BRINE SAMPLING AND EVALUATION PROGRAM
PHASE I REPORT

DOE-WIPP-87-008

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DISCLAIMER

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TABLE OF CONTENTS

	Page
Acknowledgments	
List of Tables	iii
List of Figures	iv
Executive Summary	ES-1
Abstract	
1.0 INTRODUCTION	1
1.1 Objectives of the Brine Sampling and Evaluating Program	4
1.2 Phased Approach	4
1.3 Phase I Tasks	5
1.3.1 Task 1 Activities	5
1.3.2 Task 2 Activities	6
2.0 INVENTORY OF UNDERGROUND DRILL HOLES	7
2.1 Objectives	7
2.2 Methodology	7
2.3 Accomplishments	7
3.0 BRINE OCCURRENCES	10
3.1 Observations and Measurements at the WIPP Repository Horizon	10
3.1.1 Weeps	10
3.1.2 Brine in Drill Holes	13
3.1.2.1 Downholes	14
3.1.2.2 Upholes	17
3.1.2.3 Horizontal Holes	18
3.1.3 Damp or Wet Areas on Floors	18
3.1.4 Associated Gas Occurrences	21
3.2 Brine Inflows into Mines in Evaporite Formations	21
3.2.1 Dome Salt	21
3.2.2 Bedded Salt	22
3.3 Brine Occurrences in Salado Formation Drill Holes Near WIPP	23
4.0 PRELIMINARY HYDROLOGIC-GEOMECHANICAL EVALUATION	25
4.1 Sources of Brine in the Salado Formation at WIPP	26
4.1.1 Hydrous Minerals	26
4.1.2 Fluid Inclusions	27
4.1.3 Intergranular Porosity and Open Fractures	28
4.1.4 Large Fractured Zones ("Brine Reservoirs")	29

TABLE OF CONTENTS
(Continued)

		Page
4.2	Brine Flow Mechanisms	29
4.2.1	Flow Under a Hydraulic Gradient	30
4.2.1.1	Flow Through Salt	32
4.2.1.2	Flow Through Interbeds	37
4.2.2	Flow Under a Thermal Gradient	37
5.0	BRINE SAMPLING AND EVALUATION PROGRAMS CONTINUING EFFORTS	38
6.0	SUMMARY	39
7.0	REFERENCES CITED	41

Appendices

Appendix A: Preliminary Inventory of Underground Drill Holes at WIPP Explanation of Fields Used in the Data Base for Appendices A and B

Appendix B: List of Underground Drill Holes where Brine Occurrences were Observed and Monitored for Phase I of the Brine Sampling and Evaluation Program at WIPP

Appendix C: Gas Occurrences at the Mining Face in the WIPP Repository Excavations, March and April, 1986

Appendix D: Phase I Preliminary Sampling and Evaluation of Brine Occurrences at the WIPP Repository Horizon

Appendix E: WIPP BSEP Brine Inflow Data Tables

LIST OF TABLES

Table Number	Title	Page
Table 3.1	Brine Inflow Summary for Downholes	16
Table 3.2	Brine Inflow Summary for Upholes	20

LIST OF FIGURES

Figure Number	Title	Page
Figure 1-1	Location Map of the WIPP Site	2
Figure 1-2	Generalized Stratigraphic Cross Section . .	3
Figure 2-1	Map of the WIPP Underground Workings . . .	9
Figure 3-1	Brine Weeps in the WIPP Facility Excavation	11
Figure 3-2	Geologic Cross Section of the Facility and Experimental Level in the Vicinity of the SPDV Test Rooms and the Experimental Rooms	12
Figure 3-3	Halite "Stalactites" in the WIPP Facility Excavation	19
Figure 4-1	Conceptual Model for Brine Flow Towards a Repository	31
Figure 4-2	Relationship of Salt Permeability and Depth Near an Excavation	33
Figure 4-3	Modification of Permeability in the Radial and Tangential Directions	34

BRINE SAMPLING AND EVALUATION PROGRAM PHASE I REPORT

DOE-WIPP-87-008

EXECUTIVE SUMMARY

This report presents preliminary data obtained in the course of the WIPP Brine Sampling and Evaluation Program. The investigations focus on the brine present in the near-field environment around the WIPP underground workings that flows under existing pressure gradients. Most of the data reported in this document were acquired in the 600 days after January 1, 1985.

Although the WIPP underground workings are considered "dry," small amounts of brine are present, probably on the order of 0.1 to 0.5 percent by weight of the surrounding rocks. This amount of brine is not unexpected in rocks of marine sedimentary origin. Part of that brine can and does migrate into the repository in response to pressure gradients, at essentially isothermal conditions. These small volumes of brine have little effect on the day-to-day operations, but are pervasive throughout the repository. Enough moisture may accumulate over a period of years to affect both operations and planning during the life of the project and the behavior of repository during resaturation and repressurization after sealing and closure.

The preliminary observations made during Phase I of the Brine Sampling and Evaluation Program (BSEP) began informally as an extension of the weep observations in 1983, and included observations made during 1984 of localized weeps and the growth of tubular salt stalactites at various locations in the WIPP underground. Brine occurrences manifested by salt efflorescences, moist areas, and fluid accumulations were also commonly observed in association with drill holes and at some locations on the floors of the workings. The studies were organized in 1984 and formalized in 1985. Moist areas and locations of brine inflows have been observed in all parts of the WIPP underground. The list of 70 drill holes included in Appendix B is not all-inclusive, but illustrates the widespread distribution of the occurrences.

Very small volumes of brine have been observed to "weep" from newly excavated surfaces in the WIPP underground workings. They appear as irregular moisture patches on the ribs and back. Some become visible immediately after excavation, while others may take up to several weeks to become noticeable. As the brine evaporates into the repository atmosphere, halite and very minor amounts of other evaporite minerals are precipitated, usually in the form of finely crystalline encrustations, mounds, and knobs. Individual accumulations are generally less than two centimeters in diameter, but sometimes coalesce to form small masses or ridges. Weeps are pervasive throughout the underground workings and occur on the surfaces of all exposed lithologic units. They appear to develop more quickly and occur more frequently on the units that contain some clay.

Small quantities of gas are associated with some weeps. Slowly bubbling wet areas, usually about 2 or 3 centimeters in diameter, are occasionally very noticeable within a few minutes of mining. The bubbling usually decreases within an hour or two after mining, and the rate of inflow to freshly mined surfaces of both brine and gas decreases rapidly. Most of the moisture appears slowly over periods of hours or days, and associated gas inflows are so small as to go unnoticed and be difficult to detect. Some of the weeps remain visibly moist for fairly long periods of time, but most appear dry after several months. Manually probing the halite encrustations often reveals that many of the "dry" encrustations are damp within, indicating that the inflow of brine has only decreased in flow rate, not ceased entirely.

More than 1400 holes aggregating over 14 kilometers in total length have been drilled from the WIPP underground excavations. Mostly vertical and horizontal holes, most are 15 meters or less in length. The majority are 15 centimeters (six inches) or less in diameter, although holes almost a meter (36 inches) in diameter and 6 meters long have been drilled. A preliminary listing of those holes drilled before July 1985 is included as Appendix A of this report. Fifty-four of these holes were used as observation locations during Phase I of the BSEP and are listed in Appendix B of this report.

Encrustations of halite on the sides and at the collars of the holes indicate that small volumes of brine have seeped into nearly all of them. Measurable volumes of brine have accumulated in some holes.

In the fall of 1984, at the time the BSEP was initiated, it was realized that many of the more noticeable brine occurrences were found in drill holes that had been in existence for some time and that little or nothing was known about the rate of initial brine inflow. Seventeen new holes that were drilled as part of already-planned stratigraphic data collection became available for brine observations.

Some of the then-existing brine occurrences were scheduled to be disrupted by planned experiments, especially in Room J and Experimental Rooms A1, A2, A3, and B. As a result, initial emphasis was to obtain expeditiously some baseline data prior to such disruptions, with the realization that the BSEP would evolve as the nature of the brine inflows became more apparent.

Measured occurrences have inflow rates that range from less than the rate at which surface moisture is evaporated into the repository atmosphere to approximately 0.5 liters per day. Individual occurrences vary greatly and some drill holes separated by less than a meter have inflows that contrast dramatically, making the discussion of "averages" or "typical occurrences" difficult or misleading. The reasons for this variability are still poorly understood. The inflow at any specific location is influenced by a number of factors, including local stress distribution, local brine sources, variations in local fracturing and permeability, and local variability in the geology. Most occurrences displayed a brief, initial no-flow or low-flow period, followed by maximum inflow. Brine inflow then decreased over a period of several months to relatively steady-state conditions over the 600 days of monitoring. Some occurrences had increased inflows and some ceased entirely. Most of the measurable inflow rates range between a few tenths and a few hundredths of a liter per day. The largest individual production measured during this reporting period produced an aggregate over 235 liters of brine, and continues to produce approximately 0.2 liters per day. It was clearly an unusual and exceptional occurrence and was associated with excavation-induced fracturing. Inflow rates into that drill hole have declined markedly over the observation period.

It should be noted that the brine occurrences discussed here are small and are clearly distinguished from the "brine reservoirs" found in the underlying, stratigraphically lower, and geologically older, Castile Formation in the Delaware Basin. "Brine reservoirs" are measured in hundreds of thousands of liters, flow readily into boreholes that penetrate them, and have been the subject of other investigations.

The BSEP is focused on the brine, not the gas, occurrences noted at WIPP. One important observation made during Phase 1 of the BSEP is that gas flow and brine flow appear to be intimately related. Gas is associated with many weep occurrences on freshly-mined faces. Gas commonly exsolves from solution as the brine is poured from one container to another. Gas is observed bubbling up through many of the brine occurrences. Fractures, commonly measured in fractions of a millimeter in width and a few meters in length, contain gas and brine in sufficient volume and under sufficient pressure to keep the fractures at least slightly open under lithostatic pressure.

The observations document that salt creep closure and two-phase fluid flow are occurring simultaneously, at least in the immediate vicinity of the repository excavations. It is still not clear what effect the coupling of these processes have on brine inflow or repository behavior. The resaturation of the openings which include the spaces within the waste storage areas (between and within waste containers and between any backfill), the access drifts, and the fractures in the salt, are presently being considered in light of the coupling of these processes. Data collected as part of the BSEP will continue to feed those modeling efforts.

It is clear from the preliminary data that significant pressure-driven brine inflows that are not the result of brine migration in a thermal gradient may occur after sealing and closure of the repository. Brine flow systems are not well understood at this time, but it is likely that the observed inflows are dominated by the response to transient pressure gradients resulting from the excavation of the repository. A component due to regional hydraulic head cannot be ruled out at this time, but if it exists, appears to be relatively small.

Brine chemistry data have been collected, but are not reported in this document. Characterization of the near-field brine chemistry continues, and will be included in a future BSEP report.

The major observations may be summarized as:

- Brine inflows are small, and are not related to large brine reservoirs in the Castile Formation.

- Brine occurrences, particularly those evidenced as halite efflorescence, are pervasive throughout the WIPP underground workings.
- Brine inflow rates are low, usually on the order of a few hundredths of a liter per day or less.
- Although small when measured in terms of liters per day at any given location, cumulative inflow volumes may be significant when measured in terms of the entire repository over periods of many years.
- There is a considerable variation in brine inflow between locations, even when locations are only a few meters (or, in some instances, less than a meter) apart.
- Holes that penetrate the roof and floor generally show a pattern of an initial, maximum flow rate that reduces to a fairly steady flow rate over the time period during which measurements have been made.
- Several flow systems and conditions are possible, but insufficient data exist to select the system and conditions (or combination of several systems and conditions) that best describe the phenomena at WIPP.

BRINE SAMPLING AND EVALUATION PROGRAM PHASE I REPORT

DOE-WIPP-87-008

ABSTRACT

This interim report presents preliminary data obtained in the course of the WIPP Brine Sampling and Evaluation Program. The investigations focus on the brine present in the near-field environment around the WIPP underground workings that is easily moved under existing pressure gradients. Observations began in 1983 and were expanded in 1984 and 1985. Most of the data reported in this document were acquired in the 600 days after January 1, 1985.

Although the WIPP underground workings are considered "dry," small amounts of brine are present, probably on the order of 0.1 to 0.5 percent by weight of the surrounding rocks. This amount of brine is not unexpected in rocks of marine sedimentary origin. Part of that brine can and does migrate into the repository in response to pressure gradients, at essentially isothermal conditions. These small volumes of brine have little effect on the day-to-day operations, but are pervasive throughout the repository and may contribute enough moisture over a period of years to affect resaturation and repressurization after sealing and closure.

The inflows occur as "weeps" on the exposed surfaces and as very small inflows of brine at various locations, most noticeably in holes drilled outward from the underground workings. Over 1400 underground drill holes, most 15 meters or less in length, exist at WIPP. Gas is usually associated with the brine inflows. Gas bubbles are observed in many of the brine occurrences. Gas is also known to exsolve from solution as the brine is poured from container to container.

Measured brine occurrences have inflow rates that range from less than surface evaporation rates to approximately 0.5 liters per day. Most range between a few tenths and a few hundredths of a liter per day. Individual occurrences vary greatly and some drill holes less than a meter apart have brine inflows that contrast dramatically, making the discussion of "averages" or "typical occurrences" difficult or misleading. Most occurrences have initial peak inflow rates that decline to steady rates over the observation period. Some have ceased entirely, and a few have increased inflows.

The largest individual production that was measured during this reporting period produced an aggregate of over 235 liters of brine. It was clearly an unusual and exceptional occurrence, and inflow rates for that occurrence have declined over the observation period.

It is clear from these preliminary data that the brine, gas, and salt creep phenomena are intimately associated. Pressure-driven brine inflows that are not the result of brine migration in a thermal gradient may occur at any time a pressure difference exists, including after sealing and closure of the repository. It is likely that the observed inflows into the repository excavations are dominated by the response to transient-pressure gradients

resulting from the excavation of the repository itself. A component due to regional hydraulic head cannot be ruled out at this time, but if it exists, it appears to be relatively very small.

Investigations of the occurrence and chemistry of the brines are continuing.

1.0 INTRODUCTION

The Waste Isolation Pilot Plant (WIPP) is a Department of Energy (DOE) research and development facility to demonstrate the safe disposal of radioactive wastes derived from the defense activities of the United States. The WIPP project's mission consists of two parts. The first is to demonstrate the safe handling and disposal of transuranic (TRU) waste in bedded salt. The second is to create a research facility for the examination of the technical issues related to the emplacement of defense-related radioactive waste in bedded salt.

The WIPP facility is located approximately 42 kilometers east of Carlsbad, New Mexico, in an area known as Los Medanos (Figure 1-1). The underground portion of the facility is located at a depth of approximately 655 meters in the bedded salt deposits of the Salado Formation, part of an evaporite sequence over 1000 meters thick (Figure 1-2). An extensive program of site characterization and validation has been conducted for the past ten years (1976-1986). The results of these studies are summarized in the WIPP "Geological Site Characterization Report" (Powers et al., 1978), the WIPP "Safety Analysis Report" (US DOE, 1986), the WIPP "Preliminary Design Validation Report" (Bechtel National, Inc., 1983), and the WIPP "Results of Site Validation Experiments" (Black et al., 1983). Additional site investigations are being conducted as part of an ongoing program to further refine the understanding of the site-specific geology. The hydrogeological activities of the Brine Sampling and Evaluation Program, as outlined in the Brine Testing Program Plan (Morse and Hassinger, 1985), are part of these investigations.

The purpose of the Brine Sampling and Evaluation Program (BSEP) is to investigate the origin, hydraulic characteristics, extent, and composition of brine occurrences in the excavations for the WIPP repository in the Salado Formation. Although considered dry workings, brine is observed to weep from exposed surfaces in the repository horizon and seep into drill holes in the underground excavations.

These brine occurrences become visible shortly after excavation or drilling. The more noticeable occurrences produce brine at the rate of a few tenths or a few hundredths of a liter per day or less. In locations where evaporation is very slow, a total of a few liters to several hundred liters of brine have been observed to accumulate over a period of weeks or months.

Although individual occurrences are small and not particularly noticeable on a day-to-day basis, they are pervasive throughout the repository. Over a period of months and years they may contribute enough moisture to merit consideration from the standpoint of long-term repository performance. During present operations, virtually all of the moisture entering the workings from the host rock is evaporated and removed in the air circulated by the underground ventilation system. The assessment and understanding of the brine occurrences becomes especially important when considering what their long-term impacts might be on operations during the demonstration and retrieval period and the rates of resaturation and repressurization of the excavations after closure of the facility.

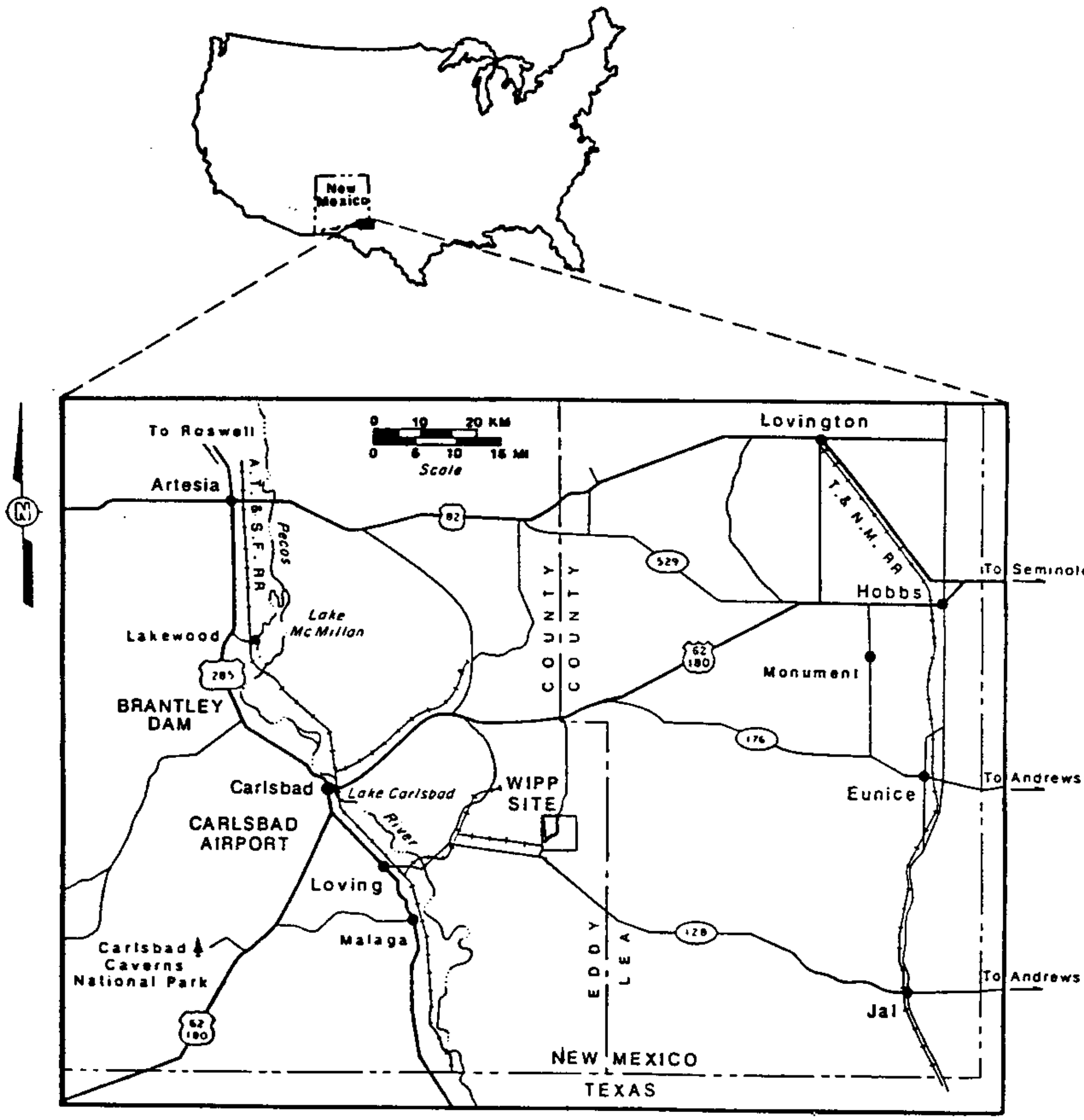


Figure 1-1.
Location Map of the WIPP Site

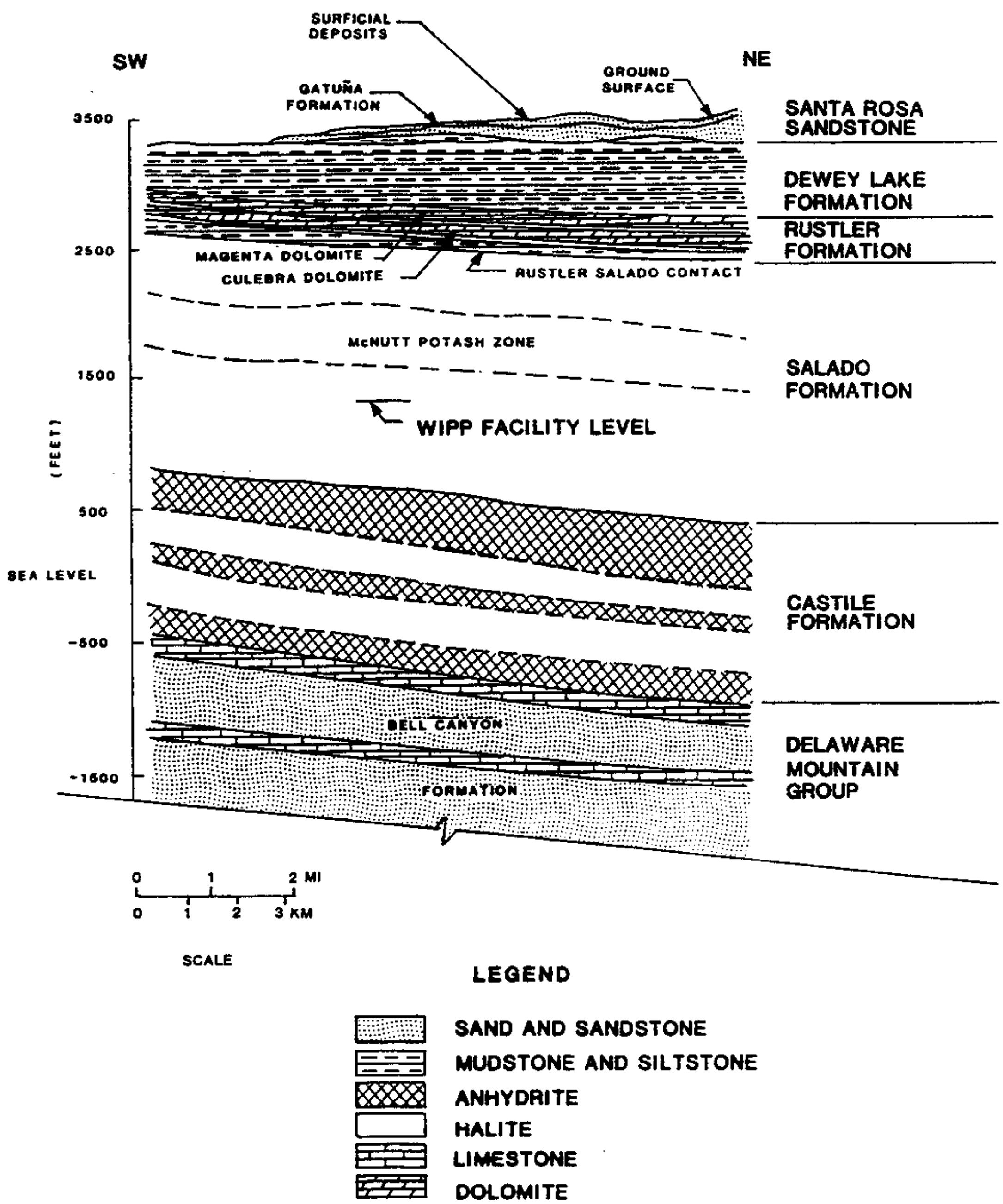


Figure 1-2.

Generalized Stratigraphic Cross Section

1.1 OBJECTIVES OF THE BRINE SAMPLING AND EVALUATION PROGRAM

The objectives of the BSEP are to characterize the hydraulics, extent, and composition of the brine occurrences in the excavations for the WIPP repository. The emphasis of this program is on those aspects of the brine occurrences that are likely to affect operations, resaturation and repressurization, and overall facility performance. The following topics are being investigated and an assessment of their relative importance is being made:

- Brine sources
- Paths for brine movement
- Mechanisms of brine movement
- Aerial extent and volume of existing and potential sources of brine
- Relationship between brine and gas occurrences
- Long-term behavior of known brine occurrences (self-limiting, persistent, etc.)
- Inflow to be anticipated during the demonstration and retrievability period
- Inflow to be anticipated after closure
- Brine composition as it might relate to the above concerns, with emphasis on the anticipated aggregate composition of brines that might enter the repository after closure.

1.2 PHASED APPROACH

This program is being conducted in three phases. Phase I was initiated in the Fall of 1984, and continued throughout 1985 and into 1986. This phase was designed to initiate the program, make preliminary observations, and to provide sufficient data on the characteristics and distribution of the brine near the repository so that a detailed and coordinated investigation could be carried out in Phase II. This document is an interim status report for Phase I.

Phase II continues selected Phase I investigations. It includes additional instrumentation and testing to further refine the understanding of brine occurrences and their chemistry and hydrology, and to identify long-term testing needs and techniques. Phase II was initiated in early 1986 and will continue into early 1987. A Phase II interim report will be issued in 1987.

Phase III monitoring will continue throughout 1987, and is intended to lead directly into a long-term monitoring program expected to continue for the operational life of the facility. A Brine Sampling and Evaluation Program final report will be issued in 1988.

The long-term brine monitoring program, which will continue throughout the life of the facility, will be coordinated with other WIPP monitoring programs.

1.3 PHASE I TASKS

Phase I of the Brine Sampling and Evaluation Program includes five specific tasks that are outlined in Appendix A of the "Brine Testing Program Plan" (Morse and Hassinger, 1985). This report covers Task 1 and Task 2 activities.

- o Task 1 included the development of an inventory of drill holes in the WIPP underground with the objective of identifying those open holes that might be locations where preliminary observations could be made for the BSEP. Task 1 also included the review of literature concerning similar low-flow and weeping brine occurrences both at WIPP and other mines. Task 1 activities are described in more detail in Section 1.3.1.

- o Task 2 involved the collection of preliminary data from existing, accessible brine occurrences within the underground workings at WIPP. Encountering these occurrences provided insight into the complex nature of the brine inflows. Some test installations were made specifically for the purpose of brine inflow observations as part of Task 2. Task 2 activities are described in more detail in Section 1.3.2.

- o Task 3 was the development of a sampling and testing plan for Phase II of the BSEP. Task 3 included the testing of techniques, the refinement of the criteria for the identification of brine sampling locations, and the refinement of sampling procedures and rationale.

- o Task 4 focuses on the assessment of the feasibility of using geophysical techniques to define source horizons and the aerial extent of brine occurrences at the repository level. This task is continuing.

- o Task 5 was to be the coordination of Phase I tasks with the Gas Testing Program (GTP) (Torres, 1985). However, the GTP was delayed and no coordination was necessary.

1.3.1 TASK 1 ACTIVITIES

The Brine Testing Program Plan (Morse and Hassinger, 1985) stated that this task would consist of the following activities:

- o Review literature pertaining to similar low-flow and weeping conditions in other mines to develop an understanding of brine occurrences.

- o Review and evaluate previous WIPP brine characterization and gas testing methodology, data, and reports, in view of their applicability to this program.

- Assemble a master inventory and map of underground boreholes from current lists available from Sandia National Laboratories (SNL), Bechtel, Westinghouse, and the mining contractor.

- Verify locations and determine the status, condition, and accessibility of these holes.

- Develop a separate inventory of accessible boreholes in which a determination of the presence or absence of brine can be made, and monitor all of these holes periodically through the duration of the program.

- Develop criteria for identifying boreholes suitable as test sites for the BSEP.

- Identify boreholes suitable as future test sites for the BSEP.

- Evaluate the applicability of available equipment on hand for pressure-transient testing in boreholes.

1.3.2 TASK 2 ACTIVITIES

The goal of Task 2 was to acquire preliminary data for the BSEP, concentrating on the sampling and evaluation of known, easily accessible brine occurrences in the WIPP underground workings. The overall objective was to obtain an initial understanding of the rate at which brine flows into open drill holes and to make a preliminary assessment of the volume of brine likely to be involved in an individual occurrence.

In order to attain this goal, Task 2 is comprised of the following activities (Morse and Hassinger, 1985):

- Removal of brine from accessible boreholes in the floor, using compressed air or other evacuation techniques such as bailing.

- Monitor additional boreholes to be drilled for the Materials Interface Interaction Test (MIIT) and Drum Durability Test (DDT) programs in Room J.

- Initiate brine sampling for preliminary chemical analysis for major and minor ions to identify analyses that will provide useful results. (Sampling for brine chemistry is continuing. The results will be included in a later report.)

- Drill boreholes in an appropriate grid pattern around selected known occurrences. Use isolation techniques and varying depth holes to determine the stratigraphic zones contributing to brine inflow.

- Drill horizontal boreholes in selected areas along ribs to assess spatial distribution of weeps.

- Attempt pressure transient testing in holes with existing equipment, if appropriate.

2.0 INVENTORY OF UNDERGROUND DRILL HOLES

2.1 Objectives

One part of the Task 1 activities was to assemble a master inventory of underground boreholes from lists available from SNL, Bechtel, Westinghouse, and the mining contractor. Most of the holes that were drilled in the WIPP underground were intended to have instrumentation installed in them. The primary objective of compiling the inventory of underground drill holes was to assist in locating those few holes that remain open (not filled with liners, casing, or instrumentation) and to document the suitability of those open holes for use in the BSEP.

2.2 Methodology

Available lists of underground drill holes were obtained and compiled into a computerized inventory, maintained on an IBM XT microcomputer utilizing dBase III software. Twenty-two sources of information were used. Locations, directions, and hole dimensions are either from as-planned or as-built data, or are approximated. Where possible, as-built data was utilized. Selected holes were located underground and visually inspected. Field observations were added to the location data contained in the computerized listing.

2.3 Accomplishments

The borehole inventory compilation resulted in a listing of 1439 holes that are known to have been drilled in the WIPP underground prior to July 1985. Most of these holes are less than 15 meters in length.

That list is attached to this report as Appendix A. It should be noted that this appendix is a preliminary listing that is based in part on unchecked information and should not be used as a definitive reference for the location or existence of underground drill holes. It does, however, serve the intended purpose of the BSEP in identifying almost all of the open holes that are accessible in the WIPP underground that might serve as points for observations of brine, fractures, or other geological occurrences or conditions. Fifty-four of these holes were used as observation locations during Phase I of the BSEP. They are listed in Appendix B.

Most of the drill holes have been made for the purpose of installing some sort of instrumentation. As a result, the vast majority were not accessible for brine inflow observations. Additionally, some holes were known to have been destroyed by subsequent mining activities. A preliminary designation of the status of each hole was made during the compilation of Appendix A. Those designations were:

- Abandoned hole or instrument
- Collar destroyed by mining
- Closed hole
- Hole used for experiment
- Filled with grout
- Lined with inclinometer guide-tube

Instrument in hole
Mined out
Rock bolt in hole

A preliminary underground field check was made of those holes listed with the status of abandoned or containing a failed instrument. Additional observations of other holes were made during routine underground work. If a hole was field checked and known to be open, it was designated as having an open status.

A preliminary listing of those holes known to be open or possibly open, (as indicated either as a status of "abandoned hole or instrument location" or "status unknown," has been abridged from Appendix A. That list contains references to 365 holes and was used as a tool to help locate holes that might be suitable for use as observation or sampling points for Phase I of the BSEP. For such use, a hole had to meet the following criteria. It had to be:

Open
Not used for a conflicting purpose
Accessible for repeated, periodic observations

The suitability of existing holes for use in transient-pressure testing was also a criteria that was initially considered.

As Phase I proceeded, it became apparent that if a hole had been in existence for a long enough period of time and had received sufficient brine inflow to be of interest for transient-pressure testing, significant salt buildups had formed on the sidewalls and, in the case of upholes, at the collar. These salt buildups will interfere with the proper seating of packers and the holes will have to be reamed before there is a chance of success in any transient-pressure testing. It also became obvious that there was enough variation in brine inflow between holes located less than a meter apart, that considerable effort needed to be expended to define probable inflow locations within holes before attempting pressure transient testing. Phase I has concentrated on acquiring accurate information as to the general nature (including stratigraphic controls, if any) of the brine weeps and inflows.

Seventeen new drill holes, sixteen of which were 15 meters (50 feet) deep, were drilled in early 1985 for stratigraphic information. The sixteen 15-meter (50-foot) holes consisted of eight pairs of upholes and downholes which span the northern end of the WIPP underground, a distance of approximately 1300 meters, east to west (Figure 2-1). These holes were available for use in the BSEP and have been monitored for brine inflow since they were drilled.

These seventeen holes, coupled with some observations from several existing holes elsewhere in the workings, provided the data base for Phase I investigations without additional drilling (Appendix B).

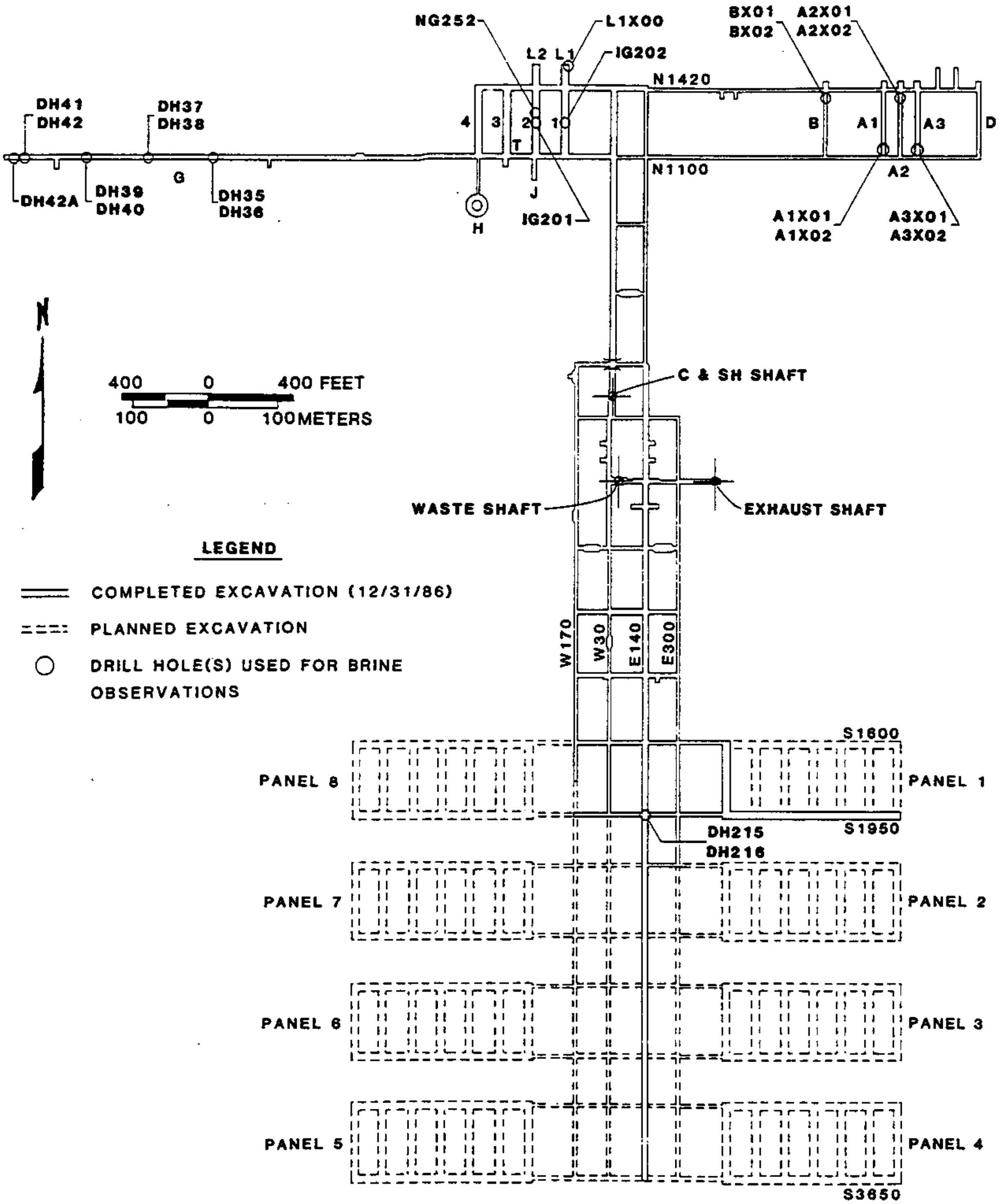


Figure 2-1.
Map of the WIPP Underground Workings

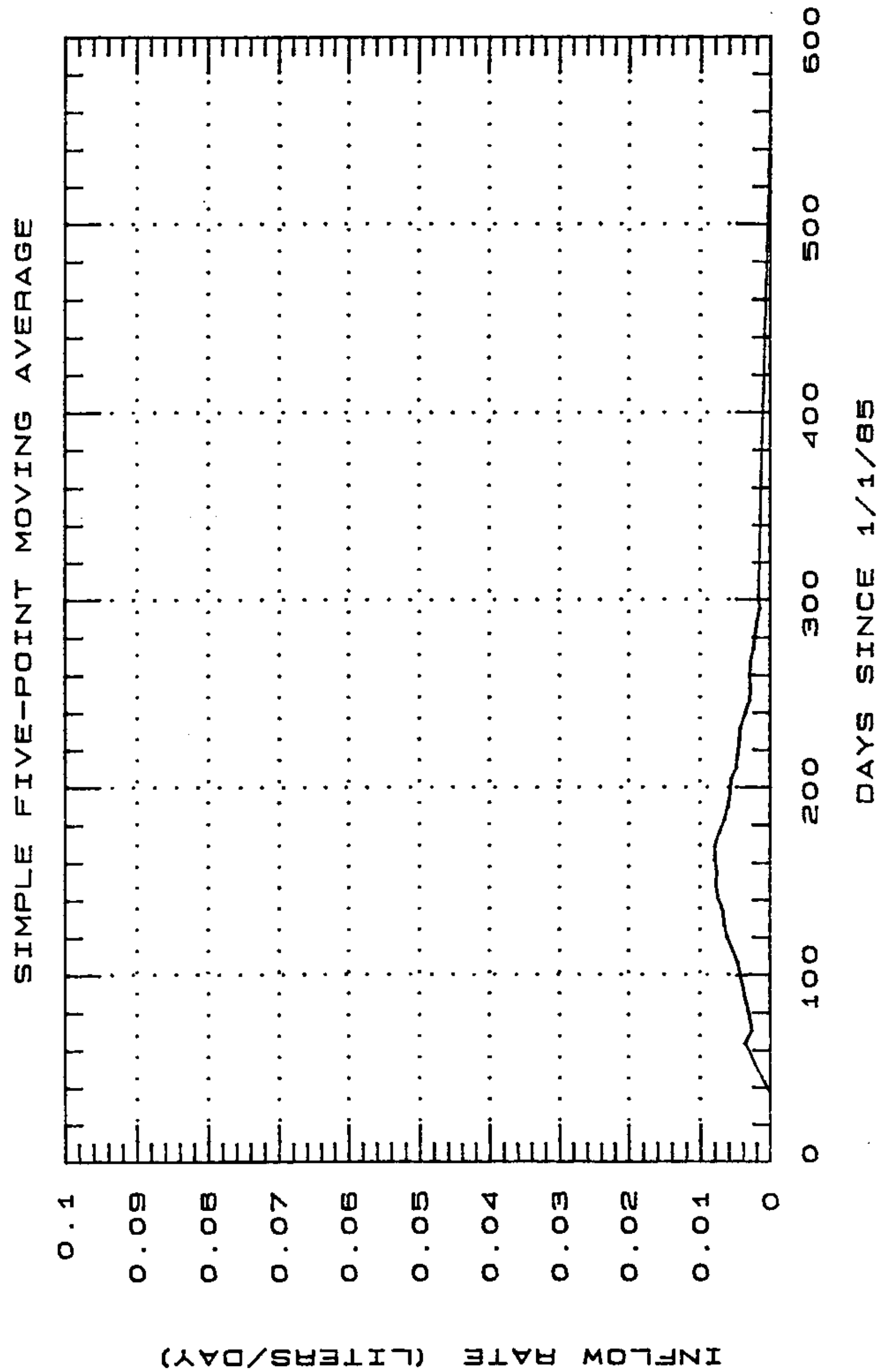
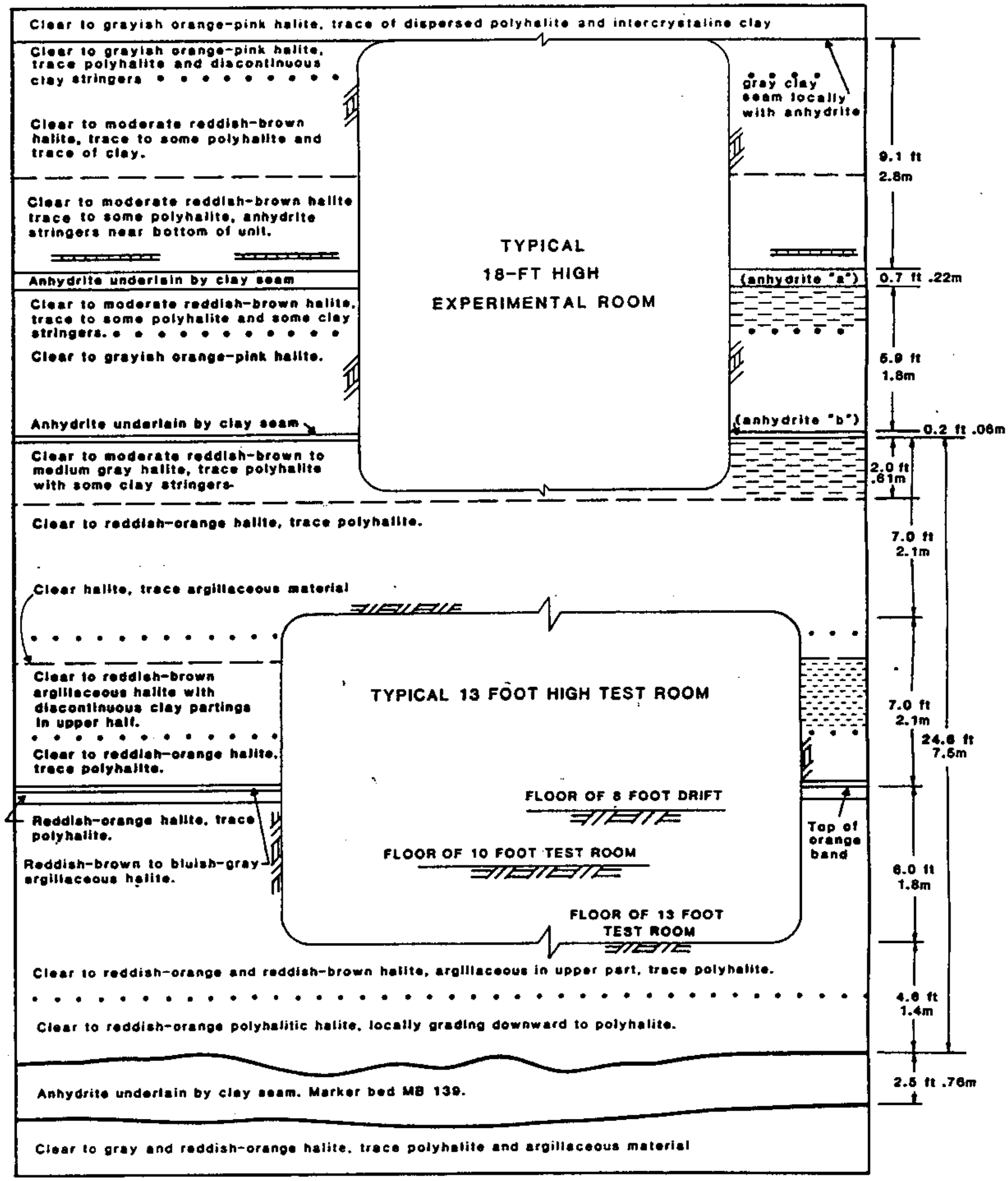


Figure D-23.
DH37 Inflow Rates

Figure 3-1.

Brine Weeps in the WIPP Facility Excavation



NOTES:

1. Dimensions and lithologic descriptions are derived primarily from corehole and geologic mapping data from the four test rooms and experimental area supplemented by geologic information from the remaining SPDV excavation.
2. Unit thicknesses are approximate and vary slightly.
3. Room dimensions have changed with time due to salt-creep closure.

Figure 3-2.

Geologic Cross Section of the Facility and Experimental Level in the Vicinity of the SPDV Test Rooms and the Experimental Rooms the weeps remain visibly moist for fairly long periods of time, but most appear dry after several months. Manually probing the halite encrustations often reveals that many of the "dry" encrustations are damp within, indicating that the inflow of brine has only decreased in volume, not ceased entirely.

Several factors are hypothesized to cause the decreased inflow rates observed to occur in the weeps noticed shortly after mining. As the transient effects of mining (discussed in more detail in Section 4.2) affect a zone ever farther from the excavated openings, local pressure gradients within a half-meter or so of the excavations probably lessen and the driving mechanism for brine and gas inflow decreases. With time, the moisture in the salt in immediate proximity to the underground openings has been driven to the surface, requiring that additional brine migrate over longer distances for inflow to continue. As evaporation into the repository atmosphere continues, more and more crystal growth takes place. This may well result in partial sealing of the surface by new halite crystals and probably results in a reduction of the permeability at the rock-air interface. Converseley, this sealing affect may be offset by an increased porosity, permeability, and fracturing in the "disturbed zone" close to the excavation, as discussed in Section 4.2.1.1. The cumulative effect of the transient conditions and the changes that take place in the physical and hydrological properties of the salt close to the mine openings is not completely understood at this time.

3.1.2 BRINE IN DRILL HOLES

More than 1400 holes aggregating over 14 kilometers in total length have been drilled from the WIPP underground excavations. They extend in all directions, and most are 15 meters or less in length. The majority are 15 centimeters (six inches) or less in diameter, although holes almost a meter (36 inches) in diameter and 6 meters long have been drilled. A preliminary listing of those holes drilled before July 1985 is included as Appendix A of this report.

Encrustations of halite on the sides and at the collars of the holes indicate that small amounts of brine have seeped into nearly all of them. Noticeable amounts of brine have accumulated in some holes.

In the fall of 1984, at the time the BSEP was initiated, it was realized that many of the more noticeable brine occurrences were found in drill holes that had been in existence for some time and that little or nothing was known about the rate of initial brine inflow. Seventeen new holes that were drilled as part of already-planned stratigraphic data collection became available for brine observations.

Some of the then-existing brine occurrences were scheduled to be disrupted by planned experiments, especially in Room J and Experimental Rooms A1, A2, A3, and B. As a result, initial emphasis was to obtain expeditiously some baseline data prior to such disruptions, with the realization that the BSEP would evolve as the nature of the brine inflows became more apparent (Morse and Hassinger, 1985).

The locations where Phase I brine observations were made are listed in Appendix B, which also contains the drill-hole data (depth, diameter, etc.). The locations of the drill holes that are described in more detail in the following sections of this report are shown on Figure 2-1, a map of the WIPP underground workings. Details of the results of Phase I preliminary brine sampling and evacuation of the drill holes in the WIPP repository horizon is presented in Appendix D. Appendix E consists of tabulation of the data discussed in Appendix D.

3.1.2.1 <u>Downholes</u>

Fluid has collected in a number of the vertical downholes drilled in the floor of the underground workings. At the time the BSEP was initiated, it was noted that some holes were filled or nearly filled with fluid, with individual accumulations occasionally totaling many liters. Brine from one hole flowed onto the floor of the East 140 drift at South 850 (TSC-D'Appolonia, 1983b, Part II; Morse and Hassinger, 1985). This hole was plugged during the excavations that lowered the floor of the East 140 drift.

During construction and experimentation, some brine and water has been introduced into the facility. At the time the BSEP was initiated, it was not known how much of the brine found in the downholes was a result of natural inflow from the surrounding salt and how much was a result of intentional or inadvertent introduction of water, whether for dust control, from leaking water pipes, inflow from water-bearing units in the Rustler Formation above the salt down the shafts prior to grouting, or from other construction or experiment related activities (Morse and Hassinger, 1985).

Plugs inserted below the collar of many of these holes have created a restricted environment within them, which reduces the amount of moisture lost by evaporation. As a result, the observations made in plugged downholes may be more representative of inflow conditions in general than those made in upholes or horizontal holes.

One objective of Phase I of the BSEP was to obtain some preliminary figures for naturally-occurring flow from the surrounding salt beds by making systematic observations at existing holes. The following is a summary of the more detailed discussion contained in Appendix D and the data tables in Appendix E.

Brine collection and inflow measurements were made as described in Procedure WP-07-410 (WIPP BSEP: Brine Collection and Inflow Measurements). The general procedure was simply to provide for the accumulation of the small brine inflows, to collect those accumulations on a periodic basis (approximately once a week for initial collections), and to measure the volume that had accumulated since the previous sampling. These measurements were then recorded and tabulated as the average fractions of liters per day collected from each location.

A variety of field techniques were used, depending upon the specifics of each occurrence. They can be divided into the following groups:

- Initial volume measurements, experimental pumping techniques, and water-level measurements
- Vacuum-assisted sampling probe for brine removal from downholes
- Hand-operated rotary suction pump
- Continuous, gravity-driven collecting installations
- Pressure-vacuum and vacuum moisture-sampler installations

Sampling of the downholes was done with a variety of bailing devices, most of which relied on check valves to retain collected brine while the bailer was raised to the surface (the floor of the repository workings). After bailing, the deeper downholes were plugged just below the collar with a piece of plastic foam which was covered, in turn, by a metal lid. The plug and lid prevented the inadvertent introduction of foreign solids into the hole and reduced moisture loss by evaporation to the repository atmosphere.

It should be noted that the northeast part of the repository (Figure 2-1), including Rooms A1, A2, A3, and B, is excavated at a different stratigraphic level, seven meters higher than the rest of the repository (Figure 3-2). The effects of the stress redistribution in the disturbed zone around the repository on the porosity and permeability of the rocks is discussed in Section 4. The fact that anhydrite Marker Bed 139 is seven meters farther below the repository excavations in holes A1X01, A2X01, A3X01, and BX01 than it is in the other downholes monitored for the BSEP, means that brine inflows from this horizon may be occurring through different stress-relieved zones.

A summary of the preliminary data for the downholes sampled during Phase 1 of the BSEP is given in Table 3-1.

General observations are:

- Immediately after drilling of a new hole, there is a short period of time (typically a few days) during which only small brine inflows are observed. This might be the result of damage done to the formation by the drilling itself.
- After the initial no-flow or low-flow period, brine inflows quickly reached maximum inflow rates and began to decline.
- Inflow rates then decreased over a period of several months to relatively steady-state conditions.
- The amount of brine that flowed into drill holes in close proximity to each other varied drastically.

TABLE 3-1

BRINE INFLOW SUMMARY FOR DOWNHOLES

Hole	Room	Date Room Excavated	Date Hole Drilled	Date First Observed	Approx. Maximum Inflow (1/day)	Approx. Inflow 8/86 (1/day)	Inflow Trend (I,S,D)*	Approx. Total Vol. Removed By 8/86 (1)	Assoc. Gas ?
A1X01	A1	10/84	2/85	3/85	0.05	0.026	S	15	
A2X01	A2	7/84	2/85	2/85	0.06	0.025	S	17	G
A3X01	A3	11/84	1/85	2/85	0.03	0.022	S	14	G
BX01	B	6/84	1/85	1/85	0.12	0.05	S	32	G
DH36	G	12/84	1/85	1/85	0.25	0.21	S	125	G
DH38	G	12/84	1/85	1/85	0.18	0.06	S	34	G
DH40	G	12/84	1/85	1/85	0.04	0.01	S	4	
DH42	G	12/84	1/85	1/85	0.05	0.03	S	19	G
DH42A	G	12/84	1/85	1/85	0.2	0.1	S	75	G
IG201	2	3/83	3/83	11/84	0.05	0.017	D	81	G
IG202	1	4/83	4/83	11/84	0.05	0.014	S	71	G
L1X00	L1	4/84	5/84	5/85	0.03	0.03	I	24	
NG252	2	3/83	3/83	12/84	0.5	0.27	D	235	G

Data summarized and rounded from Appendices D and E.

