

Organic Solutes in Ground Water at the
Idaho National Engineering Laboratory

(U.S.) Geological Survey
Idaho Falls, ID

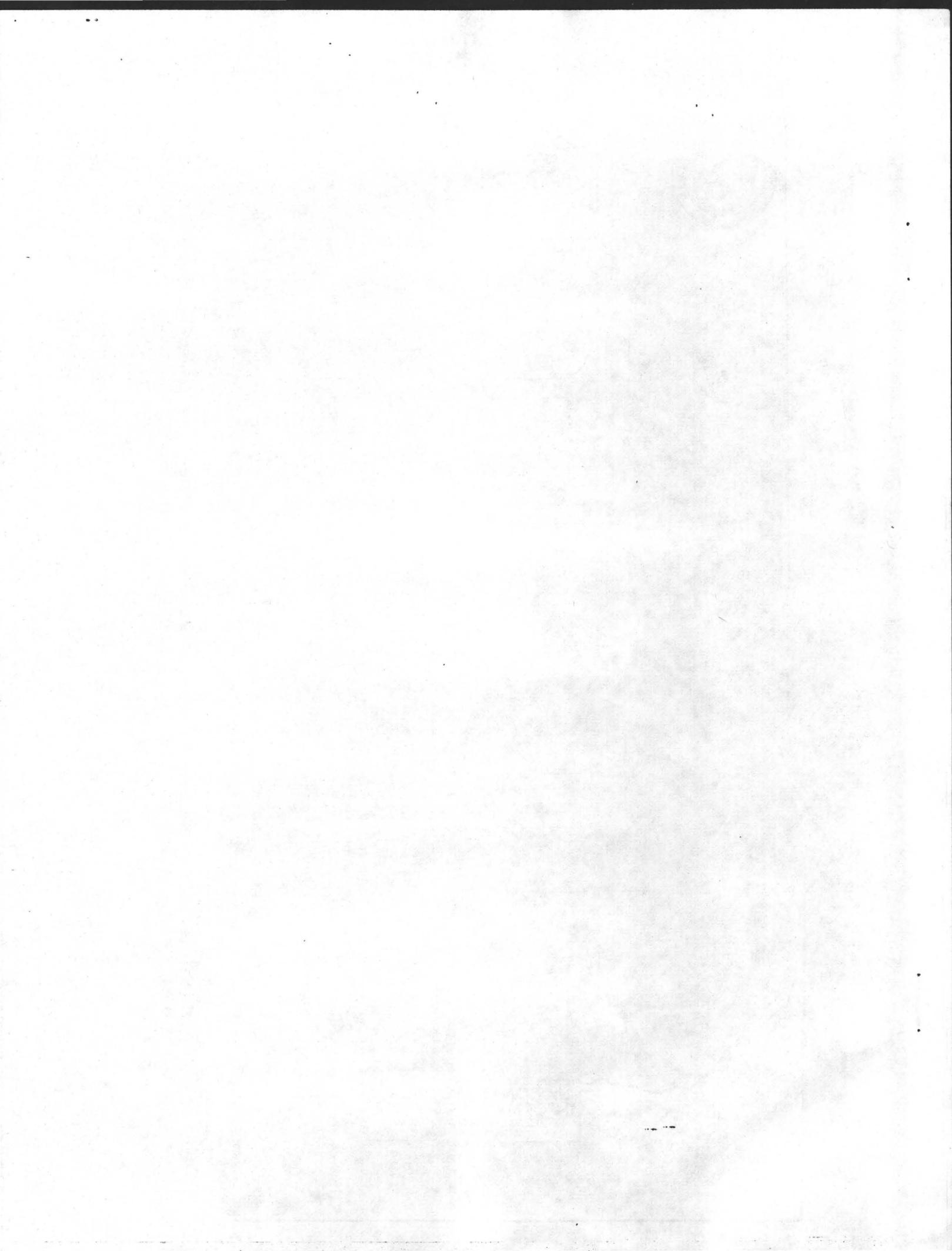
Prepared for

Department of Energy
Idaho Falls, ID

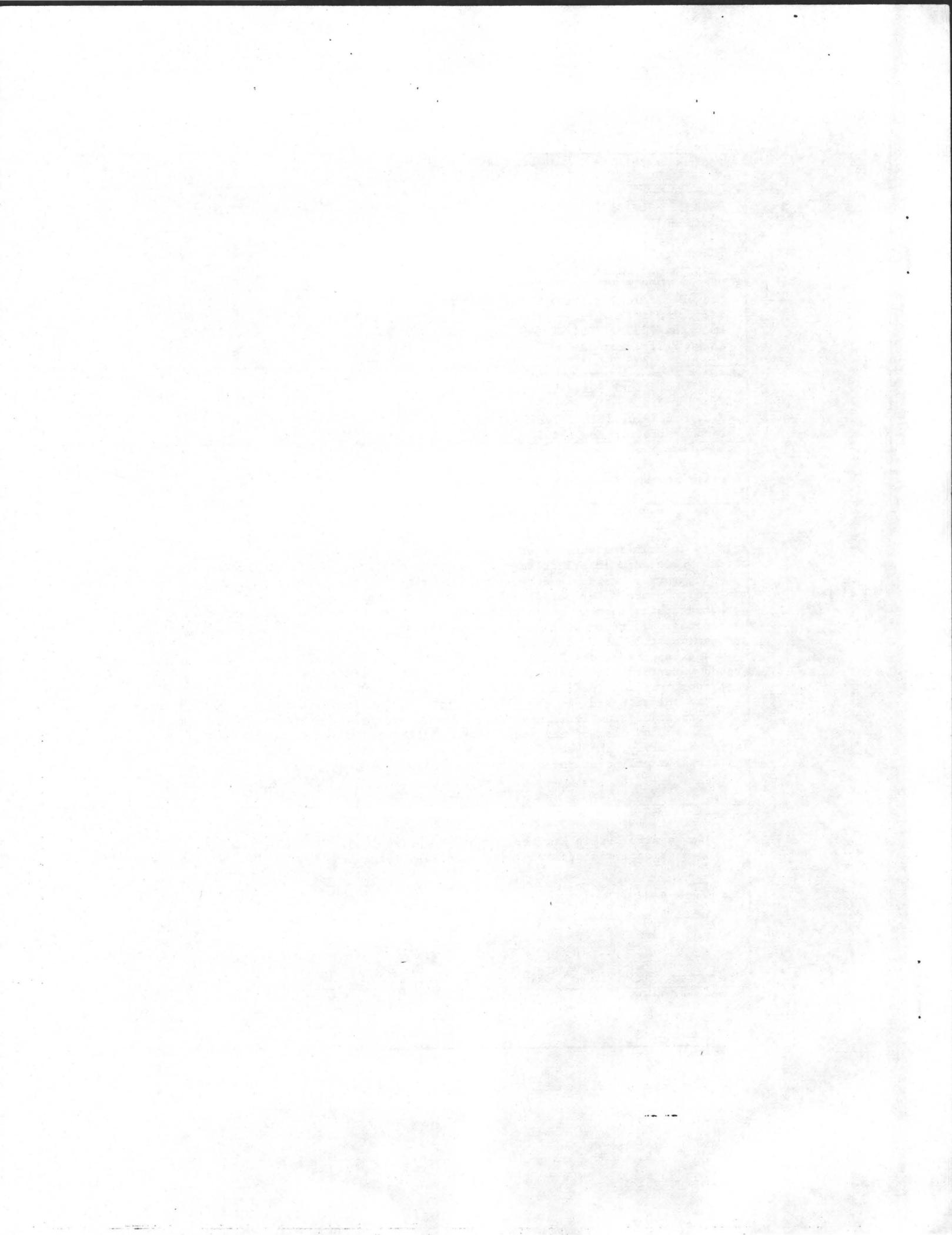
Mar 82

**U.S. DEPARTMENT OF COMMERCE
National Technical Information Service**

NTIS



REPORT DOCUMENTATION PAGE		1. Sequential submission number: USGS/WRD/WRI/82-013		3. Recipient's Accession No. 202 195280	
4. Title and Subtitle ORGANIC SOLUTES IN GROUND WATER AT THE IDAHO NATIONAL ENGINEERING LABORATORY		5. Report Date March 1982		6.	
7. Author(s) Jerry A. Leenheer and Jefferson C. Bagby		8. Performing Organization Rept. No. USGS/WRI-82-15		9. Performing Organization Name and Address	
U.S. Geological Survey, Water Resources Division Project Office P.O. Box 2230, INEL, CF-690, Room 164 Idaho Falls, Idaho 83401		10. Project/Task/Work Unit No.		11. Contract(C) or Grant(G) No. (C) (G)	
12. Sponsoring Organization Name and Address U.S. Geological Survey, Water Resources Division Project Office P.O. Box 2230, INEL, CF-690, Room 164 Idaho Falls, Idaho 83401		13. Type of Report & Period Covered Final, 1980		14.	
15. Supplementary Notes These studies have been sponsored and funded by the U.S. Department of Energy.					
16. Abstract (Limit: 200 words) In August 1980, the U.S. Geological Survey started a reconnaissance survey of organic solutes in drinking water sources, ground-water monitoring wells, perched water table monitoring wells, and in select waste streams at the Idaho National Engineering Laboratory. The survey was to be a two-phase program. In the first phase, 77 wells and 4 potential point sources were sampled for dissolved organic carbon (DOC). Four wells and several potential point sources of insecticides and herbicides were sampled for insecticides and herbicides. Fourteen wells and four potential organic sources were sampled for volatile and semivolatile organic compounds. The results of the DOC analyses indicate no high level organic contamination of INEL ground water. The only detectable insecticide or herbicide was a DDT concentration of 10 parts per trillion (0.01 micrograms per liter in one observation well). The volatile and semivolatile analyses do not indicate the presence of hazardous organic contaminants in significant amounts (>10 micrograms per liter in the samples taken). Due to the lack of any significant organic ground-water contamination in this reconnaissance survey, the second phase of the study, which was to follow up the first phase by additional sampling of any contaminated wells, was cancelled.					
17. Document Analysis a. Descriptors *Snake River Plain aquifer, Idaho, *Hydrogeology, *Ground-water quality, Aqueous chemical and radioactive waste disposal, *Organics, Herbicides, Pesticides b. Identifiers/Open-Ended Terms Snake River Plain, Idaho National Engineering Laboratory, Eastern Idaho					
Prepared for NTIS by U.S. Geological Survey, WRD					
18. Availability Statement No restriction on distribution		19. Security Class (This Report) UNCLASSIFIED		21. No. of Pages 44	
		20. Security Class (This Page) UNCLASSIFIED		22. Price	



