+02	0.70179E-02
	0.800E+02	0.54775E-02
	0.850E+02	0.40623E-02
	0.900E+02	0.29085E-02
	0.950E+02	0.20323E-02
	0.100E+03	0.13963E-02

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

1

Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 4

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	30.0	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	50.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+1
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+1
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+1
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+1
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+0
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+0
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+0
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+0
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+0
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+0
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+0
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+0
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.600E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
4	0.500E+01	0.17629E-03
	0.100E+02	0.36888E-02
	0.150E+02	0.73364E-02
	0.200E+02	0.89626E-02
	0.250E+02	0.95314E-02
	0.300E+02	0.97146E-02
	0.350E+02	0.97718E-02
	0.400E+02	0.97896E-02
	0.450E+02	0.97951E-02
	0.500E+02	0.97968E-02
	0.550E+02	0.96210E-02
	0.600E+02	0.61087E-02
	0.650E+02	0.24611E-02
	0.700E+02	0.83492E-03
	0.750E+02	0.26616E-03
	0.800E+02	0.82905E-04
	0.850E+02	0.25752E-04
	0.900E+02	0.79366E-05
	0.950E+02	0.24639E-05
	0.100E+03	0.76844E-06

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 5

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY
Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model
Run was DETERMIN
Infiltration input by user
Run was transient
Reject runs if Y coordinate outside plume
Do not reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	120.	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-09	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

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SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11

Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	50.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.600E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

TIME	CONCENTRATION
0.500E+01	0.15329E-04
0.100E+02	0.13986E-02
0.150E+02	0.46576E-02
0.200E+02	0.72266E-02
0.250E+02	0.86272E-02
0.300E+02	0.92879E-02
0.350E+02	0.95803E-02
0.400E+02	0.97059E-02
0.450E+02	0.97589E-02
0.500E+02	0.97814E-02
0.550E+02	0.97754E-02
0.600E+02	0.83961E-02
0.650E+02	0.51388E-02
0.700E+02	0.25704E-02
0.750E+02	0.11701E-02
0.800E+02	0.50959E-03
0.850E+02	0.21717E-03
0.900E+02	0.91630E-04
0.950E+02	0.38652E-04
0.100E+03	0.16168E-04

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options
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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 6

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY
Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user
Run was transient
Reject runs if Y coordinate outside plume
Do not reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.150E+04	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

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SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	50.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	100.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.600E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
6	0.500E+01	0.33825E-15
	0.100E+02	0.51508E-11
	0.150E+02	0.22232E-07
	0.200E+02	0.13677E-05
	0.250E+02	0.15406E-04
	0.300E+02	0.74412E-04
	0.350E+02	0.22191E-03
	0.400E+02	0.49033E-03
	0.450E+02	0.88818E-03
	0.500E+02	0.14016E-02
	0.550E+02	0.20024E-02
	0.600E+02	0.26580E-02
	0.650E+02	0.33355E-02
	0.700E+02	0.40100E-02
	0.750E+02	0.46471E-02
	0.800E+02	0.52012E-02
	0.850E+02	0.56200E-02
	0.900E+02	0.58667E-02
	0.950E+02	0.59313E-02
	0.100E+03	0.58291E-02

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 7

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model

Run was DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	30.0	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	50.0	-999.	0.100E-08	-999.

Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-06	0.100E+
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E-
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.100E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
7	0.500E+01	0.10361E-03
	0.100E+02	0.30212E-02
	0.150E+02	0.67335E-02
	0.200E+02	0.86437E-02
	0.250E+02	0.93893E-02
	0.300E+02	0.96595E-02
	0.350E+02	0.97510E-02
	0.400E+02	0.97819E-02
	0.450E+02	0.97923E-02
	0.500E+02	0.97958E-02
	0.550E+02	0.96933E-02
	0.600E+02	0.67761E-02
	0.650E+02	0.30639E-02
	0.700E+02	0.11539E-02
	0.750E+02	0.40829E-03
	0.800E+02	0.13806E-03
	0.850E+02	0.46598E-04
	0.900E+02	0.15692E-04
	0.950E+02	0.52925E-05
	0.100E+03	0.17910E-05