* I = Increasing
S = Steady
D = Decreasing

Table 3-1.

The data for Hole DH42A in Room G departs from the above observations in several ways. Perhaps most significantly, after the initial brief period of little or no inflow, inflow rates, although high, were not at a maximum, Inflow gradually increased for about three months before reaching a maximum rate. The decline in inflow also took place more slowly and over a longer period of time when compared to the other downholes. The inflow behavior noted at this location is especially interesting when contrasted to that exhibited in Hole DH42 (Figures D-20 and D-21), located two meters to the east and drilled 3.3 meters deeper, which produced approximately one-fourth as much brine.

One of the most important observations is the extreme variation in inflow that was observed between closely spaced locations. In addition to the contrast seen between DH42 and DH42A discussed above, the variations documented in Room 2, Room J, Room L1, and elsewhere are even more striking.

The holes in Room J drilled for the Materials Interface Interactions Test (MIIT) have been described by Morse and Hassinger (1985) and in Appendix D of this report. Over 40 closely spaced shallow drill holes were made and subsequent brine levels within them varied dramatically. Holes partially or completely filled with brine were interspersed with dry or nearly dry holes, often less than a meter away. Deeper drillhole arrays in Room L1 exhibited similar, though less extreme, variations in inflow. The great variation in inflow characteristics between locations only a short distance (a few meters, or in some instances, less than a meter) apart make the discussion of "averages" or "typical occurrences" difficult or misleading. These variations might be explained in part by the effects of mining-induced stress redistributions on porosity and permeability, which are discussed in Section 4.2.

The largest brine production that was observed occurred in Hole NG252 in Room 2, which is discussed at length in Appendix D. NG252 is located close to the west rib (wall) of Room 2 and is 38 millimeters in diameter and 2 meters deep. It is one of the physically smallest of the holes observed and appears to be something of an anomaly. The hole penetrates through anhydrite MB 139, and the brine and gas flowing into this hole appears to enter from a fracture close to the base of MB 139. A dry hole exists, approximately 4.7 meters east of NG252 and on the centerline of Room 2, that is 15 centimeters in diameter, and penetrates into the top of MB 139.

3.1.2.2 Upholes

If the brine inflow into upholes is sufficient to flow down the sides of the hole, moist areas may form on the back (roof). Highly visible salt crust buildups and salt stalactites can also form at the collar of the hole.

Many of the upholes are now inaccessible, usually because they contain installed instruments, and it is not possible to determine the extent of salt buildup within them. If there is enough brine entering the upholes to run down the sides, it will usually flow around the instruments and be evident at the collar. The inflow, coupled with the normally high evaporation rate into the repository atmosphere may cause some stalactites to grow 15 to 30 centimeters per week, but the longer ones are usually quite fragile and break easily under their own weight or in response to vibrations from the underground equipment. As a result, long stalactites are fairly rare except in undisturbed locations (Figure 3-3). Moisture entering open upholes tends to evaporate readily, as the air can circulate more freely within them. Several techniques were used to seal the collars of the upholes, but none of the techniques completely controlled evaporation (Appendix D). As a result, it is reasonable to assume that the open, accessible holes show heavier internal salt buildup and less buildup and dripping from the collar than equivalent holes which contain instruments or for some other reason have a restricted opening. The data from the upholes should be considered as providing only minimum inflow data.

The data from the upholes is summarized in Table 3-2. As discussed in more detail in Appendix D, the generally much lower and more irregular inflow values for the upholes may reflect the fact that brine was lost by dispersion from the hole collar and evaporation into the repository atmosphere. It is uncertain at this time, however, if all the differences in inflow between the upholes and the downholes can be explained by this mechanism. Further modifications have been made to the collecting techniques used for upholes in order to resolve this question.

The upholes intersect different stratigraphic horizons than those intersected by the downholes. In addition, holes A1X02, A2X02, A3X02, and BX02 are drilled in the back (roof) of rooms at a stratigraphic level approximately 9 meters higher than in the rest of the repository workings. Hole A1X02 is 18 meters long. As a result, the last 3 meters penetrate beds that are not encountered in the other three upholes in Rooms A2, A3, and B. This includes an anhydrite interbed about 2 meters from the end of the hole.

Inflow data from Hole DH215, located at the intersection of E140 and S1950 drifts almost certainly reflect changes in the stress distribution in the disturbed zone in the immediate vicinity of the repository excavations. The effects of mining-induced stress redistribution on porosity and permeability are discussed in more detail in Section 4.2. Inflow increased approximately three hundred percent when additional excavation took place at that intersection and then declined to very small amounts (Section 9.0, Appendix D).

3.1.2.3 Horizontal Holes

Horizontal holes tend to behave much like small versions of the mine drifts, with weeps and halite encrustations forming on the sides and the end. Small stalactites can grow from the top side of the holes, and occasionally brine accumulates on the bottom. In those circumstances where the openings to the holes are restricted and a saturated or partially saturated atmosphere develops in the hole, brine may accumulate on the bottom and eventually seep out at the collar, where salt buildup may develop.

3.1.3 DAMP OR WET AREAS ON FLOORS

Moist areas have been observed on the floor of the workings, but most have been associated with dust-control or other operational activities. Rare occurrences in which brine has seeped from the Salado Formation have been noted. In most

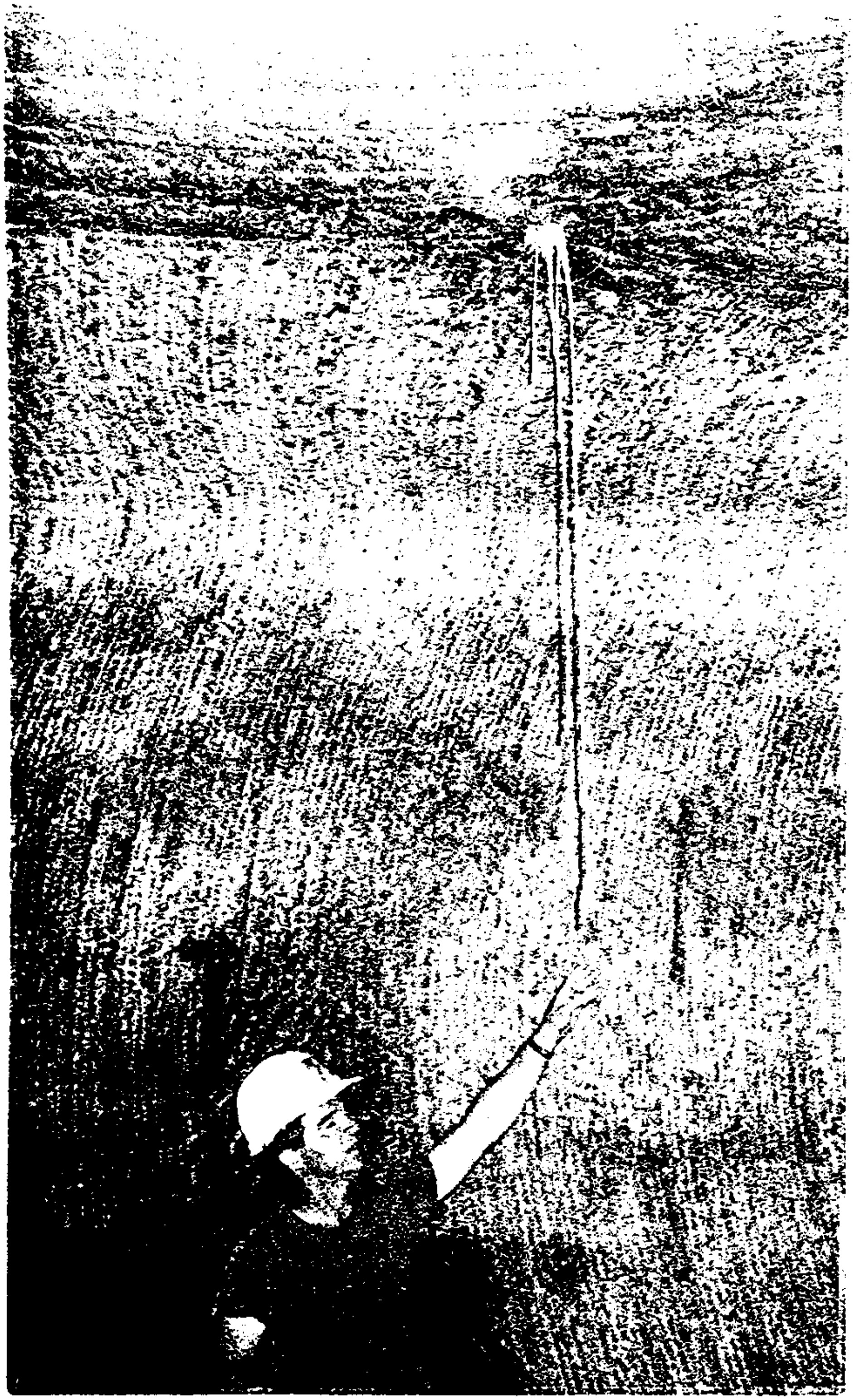


Figure 3-3.
Halite "Stalactites" in the WIPP Facility Excavation

TABLE 3-2

BRINE INFLOW SUMMARY FOR UPHOLES

Hole	Room	Date Room Excavated	Date Hole Drilled	Date First Observed	Approx. Maximum Inflow (1/day)	Approx. Inflow 8/86 (1/day)	Inflow Trend (I,S,D)*	Approx. Total Vol. Removed By 8/86 (1)
A1X02	A1	10/84	3/85	3/85	0.04	0.037	I	9
A2X02	A2	7/84	2/85	2/85	0.03	0.015	S	3
A3X02	A3	11/84	1/85	2/85	0.02	0	NA	4
BX02	B	6/84	2/85	2/85	0.02	0	NA	2
DH35	G	12/84	1/85	2/85	0.02	Trace	NA	4
DH37	G	12/84	1/85	2/85	0.01	0	NA	1
DH39	G	12/84	1/85	2/85	Trace	0	NA	0
DH41	G	12/84	1/85	2/85	Trace	0	NA	0
DH215		1/83	2/83	4/84	0.06	0.01	D	15

Data summarized and rounded from Appendices D and E.

* I = Increasing
S = Steady
D = Decreasing

Table 3-2.

instances, such damp areas have been associated with fractures that provide pathways for brine movement. Small puddles, apparently naturally occurring, were observed on the floors of Room J and Room G. The puddles were quickly limited in size by evaporation into the air circulating through the workings and rapidly became crusted over with crystallizing salt. Where the floor is covered with a layer of partially consolidated salt muck, saturation of the layer of muck below the salt crust can exist, but usually goes undetected. The occurrences of damp or wet areas on floors may be considered a special subset of the occurrences in vertical downholes.

3.1.4 ASSOCIATED GAS OCCURRENCES

The BSEP (as discussed in Section 1.3 of this report) is focused on the brine, not the gas, occurrences noted at WIPP. One important observation that has been made during Phase 1 of the BSEP is that gas flow and brine flow appear to be intimately related. As described in Section 3.1.1, small amounts of gas are associated with many weep occurrences on freshly-mined faces. Gas commonly exsolves from solution as the brine is poured from one container to another. Gas is observed bubbling up through many of the brine occurrences. Fractures, commonly measured in fractions of a millimeter in width and a few meters in length (Appendix C), contain gas and brine in sufficient volume and under sufficient pressure to keep the fractures at least slightly open under lithostatic pressure.

The observations document that salt creep closure and two-phase fluid flow are occurring simultaneously, at least in the immediate vicinity of the repository excavations. It is still not clear what effect the coupling of these processes have on brine inflow or repository behavior. The resaturation of the openings which include the spaces within the waste storage areas (between and within waste containers and between any backfill), the access drifts, and the fractures in the salt, are presently being considered in light of the coupling of these processes. Data collected as part of the BSEP will continue to feed those modeling efforts.

3.2 BRINE INFLOWS INTO MINES IN EVAPORITE FORMATIONS

Small volumes of brine are frequently encountered in mines in evaporite formations including both dome salt and bedded evaporites. A literature review was conducted to provide additional background information on the occurrence of brine. This section briefly reviews these occurrences, most of which cause no disruption of mining operations. The focus of this section is on brine occurrences other than those at WIPP. A discussion of sources of brine in the Salado Formation near WIPP is presented in Section 4.1.

3.2.1 Dome Salt

Many mines in Gulf Coast dome salt have experienced brine and gas seeps or inflows. These occurrences have been reviewed by Kelsall and Nelson (1983). Most occurrences of brine or gas in mines in dome salt are small and have had no effect on mining operations. The initial flow rates are generally the maximum flows noted, and they simply decrease until flow ceases. In rare cases, however, brine inflows have required grouting of brine-emitting zones or caused major floods which sometimes caused the abandonment of drifts or mines. Brine originates in overlying strata, (including the caprock), surrounding formations (intruded by the salt diapir), porous zones in the salt, and overlying bodies of surface water. The brine inflows or seeps reach the mines through boreholes drilled for mining or exploration purposes, fractures in the salt (particularly near the top or edges of the dome), and through structurally controlled permeable zones, such as brecciated fault zones. Movement of brine through the salt may be enhanced by fracturing of the salt and high hydraulic gradients that may exist near dome edges or the caprock.

During brine migration experiments at Avery Island, Krause (1983) reported brine inflows into an unheated site on the same order of magnitude as the brine inflows into heated holes. He measured approximately 0.026 grams of moisture per day flowing into unheated site AB.

Small quantities of gas are probably ubiquitous in dome salt and occur as intragranular or intergranular bubbles. In most cases, gas occurrences in dome salt are associated with argillaceous salt or inclusions of clastic sediment, suggesting the gases were contained within pieces of other sedimentary rocks incorporated into the salt during the rise and intrusion of the salt diapir. More rarely, large, highly pressurized occurrences result in "blowouts" which violently emit large volumes of gas and salt. Blowouts of salt and gas probably occur because of the loss of confining pressure as the result of mining activities (Kelsall and Nelson, 1983).

3.2.2 Bedded Salt

Brine seeps and leaks into mines have occasionally been encountered in the Salado Formation during potash mining operations in the Carlsbad District. Griswold (1977) indicated that the average brine inflow into mines in the area is probably on the order of 40 to 400 liters per occurrence, although he did report an account of one occurrence that yielded over 400,000 liters of brine. Small brine inflows of the magnitude of those in the WIPP excavations are rarely, if ever, reported because they neither present a hazard to personnel nor cause difficulties in routine mining operations. The McNutt potash ore zone, the principal ore-bearing unit in the basin, lies about 200 meters stratigraphically above the WIPP facility horizon. The seeps are allowed to flow until depleted and do not affect mining operations (Register, 1981).

Well-documented data on brine occurrence in bedded salt from the Mississippi Chemical Mine, east of Carlsbad, NM, resulted from experiments investigating brine movement under thermal gradients (brine migration). Some of these experiments recorded data for brine releases in unheated (ambient) conditions. Hohlfelder (1980) reported brine releases occurring during the Salt Block II Experiment prior to heating. Ewing (as reported by Shefelbine, 1982) recorded average inflows ranging between 0.077 and 0.21 grams/day during ambient conditions prior to heating in the three-heater experiment.

Minor gas releases from pressure relief holes drilled into the roof of potash mines, gas flows lasting several months, and work-disrupting blowouts are also recorded in potash mines and in drilling operations in the Carlsbad District (Rutledge and Morgan, 1963, 1964a, 1964b, 1964c; Rutledge, 1964; Rutledge and

Kennedy, 1964a, 1964b; Rutledge et al., 1964; TSC-D-Appolonia, Part II, 1983b; and Chaturvedi, 1984). Some gas releases are also accompanied by brine. Most of these occurrences do not affect mining operations and minor gas inflows such as those described in this report are rarely, if ever, reported. Blowouts are often associated with an obvious, vertical fracture.

Considerable attention was attracted by a series of three gas releases that occurred in the Kerr-McGee (now New Mexico Potash) mine near Carlsbad, New Mexico, in 1983 and 1984, one of which involved a fatality (Cavanaugh and Davidson, 1983; Chaturvedi, 1984). This occurred at a location approximately 15 kilometers north of the WIPP site in the McNutt potash zone in the upper part of the Salado Formation, 200 meters stratigraphically above the WIPP facility horizon. A very small amount of brine, sufficient to dampen the trace of the fracture, was associated with this release. After the release of pressurized gas, an open fracture 5 to 10 millimeters wide and more than 8 meters long was left (Chaturvedi, 1984). This release occurred at a depth of approximately 500 meters below surface. The question of how wide and how long the fracture was prior to the explosive release of gas remains unanswered.

Investigations of the gas occurrences cited above have concluded that most of the occurrences are small and that most of the gas present in the bedded evaporites near Carlsbad resides in clay or argillaceous beds in the salt, with far less residing in polyhalite beds or in the halite. In these studies, gas was most frequently encountered in boreholes drilled upward through the back (roof) at the intersection of drifts. This result supports the idea that the gas accumulates locally in response to the excavation-induced stress redistributions and increased near-field permeability caused by the mining operations. These effects are discussed in more detail in Section 4.2.

No other accounts of brine inflows into salt mines in North America were found in the literature search. Some potash mining has occurred in the Paradox Basin bedded evaporites in the Four Corners area. The Cane Creek Mine was the site of a disruptive, mining-related gas (not brine) release that caused the mine to be converted to a solution mining operation (Westfield et al., 1963). The gas may have originated in a dolomite interbed.

3.3 BRINE OCCURRENCES IN SALADO FORMATION DRILL HOLES NEAR WIPP

Brine and/or gas has also been encountered in the Salado Formation in the vicinity of the WIPP site during drilling for potash evaluations, oil and gas exploration, and various WIPP site characterization studies (Griswold, 1977; Powers et al., 1978; Register, 1981; Popielak et al., 1983; Mercer, 1983; and Mercer, 1987). These occurrences are distinctly separate from those encountered in the Rustler Formation overlying the Salado, and from the "brine reservoirs" in the underlying Castile Formation mentioned in Section 4.1.4 of this report. They are also separate from, but may be more closely related to, the small inflows into the mined repository that are the focus of the BSEP.

Mercer (1987, p. 15) summarizes this data, observing:

> "Very few hydraulic data are available for the Salado Formation. In the halites, the presence of water is restricted because halite does not readily maintain primary porosity, solution channels, or open fractures. Investigations to-date of the Salado Formation at the WIPP site do not indicate an active, circulating, ground-water system."

4.0 PRELIMINARY HYDROLOGIC - GEOMECHANICAL EVALUATIONS

The observations and measurements (summarized in Section 3.1, and presented in detail in Appendices D and E) suggest that multiple brine sources may be involved at the WIPP site and that complex flow induced by excavation is taking place. The potential sources of brine and the flow mechanisms that may be involved are described and evaluated in this section as to applicability at the WIPP repository horizon. Where appropriate, previous relevant scientific investigations are referenced. We emphasize that the observations and measurements have been made in the near-field environment of the underground excavations, which is to be distinguished from the far-field, overall WIPP site hydrogeologic environment.

Moisture does occur in the Salado Formation at the WIPP site. In discussing short-term mining-induced transient flow systems and the rate at which brine flows into the excavations, it may not be important whether the moisture in the Salado is residual from the Permian Sea (connate water), is the result of diagenetic or other processes including dehydration of hydrated minerals, or was introduced into the rocks by some past or present regional flow system. However, the source characteristics (moisture content, permeability, and extent of porous zone) will influence cumulative volume of brine reaching the repository.

Several investigators have measured the moisture content of salt in the Salado Formation. Black et al. (1983) measured a moisture content of 0.59 percent by weight at the repository horizon by heating the salt samples to a temperature of 400°C. The BSEP investigations focus on the water that can and does migrate into the underground openings, which are at atmospheric pressure and approximately 27°C. The migration of brine is probably in response to pre-existing or transient pressure gradients. As a result, the fluid which is locked within unfractured crystals, which is tightly bound to clays or other minerals, or which requires higher than repository temperatures to be liberated, is of lesser concern. Preliminary measurements of the fluid content present in 26 samples from the repository level heated to 250°C is on the order of 0.1 percent by weight, ranging from undetected to a maximum of 0.27 percent (Black et al., 1983). Since heating to 250°C liberates some water of hydration, the actual amount of fluid free to migrate under repository conditions is probably some fraction of those values. Additional measurements of the fluid content of rocks exposed in or occurring close to the repository excavations are presently being made and will be described in a later report.

Similar results were obtained by Hohlfelder (1981), who tested nine samples obtained from the McNutt potash zone exposed in the Mississippi Chemical Mine 19 kilometers northwest of the WIPP site. This is a mineralogically more complex horizon in the Salado Formation that contains more polyhalite than the facility horizon salts. At 200°C, he found that the weight loss ranged from 0.010 percent to 0.044 percent, with the average being 0.028 percent. At 425°C, he found that the weight loss ranged from 0.25 percent to 1.21 percent, with the average being 0.51 percent.

4.1 SOURCES OF BRINE IN THE SALADO FORMATION AT WIPP

Many occurrences of water and brine in evaporite formations, consisting mainly of halite, anhydrite, and gypsum, have been documented. They appear to occur principally as:

- o Hydrous minerals (gypsum, clays),
- o Fluid inclusions in bedded salt (intragranular and intergranular)
- o Intergranular porosity and open fractures
- o Larger porous zones often referred to as "brine reservoirs"

Occurrences of fluid inclusions and hydrous minerals are particularly well-described in the literature. Brine reservoirs have not been as well described, but the literature concerning them is increasing due to the importance of salt formations for siting nuclear waste repositories.

The Salado Formation (described in Powers et al., 1978, and U.S. DOE, 1986) has a complex mineralogy. It is composed of bedded halite with lesser amounts of anhydrite, gypsum, and polyhalite. A detailed geologic description of the repository horizon of alternating layers of halite, polyhalitic halite, and slightly argillaceous halite is provided by Holt and Powers (1986). The halite is generally white to clear, but may be tinted orange, reddish-brown, or gray by interstitial polyhalite or clay. The argillaceous halite is usually reddish-brown in color, with the clay occurring as matrix, interstitial, and intercrystalline material. Halite also occurs as large replacement crystals (pseudomorphs) after gypsum swallowtail crystals and, less commonly, as displacement crystals in some beds of argillaceous halite and anhydrite. Penecontemporaneous dissolution pits, often reaching depths greater than 3 feet, are locally abundant (Powers and Hassinger, 1985) and contain large (1-2 cm), clear halite crystals with frequent fluid inclusions. The halite and anhydrite mineralogy of the WIPP repository horizon has been described by Grim, et. al. (1960) and Stein (1985a). Stein (1985a) reports that the non-NaCl components consist of quartz, anhydrite, gypsum, magnesite, polyhalite, and clays, with traces of alkali feldspar and possibly zeolites. The salt itself contains, on the average, less than 5 percent by weight mineral impurities, except in areas of well-defined anhydrite or clay interbeds.

4.1.1 HYDROUS MINERALS

The most common hydrous minerals (i.e., minerals containing bound water) in evaporite sequences include:

- o Gypsum ($CaSO_4 \cdot 2H_2O$),
- o Clays in mudstone partings and layers, and disseminated in evaporite beds,
- o Several minor hydrous chlorides, sulfates, and carbonates.

Gypsum is a common evaporite mineral that usually dehydrates to anhydrite during consolidation and diagenesis. Most evaporite sequences older than

Tertiary contain anhydrite only, with gypsum being a rehydration product or occurring locally where dehydration was impeded by entrapped brine. One kilogram of gypsum contains over 200 grams (over 1/5 total mass) of water. Clays may be detrital or authigenic and, like gypsum, may release water to the salt when less water-rich clays are produced during diagenesis (Collins, 1975). The hydrous phases in evaporite formations are usually concentrated in individual interbeds, partings, or zones, but they may be dispersed through the salt (Holser, 1979). Gypsum veins may be common locally (Pettijohn, 1975).

The bound water in hydrous minerals is located in specific sites in the minerals' crystal structure. As such, bound water is not a significant source for brine flows. Dehydration of these minerals during burial, heating, compaction, and diagenesis may be a source of water that, if retained in the sediments, may be entrapped in inclusions and brine reservoirs.

4.1.2 FLUID INCLUSIONS

Bedded salt is known to contain up to 1.7 percent water in the form of fluid inclusions (Roedder and Belken, 1979; Roedder, 1984). Fluid inclusions are isolated pockets of brine measuring up to several millimeters in diameter occurring within (intragranular) or between (intergranular) halite crystals. Intragranular occurrences are usually crystallographically controlled and are frequently cubic in shape. Large inclusions tend to be more irregular. The enclosed brine is generally a saturated aqueous NaCl solution that usually includes other cations (Ca, Mg, K) as well as organic compounds and dissolved or exsolved gasses (Roedder, 1984).

An extensive review of the occurrences and geochemistry of fluid inclusions in salt is given by Roedder (1984). Fluid inclusions may be primary (i.e., trapped during the original deposition of the enclosing halite) or secondary, forming after original deposition. Secondary fluid inclusions may form either under near-surface sedimentary conditions, during diagenesis or recrystallization of the primary halite, or during deformation of the evaporite beds. The secondary fluid inclusions may enclose connate brine (syngenetic interstitial water), but the brine may be altered by mixing with other water sources. These sources include both waters of dehydration of hydrated mineral phases and groundwater introduced into the salt. Inclusions may be concentrated in certain horizons or may occur in thin (10's to 100's of micrometers) bands within the salt. Intergranular inclusions probably indicate recrystallization of the salt sometime following original deposition (Roedder, 1984).

The origin of fluid inclusions may be indicated by the geochemistry of the trapped fluid as well as by petrographic details. Disparate fluid compositions among trapped brines in a given unit are frequently noted even between inclusions in close proximity. Some fluid inclusions may contain connate brines while others really contain brines that are the product of mixing or rock-brine interactions (Roedder, 1984). Stein (1985a), and Stein and Krumhansl (1986) have made preliminary studies of fluid inclusions present in the Salado Formation at the WIPP site. Most of the inclusion fluids studied were extracted from the larger, recrystallized halite crystals described in Section 4.1.

Estimates of the amount of brine contained in fluid inclusions at the repository level range from 0.22 weight-percent (Black et al., 1983) to about 0.6 weight-percent (Stein, 1985b). Stein and Krumhansl (1986), came to the preliminary conclusion that the chemistry of the fluid inclusions and the chemistry of the weep and drill hole fluids differed sufficiently to suggest different origins. Additionally, the brines contained within fluid inclusions are not free to migrate into underground openings under a pressure gradient until such inclusions are intersected by fractures, hence the inclusion fluids are not a primary focus of the BSEP.

4.1.3 INTERGRANULAR POROSITY AND OPEN FRACTURES

Brine occurs in the salt of the repository horizon both in hairline fractures, along grain boundaries, and in larger fractures that cut through grains. The latter are much more significant in terms of brine movement through the salt, as some have been observed to be in locations where brine seeps into the underground openings. Fractures up to a few millimeters in width have been observed in freshly excavated surfaces at the facility horizon, 655 meters beneath the surface (Appendix C). The brine is associated with gas, both of which are pressurized and may be responsible for keeping the fractures open prior to mining. It is difficult to obtain good values for the permeability of the porous zones and open fractures in the Salado Formation.

Conventional drill-stem tests performed at WIPP-associated wells generally found that the permeability of the Salado Formation in the vicinity of WIPP was less than the sensitivity limit of the system, i.e., less than 1×10^{-7} darcy. Beauheim et al. (1983) reported field permeability values for the Salado Formation at Cabin Baby-1 of about 9×10^{-9} and 8×10^{-8} darcies, but expressed concern over data interpretations. Specialized testing obtained qualified values in the range of 2.1×10^{-5} to 2.5×10^{-5} darcies for the bulk permeability of the Salado (Peterson et al., 1981; Mercer, 1987).

Peterson et al. (1985) report the results of permeability tests made in the facility horizon at WIPP using pressurized gas. The interpreted data indicated permeabilities ranging from about 10^{-6} to less than 10^{-9} darcies for undisturbed salt. It should be noted that these values were calculated assuming an unsaturated pore volume. As the authors pointed out, "If the volume were partially or fully saturated, so that fluid migration and/or threshold pressure effects were important, the intrinsic formation permeability would be larger than reported."

As discussed in more detail in Section 4.2 below, excavation-induced stress redistributions may cause the permeability of the Salado Formation to increase or decrease with time. The Peterson et al. (1985) field data from the repository level also supports the theoretical prediction that a disturbed zone with increased permeability will develop adjacent to the repository excavations. Conversely, it is possible that at depths comparable to the waste repository and at some distance from the excavation itself, the high lithostatic pressure in combination with brine moisture will likely result in the healing or sintering of open fractures and in the isolation of zones that might yield moisture to the repository excavations. Such fracture healing may also occur after repository closure, sealing, and repressurization. This is discussed further in Section 4.2.1.1.

Brine inflows into the local potash mines were discussed in Section 3.2.2, and are generally of greater total volume than those observed at WIPP. These occurrences are associated with the McNutt potash zone, stratigraphically higher and more complex mineralogically than the WIPP facility level. These inflows occur at shallower depths than at WIPP; it would be expected that the rocks in those mines are subjected to lower lithostatic stress. Greater values for porosity and permeability would be expected in the potash zone in those mines than at the repository horizon at WIPP. The possibility of recharge from the surface may also be more likely near some of the mines.

As previously described, the bedded salt deposits at WIPP contain relatively thin interbeds of anhydrite and clay. These interbeds contain brine in porous zones or open fractures as described above for the salt. They probably have different permeabilities and porosities from the salt and have a strong local effect on both the volume of brine available and the brine flow path.

Brine may occur in interstitial porosity in interbeds or in a fracture system within brittle interbeds, such as anhydrite. Hydrogeologic evidence for brine occurrence in anhydrite Marker Bed 139 was developed by Borns (1985) who described the structure of the marker bed in several zones. In one zone where anhydritic laminae were present, horizontal fractures were found. These fractures were in-filled with polyhalite and halite, indicating past movement of brine through them.

4.1.4 LARGE FRACTURED ZONES ("BRINE RESERVOIRS")

Large fractured zones capable of producing large volumes of brine (millions of liters), referred to as "brine reservoirs," have been encountered while drilling through evaporites in the Permian Basin. A comprehensive study (TSC-D'Appolonia, 1983c) of brine reservoirs in the underlying Castile formation at the WIPP site concluded that the reservoirs occurred in massive anhydrite layers approximately 100 meters thick that had been deformed upward by the underlying salt. The brine-producing zones encountered during drilling are interpreted as a lateral system of open fractures that provide an initially vigorous flow or pressure buildup response, combined with a system of microfractures that provide a slower sustained response.

There is no evidence to indicate that large fractured zones such as these occur in the Salado Formation in proximity to the repository horizon to affect the small, near-field brine inflows discussed in this report. Additionally, the Castile brine reservoirs are stratigraphically isolated from the WIPP repository by more than 230 meters of intervening evaporite beds. At the repository horizon the anhydrite beds in the Salado are much thinner than those in the underlying Castile Formation. There is also no evidence of salt anticline development at the repository horizon that seems to be associated with the large brine producing zones. It is concluded that the source of brine at the repository horizon is not a large-scale brine reservoir.

4.2 BRINE FLOW MECHANISMS

The observations of brine and the brine inflow measurements made previously (Section 3.0) are related to the excavation of an underground repository.

Flow may occur under a hydraulic gradient or under a thermal gradient. Flow may develop through salt and through the anhydrite and clay interbeds. The preliminary data from the BSEP indicate that no single simple set of conditions exists. The observed brine inflows almost certainly reflect a combination of the mechanisms discussed below. The combination of these mechanisms varies in both time and space.

4.2.1 FLOW UNDER A HYDRAULIC GRADIENT

In describing the fluid-flow systems operational under a hydraulic gradient, several stages in the development of the repository are identified by Freeze (1983) (Figure 4-1):

- o Undisturbed flow regime prior to excavation (Stage 1)
- o Transient flow regime during repository excavation and operations (Stage 2)
- o Steady-state flow regime during repository operations (Stage 3)
- o Transient flow regime during repository resaturation (Stage 4)
- o Restoration of hydraulic gradients (Stages 5 and 6)

The first three stages are described below.

Prior to repository construction, there will be an initial steady-state hydraulic potential distribution in the vicinity of the repository (Stage 1). The flow in the undisturbed state could occur both vertically and laterally through the salt, clay interbeds, and interbeds of fractured anhydrite.

The quantity and rate of fluid movement through the Salado Formation under pre-excavation regional hydraulic gradients is small to nonexistent, and is probably not a significant factor in the mechanisms causing the observed inflows into the repository. Moisture does, however, occur in the Salado Formation (Section 4.1). For the purposes of the following discussions of short-term mining-induced transient flow systems, the source of that moisture may not be important, although it may have implications on reservoir characteristics that might determine the total volume of brine that is available for migration into the repository.

During repository construction and operation, a transient flow system (Stage 2) will be set up with flow towards the repository in response to the constant pressure drawdown that occurs at the excavation surface and the increase in permeability caused by stress redistribution near the excavation. Inflows may be evaporated and removed from the excavations by the ventilation system. If the repository is in operation long enough, inflows may become steady-state (Stage 3). If hydraulic gradients become smaller, the flow becomes non-Darcian, or a region develops around the repository where permeability is reduced from pre-excavation values, then inflow may be reduced or cease completely.

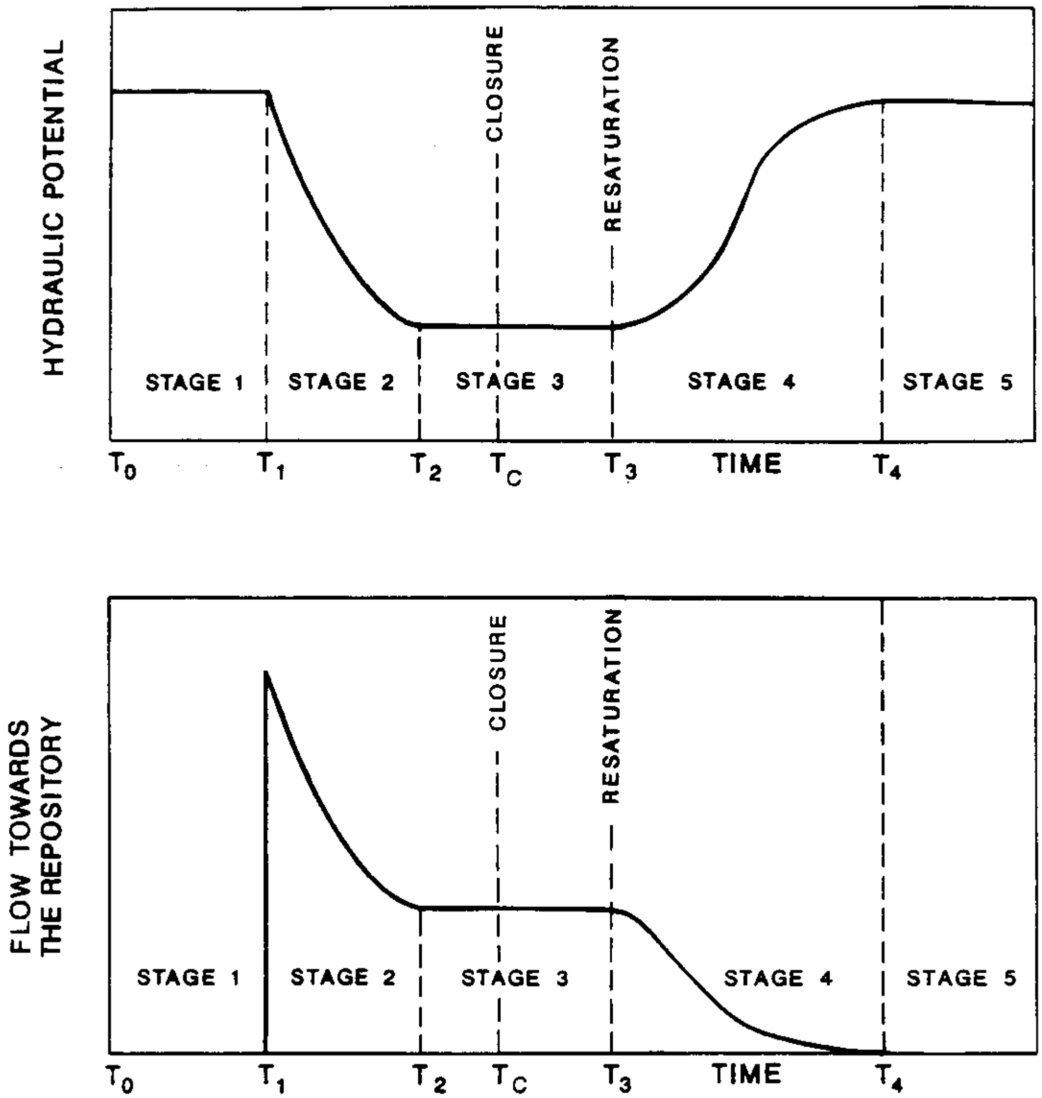


Figure 4-1.

Conceptual Model for Brine Flow Towards a Repository (Modified From Freeze, 1983)

The following discussion addresses flow during repository operations through both undisturbed salt and interbeds (Stage 1) and flow through disturbed salt and interbeds in the vicinity of the excavation (Stages 2 and 3). Disturbance encompasses both the effects of constant pressure drawdown and lithostatic stress relief. Several fluid-flow systems under a pressure gradient are then described.

4.2.1.1 Flow Through Salt

Brine may flow through either the intercrystalline or intracrystalline structure of salt. Owing to the relatively low permeability of individual salt crystals, fluid inclusions within individual crystals may move very slowly, whereas fluid movement occurs more rapidly in the intercrystalline structure of the salt. Case and Kelsall (1985) compiled laboratory and field data which show that the permeability of salt under a wide range of confining pressure ranges from 1 md to 10^{-6} md, while the measurement of the permeability of a single salt crystal was 10^{-9} md (Sutherland and Cave, 1980). It is noted by some investigators (Remson, 1984) that flow rates calculated using traditional transport equations may be too high. We suggest that this may be because the brine exists as a thin film surrounded by a massive salt matrix and that surface forces may become dominant in affecting interstitial flow. The proportionality between flux rate and hydraulic gradient (Darcy's Law) may no longer apply and the flow will occur at a much slower rate. For practical purposes, the brines may be immobile [as suggested by geochemical analysis (Popielak, et al, 1983)], although this immobility has not been proven by hydrologic observation or analysis.

During excavation of the underground facility, the local hydraulic gradient is increased, resulting in brine flow from the adjacent strata to the excavation. Stresses are redistributed in the salt fabric resulting in an increase in permeability. Both these processes would result in an increased brine flow rate. Conversely, as interstitial pressures are relieved, there is compression of the pore space and accelerated creep due to increased effective stress[1]. This, in conjunction with the reduction of the hydraulic gradient with time, will tend to reduce brine inflow rates.

Theoretical studies (Kelsall et al., 1982 and Case and Kelsall, 1985), and field measurements (Peterson et al., 1985) support the existence of a zone of increased permeability as illustrated in Figure 4-2. In the radial direction from the room, the stress has been relieved, resulting in an increase in permeability normal to this direction (Figure 4-3). In the tangential direction, the stresses may increase initially at the room boundary due to the elastic response, and then decrease due to inelastic creep deformations. The permeability may increase or decrease normal to this direction (Figure 4-3).

[1] Effective stress is used in this context as the difference between total stress and pore pressure.

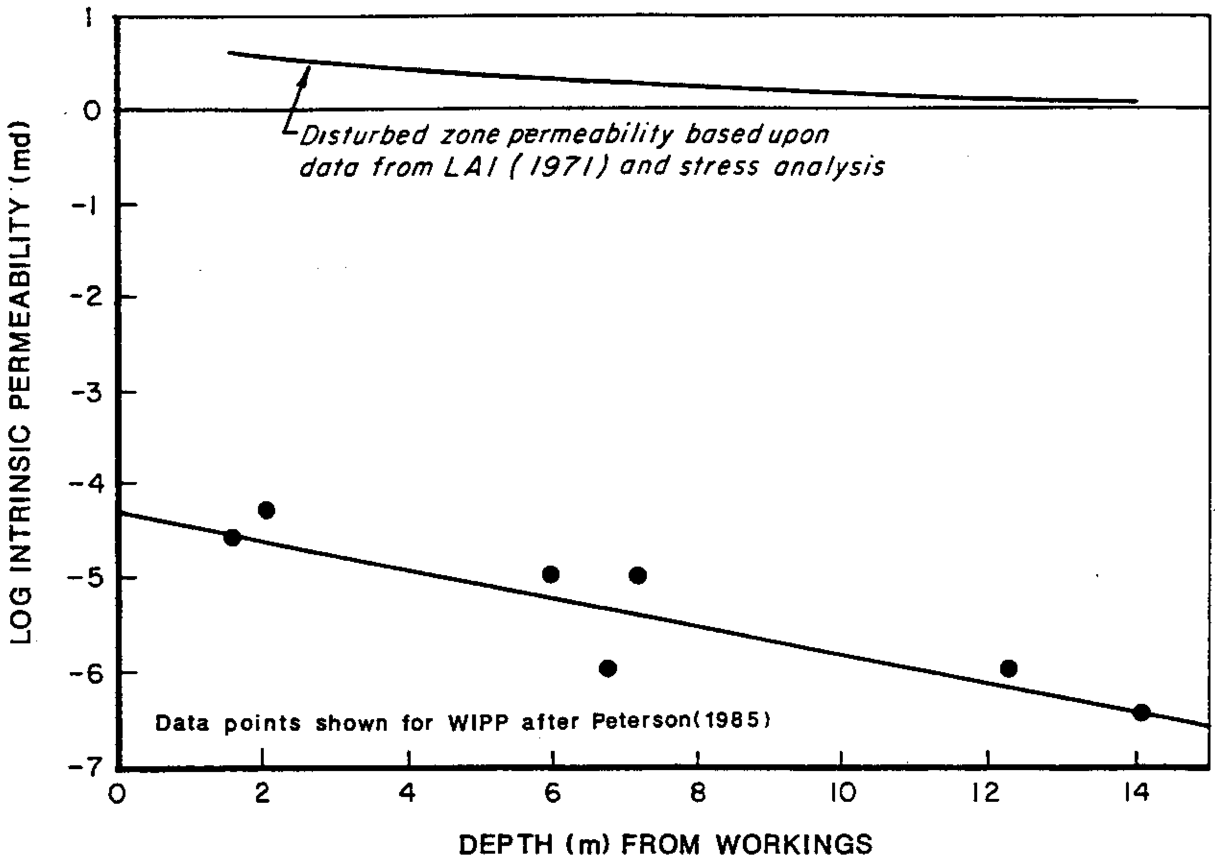


Figure 4-2.

Relationship of Salt Permeability and Depth Near an Excavation
(From Case and Kelsall, 1985)

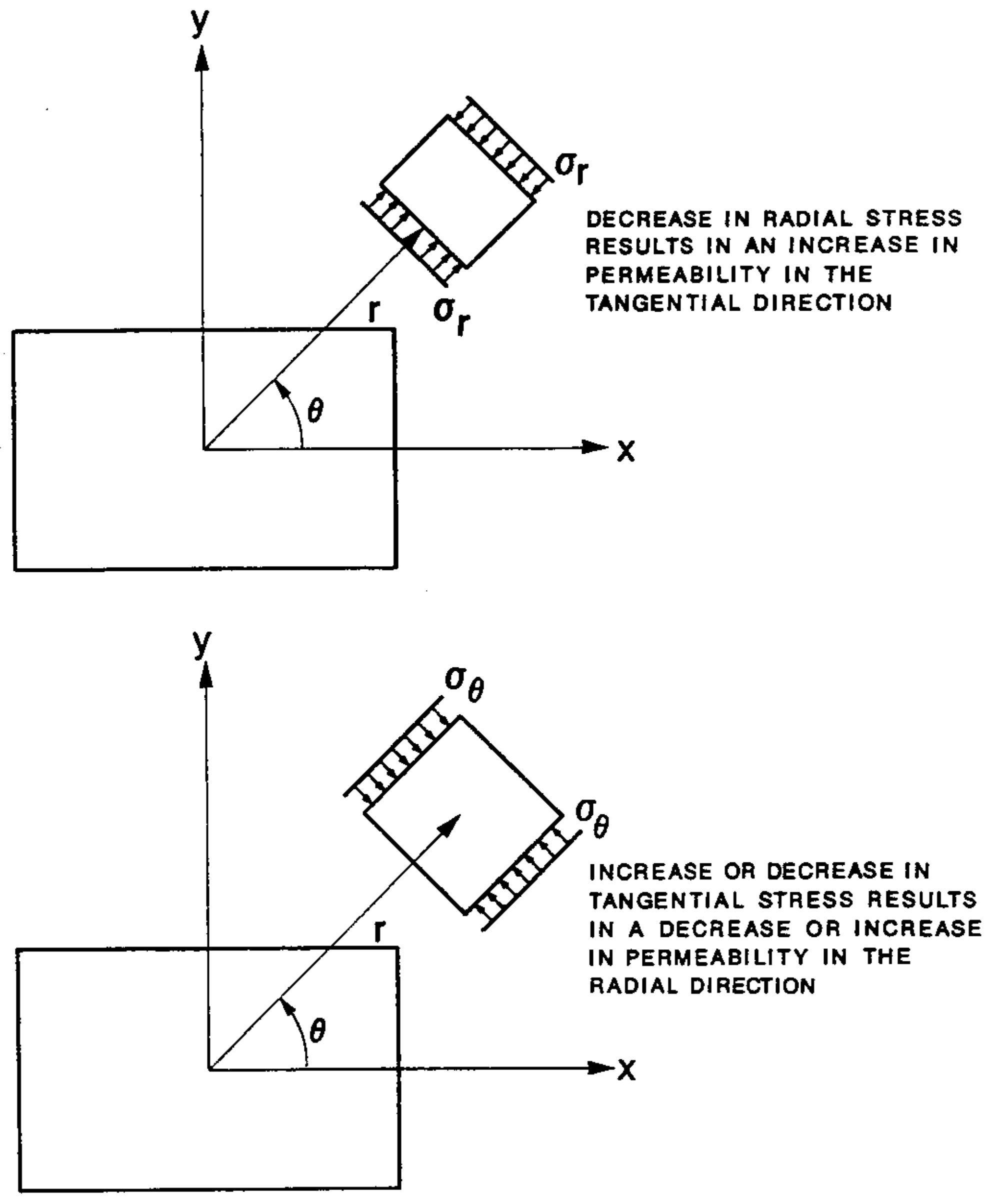


Figure 4-3.

Modification of Permeability in the Radial and Tangential Directions

This modified permeability zone ("disturbed zone") occurs in the immediate vicinity of the excavations and has a width that increases with time, beginning immediately with the excavation of a new opening and continuing until repressurization after closure. In a practical sense, this zone may extend from a few meters to a few tens of meters away from the repository. Evidence regarding this change in permeability around an entry has been obtained using a guarded straddle packer system (Peterson et al., 1985). The tests were performed to determine the permeability of salt, the variation with distance from the mined surface, and the influence of interspersed anhydrite and clay seams. The combined permeability measurements indicate that there is a relationship of permeability with test interval depth. The data indicate that permeability is increased from undisturbed values by two orders of magnitude (10^{-6} to 10^{-4} md) within one to 14 meters of the excavation. This trend is similar to that predicted by Kelsall et al. (1982). Since measurements are made for flow normal to the direction of stress relief, the results are not unexpected.

Predictions of the zone of increased permeability at WIPP are made using the stress-permeability relations developed by Lai (1971). Estimates of the amount of stress relief as a function of depth from the rectangular entry may be made using the relationships developed by Chabannes (1982). Assumptions or simplifications include: 1) that the stress distribution is steady-state, and is based upon the steady-state creep law; 2) that the cross-section of the excavation is circular in a homogeneous stress field; and 3) that the far-field stress is hydrostatic. The predicted results show a trend similar to the <u>in situ</u> data; the calculated values of permeability are four to five orders of magnitude higher. The <u>in situ</u> test results indicate steeper changes in permeability with depth than the predictive analysis. Because the actual stress distribution is probably not steady-state, the excavations are not cylindrical, and other assumptions made for the calculations only approximate actual repository conditions, this difference is not unexpected.

Permeability will also increase due to localized fracturing of intact salt, especially in the disturbed zone (Bechtel National, 1986). In Room 2, a single hole NG252 (Appendix D, Section 3.2.2) which was drilled downward for geomechanical instrumentation has produced a relatively large amount of brine. Brine and gas flow into the hole from a fracture located near the base of the anhydrite Marker Bed 139. As described by Bechtel National (1986), the fractures intersect the interbeds and the salt in the disturbed zone. This fracture or a related fracture is observed in the floor of Room 2, approximately 15 meters from the geomechanics instrument array. It is exposed approximately two meters from the west wall of Room 2 and is observed to extend to almost a meter below the surface to the east. It is expected that this type of fracturing will result in a fracture porosity and permeability in the disturbed zone in the immediate vicinity of the repository that is higher than the laboratory or field measurements described above.

Owing again to the relatively low permeability of individual salt crystals, fluid inclusions within individual crystals may move very slowly, whereas fluid movement occurs more rapidly in the intercrystalline structure. It is postulated that intercrystalline brine flow is primarily responsible for the efflorescence that is common throughout the repository.

Tests to evaluate healing of fractured WIPP salt under renewed confining stress have been conducted by Costin and Wawersik (1980) and by Withiam et al. (1984). Costin and Wawersik took short rod specimens fabricated from intact WIPP salt and loaded these specimens to failure creating a fracture along the axis of the specimen. After fracturing, the specimens were pieced together and subjected to higher temperatures (up to 100°C) and pressures (up to 35MPa) in order to "heal" the fractures. The specimens were then retested to determine the degree of fracture healing. The results indicated that 70 to 80 percent of the original strength was recovered within several days. In more recent permeability tests, Withiam et al. (1984) recovered samples from one foot below the repository horizon and created fractures either by sawing or tensile splitting. The fractures created with a bandsaw were smooth, with no discernible roughness. Fractures created by splitting followed crystal boundaries and cleavage faces, and had a typical roughness amplitude in the range of 5 to 10 mm. Permeability tests were conducted at hydrostatic pressures up to 3,000 psi at room temperature. It was concluded that the reduction of permeability with time, under constant confining pressure, suggested fracture healing.

Laboratory investigations have also established the stress dependency of permeability for intact salt through microfracture healing and reduction in porosity (Sutherland and Cave, 1980). A reduction in porosity and permeability due to salt creep could be a significant factor in limiting the inflow of brine into the repository. We hypothesize that flow of brine and gas toward the repository from the interstitial voids and fractures in undisturbed salt will reduce interstitial pressure, allowing salt creep to close void spaces and increase the tendency for fractures to heal. This may result in lowered porosity and permeability in a zone around the repository outside of the zone of increased permeability discussed above. These effects may, in time, reduce or limit the brine inflow. If this occurs, and a permeability barrier develops naturally around the repository, then it follows that air circulating for a sufficiently long period of time during operations prior to closure of the repository will dry out the workings and slow down the process of resaturation after closure.

The establishment of steady-state flow (Stage 3) through salt would be dependent on the hydrologic characteristics of the salt. Owing to its low permeability, the time frame that the repository is operational, and the nature of recharge, steady-state flow might not be established. The occurrence of brine with dissolved gas in isolated fractures or porous zones in salt may also affect the development of steady-state flow. Before excavation, the fluid pressures in fractures is theoretically equal to the lithostatic state of stress, which at the WIPP repository horizon is approximately 15 MPa. During excavation, the state of stress in the salt near the brine occurrence is relieved. The reduction in stress may result in microfracturing of salt at the excavation-brine/gas occurrence boundary and a flow of brine (and gas) into the underground workings can occur. In such a situation, the brine/gas flow is reduced as the fracture or porous zone is drained.