ORGANIC SOLUTES IN GROUND WATER AT THE
IDAHO NATIONAL ENGINEERING LABORATORY

By Jerry A. Leenheer and Jefferson C. Bagby

U.S. GEOLOGICAL SURVEY
Water-Resources Investigation 82-15

Prepared on behalf of the
U.S. DEPARTMENT OF ENERGY



March 1982

I. a

1-13-83 Barcelona B 7.50

UNITED STATES DEPARTMENT OF THE INTERIOR

JAMES G. WATT, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

U.S. Geological Survey
Water Resources Division
Project Office
Idaho National Engineering Laboratory
CF-690, Room 164, P.O. Box 2230
Idaho Falls, Idaho 83401

CONTENTS

	Page
Abstract	1
Introduction	1
Purpose of study	2
Acknowledgments	4
Regional hydrology.	4
Organic sampling program	5
Sampling site selection.	5
Field sampling techniques	13
Dissolved organic carbon	13
Insecticides, herbicides, and semivolatiles	15
Volatiles	15
Analytical methods	15
Results and discussion	17
Dissolved organic carbon	17
Insecticides and herbicides	18
Volatiles and semivolatiles	18
Cost	36
Summary and conclusions	36
Selected references	37

ILLUSTRATIONS

Figure 1. Relief map of Idaho showing the location of the INEL, Snake River Plain and generalized ground-water flow lines of the Snake River Plain aquifer	3
2. Distribution of dissolved organic carbon in ground-water, INEL vicinity, August 1980	6
3. Distribution of dissolved organic carbon in ground water, ICPP-TRA vicinity, August 1980	7
4. Photograph of bailer and thief sampler used for collecting water samples from wells without pump	14

TABLES

Table 1. Organic sample collection parameters and dissolved organic carbon results	8
2. Dissolved organic carbon concentrations in water from background wells compared to method of well sampling	17
3. Gas chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory	19

FACTORS FOR CONVERTING INCH-POUND UNITS TO METRIC UNITS

The following factors can be used to convert inch-pound units published herein to the International System (SI) of units.

<u>Multiply inch-pound units</u>	<u>By</u>	<u>To obtain metric units</u>
feet (ft)	0.3048	meters (m)
inches (in.)	25.40	millimeter (mm)
miles (mi)	1.609	kilometers (km)
square miles (mi ²)	2.590	square kilometers (km ²)
gallons (gal)	3.785	liters (L)
gallons (gal)	3.785×10^{-3}	cubic meters (m ³)
million gallons (10 ⁶ gal)	3.785×10^3	cubic meters (m ³)
acre-feet (acre-ft)	1.233×10^3	cubic meters (m ³)
temperature, degrees Celsius (°C)=	0.556 (°F-32)	

The use of trade names in this report is for identification purposes only and does not imply endorsement by the U.S. Geological Survey.

ORGANIC SOLUTES IN GROUND WATER AT THE
IDAHO NATIONAL ENGINEERING LABORATORY

By

Jerry A. Leenheer and Jefferson C. Bagby

ABSTRACT

In August 1980, the U.S. Geological Survey (USGS) started a reconnaissance survey of organic solutes in drinking water sources, ground-water monitoring wells, perched water-table monitoring wells, and in select waste streams at the Idaho National Engineering Laboratory (INEL).

The survey was to be a two-phase program. In the first phase, 77 wells and four potential point sources were sampled for dissolved organic carbon (DOC). Four wells and several potential point sources of insecticides and herbicides were sampled for insecticides and herbicides. Fourteen wells and four potential organic sources were sampled for volatile and semivolatile organic compounds.

The results of the DOC analyses indicate no high level (>20 mg/L DOC) organic contamination of ground water. The only detectable insecticide or herbicide was a dichlorodiphenyltrichloroethane (DDT) concentration of 10 parts per trillion (0.01 μ g/L) in one observation well.

The volatile and semivolatile analyses do not indicate the presence of hazardous organic contaminants in significant amounts (>10 μ g/L) in the samples taken.

Due to the lack of any significant organic ground-water contamination in this reconnaissance survey, the second phase of the study, which was to follow up the first phase by additional sampling of any contaminated wells, was canceled.

INTRODUCTION

The Idaho National Engineering Laboratory (INEL) formerly the National Reactor Testing Station (NRTS), was established in 1949 by the United States Atomic Energy Commission (AEC) (later reorganized as Energy Research and Development Administration (ERDA), and now as the Department of Energy (DOE)) to build, operate, and test various types of nuclear reactors. The reactors are built primarily to develop peacetime uses of atomic energy. Fifty-two reactors have been constructed to date, of which 17 are still operable.

The INEL site covers about 890 square miles on the eastern Snake River Plain (fig. 1) and has an average altitude of 4,900 feet above sea level. This plain is underlain by the Snake River Plain aquifer, the major aquifer in Idaho. The INEL obtains its entire water supply from this aquifer. Aqueous chemical and radioactive wastes are discharged to shallow ponds and to shallow or deep wells. The pond and shallow-well wastes infiltrate the ground, form perched bodies of water, and then percolate toward the Snake River Plain aquifer.

For the past 30 years, the U.S. Geological Survey (USGS), Water Resources Division (WRD), has maintained a research project office at the INEL. One of the primary functions of this office has been to investigate the geochemical conditions of the Snake River Plain aquifer (Barraclough and others, 1967; Robertson, 1974; Barraclough and others, 1976; Robertson, 1977; Barraclough and others, 1981).

Purpose of Study

In January 1980, the U.S. Environmental Protection Agency (EPA) recommended that a ground-water monitoring program for organic constituents be started at the INEL. In response to this recommendation, DOE requested the U.S. Geological Survey to undertake such a program. The purpose of the study was to determine the distribution and extent of organic constituents in the ground water beneath the INEL.

The U.S. Geological Survey proposed a two-phase organic sampling program. The first phase would be an organic reconnaissance survey of the ground water beneath the INEL. This would entail a large scale dissolved organic carbon (DOC) sampling program of INEL production and ground-water observation wells to identify areas containing higher levels of organic constituents (>20 mg/L DOC). Many of the samples would be collected around the Idaho Chemical Processing Plant (ICPP) and the Test Reactor Area (TRA). The ICPP and the TRA dispose of cooling tower, chemical, and radioactive wastes through the use of disposal wells and/or waste-seepage ponds and thus are potential sources of organic contamination of ground water. Samples for specific organic analysis of pesticides, volatile, and solvent-extractable semivolatile compounds would also be collected near potential contamination sources to detect organic chemicals for which EPA has established maximum contaminant levels (U.S. Environmental Protection Agency, 1976).

If the first phase organic reconnaissance survey had established any organic contamination problem areas, the second phase of the program would have begun. In this phase, ground waters with high DOC values would have been characterized in greater detail by DOC fractionation analysis (Leenheer and Huffman, 1979), in order to ascertain the nature and origin of the DOC ground-water contamination. Additional qualitative and quantitative organic analyses for specific compounds would also be performed on whole waters and fractions from the DOC fractionation procedure.