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U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 8

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	120.	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	50.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.100E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
9	0.500E+01	0.16249E-05
	0.100E+02	0.52938E-03
	0.150E+02	0.27736E-02
	0.200E+02	0.54096E-02
	0.250E+02	0.73391E-02
	0.300E+02	0.84982E-02
	0.350E+02	0.91321E-02
	0.400E+02	0.94597E-02
	0.450E+02	0.96307E-02
	0.500E+02	0.97149E-02
	0.550E+02	0.97549E-02
	0.600E+02	0.92480E-02
	0.650E+02	0.70140E-02
	0.700E+02	0.43830E-02
	0.750E+02	0.24560E-02
	0.800E+02	0.12981E-02
	0.850E+02	0.66482E-03
	0.900E+02	0.33758E-03
	0.950E+02	0.16666E-03
	0.100E+03	0.82623E-04

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options
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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 9

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY
Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user
Run was transient
Reject runs if Y coordinate outside plume
Do not reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.150E+04	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

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SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	50.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.100E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
9	0.500E+01	0.33825E-15
	0.100E+02	0.33825E-15
	0.150E+02	0.13473E-11
	0.200E+02	0.10227E-08
	0.250E+02	0.52856E-07
	0.300E+02	0.71350E-06
	0.350E+02	0.44756E-05
	0.400E+02	0.17399E-04
	0.450E+02	0.49198E-04
	0.500E+02	0.11137E-03
	0.550E+02	0.21456E-03
	0.600E+02	0.36641E-03
	0.650E+02	0.57048E-03
	0.700E+02	0.82626E-03
	0.750E+02	0.11293E-02
	0.800E+02	0.14741E-02
	0.850E+02	0.18487E-02
	0.900E+02	0.22393E-02
	0.950E+02	0.26277E-02
	0.100E+03	0.29944E-02

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 10

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	30.0	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	22.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.200E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
10	0.200E+01	0.15276E-07
	0.400E+01	0.62429E-04
	0.600E+01	0.79920E-03
	0.800E+01	0.24807E-02
	0.100E+02	0.44505E-02
	0.120E+02	0.61585E-02
	0.140E+02	0.74307E-02
	0.160E+02	0.83021E-02
	0.180E+02	0.88701E-02
	0.200E+02	0.92291E-02
	0.220E+02	0.94488E-02
	0.240E+02	0.95885E-02
	0.260E+02	0.96091E-02
	0.280E+02	0.89225E-02
	0.300E+02	0.72713E-02
	0.320E+02	0.53196E-02
	0.340E+02	0.36226E-02
	0.360E+02	0.23569E-02
	0.380E+02	0.14895E-02
	0.400E+02	0.92391E-03

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

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Run options
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RANSIENT SIMULATION - ESTIMATION OF DAF - Run 11

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY
Chemical simulated is DEFAULT CHEMICAL

Option Chosen Saturated zone model
Run was DETERMIN
Infiltration input by user
Run was transient
Reject runs if Y coordinate outside plume
Do not reject runs if Z coordinate outside plume
Gaussian source used in saturated zone model

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	l/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	120.	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	22.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+1
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+1
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+1
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+1
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+09
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+09
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.200E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
11	0.200E+01	0.17378E-08
	0.400E+01	0.22387E-04
	0.600E+01	0.42796E-03
	0.800E+01	0.16377E-02
	0.100E+02	0.33419E-02
	0.120E+02	0.50426E-02
	0.140E+02	0.64601E-02
	0.160E+02	0.75295E-02
	0.180E+02	0.82894E-02
	0.200E+02	0.88093E-02
	0.220E+02	0.91563E-02
	0.240E+02	0.93809E-02
	0.260E+02	0.95103E-02
	0.280E+02	0.92002E-02
	0.300E+02	0.80518E-02
	0.320E+02	0.63868E-02
	0.340E+02	0.47110E-02
	0.360E+02	0.33095E-02
	0.380E+02	0.22503E-02
	0.400E+02	0.14969E-02