4.2.1.2 Flow Through Interbeds

Because most interbeds create nearly planar discontinuities, flow paths along or through them tend to be less tortuous than flow paths through massive halite. As a result, flow paths associated with interbeds may provide relatively high permeability zones that may effectively collect intercrystalline fluids and provide a route for brine movement toward the repository. During excavation, a high hydraulic pressure gradient is established and flow may occur where an interbed is intersected by a borehole in the repository. Adjacent to an excavation, the permeability of interbeds may be increased by stress relief, especially if flow is occurring in fractures. Fracturing in the disturbed zone in the immediate proximity to the workings could also occur and provide a route for flow through the salt from an interbed (above the roof or below the floor) to the excavation. Separations on the order of several centimeters have developed in and along interbeds (especially associated with brittle anhydrite zones), many months after excavation (Bechtel National, 1986). Considering flow to a borehole, flow may be greater from interbeds which are close to the roof or floor of the excavation in the zone of maximum stress relief.

Indirect evidence for the effects of excavation may be found by comparing the borehole flow measurements in Rooms A1, A2, A3, 1B, and G. As mentioned previously, the anhydrite Marker Bed 139 is located at a greater depth (seven meters) in Rooms A1 through B. The flow measurements in four floor holes in these rooms form a consistent set of measurements, suggesting that the source of the flow for the four holes is the same relatively undisturbed stratum or series of strata. In contrast, the range of recorded inflow rates in Room G is much wider, perhaps reflecting disturbance, different sources of flow, different flow systems, or more local variability in the geology. For example, the two floor holes that are two meters apart, DH42 and DH42A, exhibit distinctly different flow rates and time rates of change in flow rate.

4.2.2 FLOW UNDER A THERMAL GRADIENT

The migration of brine fluid inclusions may develop along a thermal gradient. In this mechanism, the solubility of salt is temperature-dependent with dissolution occurring on the high temperature side and precipitation on the low temperature side. The fluid inclusion moves toward the higher temperature. In general, migration rates are controlled by temperature, temperature gradient, inclusion shape and size, and the salt crystal microstructure (Olander; 1984, 1985).

There is much experimental evidence for brine migration toward a high temperature source (comparable to a radioactive heat source) [Hohlfelder and Hadley (1979); Gnirk et al., (1981); Jenks and Claiborne (1981); Pigford (1982); Olander (1984, 1985); Olander et al (1982); Roedder (1984) and Clark (1985)]. Roedder (1984) states that there is no evidence of brine migration under normal geothermal gradients. In the underground repository, there is an approximate equilibrium between rock temperature and the repository air temperature, with perhaps a slight rise of temperature into the rock. Any tendency for brine to migrate up-gradient would be overshadowed by relatively high hydraulic gradients resulting in flow toward the repository.

5.0 BRINE SAMPLING AND EVALUATION PROGRAM: CONTINUING EFFORTS

The following investigations are continuing as part of the Brine Sampling and Evaluation Program at WIPP. The results will be presented in later BSEP reports.

- Additional delineation of stratigraphic variations in the brine occurrences.
- Additional delineation of horizontal variations of brine content in the rocks exposed at the facility level.
- Refinement of the data on the loosely-bound brine available for non-thermal migration into the repository.
- Characterization of the chemistry of the naturally-occurring brine that is likely to migrate into the repository.
- Continued monitoring of brine inflow into selected drill holes.
- Continued assessment of the feasibility of using geophysical techniques to define source horizons and the aerial extent of brine occurrences at the repository level.

6.0 SUMMARY

Although the WIPP underground constitutes "dry" workings, small amounts of brine are present, probably on the order of 0.1 to 0.5 percent by weight of the surrounding rocks. Part of that brine can and does migrate into the repository openings in response to transient or pre-existing pressure gradients, independent of thermal gradients. These small volumes of brine have little effect on the day-to-day operations, but are pervasive throughout the repository and may contribute enough moisture over a period of years to merit consideration with regard to resaturation and repressurization.

The inflows that occur as "weeps" on the exposed surfaces have been observed since the initial excavations in 1983. "Weeps" are very small inflows of brine that occur on almost all exposed surfaces and are evidenced by halite efflorescence. Small brine inflows also occur in drill holes. Over 1400 drill holes, most 15 meters or less in length, exist in the WIPP underground. Small quantities of gas are often associated with brine inflows. Gas bubbles are observed in many of the brine occurrences. Gas is also known to exsolve from solution as the brine is poured from container to container.

Measured occurrences have inflow rates that range from less than the rate at which surface moisture is evaporated into the repository atmosphere to approximately 0.5 liters per day. Individual occurrences vary greatly and some drill holes separated by less than a meter have inflows that contrast dramatically, making the discussion of "averages" or "typical occurrences" difficult or misleading. The reasons for this variability are still poorly understood. The inflow at any specific location is influenced by a number of factors, including local stress distribution, local brine sources, variations in local fracturing and permeability, and local variation in the geology. Most occurrences displayed a brief, initial no-flow or low-flow period, followed by maximum inflow. Brine inflow then decreased over a period of several months to relatively steady-state conditions. Some occurrences had increased inflows and some ceased entirely. Most of the noticeable inflow rates range between a few tenths and a few hundredths of a liter per day. The largest individual production measured during this reporting period produced an aggregate over 235 liters of brine, and continues to produce over 0.2 liters per day. It was clearly an unusual and exceptional occurrence and was associated with excavation-induced fracturing. Inflow rates in that drill hole have declined markedly over the observation period.

It should be noted that the brine occurrences discussed here are small and are clearly distinguished from the "brine reservoirs" found in the underlying, stratigraphically lower, and geologically older, Castile Formation in the Delaware Basin. "Brine reservoirs" are measured in hundreds of thousands of liters, flow readily into boreholes that penetrate them, and have been the subject of other investigations (Section 4.1.4).

It is clear from the preliminary data that brine inflow, gas inflow, and salt creep into the workings are intimately associated with each other and that significant pressure-driven brine inflows that are not the result of brine migration in a thermal gradient may occur after sealing and closure of the repository. Brine flow systems are not well understood at this time, but it is likely that the observed inflows are dominated by the response to transient pressure gradients resulting from the excavation of the repository. A component due to regional hydraulic head cannot, at this time, be ruled out.

Brine chemistry data has been collected, but is not reported in this document. Characterization of the near-field brine chemistry continues, and will be included in a future BSEP report.

The major observations may be summarized as:

- o Brine inflows are small, and are not related to large brine reservoirs in the Castile Formation.
- o Brine occurrences, particularly those evidenced as halite efflorescence, are pervasive throughout the WIPP underground workings.
- o Brine inflow rates are low, usually on the order of a few hundredths of a liter per day or less.
- o Although small when measured in terms of liters per day at any given location, cumulative inflow volumes may be significant when measured in terms of the entire repository over periods of many years.
- o There is a considerable variation in brine inflow between locations, even when locations are only a few meters (or, in some instances, less than a meter) apart.
- o Holes that penetrate the roof and floor generally show a pattern of an initial, maximum flow rate that reduces to a fairly steady flow rate over the time period during which measurements have been made.
- o Several flow systems and conditions are possible, but insufficient data exist to select the system and conditions (or combination of several systems and conditions) that best describe the phenomena at WIPP.

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APPENDIX A

PRELIMINARY INVENTORY OF UNDERGROUND DRILL HOLES AT WIPP

EXPLANATION OF FIELDS USED IN THE DATA BASE FOR APPENDIX A and B

Hole Number

This is the designation number that was assigned to the drill hole. A question mark in the hole number field indicates that the number used was an arbitrary number used on a temporary basis by field personnel for a drill hole actually located underground. Additional checking is necessary to unambiguously determine the assigned number.

Room

Room name or number, if the hole is located in a test or experimental room.

North-South and East-West Coordinates

Mine coordinates of the drill hole collar, in feet, referenced to the center of the C&SH Shaft.

Elevation

Elevation of the drill hole collar, in feet, referenced to mean sea level.

Accuracy

Accuracy of the coordinates and elevation data

- A = Approximate
- B = As-Built survey data
- P = As-Planned location data
- D = Duplicate hole record or record of a hole number that should be deleted from the listing of holes. This is usually the result of both a hole number and a separate instrument number being assigned to the same location.

Purpose

The reason the hole was drilled.

- Ae Acoustic Emission
- C Core

CON	Construction-related drilling
CS	Clay-seam sample
DD	Demonstration drilling
EX	Experiment
GT	Gas Testing
HF	Hydrofrac Experiment
HTR	Heater installation
I	Instrument
ID	Instrument demonstration
LT	Lab-testing sample
O	Observation hole
P	Pilot hole
Pr	Pressure-relief hole
RM	Rock mechanics
ST	Stratigraphic analysis
US	Ultra-sonic experiment
WO	Water observation

Direction

General direction of the hole from the underground workings: up, down, north, south, east, or west.

Angle

Angle from the horizontal

Depth

Depth of hole in feet, referenced to the collar.

Diameter

Diameter of the hole in inches.

References

A1 TSC-D'Appolonia, 1983a (WIPP-DOE-163)

A2 Bechtel National, 1984 (WIPP-DOE-202)

A3 Bechtel National, 1985 (WIPP-DOE-213)

B Brine Sampling and Evaluation Program File

C Record of Special Drill Holes, WIPP Facility Horizon, 9/12/83: BSEP Files

D Room A1, A2, A3, and J As-Built Survey Data, Survey Calculation Sheets: BSEP Files

E Field Notes, J. Gallerani, Bechtel: BSEP Files

F Field Notes, D. Deal, IT Corp.: BSEP Files

G Room J Brine Survey: BSEP Files

H Room L1 and L2 Field Notes: BSEP Files

J Geotechnical Instrument List, 11/02/83: BSEP Files

APPENDIX A
PRELIMINARY INVENTORY OF UNDERGROUND DRILL HOLES AT WIPP
1439 Records of Holes Drilled Before July 1985
(NOTE: This List Contains Unchecked Information)

Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
1		N1440	W0557.0	1298.5	A	DD	N	0	16.8	36
2		N1440	W0548.5	1298.5	A	DD	N	0	2.8	36
3		N1440	W0540.7	1298.5	A	DD	N	0	3.0	36
3?1		N1092.5	W0410	1306	A	?	U,S	45?	25+	3
3?2		N1093	W0410	1306	A	?	U,S	45?	25+	4
4		N1440	W0530.7	1298.5	A	DD	N	0	10.4	36
4PD01	4	N1177	W0630.5	1294	A	DD	D	90	9.1	5.12
4PD02	4	N1187	W0630.5	1294	A	DD	D	90	9.1	5.12
4PU	4	N1120	W0630.5	1304	A	DD	U	90	9.3	5
4PU01	4	N1177	W0646	1304	A	DD	U,W	60	14.1	5.12
4PU02	4	N1177	W0630.5	1304	A	DD	U	90	16.2	5.12
4PU03	4	N1187	W0630.5	1304	A	DD	U	90	9.7	5.12
A		S1250	E0140	1262	A	Ae	E	0	15.15	3
A	L2	N1515	W0365	1312.5	A	WO	D	90	12.8	1
A1041	A1	N1190.70	E1258.00	1313.33	B	HTR	D	90	19.9	30
A1042	A1	N1343.30	E1258.01	1313.78	B	HTR	D	90	19.5	30
A1043	A1	N1187.29	E1258.05	1313.10	B	HTR	D	90	20.6	30
A1044	A1	N1349.56	E1258.29	1313.81	B	HTR	D	90	19.2	30
A1045	A1	N1177.97	E1257.96	1313.09	B	HTR	D	90	19.8	36
A1046	A1	N1356.05	E1258.19	1313.60	B	HTR	D	90	19.2	36
A1061	A1	N1199.27	E1257.79	1313.22	B	HTR	D	90	19.8	16
A1062	A1	N1210.58	E1257.99	1313.58	B	HTR	D	90	19.8	16
A1063	A1	N1221.82	E1258.02	1313.54	B	HTR	D	90	19.9	16
A1064	A1	N1233.13	E1258.01	1313.73	B	HTR	D	90	19.9	16
A1065	A1	N1244.38	E1258.03	1313.57	B	HTR	D	90	19.8	16
A1066	A1	N1255.70	E1257.97	1313.33	B	HTR	D	90	20.4	16
A1067	A1	N1266.98	E1258.00	1313.41	B	HTR	D	90	19.8	16
A1068	A1	N1278.28	E1258.00	1313.49	B	HTR	D	90	19.8	16
A1069	A1	N1289.63	E1257.98	1313.80	B	HTR	D	90	19.8	16
A1070	A1	N1300.94	E1257.98	1314.21	B	HTR	D	90	19.8	16
A1071	A1	N1312.25	E1257.99	1314.34	B	HTR	D	90	19.8	16
A1072	A1	N1323.65	E1257.97	1314.06	B	HTR	D	90	20.3	16
A1073	A1	N1334.81	E1258.01	1313.99	B	HTR	D	90	20.1	16
A1095	A1	N1421	E1258.0	1322.3	D,A	I	S	0	172.5	1.88
A1303	A1	N1207.9	E1258.0	1313.5	P	I	U	90	50.75	1.875
A1304	A1	N1207.51	E1258.76	1313.83	B	I	D	90	50.3	1.875
A1305	A1	N1237.49	E1258.73	1331.69	B	I	U	90	50.45	3
A1306	A1	N1237.49	E1258.73	1313.88	B	I	D	90	50.3	3
A1307	A1	N1269.45	E1258.43	1331.50	B	I	U	90	50.4	1.875
A1308	A1	N1269.47	E1258.73	1313.82	B	I	D	90	49	1.875
A1309	A1	N1297.47	E1258.72	1331.83	B	I	U	90	50.5	1.875
A1310	A1	N1297.47	E1258.69	1314.46	B	I	D	90	49.7	1.875
A1311	A1	N1327.42	E1258.73	1331.90	B	I	U	90	50.5	1.875
A1312	A1	N1327.44	E1258.69	1314.41	B	I	D	90	49.1	1.875
A1313	A1	N1364.85	E1258.79	1331.61	B	I	U	90	50.25	1.875
A1314	A1	N1364.96	E1258.78	1313.94	B	I	D	90	49.65	1.875
A1315	A1	N1207.48	E1267.65	1322.64	B	I	E	0	29.8	1.875
A1316	A1	N1207.45	E1249.87	1322.62	B	I	W	0	50.6	1.875
A1316	A1	N1369.45	E1249.73	1322.53	B	I	W	0	47	1.875
A1317	A1	N1269.48	E1267.65	1322.53	B	I	E	0	28	1.875
A1319	A1	N1327.5	E1267.57	1323.02	B	I	E	0	50.3	1.875
A1320	A1	N1327.47	E1249.96	1323.00	B	I	W	0	50.5	1.875
A1321	A1	N1267.54	E1267.71	1328.48	B	I	E	0	59	1.875
A1322	A1	N1267.46	E1249.92	1328.47	B	I	W	0	50.0	1.875
A1323	A1	N1267.50	E1267.50	1316.52	B	I	W	0	50.15	1.875
A1324	A1	N1237.50	E1267.66	1322.90	B	I	E	0	29.65	3
A1325	A1	N1237.45	E1249.87	1322.87	B	I	W	0	49.75	3
A1703	A1	N1218.67	E1258.77	1331.42	B	I	U	90	50.75	1.875
A1704	A1	N1218.70	E1258.77	1313.81	B	I	D	90	50.65	4.875
A1705	A1	N1251.48	E1258.76	1331.62	B	I	U	90	50.0	1.875
A1706	A1	N1251.47	E1248.76	1313.71	B	I	D	90	50.6	1.875
A1707	A1	N1267.41	E1258.77	1331.49	B	I	U	90	50.45	1.875
A1709	A1	N1283.45	E1258.76	1331.54	B	I	U	90	50.25	1.875
A1710	A1	N1283.46	E1258.74	1313.98	B	I	D	90	50.65	1.875

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PRELIMINARY INVENTORY OF UNDERGROUND DRILL HOLES AT WIPP
1439 Records of Holes Drilled Before July 1985
(NOTE: This List Contains Unchecked Information)

Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
A1711	A1	N1316.25	E1258.74	1332.15	B	I	U	90	50.75	1.875
A1712	A1	N1316.26	E1258.77	1314.50	B	I	D	90	50.53	1.875
A1713	A1	N1352.85	E1258.72	1331.61	B	I	U	90	50.4	1.875
A1714	A1	N1352.96	E1258.75	1313.96	B	I	D	90	49.8	1.875
A1717	A1	N1218.67	E1367.68	1322.62	B	I	E	0	29.75	1.875
A1718	A1	N1218.65	E1249.92	1322.65	B	I	W	0	50.4	1.875
A1719	A1	N1251.49	E1267.65	1322.73	B	I	E	0	16.6	1.875
A1721	A1	N1267.50	E1267.62	1330.01	B	I	E	0	16.2	1.875
A1722	A1	N1267.45	E1267.81	1314.94	B	I	E	0	16.0	1.875
A1723	A1	N1267.51	E1250.01	1330.00	B	I	W	0	50.0	1.875
A1724	A1	N1267.43	E1250.25	1314.96	B	I	W	0	50.15	1.875
A1725	A1	N1283.50	E1267.46	1322.83	B	I	E	0	16.0	1.875
A1727	A1	N1316.28	E1267.71	1323.31	B	I	E	0	16.0	1.875
A1728	A1	N1316.27	E1249.90	1323.29	B	I	W	0	50.1	1.875
A1729	A1	N1352.99	E1267.72	1322.68	B	I	E	0	16.55	1.875
A1730	A1	N1352.89	E1249.94	1322.72	B	I	W	0	50.25	1.875
A1731	A1	N1251.43	E1267.24	1331.20	B	I	U,E	45	38	1.875
A1732	A1	N1251.46	E1267.38	1313.87	B	I	D,E	45	37.9	1.875
A1735	A1	N1283.44	E1267.25	1331.18	B	I	U,E	45	37.9	1.875
A1736	A1	N1283.46	E1267.32	1314.22	B	I	D,W	45	37.15	1.875
A1751	A1	N1272.48	E1258.04	1313.62	B	I	D	90	21.5	1.875
A1752	A1	N1275.72	E1258.21	1313.66	B	I	D	90	21.44	1.875
A1753	A1	N1278.17	E1259.24	1313.76	B	I	D	90	21.29	1.875
A1754	A1	N1278.30	E1260.48	1313.75	B	I	D	90	21.27	1.875
A1755	A1	N1278.34	E1263.72	1313.85	B	I	D	90	21.23	1.875
A1756	A1	N1279.66	E1258.01	1313.75	B	I	D	90	21.23	1.875
A1757	A1	N1280.86	E1258.07	1313.86	B	I	D	90	21.48	1.875
A1758	A1	N1283.93	E1258.11	1313.96	B	I	D	90	21.63	1.875
A1759	A1	N1287.04	E1258.03	1313.98	B	I	D	90	21.60	1.875
A1760	A1	N1288.07	E1258.02	1313.99	B	I	D	90	21.60	1.875
A1761	A1	N1289.65	E1252.33	1314.03	B	I	D	90	21.65	1.875
A1762	A1	N1289.60	E1255.47	1314.03	B	I	D	90	21.69	1.875
A1763	A1	N1289.69	E1256.68	1314.02	B	I	D	90	21.73	1.875
A1?1	A1	N1273	E1259	1314	A	I	D	90	21.4	2
A1?2	A1	N1276.5	E1259	1314	A	I	D	90	21.4	2
A1?3	A1	N1278	E1259.8	1313.5	A	I	D	90	21.3	2
A1?4	A1	N1278	E1261.3	1313.5	A	I	D	90	21.3	2
A1?5	A1	N1278	E1264.8	1313.5	A	I	D	90	21.4	2
A1?6	A1	N1260.3	E1258	1313.3	A	I	D	90	1.6	6
A1F41	A1	N1261.39	E1258.01	1313.28	B	C,I	D	90	1.5	6
A1F91	A1	N1295.24	E1258.10	1314.09	B	C,I	D	90	1.5	6
A1X01	A1	N1147.02	E1254.40	1313.26	B	C	D	90	49.75	4
A1X02	A1	N1146.88	E1254.24	1331.29	B	C	U	90	59.0	4
A2001	A2	N1237.49	E1326.65	1328.31	B	I	W	0	59.6	4.0
A2002	A2	N1237.54	E1326.70	1312.28	B	I	W	0	59.9	4.0
A2003	A2	N1237.48	E1344.88	1328.28	B	I	E	0	59.5	4.0
A2004	A2	N1237.55	E1344.74	1312.27	B	I	E	0	59.8	4.0
A2005	A2	N1327.50	E1327.08	1329.15	B	I	U,W		84.1	4.0
A2006	A2	N1237.48	E1326.97	1311.43	B	I	D,W		83.2	4.0
A2007	A2	N1237.56	E1344.75	1329.01	B	I	U,E		93.8	4.0
A2008	A2	N1237.49	E1344.42	1311.57	B	I	D,E		83.6	4.0
A2009	A2	N1275.06	E1326.66	1328.29	B	I	W	0	62.2	4.0
A2010	A2	N1275.02	E1326.76	1312.36	B	I	W	0	59.7	4.0
A2011	A2	N1275.05	E1344.86	1328.43	B	I	E	0	59.7	4.0
A2012	A2	N1275.10	E1344.61	1312.45	B	I	E	0	59.7	4.0
A2013	A2	N1274.99	E1327.10	1329.27	B	I	U,W		84.3	4.0
A2014	A2	N1275.17	E1326.95	1311.71	B	I	D,W		84.0	4.0
A2015	A2	N1275.03	E1344.60	1329.37	B	I	U,E		84.2	4.0
A2016	A2	N1275.10	E1344.53	1311.91	B	I	D,E		83.7	4.0
A2017	A2	N1357.46	E1326.67	1327.77	B	I	W	0	59.3	4.0
A2018	A2	N1357.48	E1326.91	1311.90	B	I	W	0	59.0	4.0
A2019	A2	N1357.49	E1344.89	1327.88	B	I	E	0	58.8	4.0
A2020	A2	N1357.50	E1344.69	1311.96	B	I	E	0	59.6	4.0
A2021	A2	N1357.56	E1327.02	1326.60	B	I	U,W		84.0	4.0

APPENDIX A
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A2022	A2	N1357.55	E1327.10	1311.22	B	I	D,W		83.3	4.0
A2023	A2	N1257.50	E1344.64	1328.78	B	I	U,E		83.4	4.0
A2024	A2	N1357.47	E1344.47	1311.35	B	I	D,E		83.1	4.0
A2031	A2	N1217.90	E1331.24	1311.38	B	HTR	D	90	20.0	30
A2032	A2	N1218.32	E1338.79	1311.91	B	HTR	D	90	20.5	30
A2033	A2	N1225.44	E1331.20	1311.32	B	HTR	D	90	20.8	30
A2034	A2	N1225.78	E1338.93	1311.23	B	HTR	D	90	20.8	30
A2035	A2	N1233.16	E1331.15	1312.01	B	HTR	D	90	20.1	30
A2036	A2	N1233.03	E1338.80	1312.10	B	HTR	D	90	20.2	30
A2037	A2	N1240.66	E1331.21	1311.55	B	HTR	D	90	20.2	30
A2038	A2	N1240.64	E1338.74	1311.61	B	HTR	D	90	20.2	30
A2039	A2	N1248.10	E1331.26	1311.59	B	HTR	D	90	20.1	30
A2040	A2	N1248.17	E1338.78	1311.76	B	HTR	D	90	20.8	30
A2041	A2	N1255.63	E1331.21	1311.70	B	HTR	D	90	20.6	30
A2042	A2	N1255.68	E1338.79	1311.88	B	HTR	D	90	20.6	30
A2043	A2	N1263.04	E1331.28	1311.86	B	HTR	D	90	20.5	30
A2044	A2	N1263.15	E1339.23	1311.93	B	HTR	D	90	20.4	30
A2045	A2	N1270.79	E1331.39	1311.81	B	HTR	D	90	20.2	30
A2046	A2	N1270.77	E1338.78	1312.06	B	HTR	D	90	20.3	30
A2047	A2	N1278.23	E1331.27	1311.89	B	HTR	D	90	20.5	30
A2048	A2	N1278.14	E1338.82	1311.96	B	HTR	D	90	20.5	30
A2049	A2	N1285.73	E1331.22	1311.90	B	HTR	D	90	21.0	30
A2050	A2	N1285.60	E1338.73	1312.04	B	HTR	D	90	21.0	30
A2051	A2	N1292.97	E1331.27	1311.76	B	HTR	D	90	20.2	30
A2052	A2	N1293.34	E1338.72	1311.94	B	HTR	D	90	20.1	30
A2053	A2	N1300.84	E1331.23	1311.78	B	HTR	D	90	20.7	30
A2054	A2	N1300.54	E1338.81	1311.79	B	HTR	D	90	19.8	30
A2055	A2	N1308.30	E1331.22	1311.60	B	HTR	D	90	20.4	30
A2056	A2	N1308.21	E1338.82	1311.82	B	HTR	D	90	21.0	30
A2057	A2	N1315.72	E1331.18	1311.39	B	HTR	D	90	19.8	30
A2058	A2	N1315.69	E1338.79	1311.91	B	HTR	D	90	20.5	30
A2076	A2	N1210.76	E1331.21	1310.69	B	HTR	D	90	20.7	16
A2077	A2	N1210.66	E1338.80	1311.26	B	HTR	D	90	20.4	16
A2078	A2	N1323.35	E1331.23	1311.83	B	HTR	D	90	20.2	16
A2079	A2	N1323.32	E1338.76	1311.99	B	HTR	D	90	20.1	16
A2085	A3	N1420.19	E1348.67	1315.48	B					
A2086	A2	N1420.13	E1353.74	1315.39	B					
A2095	A2	N1421	E1335	1322	D,A	I	S	0	202	1.88
A2331	A2	N1175.45	E1335.74	1328.79	B	I	U	90	50.1	1.875
A2331A	A2				D					
A2332	A2	N1175.58	E1335.77	1310.55	B	I	D	90	50.35	1.875
A2332A	A2				D					
A2333	A2	N1207.44	E1335.76	1329.06	B	I	U	90	50.1	1.875
A2334	A2	N1207.54	E1335.78	1310.75	B	I	D	90	50.1	1.875
A2335	A2	N1237.50	E1335.77	1329.31	B	I	U	90	50.3	3.0
A2336	A2	N1237.50	E1335.77	1311.11	B	I	D	90	50.37	3.0
A2337	A2	N1269.06	E1335.73	1330.39	B	I	U	90	50.3	1.875
A2338	A2	N1269.51	E1335.80	1311.85	B	I	D	90	50.3	1.875
A2339	A2	N1297.47	E1335.73	1329.44	B	I	U	90	50.2	1.875
A2340	A2	N1297.53	E1335.73	1311.02	B	I	D	90	49.4	1.875
A2341	A2	N1327.61	E1335.81	1329.61	B	I	U	90	50.2	1.875
A2342	A2	N1327.56	E1335.82	1311.84	B	I	D	90	50.4	1.875
A2343	A2	N1357.49	E1335.75	1328.73	B	I	U	90	50.4	1.875
A2344	A2	N1357.42	E1335.85	1311.10	B	I	D	90	47.1	1.875
A2345	A2	N1207.50	E1344.69	1319.92	B	I	E	0	30.4	1.875
A2346	A2	N1207.50	E1326.80	1319.85	B	I	W	0	29.8	1.875
A2347	A2	N1269.52	E1344.63	1320.63	B	I	E	0	30.1	1.875
A2348	A2	N1269.52	E1326.89	1320.64	B	I	W	0	30.1	1.875
A2349	A2	N1327.61	E1344.62	1320.58	B	I	E	0	30.1	1.875
A2350	A2	N1327.58	E1335.86	1320.67	B	I	W	0	29.8	1.875
A2351	A2	N1204.50	E1344.73	1319.43	B	I	E	0	55.8	1.875
A2352	A2	N1204.48	E1326.91	1326.91	B	I	W	0	56.3	1.875
A2353	A2	N1267.53	E1344.55	1320.64	B	I	E	0	56.1	1.875
A2354	A2	N1267.45	E1326.85	1320.69	B	I	W	0	56.0	1.875

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Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
A2355	A2	N1329.49	E1344.64	1320.62	B	I	E	0	56.5	1.875
A2356	A2	N1329.48	E1326.88	1320.65	B	I	W	0	56.5	1.875
A2357	A2	N1237.52	E1344.62	1320.30	B	I	E	0	30.1	3.0
A2358	B	N1237.56	E1326.82	1320.24	B	I	W	0	30.3	3.0
A2393	A2	N1267.59	E1344.57	1314.65	B	I	E	0	68.4	1.875
A2394	A2	N1267.53	E1326.75	1314.64	B	I	W	0	68.6	1.875
A2531	A2	N1265.96	E1335.77	1329.38	B	I	U	90	50.3	1.875
A2532	A2	N1263.06	E1335.76	1329.39	B	I	U	90	16.2	1.875
A2533	A2	N1264.43	E1335.76	1329.38	B	I	U	90	4.8	1.875
A2534	A2	N1266.10	E1335.76	1311.91	B	I	D	90	50.3	1.875
A2535	A2	N1263.07	E1335.74	1311.93	B	I	D	90	16.4	1.875
A2536	A2	N1264.54	E1335.77	1311.80	B	I	D	90	4.10	1.875
A2537	A2	N1326.06	E1335.79	1329.55	B	I	U	90	50.0	1.890
A2538	A2	N1323.08	E1335.80	1329.54	B	I	U	90	16.3	1.890
A2539	A2	N1324.59	E1335.79	1329.58	B	I	U	90	4.10	1.890
A2540	A2	N1326.04	E1335.78	1311.68	B	I	D	90	48.5	1.875
A2541	A2	N1323.05	E1335.79	1311.94	B	I	D	90	16.5	1.875
A2542	A2	N1324.55	E1335.79	1311.84	B	I	D	90	4.3	1.875
A2543	A2	N1209.09	E1344.67	1319.80	B	I	E	0	32.6	1.50
A2546	A2	N1209.01	E1326.81	1319.88	B	I	W	0	33.0	1.50
A2549	A2	N1266.00	E1344.56	1320.61	B	I	E	0	29.8	1.875
A2550	A2	N1262.97	E1344.63	1320.68	B	I	E	0	16.6	1.875
A2551	A2	N1264.63	E1344.64	1319.62	B	I	E	0	4.9	1.875
A2552	A2	N1265.98	E1326.78	1320.67	B	I	W	0	29.9	1.875
A2553	A2	N1262.99	E1326.85	1320.63	B	I	W	0	16.4	1.875
A2554	A2	N1264.50	E1326.88	1320.62	B	I	W	0	4.7	1.875
A2555	A2	N1326.06	E1344.52	1320.66	B	I	E	0	29.0	1.875
A2556	A2	N1323.07	E1344.58	1320.71	B	I	E	0	16.5	1.875
A2557	A2	N1324.52	E1344.61	1320.67	B	I	E	0	5.2	1.875
A2558	A2	N1326.04	E1326.90	1320.63	B	I	W	0	30.0	1.875
A2559	A2	N1323.06	E1326.86	1320.61	B	I	W	0	16.0	1.875
A2560	A2	N1324.57	E1326.86	1320.67	B	I	W	0	4.9	1.875
A2803	A2	N1218.75	E1335.80	1329.14	B	I	U	90	50.5	1.875
A2804	A2	N1218.71	E1335.72	1311.32	B	I	D	90	50.4	1.875
A2805	A2	N1251.50	E1335.83	1329.23	B	I	U	90	50.3	1.875
A2806	A2	N1251.59	E1335.76	1311.60	B	I	D	90	50.3	1.875
A2807	A2	N1267.52	E1335.79	1329.28	B	I	U	90	50.4	1.875
A2808	A2	N1267.61	E1335.80	1311.85	B	I	D	90	50.25	1.875
A2809	A2	N1283.43	E1335.79	1329.31	B	I	U	90	50.2	1.875
A2810	A2	N1282.97	E3894.28	1312.32	B	I				
A2810	A2	N1283.53	E1335.79	1311.86	B	I	D	90	50.5	1.875
A2811	A2	N1316.42	E1335.79	1324.60	B	I	U	90	50.2	1.875
A2812	A2	N1316.41	E1335.77	1311.71	B	I	D	90	50.35	1.875
A2813	A2	N1349.43	E1335.81	1328.86	B	I	U	90	50.3	1.875
A2814	A2	N1349.49	E1335.79	1311.20	B	I	D	90	50.8	1.875
A2817	A2	N1218.72	E1344.53	1320.22	B	I	E	0	30.0	1.875
A2818	A2	N1218.74	E1326.93	1320.19	B	I	W	0	29.9	1.875
A2819	A2	N1251.51	E1344.64	1320.47	B	I	E	0	29.85	1.875
A2820	A2	N1251.50	E1326.84	1320.49	B	I	W	0	29.9	1.875
A2821	A2	N1267.47	E1344.60	1328.10	B	I	E	0	29.7	1.875
A2822	A2	N1267.55	E1344.39	1313.13	B	I	E	0	30.02	1.875
A2823	A2	N1267.49	E1326.87	1328.14	B	I	W	0	29.8	1.875
A2824	A2	N1267.53	E1326.90	1313.12	B	I	W	0	30.0	1.875
A2825	A2	N1283.58	E1344.66	1320.52	B	I	E	0	29.9	1.875
A2826	A2	N1287.47	E1326.87	1320.59	B	I	W	0	30.0	1.875
A2827	A2	N1316.29	E1344.57	1320.55	B	I	E	0	29.87	1.875
A2828	A2	N1316.39	E1326.79	1320.58	B	I	W	0	29.8	1.875
A2829	A2	N1349.51	E1344.48	1320.03	B	I	E	0	30.1	1.875
A2830	A2	N1289.29	E1338.89	1321.09	B	I				
A2830	A2	N1349.50	E1326.94	1319.95	B	I	W	0	29.7	1.875
A2831	A2	N1251.50	E1344.35	1329.08	B	I	U,E		50.3	1.875
A2832	A2	N1251.63	E1344.27	1312.15	B	I	D,E		50.1	1.875
A2833	A2	N1251.50	E1327.41	1329.02	B	I	U,W		50.25	1.875
A2834	A2	N1251.58	E1327.19	1311.94	B	I	D,W		50.25	1.875

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A2835	A2	N1283.52	E1344.41	1329.13	B	I	U,E		50.02	1.875
A2836	A2	N1283.73	E1344.12	1312.30	B	I	D,E		49.8	1.875
A2837	A2	N1283.57	E1327.32	1329.07	B	I	U,W		50.25	1.875
A2838	A2	N1283.55	E1327.28	1312.06	B	I	D,W		50.1	1.875
A2839	A2	N1251.58	E1339.45	1311.61	B	I	D,E		49.08	1.875
A2840	A2	N1267.99	E1339.47	1314.51	B	I	D,E		49.0	1.875
A2841	A2	N1282.93	E3902.96	1311.32	B	I				
A2841	A2	N1283.55	E1339.40	1312.00	B	I	D,E		50.3	1.875
A2851	A2	N1278.26	E1333.15	1312.17	B	I				
A2852	A2	N1278.32	E1336.77	1312.01	B	I				
A2854	A2	N1278.33	E1340.80	1312.10	B	I				
A2855	A2	N1278.38	E1342.46	1311.96	B	I				
A2857	A2	N1280.29	E1336.77	1312.24	B	I				
A2858	A2	N1280.34	E1331.20	1312.04	B	I				
A2859	A2	N1280.27	E1338.83	1312.19	B	I				
A2860	A2	N1288.96	E1334.84	1317.05	B	I				
A2861	A2	N1282.10	E1334.97	1312.16	B	I				
A2862	A2	N1282.05	E3903.21	1312.15	B	I				
A2863	A2	N1283.85	E1331.21	1312.05	B	I				
A2864	A2	N1283.84	E1338.81	1312.22	B	I				
A2865	A2	N1283.86	E1333.19	1312.02	B	I				
A2866	A2	N1283.71	E1336.82	1312.10	B	I				
A2868	A2	N1285.77	E1333.17	1312.10	B	I				
A2869	A2	N1285.87	E1334.94	1312.09	B	I				
A2870	A2	N1285.85	E1336.84	1312.21	B	I				
A2873	A2	N1285.74	E1340.83	1312.21	B	I				
A2874	A2	N1285.75	E1342.48	1312.26	B	I				
A2877	A2	N1287.88	E1331.20	1313.48	B	I				
A2878	A2	N1287.76	E1338.85	1321.05	B	I				
A2879	A2	N1289.62	E1331.26	1313.47	B	I				
A2F41	A2	N1274.65	E1334.77	1311.85	B	C,I	D	90	1.5	6
A2F45	A2	N1278.40	E1334.95	1311.93	B	C,I	D	90	1.5	6
A2F91	A2	N1274.43	E1338.76	1311.83	B	C,I	D	90	1.5	6
A2F95	A2	N1281.89	E1329.68	1311.88	B	C,I	D	90	1.5	6
A2US1	A2	N1300.02	E1343.81	1314.54	B	US				
A2X01	A2	N1393.72	E1338.88	1311.20	B	C	D	90	50.15	4
A2X02	A2	N1393.65	E1338.89	1328.86	B	C	U	90	52.75	4
A2X50	A2	N1177.41	E1335.76	1329.04	B	I	U	90	50.6	1.875
A2X51	A2	N1177.37	E1335.67	1310.31	B	I	D	90	50.2	1.875
A3082	A3	N1176.74	E1411.97	1309.65	B	HTR	D	90	20.4	16
A3083	A3	N1188.14	E1411.97	1309.77	B	HTR	D	90	20.0	16
A3084	A3	N1199.33	E1411.96	1309.54	B	HTR	D	90	21.6	16
A3085	A3	N1210.61	E1412.03	1309.31	B	HTR	D	90	20.8	16
A3085D		N1421	E1426	131.5	A	Ae	S	0	127.1	3.88
A3086	A3	N1221.79	E1411.95	1309.32	B	HTR	D	90	20.8	16
A3086D		N1421	E1431	1317.5	A	Ae	S	0	127.2	3.88
A3087	A3	N1233.07	E1411.96	1309.46	B	HTR	D	90	20.8	16
A3087D	A3	N1421	E1436	1317.5	A	Ae	S	0	127.2	3.88
A3088	A3	N1244.36	E1411.92	1309.59	B	HTR	D	90	21.0	16
A3089	A3	N1255.71	E1411.94	1309.49	B	HTR	D	90	20.6	16
A3090	A3	N1266.91	E1411.90	1309.74	B	HTR	D	90	20.0	16
A3091	A3	N1278.36	E1411.91	1309.99	B	HTR	D	90	20.3	16
A3092	A3	N1289.72	E1411.99	1309.77	B	HTR	D	90	20.1	16
A3093	A3	N1300.86	E1412.00	1310.01	B	HTR	D	90	20.2	16
A3094	A3	N1312.15	E1411.90	1309.73	B	HTR	D	90	20.2	16
A3095	A3	N1323.40	E1411.96	1309.70	B	HTR	D	90	20.5	16
A3095D	A3	N1421	E1412	1322	D,A	I	S	0	115.2	1.88
A3096	A3	N 334.55	E1411.91	1309.64	B	HTR	D	90	20.3	16
A3097	A3	N1345.77	E1411.97	1309.54	B	HTR	D	90	20.7	16
A3098	A3	N1357.10	E1411.97	1309.16	B	HTR	D	90	20.6	16
A3363	A3	N1207.41	E1412.76	1327.19	B	I	U	90	50.0	1.875
A3364	A3	N1307.45	E1412.71	1309.64	B	I	D	90	50.2	1.875
A3365	A3	N1237.51	E1412.66	1327.21	B	I	U	90	50.1	3
A3366	A3	N1237.47	E1412.81	1309.65	B	I	D	90	50.0	3

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Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
A3367	A3	N1267.48	E1412.75	1327.55	B	I	U	90	60.2	1.875
A3368	A3	N1267.41	E1412.76	1310.03	B	I	D	90	50.0	1.875
A3369	A3	N1397.44	E1412.75	1327.78	B	I	U	90	50.4	1.875
A3370	A3	N1397.46	E1412.78	1310.19	B	I	D	90	49.3	1.875
A3371	A3	N1327.43	E1412.70	1327.47	B	I	U	90	50.6	1.875
A3372	A3	N1327.41	E1412.78	1309.77	B	I	D	90	51.5	1.875
A3373	A3	N1363.38	E1412.74	1327.01	B	I	U	90	50.9	1.875
A3374	A3	N1363.38	E1412.77	1309.36	B	I	D	90	50.2	1.875
A3375	A3	N1207.45	E1421.66	1318.49	B	I	E	0	50.2	1.875
A3376	A3	N1207.43	E1403.86	1318.43	B	I	W	0	29.8	1.875
A3377	A3	N1269.54	E1421.61	1318.82	B	I	E	0	50.2	1.875
A3378	A3	N1269.50	E1403.90	1318.94	B	I	W	0	30.0	1.875
A3379	A3	N1327.54	E1421.20	1318.97	B	I	E	0	51.3	1.875
A3380	A3	N1327.49	E1403.87	1318.93	B	I	W	0	30.8	1.875
A3381	A3	N1269.48	E1421.52	1312.77	B	I	E	0	50.1	1.875
A3382	A3	N1267.52	E1403.96	1324.81	B	I	W	0	58.8	1.875
A3383	A3	N1237.5	E1403.81	1318.48	B	I	W	0	29.9	3
A3384	A3	N1237.44	E1421.50	1318.54	B	I	E	0	50.2	3
A3579	A3	N1265.97	E1421.63	1318.68	B	I	E	0	50.3	1.5 s
A3580	A3	N1262.98	E1421.59	1318.70	B	I	E	0	19.6	1.5 s
A3581	A3	N1264.51	E1421.57	1318.66	B	I	E	0	7.8	1.5 s
A3583	A3	N1262.98	E1403.85	1318.63	B	I	W	0	19.5	1.5 s
A3584	A3	N1264.51	E1403.85	1318.70	B	I	W	0	7.8	1.5 s
A3903	A3	N1218.63	E1412.70	1327.07	B	I	U	90	50.4	1.875
A3904	A3	N1218.67	E1412.74	1309.59	B	I	D	90	50.0	1.875
A3905	A3	N1251.52	E1412.74	1327.23	B	I	U	90	50.2	1.875
A3906	A3	N1251.46	E1412.77	1309.72	B	I	D	90	50.4	1.875
A3907	A3	N1267.50	E1412.72	1327.59	B	I	U	90	50.3	1.875
A3909	A3	N1283.47	E1412.71	1327.76	B	I	U	90	50.4	1.875
A3910	A3	N1283.49	E1412.74	1310.23	B	I	D	90	50.1	1.875
A3911	A3	N1316.24	E1412.77	1327.55	B	I	U	90	50.5	1.875
A3912	A3	N1316.24	E1412.77	1309.97	B	I	D	90	50.4	1.875
A3913	A3	N1349.50	E1412.92	1326.92	B	I	U	90	50.4	1.875
A3914	A3	N1349.40	E1412.71	1309.51	B	I	D	90	50.8	1.875
A3917	A3	N1218.67	E1421.61	1318.37	B	I	E	0	50.2	1.875
A3918	A3	N1218.62	E1403.82	1318.37	B	I	W	0	30.1	1.875
A3919	A3	N1251.52	E1403.91	1318.55	B	I	E	0	50.4	1.875
A3920	A3	N1251.54	E1403.96	1318.54	B	I	W	0	16.4	1.875
A3921	A3	N1268.46	E1421.40	1326.34	B	I	E	0	50.5	1.875
A3922	A3	N1267.42	E1421.50	1311.36	B	I	E	0	50.4	1.875
A3923	A3	N1267.50	E1404.01	1326.36	B	I	W	0	29.0	1.875
A3924	A3	N1267.53	E1403.90	1311.34	B	I	W	0	29.9	1.875
A3925	A3	N1283.48	E1421.60	1318.95	B	I	E	0	51.5	1.875
A3926	A3	N1283.48	E1403.97	1319.01	B	I	W	0	16.3	1.875
A3927	A3	N1316.24	E1421.60	1318.90	B	I	E	0	50.0	1.875
A3928	A3	N1316.30	E1403.88	1318.88	B	I	W	0	30.2	1.875
A3929	A3	N1349.41	E1421.59	1318.34	B	I	E	0	50.0	1.875
A3930	A3	N1349.51	E1404.02	1318.31	B	I	W	0	29.1	1.875
A3931	A3	N1253.50	E1420.87	1326.89	B	I	D,E	45	50.0	1.875
A3931A	A3				D					
A3931A	A3				D					
A3932	A3	N1251.52	E1421.18	1310.16	B	I	D,E	45	50.9	1.875
A3933	A3	N1253.55	E1404.28	1326.98	B	I	U,W	45	38.1	1.875
A3934	A3	N1251.43	E1404.28	1310.07	B	I	D,W	45	37.4	1.875
A3935	A3	N1283.49	E1421.12	1327.36	B	I	U,E	45	50.3	1.875
A3936	A3	N1287.51	E1421.18	1310.44	B	I	D,E	45	50.3	1.875
A3937	A3	N1283.54	E1404.28	1327.38	B	I	U,W	45	38.3	1.875
A3938	A3	N1283.53	E1404.27	1310.50	B	I	D,E	45	37.8	1.875
A3939	A3	N1251.42	E1409.12	1309.66	B	I	D,W	62.5	50.2	1.875
A3940	A3	N1267.39	E1409.10	1309.91	B	I	D,W	62.5	50.7	1.875
A3941	A3	N1282.96	E1408.36	1310.13	B	I	D,W	62.5	50.5	1.875
A3951	A3	N1272.57	E1411.98	1310.10	B	I	D	90	22.92	1.875
A3952	A3	N1275.80	E1411.98	1310.28	B	I	D	90	23.04	1.875
A3953	A3	N1277.14	E1411.87	1310.23	B	I	D	90	22.77	1.875

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Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
A3954	A3	N1278.26	E1406.56	1310.31	B	I	D	90	22.20	1.875
A3955	A3	N1278.18	E1409.53	1310.23	B	I	D	90	22.20	1.875
A3956	A3	N1278.21	E1410.76	1310.21	B	I	D	90	21.23	1.875
A3957	A3	N1277.93	E1413.14	1310.23	B	I	D	90	22.93	1.875
A3958	A3	N1278.29	E1414.39	1310.20	B	I	D	90	23.08	1.875
A3959	A3	N1278.25	E1417.64	1310.24	B	I	D	90	22.00	1.875
A3960	A3	N1279.52	E1411.99	1310.14	B	I	D	90	23.07	1.875
A3961	A3	N1280.78	E1411.87	1310.11	B	I	D	90	23.05	1.875
A3962	A3	N1283.82	E1411.83	1310.07	B	I	D	90	22.20	1.875
A3963	A3	N1287.09	E1412.05	1310.20	B	I	D	90	22.34	1.875
A3964	A3	N1288.01	E1411.88	1310.07	B	I	D	90	22.54	1.875
A3965	A3	N1289.43	E1406.41	1310.11	B	I	D	90	22.44	1.875
A3966	A3	N1289.49	E1409.48	1310.11	B	I	D	90	22.60	1.875
A3967	A3	N1289.52	E1410.65	1310.15	B	I	D	90	22.54	1.875
A3968	A3	N1289.59	E1413.24	1310.12	B	I	D	90	22.65	1.875
A3969	A3	N1289.59	E1414.40	1310.15	B	I	D	90	22.65	1.875
A3970	A3	N1289.55	E1417.59	1310.20	B	I	D	90	22.73	1.875
A3971	A3	N1290.86	E1411.99	1310.20	B	I	D	90	22.58	1.875
A3972	A3	N1292.24	E1411.94	1310.08	B	I	D	90	22.50	1.875
A3973	A3	N1295.39	E1411.99	1310.13	B	I	D	90	22.48	1.875
A3974	A3	N1283.85	E1406.35	1310.32	B	I	D	90	22.94	1.875
A3975	A3	N1283.91	E1417.59	1310.11	B	I	D	90	22.59	1.875
A3981A	A3				D					
A3US1	A3	N1300.31	E1420.92	1312.22	B	US				
A3US2	A3	N1298.03	E1420.96	1313.92	B	US				
A3US3	A3	N1296.06	E1420.99	1313.85	B	US				
A3X01	A3	N1125	E1408	1309	A	C	D	90	50.5	4
A3X02	A3	N1125	E1408	1327	A	C	U	90	50.75	4
A3X57	A3	N1351.49	E1421.06	1329.04	B	I	U,E	45	50.3	1.875
A3X58	A3	N1251.49	E1404.19	1327.07	B	I	U,W	45	37.3	1.875
A3X59	A3	N1267.48	E1421.61	1312.84	B	I	E	0	50.3	1.875
B		S1246	E0140	1266	A	Ae	E	0	15.1	3
B	L2	N1515	W0365	1312.5	A	WO	D	90	13.0	1
B001	B	N1259.21	E0969.63	1334.72	B	I	W	0	50.4	4.0
B002	B	N1259.27	E0969.88	1318.72	B	I	W	0	50.3	4.0
B003	B	N1258.79	E0989.88	1334.66	B	I	E	0	50.25	4.0
B004	B	N1259.26	E0987.84	1318.71	B	I	E	0	50.2	4.0
B005	B	N1259.23	E0970.00	1335.41	B	I	U,W	45	50.35	4.0
B006	B	N1259.24	E0970.09	1318.06	B	I	D,W	45	50.15	4.0
B007	B	N1259.26	E0987.40	1335.31	B	I	U,E	45	50.5	4.0
B008	B	N1259.21	E0987.45	1318.01	B	I	D,E	45	50.4	4.0
B009	B	N1276.53	E0969.77	1334.57	B	I	W	0?	50.1	4.0
B010	B	N1276.53	E0969.92	1318.59	B	I	W	0?	50.4	4.0
B011	B	N1276.63	E0987.62	1334.62	B	I	E	0?	50.6	4.0
B012	B	N1276.55	E0988.06	1318.62	B	I	E	0?	50.2	4.0
B013	B	N1276.49	E0970.08	1335.29	B	I	U,W	45	50.1	4.0
B014	B	N1276.52	E0970.22	1318.10	B	I	D,W	45	50.2	4.0
B015	B	N1276.53	E0987.53	1335.43	B	I	U,E	45	50.4	4.0
B016	B	N1276.61	E0987.53	1317.84	B	I	D,E	45	54.97	4.0
B020	B	N1232.57	E0977.97	1317.93	B	HTR	D	90	18.0	16
B021	B	N1242.79	E0978.01	1317.66	B	HTR	D	90	18.5	16
B022	B	N1252.38	E0977.94	1317.78	B	HTR	D	90	18.4	16
B023	B	N1262.45	E0977.94	1317.73	B	HTR	D	90	18.4	16
B024	B	N1272.30	E0978.01	1317.73	B	HTR	D	90	18.0	16
B025	B	N1282.28	E0977.96	1317.84	B	HTR	D	90	17.9	16
B026	B	N1292.31	E0977.99	1317.90	B	HTR	D	90	18.2	16
B027	B	N1302.18	E0977.94	1317.93	B	HTR	D	90	18.1	16
B030	B	N1227.20	E0977.93	1318.00	B	HTR	D	90		16
B031	B	N1237.38	E0978.01	1317.86	B	HTR	D	90	18.3	16
B032	B	N1247.56	E0978.00	1317.77	B	HTR	D	90		
B033	B	N1257.43	E0978.02	1317.70	B	HTR	D	90		16
B034	B	N1267.43	E0977.99	1317.79	B	HTR	D	90	18.5	16
B035	B	N1277.29	E0977.94	1317.83	B	HTR	D	90	18.0	16
B036	B	N1287.37	E0977.98	1317.73	B	HTR	D	90	18.0	16