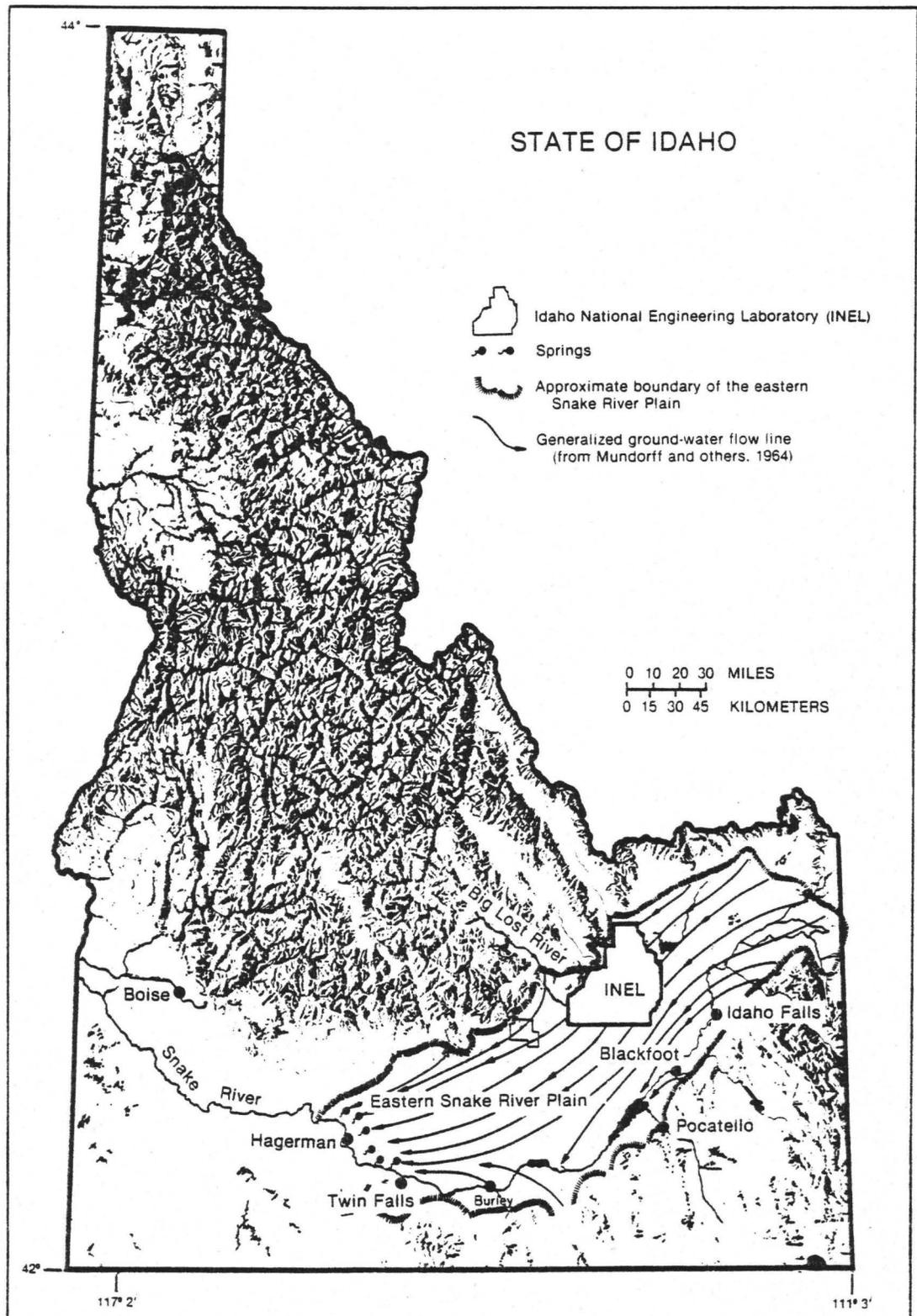


Figure 1. Relief map of Idaho showing the location of the INEL, Snake River Plain and generalized ground water flow lines of the Snake River Plain aquifer.

In August 1980, the USGS collected water samples for phase one. This report contains a brief explanation of how the sampling locations were selected, how the samples were collected, and how the samples were analyzed. It also contains a complete presentation of the data collected, the interpretation thereof, and a suggestion concerning future organic monitoring at the INEL.

Acknowledgments

The U.S. Geological Survey wishes to express appreciation to the DOE, EG&G Idaho, Inc., EXXON Nuclear Idaho Company, Inc., and Westinghouse Electric Corporation employees who helped, through their cooperation, to complete phase one of this study. Special thanks go to the employees of the National Water Quality Laboratory (NWQL) in Denver for their prompt analysis of a large number of samples and their aid in the interpretation of the results.

Regional Hydrology

The eastern Snake River Plain is a large structural basin 12,000 square miles in area (fig. 1). It has been filled to its present level with 2,000 to 10,000 feet of thin basaltic lava flows, rhyolitic deposits, and interbedded sediments. A more detailed description of the geology is found in Robertson, Schoen, and Barraclough (1974). Nearly all the eastern Snake River Plain is underlain by a vast ground-water reservoir known as the Snake River Plain aquifer, which contains an estimated 1 billion acre-feet of water. The flow of ground water in the aquifer is principally to the south-southwest (fig. 1) at relatively high velocities, generally 5 to 25 feet per day (Robertson, Schoen, and Barraclough, 1974, p. 13). Transmissivity of the aquifer is high, generally ranging from 1 million to 100 million gallons per day per foot or 134,000 to 13,400,000 feet squared per day (Robertson, Schoen, and Barraclough, 1974, p. 12).

The basaltic volcanic rocks and interbedded sediments composing the aquifer are all included in the Snake River Group of Quaternary age. The basement rocks are probably composed of older volcanic and sedimentary rocks. The basalt is the principal aquifer. The water-bearing openings in the basalt are distributed throughout the rock system in the form of intercrystalline and intergranular porespace, fractures, cavities, interstitial voids, interflow zones, and lava tubes. The variety and degree of interconnection of these openings complicates the direction of ground-water movement locally throughout the aquifer.

Ground-water recharge to the INEL is derived primarily as underflow from the northeastern part of the Plain and also from adjacent drainages on the west and north. Most of the ground water underlying the INEL enters the ground in the uplands to the north, northeast, and northwest;

moves south or southwestward through the aquifer; and discharges through springs along the valley of the Snake River near Hagerman (fig. 1). Lesser amounts of recharge are derived from direct precipitation on the Plain. Some of the precipitation evaporates, and some infiltrates the ground surface and percolates through the unsaturated subsurface to the regional water table.

ORGANIC SAMPLING PROGRAM

Sampling Site Selection

The sites selected for DOC sampling were placed into two separate groups based on two criteria. The first group, consisting of ten wells, was chosen as background wells for ground-water DOC baseline data. These background wells were chosen because they are remote from any possible INEL organic input and include the Atomic City well, Fire Station #2, Highway #3, P&W-2, Blaine Larsen's well, Site 14, and USGS observation wells 4, 19, 26, and 27 (fig. 2). Five of the wells selected are equipped with pumps. The other five wells are not, and required a thief sampling to obtain a comparison of the two sampling methods.

The second group of wells was chosen because they are used for drinking water or because of their close proximity to a potential source of organic ground-water contamination. For the purpose of this study, any INEL facility was considered to be a potential source of organic ground-water contamination.

A total of seventy-seven DOC samples was collected from seventy-four surface- and ground-water sources across the INEL. These samples provided the data base for the phase one study. Two water samples each were collected from the Site 14 well, well 65, and well 47, to check sampling repeatability.

The locations of all wells sampled are indicated on the maps in figures 2 and 3. Additional information on each well is given in table 1.

Samples for insecticide and herbicide analyses were taken from the ICPP east side waste effluent and the TRA cooling tower effluent. Both of these effluent streams are discharged directly into the Snake River Plain aquifer and thus could be point sources for organic ground-water contamination. Samples for insecticide and herbicide analysis were also taken from wells 40, 43, 47, and 67. These wells are all near the ICPP disposal well which has had low concentrations of insecticides and herbicides discharged into it in the past. If insecticides or herbicides could be detected in the ground water, these wells would be the most likely to show them (as was shown by the results).

Volatile and semivolatile organic samples were collected for GC-MS analysis from the following possible organic contaminant sources: (1) ICPP east side waste effluent (disposal well), (2) TRA chemical waste pond, (3) TRA cooling tower waste effluent (disposal well), and (4) TRA radioactive waste pond. Samples were also collected from observation wells 40, 43, 46, 47, 53, 54, 55, 56, 57, 58, 65, 67, 68, and 70.

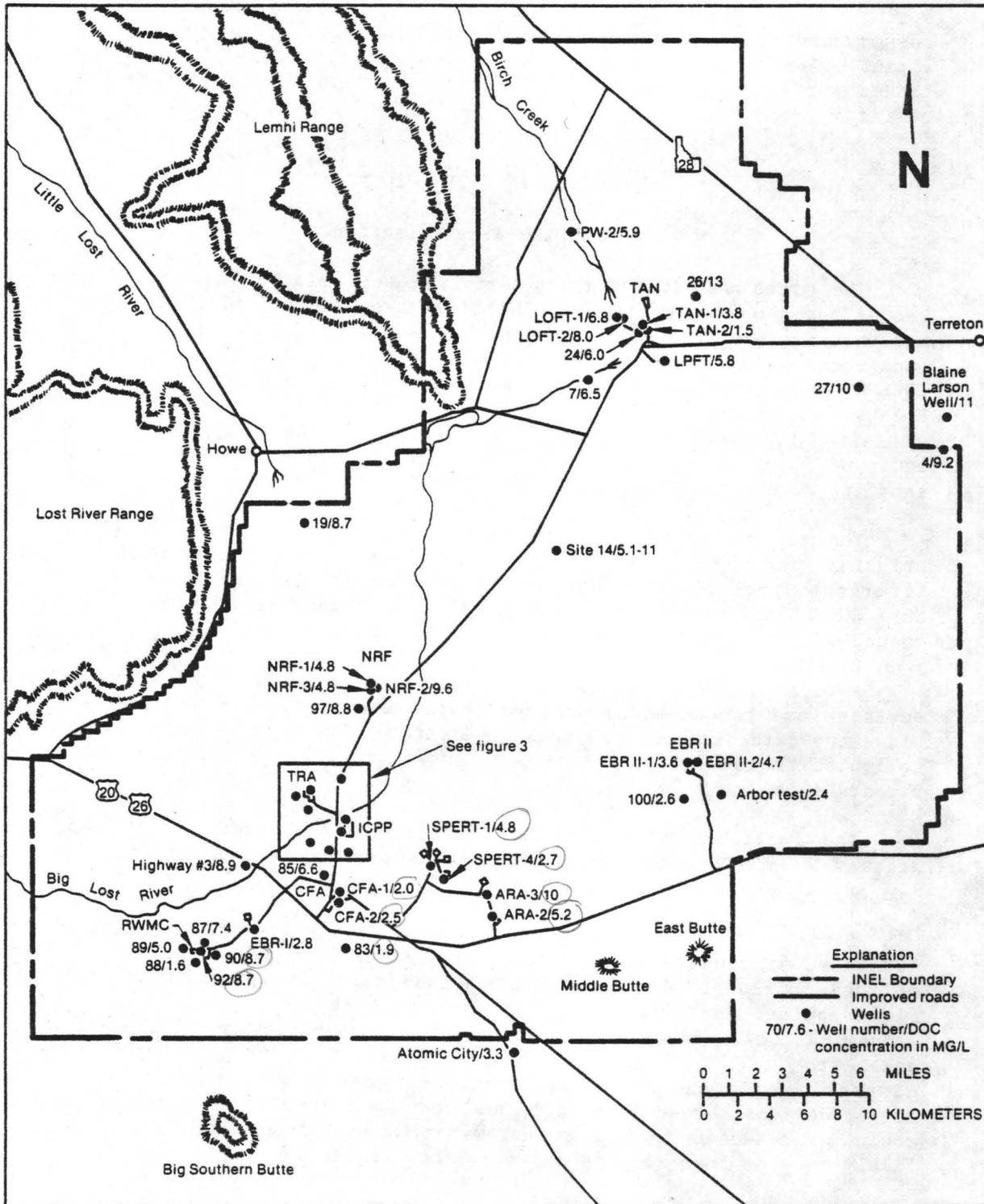


Figure 2. Distribution of dissolved organic carbon in ground water, INEL vicinity, August 1980.