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 12

EPRES-TANYA LANDFILL - BOKSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.150E+04	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	22.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.200E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
12	0.200E+01	0.33825E-15
	0.400E+01	0.14235E-11
	0.600E+01	0.95357E-08
	0.800E+01	0.73282E-06
	0.100E+02	0.94524E-05
	0.120E+02	0.50043E-04
	0.140E+02	0.15952E-03
	0.160E+02	0.37085E-03
	0.180E+02	0.69926E-03
	0.200E+02	0.11400E-02
	0.220E+02	0.16733E-02
	0.240E+02	0.22721E-02
	0.260E+02	0.29080E-02
	0.280E+02	0.35551E-02
	0.300E+02	0.41916E-02
	0.320E+02	0.47947E-02
	0.340E+02	0.53291E-02
	0.360E+02	0.57513E-02
	0.380E+02	0.60248E-02
	0.400E+02	0.61338E-02

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 13

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	30.0	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	22.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.600E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
13	0.200E+01	0.35906E-08
	0.400E+01	0.31574E-04
	0.600E+01	0.52838E-03
	0.800E+01	0.18864E-02
	0.100E+02	0.36888E-02
	0.120E+02	0.54063E-02
	0.140E+02	0.67875E-02
	0.160E+02	0.77979E-02
	0.180E+02	0.84964E-02
	0.200E+02	0.89626E-02
	0.220E+02	0.92666E-02
	0.240E+02	0.94590E-02
	0.260E+02	0.95550E-02
	0.280E+02	0.91368E-02
	0.300E+02	0.78202E-02
	0.320E+02	0.60569E-02
	0.340E+02	0.43587E-02
	0.360E+02	0.29898E-02
	0.380E+02	0.19870E-02
	0.400E+02	0.12932E-02

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 14

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

1

CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	120.	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry's law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

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SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11

Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	22.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+1
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+1
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+1
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+1
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E 05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.600E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
14	0.200E+01	0.50834E-11
	0.400E+01	0.13590E-05
	0.600E+01	0.74111E-04
	0.800E+01	0.48894E-03
	0.100E+02	0.13986E-02
	0.120E+02	0.26538E-02
	0.140E+02	0.40065E-02
	0.160E+02	0.52707E-02
	0.180E+02	0.63524E-02
	0.200E+02	0.72266E-02
	0.220E+02	0.79065E-02
	0.240E+02	0.84214E-02
	0.260E+02	0.88026E-02
	0.280E+02	0.90104E-02
	0.300E+02	0.87989E-02
	0.320E+02	0.80327E-02
	0.340E+02	0.68859E-02
	0.360E+02	0.56082E-02
	0.380E+02	0.43973E-02
	0.400E+02	0.33535E-02

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 15

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.150E+04	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

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SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11

Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	22.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.600E-03	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
15	0.200E+01	0.33825E-15
	0.400E+01	0.33825E-15
	0.600E+01	0.33825E-15
	0.800E+01	0.92212E-14
	0.100E+02	0.51508E-11
	0.120E+02	0.34300E-09
	0.140E+02	0.67765E-08
	0.160E+02	0.62665E-07
	0.180E+02	0.34942E-06
	0.200E+02	0.13677E-05
	0.220E+02	0.41393E-05
	0.240E+02	0.10332E-04
	0.260E+02	0.22237E-04
	0.280E+02	0.42611E-04
	0.300E+02	0.74412E-04
	0.320E+02	0.12052E-03
	0.340E+02	0.18347E-03
	0.360E+02	0.26528E-03
	0.380E+02	0.36728E-03
	0.400E+02	0.48998E-03

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 16

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	30.0	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX

Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+1
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.
Duration of pulse	yr	CONSTANT	22.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+1
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+1
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+1
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+1
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+0
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999	0.100E-08	0.100E+0
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+0
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+0
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+0
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+0
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+0
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+0
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.100E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
16	0.200E+01	0.84023E-09
	0.400E+01	0.15845E-04
	0.600E+01	0.34584E-03
	0.800E+01	0.14182E-02
	0.100E+02	0.30212E-02
	0.120E+02	0.46905E-02
	0.140E+02	0.61325E-02
	0.160E+02	0.72533E-02
	0.180E+02	0.80708E-02
	0.200E+02	0.86437E-02
	0.220E+02	0.90347E-02
	0.240E+02	0.92968E-02
	0.260E+02	0.94517E-02
	0.280E+02	0.92390E-02
	0.300E+02	0.82413E-02
	0.320E+02	0.66869E-02
	0.340E+02	0.50491E-02
	0.360E+02	0.36274E-02
	0.380E+02	0.25199E-02
	0.400E+02	0.17111E-02

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 17

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	120.	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	22.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-08	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.100E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
17	0.200E+01	0.14414E-13
	0.400E+01	0.77984E-07
	0.600E+01	0.11897E-04
	0.800E+01	0.13335E-03
	0.100E+02	0.52938E-03
	0.120E+02	0.12569E-02
	0.140E+02	0.22340E-02
	0.160E+02	0.33241E-02
	0.180E+02	0.44097E-02
	0.200E+02	0.54096E-02
	0.220E+02	0.62839E-02
	0.240E+02	0.70209E-02
	0.260E+02	0.76257E-02
	0.280E+02	0.81005E-02
	0.300E+02	0.83649E-02
	0.320E+02	0.82713E-02
	0.340E+02	0.77788E-02
	0.360E+02	0.69830E-02
	0.380E+02	0.60322E-02
	0.400E+02	0.50499E-02

U. S. ENVIRONMENTAL PROTECTION AGENCY

EXPOSURE ASSESSMENT

MULTIMEDIA MODEL

MULTIMED (Version 1.01, June 1991)

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Run options

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TRANSIENT SIMULATION - ESTIMATION OF DAF - Run 18

EPRES-TANYA LANDFILL - BORSOD COUNTY, HUNGARY

Chemical simulated is DEFAULT CHEMICAL

Option Chosen	Saturated zone model
Run was	DETERMIN

Infiltration input by user

Run was transient

Reject runs if Y coordinate outside plume

Do not reject runs if Z coordinate outside plume

Gaussian source used in saturated zone model

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CHEMICAL SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Solid phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Dissolved phase decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Overall chemical decay coefficient	1/yr	DERIVED	-999.	-999.	0.000E+00	0.100E+11
Acid catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Neutral hydrolysis rate constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Base catalyzed hydrolysis rate	1/M-yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Reference temperature	C	CONSTANT	25.0	-999.	0.000E+00	100.
Normalized distribution coefficient	ml/g	CONSTANT	0.150E+04	-999.	0.000E+00	-999.
Distribution coefficient	--	DERIVED	0.107E+04	-999.	0.000E+00	0.100E+11
Biodegradation coefficient (sat. zone)	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Air diffusion coefficient	cm2/s	CONSTANT	0.000E+00	-999.	0.000E+00	10.0
Reference temperature for air diffusion	C	CONSTANT	25.0	-999.	0.000E+00	100.
Molecular weight	g/M	CONSTANT	266.	-999.	0.000E+00	-999.
Mole fraction of solute	--	CONSTANT	0.340E-03	-999.	0.100E-08	1.00
Vapor pressure of solute	mm Hg	CONSTANT	0.182E-05	-999.	0.000E+00	100.
Henry`s law constant	atm-m^3/M	CONSTANT	0.462E-05	-999.	0.100E-09	1.00
Overall 1st order decay sat. zone	1/yr	DERIVED	0.000E+00	0.000E+00	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00
Not currently used		CONSTANT	-999.	-999.	0.000E+00	1.00

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SOURCE SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS MEAN	PARAMETERS STD DEV	LIMITS MIN	LIMITS MAX
Infiltration rate	m/yr	CONSTANT	0.122	-999.	0.100E-09	0.100E+11
Area of waste disposal unit	m^2	CONSTANT	0.360E+05	-999.	0.100E-01	-999.