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B037	B	N1297.27	E0977.94	1318.00	B	HTR	D	90	18.3	16
B038	B	N1307.09	E0978.07	1317.89	B	I	D	90	18.3	16
B041	B	N1220.36	E0974.20	1317.86	B	I	D	90	18.7	16
B042	B	N1314.33	E0974.18	1317.78	B	I	D	90	18.4	36
B043	B	N1220.91	E0981.69	1317.93	B	I	D	90	18.5	36
B044	B	N1314.21	E0981.83	1317.96	B	I	D	90	17.4	36
B045	B	N1212.44	E0974.16	1317.58	B	I	D	90	17.7	36
B046	B	N1322.32	E0974.24	1317.84	B	I	D	90	18.3	36
B047	B	N1212.69	E0981.67	1317.80	B	I	D	90	18.3	36
B048	B	N1322.56	E0981.75	1317.93	B	I	D	90	17.2	36
B049	B	N1200.03	E0981.50	1317.83	B	I	D	90	17.5	36
B050	B	N1335.03	E0974.19	1317.60	B	I	D	90	18.0	36
B051	B	N1199.43	E0981.77	1317.92	B	I	D	90	17.8	36
B052	B	N1335.08	E0981.86	1317.76	B	I	D	90	19.1	36
B061	B	N1204.17	E0974.24	1317.63	B	I	D	90	18.2	30
B062	B	N1330.51	E0974.18	1317.80	B	I	D	90	18.8	30
B063	B	N1204.25	E0981.25	1317.88	B	HTR	D	90	18.4	30
B064	B	N1330.26	E0981.82	1317.87	B	HTR	D	90	18.9	30
B090D	B	N1430.92	E0970.33	1318.44		I	D	90	100?	6
B090U		N1431.59	E0970.48	1330.63	B	I	U	90	100?	6
B099	B	N1419.47	E0896.01	1325.46	B	I	N	0	306	1.5
B301	B	N1202.23	E0978.79	1335.83	B	I	U	90	50.13	1.875
B302	B	N1202.19	E0978.74	1318.10	B	I	D	90	49.29	1.875
B303	B	N1250.42	E0978.77	1335.64	B	I	U	90	50.21	1.875
B304	B	N1250.45	E0978.76	1318.02	B	I	D	90	47.85	1.875
B305	B	N1275.38	E0978.78	1335.91	B	I	U	90	50.38	1.875
B305A	B				D	I				
B306	B	N1275.25	E0978.77	1317.61	B	I	D	90	50.35	1.875
B306A	B				D	I				
B307	B	N1285.34	E0978.70	1335.65	B	I	U	90	50.1	1.875
B308	B	N1285.32	E0978.70	1317.99	B	I	D	90	50.4	1.875
B309	B	N1310.27	E0978.69	1335.66	B	I	U	90	50.4	1.875
B310	B	N1310.4	E0970	1300	P	I	D	90	48.9	1.875
B310A	B	N1311.31	E0978.71	1318.09	B	I	D	90	50.0	1.875
B311	B	N1353.27	E0978.78	1335.35	B	I	U	90	50.06	1.875
B312	B	N1353.26	E0978.78	1317.84	B	I	D	90	49.71	1.875
B313	B	N1202.22	E0987.61	1326.95	B	I	E	0	50.0	1.875
B314	B	N1202.26	E0969.99	1326.97	B	I	W	0	49.7	1.875
B315	B	N1250.37	E0987.60	1326.67	B	I	E	0	50.2	1.875
B316	B	N1250.47	E0969.83	1326.66	B	I	W	0	50.4	1.875
B317	B	N1270.42	E0987.73	1326.79	B	I	E	0	50.4	1.875
B318	B	N1270.40	E0969.87	1327.15	B	I	W	0	50.33	1.875
B319	B	N1285.35	E0987.63	1326.76	B	I	E	0	50.2	1.875
B320	B	N1285.38	E0969.99	1326.72	B	I	W	0	50.2	1.875
B321	B	N1310.38	E0987.75	1326.73	B	I	E	0	50.1	1.875
B322	B	N1310.42	E0970.04	1326.68	B	I	W	0	50.2	1.875
B323	B	N1353.23	E0987.67	1326.59	B	I	E	0	49.1	1.875
B324	B	N1353.46	E0970.08	1326.52	B	I	W	0	49.0	1.875
B327	B	N1270.36	E0987.89	1331.38	B	I	E	0	50.0	1.875
B327B	B				D	I				
B328	B	N1270.38	E0989.81	1322.68	B	I	W	0	50.75	1.875
B329	B	N1272.41	E0987.52	1335.36	B	I	U,E	45	51.15	1.875
B329A	B				D					
B330	B	N1270.42	E0970.32	1335.22	B	I	U,W	45	50.0	1.875
B331	B	N1270.41	E0987.22	1318.35	B	I	D,E	45	49.0	1.875
B332	B	N1270.41	E0970.30	1318.30	B	I	D,W	45	50.4	1.875
B333	B	N1259.97	E0978.76	?	B	I	U	90	50.5	3.0
B334	B	N1259.97	E0978.76	1317.88	B	I	D	90	50.1	3.0
B335	B	N1260.02	E0987.81	1326.64	B	I	E	0	50.1	1.875
B336	B	N1259.90	E0969.75	1326.65	B	I	W	0	49.6	1.875
B507	B	N1265.39	E0977.29	1335.58	B	I	U	0	52.8	1.50
B508	B	N1265.45	E0980.26	1335.59	B	I	U	0	27.85	1.50
B509	B	N1265.46	E0978.78	1335.59	B	I	U	0	15.7	1.50
B510	B	N1265.56	E0977.20	1317.95	B	I	D	0	66.6	1.50

APPENDIX A
PRELIMINARY INVENTORY OF UNDERGROUND DRILL HOLES AT WIPP
1439 Records of Holes Drilled Before July 1985
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Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
B511	B	N1265.46	E0980.26	1318.03	B	I	D	0	27.8	1.50
B512	B	N1265.48	E0978.76	1316.80	B	I	D	0	15.9	1.50
B525	B	N1265.53	E0987.72	1328.65	B	I	D,E	45	53.21	1.50
B526	B	N1265.48	E0987.70	1325.70	B	I	D,E	45	28.2	1.50
B527	B	N1265.47	E0987.74	1327.19	B	I	D,E	45	15.1	1.50
B528	B	N1265.45	E0969.80	1325.68	B	I	D,W	45	53.4	1.50
B529	B	N1265.41	E0969.81	1328.70	B	I	D,W	45	28.1	1.50
B530	B	N1265.44	E0969.84	1327.17	B	I	D,W	45	15.2	1.5
B540	B	N1419.95	E0948.66	1326.42	B	I	S	0	52.4	1.875
B541	B	N1420.06	E0935.67	1326.38	B	I	S	0	53.0	1.875
B542	B	N1420.00	E0896.77	1325.46	B	I	S	0	156.0	1.5
B543	B	N1100	E0896	1325	A	I	N	0	306	1.5
B703	B	N1203.75	E0978.80	1335.68	B	I	U	90	50.11	1.875
B704	B	N1203.69	E0978.81	1318.01	B	I	D	90	50.0	1.875
B705	B	N1267.90	E0978.74	1335.58	B	I	U	90	50.1	1.875
B706	B	N1267.90	E0982.42	1318.07	B	I	D,E		50.6	1.875
B707	B	N1340.30	E0978.59	1335.51	B	I	U	90	50.45	1.875
B708	B	N1339.30	E0978.62	1317.87	B	I	D	90	50.38	1.875
B708A	B				D					
B709	B	N1366.38	E0978.93	1335.31	B	I	U	90	50.16	1.875
B710	B	N1366.47	E0978.88	1317.76	B	I	D	90	50.03	1.875
B713	B	N1203.75	E0987.67	1326.93	B	I			50.2	1.875
B714	B	N1203.71	E0969.98	1326.94	B	I	W	0	50.3	1.875
B715	B	N1250.91	E0987.63	1326.65	B	I	E	0	50.2	1.875
B716	B	N1251.91	E0969.89	1326.08	B	I	W	0	50.2	1.875
B717	B	N1367.94	E0987.48	1334.29	B	I	E	0	50.62	1.875
B718	B	N1267	E0987	1319	A	I	E	0	50	1.875
B718A	B	N1266.94	E0987.35	1319.30	B	I	E	0	50.4	1.875
B719	B	N1267.93	E0969.93	1334.22	B	I	W	0	50.25	1.875
B720	B	N1267.87	E0970.19	1319.22	B	I	W	0	50.15	1.875
B721	B	N1311.87	E0987.76	1326.65	B	I	E	0?	50.2	1,875
B722	B	N1311.89	E0969.99	1326.68	B	I	W	0?	50.6	1.875
B723	B	N1340.14	E0987.78	1326.64	B	I	E	0?	50.0	1.875
B724	B	N1340.37	E0969.67	1326.66	B	I	W	0?	50.3	1.875
B725	B	N1366.33	E0987.85	1326.37	B	I	E	0	50.19	1.875
B726	B	N1366.56	E0970.08	1326.42	B	I	W	0	50.1	1.875
B727	B	N1203.70	E0987.21	1335.32	B	I	U,E	45	50.0	1.875
B728	B	N1203.72	E0987.46	1318.29	B	I	D,E	45	50.08	1.875
B729	B	N1203.74	E0970.31	1335.40	B	I	U,W	45	50.43	1.875
B730	B	N1203.70	E0970.59	1318.66	B	I	D,W	45	50.00	1.875
B731	B	N1251.94	E0987.20	1335.12	B	I	U,E	45	50.04	1.875
B732	B	N1251.97	E0987.24	1318.10	B	I	D,E		50.0	1.875
B733	B	N1251.91	E0970.13	1335.20	B	I	U,W		50.35	1.875
B734	B	N1251.93	E0970.37	1318.28	B	I	D,W		50.5	1.875
B735	B	N1283.9	E0979.85	1317.75	P	I	E,U	45	50	1.875
B735A	B				D	I				
B735B	B				D					
B736	B	N1283.85	E0987.39	1318.07	B	I	D,E		50.04	1.875
B739	B	N1339	E0987	1335	A	I	U,E	45	50	1.875
B739A	B				D					
B740	B	N1342	E0989	1318	A	I	D,E	45	50	1.875
B740A	B	N1341.74	E0988.92	1318.03	B	I	D,E		50.0	1.875
B741	B	N1340.31	E0970.06	1335.17	B	I	U,W		50.0	1.875
B742	B	N1340.33	E0970.40	1318.32	B	I	D,W		50.25	1.875
B743	B	N1251.98	E0978.78	1335.67	B	I	U	90	49.92	1.875
B744	B	N1251.66	E0978.73	1317.92	B	I	D,E		50.0	1.875
B745	B	N1283.92	E0978.73	1335.63	B	I	U	90	50.1	1.875
B746	B	N1284.11	E0978.74	1317.93	B	I	D	90	50.0	1.875
B747	B	N1311.90	E0978.70	1335.67	B	I	U	90	50.5	1.875
B748	B	N1311.85	E0978.75	1317.96	B	I	D	90	50.00	1.875
B749	B	N1251.92	E0982.50	1318.13	B	I	D	90	50.00	1.875
B750	B	N1283.84	E0982.33	1317.98	B	I	D,E		50.1	1.875
B801	B	N1234.90	E0978.02	1318.27	B	I	D	90	21.5	1.8
B802	B	N1236.23	E0978.03	1318.19	B	I	D	90	21.5	1.8

APPENDIX A
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1439 Records of Holes Drilled Before July 1985
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B803	B	N1236.18	E0978.01	1318.37	B	I	D	90	21.5	1.875
B804	B	N1237.39	E0975.58	1318.22	B	I	D	90	21.5	1.8
B805	B	N1237.38	E0976.74	1318.18	B	I	D	90	21.5	1.9
B806	B	N1237.4	E0977.5	1317.8	A	I	D	90		1.875
B807	B	N1237.4	E0978.5	1317.8	A	I	D	90		1.875
B808	B	N1237.39	E0979.39	1318.19	B	I	D	90	21.5	1.9
B809	B	N1237.42	E0980.50	1318.20	B	I	D	90	21.5	1.9
B810	B	N1238	E0978	1317.8	A	I	D	90		1.875
B811	B	N1238.75	E0977.99	1318.34	B	I	D	90	21.5	1.9
B812	B	N1241.3	E0978	1317.7	A	I	D	90	21.5	1.9
B813	B	N1238.75	E0977.95	1318.18	B	I	D	90		
B814	B	N1242.42	E0975.50	1318.18	B	I	D	90	21.5	1.9
B815	B	N1242.47	E0976.67	1318.23	B	I	D	90	21.5	1.9
B817	B	N1242.8	E0979	1317.7	A	I	D	90		1.875
B818	B	N1242.43	E0979.37	1318.19	B	I	D	90	18.9	1.875
B819	B	N1242.46	E0980.52	1318.17	B	I	D	90	19.6	1.875
B820	B	N1243	E0978	1317.7	A	I	D	90	21.0	1.9
B821	B	N1243.65	E0977.96	1318.25	B	I	D	90	19.6	1.875
B822	B	N1244.99	E0977.97	N1318.21	B	I	D	90	19.6	1.875
B823	B	N1240.01	E0978.02	1318.25	B	I	D	90	19.6	1.875
B824	B	N1234.86	E0980.55	1318.30	B	I	D	90	18.8	1.875
B825	B	N1235.05	E0975.53	1318.11	B	I	D	90	19.6	1.875
B826	B	N1239.90	E0980.48	1318.24	B	I	D	90	19.9	1.875
B827	B	N1239.91	E0975.56	1318.24	B	I	D	90	19.7	1.875
B828	B	N1244.99	E0980.43	1318.15	B	I	D	90	19.5	1.875
B829	B	N1244.81	E0975.48	1318.16	B	I	DO	90	19.8	1.875
B842	B	N1314	E0974	1298	A	I	D	90		
B846	B	N1322	E0974	1298	A	I	D	90		
B850	B	N1335	E0974	1298	A	I	D	90		
BF41	B	N1289.87	E0977.54	1318.46	B	C,I	D	90	1.5	6
BF91	B	N1295.00	E0977.61	1318.26	B	C,I	D	90	6	1.5
BX01	B	N1384.66	E0982.33	1317.44	B	C	D	90	50.15	4
BX02	B	N1384.44	E0982.87	1335.47	B	C	U	90	49.25	4
BX50	B	N1270.40	E0969.85	1299.75	P	I	U	90	50.38	1.875
BX51	B	N1270.40	E0969.85	1299.75	P	I	D	90	50.2	1.875
BX52	B	N1270.4	E0994	1304	P	I	E	0	50.38	1.875
BX53	B	N1270.4	E0994	1304	P	I	E	0	50.3	1.875
BX54	B	N1271.41	E0987.52	1335.36	B	I	U,E	45	50.2	1.875
BX55	B	N1285	E0980	1318	A	I	U,E	45	50.2	1.875
BX56	B	N1282	E0980	1318	A	I	U,E	45	50.3	1.875
BX57	B	N1339	E0978.5	1318	A	I	D	90	49.7	1.875
BX58	B	N1339.11	E0987.28	1335.24	B	I	U,E	45	50.3	1.875
C		S1246	E0140	1262	A	Ae	E	0	15.13	3
C	L2	N1515	W0365	1312.5	A	WO	D	90	12.6	1
CS1		S0994	E0161.5	1258.5	A	CS	N	0	7.8	4
CS2		S0994	E0162.5	1258.5	A	CS	N	-10	10.9	4
CS3		S1000	E0140	1260	A	CS	U	90	31.0	4
D	L2	N1515	W0365	1312.5	A	WO	D	90	10.7	1
D001	D	N1264.9	E1683.63	1317.75	P	I	U	90	51.0	3.8
D002	D	N1264.9	E1699.63	1317.75	P	I	U	90	50	3.8
D003	D	N1264.9	E1683.63	1299.75	P	I	D	90	51.0	3.8
D18	M	N1426.2	E1701.5	1304	A	DD	E	0	12.4	16
D19	M	N1426.2	E1701.5	1308.5	A	DD	E	0	12.4	16
D301	D	N1267.82	E1691.63	1318.17	A	I	U	90	50	3.8
D302	D	N1267.84	E1691.63	1299.97	A	I	D	90	50	3.8
D303	D	N1267.92	E1682.60	1308.72	A	I	W	0	50	3.8
D304	D	N1267.87	E1700.66	1308.77	A	I	E	0	50	3.8
D?01	D	N1155.33	E1691.94	1300.39	A	I	D	90	46.5	1.875
D?02	D	N1156.26	E1691.97	1318.14	A	I	U	90	50?	1.875
D?03	D	N1154.58	E1700.24	1300.86	A	I	D,E	45	50?	1.875
D?04	D	N1156.78	E1683.02	1309.20	A	I	W	90	50?	5
D?05	D	N1156.01	E1683.97	1317.56	A	I	W	90	50?	5
D?06IG	D	N1261.95	E1698.99	1317.76	B	I	U,E	45	50?	
D?07IG	D	N1261.77	E1684.35	1317.77	B	I	U,W	45	50?	

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D?08IG	D	N1261.71	E1684.21	1299.48	B	I	D,W	45	50?	
D?09	D	N1189.94	E1682.50	1313.90	A	I	W	0		5
D?10	D	N1189.39	E1683.33	1308.57	A	I	W	0		4
DH001		N1424	E0439.5	1318.2	A	C	U	90	50.8	3
DH002		N1424	E0440	1307	A	C	D	90	50.2	3
DH002A		N1424	E0435	1307	A	C	D	90	49.2	3
DH002B		N1424	E0442	1306.3	A	C	D	90	53.0	3
DH003		N1112	E0444	1318.1	A	C	U	90	48.8	3
DH003A		N1112	E0450.5	1317.4	A	C	U	90	49.9	3
DH004		N1112.5	E0444	1309.6	A	C	D	90	45.8	3
DH004A		N1113	E0446	1310	A	C	D	90	11.2	3
DH004B		N1112	E0450.5	1309.7	A	C	D	90	51.4	3
DH005		N1463	E0972	1329.9	A	C	U	90	51.0	4.5
DH006		N1463	E0972	1317.9	A	C	D	90	49.75	4.5
DH007		N1112	E0976.5	1326.7	A	C	U	90	49.8	3
DH008		N1112	E0976.5	1318.8	A	C	D	90	38.3	3
DH008A		N1112	E0975	1318	A	C	D	90	50.7	3
DH008B		N1112	E0979.5	1318.0	A	C	D	90	51.4	3
DH009		N1432	E1332.5	1324.5	A	C	U	90	51.4	3
DH010		N1432	E1332.5	1312.1	A	C	D	90	52.0	3
DH011		N1112	E1332.5	1320.5	A	C	U	90	50.9	3
DH012		N1112	E1312.5	1311.1	A	C	D	90	51.3	3
DH013		N1424	E1690	1311.4	A	C	U	90	13.8	3
DH013A		N1424.5	E1691	1311.5	A	C	U	90	49.0	3
DH013B		N1425	E1695	1311.4	A	C	U	90	21.0	3
DH014		N1425	E1695	1299.5	A	C	D	90	49.1	3
DH015		N1104	E1688.5	1318.9	A	C	U	90	51.0	3
DH016		N1104	E1688	1309.3	A	C	D	90	51.0	3
DH017		N1427	E0178	1316.5	A	C	U	90	52.0	3
DH018		N1429	E0181	1305.1	A	C	D	90	50.8	
DH019		N1107	E0206.5	1314.7	A	C	U	90	51.6	3
DH020		N1109	E0206	1306.2	A	C	D	90	51.1	3
DH021		N1421	E0786	1331.0	A	C	U	90	50.4	3
DH022		N1421.5	E0785.5	1318.8	A	C	D	90	51.0	3
DH023		N1112	E0781	1328.0	A	C	U	90	51.0	3
DH024		N1112	E0781	1319.5	A	C	D	90	49.4	3
DH024A		N1112	E0780	1319.5	A	C	D	90	50.4	3
DH025		N1422	E1510	1318.8	A	C	U	90	51.8	3
DH026		N1427	E1510	1307.2	A	C	D	90	53.0	3
DH027	Ge	N1107	W0682	1300.8	A	C	U	90	50.5	3.5
DH028	Ge	N1107	W0682	1289.9	A	C	D	90	50.5	3.5
DH029	Ge	N1099	W0982	1298.3	A	C	U	90	50.4	3.5
DH029A	Ge	N1099	W0987	1298.1	A	C	U	90	35.0	3.5
DH030	Ge	N1099	W0982	1289.2	A	C	D	90	50.1	3.5
DH031	Ge	N1099	W1280	1298.5	A	C	U	90	50.5	3.5
DH031A	Ge	N1099	W1282	1298.5	A	C	U	90	49.2	3.5
DH031B	Ge	N1099	W1265	1298.5	A	C	U	90	4.9	3.5
DH032	Ge	N1099	W1280	1289.6	A	C	D	90	50.0	3.5
DH032A	Ge	N1099	W1265	1289.5	A	C	D	90	5.5	3.5
DH033	Ge	N1099	W1582	1298.6	A	C	U	90	50.5	3.5
DH033A	Ge	N1099	W1570	1297.4	A	C	U	90	4.1	3.5
DH033B	Ge	N1099	W1570.5	1297.4	A	C	U	90	1.2	3.5
DH034	Ge	N1099	W1582	1289.4	A	C	D	90	51.5	3.5
DH034A	Ge	N1099	W1570	1289.2	A	C	D	90	3.6	3.5
DH035	G	N1102	W1882	1294.4	A	C	U	90	52.0	3.5
DH036	G	N1102	W1882	1284.6	A	C	D	90	51.5	3.5
DH037	G	N1101	W2182	1287.0	A	C	U	90	51.5	3.5
DH038	G	N1101	W2182	1297.4	A	C	D	90	47.5	3.5
DH039	G	N1101	W2482	1296.0	A	C	U	90	50.7	3.5
DH040	G	N1101	W2482	1286.1	A	C	D	90	51.0	3.5
DH041	G	N1101	W2782	1295.8	A	C	U	90	49.9	3.5
DH042	G	N1101	W2782	1285.9	A	C	D	90	51.2	3.5
DH042A	G	N1101	W2789	1285.7	A	C	D	90	40.5	3.5
DH207		S0697	E0155	1259.8	A	C,I	U	90	52.8	3

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DH208		S0698	E0150	1251.6	A	C	D	90	42.9	3
DH211		S1320	E0163	1270.5	A	C	U	90	50.0	3
DH212		S1320	E0163	1261.7	A	C	D	90	52.1	3
DH215		S1960	E0153	1272.0	A	C,I	U	90	51.1	3
DH216		S1960	E0153	1262.6	A	C,I	D	90	54.2	3
DH219		S2422	E0162	1266.3	A	C	U	90	51.0	3
DH219A		S2418	E0162	1266.1	A	C	U	90	11.3	3
DH220		S2421	E0162	1257.4	A	C	D	90	51.8	3
DH223		S3114	E0154	1255.1	A	C,I	U	90	52.6	3
DH224		S3114	E0154	1246.6	A	C,I	D	90	52.5	3
DH227		S3656	E0147	1247.0	A	C	U	90	51.7	3
DH228		S3656	E0147	1237.8	A	C	D	90	50.4	3
DH301		N0150	W0170	1276.9	A	C	U	90	50.75	3.5
DH302		N0150	W0170	1264.9	A	C	D	90	50.6	3.5
DH303		S0400	W0170	1267.2	A	C	U	90	51.4	3.5
DH304		S0400	W0170	1254.3	A	C	D	90	50.5	3.5
DH306		S0400	E0140	1244.1	A	C	D	90	52.0	3
DH306A		S0400	E0125	1244.0	A	C	D	90	8.5	3.5
DH307		S0400	E0300	1262.6	A	C,I	U	90	52.0	3
DH309		S0700	E0220	1259.8	A	C,I	U	90	52.3	3
DH311		S1000	E0300	1264.4	A	C,I	U	90	52.0	3
DH313		S1300	E0300	1270.6	A	C	U	90	19.6	3
DH313A		S1300	E0299	1270.9	A	C	U	90	50.2	3
DH314		S1300	E0300	1258.3	A	C	D	90	50.75	3
DH315		S1300	W0170	1272.1	A	C	U	90	50.3	3.5
DH316		S1300	W0170	1259.9	A	C	D	90	50.1	3.5
DH317		S1600	W0030	1271.2	A	C	U	90	50.1	3
DH317A		S1600	W0028.5	1271.2	A	C	U	90	5.0	3
DH317B		S1597	W0027	1271.2	A	C	U	90	51.0	3.5
DH317C		S1600	W0029.5	1271.2	A	C	U	90	5	3
DH318		S1600	W0030	1258.5	A	C	D	90	50.0	3
DH319		S0700	E0300	1260.0	A	C	U	90	51.05	3.5
DH321		S0400	E0000	1261.4	A	C,I	U	90	52.0	3
DH323		S0395.53	E0057.61	1261.2	B	C	U	90	52.5	3
DO045		N0249.5	E0147.13	1286.24	B	C,I	U	90	52.7	3
DO046		N0249.2	E0147	1276.5	A	C	D	90	51.5	3
DO052		N0146	W0002	1280.4	A	C	U	90	50?	3
DO053		N0146	W0004	1266.6	A	C	D	90	49.2	3
DO056		N621	E000	1296.8	A	C,I	U	90	52.1	3
DO057		N0621	E0000	1288.1	A	C	D	90	52.1	3
DO063		N1110	E0000	1310.6	A	C,I	U	90	52.8	3
DO064		N1110	E0000	1301.5	A	C	D	90	52.8	3
DO067	1	N1265	W0231.5	1296.8	A	C,I	D	90	51.7	3
DO069	1	N1265	W0231.5	1310.1	A	C,I	U	90	51.4	3
DO077	2	N1270	W0364.5	1294.6	A	C,I	D	90	53.4	3
DO079	2	N1270	W0364.5	1307.7	A	C,I	U	90	51.8	3
DO088	3	N1265	W0497.5	1305.9	A	C,I	U	90	52.7	3
DO090	3	N1265	W0497.5	1292.1	A	C,I	D	90	53.6	3
DO091	4	N1275	W0630.5	1292.1	A	C,I	D	90	51.8	3
DO093	4	N1275	W0630.5	1304.9	A	C,I	U	90	52.0	3
DO201		S0406	W0019	1262.2	A	C	U	90	51.7	3
DO202		S0406	W0019	1248.6	A	C	D	90	51.4	3
DO203		N0624	E0140	1298.2	A	C,I	U	90	51.75	3
DO204		N0640	E0140	1290.5	A	C	D	90	51.6	3
DO205		N1410	E0000	1316.5	A	C	U	90	50.7	3
DO206		N1410	E0000	1308.0	A	C	D	90	50.6	3
DO229		S0401	E0153	1259.8	A	C	U	90	50.6	3
DPDO1		N1433	E1672	1300	A	EX	D,N	45	40.5	5
DT01	4					DD	W	0	13	1.875
DT02	4					DD	W	0	13	1.875
DT03	4					DD	W	0	13	3
DT04	He	N1100	W0646	1296.5	A	DD,C	S	0	3.8	16
DT05		N1095	W0656?		A	DD,C	S	0	2.5	6
DT06	He	N1100	W0646	1296	A	DD,C	S	0	1	4

APPENDIX A
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1439 Records of Holes Drilled Before July 1985
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Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
DT07		S0750?	E0140		D	DD	E	0	12	1.875
DT08		S0750?	E0140		D	DD	E	0	12	1.875
DT09		S0750?	E0140		D	DD	E	0	7	1.875
DT10		S0750?	E0140		D	DD	E	0	9	1.875
DT11		S0750?	E0140		D	DD	E	0	9	1.875
DT12		S1000	E0176.5	1256	A	DD	E	0	50	1.875
DT13		S1002	E0176.5	1256	A	DD	E	0	50	1.875
DT14		S1002	E0176.5	1257	A	DD	E	0	50	1.875
DX01	D	N1237.9	E1691.63	1317.75	P	I	U	90	50	1.875
DX02	D	N1237.9	E1700.63	1317.75	P	I	E,U	45	50	4
DX03	D	N1237.9	E1700.63	1317.75	P	I	E	0	50	1.875
DX04	D	N1237.9	E1691.63	1299.75	P	I	D	90	50	1.875
DX05	D	N1237.9	E1682.63	1299.75	P	I	W,D	45	50	1.875
DX10	D	N1247.9	E1700.63	1317.75	P	I	E,U	45	50	3.8
DX15	D	N1372.89	E1700.17	1303.97	A	DD	E	0	3.0	16
DX16	D	N1370.06	E1700.54	1304.19	A	DD	E	0	6.8	16
DX17	D	N1371.50	E1700.60	1308.49	A	DD	E	0	7.3	16
DX30	D	N1247.90	E1691.63	1299.75	P	I	D	90	50	1.875
DX50	D	N1247.90	E1700.63	1308.75	P	I	E	0	50	2
DX51	D	N1247.90	E1682.63	1308.75	P	I	W	0	50	2
DX70	D	N1247.90	E1691.63	1317.75	P	I	U	90	50	1.875
DX71	D	N1247.90	E1687.93	1299.75	P	I	E,D	45?	33?	1.875
E	L2	N1515	W0365	1312.5	A	WO	D	90	7.1	5
GA090-D	G	N1100	W1868	1285	A	I	D	90	103.5	1.88
GA090-U	G	N1100	W1868	1296	A	I	U	90	103.4	1.88
GA301	G	N1102.54	W2327.30	1296.71	B	I	U	90	50.9	3.0
GA302	G	N1102.53	W2327.21	1286.74	B	I	D	90	51.00	3.0
GA303	G	N1112.28	W2327.21	1291.73	B	I	N	0	50.67	3.0
GA304	G	N1092.57	W2327.20	1291.76	B	I	S	0	50.75	3.0
GA311-1	G	N1102.54	W2325.33	1296.89	B	I	U	90	50.66	1.875
GA311-2	G	N1102.57	W2321.29	1296.82	B	I	U	90	30.36	1.875
GA311-3	G	N1102.58	W2322.18	1296.78	B	I	U	90	20.41	1.875
GA311-4	G	N1102.54	W2323.29	1296.83	B	I	U	90	10.55	1.875
GA311-5	G	N1102.58	W2324.26	1296.84	B	I	U	90	5.51	1.875
GA312-1	G	N1102.54	W2325.26	1286.27	B	I	D	90	50.50	1.875
GA312-2	G	N1102.51	W2321.25	1286.63	B	I	D	90	30.25	1.875
GA312-3	G	N1102.53	W2322.25	1286.62	B	I	D	90	20.50	1.875
GA312-4	G	N1102.54	W2323.24	1286.71	B	I	D	90	10.44	1.875
GA312-5	G	N1102.53	W2324.26	1286.63	B	I	D	90	5.10	1.875
GA313-1	G	N1112.55	W2325.22	1291.76	B	I	N	0	50.95	1.875
GA313-2	G	N1112.58	W2321.29	1291.75	B	I	N	0	30.4	1.875
GA313-3	G	N1112.53	W2322.29	1291.75	B	I	N	0	20.4	1.875
GA313-4	G	N1112.54	W2323.27	1291.79	B	I	N	0	10.6	1.875
GA313-5	G	N1112.55	W2324.29	1291.77	B	I	N	0	5.7	1.875
GA314-1	G	N1092.37	W2325.25	1291.81	B	I	S	0	50.92	1.875
GA314-2	G	N1092.33	W2321.28	1291.76	B	I	S	0	30.40	1.875
GA314-3	G	N1092.38	W2322.26	1291.79	B	I	S	0	20.36	1.875
GA314-4	G	N1092.33	W2323.27	1291.78	B	I	S	0	10.50	1.875
GA314-5	G	N1092.34	W2324.26	1291.81	B	I	S	0	5.75	1.875
GA333	G	N1112.32	W2730.26	1290.63	B	I	N	0	55.50	3.0
GA334	G	N1092.43	W2730.27	1290.60	B	I	S	0	55.4	3.0
GA501	G	N1092.54	W2335.20	1291.78	B	I	S	0	138.7	2.25
GA503	G	N1092.61	W2331.71	1291.77	B	I	S	0	55.6	1.5
GA505	G	N1092.60	W2330.23	1291.73	B	I	S	0	23.3	1.5
GA507	G	N1092.59	W2328.74	1291.75	B	I	S	0	8.3	1.5
GB1	4	N1400	W0630	1293	A	WO,C	D	90	18	1
GB331	G	N1102.56	W2730.26	1295.62	B	I	U	90	50.62	3.0
GB332	G	N1102.52	W2730.26	1285.90	B	I	D	90	50.0	3.0
GB341-1	G	N1102.53	W2732.21	1295.88	B	I	U	90	50.45	1.875
GB341-2	G	N1102.53	W2736.23	1295.93	B	I	U	90	30.2	1.875
GB341-3	G	N1102.53	W2735.21	1295.89	B	I	U	90	20.4	1.875
GB341-4	G	N1102.53	W2734.22	1295.85	B	I	U	90	10.4	1.875
GB341-5	G	N1102.55	W2733.19	1295.90	B	I	U	90	5.1	1.875
GB342-1	G	N11-2.54	W2732.21	1285.64	B	I	D	90	50.4	1.875

APPENDIX A
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GB342-2	G	N1102.55	W2736.22	1285.66	B	I	D	90	30.2	1.875
GB342-3	G	N1102.55	W2735.22	1285.64	B	I	D	90	20.4	1.875
GB342-4	G	N1102.56	W2734.23	1285.67	B	I	D	90	10.3	1.875
GB342-5	G	N1102.54	W2733.22	1285.62	B	I	D	90	5.2	1.875
GB343-1	G	N1112.53	W2732.20	1290.17	B	I	N	0	55.17	1.875
GB343-2	G	N1112.58	W2736.21	1290.72	B	I	N	0	35.1	1.875
GB343-3	G	N1112.52	W2735.25	1290.72	B	I	N	0	25.3	1.875
GB343-4	G	N1112.56	W2734.23	1290.77	B	I	N	0	15.25	1.875
GB343-5	G	N1112.56	W2733.20	1290.75	B	I	N	0	10.17	1.875
GB343-6	G	N1112.56	W2737.21	1290.72	B	I	N	0	5.1	1.875
GB344-1	G	N1092.22	W2732.21	1290.73	B	I	S	0	55.2	1.875
GB344-2	G	N1092.26	W2736.17	1290.75	B	I	S	0	35.3	1.875
GB344-3	G	N1092.25	W2735.24	1290.75	B	I	S	0	25.4	1.875
GB344-4	G	N1092.21	W2734.19	1290.75	B	I	S	0	15.3	1.875
GB344-5	G	N1092.22	W2733.20	1290.73	B	I	S	0	10.3	1.875
GB344-6	G	N1092.27	W2737.26	1290.75	B	I	S	0	5.5	1.875
GB522	G	N1112.01	W2717.23	1290.75	B	I	N	0	140.5	1.875
GB522A	G				D					
GB523	G	N1112.22	W2725.00	1290.58	B	I	N	0	64.17	1.875
GB525	G	N1112.28	W2727.26	1290.66	B	I	N	0	25.25	1.875
GB527	G	N1112.27	W2728.76	1290.72	B	I	N	0	10.25	1.875
GBX50	G	N1112.23	W2722.25	1290.64	B	I	N	0	80.0	1.875
GD401	G	N1102.55	W2482.32	1295.18	B	I	U	90	50.63	3.0
GD402	G	N1102.57	E2482.19	1285.32	B	I	D	90	50.28	3.0
GD403	G	N1102.45	W2490.17	1295.06	B	I	U	90	50.28	3.0
GD404	G	N1102.49	W2490.17	1285.28	B	I	D	90	50.1	3.0
GD405	G	N1102.48	W2520.34	1295.73	B	I	U	90	50.5	3.0
GD406	G	N1102.42	W2520.24	1286.11	B	I	D	90	50.3	3.0
GD411-1	G	N1102.51	W2480.31	1295.41	B	I	U	90	50.7	1.875
GD411-2	G	N1102.48	W2476.25	1295.61	B	I	U	90	30.08	1.875
GD411-3	G	N1102.49	W2477.26	1295.59	B	I	U	90	20.5	1.875
GD411-4	G	N1102.53	W2478.25	1295.49	B	I	U	90	10.58	1.875
GD411-5	G	N1102.54	W2478.30	1295.50	B	I	U	90	5.42	1.875
GD412-1	G	N1102.54	W2480.24	1285.28	B	I	D	90	50.58	1.875
GD412-2	G	N1102.50	W2476.25	1285.42	B	I	D	90	30.3	1.875
GD412-3	G	N1102.54	W2477.25	1285.34	B	I	D	90	20.75	1.875
GD412-4	G	N1102.50	W2478.26	1285.23	B	I	D	90	10.60	1.875
GD412-5	G	N1102.53	W2479.24	1285.22	B	I	D	90	5.70	1.875
GD413-1	G	N1102.55	W2475.22	1295.66	B	I	U	90	16.08	1.875
GD413-2	G	N1102.53	W2474.22	1295.71	B	I	U	90	5.42	1.875
GD414-1	G	N1102.52	W2475.23	1285.49	B	I	D	90	10.3	1.875
GD414-2	G	N1102.54	W2474.76	1285.58	B	I	D	90	5.42	1.875
GD415-1	G	N1102.50	W2470.20	1295.88	B	I	U	90	50.55	1.875
GD415-2	G	N1102.49	W2466.20	1295.97	B	I	U	90	30.17	1.875
GD415-3	G	N1105.51	W2467.26	1295.96	B	I	U	90	20.25	1.875
GD415-4	G	N1102.51	W2468.25	1295.92	B	I	U	90	10.50	1.875
GD415-5	G	N1102.51	W2469.23	1295.95	B	I	U	90	5.66	1.875
GD416-1	G	N1102.51	W2466.3	1285.6	B	I	D	90	50.1	1.875
GD416-2	G	N1102.51	W2466.27	1285.59	B	I	D	90	30.8	1.875
GD416-3	G	N1102.51	W2467.29	1285.63	B	I	D	90	20.8	1.875
GD416-4	G	N1102.51	W2468.28	1285.68	B	I	D	90	10.8	1.875
GD416-5	G	N1102.53	W2469.25	1285.56	B	I	D	90	5.6	1.875
GD417-1	G	N1102.56	W2460.27	1296.16	B	I	U	90	50.7	1.875
GD417-2	G	N1102.57	W2456.28	1296.17	B	I	U	90	30.25	1.875
GD417-3	G	N1102.50	W2457.25	1296.21	B	I	U	90	20.6	1.875
GD417-4	G	N1102.54	W2458.27	1296.18	B	I	U	90	9.3	1.875
GD417-5	G	N1102.53	W2459.25	1296.17	B	I	U	90	5.3	1.875
GD418-1	G	N1102.53	W2460.29	1285.94	B	I	D	90	50.5	1.875
GD418-2	G	N1102.55	W2456.26	1285.95	B	I	D	90	30.22	1.875
GD418-3	G	N1102.53	W2457.26	1285.94	B	I	D	90	20.79	1.875
GD418-4	G	N1102.54	W2458.22	1285.91	B	I	D	90	10.83	1.875
GD418-5	G	N1102.55	W2459.23	1285.99	B	I	D	90	5.83	1.875
GD419-1	G	N1102.63	W2440.18	1296.26	B	I	U	90	5.42	1.875
GD419-2	G	N1102.55	W2436.35	1296.32	B	I	U	90	32.67	1.875

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GD419-3	G	N1102.53	W2437.25	1296.31	B	I	U	90	20.17	1.875
GD419-4	G	N1102.52	W2438.24	1296.32	B	I	U	90	10.67	1.875
GD419-5	G	N1102.53	W2439.21	1296.27	B	I	U	90	5.42	1.875
GD420-1	G	N1102.54	W2440.25	1286.18	B	I	D	90	51.0	1.875
GD420-2	G	N1102.51	W2436.26	1286.32	B	I	D	90	30.72	1.875
GD420-3	G	N1102.53	W2437.25	1286.29	B	I	D	90	20.90	1.875
GD420-4	G	N1102.51	W2438.23	1286.19	B	I	D	90	10.77	1.875
GD420-5	G	N1102.53	W2439.25	1286.14	B	I	D	90	5.46	1.875
GD421-1	G	N1102.53	W2420.22	1295.80	B	I	U	90	51.25	1.875
GD421-2	G	N1102.49	W2416.22	1295.93	B	I	U	90	30.50	1.875
GD421-3	G	N1102.58	W2417.23	1295.94	B	I	U	90	21.70	1.875
GD421-4	G	N1102.55	W2418.21	1295.88	B	I	U	90	15.54	1.875
GD421-5	G	N1102.50	W2419.18	1295.87	B	I	U	90	7.55	1.875
GD422-1	G	N1102.54	W2420.26	1285.77	B	I	D	90	50.5	1.875
GD422-2	G	N1102.55	W2416.28	1285.91	B	I	D	90	30.71	1.875
GD422-3	G	N1102.53	W2417.30	1285.87	B	I	D	90	20.25	1.875
GD422-4	G	N1102.54	W2418.26	1285.82	B	I	D	90	10.5	1.875
GD422-5	G	N1102.54	W2419.24	1285.84	B	I	D	90	5.5	1.875
GE206	4	N1275	W0620	1293	A	I	E	0	52.6	3
GE207					D	I				
GE208	4	N1275	W0625	1293	A	I	W	0	52.0	3
GE209					D	I				
GE210					D	I				
GE211	3	N1250	W0490	1302	A	I	E	0	51.75	3
GE212					D	I				
GE213	2	N1275.77	W0348.05	1294.89	B	I	E	0	52.0	3
GE214					D	I				
GE215	2	N1276.19	W0380.82	1301.83	B	I	W	0	52.0	3
GE216					D	I				
GE217	1	N1265.58	W0215.14	1303.88	B	I	E	0	51.5	3
GE218					D	I				
GE219	1	N1265.47	W0248.31	1303.87	B	I	W	0	52.5	3
GE220					D	I				
GE221					D	I				
GE222		N1266.18	E0155.94	1312.94	B	I	E	0	51.5	3
GE223		N0626.83	W0027.46	1292.21	B	I	W	0	51.6	3
GE224		N0624.54	E0010.18	1294.44	B	I	E	0	53.3	3
GE225		N1265.73	E0140.87	1312.96	B	I	W	0	52.5	3
GE226					D	I				
GE226		N0146	W0004	1280.4	A	C,I	U	90	51.6	3
GE227		N0035.37	E0001.25	1272.97	B	I	U	90	52.0	3
GE228		S0065.56	W0007.51	1274.15	B	I	U	90	50.5	3
GE229		N0254.26	E0141.25	1281.61	B	I	W	0	51.3	3
GE230		N0254.27	E0147.19	1285.74	B	I	U	90	52.3	3
GE231		S0410.68	E030.39	1254.03	B	I	S	0	53.0	3
GE232		S0399.65	E0044.9	1261.35	B	I	U	90	51.0	3
GE233		N1263.11	W0002.95	1314.40	B	I	U	90	51.9	3
GE234					D	I				
GE235					D	I				
GE236		N1266.02	E0148.08	1316.71	B	I	U	90	51.0	3
GE237	2	N1276.05	W0372.76	1307.75	B	I	U	90	51.5	3
GE238	2	N1275.85	W0356.49	1294.89	B	I	U	90	51.75	3
GE239	1	N1265.24	W0223.46	1310.15	B	I	U	90	52.0	3
GE240	1	N1265.17	W0239.42	1310.15	B	I	U	90	52.0	3
GE241		N1111.14	W0363.04	1309.72	B	I	U	90	52.5	3
GE242		N1111.14	W0363.09	1295	B	I	D	90	52.0	3
GE243					D	I				
GE244		S0027.98	W0005.89	1276.58	B	I	U	90	46.9	3
GE245		S0395.97	E0009.03	1262.50	B	I	U	90	46.5	3
GE246					D	I				
GE247					D	I				
GE248					D	I				
GE249					D	I				
GE250		S3079.66	E0154.38	1246.29	B	I	D	90	52.5	3

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Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
GE251		S0015.80	W0005.29	1276.78	B	I	U	90	52.0	3
GE252		S0027.5	W0024.79	1268.72	B	I	W	0	36.25	3
GE253		S0028.6	W0004.69	1258.89	B	I	D	90	52.1	3
GE254		S0027.59	E0010.9	1268.35	B	I	E	0	36.0	3
GE255					D	I				
GE256		S0404	E0138	1260.5	A	I	U	90	51.0	3
GE257		S0397	E0141	1260.5	A	I	U	90	51.0	3
GE257A		S0398	E0136	1260.5	A	I	U	90	45	3
GE258		N1099	W0001	1301.4	A	I	D	90	60.0	3
GE259		N1420	W0231	1310	A	I	U	90	50.0	3
GE260		N1420	W0231	1298	A	I	D	90	50.4	3
GE261		N1420	W0365	1308	A	I	U	90	51.75	3
GE262		N1420	W0365	1296	A	I	D	90	49.3	3
GE263					D	I				
GE264		S0400	E0300	1262.5	A	I	U	90	50.4	3
GE265					D	I				
GE266		S0400	E0140	1244	A	I	D	90	52.0	3
GE267					D	I				
GE268		S0400	E0000	1259	A	I	U	90	50.0	3
GE431	G	N1097.56	W2471.28	1295.52	B	I	U	90	50.35	3.0
GE432	G	N1097.49	W2471.25	1285.56	B	I	D	90	50.2	3.0
GE433	G	N1111.57	W2489.26	1294.91	B	I	U	90	55.3	3.0
GE434	G	N1111.47	W2489.22	1285.66	B	I	D	90	50.2	3.0
GE435	G	N1103.13	W2489.89	1290.35	B	I	NW	0	55.7	3.0
GE436	G	N1092.78	W2470.47	1290.24	B	I	SE	0	50.45	3.0
GE584	G	N1112.00	W2495.21	1290.26	B	I	NW	0	41.3	1.875
GE585	G	N1112.02	W2492.79	1290.22	B	I	NW	0	21.6	1.875
GE586	G	N1112.07	W2491.35	1290.25	B	I	NW	0	10.8	1.875
GE588	G	N1092.67	W2464.31	1290.42	B	I	SE	0	85.8	1.50
GE590	G	N1092.70	W2467.38	1290.47	B	I	SE	0	42.8	1.50
GE592	G	N1092.79	W2468.97	1290.38	B	I	SE	0	17.5	1.50
H003	H	N0869.46	W0642.87	1296.90	B	I	U,NE		22.76	4.0
H004	H	N0869.35	W0642.99	1287.61	B	I	D,NE		23.00	4.0
H005	H	N0844.69	W0667.60	1296.71	B	I	U,SW		49.99	4.0
H006	H	N0844.87	W0667.51	1287.42	B	I	D,SW		49.73	4.0
H007	H	N0895.70	W0616.56	1297.21	B	I	U,SW		22.72	4.0
H008	H	N0895.58	W0616.65	1287.91	B	I	D,SW		22.78	4.0
H009	H	N0920.46	W0591.95	1297.26	B	I	NE,U		54.62	4.0
H010	H	N0920.5	W0592	1288	A	I	D,E	45	50	4
H011	H	N0920.41	W0591.99	1287.90	B	I	SW	0	36.4	4.0
H012	H	N0895.32	W0616.92	1288.63	B	I	SW	0	36.31	4.0
H090-D		N1095	W0415	1292	A	I	D	90	103.0	12.00
H090-U		N1095	W0415	1306	A	I	U	90	103.0	12.00
H1SE		S0436	W0011	1258	A	LT,C	E	0	3.7	4
H2SE		S0436	W0011	1257	A	LT,C	E	0	4.0	4
H301	H	N0907.96	W0655.23	1297.74	B	I	U	90	50.2	1.875
H302	H	N0908.02	W0655.22	1288.18	B	I	D	90	50.25	1.875
H303	H	N0857.11	W0655.24	1297.26	B	I	U	90	50.14	3.0
H304	H	N0857.05	W0655.22	1287.44	B	I	D	90	50.0	3.0
H305	H	N0857.04	W0604.32	1297.03	B	I	U	90	50.33	1.875
H306	H	N0857.10	W0604.34	1287.69	B	I	D	90	50.5	1.875
H307	H	N0907.47	W0604.30	1297.66	B	I	U	90	50.62	3.0
H308	H	N0907.99	W0604.26	1287.10	B	I	D	90	50.15	3.0
H309	H	N0895.54	W0642.75	1293.17	B	I	SE	0	18.64	1.875
H310	H	N0920.44	W0667.70	1293.18	B	I	NW	0	50.2	1.875
H311	H	N0869.60	W0642.73	1292.18	B	I	NE	0	17.34	3.0
H312	H	N0844.55	W0667.75	1292.11	B	I	SW	0	50.29	3.0
H313	H	N0869.53	W0616.80	1292.36	B	I	NW	0	18.0	1.875
H314	H	N0844.57	W0591.85	1292.36	B	I	SE	0	50.45	1.875
H315	H	N0895.41	W0616.88	1292.59	B	I	SW	0	17.58	3.0
H316	H	N0920.60	W0591.76	1292.62	B	I	NE	0	50.60	3.0
H317	H	N0900.76	W0629.73	1294.75	B	I	S	0	36.17	1.875
H318	H	N0895.77	W0643.00	1297.46	B	I	U,SE		26.10	1.875
H319	H	N0895.85	W0643.07	1288.58	B	I	D,SE		26.16	1.875

APPENDIX A
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Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
H320	H	N0920.18	W0667.38	1297.27	B	I	NW,U		50.3	1.875
H321	H	N0920.06	W0667.24	1288.51	B	I	D,NW		50.3	1.875
H326	H	N0869.24	W0616.48	1296.58	B	I	NW,U		25.8	1.875
H327	H	N0869.24	W0616.45	1287.60	B	I	NW,D	25.6	1.875	I
H328	H	N0844.80	W0592.10	1296.83	B	I	SE,U		50.0	1.875
H329	H	N0844.99	W0592.23	1287.81	B	I	SE,D		50.3	1.875
H3SF		S0442	W0018	1257	A,D	LT,C	S	0	3.2	4
H501	H	N0844.54	W0666.13	1297.52	B	I	U	90	28.50	1.50
H502	H	N0880.66	W0665.63	1297.61	B	I	U	90	14.59	1.50
H504	H	N0844.45	W0665.65	1288.03	B	I	D	90	28.35	1.50
H505	H	N0880.62	W0665.67	1287.92	B	I	D	90	28.35	1.50
H513	H	N0880.55	W0593.96	1297.39	B	I	U	90	28.5	1.50
H514	H	N0884.35	W0593.79	1297.59	B	I	U	90	14.3	1.50
H516	H	N0880.59	W0593.99	1287.84	B	I	D	90	27.50	1.50
H517	H	N0884.46	W0593.86	1288.11	B	I	D	90	13.4	1.50
H519	H	N0881.58	W0648.00	1292.65	B	I	SE	0	22.7	1.50
H520	H	N0883.50	W0648.01	1292.81	B	I	SE	0	12.0	1.50
H523	H	N0879.76	W0683.19	1292.67	B	I	W	0	29.0	1.50
H524	H	N0885.34	W0683.28	1292.80	B	I	W	0	14.5	1.50
H532	H	N0820.52	W0611.53	1292.53	B	I		0	15.54	1.50
H533	H	N0881.58	W0611.56	1292.54	B	I		0	9.46	1.50
H535	H	N0885.39	W0576.05	1292.58	B	I	E,NE	0	28.7	1.50
H536	H	N0879.72	W0576.05	1292.62	B	I	E	0	14.4	1.50
H537	H	N0881.96	W0649.40	1297.54	B	I	U,SE		33.38	1.50
H538	H	N0882.58	W0610.76	1296.86	B	I	U,W		23.34	1.50
H543	H	N0881.98	W649.58	1288.07	B	I	D,SE		33.99	1.50
H544	H	N0882.51	W0611.18	1287.99	B	I	D,W		23.85	1.50
H549	H	N0901.24	W0630.72	1291.06	B	I	S	0	24.17	1.875
H550	H	N0901.31	W0628.78	1290.98	B	I	S	0	16.08	1.875
H551	H	N0901.25	W0692.70	1291.09	B	I	S	0	9.25	1.875
H701	H	N1033.35	W0635.43	1295.70	B	I	W	0	50.21	1.875
H702	H	N0900.54	W0660.91	1297.70	B	I	U	90	50.42	1.875
H703	H	N0900.54	W0660.91	1288.18	B	I	D	90	50.10	1.875
H704	H	N0846.51	W0627.97	1297.22	B	I	U	90	50.1	1.875
H705	H	N0846.49	W0627.92	1287.31	B	I	U	90	50.10	1.875
H705A	H				D					
H708	H	N0891.69	W0645.68	1292.92	B	I	SE	0	15.45	1.875
H709	H	N0909.41	W0676.25	1292.93	B	I	NW	0	50.33	1.875
H710	H	N0864.19	W0629.78	1292.12	B	I	N	0	10.5	1.875
H711	H	N0828.67	W0629.81	1292.09	B	I	S	0	50.5	1.875
H712	H	N0891.58	W0614.04	1292.76	B	I	W	0	15.6	1.875
H714	H	N0892.30	W0646.72	1297.58	B	I	SE,U		27.8	1.875
H715	H	N0891.87	W0646.01	1297.27	B	I	U		17.4	1.875
H716	H	N0892.44	W0646.93	1288.13	B	I	D		28.0	1.875
H717	H	N0891.97	W0646.14	1288.34	B	I	D		17.45	1.875
H718	H	N0909.18	W0675.66	1297.18	B	I	U,NW		50.63	1.875
H719	H	N0909.05	W0675.65	1288.39	B	I	D,NW		50.5	1.875
H720	H	N0863.00	W0629.77	1296.76	B	I	N.U		40.0	1.875
H721	H	N0863.75	W0629.76	1296.31	B	I	N,U		23.12	1.875
H722	H	N0862.93	W0629.73	1287.01	B	I	D		39.25	1.875
H723	H	N0863.72	W0629.80	1287.31	B	I	D		23.1	1.875
H724	H	N0829.09	W0629.87	1296.45	B	I	S,U		50.5	1.875
H725	H	N0829.22	W0629.76	1287.28	B	I	S,D		50.0	1.875
H726	H	N0892.35	W0612.66	1297.46	B	I	U,W		28.05	1.875
H727	H	N0892.24	W0613.22	1297.19	B	I	U,W		17.4	1.875
H728	H	N0892.24	W0612.75	1288.09	B	I	D,W		26.9	1.875
H729	H	N0891.44	W0613.51	1288.34	B	I	D,W		17.5	1.875
HF1		N0079	E0167.5	1267	A	HF	E	0	50	4
HF2	Ge	N1110	W0685	1294	A	HF	W	0	512	4
HF3	Ge	N1110	W0685	1294	A	HF	W	0	74	4
HX50	H	N0846.57	W0629.71	1287.09	B	I	D	90	3.0	3.0
HX51	H	N0920.5	W0592	1289	A	I	NE,D	45	50.70	4.0
ID1	4					ID	E	0	100	1.875
ID2	4					ID	E	0	100	1.875