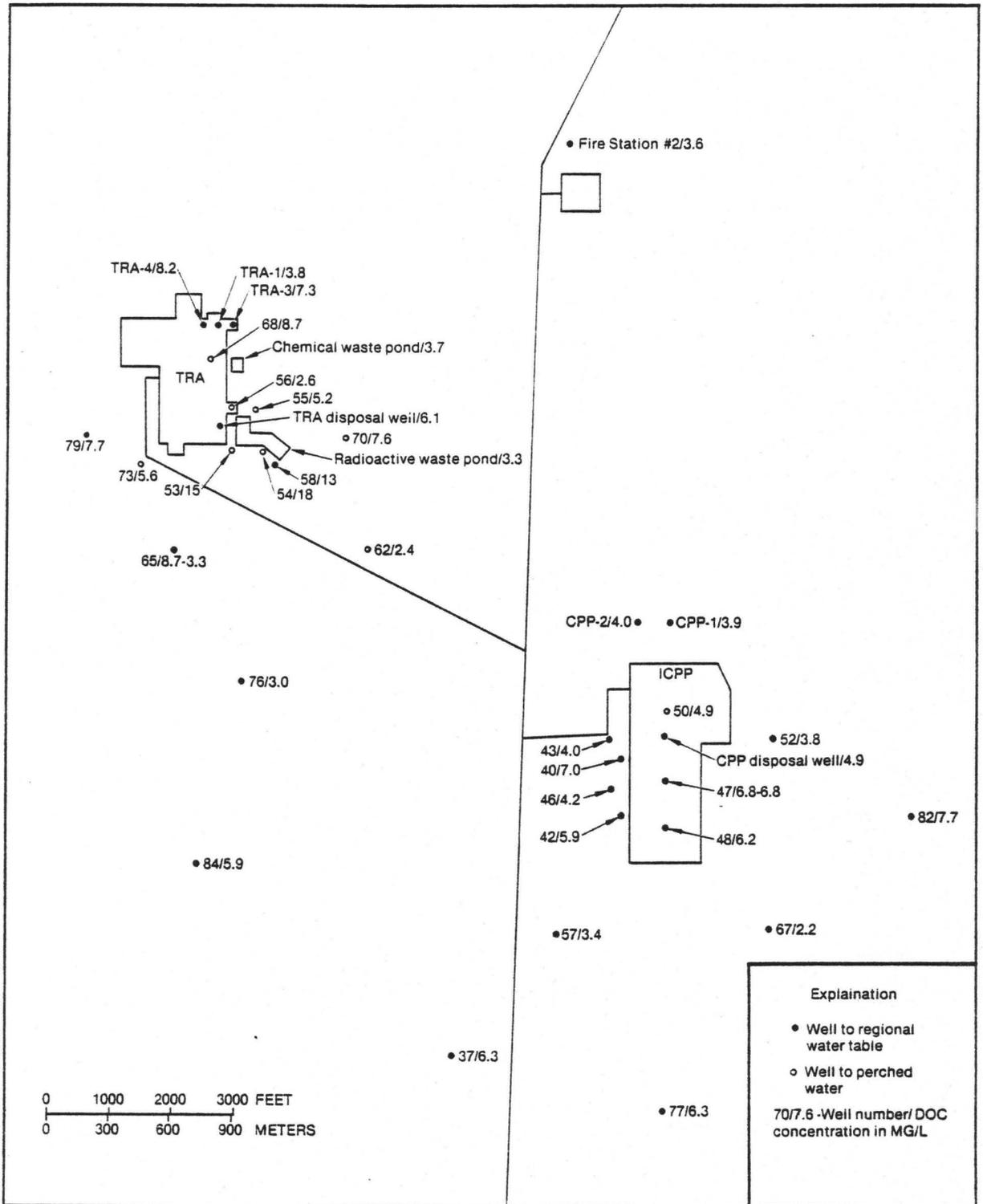


Figure 3. Distribution of dissolved organic carbon in ground water, ICPP-TRA vicinity, August 1980.

Table 1.--Data table for organic sample collection parameters and dissolved organic carbon results

[P, Production well in operation, pumping more than 500 gpm; NA, not available]

Well Number	Station Identification Number	Collection Date - Time	Filtration Date - Time	Temperature at collection (°C)	Method of collection	Sample depth or pump time (min)/rate (gal/min)	DOC (mg/L)
ARA-2	433106112492101	8/12/80 - 1000	8/12/80 - 1300	14.0	Pump	P	5.2
ARA-3	433156112494401	8/12/80 - 1015	8/12/80 - 1315	15.5	Pump	P	10
ARBOR test	433508112384801	8/14/80 - 0936	8/14/80 - 1030	13.0	Thief	710 feet	2.4
Atomic City	432638112484101	8/13/80 - 1115	8/13/80 - 1220	15.0	Pump	NA	3.3
Blaine Larsen Well	434715112282701	8/12/80 - 1220	8/13/80 - 0943	NA	Pump	P	11
CFA-1	433204112562001	8/12/80 - 1105	8/12/80 - 1215	11.5	Pump	P	2
CFA-2	433144112563501	8/12/80 - 1120	8/12/80 - 1225	12.0	Pump	P	2.5
CPP-1	433433112560201	8/15/80 - 1037	8/15/80 - 1055	15.5	Pump	P	3.9
CPP-2	433432112561001	8/13/80 - 1538	8/14/80 - 0840	16.0	Pump	P	4
CPP eastside waste	433413112560401	8/18/80 - 0955	8/18/80 - NA	22.0	Surface	Stream	4.9
EBR-1	433051113002601	8/12/80 - 0920	8/12/80 - 0950	NA	Pump	P	2.8
EBR-II-1	433546112391601	8/14/80 - 0830	8/14/80 - 1055	13.0	Pump	P	3.6
EBR-II-2	433544112391301	8/14/80 - 0842	8/14/80 - 1054	13.5	Pump	P	4.7
Fire Station #2	433548112562301	8/11/80 - 1522	8/12/80 - 0925	15.0	Pump	P	3.6
Highway #3	433256113002501	8/11/80 - 1350	8/11/80 - 1450	NA	Pump	NA	8.9
LOFT-1	435120112432101	8/12/80 - 1448	8/13/80 - 0935	10.0	Pump	1/1000	6.8
LOFT-2	435119112431801	8/12/80 - 1420	8/13/80 - 0900	10.0	Pump	1/1000	8

Table 1.--Data table for organic sample collection parameters and dissolved organic carbon results (continued)

[P, Production well in operation, pumping more than 500 gpm; NA, not available]

Well Number	Station Identification Number	Collection Date - Time	Filtration Date - Time	Temperature at collection (°C)	Method of collection	Sample depth or pump time (min)/rate (gal/min)	DOC (mg/L)
LPFT	434946112412401	8/12/80 - 1531	8/13/80 - 0930	13.0	Pump	P	5.8
NRF-1	433859112545401	8/13/80 - 1055	8/13/80 - 1335	13.5	Pump	P	4.8
NRF-2	433854112545401	8/13/80 - 1108	8/13/80 - 1337	11.5	Pump	P	9.6
NRF-3	433858112545501	8/13/80 - 1047	8/13/80 - 1417	15.0	Pump	P	4.8
PW-2	435419112453101	8/12/80 - 1625	8/12/80 - 2020	13.0	Thief	350 feet	5.9
Site 14 (1)	434334112463101	8/13/80 - 1500	8/13/80 - 1550	16.0	Pump	30/8	5.1
Site 14 (2)	434334112463101	8/13/80 - 1505	8/13/80 - 1552	16.0	Pump	35/8	11
SPERT-1	433252112520301	8/12/80 - 1042	8/12/80 - 1240	11.0	Pump	P	4.8
SPERT-4	433247112515201	8/12/80 - 1035	8/12/80 - 1255	12.0	Pump	P	2.7
TAN-1	435056112420001	8/12/80 - 1510	8/13/80 - 0912	11.0	Pump	P	3.8
TAN-2	435100112420701	8/12/80 - 1517	8/13/80 - 0855	11.0	Pump	P	1.5
TRA-1	433521112573801	8/13/80 - 1255	8/13/80 - 1415	17.0	Pump	P	3.8
TRA-3	433521112573501	8/13/80 - 1301	8/13/80 - 1350	18.0	Pump	P	7.3
TRA-4	433521112574201	8/13/80 - 1247	8/13/80 - 1352	18.0	Pump	P	8.2
TRA chemical waste pond	NA	8/18/80 - 1310	8/18/80 - 1445	NA	Surface	Pond	3.7
TRA cooling tower disposal	NA	8/18/80 - 1234	8/18/80 - 1446	17.0	Surface	Stream	6.1
TRA radioactive waste pond	NA	8/18/80 - 1330	8/18/80 - 1400	NA	Surface	Pond	3.3

Table 1.--Data table for organic sample collection parameters and dissolved organic carbon results (continued)

[P, Production well in operation, pumping more than 500 gpm; NA, not available]