Duration of pulse	yr	CONSTANT	22.0	-999.	0.100E-08	-999.
Spread of contaminant source	m	DERIVED	-999.	-999.	0.100E-08	0.100E+11
Recharge rate	m/yr	CONSTANT	0.122	-999.	0.000E+00	0.100E+11
Source decay constant	1/yr	CONSTANT	0.000E+00	-999.	0.000E+00	-999.
Initial concentration at landfill	mg/l	CONSTANT	1.00	-999.	0.000E+00	-999.
Length scale of facility	m	CONSTANT	300.	-999.	0.100E-08	0.100E+11
Width scale of facility	m	CONSTANT	120.	-999.	0.100E-08	0.100E+11
Near field dilution		DERIVED	1.00	0.000E+00	0.000E+00	1.00

AQUIFER SPECIFIC VARIABLES

VARIABLE NAME	UNITS	DISTRIBUTION	PARAMETERS		LIMITS	
			MEAN	STD DEV	MIN	MAX
Particle diameter	cm	CONSTANT	4.00	-999.	0.100E-08	100.
Aquifer porosity	--	CONSTANT	0.250	-999.	0.100E-06	0.990
Bulk density	g/cc	CONSTANT	1.85	-999.	0.100E-01	5.00
Aquifer thickness	m	CONSTANT	10.0	-999.	0.100E-08	0.100E+06
Source thickness (mixing zone depth)	m	DERIVED	-999.	-999.	0.100E-08	0.100E+06
Conductivity (hydraulic)	m/yr	CONSTANT	0.201E+05	-999.	0.100E-06	0.100E+09
Gradient (hydraulic)		CONSTANT	0.140E-02	-999.	0.100E-07	-999.
Groundwater seepage velocity	m/yr	DERIVED	200.	-999.	0.100E-09	0.100E+09
Retardation coefficient	--	DERIVED	-999.	-999.	1.00	0.100E+09
Longitudinal dispersivity	m	CONSTANT	150.	-999.	0.100E-02	0.100E+05
Transverse dispersivity	m	CONSTANT	50.0	-999.	0.100E-02	0.100E+05
Vertical dispersivity	m	CONSTANT	0.840	-999.	0.100E-02	0.100E+05
Temperature of aquifer	C	CONSTANT	18.5	-999.	0.000E+00	100.
pH	--	CONSTANT	6.80	-999.	0.300	14.0
Organic carbon content (fraction)		CONSTANT	0.100E-02	-999.	0.100E-05	1.00
Well distance from site	m	CONSTANT	0.150E+04	-999.	1.00	-999.
Angle off center	degree	CONSTANT	0.000E+00	-999.	0.000E+00	360.
Well vertical distance	m	CONSTANT	0.000E+00	-999.	0.000E+00	1.00

	TIME	CONCENTRATION
18	0.200E+01	0.33825E-15
	0.400E+01	0.33825E-15
	0.600E+01	0.33825E-15
	0.800E+01	0.33825E-15
	0.100E+02	0.33825E-15
	0.120E+02	0.17140E-14
	0.140E+02	0.20105E-12
	0.160E+02	0.71026E-11
	0.180E+02	0.11276E-09
	0.200E+02	0.10227E-08
	0.220E+02	0.61734E-08
	0.240E+02	0.27463E-07
	0.260E+02	0.96610E-07
	0.280E+02	0.28264E-06
	0.300E+02	0.71350E-06
	0.320E+02	0.15979E-05
	0.340E+02	0.32428E-05
	0.360E+02	0.60622E-05
	0.380E+02	0.10576E-04
	0.400E+02	0.17399E-04