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ID3	4					ID	S	0	100	1.875
ID4	4					ID	E	0	55	3
IG201	2	N1276.07	W0378.75	1294.97	B	I	D	90	54	4.5
IG202	1	N1265.32	W0245.35	1296.49	B	I	D	90	47.5	4.5
IG203	2	N1276.18	W0379.31	1307.30	B	I	U	90	52	4.5
IG204	2	N1275.87	W0349.99	1307.22	B	I	U	90	52	4.5
IG205	1	N1265.47	W0245.94	1310.29	B	I	U	90	56	4.5
IG206	1	N1265.27	W0216.92	1309.52	B	I	U	90	52	4.5
IG211	2	N1275.75	W0348.81	1306.73	B	I	E	0	17	4.5
IG212	2	N1275.97	W0348.53	1296.88	B	I	E	0	17	4.5
IG213	2	N1275.96	W0379.84	1307.07	B	I	W	0	17	4.5
IG214	2	N1276.26	W0380.18	1296.87	B	I	W	0	17	4.5
IG215	1	N1265.39	W0215.88	1309.28	B	I	E	0	16.5	4.5
IG216	1	N1265.39	W0215.71	1298.70	B	I	E	0	16.5	4.5
IG217	1	N1265.4	W0247.18	1309.28	B	I	W	0	16.5	4.5
IG218	1	N1265.59	W0247.51	1298.88	B	I	W	0	16.5	4.5
IG219	3	N1265.63	W0481.94	1305.09	B	I	E	0	17	4.5
IG220	3	N1265.60	W0480.86	1293.53	B	I	E	0	17	4.5
IG221	3	N1265.59	W0513.19	1304.87	B	I	W	0	17	4.5
IG222	3	N1265.86	W0513.33	1293.59	B	I	W	0	17	4.5
IG223	4	N1274.65	W0614.78	1304.20	B	I	E	0	16.5	4.5
IG224	4	N1274.01	W0612.80	1294.35	B	I	E	0	16.5	4.5
IG225	4	N1274.72	W0646.07	1303.93	B	I	W	0	16.5	4.5
IG226	4	N1275.04	W0646.14	1293.91	B	I	W	0	16.5	4.5
IG227	D				D	I				
IG228	D				D	I				
JV1	J	N1004	W0367	1288	A	CON	D	90	8	36
JV2	J	N1008	W0367	1288	A	CON	D	90	7.39	36
JV3	J	N1019	W0367	1288	A	CON	D	90	8	36
JV4	J	N1055	W0367	1289	A	CON	D	90	8	36
JV5	J	N1060	W0367	1290	A	CON	D	90	8	36
JV6	J	N1065	W0367	1290	A	CON	D	90	36	7.5
JV7	J	N1067	W0367	1290	A	CON	D	90	7.5	36
JV8	J	N1067	W0374	1290	A	CON	D	90	8.1	36
JV9	J	N1067	W0378	1290	A	CON	D	90	8.1	36
L1PD01	L1	N1500	W0231.5	1312	A	DD	D	90	45	5
L1PU01	L1	N1500	W0231.5	1325	A	DD	U	90	50	5
L1S02	L1	N1534.1	W0220	1312	A	EX	D	90	12.2	2
L1S03	L1	N1534.1	W0222	1312	A	EX	D	90	12.1	2
L1S04	L1	N1534.1	W0224	1312	A	EX	D	90	12.1	2
L1S05	L1	N1534.1	226	1312	A	EX	D	90	12.0	2
L1S06	L1	N1534.1	W0228	1312	A	EX	D	90	12.0	2
L1S07	L1	N1534.1	W0235	1312	A	EX	D	90	12.0	2
L1S08	L1	N1534.1	W0237	1312	A	EX	D	90	12.0	2
L1S09	L1	N1534.1	W0239	1312	A	EX	D	90	12.0	2
L1S10	L1	N1534.1	W0241	1312	A	EX	D	90	12.0	2
L1X00	L1	N1538.5	W0225	1312	A	C	D	90	12.55	4
L1X11	L1	N1534.1	W0243	1312	A	EX	D	90	12.0	2
L1X12	L1	N1534.1	W0245	1312	A	EX	D	90	12.0	2
L1XS01	L1	N1534.1	W0218	1312	A	EX	D	90	12	2
L2C03	L2	N1510	W0365	1312.5	A	EX	D	90	12?	16
L2C25	L2	N1510	W0365	1312	D	EX,C	D	90	12	5
L2C29	L2	N1515	W0365	1312.5	A	EX,C	D	90	8.0	8
L2CO2	L2	N1534.19	W0375.05	1312.5	A	EX	D	90	12	30
L2CO4	L2	N1524.19	W0375.05	1312.5	A	EX	D	90	12	30
L2PD01	L2	N1500	W0364.5	1312.4	A	DD	D	90	13.0	5
L2PH01	L2	N1540.19	W0364.5	1317	A	DD	N	0	25.0	5
L2PU01	L2	N1535	W0364.5	1325	A	DD	U	90	25.4	5
L2PU02	L2	N1500	W0364.5	1325	A	DD	U	90	9.2	5
L2S01	L2	1535.8	W0375.3	1312.5	A	EX	D	90	12.0	1.875
L2S02	L2	N1535.6	W0375.6	1312.5	A	EX	D	90	12.0	1.875
L2S03	L2	N1535.3	W0375.9	1312.5	A	EX	D	90	12.0	1.875
L2S04	L2	N1535.0	W0376.2	1312.5	A	EX	D	90	12.0	1.875
L2S05	L2	N1534.7	W0376.5	1312.5	A	EX	D	90	12.0	1.875

APPENDIX A
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1439 Records of Holes Drilled Before July 1985
(NOTE: This List Contains Unchecked Information)

Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
L2S06	L2	N1534.4	W0376.65	1312.5	A	EX	D	90	12.0	1.875
L2S07	L2	N1534.1	W0376.65	1312.5	A	EX	D	90	12.0	1.875
L2S08	L2	N1533.8	W0376.5	1312.5	A	EX	D	90	12.0	1.875
L2S09	L2	N1533.5	W0376.2	1312.5	A	EX	D	90	12.0	1.875
L2S10	L2	N1533.2	W0375.9	1312.5	A	EX	D	90	12.0	1.875
L2S11	L2	N1532.9	W0375.6	1312.5	A	EX	D	90	12.0	1.875
L2S12	L2	N1532.6	W0375.3	1312.5	A	EX	D	90	12.0	1.875
L2S13	L2	N1532.6	W0375.0	1312.5	A	EX	D	90	12.0	1.875
L2S14	L2	N1532.9	W0374.7	1312.5	A	EX	D	90	12.0	1.875
L2S15	L2	N1533.2	W0374.4	1312.5	A	EX	D	90	12.0	1.875
L2S16	L2	N1533.5	W0374.1	1312.5	A	EX	D	90	12.0	1.875
L2S17	L2	N1533.8	W0373.8	1312.5	A	EX	D	90	12.0	1.875
L2S18	L2	N1534.1	W0373.45	1312.5	A	EX	D	90	12.0	1.875
L2S19	L2	N1534.4	W0373.45	1312.5	A	EX	D	90	12.0	1.875
L2S20	L2	N1534.7	W0373.8	1312.5	A	EX	D	90	12.0	1.875
L2S21	L2	N1535.0	W0374.1	1312.5	A	EX	D	90	12.0	1.875
L2S22	L2	N1535.3	W0374.4	1312.5	A	EX	D	90	12.0	1.875
L2S23	L2	N1535.6	W0374.7	1312.5	A	EX	D	90	12.0	1.875
L2S24	L2	N1515.8	W0375.0	1312.5	A	EX	D	90	12.0	1.875
L2S25	L2	N1515	W0365	1312.5	A	EX	D	90	12.0	2
L2S26	L2	N1515	W0365	1312.5	A	EX	D	90	12.0	2
L2S27	L2	N1515	W0365	1312.5	A	EX	D	90	12.0	2
L2S28	L2	N1515	W0365	1312.5	A	EX	D	90	12.0	2
L2S29	L2	N1515	W0365	1312.5	A	C	D	90	7.7	5
L2S30	L2	N1535.8	W0354.43	1312.5	A	EX	D	90	12	4
L2S31	L2	N1534.9	W0354.9	1312.5	A	EX	D	90	12	4
L2S32	L2	N1534.2	W0355.6	1312.5	A	EX	D	90	12	4
L2S33	L2	N1533.8	W0355.6	1312.5	A	EX	D	90	12	4
L2S34	L2	N1533.2	W0354.9	1312.5	A	EX	D	90	12	4
L2S35	L2	N1532.6	W0354.3	1312.5	A	EX	D	90	12	4
L2S36	L2	N1532.6	W0353.7	1312.5	A	EX	D	90	12	4
L2S37	L2	N1533.2	W0353.0	1312.5	A	EX	D	90	12	4
L2S38	L2	N1533.8	W0352.4	1312.5	A	EX	D	90	12	4
L2S39	L2	N1534.2	W0352.4	1312.5	A	EX	D	90	12	4
L2S40	L2	N1534.9	W0353.0	1312.5	A	EX	D	90	12	4
L2S41	L2	N1535.8	W0353.7	1312.5	A	EX	D	90	12	4
L2S42	L2	N1525.8	W0375.3	1312.5	A	EX	D	90	12	4
L2S43	L2	N1525.2	W0375.9	1312.5	A	EX	D	90	12	4
L2S44	L2	N1524.5	W0376.7	1312.5	A	EX	D	90	12	4
L2S45	L2	N1523.9	W0376.7	1312.5	A	EX	D	90	12	4
L2S46	L2	N1523.2	W0375.9	1312.5	A	EX	D	90	12	4
L2S47	L2	N1522.6	W0375.3	1312.5	A	EX	D	90	12	4
L2S48	L2	N1522.6	W0374.7	1312.5	A	EX	D	90	12	4
L2S49	L2	N1523.2	W0374.1	1312.5	A	EX	D	90	12	4
L2S50	L2	N1523.9	W0373.8	1312.5	A	EX	D	90	12	4
L2S51	L2	N1524.5	W0373.8	1312.5	A	EX	D	90	12	4
L2S52	L2	N1525.2	W0374.1	1312.5	A	EX	D	90	12	4
L2S53	L2	N1525.8	W0374.7	1312.5	A	EX	D	90	12	4
L2T01	L2	N1535.8	W0375.05	1312.5	A	EX	D	90	12.0	1.875
L2T02	L2	N1532.6	W0375.05	1312.5	A	EX	D	90	12.0	1.875
L2T03	L2	N1535.8	W0353.95	1312.5	A	EX	D	90	12	1.875
L2T04	L2	N1532.6	W0353.95	1312.5	A	EX	D	90	12	1.875
L2T05	L2	N1525.79	W0375.05	1312.5	A	EX	D	90	12	1.875
L2T06	L2	N1522.59	W0375.05	1312.5	A	EX	D	90	12	1.875
LH1	4	?? New	Number		D	C				
LH2	4	?? New	Number		D	C				
LH3	4	?? New	Number		D	C				
LH4	4	?? New	Number		D	C				
LMG1		S0016	W0006	1277	A	I	U	90	6.25	1
LMG2		S0028	W0009	1276.5	A	I	U	90	5.9	1
LMG3		S0028	W0003	1276.5	A	I	U	90	6.3	1
LMG4		S0065	W0007	1274	A	I	U	90	8.6	1
MAA01	M	N1425.17	E1688.9	1300	P	EX	D,E	60	11.66	4
MAA11	M	N1453.67	E1688.9	1300	P	EX	D,W	60	12.0	4

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Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
MAA12	M	N1455.67	E1688.9	1300	P	EX	D,E	60	12.0	4
MAA21	M	N1459.17	E1689.9	1300	P	EX	D,W	60	13.25	4
MAA22	M	N1461.17	E1687.9	1300	A	EX	D,E	60	13.25	4
MAA31	M	N1446.17	E1691.3	1300	A	EX	D,W	60	14.25	4
MAA32	M	N1449.17	E1686.5	1300	P	EX	D,E	60	14.25	4
MAE11	M	N1453.67	E1682.9	1300	P	EX	D	90	10.27	6
MAE12	M	N1455.67	E1694.9	1300	P	EX	D	90	10.27	6
MAE21	M	N1459.17	E1682.9	1300	P	EX	D	90	11.27	16
MAE22	M	N1461.17	E1694.9	1300	P	EX	D	90	11.27	16
MAE31	M	N1446.17	E1682.9	1300	P	EX	D	90	12.27	36
MAE32	M	N1449.17	E1694.9	1300	P	EX	D	90	12.27	36
MAI11	M	N1454.47	E1682.9	1300	P	EX	D	90	6.66	1.87
MAI12	M	N1452.87	E1682.9	1300	P	EX	D	90	6.66	1.87
MAI21	M	N1460.42	E1682.9	1300	P	EX	D	90	7.16	1.87
MAI22	M	N1457.92	E1682.9	1300	P	EX	D	90	7.16	1.87
MAI31	M	N1448.27	E1682.9	1300	P	EX	D	90	7.66	1.87
MAI32	M	N1444.07	E1682.9	1300	P	EX	D	90	7.66	1.87
MAP01	M	N1425.17	E1694.9	1300	P	EX	D	90	10	6
MAP02	M	N1421.17	E1694.9	1300	P	EX	D	90	10	4
MB139-1		N0079	W0006	1264.1	A	C	D	90	10.0	3
MB139-2		S0410	E0150	1251.2	A	C	D	90	15.7	3
MB139-3		S0101	E0157	1260.5	A	C	D	90	16.0	3
MB139-4		S0099	W0017	1258.7	A	C	D	90	16.2	3
MIIT01	J	N1087.99	W0379.09	1290.99	B	EX	D	90	3.1	3.25
MIIT02	J	N1088.03	W0377.02	1290.81	B	EX	D	90	2.9	3.25
MIIT03	J	N1086.02	W0379.09	1290.89	B	EX	D	90	3.2	3.25
MIIT04	J	N1086.05	W0377.13	1290.82	B	EX	D	90	2.77	3.25
MIIT05	J	N1084.07	W0379.04	1290.78	B	EX	D	90	3.07	3.25
MIIT06	J	N1084.06	W0377.15	1290.55	B	EX	D	90	3.12	3.25
MIIT07	J	N1084.07	W0379.04	1290.78	B	EX	D	90	3.12	3.25
MIIT08	J	N1082.08	W0377.24	1290.48	B	EX	D	90	3.05	3.25
MIIT09	J	N1080.02	W0379.05	1290.42	B	EX	D	90	2.97	3.25
MIIT10	J	N1079.98	W0377.23	1290.38	B	EX	D	90	3.08	3.25
MIIT11	J	N1078.43	W0379.31	1290.03	B	EX	D	90	2.92	3.25
MIIT12	J	N1078.11	W0377.21	1290.20	B	EX	D	90	3.05	3.25
MIIT13	J	N1075.91	W0379.10	1289.89	B	EX	D	90	3.20	3.25
MIIT14	J	N1076.18	W0377.30	1289.85	B	EX	D	90	3.05	3
MIIT15	J	N1074.21	W0379.01	1289.25	B	EX	D	90	2.90	3
MIIT16	J	N1074.17	W0377.18	1289.2	B	EX	D	90	2.98	3
MIIT17	J	N1072.03	W0379.10	1290.31	B	EX	D	90	3.25	3
MIIT18	J	N1071.91	W0377.18	1290.25	B	EX	D	90	2.92	3
MIIT19	J	N1069.99	W0379.08	1290.77	A	EX	D	90	6.10	3
MIIT20	J	N1069.84	W0377.22	1290.34	B	EX	D	90	5.98	3
MIIT21	J	N1068.04	W0379.08	1290.60	B	EX	D	90	5.92	3
MIIT22	J	N1067.93	W0377.23	1290.44	B	EX	D	90	5.82	3
MIIT23	J	N1065.74	W0379.22	1260.77	B	EX	D	90	6.35	3
MIIT24	J	N1065.79	W0377.21	1290.74	B	EX	D	90	5.98	3
MIIT25	J	N1074.01	W0361.72	1291	B	EX	D	90	3.0	3
MIIT26	J	N1088.18	W0359.95	1290.77	B	EX	D	90	2.9	3
MIIT27	J	N1076.14	W0361.70	1291.03	B	EX	D	90	3.0	3
MIIT28	J	N1086.16	W0359.89	1290.67	B	EX	D	90	2.8	3
MIIT29	J	N1078.04	W0361.77	1290.98	B	EX	D	90	3.0	3
MIIT30	J	N1084.12	W0359.82	1290.59	B	EX	D	90	3.0	3
MIIT31	J	N1080.18	W0361.86	1291.09	B	EX	D	90	3.0	3
MIIT32	J	N1082.14	W0359.82	1290.80	B	EX	D	90	2.9	3
MIIT33	J	N1082.21	W0361.74	1291.18	B	EX	D	90	3.0	3
MIIT34	J	N1080.08	W0359.88	1291.04	B	EX	D	90	3.0	3
MIIT35	J	N1084.18	W0361.96	1291.22	B	EX	D	90	3.0	3
MIIT36	J	N1078.12	W0359.78	1290.93	B	EX	D	90	3.0	3
MIIT37	J	N1086.18	W0361.87	1291.23	B	EX	D	90	3.0	3
MIIT38	J	N1076.07	W0359.77	1290.71	B	EX	D	90	3.0	3
MIIT39	J	N1088.26	W0361.92	1290.93	B	EX	D	90	2.9	3
MIIT40	J	N1074.06	W0359.61	1290.88	B	EX	D	90	3.0	3
MIITP	J	N1067	W0378	1290.8	A	P	D	90	8.8	1.5

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Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
N950A		N0949	E0000	1264	A	Gt	U	90	15.5	1
NG252	2	N1277.02	W0380.66	1294.89	B	I	D	90	7	1.5
NG254	2	N1276.39	W0380.29	1294.92	B	I	D	90	7	1.5
NG255	2	N1278.52	W0380.66	1294.89	B	I	D	90	7	1.5
NG256	2	N1276.39	W0382	1295	A	I	D	90	7	1.5
NoNumber		N0079	E0167.5	1267.8	A	?	E	0	25+	2
NoNumber		N0079	E0167.5	1288.5	A	?	E,U	10	25+	2
NoNumber		N0070	E0167.5	1269.9	A	?	E,U	20	25+	2
NoNumber		N1099	E0001	1310.6	A	Dril	U	90	3	8
NoNumber		N1099	E0001	1310.6	A	Dril	U	90	3	2
OH02		S0402	E0143	1260.5	A	O	U	90	20	4
OH03	2	N1265	W0364.5	1307.7	A	O	U	90	20.0	4
OH04		N1115.14	W0363.04	1309.72	A	O	U	90	20.0	4
OH05		S0400	E0045	1261	A	O	U	90	20.0	4
OH06		N1100	W0005	1310.6	A	O	U	90	20.0	4
OH07		S0070	E0000	1274	A	O	U	90	20.0	4
OH08		N0139	W0004	1280.4	A	O	U	90	20.0	4
OH09		N1433	W0231.5	1310	A	O	U	90	15.4	4
OH10		N1420	W0230	1310	A	O	U	90	21.0	4
OH11		N1433	W0364.5	1308	A	O	U	90	19.7	4
OH12		N1420	W0365	1308	A	O	U	90	18	4
OH13		N1433	W0231.5	1298	A	O	D	90	9.5	4
OH14		N1433	W0364.5	1296	A	O	D	90	9.7	4
P4001	4	N1155	W0613	1304	A	EX	U,E	45	34.4	4
P4002	4	N1143	W0613	1304	A	EX	U,E	45	34.4	4
P4003	4	N1151	W0613	1304	A	EX	U,E	45	34.4	4
P4004	4	N1148	W0613	1304	A	EX	U,E	45	34.4	4
P4301	4	N1168.6	W0614.4	1297.1	P	I	E	0	50	1.875
P4351	4	N1165.3	W0614.3	1297.1	P	I	E	90	33	3
P4399	4	N1170.4	W0614.3	1297.1	P	I	E	90	30	1.875
P4511	4	N1265.0	W0614	1298.5	P	I	E	0	48	2.5
P4512	4	N1260.0	W0614.0	1298.5	P	I	E	0	48	2.5
P4513	4	N1255.0	W0614.0	1298.5	P	I	E	0	48	2.5
P4514	4	N1250.0	W0614.0	1298.5	P	I	E	0	48	2.5
P4521	4	N1284	W0614	1298.5	A	I	E	0	48	2.5
P4522	4	N1289	W0614	1298.5	A	I	E	0	48	2.5
P4523	4	N1294	W0614	1298.5	A	I	E	0	48	2.5
P4524	4	N1299	W0614	1298.5	A	I	E	0	48	2.5
P4525	4	N1304	W0614	1298.5	A	I	E	0	49.0	4
P4531	4	N1240.0	W0614.0	1298.5	P	I	E	0	49	2
P4532	4	N1235.0	W0614.0	1298.5	P	I	E	0	49	2
P4541	4	N1309	W0614	1298.5	A	I	E	0	48?	3
P4542	4	N1314	W0614	1298.5	A	I	E	0	48?	3
P4701	4	N1171.0	W0614.2	1297.1	P	I	E	0	50	1.875
P4702	4	N1160.0	W0619.0	1305.0	P	EX	U,E	45?	150	2
P4X01	4	N1395	W0630.5?	1292	A	C	D	90	8	5.25
P4X02	4	N1386.5	W0633.5	1292.0	P	C	D	90	8	5.25
P4X03	4	N1389.8	W0627.5	1292.0	P	C	D	90	8	5.25
P4X04	4	N1373.3	W0633.5	1292.0	P	C	D	90	8	5.25
P4X05	4	N1379.1	W0630.5	1292.0	P	C	D	90	8	5.25
P4X06	4	N1373.9	W0627.5	1292.0	P	C	D	90	8	5.25
P4X15	4				D	RM,D				
P4X16	4	N1358	W0646	1299	A	RM	W	0	10.5	16
P4X17	4	N1358	W0646	1296	A	RM	W	0	10.1	16
P4X18	4	N1148	W0613	1302	A	CS	E	0	5.9	16
P4X19	4	N1143	W0613	1302	A	CS	E	0	6.0	16
P4X20	4					C	D	90	15.0	4
P4X20A	4				A	C	D	90	17.9	16
P4X21		N1440	W0510	1302	A	CS	N	0	3	16
P4X25	4	N1364	W0631	1292	A	C,RM	D	90	50.2	5
P4X26	4	N1364	W0631	1305	A	C	U	90	52.1	5
P4X27	4	N1361	W0631	1292	A	C	D	90	51.05	5
P4X28	4	N1361	W0631	1305	A	C	U	90	50.4	4
P4X29	4	N1362.6	W0627.5	1292	A	C	D	90	49.5	5

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P4X30	4	N1360	W0628.5	1305	A	C	U	90	50.9	4
P4X31	4	N1360	W0628.5	1292	A	C	D	90	50.35	5
P4X32	4	N1346	W0631	1292	A	C	D	90		NX
P4X40		N1122.0	W0582.5	1294.5	A	AE	N	0	11.4	3
P4X41		N1122.0	W0581.5	1295.0	A	AE	N	0	10.5	3
P4X42		N1122.0	W0581.5	1297.0	A	AE	N	0	10.55	3
P4X43		N1122.0	W0581.5	1301.0	P	AE	N	0	10.95	3
P4X44		N1122.0	W0579.5	1295.0	A	AE	N	0	10.88	3
P4X45		N1122.0	W0573.0	1295.0	A	AE	N	0	11.44	3
P4X46		N1122.0	W0580.5	1296.2	A	C,AE	N	0	9.5	4
P4X50	4	N1160.0	W0614.0	1297.0	P	DD	E	0	100	1.875
P4X51	4	N1151.0	W0614.0	1297.0	P	DD	E	0	100	3
P4X52	4	N1160.0	W0619.0	1292.25	P	DD	D	90	50	2
P4X61	4	N1141	W0643.5	1297	A	DD	W	0	50	1.875
P4X81	4	N1141	W0643.5	1294	A	C,DD	D	90	18.7	16
P4X82	4	N1141	W0631	1294	A	C,DD	D	90	17.0	30
P4X83	4	N1155	W0643	1294	A	C,DD	D	90	6.1	16
P4X84	4	N1138	W0644	1294	A	C	D	90	15.7	36
P4X85	4	N1163?	W0643	1294	A	C,DD	D	90	?	36
P4X86	4	N1113	W0613	1302.5	A	DD	E	0	1.9	16.5
P4X?1	4	N1358	W0643	1305	A		U	90	7	6
P4X?2	4	N1143	W0613	1296	A		E	0		
P4X?3	4	N1170	W0646	1294	A		W	0	25+	2.5
P4X?4	4	N1173	W0646	1294	A	I	W	0	13+	2
P4X?5	4	N1177	W0642.5	1292	A		D	90	7	5
P4X?6	4	N1141	W0643.5	1298	A		W	0		1.875
P4X?7	4	N1235	W0625	1293	A		U	90		5?
P4X?9	4					ST	U	90	50	4
P4X?9A	4					C,RM	W	0	10	16
PC1	4	?? New	Number			I	E	0	50	3
PC2	4	?? New	Number			I	E	0	50	3
PC3	4	?? New	Number			I	E	0	50	3
PC4	4	?? New	Number		D	I				
PR01		S1000	E0140	1260	A	PR	U	90	20	2
PR02		S1600	E0140	1271.2	A	PR	U	90	20	2
PR03		S2182	E0140	1263	A	PR	U	90	20	2
PR04		S2748	E0140	1250	A	PR	U	90	20	2
PR05		S3314	E0140	1250	A	PR	U	90	20	2
PR06		S0090	E0140	1274	A	PR	U	90	20	2
PR07		N0460	E0000	1286	A	PR	U	90	20	2
PR08		N0460	E0140	1287	A	PR	U	90	20	2
PR09		N0780	E0000	1298	A	PR	U	90	20	2
PR10		N0780	E0140	1298	A	PR	U	90	20	2
PR11		N1420	W0365	1309	A	PR	U	90	20	2
PR12		N1100	W0620	1305	A	PR	U	90	20	2
PR13		N1420	W0620	1305	A	PR	U	90	20	2
PR14		N1100	E0140	1309	A	PR	U	90	20	2
PR15		N0140	E0140	1280	A	PR	U	90	20	2
PR16		N1420	W0498	1306	A	PR	U	90	20	2
PR17		S0398	E0138	1260.5	A	PR	U	90	20	2
PR?		N1109	E0348	1318	A	PR	U	90	20?	2
PR?		N1109	E0456.5	1318	A	PR	U	90	20?	2
PR?		N1112	E1411	1320	A	PR	U	90	20?	2
RM1	4	?? New	Number		D	C				
RM2	4	?? New	Number		D	C				
RM3	4	?? New	Number		D	C				
RM4	4	?? New	Number		D	C				
RM5	4	?? New	Number		D	C				
RM6	4	?? New	Number		D	C				
RM7	4	?? New	Number		D	C				
S1160A		S1160	E0140	1265	A	Gt	U	90	47	3.5
S2575A		S2575	E0140	1266	A	Gt	U	90	12.9	1
S550A		S0550	E0140	1260	A	Gt	U	90	12.9	1
S850A		S0850	E0140	1259	A	Gt	U	90	8.8	1

APPENDIX A
PRELIMINARY INVENTORY OF UNDERGROUND DRILL HOLES AT WIPP
1439 Records of Holes Drilled Before July 1985
(NOTE: This List Contains Unchecked Information)

Hole Number	Room	N-S Coord.	E-W Coord.	Elevation	Accuracy	Purp.	Dir.	Angle	Depth (Ft)	Dia. (In)
S850C		S0850	E0140	1251	A	Gt	D	90	16.1	1
SH1	4	?? New	Number			ST	D	90	44	4
SH2	4	?? New	Number			ST	U	90	50	5.25
SH3	4	?? New	Number			ST	D	90	50	5.25
SH4	4	?? New	Number			ST	D	90	50	5.25
SH5	4	?? New	Number			LT,S	W	0	10	16
SM01	4	?? New	Number			I	E	0	50	1.875
SM02	4	?? New	Number			I	E	0	50	1.875
SM03	4	?? New	Number			I	E	0	50	1.875
SM04	4	?? New	Number			I	E	0	50	1.875
SM05	4	?? New	Number			I	E	0	50	1.875
SM06	4	?? New	Number			I	E	0	50	2.25
SM07	4	?? New	Number			I	E	0	50	2.25
SM08	4	?? New	Number			I	E	0	50	2.25
SM09	4	?? New	Number			I	E	0	50	2.25
SM10	4	?? New	Number			I	E	0	50	2.25
SM11		N0237.7	E0153	1280	A	I	E	0	50	3
SM12		N0232.2	E0153	1280	A	I	E	0	50	3
SM13		N0227.2	E0153	1280	A	I	E	0	50	3
SM14		N0222.4	E0153	1280	A	I	E	0	50	3
SM15		N0217.0	E0153	1280	A	I	E	0	50	3
SM16		N0211.8	E0153	1280	A	I	E	0	50	3
T15	T				A	C				
T19	T				A	C				
V1SE		S0436	W0013	1262	A	LT,C	U	90	2.6	4
V2SE		S0437	W0012	1262	A	LT,C	U	90	3.5	4
V3SF		S0438	W0018	1262	A	LT,C	U	90	4.3	4
WG201		S0030	W0004	1276	A	I	U	90	15	1.62
WG202		S0030	E0004	1276	A	I	U	90	15	1.62
WG203		S0065	W0004	1274	A	I	U	90	10	1.62
WG204		S0065	E0004	1274	A	I	U	90	10	1.62

APPENDIX B
LIST OF UNDERGROUND DRILL HOLES WHERE BRINE OCCURRENCES WERE OBSERVED AND MONITORED FOR PHASE I OF THE BRINE SAMPLING AND EVALUATION PROGRAM AT WIPP.

Hole Number	Room	Location Accuracy S=Survey A=Approx	N-S Coord	E-W Coord	Elevation	Dia. (in)	Depth (ft)	Direction	Angle	References	Remarks Brine, gas and general.
A1X01	A1	S	N1147.02	E1254.40	1313.26	4	49.75	D	90	B, D, E	Monitored as part of the BSEP since it was drilled in 3/85.
A1X02	A1	S	N1146.88	E1254.24	1331.29	4	59.0	U	90	B, D, E	Monitored as part of the BSEP since it was drilled in 3/85.
A2X01	A2	S	N1393.72	E1338.88	1311.20	4	50.15	D	90	B, D, E	Monitored as part of the BSEP since it was drilled in 2/85
A2X02	A2	S	N1393.65	E1338.89	1328.86	4	52.75	U	90	B, D, E	Monitored as part of the BSEP since it was drilled in 2/85.
A3X01	A3	S	N1137.94	E1406.84	1309.78	4	50.5	D	90	B, D, E	Monitored as part of the BSEP since it was drilled in 1/85. Drillers did not report any moisture while drilling. Hole started producing brine few weeks later.
A3X02	A3	S	P1138.00	E1406.89	1327.93	4	50.75	U	90	B, D, E	Monitored as part of the BSEP since it was drilled 1/85. Drillers did not encounter moisture while drilling. Hole started producing brine few weeks later.
BX01	B	S	N1384.68	E0982.33	1317.44	4	50.15	D	90	B, E	Monitored as part of the BSEP since it was drilled in 1/85.
BX02	B	S	N1384.44	E0982.87	1335.47	4	49.25	U	90	B, E	Monitored as part of the BSEP since it was drilled in 1/85.
DH035	G	A	N1102	W1882	1294.4	3.5	52.0	U	90	A3, B	Monitored as part of BSEP since 2/85.
DH036	G	A	N1102	W1882	1284.6	3.5	51.5	D	90	A3, B	Monitored as part of BSEP since 1/85.
DH037	G	S	N1101	W2182	1297.4	3.5	51.5	U	90	A3, B	Monitored as part of BSEP since 1/85. At the present no brine is collected because of insufficient inflow.
DH038	G	S	N1101	W2182	1287.0	3.5	47.5	D	90	A3, B	Monitored as part of BSEP since 1/85.
DH039	G	S	N1101	W2482	1296.0	3.5	50.7	U	90	A3, B	Monitored as part of BSEP since 2/85. At the present no brine is collected because of insufficient inflow.
DH040	G	S	N1101	W2482	1286.1	3.5	51.0	D	90	A3, B	Monitored as part of BSEP since 1/85.
DH041	G	S	N1101	W2782	1295.8	3.5	49.9	U	90	A3, B	Monitored as part of BSEP since 2/85. At the present no brine is collected because of insufficient inflow.
DH042	G	S	N1101	W2782	1285.9	3.5	51.2	D	90	A3, B	Monitored as part of the BSEP since 2/85.
DH042A	G	S	N1101	W2789	1285.7	3.5	40.5	D	90	A3, B	Monitored as part of the BSEP since 2/85.
DH215		S	S1960	E0153	1272.0	3	52.0	U	90	A1, B	Gas releases had been observed in this hole. Monitored as part of the BSEP since 1/85.
DH216		S	S1960	E0153	1262.6	3	54.2	D	90	A1, B	Gas releases had been observed in this hole. Monitored as part of the BSEP from 1/85 to 6/85.
DH317		S	S1600	W0033	1271.3	3	50.1	U	90	A2, B	Stalactite growth monitored as part of BSEP from 05/07/85 to 01/31/86.
DH317A		S	S1600	W0030	1271.2	3	5.0	U	90	A2, B	Stalactite growth monitored as part of BSEP from 05/07/85 to 01/31/86.
DH317B		S	S1597	W0030	1271.2	3.5	51.0	U	90	A2, B	Gas pocket at 45.91. Brine seeped from hole after drill rods were broken at end of run at depth of 16.3 ft. Probable source was anhydrite "a". Monitored as part of BSEP from 05/07/85 to 01/31/86.
IG201	2	S	N1275.54	W0379.51	1294.97	2.875	53.83	D	90	A3, B, H, J	Monitored as part of BSEP since 11/84.
IG202	1	S	N1264.79	W0246.11	1296.49	2.875	48.16	D	90	A3, B, H, J	Monitored as part of BSEP since 11/84.
JV8	J	S	N1067	W0374	1290	36	8.1	D	90	D, F, G	Drilled 8/08/85, drillers reported water at 7 ft 10 inches.
JV9	J	S	N1067	W0378	1290.4	36	8.1	D	90	D, G	Brine in bottom of pilot hole on 8/20/85.
L1S25	L1	A	N1524	W0218	1312	4	11.90	D	90	B, H	Monitored as part of BSEP since 12/10/85.
L1S26	L1	A	N1524	W0220	1312	4	11.72	D	90	B, H	Monitored as part of BSEP since 12/10/85.
L1S27	L1	A	N1524	W0222	1312	4	11.93	D	90	B, H	Monitored as part of BSEP since 12/10/85.
L1S29	L1	A	N1524	W0226	1312	4	12.03	D	90	B, H	Monitored as part of BSEP since 12/10/85.
L1S30	L1	A	N1524	W0228	1312	4	12.18	D	90	B, H	Monitored as part of BSEP since 12/10/85.
L1S32	L1	A	N1524	W0237	1312	4	11.95	D	90	B, H	Monitored as part of BSEP since 12/10/85.
L1S33	L1	A	N1524	W0239	1312	4	11.98	D	90	B, H	Monitored as part of BSEP since 12/10/85.

APPENDIX B
LIST OF UNDERGROUND DRILL HOLES WHERE BRINE OCCURRENCES WERE OBSERVED AND MONITORED FOR PHASE I OF THE BRINE SAMPLING AND EVALUATION PROGRAM AT WIPP.

Hole Number	Room	Location Accuracy S=Survey A=Approx	N-S Coord	E-W Coord	Elevation	Dia. (in)	Depth (ft)	Direction	Angle	References	Remarks Brine,gas and general.
L1S36	L1	A	N1524	W0245	1312	4	12.22	D	90	B, H	Monitored as part of BSEP since 12/10/85.
L1X00	L1	A	N1538.5	W0225	1312	4	12.45	D	90	B, H	Drillers reported "found water in hole at 10 ft, 5/13/84", monitored since 10/26/84.
L2C25	L1	A	N1510	W0365	1312	5	11.36	D	90	B, H	Monitored as part of BSEP since 12/17/85.
MIIT02	J	S	N1088.03	W0377.02	1290.81	3.25	2.9	D	90	B, D, G	Brine since drilled, monitored from 10/26/85 to 4/23/85.
MIIT04	J	S	N1086.05	W0377.13	1290.82	3.25	3.275	D	90	B, D, G	Brine since drilled, monitored from 10/26/84 through 4/23/85.
MIIT06	J	S	N1084.16	W0377.15	1290.55	3.25	3.125	D	90	B, D, G	Brine since drilled, monitored from 10/26/84 through 4/23/85.
MIIT08	J	S	N1082.08	W0377.24	1290.48	3.25	3.05	D	90	B, D, G	Brine since drilled, monitored from 10/26/84 to 4/23/85.
MIIT10	J	S	N1079.98	W0377.23	1290.38	3.25	3.075	D	90	B, D, G	Brine since drilled, monitored from 10/26/84 through 4/23/85.
MIIT12	J	S	N1078.11	W0377.21	1290.20	3.25	3.05	D	90	B, D, G	Brine since drilled, monitored from 10/26/84 through 4/23/85.
MIIT14	J	S	N1076.18	W0377.30	1289.85	3	3.05	D	90	B, D, G	Brine since drilled, monitored from 10/26/84 through 4/23/85.
MIIT16	J	S	N1074.17	W0377.18	1289.2	3	2.975	D	90	B, D, G	Brine since drilled, monitored from 10/26/84 through 4/23/85.
MIIT17	J	S	N1072.03	W0379.10	1290.31	3	3.250	D	90	B, D, G	Brine since drilled, monitored from 10/26/84 through 4/23/85, Sandia filled hole with Brine A solution 4/30/85.
MIIT18	J	S	N1071.91	W0377.18	1290.25	3	3.925	D	90	B, D, G	Brine since drilled, monitored from 10/26/84 through 4/23/85, Sandia Experiment filled hole with Brine A 04/20/85 and plugged hole with rubber cork.
MIIT20	J	S	N1069.84	W0377.22	1290.34	3	5.975	D	90	B, D, G	Brine noted 10/26/84, monitored from 10/26/84 through 4/23/85.
MIIT22	J	S	N1067.93	W0377.23	1290.44	3	5.825	D	90	B, D, G	Brine noted 10/26/84, monitored from 10/26/84 through 4/23/85.
MIIT24	J	S	N1065.79	W0377.21	1290.74	3	5.975	D	90	B, D, G	Brine noted 10/26/84, monitored 10/26/84 through 4/23/85, Sandia experiment added Brine A to hole 4/30/85 and capped with rubber cork.
MIITP	J	A	N1067	W0378	1290.8	1.5	8.8	D	90	B, F	Brine since drilled, pilot hole for 36-inch diameter hole that was never completed. Monitored from 4/02/85 through 4/23/85.
NG252	2	S	N1275.86	W0381.05	1294.89	1.5	7.54	D	90	A3, B, H, J	Monitored as part of the BSEP since 11/84. This hole continues to produce gas, first time noticed before 10/84.
PR02		A	S1600	E0140	1271.2	2	20	U	90	B, C	Stalactite growth monitored as part of the BSEP from 05/07/1985 to 02/19/1986.
PR03		A	S2182	E0140	1263	2	20	U	90	B, C	Stalactite growth monitored as part of the BSEP from 05/07/85 to 02/19/86.
PR04		A	S2748	E0140	1250	2	20	U	90	B, C	Stalactite growth monitored as part of the BSEP from 05/07/85 to 02/19/86.

APPENDIX C

GAS OCCURRENCES AT THE MINING FACE IN THE WIPP REPOSITORY EXCAVATIONS, MARCH AND APRIL, 1986

by Richard Deshler
IT Corporation

A review of WIPP mining operations shift reports has been made for any documented occurrences of gas at the mining face which were described as "audible" releases prior to March 21, 1986. Only two such documented occurrences were noted. These were reported on February 6, 1983, in the face at E0, N800, and on April 1, 1984 in the C2 alcove.

There were several reports of gas releases from holes drilled into the roof of the facility. This type of occurrence is not uncommon at WIPP and only those occurrences considered anomalous are reported here.

The only notable cases of gas encountered in the face were those which occurred during mining activities in the S2180 area during March and April of 1986. None of these resulted in any personnel injury or property damage. These encounters are described below:

1. A small release occurred during mining in the S2180 drift at about E233 on March 21, 1986. The same day, a horizontal probe hole drilled ahead of the face also encountered gas.

2. A pressure relief hole drilled into the roof of the S1950 and E300 intersection in December, 1985 began venting <u>during mining</u> to the south of this intersection on April 7, 1985. In addition, a small release was noted in the horizontal probe hole in the E300 drift on April 2, 1986.

3. A small release occurred in the face during mining in the E300 drift at about S2140 on April 9, 1986.

REPORT OF GAS OCCURRENCE

Location: S2180 Drift Between E140 and E300

Date: March 21, 1986

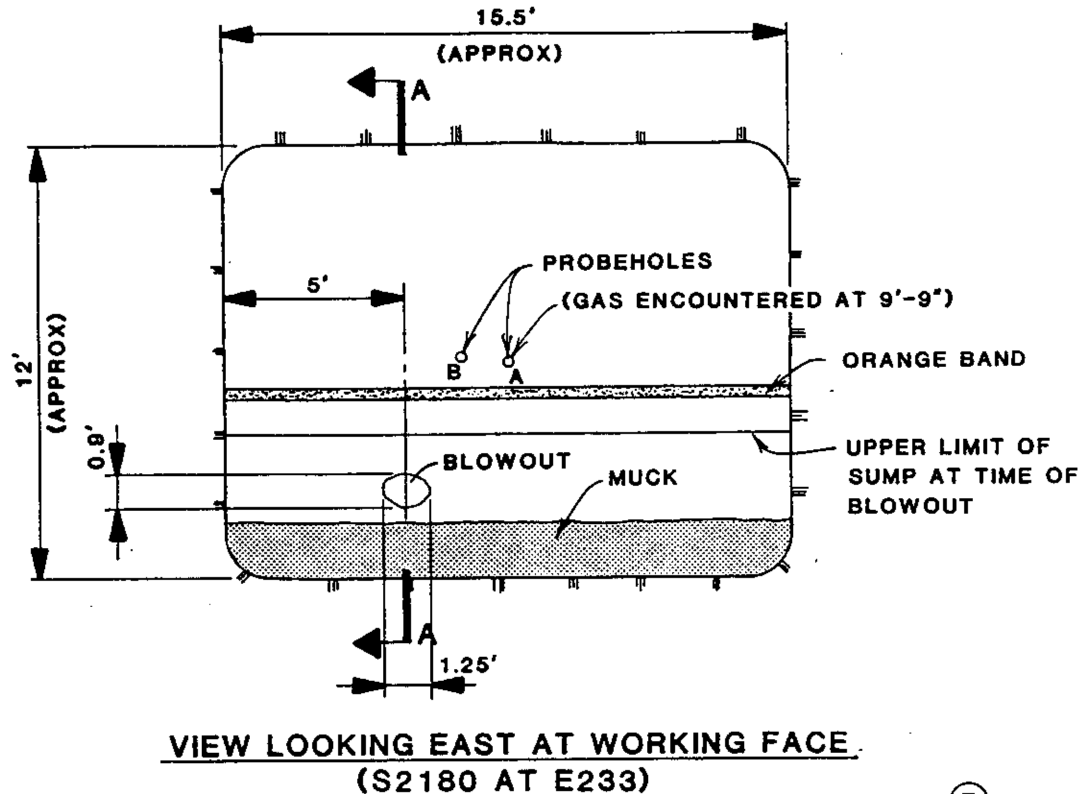
Description:

On Friday, March 21, 1986, at 1:00 p.m. the continuous miner was extending the S2180 drift to the east. While sumping the E233 face, a sudden exfoliation occurred, accompanied by the release of a small quantity of gas. A small slab of rock was thrown into the cutting head of the continuous miner. The miner operators reported hearing a sharp noise which was described as sounding like a shotgun discharge. All personnel were immediately evacuated from the area. All equipment, except the face fan, was shut off, and all appropriate safety and notification procedures were followed. A test was conducted for the presence of CH_4, NO_2, CO, H_2S, and SO_2, none of which were detected.

Inspection of the face showed that an oval-shaped slab of salt had exfoliated from the face. The slab was nearly vertical in orientation, 0.9 ft. high, 1.25 ft. long, and 0.25 ft. thick as shown in Figure C.1. The location was approximately 5 feet south of the north rib and 10 feet below the back. The source of the gas appeared to be two sub-parallel fractures oriented roughly north-south and dipping about 85 degrees to the west. The fractures were very clean, had no infilling, and no visible alteration of the surface. No brine was noted during the first examinations. However, on March 26, 1986, the day after mining, the main fractures stood out as a damp outline on the ribs, roof, and floor of the drift. The fractures appeared to be open 1/16 to 1/8 inch in the vicinity of the release, but mining showed them to be very tight away from the location of the gas release.

After mining was discontinued in the drift, mining operations proceeded to drill a horizontal probe hole close to the center of the face (Hole A, Figure C.1). At 5:00 p.m. the same afternoon, when the drill had penetrated to a depth of 9.75 feet, another fracture containing gas was encountered. The drill and 10 feet of drill steel were ejected from the hole accompanied by a brief noise like "a broken air hose." The area was again evacuated and another test was conducted for the presence of H_2S and SO_2 gas, neither of which were detected. Mining operations were suspended over the weekend. A second horizontal probe hole was drilled on Monday, March 24th, parallel to and about 2 feet north of the first hole, to a depth of 60 feet (Hole B, Figure C.1). No additional gas was noted.

Upon resumption of mining in the drift on March 25th, geotechnical personnel monitored the face advance to describe the fractures and any additional gas occurrences. As the face above the location of the exfoliation was mined, an additional gas release was observed. There was a visible "puff" of dust from the upper north corner of the face above and to the west of the exfoliation site. The continuous miner was shut down immediately, but no additional indications of a gas release were noted. This release came from a fracture which



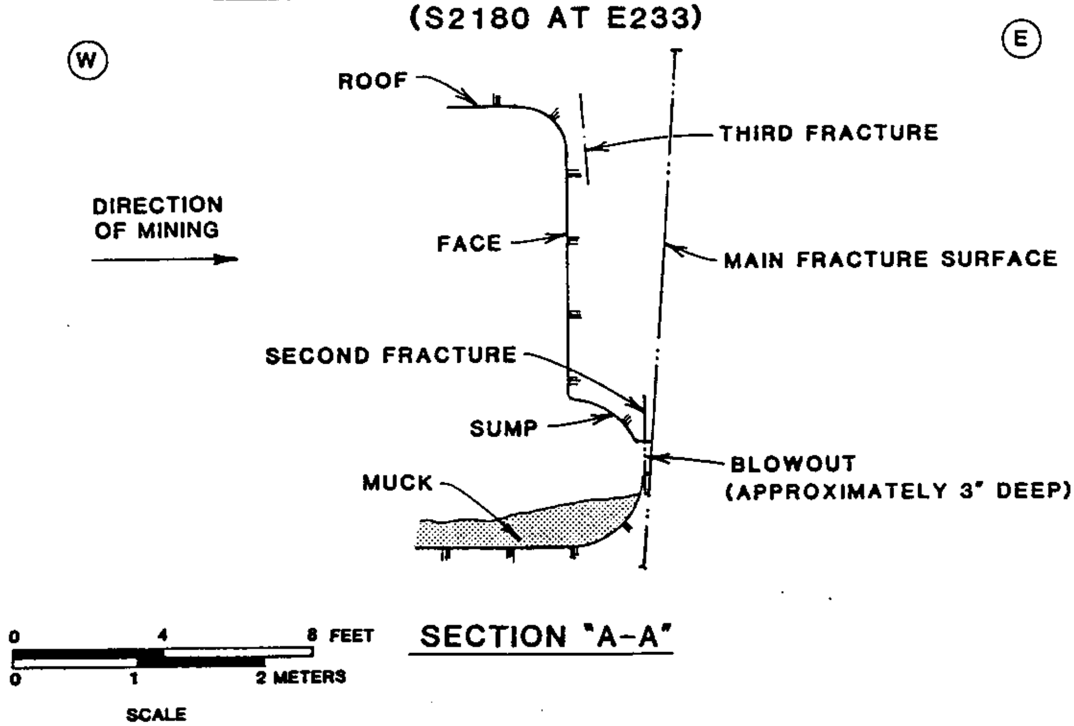


Figure C.1

Location of Gas Releases at the Working Face
at S2180 and E233

had a similar orientation to the fractures involved in the exfoliation and may have been part of the same fracture system. The fracture was very tight and had no evidence of infilling. However, a small and unmeasurable amount of brine and gas bubbles issued from this fracture. This fracture was not traceable once the area had been mined. The smell of "rotten vegetables" was reported in both of these cases of gas release.

As the mining face was advanced close to the point where the first probe hole encountered gas (9.75 ft.), excavation was carefully monitored. The source of the gas at that location was another near-vertical north-south trending fracture (Figure C.2). This fracture was very tight, hard to see, and not distinguishable in the roof or ribs after the area was mined. Continued mining eastward along S2180 exposed three additional fractures in the upper portion of the face with north-south trends and dips of about 50 degrees east (Figure C.2). It is not known whether these fractures are related to the gas-containing fracture encountered in the first probe hole or not. The fractures in the back have a much shallower dip, and there was no visible evidence of gas.

Careful monitoring of the mining continued, and other very minor, gas releases were noted. Most of the occurrences were in the form of small "weeps" of bubbling brine not associated with any recognizable fracturing, and generally not lasting more than 10 or 15 minutes. At S2180/E255, an audible hiss was noticed at the face. The hiss was only noticed after the continuous miner was shut down for lunch break. It was audible for about seven minutes, and minor amounts of brine and gas bubbles were still seeping from a fracture when mining resumed 20 minutes later. The fracture associated with this release was not as obvious or as well developed as the previous fractures.