Well Number	Station Identification Number	Collection Date - Time	Filtration Date - Time	Temperature at collection (°C)	Method of collection	Sample depth or pump time (min)/rate (gal/min)	DOC (mg/L)
4	434657112282201	8/12/80 - 1200	8/12/80 - 2000	NA	Thief	300 feet	9.2
7	434926112444201	8/12/80 - 1350	8/12/80 - 2030	17.0	Thief	250 feet	6.5
19	434430112575901	8/12/80 - 1750	8/12/80 - 1955	18.0	Thief	295 feet	8.7
24	435053112420801	8/12/80 - 1456	8/12/80 - 1940	14.0	Thief	300 feet	6
26	435215112394201	8/12/80 - 1341	8/12/80 - 1940	18.0	Thief	260 feet	13
27	434854112322101	8/12/80 - 1258	8/12/80 - 2015	18.0	Thief	255 feet	10
37	433326112564801	8/11/80 - 1550	8/12/80 - 0930	12.0	Pump	20/5	6.3
40	433413112561201	8/18/80 - NA	8/18/80 - 1143	21.2	Pump	20/7	7
42	433403112561201	8/13/80 - 1604	8/14/80 - 0857	17.5	Thief	500 feet	5.9
43	433415112561501	8/18/80 - 0945	8/18/80 - 1205	16.1	Pump	20/7	4
46	433407112561501	8/18/80 - 1008	8/18/80 - 1040	14.0	Thief	500 feet	4.2
47(1)	433407112560301	8/18/80 - 1140	8/18/80 - 1246	15.7	Pump	20/7	6.8
47(2)	433407112560301	8/18/80 - 1145	8/18/80 - NA	15.7	Pump	20/7	6.8
48	433401112560301	8/14/80 - 1206	8/14/80 - 1414	14.0	Thief	520 feet	6.2
50	433419112560201	8/14/80 - 1223	8/14/80 - 1412	19.5	Bailer	379 feet	4.9
52	433415112554401	8/13/80 - 1713	8/14/80 - 0837	16.0	Thief	500 feet	3.8
53	433503112573401	8/18/80 - 1438	8/18/80 - 1515	NA	Bailer	78 feet	15

Table 1.--Data table for organic sample collection parameters and dissolved organic carbon results (continued)

[P, Production well in operation, pumping more than 500 gpm; NA, not available]

Well Number	Station Identification Number	Collection Date - Time	Filtration Date - Time	Temperature at collection (°C)	Method of collection	Sample depth or pump time (min)/rate (gal/min)	DOC (mg/L)
54	433503112572801	8/18/80 - 1426	8/18/80 - 1459	NA	Thief	85 feet	18
55	433508112573001	8/18/80 - 1354	8/18/80 - 1515	NA	Thief	78 feet	5.2
56	433509112573501	8/18/80 - 1302	8/18/80 - 1408	12.0	Thief	79 feet	2.6
57	433344112562601	8/18/80 - 0937	8/18/80 - 1041	NA	Thief	550 feet	3.4
58	433500112572501	8/18/80 - 1141	8/18/80 - 1429	12.0	Thief	495 feet	13
62	433446112570601	8/14/80 - 1312	8/14/80 - 1350	13.0	Thief	152 feet	2.4
65(1)	433447112574701	8/18/80 - 1225	8/18/80 - 1244	14.5	Pump	20/7	3.3
65(2)	433447112574701	8/18/80 - 1220	8/18/80 - NA	14.5	Pump	20/7	8.7
67	433344112554101	8/18/80 - 1104	8/18/80 - 1145	13.5	Pump	25/7	2.2
68	433516112573901	8/18/80 - 1211	8/18/80 - 1427	14.0	Thief	120 feet	8.7
70	433504112571201	8/18/80 - 1335	8/18/80 - 1500	10.5	Thief	95 feet	7.6
73	433502112575401	8/14/80 - 1255	8/18/80 - 1427	15.5	Thief	120 feet	5.6
76	433425112573201	8/13/80 - 1732	8/14/80 - 0821	14.0	Thief	500 feet	3.0
77	433315112560501	8/13/80 - 1305	8/13/80 - 1435	14.0	Thief	540 feet	6.3
79	433505112581901	8/13/80 - 1801	8/14/80 - 0858	14.0	Thief	550 feet	7.7
82	433401112551001	8/13/80 - 1216	8/13/80 - 1500	14.0	Thief	500 feet	7.7
83	433023112561501	8/13/80 - 1620	8/14/80 - 0815	11.5	Pump	45/7	1.9

Table 1.--Data table for organic sample collection parameters and dissolved organic carbon results (continued)

[P, Production well in operation, pumping more than 500 gpm; NA, not available]

Well Number	Station Identification Number	Collection Date - Time	Filtration Date - Time	Temperature at collection (°C)	Method of collection	Sample depth or pump time (min)/rate (gal/min)	DOC (mg/L)
84	433357112574201	8/13/80 - 1516	8/13/80 - 1845	NA	Bailer	479 feet	5.9
85	433246112571201	8/13/80 - 1431	8/13/80 - 1835	14.0	Thief	570 feet	6.6
87	433013113024301	8/11/80 - 1330	8/11/80 - 1450	14.0	Pump	45/2	7.4
88	432940113030201	8/11/80 - 1315	8/11/80 - 1430	13.0	Pump	20/5	1.6
89	433005113032901	8/11/80 - 1330	8/11/80 - 1430	13.0	Pump	20/5	5.0
90	432954113020501	8/11/80 - 1245	8/11/80 - 1505	13.0	Pump	20/4	8.7
92	433000113025301	8/14/80 - 1120	8/14/80 - 1352	11.5	Bailer	209 feet	8.7
97	433807112551501	8/13/80 - 1131	8/13/80 - 1437	13.0	Thief	440 feet	8.8
100	433503112400701	8/14/80 - 0906	8/14/80 - 1032	13.0	Thief	710 feet	2.6

It should be noted that some of the observation wells sampled for various types of organic compounds are perched water wells (fig. 3) and do not reflect the organic concentrations in the Snake River Plain aquifer (Robertson, 1977). Perched water wells 50, 53, 54, 55, 56, 68, 70, and 92 were sampled to study the leaching tendencies of surface disposed organic compounds at various INEL facilities.

FIELD SAMPLING TECHNIQUES

Special sampling techniques were employed in the organic sampling program. Special collection methods are required to assure that the sample analyzed in the laboratory is in the same organic state as it was when originally collected. Samples were collected in special detergent-washed, acid-rinsed, sterilized bottles. Immediately after collection, all samples were placed on ice and kept at 1-4°C until time of analysis.

materials

Wells equipped with pumps were pumped until the water was representative of the water in the aquifer. Then a water sample was collected. For wells without pumps, a thief sampler (fig. 4) was used to collect samples from the well at a given depth. Four water samples from perched-water wells were collected using a bailer (fig. 4). The bailer and thief sampler were washed with detergent, rinsed with distilled water, washed with acetone, and again rinsed with distilled water before sampling began each day. Between samples, the bailer and thief sampler were rinsed with distilled water.

Dissolved Organic Carbon

Samples for DOC analyses were collected between August 11 and 18 by either pump, thief sampler, or bailer. Immediately after collection, the sample bottles were put on ice and transported to the Radiological and Environmental Sciences Laboratory (RESL) at the INEL where they were filtered and refrigerated prior to their shipment to the NWQL in Denver, Colorado.

The preservation of samples for DOC analyses is accomplished by the combined effects of filtration, chilling, and contact with silver (Ag). Most micro-organisms will not pass through a 0.45-micron Ag filter. During filtration, approximately 1 μ g of Ag is dissolved from the filter per milliliter of water filtered. Silver in solution or as a colloid exhibits bactericidal properties (Chambers and others, 1962). In addition to the filtering and bactericidal effects of the Ag filter, the samples are sealed in a glass water-tight container and kept chilled on ice until analysis. Over a four week period of testing on a variety of samples (at the NWQL), no losses of DOC or contamination have been observed when using this method.

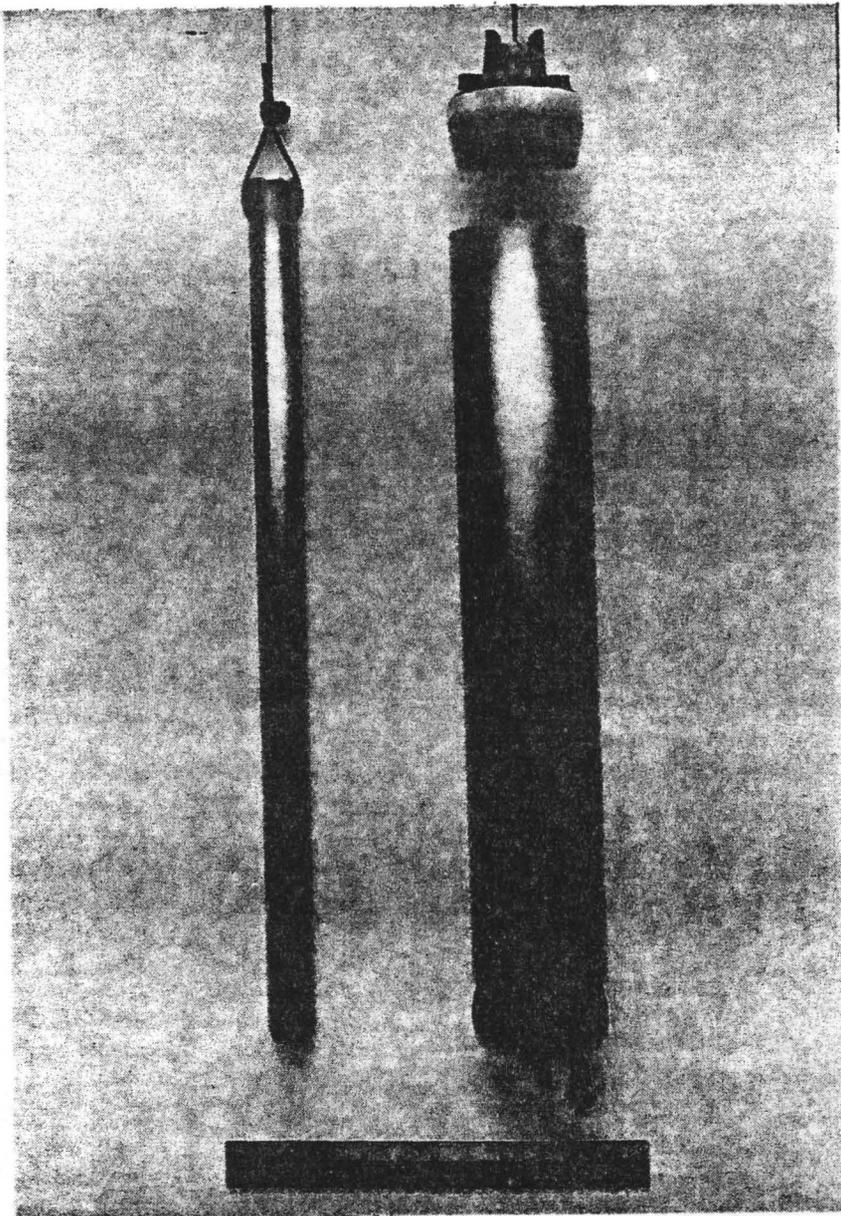


Figure 4. Photograph of bailer (left) and thief sampler (right) used for collecting water samples from wells without pump.