In all of the cases listed, the "rotten vegetable" smell was present in various intensities. The odor was also often noted when approaching the face immediately after an area was mined.

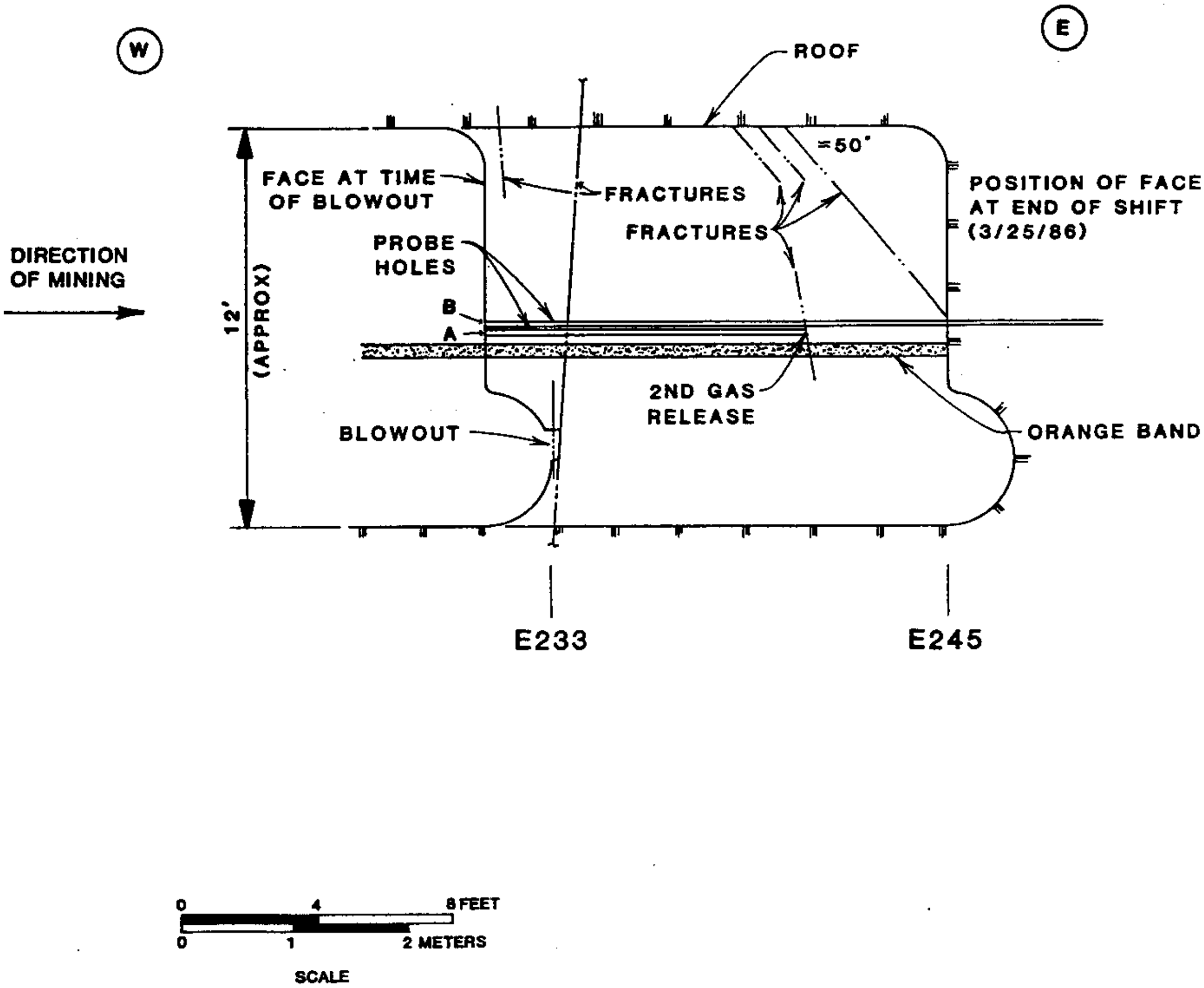


Figure C.2

Cross Section of the S2180 Drift
in the Vicinity of E233

REPORT OF GAS OCCURRENCE

Location: Intersection of S1950 and E300

Date: 3:00 p.m. on Monday, April 7, 1986

Description:

Gas was heard blowing from the vertical pressure release hole drilled into the back at the intersection of S1950 and E300 when the continuous miner was shut down at the end of the shift. Safety was notified and they ran tests for the presence of CH_4, CO, H_2S, NO_2, CO_2, and SO_2, none of which were detected. In addition, they reported being able to feel gas coming from the hole when a hand was placed at the opening and smelling a slight "rotten cabbage" odor. The mining face at the time of the gas release was at about S2090 in the E300 drift. The hole was not blowing when checked at 10:00 a.m. on Tuesday.

REPORT OF GAS OCCURRENCE

Location: E300 Drift at S2140

Date: April 9, 1986

Description:

On Wednesday, April 9, 1986, at about 10:00 a.m., there was a small gas release at S2140 in the E300 drift. A roughly oval-shaped piece of salt was rapidly exfoliated from the working face, accompanied by a small pop. Debris was thrown about 20 feet. This exfoliation left an elongate hole in the salt 2 ft. high, 0.6 ft. wide, and 0.0 to 0.2 ft. deep, increasing in depth from west to east. The release was located in the upper east corner of the face, about 1 foot below the back and 1 foot west of the east rib. The cutting head of the miner was sumping in the lower west corner of the face when the gas release occurred.

There was an obvious fracture at the back of the space left by the exfoliating slab of salt. The fracture was oriented N50E and dipped 53 degrees south. The fracture was open as much as 3/8 inch in the area of the cavity, but was very tight away from that immediate vicinity and disappeared entirely in the clayey zone below. The open part was in the clear halite and no evidence showed infilling or alteration of the surfaces to indicate whether or not there was a cavity there prior to mining.

Tests were conducted to detect the presence of H_2S, SO_2, NO_2, and CH_4, none of which were detected.

Another minor gas occurrence was noted in the E300 drift at about S1960 on April 2 at about 11.30 a.m. The mining machine had been cutting to the south and was shut down for lunch. An audible hiss was noted coming form the horizontal probe hole which had been drilled ahead of the face to the S2180/E300 intersection about a week earlier. No gas releases had been noted during drilling. The intensity of the hiss decreased gradually with time, but continued for at least 50 minutes and was still audible just before the miner started up after lunch.

APPENDIX D

PHASE I PRELIMINARY SAMPLING AND EVALUATION OF BRINE OCCURRENCES AT THE WIPP REPOSITORY HORIZON

This appendix contains a discussion of the Task 2 sampling activities that were part of Phase I of the WIPP Brine Sampling and Evaluation Program (BSEP). Included in this discussion is a description of sampling methodology, the manner in which the data was handled and calculations made, and a location-by-location description of both the sampling and the sampling results. The data obtained during Task 2 of Phase I are presented in tabular form in Appendix E.

1.0 SAMPLING METHODOLOGY AND PROBLEMS

The general procedure for brine collection and inflow measurements was simply to provide for the accumulation of the small brine inflows, to collect those accumulations on a periodic basis (approximately once a week for initial collections), and to measure the volume that had accumulated since the previous sampling. These measurements were then recorded and tabulated as the average fractions of liters per day collected from each location.

A variety of field techniques were used, depending upon the specifics of each occurrence. They can be broken down into the following groups:

- Initial volume measurements, experimental pumping techniques, and water-level measurements
- Vacuum-assisted sampling probe for brine removal from downholes
- Hand-operated rotary suction pump
- Continuous, gravity-driven collecting installations
- Pressure-vacuum and vacuum moisture-sampler installations

Additional details concerning the brine sampling procedures is provided in WIPP Procedure WP 07-410.

Down-hole sampling was done with a variety of bailing devices, most of which relied on check valves to retain collected brine while the bailer was raised to the surface (the floor of the repository workings). These devices occasionally failed when debris (mostly salt crystals and other muck in the holes) prevented the valves from seating properly, allowing some brine to leak from the sampler and flow down the inside of the drill hole. The result was an anomalously small recorded value for brine withdrawn at that time, usually followed the next week by a larger than expected amount. In most cases, the average of those two values was consistent with the trend of earlier and later readings. The result is a "kick" in the data that is not representative of the actual, much more consistent, inflow rates. Such sampling problems were noted on the field data sheets.

The bailing techniques would remove most, but not all of the brine in the hole. The amount of brine remaining in the hole was a fairly consistent amount, so the values obtained for "brine removed" were very close to the amount that actually flowed into the hole during the period between evacuations. After sampling, a visual inspection was made of the bottom of the hole to see if the bottom was at least partially exposed. If a partially-dry bottom was not observed after initial evacuation, the sampler was lowered to the bottom again and the evacuation repeated. After bailing, the downholes were plugged just below the collar with a piece of plastic foam which was covered, in turn, by a metal lid. The plug and lid prevented the inadvertent introduction of foreign solids into the hole and reduced moisture loss by evaporation to the repository atmosphere.

Evaporation has played a significant role in reducing the measured amounts of brine inflow, especially from the upholes. Several techniques were used to seal the collar of the upholes, but none of the techniques completely controlled evaporation. The projected high temperatures that will eventually be reached in Rooms A1, A2, A3, and B required that some of the materials used in the initial phases of the study be removed (they might give off deleterious vapors at high temperatures) and caused the replacement of some plastic items with metal.

Occasionally large "kicks" are observed in the uphole data. Many of these are a result of the clearing of a temporary blockage in the plastic tube leading from the collecting device at the hole collar to the collecting container. It was not uncommon for pieces of clay to slough from the clay seams exposed in the holes and for clay to fall down into the collecting device. The clay, in addition to pieces of salt that either fall from the sides of the hole or accumulate by the evaporation of brine, occasionally completely plugged the devices.

The result of these conditions and disruptions are that the data from the upholes should be considered as providing only minimum inflow data. Additionally, the effects of heat, the presence of metal, and the close proximity of many other holes need to be considered when evaluating the data from the A rooms and Room B.

2.0 DATA HANDLING AND CALCULATIONS

The data collected as part of the BSEP were initially recorded on field data sheets and then transferred to a computerized data base using an IBM XT microcomputer. Standard software programs (dBase III Plus and Lotus 1-2-3) were used for storage and calculations. Samples were collected about once a week except for special circumstances discussed later. The amount of brine removed was measured to the nearest hundredth of a liter and recorded, along with the date and time of collection, on the field data sheets. Brine levels were also measured and recorded. An approximation of the volume of brine in the downholes can be calculated from the height of the column of brine in the hole and the average diameter of the hole. The result of this calculation is less accurate than actually measuring the volume of brine removed, but the brine level was routinely measured prior to attempting evacuation of the accumulated brine. In a few instances, the brine level data were used to resolve apparent anomalies in the brine volume measurements that resulted from equipment failure or human error.

The dates and times at which collections were made were transformed into decimal days since an arbitrary reference date (January 1, 1985) and the elapsed time in decimal days between samples was used to calculate average brine inflow rates in terms of fractions of liters per day.

As described in Section 1.0, much of the variability in the quantity of brine collected resulted from limitations of the collecting techniques rather than variations in the actual inflow of brine from the bedrock into the collecting locations. As a result, plotting of the inflow data from the data tables (Appendix E) results in an irregular plot which implies variations in inflow that, in fact, do not exist. The graphed data included in this report were processed and plotted by a standard computer software program (STSC Statgraphics) on an IBM AT microcomputer, using a simple moving average to smooth the curves. A five-point moving average was used for the majority of the graphs. The smoothed result reflects trends that are representative of the brine inflow rates while still showing variations that are probably the result of collecting problems.

An alternative technique to smooth the data is to plot cumulative inflow against time, fit a curve to that plot, and then differentiate the best-fit equation to determine the flow rate. This technique may be attempted after more data has been acquired.

3.0 OBSERVATIONS

3.1 Room 1, Hole IG202

SPDV Test Room 1 was one of the first rooms excavated in the northern part of the WIPP underground (Figure D-1). Initial mining was finished on April 13, 1983, and a number of instrument holes were drilled in it during the following few weeks. One of those was downhole IG202, located near the west rib in the center of the room, which was drilled for use as an inclinometer observation location. It is lined with a 74 millimeter (2 7/8th inch) I.D. flexible PVC inclinometer guide tube that is not a normal well casing. Leaks may occur into the guide tube. This type of liner has flexible expansion joints that can transmit fluids and a plastic cap on the bottom that was not installed with the intent of preventing brine inflow.

IG202 was drilled using brine as the drilling fluid. On April 21, 1983, the PVC guide tube was installed in the hole and a small-diameter tremie pipe (plastic tubing) was used to grout the liner in place. It is likely that the grouting is incomplete and that vertical movement of fluid takes place in open, ungrouted spaces outside the guide tube. When the guide tube was installed, it was filled with fresh water to assist in sinking the guide tube to the bottom of the hole. The fluid in the guide tube was reportedly blown out with compressed air, but it is not known how complete that removal was. It is probable at least some fluid remained in the partially grouted space outside the guide tube and in pore spaces and fractures in the rock which drained into the bottom of the hole after it was "blown dry."

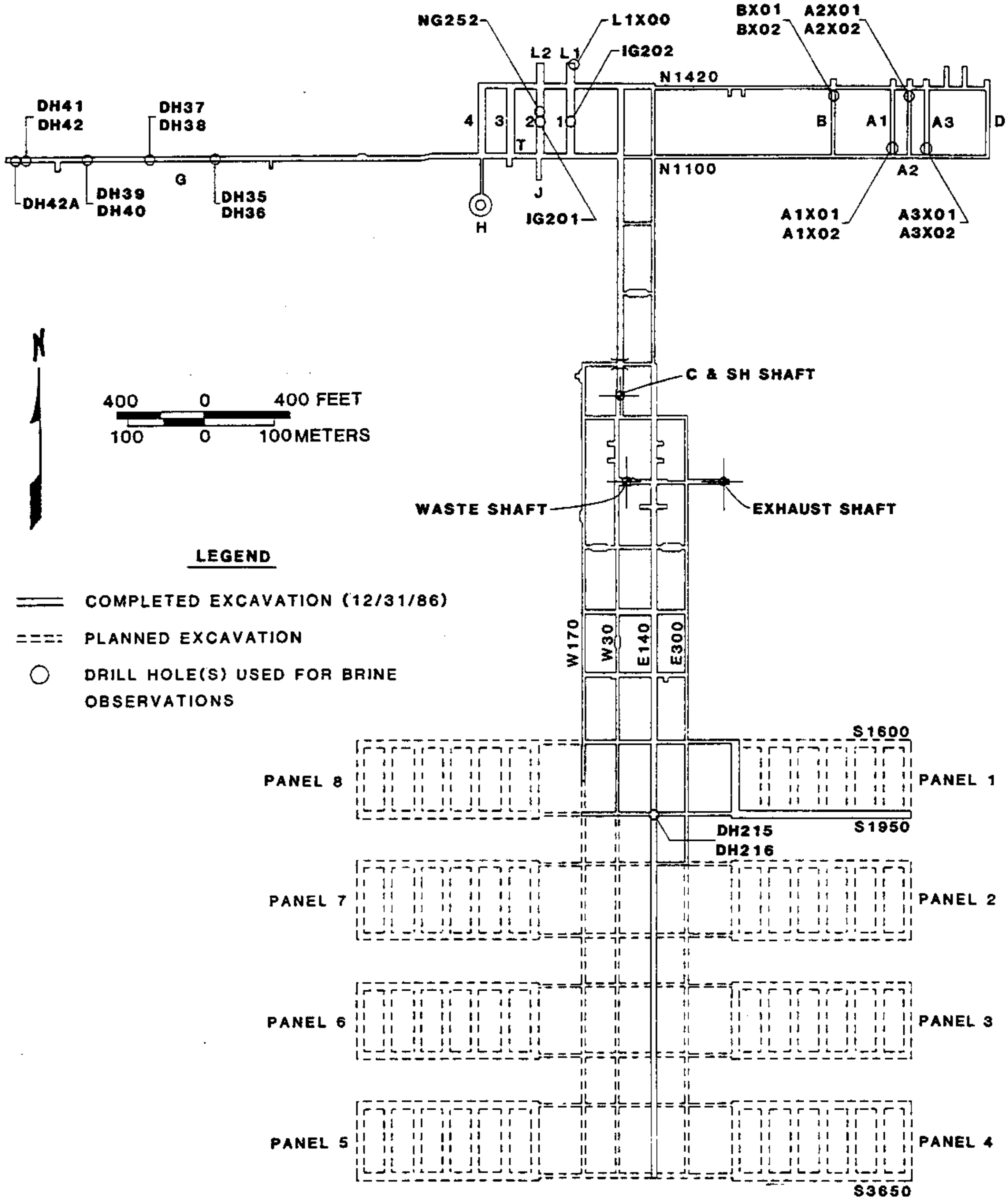


Figure D-1.

Map of the WIPP Underground Workings

On November 30, 1984, fluid filled the hole to within approximately two meters of the collar. It is known that fluids were introduced into this hole on at least two occasions (brine of unknown composition at the time of drilling and fresh water during guide-tube emplacement). The chemistry of fluids in this hole has certainly been affected by the materials and fluids introduced into the hole, especially the grout. Room 1 was also used by the mining contractor as an underground shop and lunchroom. As a result, the origin, quantity, and chemical composition of the fluid in the hole at the time of initial BSEP testing was probably not representative of naturally occurring, spontaneous inflows from the surrounding rocks.

This hole was the location of some of the initial experiments with air-jet pumping techniques. On November 30, 1984, over 52 liters of brine were removed from the hole and the inside of the guide tube was blown as dry as possible with high-pressure air. On January 8, 1985, an additional 12.6 liters was removed and the inside of the guide tube blown dry again. Some brine was lost during both of these evacuations, so those figures, although reasonably accurate, represent minimum figures for the amount of brine actually in the hole. Evacuation using the vacuum-assisted sampling system and measuring technique described in WIPP Procedure WP 07-410 began January 15, 1985, and continued until October 15, 1985, when the guide tube had become so distorted due to shear movement in the bedrock that sampling was discontinued for fear that the sampling device would become wedged in the hole. Most of the displacement is taking place along fractures in anhydrite interbed MB 139, which is about one to two meters below the floor of Room 2 (Figure D-2).

Relatively few data points exist for the inflow data for IG202. As a result, a four-point moving average was used to smooth this data (Figure D-3) instead of the five-point average used for most of the rest of the data.

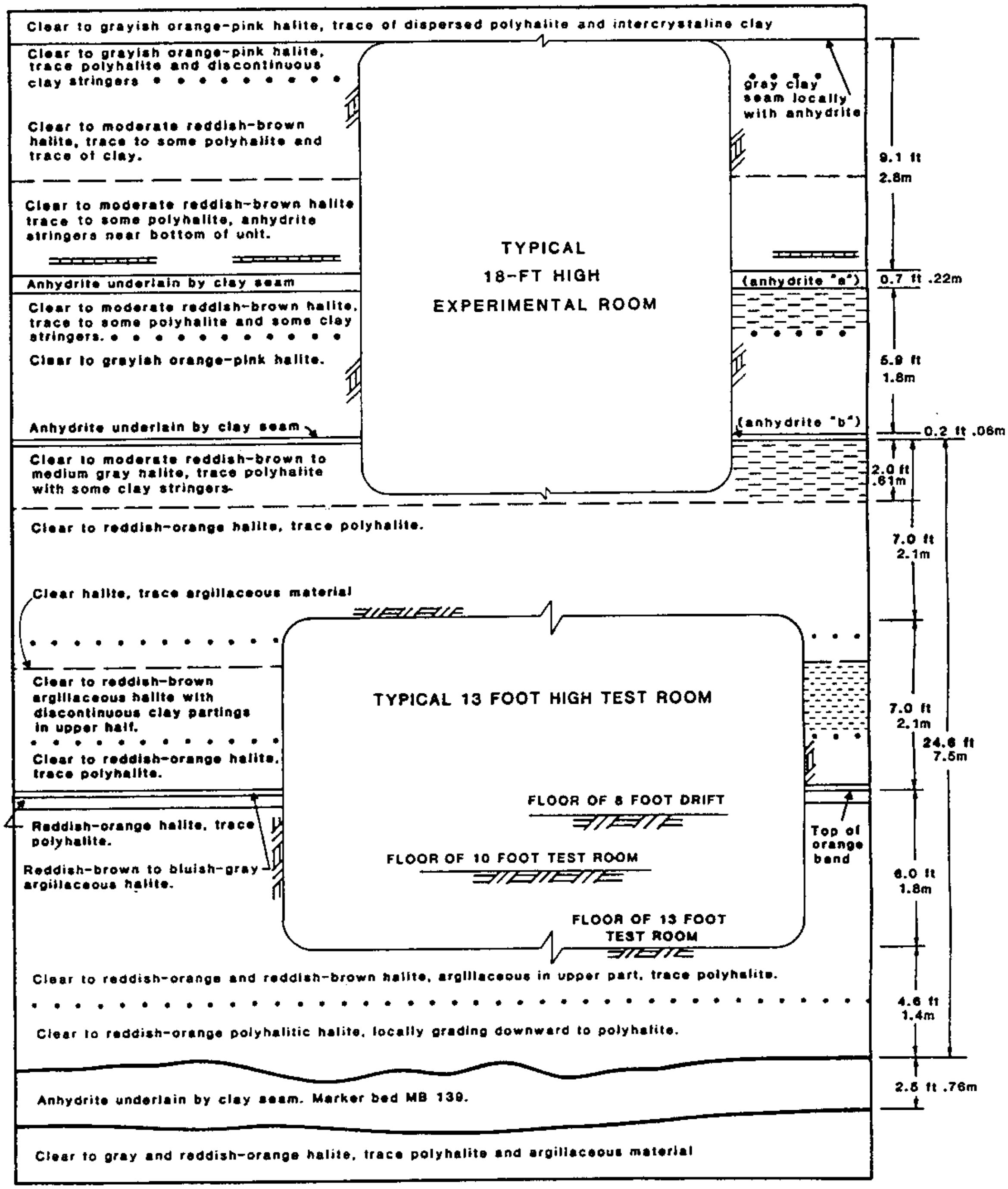
Average inflow rates were on the order of 0.05 liters per day in early 1985, decreasing gradually for about 175 days (Table E.18; Figure D-3). Inflow rates leveled out to between 0.01 and 0.02 liters per day for the remainder of the sampling period with the fluctuations falling within the limit of error of the sampling and measuring techniques. A total of over 71 liters of brine was removed from hole IG202 between November 30, 1984 and August 24, 1986.

3.2 Room 2

SPDV Test Room 2 was also one of the first rooms excavated in the northern part of the WIPP underground (Figure D-1). Initial mining was finished March 17, 1983 and a number of test holes were drilled in it during the following few weeks. Two of these holes were included in Phase I of the BSEP: inclinometer hole IG201 and stressmeter hole NG252.

3.2.1 Hole IG201

IG201 was drilled for use as an inclinometer observation location and is located near the west rib in the center of Room 2. Brine was used as the drilling fluid. On March 28, 1983 a 74 millimeter (2 7/8th inch) I.D. PVC guide tube identical to the one in Hole IG202 was installed in the hole, and a small-diameter tremie pipe (plastic tubing) was used to grout the liner in



NOTES:

1. Dimensions and lithologic descriptions are derived primarily from corehole and geologic mapping data from the four test rooms and experimental area supplemented by geologic information from the remaining SPDV excavation.
2. Unit thicknesses are approximate and vary slightly.
3. Room dimensions have changed with time due to salt-creep closure.

Figure D-2.

Geologic Cross Section of the Facility and Experimental Level

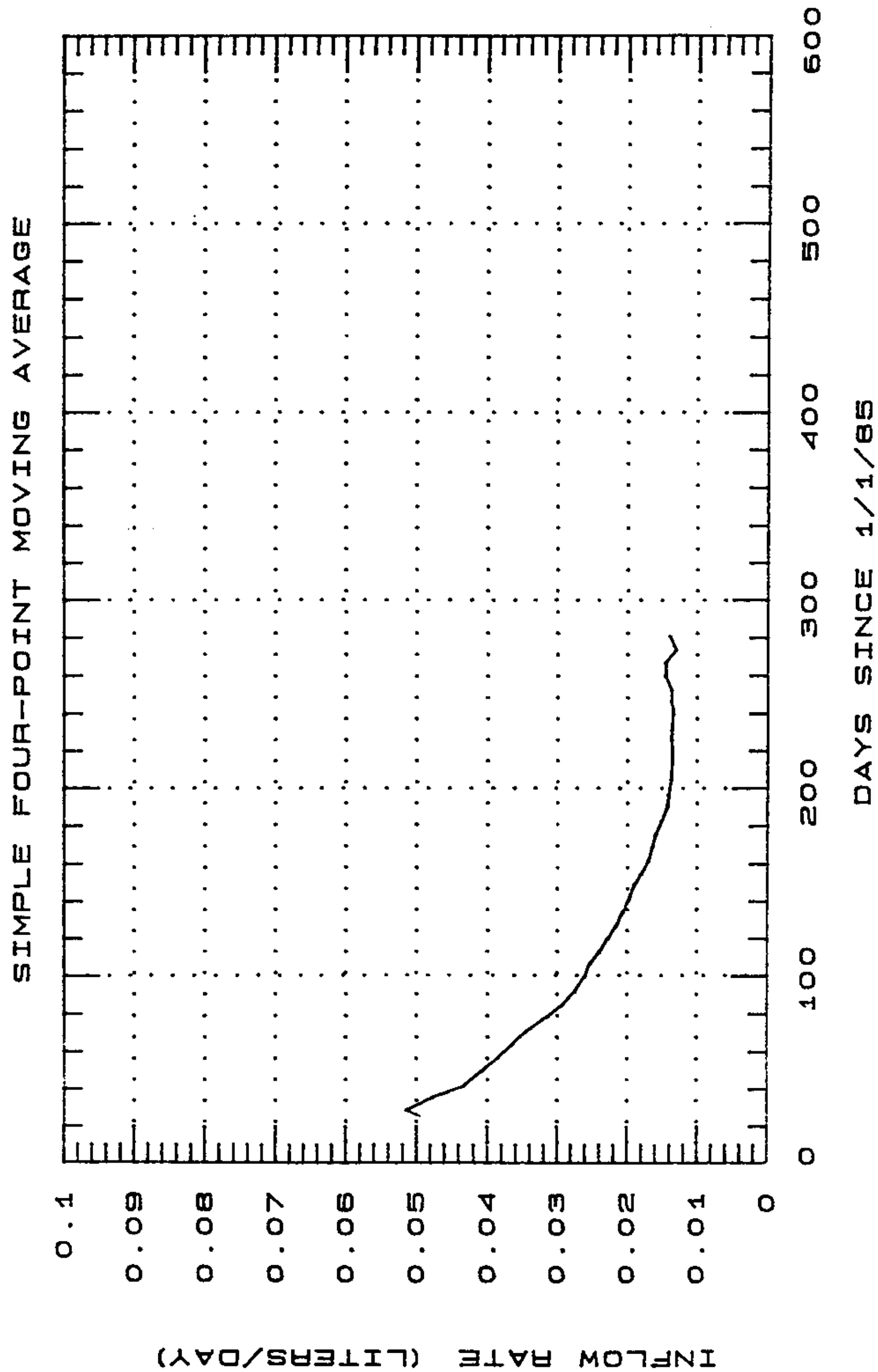


Figure D-3.
IG202 Inflow Rates

place. It is highly likely that the grouting is incomplete and that vertical movement of fluid takes place in open, ungrouted spaces outside the guide tube. When the guide tube was installed, it was filled with fresh water to assist in sinking the guide tube to the bottom of the hole.

On November 21, 1984 fluid filled the hole to within 1.23 meters (4.05 feet) of the collar. It is known that fluids were introduced into this hole on at least two occasions (brine of unknown composition at the time of drilling and fresh water during guide-tube emplacement). The chemistry of fluids in this hole has certainly been affected by the materials and fluids introduced into the hole, especially the grout. Room 2 was also used by the mining contractor as an underground storage area. The origin, quantity, and chemical composition of the fluid in the hole at the time of initial BSEP testing was probably not representative of naturally-occurring, spontaneous inflows from the surrounding rocks.

This hole was the location of some of the initial experiments with air-jet pumping techniques. On November 21, 1984, about 8.4 liters of brine had been removed from the hole when the experimental pumping system failed. On November 30, 1984, an additional 54.7 liters were removed and the inside of the guide tube was blown as dry as possible with high-pressure air. On January 8, 1985, 1.5 liters were removed before the check valve failed on a different experimental sampler. An additional 2.5 liters were removed on January 9, 1985. Some brine was lost during these evacuations, so those figures, although reasonably accurate, represent minimum figures for the amount of brine that was actually in the hole. Evacuation using the vacuum-assisted sampling system and measuring technique described in WIPP Procedure WP 07-410 began January 15, 1985.

Initial brine inflow rates were slightly greater than 0.05 liters per day, decreasing gradually to slightly less than 0.02 liters per day at the end of April, 1986 (Table E.17, Figure D-4). At that time, the guide tube had become so distorted from shear within the bedrock that sampling was discontinued. A total of over 81 liters of brine had been removed from hole IG201 over that period of time.

3.2.2 Hole NG252

Stressmeter downhole NG252 is located about 3 meters north of IG201 in SPDV Test Room 2. This hole has a fairly complicated history (Figure D-5). The initial 38 millimeters (1.5 inch) hole was drilled 2 meters (6.5 feet) deep in March 1983 with brine used as the drilling fluid. The stressmeter failed in December 1983 and on March 4, 1984, the instrument was over-cored with a 152-millimeter (6-inch) core barrel and removed. As a result, the upper 50 centimeters (1.5 feet) of this hole is 152 millimeters (6 inches) in diameter and the bottom 1.5 meters (5 feet) is 38 millimeters in diameter.

On November 21, 1984, this hole was found to be filled with both brine and muck. The top of the brine was 18 centimeters (7 inches) below the collar and the top of the salt muck was 28 centimeters below the collar. Approximately 1.3 liters of brine were removed on November 21, effectively evacuating the hole to the level of the top of the salt muck.

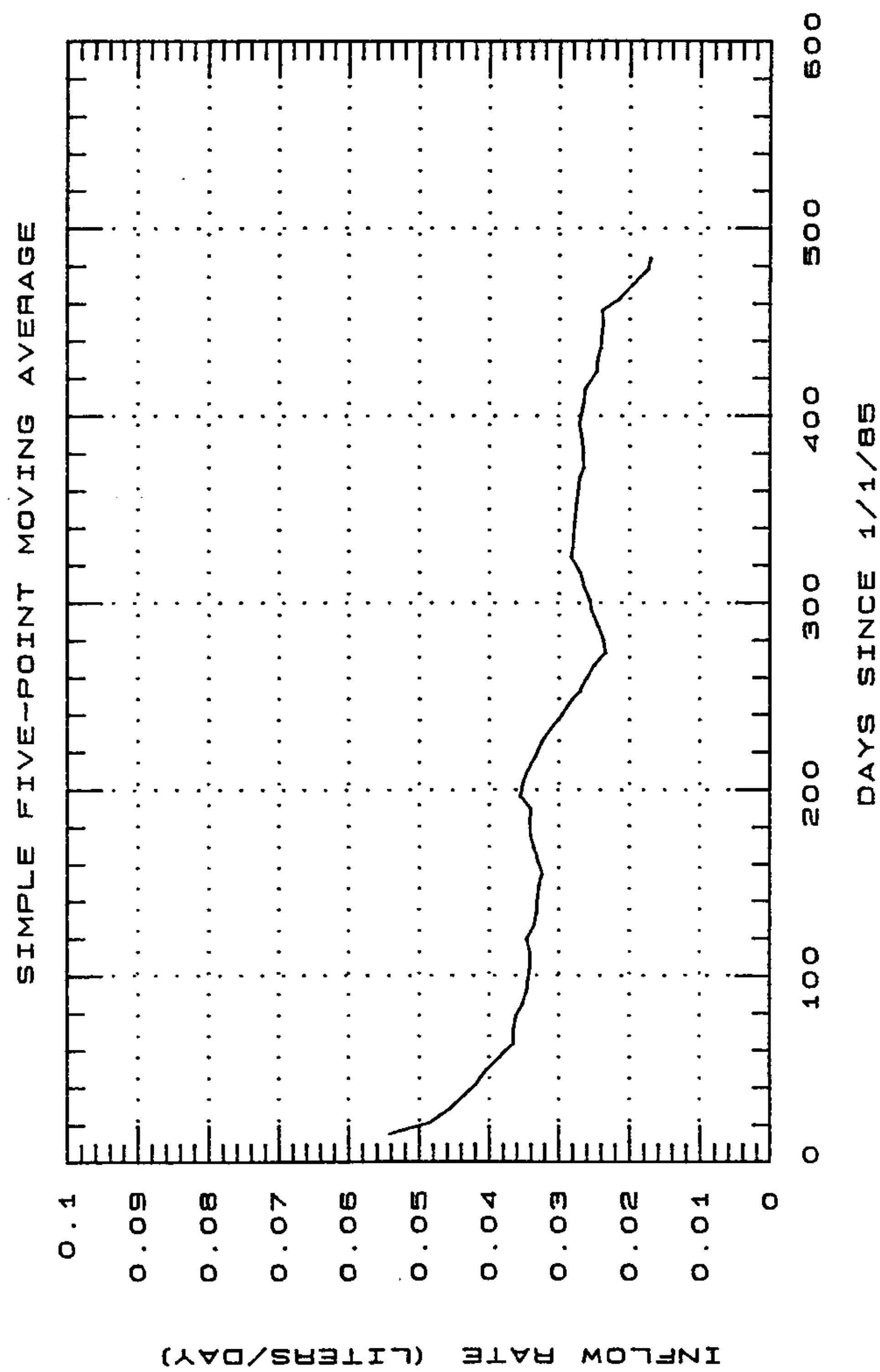


Figure D-4.

IG201 Inflow Rates

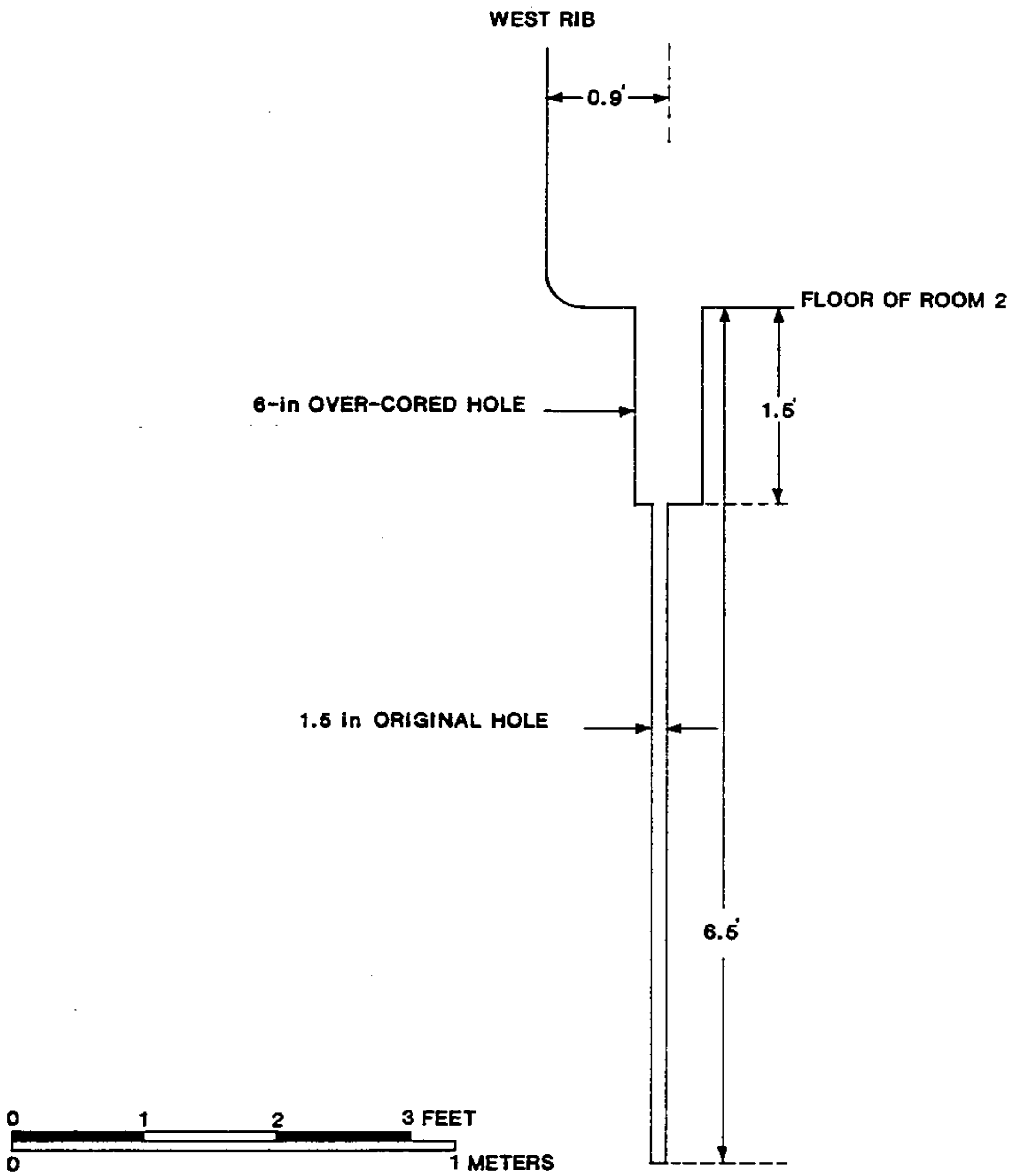


Figure D-5.
NG252 Configuration

Six days later, on November 27, 1984, the brine level had risen to 6.4 centimeters above the salt muck. About 0.76 liters of brine were evacuated, exposing the top of the salt muck. Later that day, the brine level was observed to have risen to completely cover the salt muck.

On November 29, 1984, compressed air was used to blow all the salt muck and accumulated brine out of NG252. The quantity of brine that was blown out was not measured, but it amounted to several liters. PVC casing with a cap was installed to prevent debris from entering and plugging the hole.

Twenty days later, on December 19, 1984, representatives of the Environmental Evaluation Group (EEG) collected a sample of brine from this location. On that date, the level of the brine surface had risen to approximately the level observed on November 21; 18 centimeters below the collar or about 50 centimeters below the top of the new PVC casing.

Since this hole was easily accessible, known to produce brine, and of small diameter, it was selected as the location for initial observations. The hole was evacuated and a short-term inflow test was performed following normal surface-well recovery analysis techniques. Initial brine levels were measured every hour. Intervals between measurements were lengthened as appropriate once initial inflow rates were determined. Measurements continued around the clock until the brine level stabilized (Table E.20).

The diameter of the hole enlarges from 38 to 152 millimeters at a point approximately 1.5 meters above the bottom of the hole. The inflow data was recorded as the increasing level of brine in the hole with time. To correct for the change in hole diameter, brine level was converted to approximate volume of brine in the hole by multiplying by the appropriate cross-sectional area. The calculations were made using Lotus 123 software. This figure is reported as equivalent volume in liters in Table E-20 and on Figures D-6 and D-7.

The data for the rise in static level was plotted both as an X-Y plot (Figure D-6) and as a semi-log plot (Figure D-7), the more conventional form for recovery graphs. These curves are not strictly analogous to "recovery tests," however, since the initial point for the curves probably does not represent a steady-state drawn-down condition. In addition, the distribution of potential energy (hydrologic regime) of the brine in the vicinity of the underground drill holes is still poorly understood.

Brine flowed into the evacuated hole from the fractures and pores close to the hole and, for a while, the hole actually filled faster the fuller it became. This can be seen on Figure D-6 between approximately 35 and 175 hours. Both graphs show an abrupt change-in-slope at a brine level of approximately 1.5 liters, where the hole diameter enlarged from 38 to 152 millimeters. Inflow ceased after the hole became filled with brine to a depth of approximately 6.1 feet. The floor of Room 2 slopes down toward the south, and it is probable that when Hole NG252 is filled to this level, additional inflow ceases because the brine discharges through some undetermined flow path into unconsolidated muck on the floor of Room 2. The conclusion reached was that this type of data, although interesting, is not very useful unless an equilibrium draw-down state is established prior to recording the rising brine level.

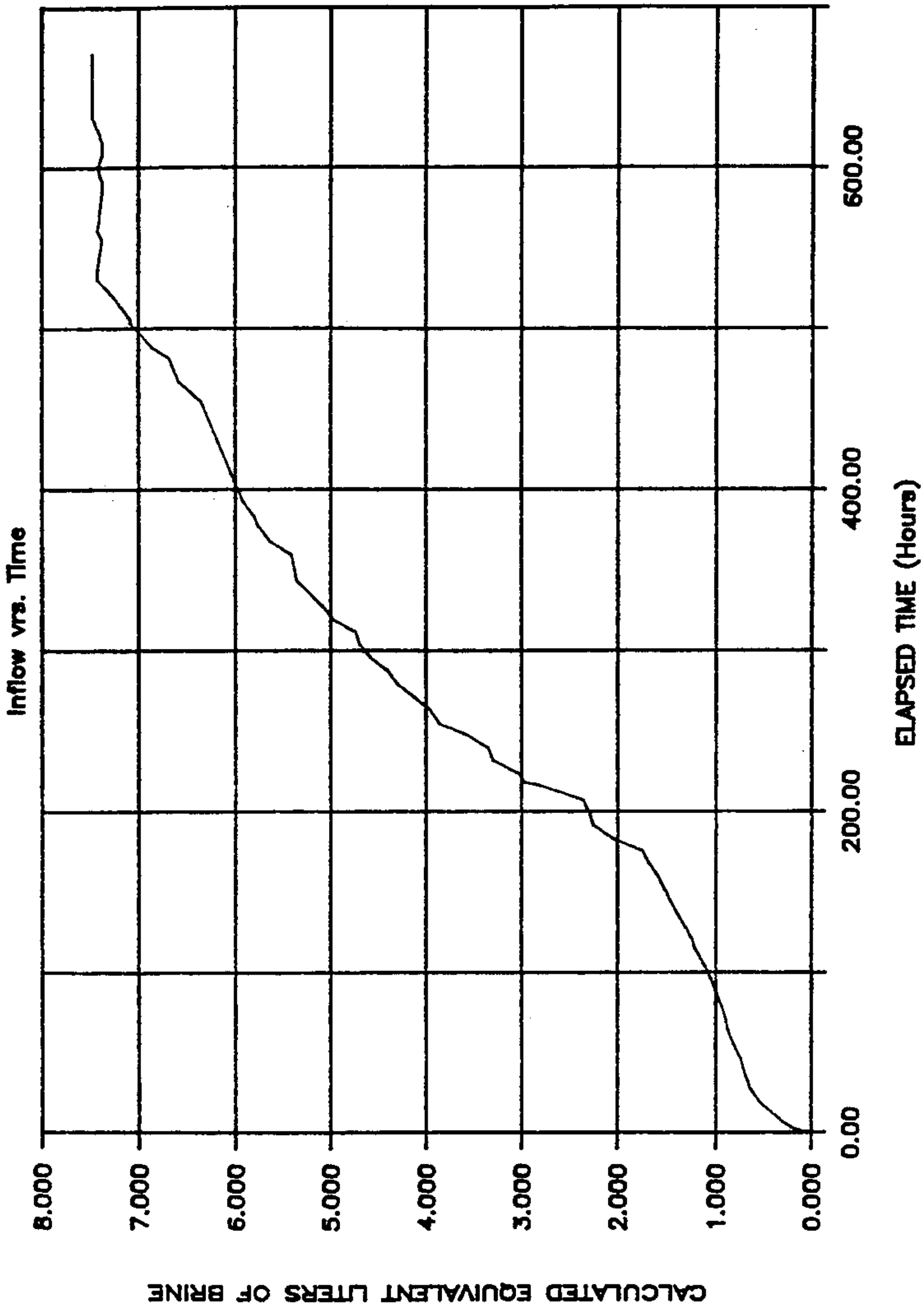


Figure D-6.

NG252 Short Term Inflow

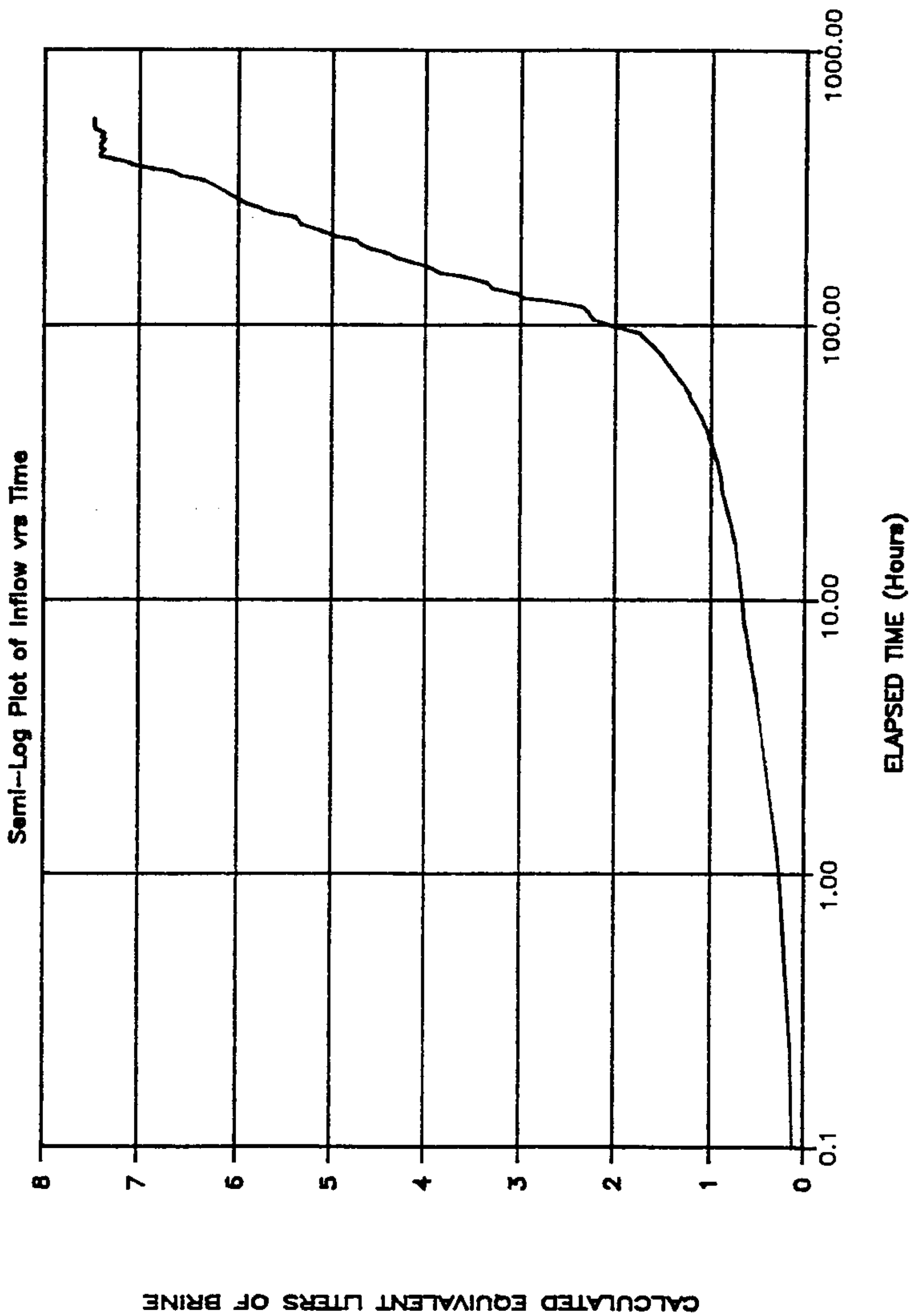


Figure D-7.
Semi-Log Plot of NG252 Short Term Inflow

Starting in February 1985, brine was bailed from NG252 on a regular basis (Table E.21; Figure D-8). Inflow rates were initially close to 0.6 liters per day, gradually declining to about 0.27 liters per day by August 19, 1986. Over 235 liters of brine had been removed from this hole by that date. Significant quantities of gas are associated with the brine inflow into NG252. Gas bubbles are almost always observed. Brine withdrawn from the hole effervesces immediately after bailing as it is poured from one container into another. NG252 penetrates anhydrite Marker Bed 139 and most of the brine flows into this hole from a fracture very close to the bottom of the hole, near the base of Marker Bed 139 (Figure D-2).

NG252 is the largest brine producer of any of the drill holes observed during Phase I of the BSEP, and appears to be something of an anomaly. It is located in close proximity to a completely dry downhole. The dry hole is approximately 4.7 meters east of NG252 on the centerline of Room 2, is 15 centimeters in diameter, is 1.65 meters deep, and penetrates into MB 139. It does not appear to completely penetrate MB 139, which may be the reason it is dry.

3.3 Experimental Rooms A1, A2, A3, and B

Experimental Rooms A1, A2, A3, and B are in the northeastern part of the WIPP underground workings (Figure D-1). Excavation of Room A1 was completed in October 1984, Room A2 in July 1984, Room A3 in November 1984, and Room B in June 1984. They are 5.5 meters (18 feet) high and are excavated in a zone about 6 meters (20 feet) stratigraphically higher than the rest of the workings (Figure D-2). As a result, the drill holes penetrate a slightly different stratigraphy, a fact that results in especially useful data. The end of 15-meter upholes typically penetrate rocks about seven meters stratigraphically above the end of other 15-meter upholes. Hole A1X02 is 18 meters long and penetrates an additional 3 meters, intersecting an anhydrite interbed not present in the other three upholes in Rooms A2, A3, and B. Downholes typically penetrate MB139 at depths of 7 to 7.6 meters. The data from these holes reflects both the sampling of different geological horizons and, perhaps, more importantly, interbeds such as MB 139 under different stress conditions than is encountered elsewhere in the facility.

These rooms all contain many experimental and instrument holes (Appendix A), almost all of which are inaccessible to the BSEP. In early 1985, a pair of stratigraphic observation holes were drilled in each of these rooms. These holes were drilled with air as the drilling fluid. Inflow to these pairs of holes have been monitored from the time they were drilled.

The A and B rooms are the location of the heated room experiments. Canisters containing electric heaters have been emplaced at the stratigraphic level of the facility, below the floor of the rooms. The power was turned on to the heaters in the A rooms on October 2, 1985 (day 274 after 1/01/85), and in Room B on April 23, 1985 (day 112 after 1/01/85). Since that time the rooms have been heating up, a factor that is expected to effect both the inflow of brine and the brine chemistry.

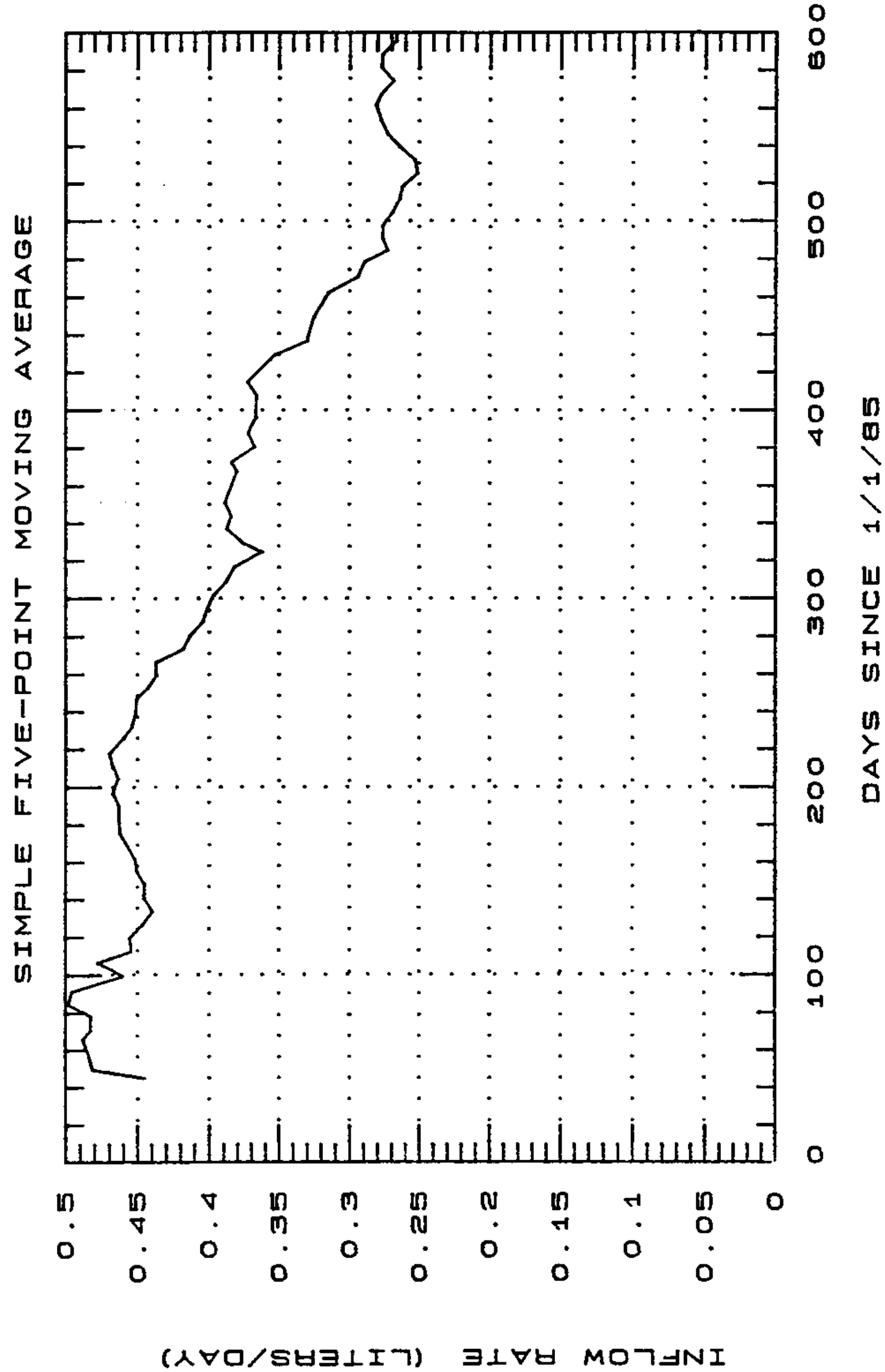


Figure D-8.

NG252 Inflow Rates

3.3.1 Room A1, Hole A1X01

Hole A1X01 is a downhole drilled in the south end of Room A1 on February 26, 1985. No brine or gas was noticed during drilling. Brine accumulations were noticed shortly after drilling. Brine was first removed from this hole on March 12, 1985. Inflow rates in April 1985, were on the order of 0.047 liters per day, gradually decreasing to slightly greater than 0.026 liters per day in October 1985. Inflow appeared to stabilized at that rate and remained quite constant through August 1986 (Table E.1, Figure D-9). A total of approximately 15.3 liters of brine had been removed from A1X01 by August 19, 1986.

3.3.2 Room A1, Hole A1X02

Hole A1X02 is an uphole completed March 7, 1985, in the south end of Room A1, directly over hole A1X01. The end of this hole penetrates beds that are stratigraphically higher than those penetrated by any of the other holes monitored as part of the BSEP, intersecting an additional anhydrite interbed. Drillers noted that brine entered the hole at a depth of 3.55 meters. The hole was reamed on February 28, 1985 to a 12.7 centimeters (5-inch) diameter for the first 3.7 meters to eliminate drilling problems caused by moist cuttings. A moist area was noted developing around the collar on March 7, 1985. On March 12, 1985 the moist area on the back (roof) extended for a third of a meter in all directions from the drill hole.

Several different types of collecting devices were installed, with successful collection of brine first occurring on April 2, 1985. Most of the irregularities in the data (Table E.2) are a result of collecting difficulties and evaporation losses, not real variations in brine inflow. Inflow rates were on the order of 0.02 liters per day between drilling and the end of October 1985, decreasing slightly between November 1985 through June 1986, followed by an increase to almost 0.04 liters per day in August 1986 (Figure D-10). A total of over 8.7 liters of brine had been collected from this hole by August 19, 1986. A significant, additional amount was certainly produced from the hole but lost by dissipation near the borehole collar and evaporation to the repository atmosphere.

3.3.3 Room A2, Hole A2X01

Hole A2X01 is a downhole completed February 9, 1985 in the north end of Room A2. No brine or gas inflows were noted during drilling, but moist, irregular vugs were observed in the core, usually in coarsely crystalline polyhalitic halite, clear halite, and halite containing some brown clay. Brine accumulations were noticed shortly after drilling. Brine-soaked muck containing some oil (contamination from the drilling operations) was first removed from this hole on February 19, 1985. Mixtures of brine and muck were also bailed from the hole on March 7, 1985 and March 12, 1985. On March 20, 1985, 0.52 liters of fairly clear brine were removed from the hole (Table E.3). Initial inflow rates in late March and early April 1985, were slightly greater than 0.05 liters per day, declining fairly rapidly to slightly less than 0.035 liters per day by mid-May. Inflow then remained quite steady, decreasing very gradually to about 0.025 liters per day in late August 1986 (Table E.3, Figure D-11). A total of approximately 16.8 liters of brine had been removed from A2X01 by August 19, 1986.

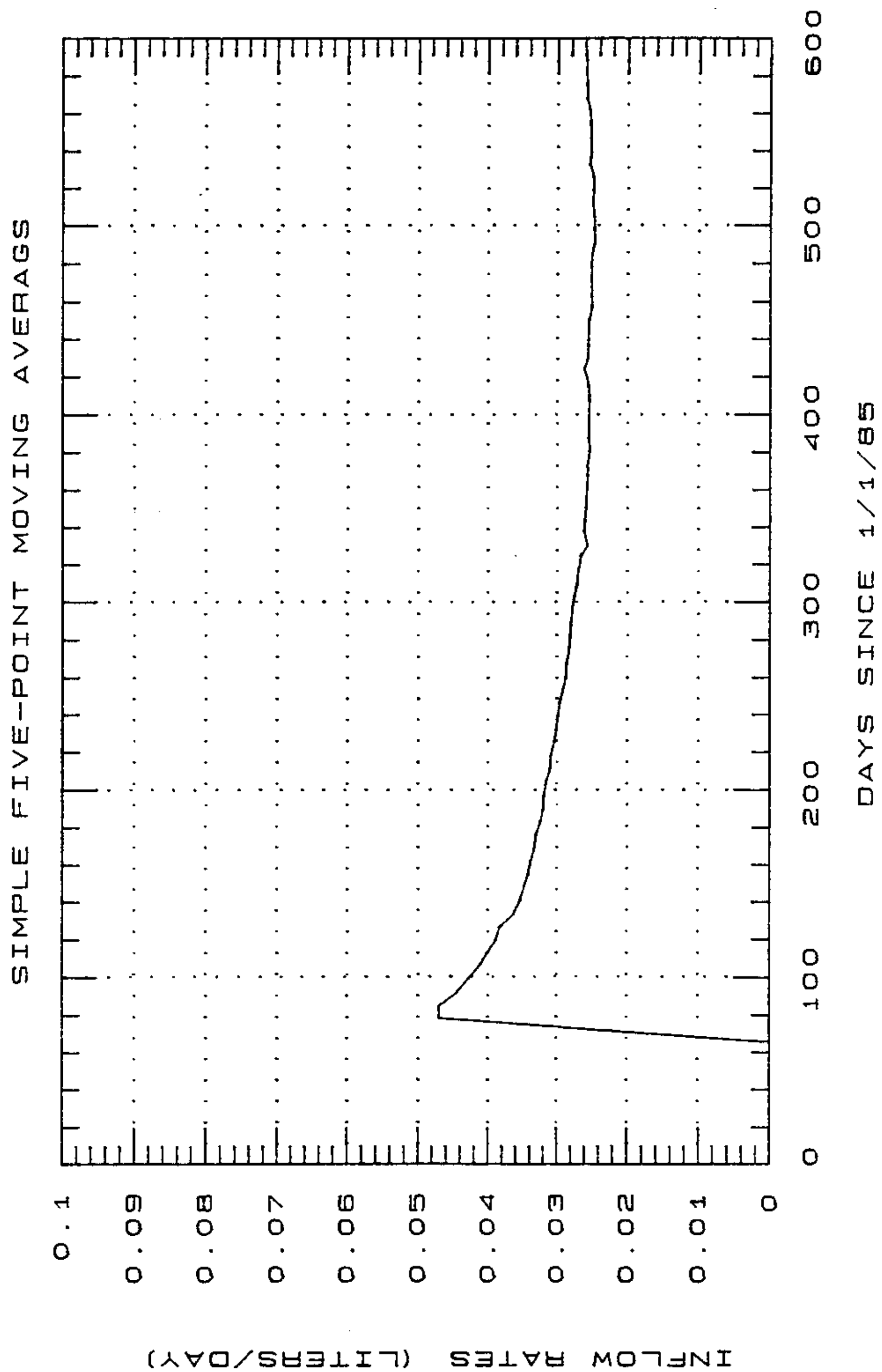


Figure D-9.

A1X01 Inflow Rates

3.3.4 Room A2, Hole A2X02

Hole A2X02 is an uphole completed February 20, 1985, in the north end of Room A2, directly over Hole A2X01. The drillers noted that the hole produced brine during drilling at both 3.5 meters and 7.7 meters. The hole was reamed on February 13, 1985, to a 12.7 centimeter (5-inch) diameter for the first 7.6 meters to eliminate drilling problems caused by moist cuttings.

A collecting device was installed on the hole February 19, 1985. The same difficulties described for Hole A1X02 were encountered, and the same cautions concerning the use of the data are applicable. A moist area immediately developed on the back (roof) around the hole and was about 1.5 meters in diameter on March 12, 1985. The irregularities in the data are mostly the result of problems in collecting the brine. A large amount of brine is known to have been lost by evaporation. Inflow rates were over 0.03 liters per day in March 1985, but then decreased to less than 0.01 liters per day (Table E.4, Figure D-12). Problems with the collecting device from April through August 1985 resulted in most of the brine inflows escaping and not being recorded, so the low readings during that time period do not reflect the fact that considerable brine flowed from Hole A2X02. Flow does appear to have been much lower during the winter of 1985-86, but shows an increase in the summer of 1986 to more than about 0.015 liters per day. Figure D-12 shows trends that roughly parallel the humidity measurements taken in the room, but the above-mentioned collecting uncertainties caution against drawing too strong a correlation.

Approximately 3.35 liters of brine had been collected from Hole A2X02 by August 19, 1986. A significant additional amount was certainly produced from the hole but lost by dissipation near the borehole collar and evaporation to the repository atmosphere.

3.3.5 Room A3, Hole A3X01

Hole A3X01 is a downhole completed on January 14, 1985 in the south end of Room A3. No brine or gas inflows were noted during drilling, but moist, irregular vugs were observed in the core, usually in coarsely crystalline polyhalitic halite, clear halite, and halite containing some brown clay. Brine accumulations were noticed shortly after drilling. Brine-soaked muck was noticed in this hole on February 5, 1985. Approximately 0.3 liters of brine, muck, and oil was removed from the hole on February 19, 1985 (Table E.5). Inflow rates in February and March were on the order of 0.03 liters per day, decreasing gradually through October 1985, and then maintaining a fairly constant inflow slightly greater than 0.02 liters per day through August 1986 (Table E.5, Figure D-13). Over 13.6 liters of brine had been removed from A3X01 by August 19, 1986.

3.36 Room A3, Hole A3X02

Hole A3X02 is an uphole completed January 22, 1985 in the south end of Room A3, directly over Hole A3X01. No brine or gas inflows were noted during drilling, but moist, irregular vugs were observed in the core, usually in coarsely crystalline polyhalitic halite, clear halite, and halite containing some brown clay. Brine accumulations were noticed shortly after drilling. A collecting device was installed February 5, 1985 and on February 19, 1985, over 0.1 liters of brine had accumulated in the collection container. The wet

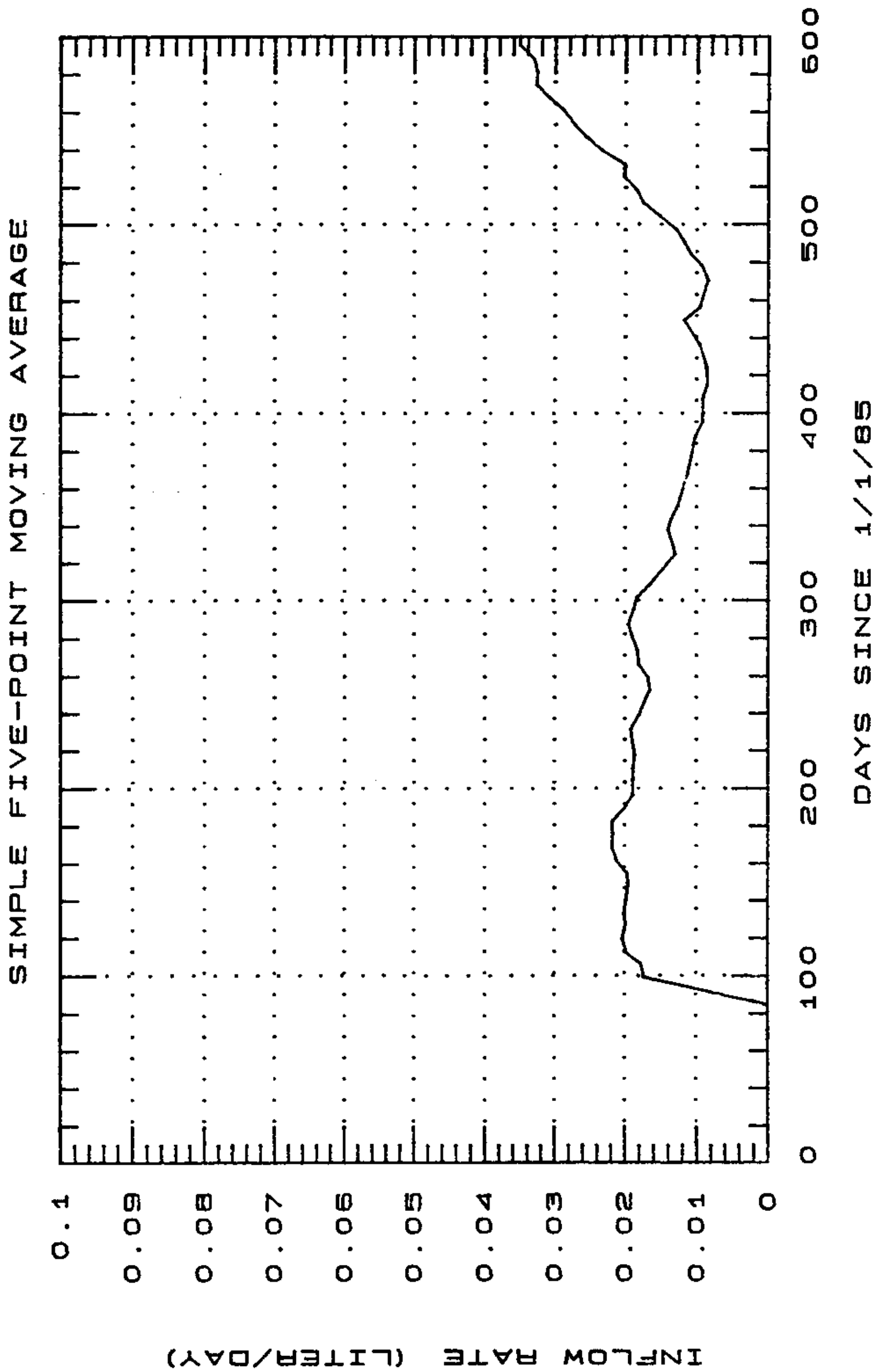


Figure D-10.

A1X02 Inflow Rates

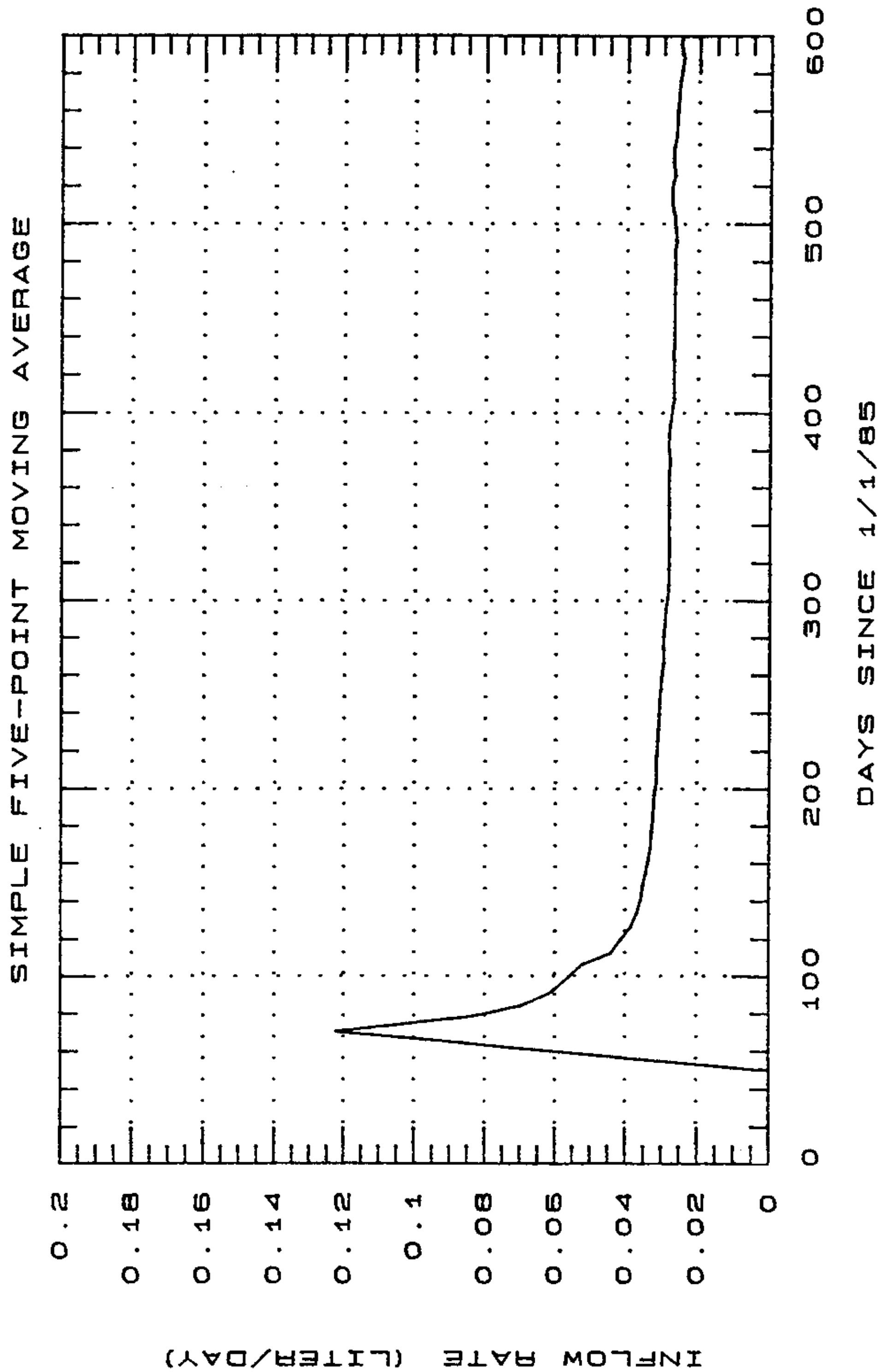


Figure D-11.

A2X01 Inflow Rates

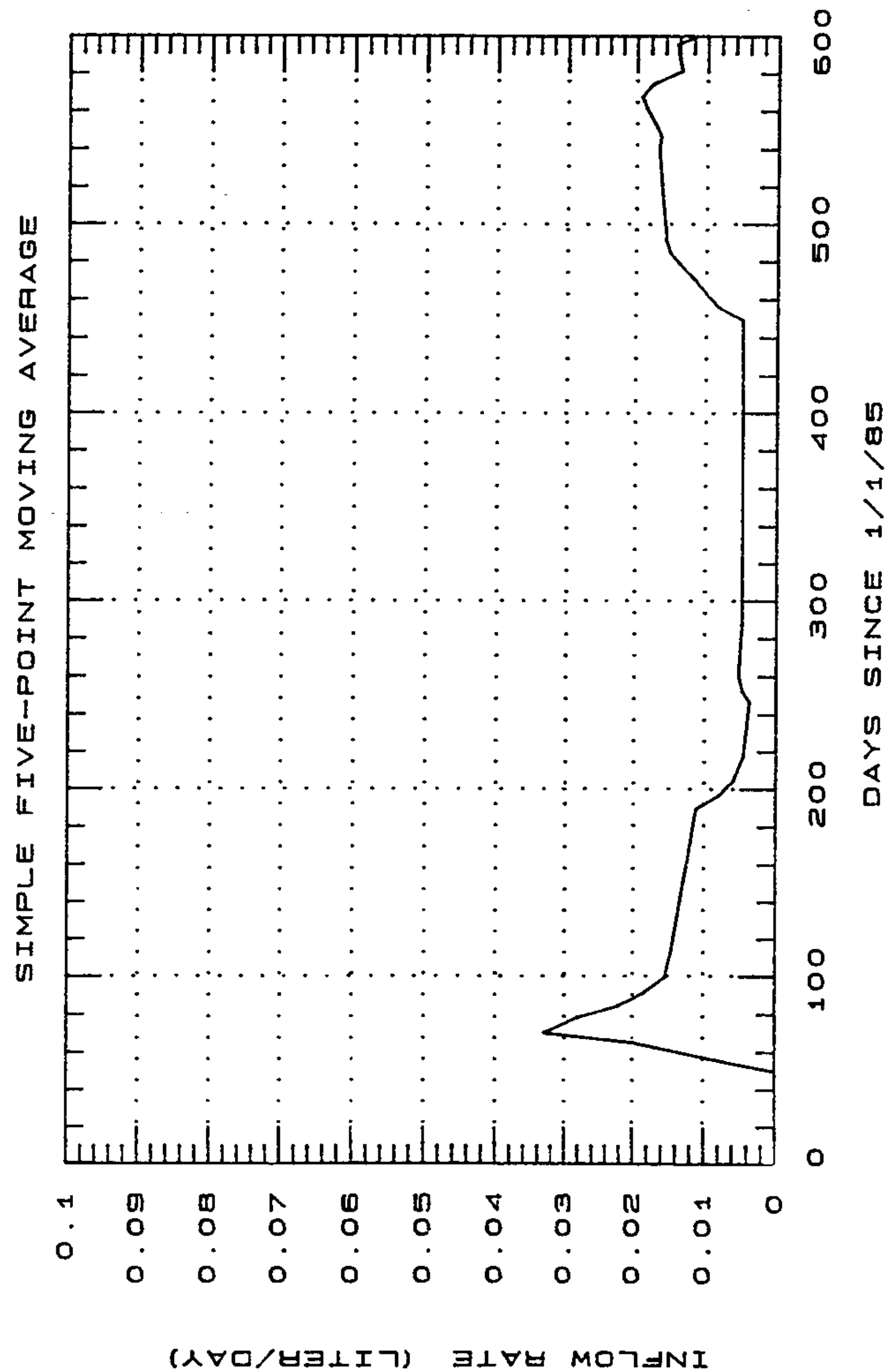


Figure D-12

A2X02 Inflow Rates

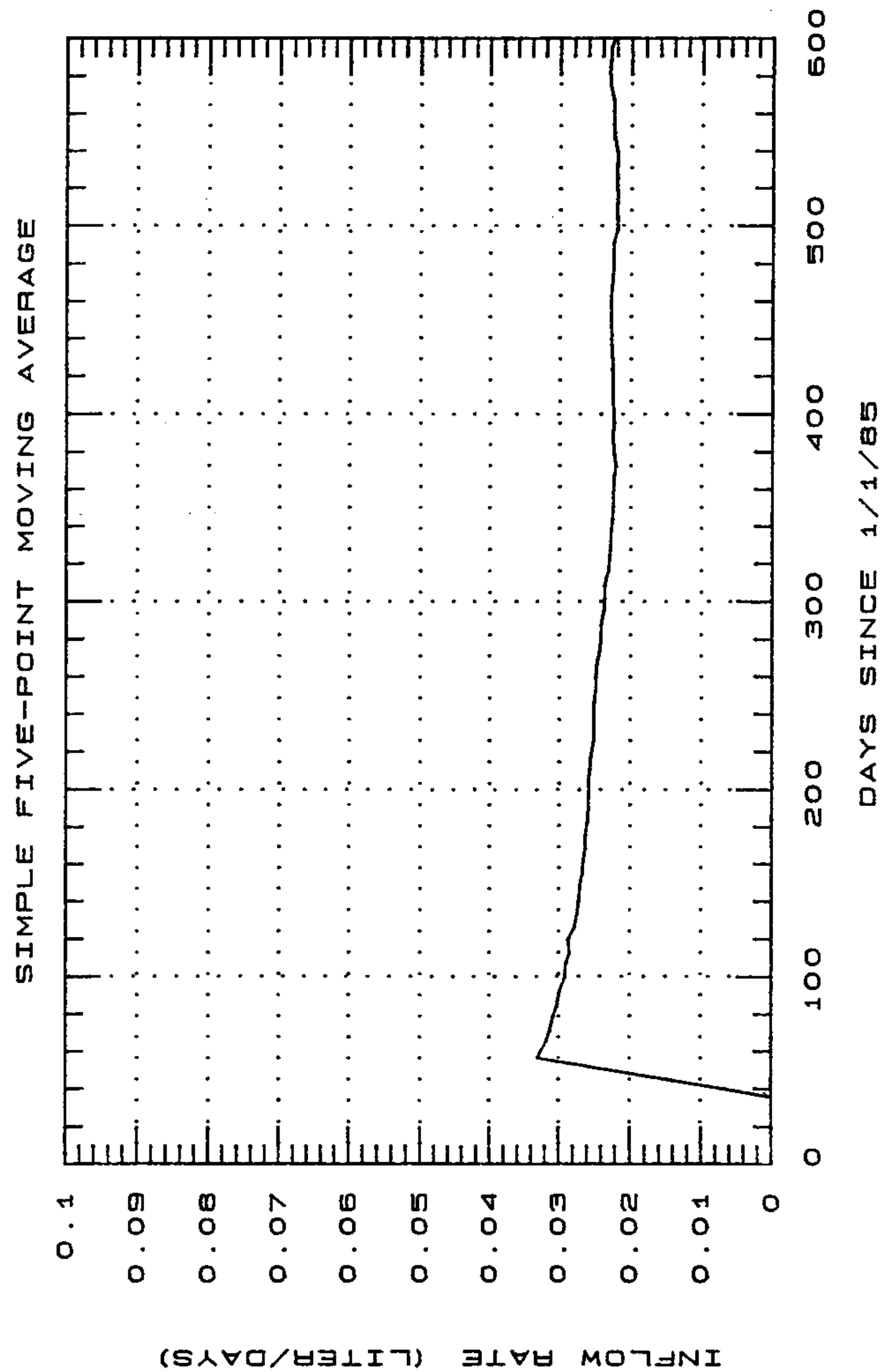


Figure D-13.

A3X01 Inflow Rates

area on the back (roof) was 3 feet in diameter by February 26, 1985. Inflow rates exceeded 0.02 liters per day in March 1985, declined slowly to about 0.01 liters per day in October 1985, and then declined more rapidly to trace amounts (0.01 liters per day or less) by the end of January 1986 (Table E.6, Figure D-14). A total of approximately 4.4 liters of brine had been collected by the end of January 1986, when significant inflows effectively ceased. An additional amount was certainly produced from the hole but lost by dissipation near the borehole collar and evaporation into the repository atmosphere.

3.3.7 Room B, Hole BX01

Hole BX01 is a downhole completed on January 27, 1985 in the north end of Room B. Marker Bed 139 was penetrated from 7.09 to 7.91 meters. When the core from 10.7 to 11.1 meters was removed from the core barrel, it was visibly wet with brine, and brine dripped from the fresh core. This interval consisted of clear to light reddish-orange, coarsely crystalline halite and polyhalitic halite. Moist, irregular vugs were observed in the core, usually in coarsely crystalline polyhalitic halite, clear halite, and halite containing some brown clay. Brine accumulations were noticed shortly after drilling. Approximately 0.4 liters of brine and muck were bailed from the hole on February 5, 1985 (Table E.7). Inflow rates in February 1985, were on the order of 0.1 liters per day, declining to about 0.06 liters per day by the end of April 1985 (Table E.7, Figure D-15). Inflow rates then continued through August 1986, showing only a slight decline to about 0.05 liters per day. A total of over 32 liters had been collected from BX01 by August 19, 1986.

3.3.8 Room B, Hole BX02

Hole BX02 is an uphole completed February 1, 1985 in the north end of Room B, directly over Hole BX01. Some moisture was noted on the core at 2.9 meters, but presented no problems to the drilling operations. The drillers noted that the hole was dry at completion of the drilling. Moist, irregular vugs were observed in the core, usually in coarsely crystalline polyhalitic halite, clear halite, and halite containing some brown clay. A collecting device was attached to the collar of the hole on February 5, 1985, and a few drops of brine were observed in the collecting container on March 12, 1985. On March 20, 1985, about 0.1 liter was removed from the collecting device (Table E.8). In April 1985, the inflow rate was on the order of 0.02 liters per day, declining gradually to about 0.015 liters per day in June 1985 (Table E.8, Figure D-16). Inflow then declined abruptly so that by the end of July 1985, only trace amounts were noticed. The evaporation problem has been exacerbated by the increasing air temperatures that began to develop in this room after the heaters were turned on. A total of about 1.75 liters of brine were collected from BX02 by the middle of January 1986. An additional amount was certainly lost by dissipation near the borehole collar and evaporation to the repository atmosphere, and the hole has been essentially dry since the end of January 1986.

3.4 Room G

Room G extends farther to the northwest than any of the rest of the WIPP underground workings (Figure D-1). It was excavated in November through December 1984. Four pairs of 15-meter up and down, vertical, stratigraphic observation holes were drilled to obtain geologic cores. These holes were

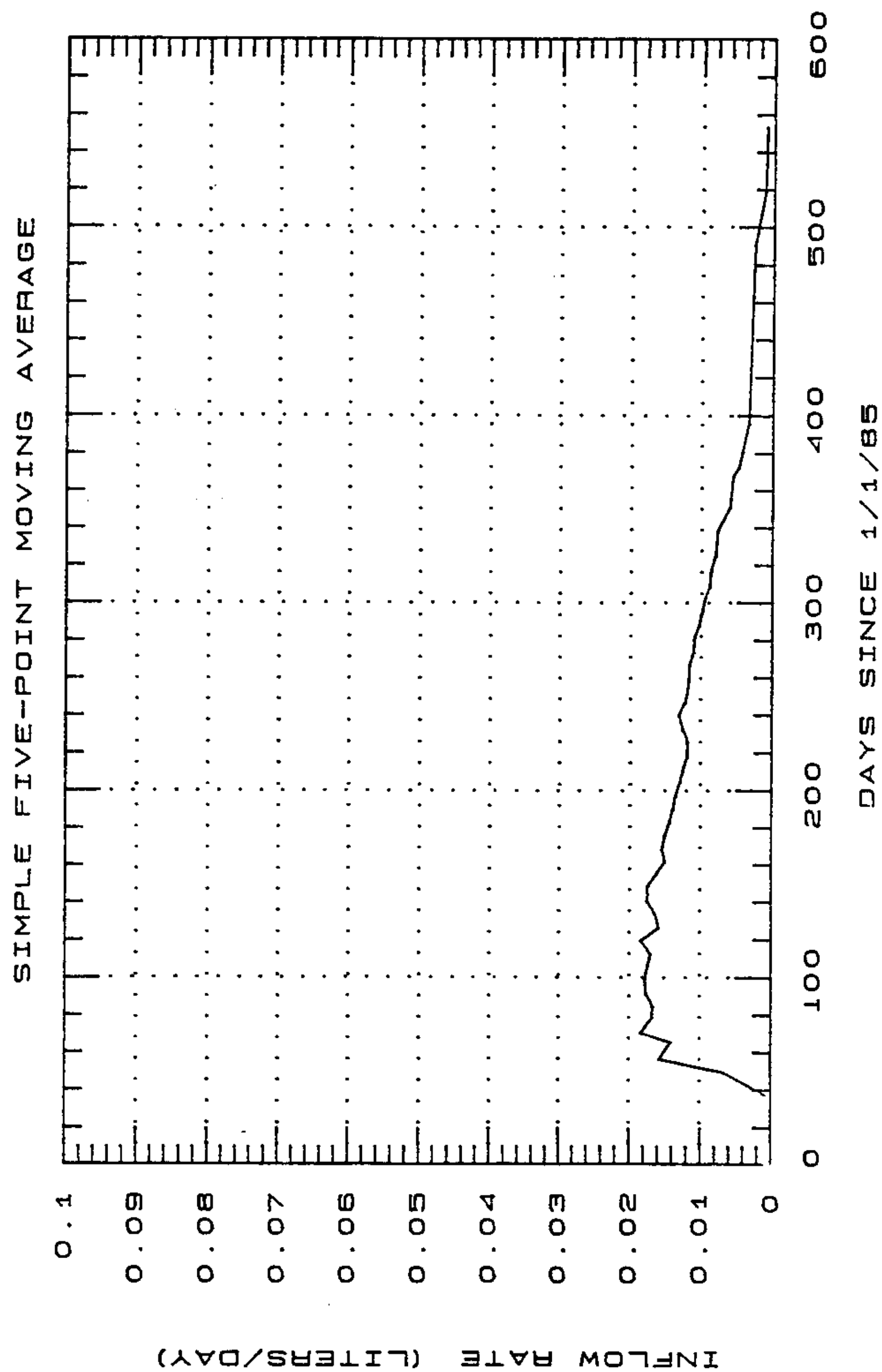


Figure D-14

A3X02 Inflow Rates

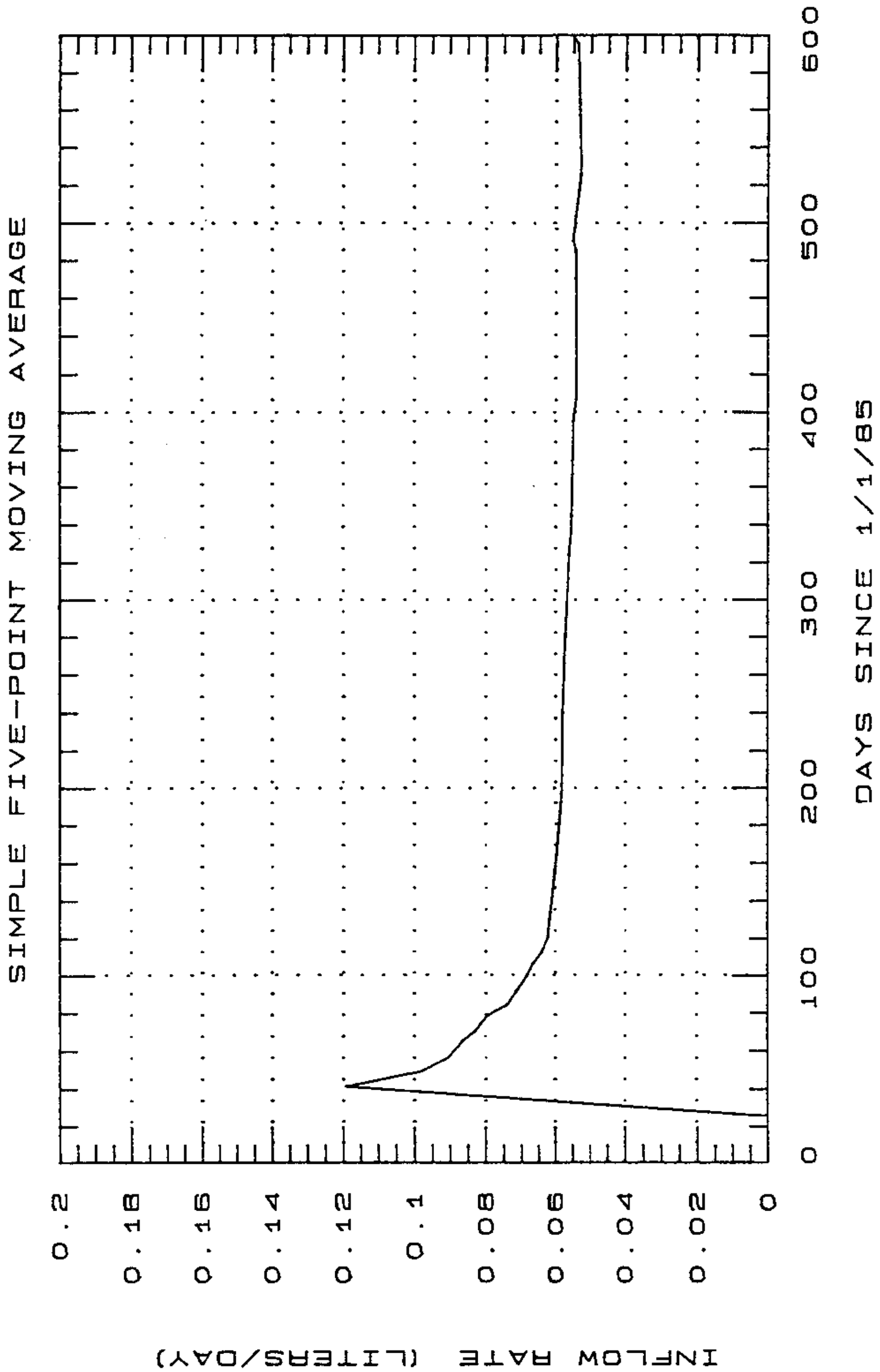


Figure D-15.

BX01 Inflow Rates

drilled with air as the drilling fluid. They were monitored from the time of drilling as part of the BSEP. The numbering system used assigned odd numbers to the upholes (DH35, DH37, DH39, and DH41) and even numbers to the corresponding downholes (DH36, DH38, DH40, and DH42). As a result of poor core recovery from the 6- to 12-meter interval in the westernmost downhole, DH42, an offset hole, DH42A, was drilled 12 meters deep, 2 meters west of DH42. It is interesting to note the striking difference in the inflow into this pair of holes, only 2 meters apart. Marker Bed 139 was generally intersected at depths of about 1.4 to 2 meters below the floor of Room G (Figure D-2).

3.4.1 Hole DH36

Hole DH36 is the easternmost downhole in Room G and was completed January 26, 1985. No brine or gas inflows were noted during drilling, but brine accumulations were noticed shortly after drilling. Moist muck was observed in the bottom of the hole on January 28, 1985 and 2.5 liters of brine, muck, and hydraulic fluid (contamination from drilling) were bailed from the hole on February 5, 1985 (Table E.10). Initial inflow rates were on the order of 0.25 liters per day and remained quite steady, decreasing only slightly through August 1986, when inflow rates still exceeded 0.2 liters per day (Table E.10, Figure D-17). Almost 125 liters of brine had been removed from DH36 by August 19, 1986.

3.4.2 Hole DH38

Hole DH38 is a downhole completed January 26, 1985 just east of the center of Room G. No brine or gas inflows were noted during drilling, but brine accumulations were noticed shortly after drilling. Moist muck was observed in the bottom of the hole on February 5, 1985 and 0.8 liters of brine and muck were bailed from the hole on February 19, 1985 (Table E.12). Initial inflow rates exceeded 0.1 liters per day in February 1985, but by mid-March had declined to less than 0.06 liters per day (Table E.12, Figure D-18). Inflow rates show a slightly increasing trend through October 1985, followed by a slightly decreasing trend through August 1986, but overall the inflow rate has been remarkably steady. Over 34 liters of brine had been removed from DH38 by August 19, 1986.

3.4.3 Hole DH40

Hole DH40 is a downhole completed January 25, 1985 just west of the center of Room G. No brine or gas inflows were noted during drilling, but brine accumulations were noticed shortly after drilling. Moist muck was observed in the bottom of the hole on February 5, 1985 and about a liter of brine, muck, and hydraulic fluid was bailed from the hole on April 17, 1985 (Table E.13). Calculated inflow rates in April 1985 exceeded 0.04 liters per day but quickly decreased to about 0.01 liters per day in May, then decreased only gradually through August 1986 (Table E.13, Figure D-19). A total of slightly more than 4.3 liters had been removed from DH40 by June 3, 1986.

3.4.4 Hole DH42

Hole DH42 is a downhole completed on January 23, 1985 at the west end of Room G. No brine or gas inflows were noted during drilling, but brine accumulations were noticed shortly after drilling. Moist muck was observed in the

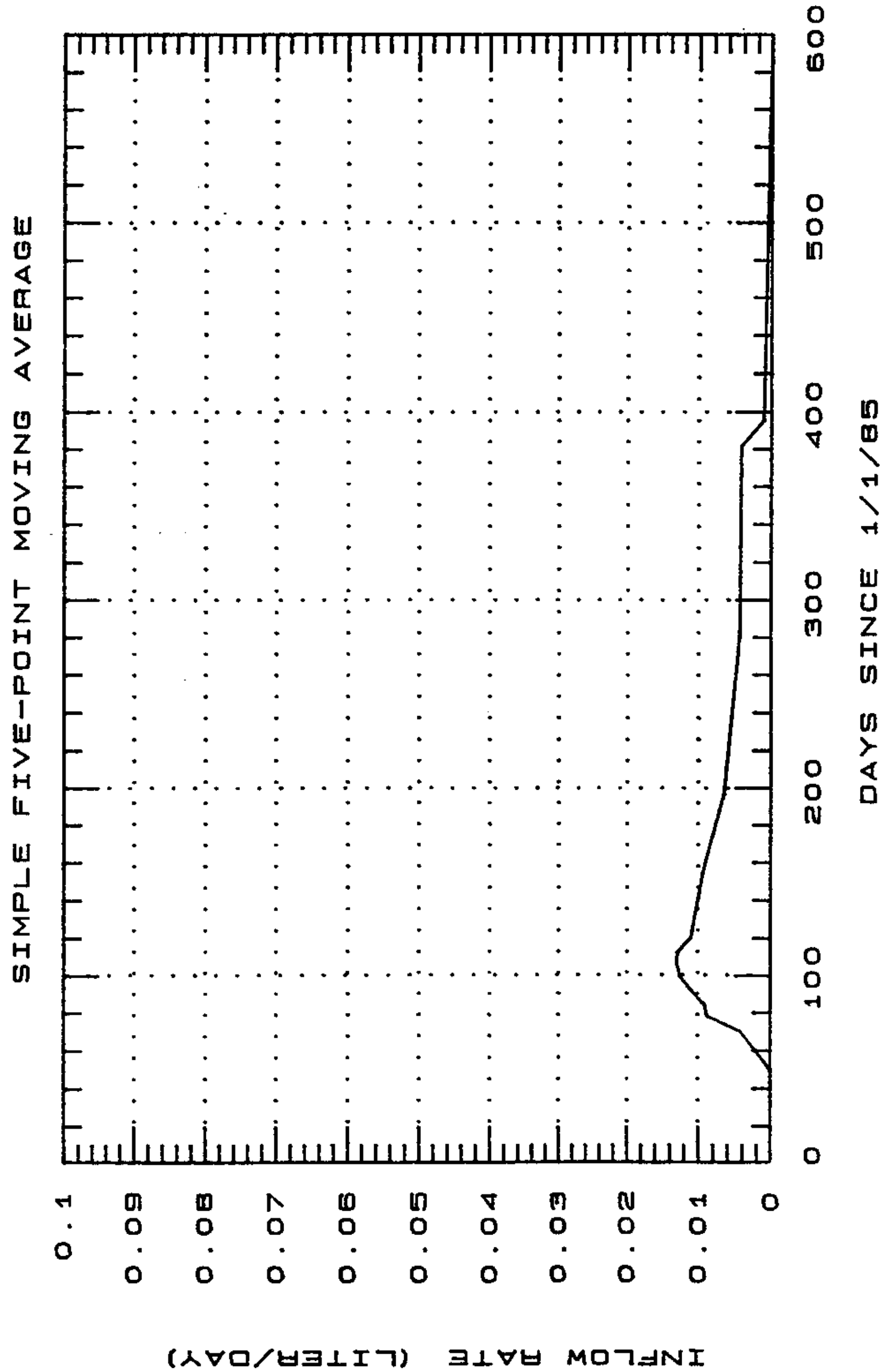


Figure D-16.

BX02 Inflow Rates

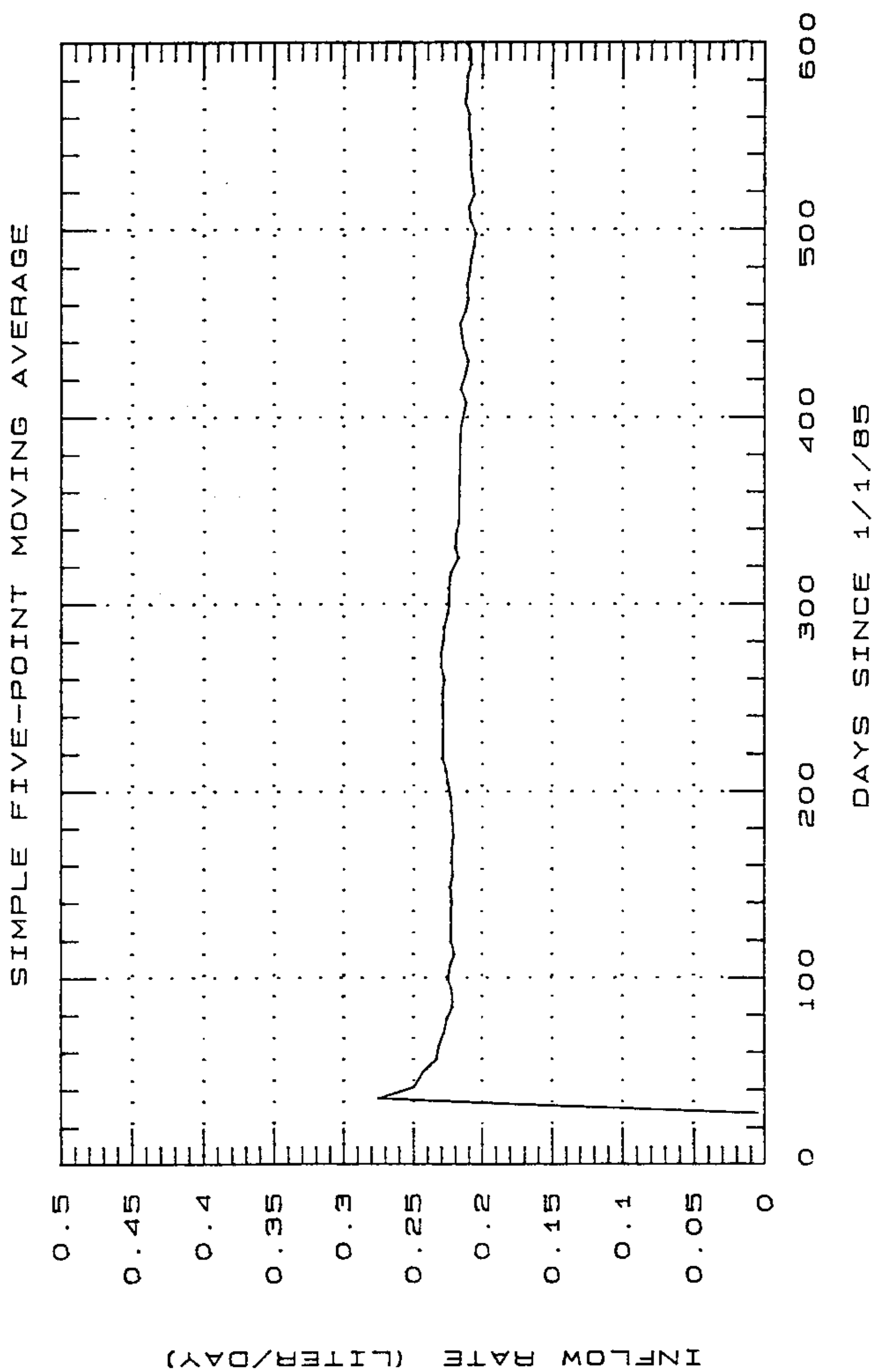


Figure D-17

DH36 Inflow Rates

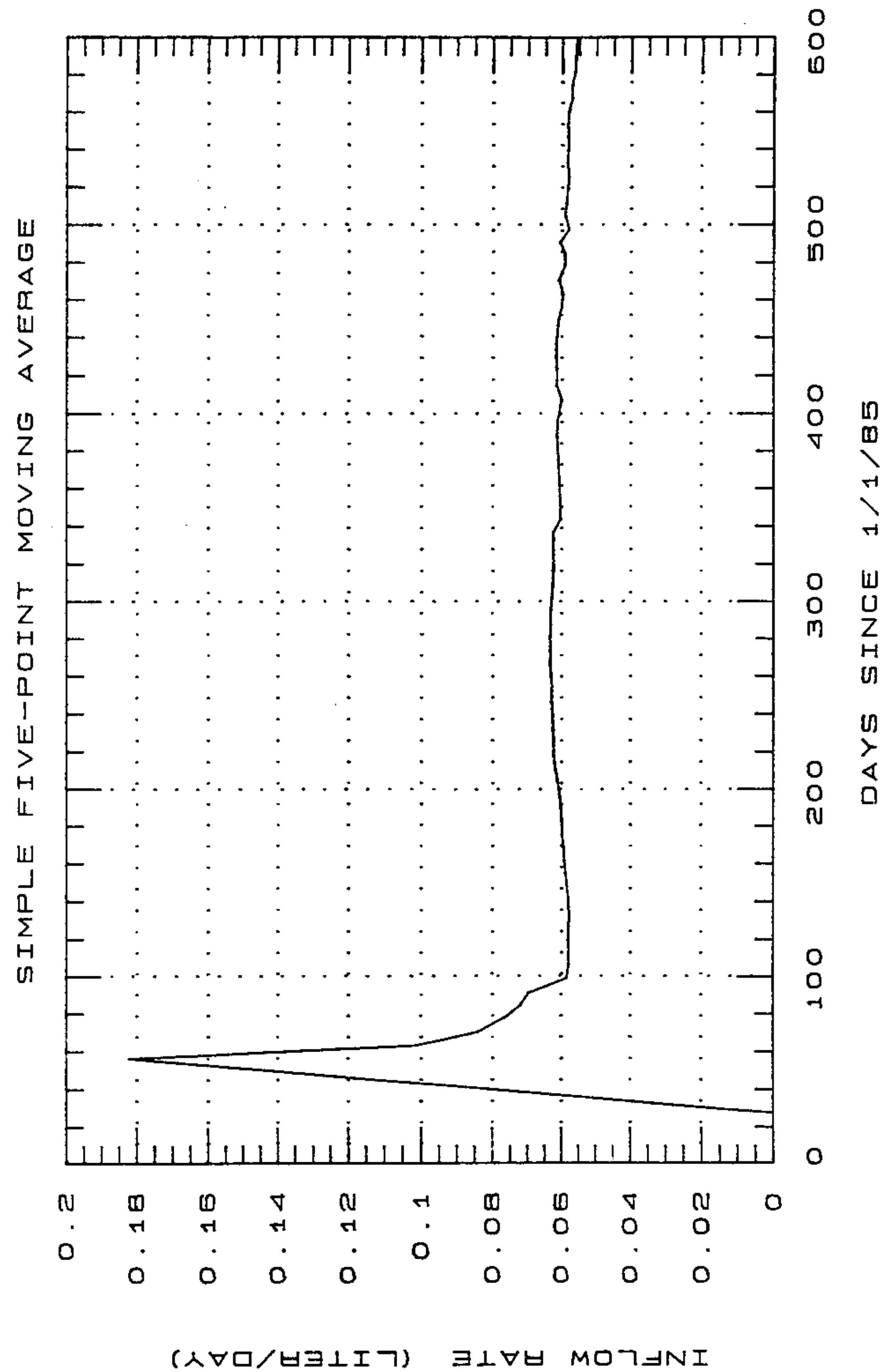


Figure D-18.
DH38 Inflow Rates

bottom of the hole on January 28, 1985 and about 0.3 liters of brine and muck was bailed from the hole on February 5, 1985 (Table E.14). Calculated inflow rates in mid-February 1985, were on the order of 0.05 liters per day and decreased only gradually to about 0.03 liters per day through August 1986 (Table E.14, Figure D-20). A total of approximately 19 liters had been removed from DH42 by August 19, 1986.