Insecticides, Herbicides, Semivolatiles

Insecticide, herbicide, and semivolatile samples were collected on August 18, 1980 by thief and pump sampling methods. One liter of raw unfiltered water was collected for each analysis. Immediately after collection, all samples were chilled and held at between 1-4°C until analyses were done at the NWQL.

Volatiles

Samples for volatile organics were collected on August 18, 1980 by thief, bailer, or pump methods.

The Volatile Class of EPA priority pollutants includes those compounds that can be sparged from a water sample at room temperature. The fact that these low-boiling compounds are quite easily removed from the sample necessitates special care in the collection, shipping and storage of volatile samples. Bottles used for volatile sample collection are 250 milliliter, screw cap, septum-bottles, made of non-actinic (brown) glass. The septa are teflon coated.

Samples are collected in quadruplicate because once the water is subsampled during analysis, headspace is created in the bottle. This precludes further subsampling as the very volatile organic compounds will evaporate into the headspace and will no longer be present in the water sample at the original concentration.

During actual sample collection, the sample is collected in such a manner as to insure that no air bubbles pass through the bottle while it is being filled. The bottle is filled to overflowing and the cap is immediately replaced. Then the bottle is turned upside down to check for air bubbles. If bubbles are present, the bottle must be emptied and another sample taken. This process is repeated until no air bubbles are present in the sample. The sample is then kept chilled to 1-4°C until it is analyzed.

For best results, analysis for volatile organics must be made within 36 hours of sample collection. For this reason, after sample collection was completed on August 18, 1980, the organic samples were removed from the storage refrigerator at the INEL, packed in ice, and transported to the NWQL in Denver where volatile organic analysis began on August 19, 1980.

Analytical Methods

Dissolved organic carbon was determined by the sealed ampoule, wet-oxidation procedure described by Malcolm and others, 1973. DOC results were reported in milligrams per liter \pm 1 mg/L.

Insecticide and PCB analyses were performed by various specific gas chromatographic procedures (Goerlitz and Brown, 1973) and covered the following compounds:

Aldrin - Total (Water)	Lindane - Total (Water)
Chlordane - Total (Water)	Methoxychlor - Total (Water)
DDD - Total (Water)	Mirex - Total (Water)
DDE - Total (Water)	PCB - Total (Water)
DDT - Total (Water)	PCN - Total (Water)
Dieldrin - Total (Water)	Perthane - Total
Endosulfan I - Total (Water)	Silvex - Total (Water)
Endrin - Total (Water)	Toxaphene - Total (Water)
Heptachlor Epoxide - Total (Water)	2,4-D - Total (Water)
Heptachlor - Total (Water)	2,4-DP - Total (Water)
	2,4,5-T - Total (Water)

Insecticide results were reported in $\mu\text{g/L} \times 10^{-2}$ with the exception of the results for chlordane, PCB, and Toxaphene which were reported in $\mu\text{g/L} \times 10^{-1}$.

Volatile analyses were performed by sparging a five-milliliter aliquot of sample for ten minutes with helium, and trapping volatile organic compounds on a column of Tenax GC. Trapped compounds were thermally desorbed and flushed onto the head of a Carbowax 20M column for GC-MS analysis as described by Pereira and Hughes, 1980.

Semivolatile compounds from one-liter samples were solvent extracted with methylene chloride first at pH 12 to isolate base-neutral semivolatile compounds, followed by a second extraction at pH-2 to isolate acid compounds. Methyl esters of organic acids were prepared by derivatization with diazomethane. The GC-MS analyses of each fraction were performed on a 2 mm ID x 6 feet glass column packed with a 3 percent SP 2100. This column was temperature-programmed with 50° to 260°C at $6^{\circ}/\text{minute}$ after a 5 minute hold at 50°C and was held at 260°C for 10 minutes at the end of the program. Mass spectral scans were run from 60 to 450 amu. Water and reagent blanks were run, and semi-quantitative results were calculated by comparison of unknown chromatographic peaks with a $10 \mu\text{g/L}$ internal standard.

Mass spectral identifications of volatile and semivolatile compounds were performed by computer comparison with the National Bureau of Standards mass spectral data base. Only those identifications which have met vigorous comparison tests have been reported as present in the sample. Briefly, the criteria for identification are $\text{Fit} \geq 800$ and $\text{Purity} \geq 400$. Purity measures the resemblance of the unknown spectrum to a specified library entry. A Purity value of 1000 signifies identical mass spectra. Fit is also a measure of spectral resemblance; however, peaks present in the unknown but absent in the library spectrum are not considered in the Fit algorithm. A Fit of 1000 would indicate that the unknown spectrum contains the library spectrum but possibly as an unresolved mixture. Those compounds which could not be identified with a high degree of certainty or which were present in the reagent blank have not been reported.

RESULTS AND DISCUSSION

In considering the results of any organic reconnaissance programs, it is important to remember several facts (U.S. Environmental Protection Agency, 1976):

1. Organic compounds, both synthetic and natural, are present in all drinking waters to some extent. In addition, some halogenated organic compounds are produced during the disinfection of drinking water with chlorine.
2. The major portion of organic compounds in most waters is of natural origin.
3. Most of the specific organic compounds in drinking water have not been identified, and analysis for many of them is very difficult.
4. Most of the identified organic compounds in drinking water have not been bioassayed.
5. The effect on humans of long-term ingestion of very low levels (ng/L to mg/L) of organic chemicals in drinking water is not known, and the portion of human exposure from drinking water versus the total exposure from all sources (food, air) is seldom known. However, the drinking water portion is usually considered to be small.

Dissolved Organic Carbon

The DOC results were more reflective of the sampling procedure (thief vs. pump sampling) than of the presence of organic contamination. This relationship is shown in table 2.

Table 2.--Dependence of dissolved organic carbon concentration in background wells on method of well sampling

Well designation	Pump sampled, dissolved organic carbon (milligrams per liter)	Thief sampled, dissolved organic carbon (milligrams per liter)
Atomic City	3.3	
Blain Larson	11	
Fire Station #2	3.6	
Highway #3	8.9	
P&W #2		5.9
Site 14	5.1, 11	
4		9.2
19		8.7
26		13
27		10
Mean	7.1	9.3

Thief or bailer sampling does not flush the well, and relatively high DOC values can result from stagnant water and organic contamination remaining from drilling fluids and well casing. Pump sampling, on the other hand, does exchange the water in the well bore for new water from the aquifer, and therefore gives a more representative sample of actual DOC concentrations in the ground water.

In order to indicate any significant organic contamination, the DOC value for any given well should exceed twice the average DOC background value for the particular sampling method used. The average DOC value for background wells sampled with a thief sampler was 9.3 mg/L and for background wells sampled with a pump was 7.1 mg/L (table 2). Therefore, a well sampled with a thief sampler should have a DOC value of about 20 mg/L and a pumped well should have a DOC value of about 15 mg/L before any significant amount of organic contamination would be indicated.

Generally, the INEL production wells that are pumped regularly had the lowest DOC concentrations (table 1). The other pumped wells also had low concentrations. Wells sampled with a thief sampler had higher concentrations. The highest DOC concentrations were measured in the perched water wells around the TRA chemical and radioactive-waste ponds. However, none of the DOC samples taken from the INEL indicated any high level organic contamination of ground water.

Insecticides and Herbicides

No insecticides or herbicides were detected in any samples except for observation well 40, where dichlorodiphenyltrichloroethane (DDT) was found to be present at 10 parts per trillion (0.01 μ g/L). This low level (coupled with the absence of detectable insecticides and herbicides in the other samples) does not indicate significant contamination in INEL ground water by insecticides and herbicides.

Volatiles and Semivolatiles

Of the eighteen water samples sent to the NWQL, seventeen were analyzed for extractable and volatile organic constituents. The eighteenth sample was from the TRA radioactive waste disposal pond and was not analyzed due to its radioactivity. The results are presented in table 3.

The compounds identified as being in the analyzed sample can be broken down into four categories based upon the judgment of the analyst.

1. Occurs in Blank - These compounds are present in the blank (distilled water) sample run prior to analysis of the other samples, and therefore probably do not occur in the original sample.
2. Unlikely to Occur - These compounds probably result from variable sample contaminants which may or may not occur during the

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory

I. ICPP Waste Effluent

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Ethylbenzene	Chloroform Trichloroethene	Methyldihydrofuran Trichloroethene Dihydromethylpyran Trimethyldodecatrienol	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Ethylbenzene Heneicosanoic acid	Trichloroethene Heptane Methylhexane Dimethylhexane Ethylmethylhexane Xylene isomers Tetrachloroethane Dichloropentane Tetramethylpentane Bromohexane isomers Methyloctane Chlorooctane Diethylphthalate Oxybis-octane Octanone Hexanal Methylhexanone Nitromethylbenzene	Methylpentanoic acid Pentanoic acid Benzoic acid Methylhexanoic acid isomers Methylnonanoic acid isomers Benzenedioic acid isomers Methyldecanoic acid isomers Tridecynoic acid Tetradecynoic acid Hexadecynoic acid Triacontanoic acid Undecanoic acid Dimethylhexanone nonanoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
		Cyclohexane Dimethyloxetane Methylpropane	None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

II. Well-70

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Tetrachloroethene Ethylbenzene			None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Heneicosanoic acid	Trichloroethene Methylhexane Xylene isomers Dichloropentane Propylbenzene Methoxypropanediol Bromohexane isomers Dimethylheptane isomers Diethylphthalate Oxybis-octane	Ethanedioic acid Methylpentanoic acid isomers Benzoic acid Decanoic acid Undecanoic acid Methyldecanoic acid isomers Tridecanoic acid Tridecynoic acid Hexadecenoic acid Tetradececynoic acid Octadecenoic acid Triacontanoic acid Tetradecanoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylene chloride	Propanone Dimethylacetone Methylbutanone	None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

III. Well-67

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Diethylphthalate Dipropylphthalate	Tridecadiene Undecanoic acid methyl ester Tetramethylhexadecatirienol	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Acetic acid ethyl ester Heneicosanoic acid	Trichloroethene Heptane Trichloroethane nonanediol Bromohexane isomers Ethylmethylhexane Diisooctylphthalate Dimethylhexanal	Benzoic acid Methylhexanoic acid Methylnonanoic acid Decanoic acid Undecanoic acid Tetradecynoic acid Tetradecanoic acid Hexadecenoic acid Triacontanoic acid Cyclopentaneundecanoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylene chloride		None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory (continued)

IV. Well-65

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Ethylbenzene	Diisooctylphthalate Trimethylpentene	Hexylpentyl ether Trimethyltetracontane Trimethyldodecatrienol Hexatriaceontane	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Acetic acid ethyl ester Heneicosanoic acid	Methylhexane Heptane Methylcyclohexane Tetrachloroethane Bromohexane isomers Dimethylhexane Oxybis-octane Diisooctylphthalate Methylpentanol Decenone	Methylnonanoic acid Decanoic acid Tetradecanoic acid Methyltetradecanoic acid Hexadecynoic acid Pentadecynoic acid Cyclopentaneundecanoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylene chloride	Trimethylpentane Dimethyldisulfide	Trimethylpentane Dimethyldisulfide

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

V. Well-58

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/l.)</u>
		Methylnonanoic acid methyl ester Methylethyldioxetane	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/l.)</u>
Acetic acid ethyl ester	Cyclohexane Trichloroethene Heptane Methylcyclohexane Trichloroethane Xylene isomers Bromohexane isomers Methyltetrahydrofuranol Methylpentanol Hexanal Decanone	Benzoic acid Methylhexanoic acid isomers Nonanoic acid Methylnonanoic acid isomers Methyldecanoic acid isomers Undecanoic acid Tridecynoic acid Octadecadiynoic acid Dimethyloctahydrophenanthrene carboxylic acid Cyclopentaneundecanoic acid Octadecadecynoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/l.)</u>
	Methylene chloride	Cyclohexane Dimethyloxetane Methylpropane	None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory (continued)

VI. Well-57

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Diethylphthalate Dimethylphthalate	Decylhydroxylamine Phenylmethylsydnone Propylheptanol Methylnonanoic acid methyl ester	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Acetic acid ethyl ester Heneicosanoic acid	Trichloroethene Heptane Methylcyclohexane Dimethylhexane Dimethyloxirane Xylene isomers Tetrachloroethane Dichloropentane Dimethylnonane Bromohexane isomers Diethylphthalate Oxybis-octane Diisooctylphthalate Heptenone Benzeneacetaldehyde Octanedione Tetramethylhexatrienol Nitromethylbenzene Nitropropylbenzene	Methyl pentanoic acid isomers Benzoic acid Octanoic acid Cyclopentaneundecanoic acid Decanoic acid Methyldecanoic acid Oxononanoic acid Benzene dicarboxylic acid isomers Triacontanoic acid Undecanoic acid Tridecynoic acid Tetradecanoic acid Pentadecynoic acid Methyltetradecanoic acid isomers Hexadecenoic acid isomers Octadecadiynoic acid Dimethyloctahydrophenanthrene Carboxylic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylene chloride	Cyclohexane Dimethylpentane Methylethylcyclopropane	None of compounds reported

Table 3.--Gas Chromatographic--mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

VII. Well-56

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Diethylphthalate Butyl 2-methylpropyl- phthalate	Propionamide Propylethylhexanol Hexylpentyl ether Hexatriacontane Trimethyltetracontane Tetratetracontane Tetradecynoic acid methyl ester	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Ethylbenzene Acetic acid ethyl ester Heneicosanoic acid	Methylcyclohexane Trichloroethene Methylhexene Acetic acid pentyl ester Bromocyclohexane isomers Dimethylheptane Diethylthalate Oxybis-octane Diisooctylphthalate Ethnyloxirane Dimethylhexanal Benzaldehyde	Methylhexanoic acid Benzoic acid Cyclopentaneundecanoic acid Heptanoic acid Benzenedicarboxylic acid isomers Undecanoic acid Methyldecanoic acid isomers Tetradecanoic acid Docosenoic acid Heptadecatriynoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylene chloride	Cyclohexane Methylethylcyclopropane	None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

VIII. Well-55

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Trichloroethene Dimethylpentene	Heptanol Methylethyldioxolane Trimethylcyclopentane Trimethyldodecatrienol	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Acetic acid ethyl ester Heneicosanoic acid	Trichloroethene Cyclohexane Bromohexane isomers Bromocyclohexane Tetrahydro-dimethylpyranone Benzaldehyde	Benzoic acid Hexanoic acid Methylhexanoic acid isomers Methylnonanoic acid isomers Methyldecanoic acid isomers Nonanoic acid isomers Tridecanoic acid Hexadecanoic acid Tetradecanoic acid Cyclopentaneundecanoic acid	None of compounds reported

C. Volatiles - none detected

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory (continued)

IX. Well-54

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Ethylbenzene	Ethylmethylcyclopentane Tetrachloroethane Xylene isomers Dipropylphthalate Trimethylhexane	Nonanal Dimethylethoxyl methylbenzene Hexylpentyl ether Hexatriacontane High-molecular-weight hydrocarbons	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Heneicosanoic acid	Cyclohexane Methylcyclohexane Chloroform Bromohexane isomers Oxybis-octane	Hexanoic acid Methylnonanoic acid Decanoic acid Undecanoic acid Tetradecanoic acid Tridecanoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylene chloride	Cyclohexane Methylethylcyclopropane	None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

X. Well-53

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Diethylphthalate Diisooctylphthalate Butyl 2-methylpropyl- phthalate Xylene isomers	Trimethyldodecatrienol High-molecular-weight hydrocarbons	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Dimethylpentane Methylcyclohexane Tetrachloroethane	Methylnonanoic acid isomers Undecanoic acid isomers Methyldecanoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
		Methylethylcyclopropane Dimethyloxetane	None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

XI. Well-47

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Ethylbenzene	Xylene isomers Butyl 2-methyl-propylphthalate	Methylphenylhydrazine Hexylpentyl ether Methoxyhexene Nonanediol Tridecadiene Dimethyldodecatrienol Methylpentanol Methylnonanoic acid methylester isomers Cyclopentaneundecanoic acid Methylester	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Ethylbenzene Acetic acid ethyl ester	Trichloroethene Heptane Cyclohexane Dichloromethylpropane Xylene isomers Tetrachloroethane Dichloropentane Tetramethylhexane Bromohexane isomers Dimethylheptane Methyloctane Ethylbenzene Chlorooctane Decenone Dimethylheptanol Benzaldehyde Trimethylpentenol Octadecenol	Benzoic acid Benzene acetic acid Methylnonanoic acid isomers Methyldecanoic acid isomers Tridecynoic acid Tetradecanoic acid Cyclopentaneundecanoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylene chloride		None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

XII. Well-43

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Ethylbenzene	Diethylphthalate Diisooctylphthalate Trimethylhexane Xylene isomers	Methoxyhexene Nonanediol Methylnonane Nonanoic acid methyl ester Dodecanone Methylnonanoic acid methyl ester Phenylphenyl hydrazine Dodecadiene Cyclopentaneundecanoic acid methyl ester Trimethyldodecatrienol Methylpentadecanoic acid methyl ester Hexadecenoic acid methyl ester	Methylpentadecanoic acid methyl ester Hexadecenoic acid methyl ester

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylcyclohexane Trimethylpentenol	Methylnonanoic acid isomers Undecanoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylene chloride		None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

XIII. TRA disposal well

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/l.)</u>
Ethylbenzene	Diethylphthalate Trichloroethene Xylene isomer Dimethylpentene Ethylmethylpentane	Trimethyldodecatrienol Phenyl propanone Methylethylcyclopentane isomers Dimethylethyl benzene Methylphenylethanone Tetramethylbenzene Dihydro-methyl-1(N)indene Naphthalene Dimethyl-methylethylbenzene Methylene-bis-pyrrolidine Hexylpentyl ether Butylbenzene	Trimethyldodecatrienol

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/l.)</u>
Acetic acid ethyl ester Ethylbenzene	Methylcyclohexane Dichloropentane Bromohexane isomers Dimethylheptane Methylpentanol Hexenone Methylbutynol Trimethylpentenol	Benzoic acid Methylhexanoic acid isomers Methylnonanoic acid isomers Methyldecanoic acid isomers Tetradecanoic acid Tetradecynoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/l.)</u>
	Methylene chloride		None of compounds reported

31

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

XIV. Well-40

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Xylene	Dihydromethylpyrone	None of compounds reported
	Diethylphthalate	Propenylcyclopentane	
	Di(methylethyl)-dimethyl-aziridine	Trimethylcyclobutane	
	Tetrachloroethane	Ethylpropylhexanol	
	Dimethylhexene	Hexylpentylether	
	Propylcyclopentane	Hexatriacontane	
	Trimethylhexane	Trimethyldodecatrienol	
		Methylnonanoic acid methyl ester	
		Cyclopentaneundecanoic acid methyl ester	
		Tetradecynoic acid methyl ester	

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Diisooctylphthalate	Methylnonanoic acid	None of compounds reported
	Diethylphthalate	Methyldecanoic acid	
	Octadecenal	Undecanoic acid	
	Dimethyloctanol	Octadecanol	
	Tetramethylhexadecatrienol	Tetradecanoic acid	
	Docecanal	Methyltetradecanoic acid isomers	
	Octadecanol	Hexadecenoic acid	

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylene chloride		None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

XV. TRA chemical waste pond

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Xylene isomers Diisooctylphthalate Trichloroethene Diethylphthalate Methylbutanoic acid	Ethylmethylcyclohexane Heptane Methyl dihydropyran Dimethylcyclohexane Ethylmethylcyclohexane Propylcyclohexane Bicyclotrimethyloctanone (Dimethylethoxy) methyl benzene	Ethylmethylcyclohexane

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
Henicosanoic acid	Methylcyclohexane Oxybis-octane Diisooctylphthalate Tetramethylhexadecatrienol	Methyldecanoic acid isomers Undecanoic acid isomers Tetradecanoic acid isomers Hexadecanoic acid isomers	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Methylene chloride	Dimethyloxetane	None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory
(continued)

XVI. Well-46

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Xylene Diethylphthalate Diisooctylphthalate	N-(hydroxy methyl) propenamide Methylphenyl-dioxolane	None of compounds reported

B. Acid extractable fraction - lost prior to analysis

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/L)</u>
	Aziridine	Ethylmethylcyclopropane	None of compounds reported

Table 3.--Gas Chromatographic-mass spectrometric reconnaissance survey of extractable and volatile organic solutes in ground water at the Idaho National Engineering Laboratory (continued)

XVII. Well-68

A. Base-neutral extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/l.)</u>
Ethylbenzene	Trichloroethene Xylene isomer Diethylphthalate Butyl 2-methylpropylphthalate	Methylpentenol Dimethylpentene Ethylmethylcyclopentane Ethylcyclopentane Dimethylhexane Trimethylcyclopentane isomers Butenediamide Ethylcyclohexane Propylcyclopentane Ethyldecene Trimethyldecatrienol	None of compounds reported

B. Acid extractable fraction

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/l.)</u>
Ethylbenzene Heneicosanoic acid	Trichloroethane Bromocyclopentane Bromohexane Dimethylheptane Diisooctylphthalate Dimethylhexanal Benzaldehyde Nitromethylbenzene Tetramethyl-hexadecatrienol	Hydroxypropanoic acid Benzoic acid Methylhexanoic acid isomers Methylnonanoic acid isomers Decanoic acid Methyldecanoic acid Undecanoic acid Tetradecanoic acid Tetradecynoic acid Hexadecanoic acid Pentadecynoic acid	None of compounds reported

C. Volatiles

<u>Occurs in Blank</u>	<u>Unlikely Occurrence</u>	<u>Tentatively Identified</u>	<u>Significant Concentration (>10 µg/l.)</u>
	Methylene chloride	Chloroform Ethylmethylcyclopropane	Chloroform

analytical procedure. A "clean lab" capability is required to avoid these contaminants and the NWQL does not have this capability.

3. Tentatively Identified - These compounds were probably in the water samples when they were received at the NWQL. Keep in mind that these analyses are unconfirmed by standards and their source may be due to (a) organics introduced by well drilling, (b) organic compounds introduced by sampling, (c) organic compounds introduced by well casing, (d) organic compounds which naturally occur in the area ground water, and (e) organic contaminants introduced into the ground water through present waste disposal practices.
4. Significant Concentration - All compounds which occur at levels near or above the internal standard ($>10 \mu\text{g/L}$) were grouped at this level. The analysis was qualitative in nature and the specific concentration of the compounds in this category cannot be estimated except to say that they were near or above the internal standard.

Only those compounds from the "Tentatively Identified" categories which were also found in "Significant Concentrations" will be discussed here. The other compounds are either unlikely to occur or else they occur in such low concentrations as to be negligible.

Well 65 - Trimethylpentane and dimethyldisulfide were tentatively identified in the volatiles fraction. These compounds may have migrated from the TRA disposal well or may result, especially dimethyldisulfide, from microbiological transformations of natural organic substrates. The first compound is used as a solvent and in making fuels.

Well 43 - Methylpentadecanoic acid methyl ester and hexadecenoic acid methyl ester were tentatively identified in the base-neutral extractable fraction. These compounds probably occur naturally in ground water.

TRA disposal well - Trimethyldodecatrienol was tentatively identified in the base-neutral fraction. This is an alcohol, possibly used as detergent somewhere in the cooling tower system.

TRA chemical waste pond - Ethylmethylcyclohexane was tentatively identified in the base-neutral fraction. This compound may originate from solvents, greases, or fuels used at the TRA.

Well 68 - Chloroform has been tentatively identified in the volatiles fraction. This is a perched water well inside the TRA compound where chloroform may occur from chlorinated water leaching into the well or it may be a result of the analytical process.

None of these compounds reported at significant concentrations are reported to be hazardous except chloroform, and chloroform was an unconfirmed analysis which occurred in only one sample.

COST

The cost for the 1980 Organic Reconnaissance Study at the INEL, including planning, sample collection, sample analysis, laboratory time, manpower, equipment, sample transportation, result interpretation, and initial report publication, has amounted to about \$20,000.

SUMMARY AND CONCLUSION

Results of the 1980 reconnaissance survey of organic solutes in ground water at the INEL have indicated no significant areas of organic contamination of ground water. Because of this, the second phase of this study was canceled. It is suggested that general organic reconnaissance studies be conducted at the INEL in the future on a periodic basis.

SELECTED REFERENCES

- Barraclough, J. T., Teasdale, W. E., and Jensen, R. G., 1967, Hydrology of the National Reactor Testing Station, Idaho, 1965: U.S. Geological Survey Open-File Report IDO-22047, 107 p.
- Barraclough, J. T., Teasdale, W. E., Robertson, J. B., and Jensen, R. G., 1967, Hydrology of the National Reactor Testing Station, Idaho, 1966: U.S. Geological Survey Open-File Report IDO-22048, 95 p.
- Barraclough, J. T., and Jensen, R. G., 1976, Hydrologic data for the Idaho National Engineering Laboratory site, Idaho, 1971 to 1973: U.S. Geological Survey Open-File Report 75-318 (IDO-22055), 52 p.
- Barraclough, J. T., Robertson, J. B., and Janzer, V. J., 1976, Hydrology of the solid waste burial ground, as related to the potential migration of radionuclides, Idaho National Engineering Laboratory, with a section on Drilling and sample analyses, by L. G. Saindon: U.S. Geological Survey Open-File Report 76-471 (IDO-22056), 183 p.
- Barraclough, J. T., Lewis, B. D., and Jensen, R. G., 1981, Hydrologic conditions at the Idaho National Engineering Laboratory, Idaho, Emphasis: 1974-1978: U.S. Geological Survey Water Resources Investigations 81-526, 77 p.
- Chambers, C. W., Proctor, C. M., and Kabler, P. W., 1962, Bactericidal effect of low concentrations of silver: Journal of the American Water Works Association, 54: p. 28-216.
- Goerlitz, D. F., and Brown, E., eds, 1973, Methods for analysis of organic substances in water: U.S. Geological Survey Techniques Water-Resources Investigations, Book 5, Chapter A3, 34 p.
- Leenheer, J. A., and Huffman, Edward, W. D. Jr. , 1979, Analytical method for dissolved-organic carbon fractionation, U.S. Geological Survey Water-Resources Investigations 79-4, 16 p.
- Malcolm, R. L., Leenheer, J. A., McKinley, P. W., and Eccles, L. A., 1973, Supplement II - Dissolved organic carbon, wet-oxidation method, in Methods for analysis of organic substances in water, D. F. Goerlitz and E. Brown, eds: U. S. Geological Survey Techniques of Water-Resources Investigations, Book 5, Chapter, A3, 34 p.
- Mundorff, M. J., Crosthwaite, E. G., and Kilburn, Chabot, 1964, Ground water for irrigation in the Snake River Basin in Idaho: U.S. Geological Survey Water-Supply Paper 1654, 222 p.
- Pereira, W. E., and Hughes, B. A., 1980, Determination of selected volatile organic priority pollutants in water by computerized gas chromatography - quadrupole mass spectrometry: Journal of the American Water Works Association, v. 72, p. 220-230.

- Robertson, J. B., 1977, Numerical modeling of subsurface radioactive solute transport from waste-seepage ponds at the Idaho National Engineering Laboratory, U.S. Geological Survey Open-File Report IDO-22057, 68 p.
- Robertson, J. B., Schoen, Robert, and Barraclough, J. T., 1974, The influence of liquid waste disposal on the geochemistry of water at the National Reactor Testing Station, Idaho, 1952-1970: U.S. Geological Survey Open-File Report IDO-22053, 231 p.
- Robertson, J. B., 1974, Digital modeling of radioactive and chemical waste transport in the Snake River Plain aquifer at the National Reactor Testing Station, Idaho: U.S. Geological Survey Open-File Report IDO-22054, 41 p.
- U.S. Environmental Protection Agency, 1976, National interim primary drinking water regulations: U.S. Environmental Protection Agency, Office of Water Supply Publication, EPA-570/9-76-003, 159 p.