3.4.5 Hole DH42A

Hole DH42A is the westernmost downhole at the west end of Room G, 2 meters west of DH42. This hole was drilled because of poor core recovery from the 6- to 12-meter interval in DH42, which is 15.6 meters deep. DH42A was completed January 25, 1985 and is 12.3 meters deep. No brine or gas inflows were noted during drilling, but brine accumulations were noticed shortly after drilling. Brine was observed in the bottom of the hole on January 28, 1985 and 0.85 liters of brine were bailed from the hole on February 5, 1985 (Table E.15).

Calculated inflow rates in mid-February 1985, were on the order of 0.18 liters per day, increased gradually to about 0.2 liters per day in May 1985, and then began decreasing to about 0.1 liters per day in April 1986, where the inflow rate appeared to level out (Table E.15, Figure D-21). A total of approximately 75 liters of brine had been removed from DH42A by August 19, 1986. It is interesting to note that approximately four times as much brine flowed into DH42A than into DH42, which is 2 meters to the east and 3.3 meters deeper.

Most of the downholes studied showed an initial period of little or no inflow followed by a brief maximum inflow period lasting for a few days or a week or two, followed in turn by a decreasing inflow trend. Hole DH42A is the only location studied during Phase I that exhibited an early inflow trend that increased gradually over a much longer period of time (three months). The decreasing trend that followed also took much longer to begin to level out to a fairly steady inflow rate (Figure D-21).

3.4.6 Hole DH35

Hole DH35 was completed January 25, 1985 and is the easternmost uphole at the east end of Room G, above Hole DH36. No brine or gas inflows were noted during drilling, but brine accumulations were noticed shortly after drilling. Brine was observed dripping from the collar on February 5, 1985. A collecting device was installed under the collar on that date, and almost 0.2 liters was collected on March 5, 1985. Inflow rates were in excess of 0.02 liters per day in mid-March 1985, and decreased fairly steadily to 0.01 liters per day in May 1986 (Table E.9, Figure D-22). The lack of brine collected in late May and early April 1986, reflects the fact that the collecting device was broken, not that inflow ceased. However, a marked decrease in inflow did take place about that time. Calculated inflow rates in the summer of 1986 were less than 0.05 liters per day and seemed to be reduced to trace amounts by late August 1986. A total of approximately 4.3 liters was collected from DH35 by August 19, 1986.

3.4.7 Hole DH37

Hole DH37 was completed January 26, 1985 and is located just east of the center of Room G, above Hole DH38. No brine or gas inflows were noted during

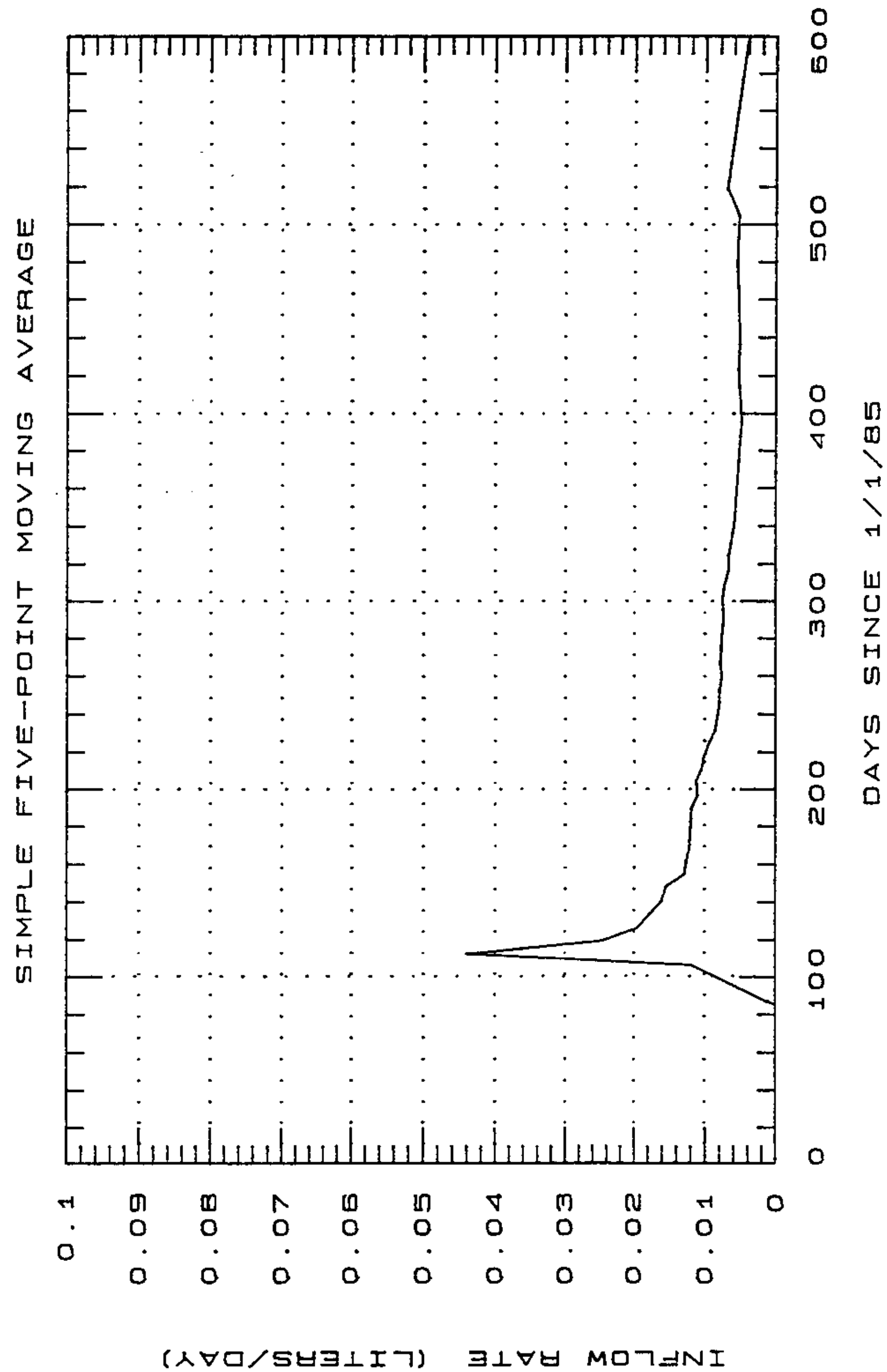


Figure D-19

DH40 Inflow Rates

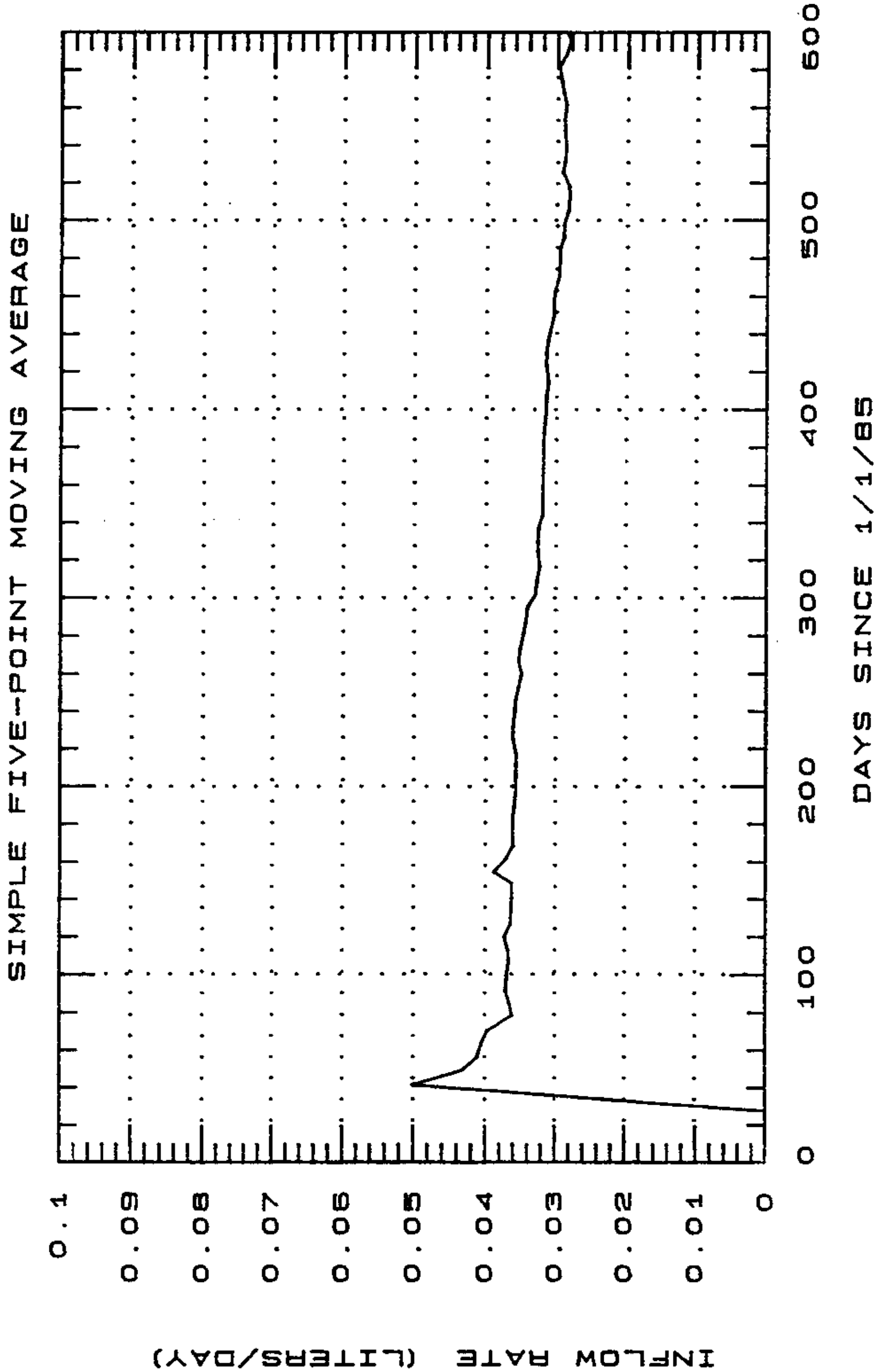


Figure D-20.

DH42 Inflow Rates

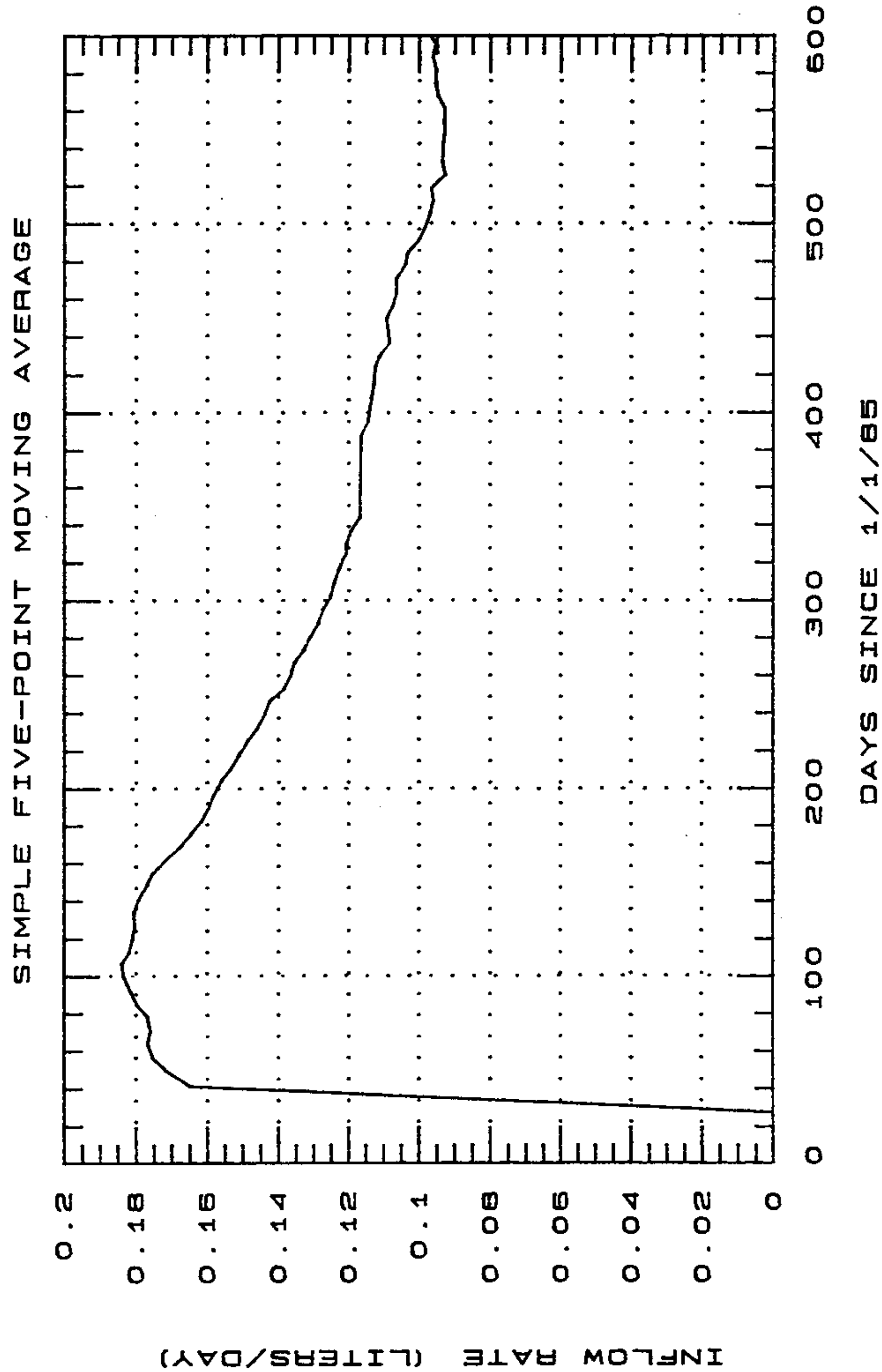


Figure D-21

DH42A Inflow Rates

drilling, but brine accumulations were noticed shortly after drilling. Brine was observed dripping from the collar on February 5, 1985. A collecting device was installed under the collar on that date, and approximately 0.06 liters was collected on March 5, 1985. Inflow rates were on the order of 0.01 liters per day through July 1985, decreasing to less than 0.005 through September 1985, and then decreased further to trace quantities accumulating in the collecting container (Table E.11; Figure D-23). A total of a little over 1.2 liters was collected from DH37 by July 1, 1986.

3.4.8 Hole DH39

Hole DH39 was completed January 24, 1985 and is located just west of the center of Room G, above Hole DH40. No brine or gas inflows were noted during drilling, but brine accumulations were noticed shortly after drilling. A moist area on the back (roof) around the collar was observed on February 5, 1985. A collecting device was installed under the collar on that date, and trace amounts of brine were collected in May 1985. Measurable quantities of brine did not accumulate in the collecting device.

3.4.9 Hole DH41

Hole DH41 was completed January 25, 1985 at the west end of the center of Room G, above Hole DH42. No brine or gas inflows were noted during drilling, but brine accumulations were noticed shortly after drilling. A moist area on the back (roof) around the collar was observed on February 5, 1985. A collecting device was installed under the collar on that date. Measurable quantities of brine did not accumulate in the collecting device.

3.5 Room J

Room J is the site of the Materials Interface Interactions Test (MIIT) and the Drum Durability Test (DDT). Room J was excavated in April 1984. A pit was excavated in the southwest floor of the room and a series of 1- to 2-meter deep drill holes were made in the north end of the room (Figure D-24; Morse and Hassinger, 1985). Brine flowed into Holes MIIT-2 and MIIT-4 during drilling, and began to seep into the pit immediately after excavation. The brine pit was cleaned and blown dry with compressed air on June 27, 1984. Five days later the pit had refilled to about one-half of its previous depth.

Forty shallow drill holes were made for the MIIT program. The fact that the brine levels in these closely-spaced drill holes were dramatically different was observed during the summer and fall of 1984. Holes partially or completely filled with brine were interspersed with dry or nearly dry holes, often less than a meter away. On October 26, 1984, the room and the brine accumulations were surveyed (Figure D-24; Morse and Hassinger, 1985). The brine levels in the drill holes were resurveyed on November 26, 1984. At that time, the floor of the room was observed to be contaminated by a variety of materials and fluids.

On November 29, 1984, the MIIT holes were evacuated and cleaned with compressed air, the DDT pit was cleaned, and the contaminants that were loose on the floor removed. Approximately 75 liters of brine and salt crystals were removed from

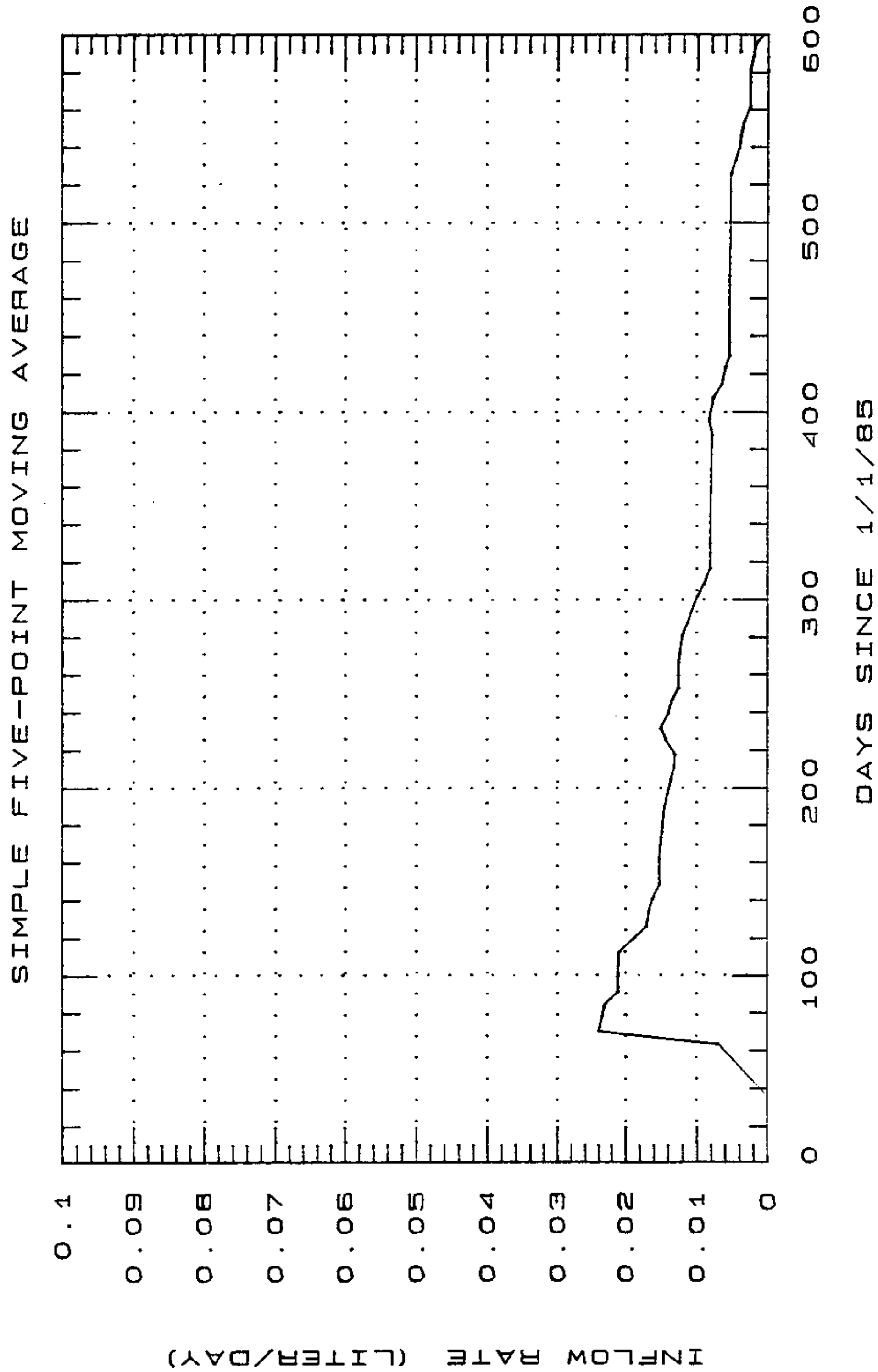


Figure D-22.

DH35 Inflow Rates

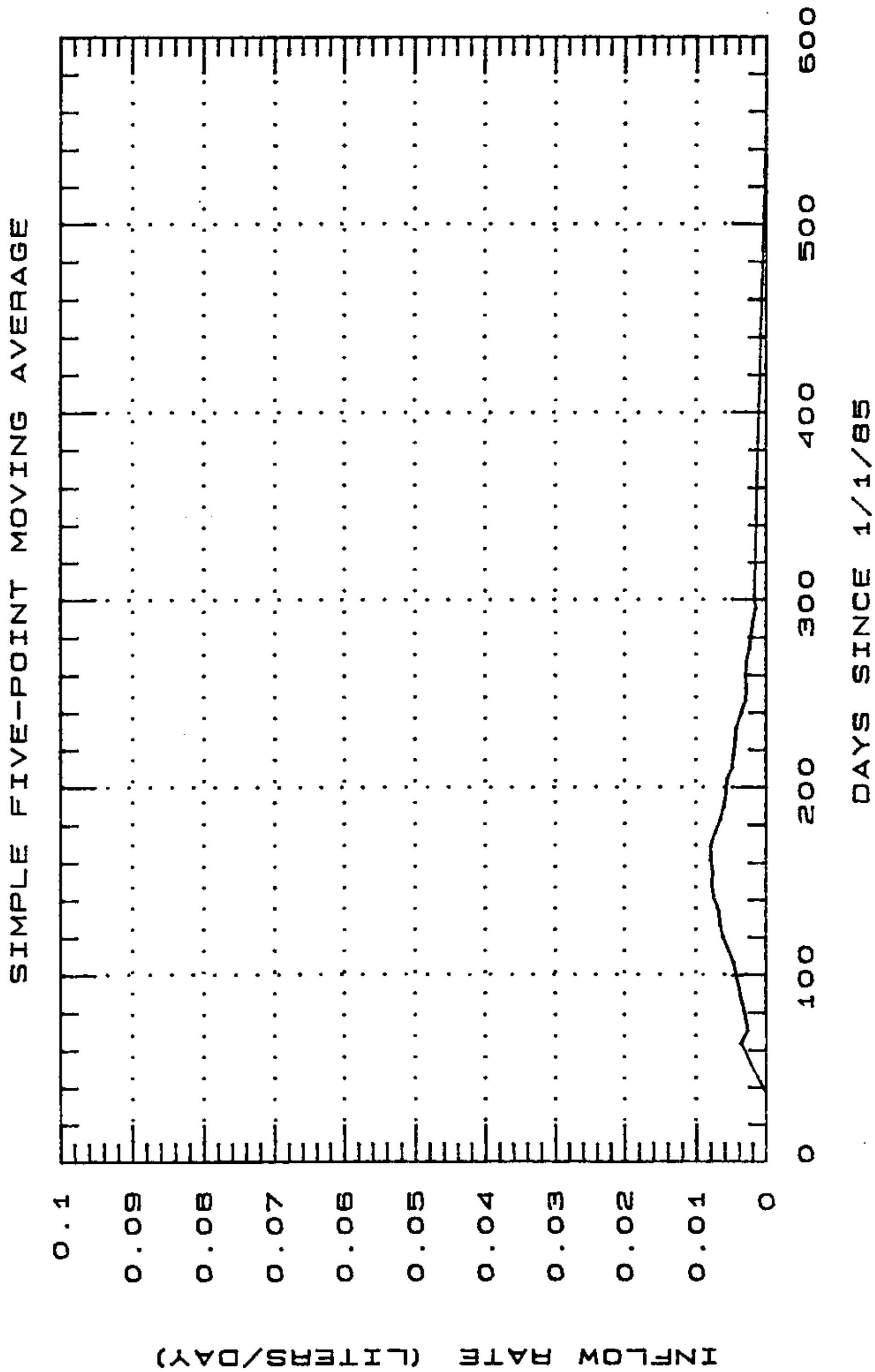


Figure D-23.

DH37 Inflow Rates

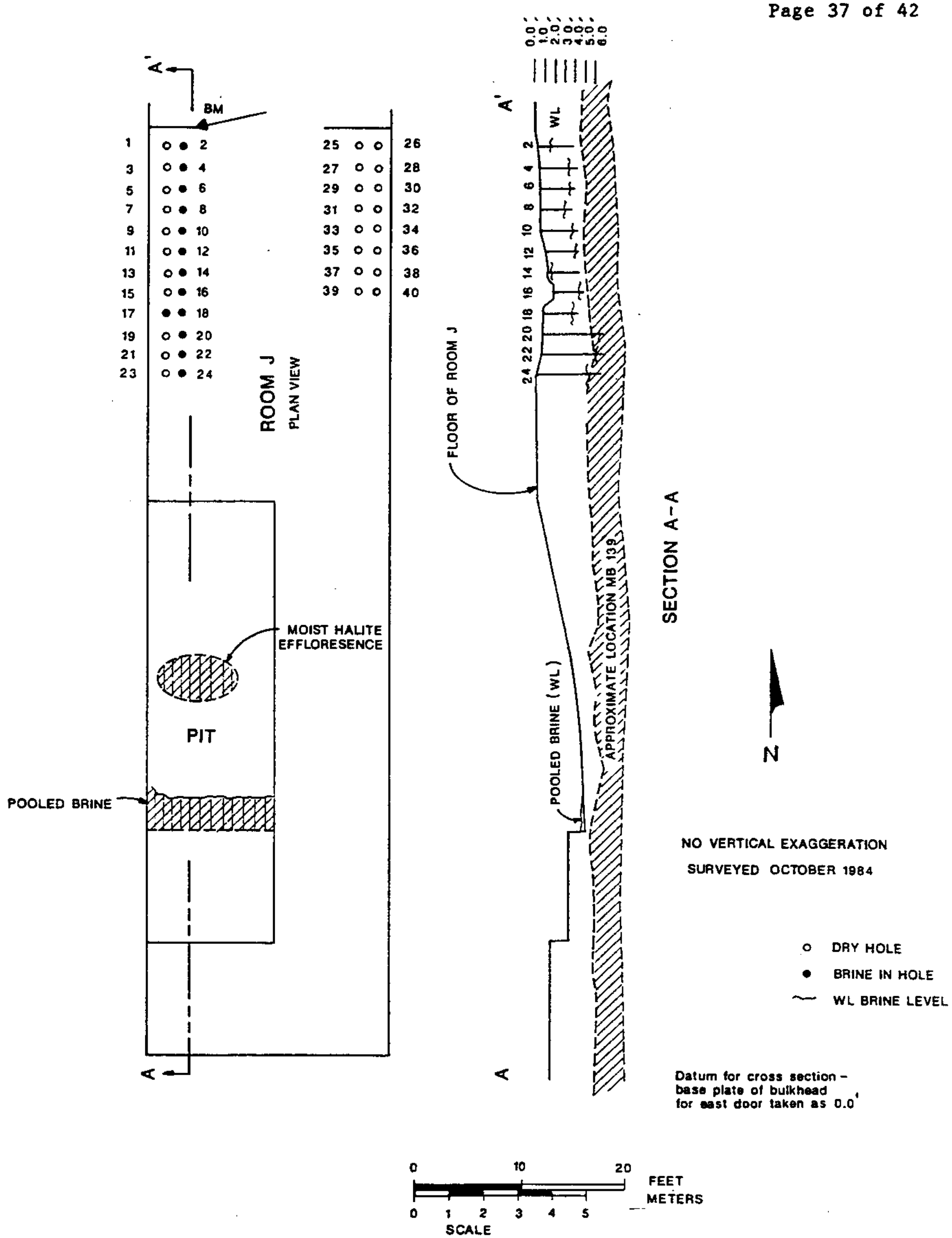


Figure D-24.

Room J Brine Survey, Plan and Cross Section
(After Morse and Hassinger, 1985)

the pit and about 17.5 liters were removed from the MIIT holes. Eighteen days later brine puddles had returned to the floor of the DDT pit and some brine had returned to all except one of the MIIT holes that had previously contained brine.

On January 8, 1985, the brine levels were again surveyed and the holes evacuated. Brine inflows were monitored through April 23, 1985, when Room J was closed to the BSEP in the course of the MIIT experiments.

The significance of the observations that were made in Room J is that drill holes less than a meter apart exhibited strikingly different brine inflows and the brine level in adjacent holes stood at strikingly different levels. Marker Bed 139 was obviously playing a significant role in the migration of brine to the MIIT holes and the brine pit (Figure D-24), and gas bubbles were associated with almost all occurrences. A total of over 18 liters of brine were removed from the MIIT holes.

3.6 Room L1, Hole L1X00

Room L1 was excavated in April 1984. Shortly after excavation, 11 holes were drilled in the floor across the north end of the room and approximately one foot of brine accumulated in each of these holes. On November 27, 1984 it was observed that 10 of the 11 holes had been filled and sealed with grout as part of the Plugging and Sealing test program. The remaining hole, L1X00, was still open and contained brine, and about 11 liters of brine were removed from the hole. On November 30, 1984 compressed air was used to completely evacuate the hole. On May 14, 1985 the hole was found to contain brine and an additional 11.46 liters were removed. Inflow rates at the end of May were calculated to be on the order of 0.03 liters per day, declining gradually to about 0.02 liters per day in early December 1985 (Table E.19, Figure D-25). Inflow rates then gradually increased through August 1986 returning almost to their May 1985, values. A total of over 23.5 liters of brine had been removed from L1X00 by August 19, 1986.

Thirty-six downholes, 10 centimeters in diameter, and 3.6 meters deep were drilled through MB 139 on a 1 meter by 1.5 meter grid in the north end of Room L1. Observations of brine inflows into some of these holes showed variations between holes that were similar to, but somewhat less dramatic than, those described above for the MIIT holes in Room J.

3.7 E140 Drift at S1950, Holes DH215 and DH216

The south exploratory drift was excavated at E140 in 1982 and 1983, reaching the southern end (S3666) of the planned underground facility January 29, 1983. The initial excavation was 2.4 meters high and 7.6 meters wide. The part of the drift at S1950 was mined on January 3, 1983. A pair of uphole and downholes (DH215 and DH216) were drilled shortly after excavation, and sonic-probe extensometers (GE247 and GE248) were installed in them. Both holes were drilled with brine as the drilling fluid and both encountered traces of pressurized gas during drilling. Hole DH215 is the uphole and is 15.8 meters deep. Hole DH216 is the downhole and is 16.5 meters long. Both holes began producing brine shortly after drilling and, partially because they were far removed from the observation holes in the northern, experimental part of the WIPP workings, were the location of early, informal, brine inflow observations.

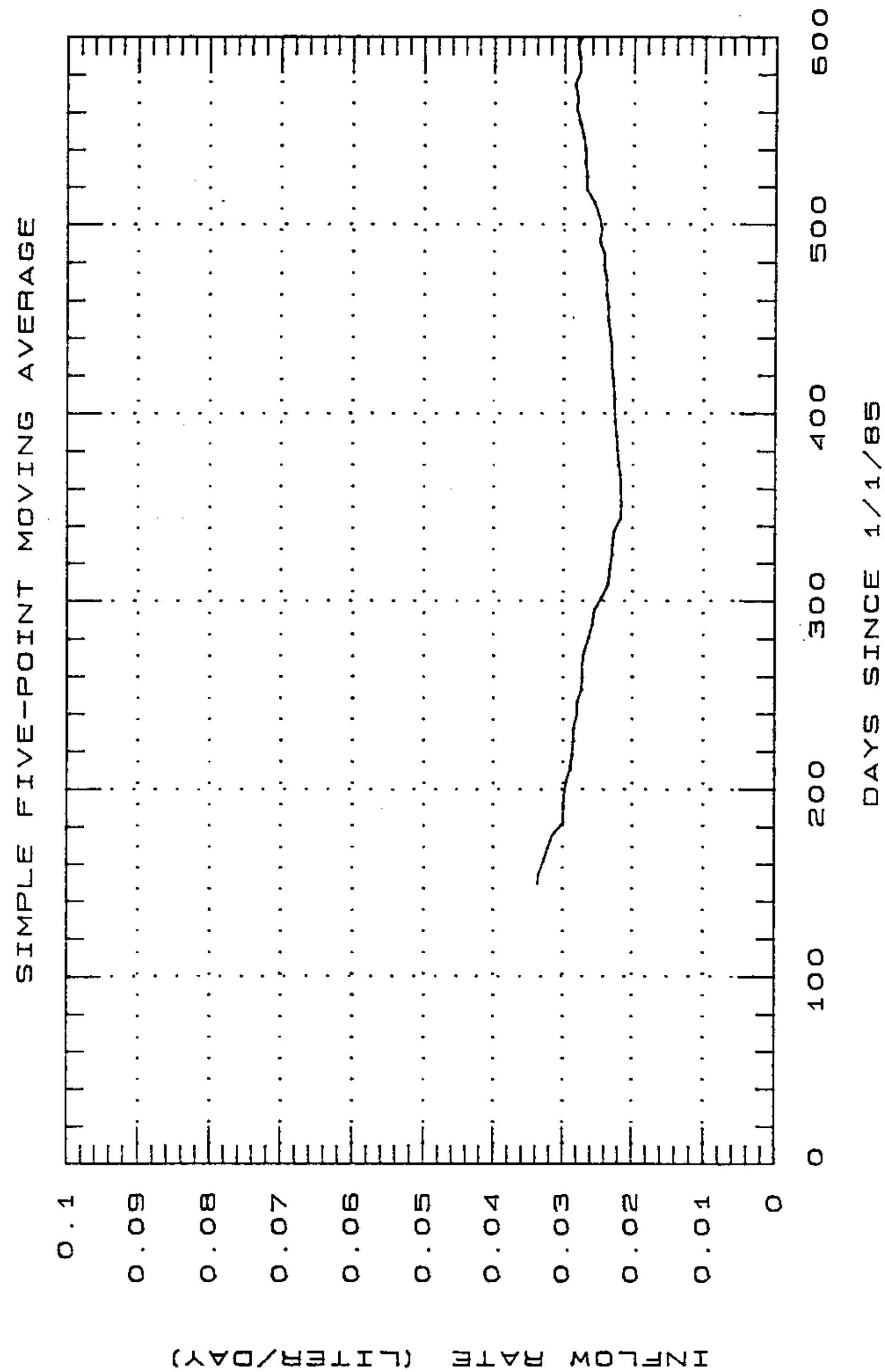


Figure D-25.

L1X00 Inflow Rates

The presence of instrumentation in both holes makes it difficult to obtain good quantitative data and probably effects any chemical data obtained from brine withdrawn from them.

In April 1984, the downhole was observed to be completely filled with brine, and brine was observed dripping into it from the uphole over it. It was not known how much of the 15.8 meters of brine in the downhole had been produced from the rocks exposed in the sides of the hole and how much had dripped into it from the uphole. It was further recognized that both holes had been drilled with brine and that water had been spread on the floor of the drift by the mining contractor for dust control, both possible sources of brine that may have accumulated in the downhole.

On April 20, 1984, a funnel and collecting device was installed on the uphole to collect the brine issuing from it, and the brine that filled the downhole was evacuated down to the level of the instrument head, approximately 0.55 meters below the collar. It was not possible to conveniently extract brine from below the instrument head, so a column of brine more than 15.2 meters long remained in the hole.

Three days later, on April 23, 1984, about an inch of brine had accumulated over the instrument head in the downhole (DH216), but no brine had been collected from the uphole (DH215). Gas bubbles were observed rising around the instrument head in DH216. By the end of April, small amounts of brine were collected from the uphole, and incidental observations throughout the summer and fall of 1984 documented that more brine was being produced from the downhole than from the uphole, but that both did yield brine.

Formal collections were initiated in January 1985, at which time the uphole seemed to be producing more brine than the downhole. Accurate data from the downhole (DH216) was difficult to obtain, and the collar was destroyed and the hole plugged by mining November 19, 1985.

Data from the uphole, DH215, is more complete (Table E.16) and is quite interesting (Figure D-26). Inflow rates in January 1985 were on the order of 0.01 liters per day and showed a gradual increase, almost doubling to 0.02 liters per day by November 1985. On November 19, 1985, the floor of E140 was lowered by 4 feet at S1950. On November 20, 1985, mining of the cross drift S1950 began, with mining to the east, toward E300. On January 29, 1986, the cross drift was extended to the west, toward W30. Hole DH215 was the uphole in the center of what then became the intersection of E140 and S1950. On February 28, 1986, additional mining took place at this intersection as the floor of E140 south of the intersection was lowered 1.2 meters.

Inflow rates increased three-fold, to approximately 0.06 liters per day, immediately following the lowering of the floor and the excavation of the cross drift to the east. It is highly probable that the change in the stress distribution in the vicinity of the intersection resulted in the increased inflow and that the sudden increase shown on Figure D-26 is a mining-induced transient effect. Inflow rates then declined steadily, perhaps beginning coincidentally with the additional mining at the intersection or perhaps related to that mining, through August 1986, to rates below those observed in January 1985.

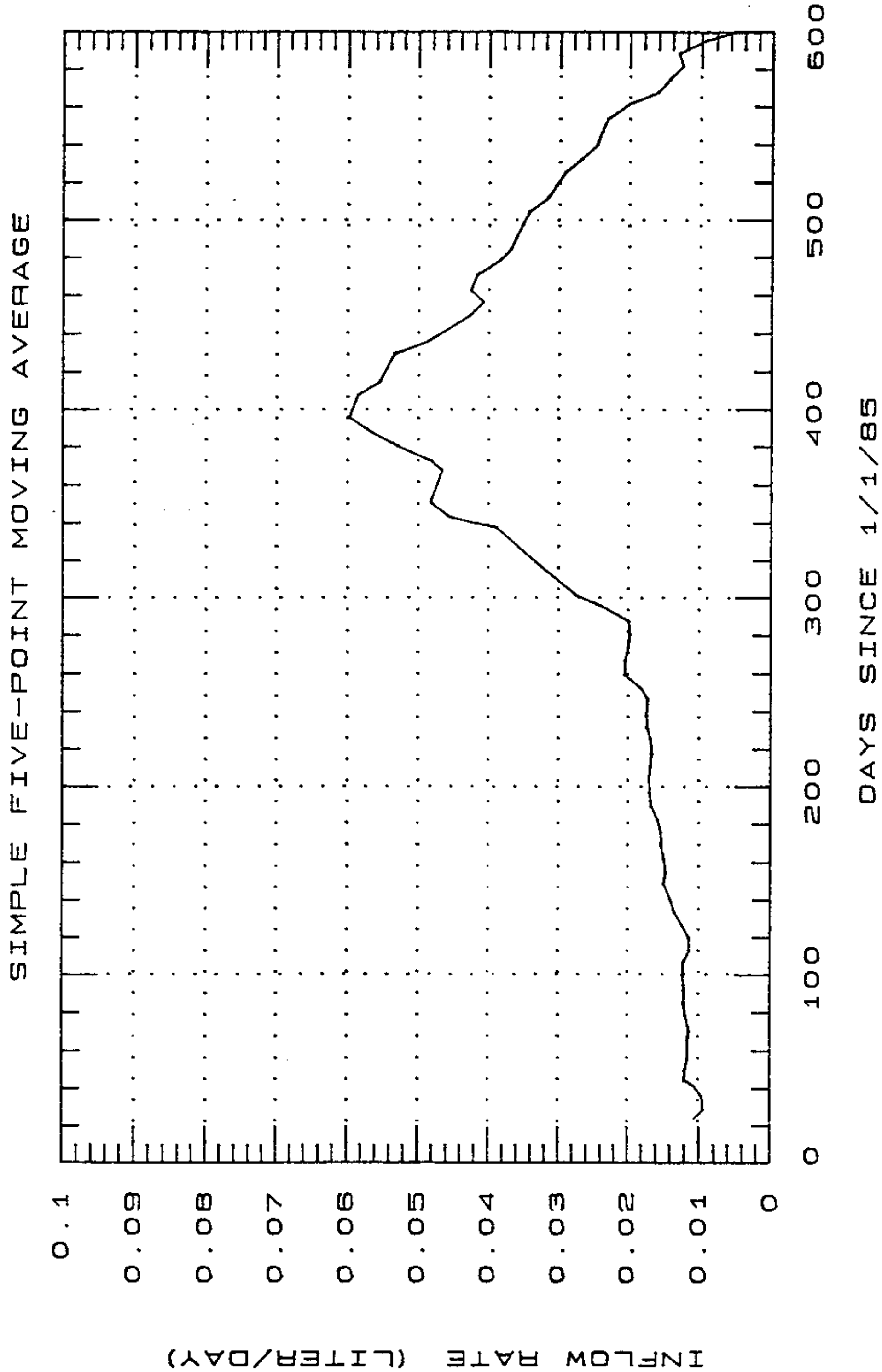


Figure D-26.

DH215 Inflow Rates

Over 15 liters of brine were collected from DH215 over the 600 days of collection. This figure is a minimum figure and much more brine had been produced from the hole, but not collected and measured, prior to January 1985.

APPENDIX E

WIPP BSEP BRINE INFLOW DATA TABLES

TABLE E.1
Inflow Data for Hole A1X01 in Room A1

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
03/12/85	12:20	00.08	70.514	0.08	0.000	First time bailed.
03/20/85	13:30	00.38	78.562	0.46	0.047	Brine plus some muck.
03/26/85	11:25	00.23	84.476	0.69	0.039	Muck in hole. Valved leaked, some brine drained back down hole.
04/02/85	12:15	00.39	91.510	1.08	0.055	
04/10/85	12:20	00.33	99.514	1.41	0.041	
04/17/85	11:30	00.28	106.479	1.69	0.040	
04/23/85	10:50	00.23	112.451	1.92	0.039	
04/30/85	13:26	00.26	119.560	2.18	0.037	
05/07/85	09:10	00.25	126.382	2.43	0.037	
05/14/85	10:06	00.24	133.421	2.67	0.034	
05/21/85	11:40	00.26	140.486	2.93	0.037	
05/29/85	10:00	00.27	148.417	3.20	0.034	
06/04/85	10:20	00.20	154.431	3.40	0.033	
06/11/85	09:40	00.23	161.403	3.63	0.033	
06/18/85	09:34	00.23	168.399	3.86	0.033	
06/25/85	09:40	00.22	175.403	4.08	0.031	
07/02/85	11:00	00.23	182.458	4.31	0.033	
07/09/85	10:00	00.23	189.417	4.54	0.033	
07/16/85	10:55	00.23	196.455	4.77	0.033	
07/24/85	10:00	00.25	204.417	5.02	0.031	
07/30/85	09:32	00.19	210.397	5.21	0.032	
08/06/85	09:37	00.21	217.401	5.42	0.030	
08/14/85	09:48	00.23	225.408	5.65	0.029	
08/20/85	10:18	00.19	231.429	5.84	0.032	
08/28/85	09:13	00.23	239.384	6.07	0.029	
09/04/85	09:46	00.19	246.407	6.26	0.027	
09/10/85	09:30	00.18	252.396	6.44	0.030	
09/17/85	09:10	00.19	259.382	6.63	0.027	
09/24/85	09:11	00.21	266.383	6.84	0.030	
10/01/85	09:23	00.21	273.391	7.05	0.030	
10/08/85	12:24	00.20	280.517	7.25	0.028	Room A1 heaters turned on 10/02/85.
10/15/85	09:43	00.19	287.405	7.44	0.028	
10/23/85	09:55	00.20	295.413	7.64	0.025	
10/29/85	11:05	00.17	301.462	7.81	0.028	
11/05/85	08:50	00.19	308.368	8.00	0.028	
11/13/85	09:15	00.22	316.385	8.22	0.027	
11/21/85	10:40	00.21	324.444	8.43	0.026	
11/26/85	10:10	00.14	329.424	8.57	0.028	
12/04/85	14:13	00.20	337.592	8.77	0.024	
12/10/85	10:40	00.15	343.444	8.92	0.026	
12/17/85	13:59	00.19	350.583	9.11	0.027	
01/03/86	09:40	00.41	367.403	9.52	0.024	
01/08/86	10:20	00.09	372.431	9.61	0.018	
01/16/86	09:50	00.25	380.410	9.86	0.031	
01/23/86	10:10	00.18	387.424	10.04	0.026	
01/31/86	11:05	00.21	395.462	10.25	0.026	
02/12/86	10:10	00.30	407.424	10.55	0.025	
02/19/86	10:55	00.18	414.455	10.73	0.026	
02/28/86	14:05	00.23	423.587	10.96	0.025	
03/06/86	10:00	00.15	429.417	11.11	0.026	
03/13/86	09:30	00.18	436.396	11.29	0.026	
03/26/86	09:20	00.33	449.389	11.62	0.025	
04/02/86	09:00	00.18	456.375	11.80	0.026	

TABLE E.1
Inflow Data for Hole A1X01 in Room A1

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
04/08/86	09:09	00.15	462.381	11.95	0.025	
04/16/86	11:30	00.20	470.479	12.15	0.025	
04/24/86	09:35	00.20	478.399	12.35	0.025	
04/30/86	10:13	00.15	484.426	12.50	0.025	
05/06/86	09:40	00.12	490.403	12.62	0.020	
05/13/86	09:25	00.19	497.392	12.81	0.027	
05/20/86	10:16	00.18	504.428	12.99	0.026	
05/27/86	15:05	00.18	511.628	13.17	0.025	
06/03/86	09:28	00.17	518.394	13.34	0.025	
06/10/86	10:50	00.15	525.451	13.49	0.021	
06/17/86	09:59	00.19	532.416	13.68	0.027	
06/24/86	10:10	00.18	539.424	13.86	0.026	
07/01/86	12:46	00.19	546.532	14.05	0.027	
07/08/86	10:05	00.16	553.420	14.21	0.023	
07/16/86	09:57	00.20	561.415	14.41	0.025	
07/22/86	09:26	00.16	567.393	14.57	0.027	
07/29/86	10:05	00.17	574.420	14.74	0.024	
08/05/86	10:21	00.19	581.431	14.93	0.027	
08/12/86	09:58	00.18	588.415	15.11	0.026	
08/19/86	10:40	00.18	595.444	15.29	0.026	

TABLE E.2
Inflow Data for Hole A1X02 in Room A1

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
03/07/85	09:30	NA	65.396	0.00	0.000	First record, completed drilling 3/07/85. Hit brine at 12 ft. on 2/27/85.
03/12/85	12:00	NA	70.500	0.00	0.000	Trace brine, deepened hole to clay seam. Moisture on back 1 ft radius.
03/20/85	13:00	NA	78.542	0.00	0.000	Trace brine, drip missing funnel.
03/26/85	11:25	NA	84.476	0.00	0.000	Repositioned funnel, collected one cup of salt crystals with trace brine.
04/02/85	12:15	00.21	91.510	0.21	0.008	Some drips missing funnel.
04/10/85	12:20	00.22	99.514	0.43	0.027	Collecting container had leak.
04/17/85	11:30	00.12	106.479	0.55	0.017	Some drips missing funnel.
04/23/85	10:50	00.12	112.451	0.67	0.020	Some drips missing funnel.
04/30/85	13:16	00.12	119.553	0.79	0.017	Some drips missing funnel.
05/07/85	09:05	00.16	126.378	0.95	0.023	
05/14/85	10:04	00.19	133.419	1.14	0.027	
05/21/85	11:35	00.13	140.483	1.27	0.018	Some drips missing funnel.
05/29/85	10:00	00.21	148.417	1.48	0.026	
06/04/85	10:25	00.17	154.434	1.65	0.028	
06/11/85	09:40	00.05	161.403	1.70	0.007	
06/18/85	09:30	00.08	168.396	1.78	0.011	Some missing funnel, big stalactite formed.
06/25/85	09:45	00.16	175.406	1.94	0.023	
07/02/85	11:00	00.10	182.458	2.04	0.014	
07/09/85	09:58	00.15	189.415	2.19	0.022	
07/16/85	10:53	00.24	196.453	2.43	0.034	
07/24/85	09:49	00.24	204.409	2.67	0.030	
07/30/85	09:30	00.15	210.396	2.82	0.025	
08/06/85	09:35	00.14	217.399	2.96	0.020	
08/14/85	09:26	00.05	225.393	3.01	0.006	
08/20/85	10:13	00.09	231.426	3.10	0.015	
08/28/85	09:08	00.06	239.381	3.16	0.008	
09/04/85	09:44	00.07	246.406	3.23	0.010	
09/10/85	09:24	00.12	252.392	3.35	0.020	
09/17/85	09:08	00.13	259.381	3.48	0.019	Some drips missing funnel.
09/24/85	09:07	00.17	266.380	3.65	0.024	
10/01/85	09:21	00.14	273.390	3.79	0.020	
10/08/85	12:19	00.16	280.513	3.95	0.022	Room A1 heaters turned on 10/02/85.
10/15/85	09:41	00.12	287.403	4.07	0.017	
10/23/85	09:43	00.19	295.405	4.26	0.024	
10/29/85	11:02	00.12	301.460	4.38	0.020	
11/05/85	08:46	00.12	308.365	4.50	0.017	
11/13/85	09:16	00.13	316.386	4.63	0.016	Some drips missing funnel.
11/21/85	10:45	00.13	324.448	4.76	0.016	Some drips missing funnel.
12/04/85	14:07	00.14	337.588	4.90	0.011	
12/10/85	10:31	00.08	343.438	4.98	0.014	
12/17/85	13:56	00.03	350.581	5.01	0.004	
01/03/86	09:40	00.01	367.403	5.02	0.001	Some drips missing funnel.
01/23/86	10:10	00.06	387.424	5.08	0.003	New, larger, funnel since 01/17.
01/31/86	11:05	00.23	395.462	5.31	0.029	
02/12/86	10:10	00.22	407.424	5.53	0.018	
02/19/86	10:50	00.07	414.451	5.60	0.010	

TABLE E.2
Inflow Data for Hole A1X02 in Room A1

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
02/28/86	14:00	00.02	423.583	5.62	0.002	
03/13/86	09:30	00.05	436.396	5.67	0.004	
03/26/86	09:20	00.05	449.389	5.72	0.004	
04/02/86	09:00	00.08	456.375	5.80	0.011	
04/16/86	11:30	00.10	470.479	5.90	0.007	
04/24/86	09:35	00.05	478.399	5.95	0.006	
04/30/86	10:10	00.07	484.424	6.02	0.012	
05/06/86	09:40	00.16	490.403	6.18	0.027	
05/13/86	09:25	00.02	497.392	6.20	0.003	
05/20/86	10:16	00.04	504.428	6.24	0.006	
05/27/86	15:05	00.15	511.628	6.39	0.021	
06/03/86	09:28	00.13	518.394	6.52	0.019	
06/10/86	10:50	00.10	525.451	6.62	0.014	
06/17/86	09:59	00.12	532.416	6.74	0.017	
06/24/86	10:10	00.25	539.424	6.99	0.036	
07/01/86	12:44	00.23	546.531	7.22	0.032	
07/08/86	10:05	00.11	553.420	7.33	0.016	
07/16/86	09:54	00.25	561.413	7.58	0.031	
07/22/86	09:26	00.16	567.393	7.74	0.027	
07/29/86	10:05	00.26	574.420	8.00	0.037	
08/05/86	10:19	00.22	581.430	8.22	0.031	
08/12/86	09:58	00.28	588.415	8.50	0.040	
08/19/86	10:38	00.26	595.443	8.76	0.037	

TABLE E.3
Inflow Data for Hole A2X01 in Room A2

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
02/19/85	13:20	NA	49.556	0.00	0.000	Moist muck. First entry.
03/07/85	09:30	00.29	65.396	0.29	0.017	Lots of muck, some oil.
03/12/85	11:30	00.62	70.479	0.91	0.122	Brine and muck.
03/20/85	13:04	00.52	78.544	1.43	0.064	
03/26/85	11:02	00.38	84.460	1.81	0.064	
04/02/85	11:58	00.36	91.499	2.17	0.051	
04/10/85	11:53	00.36	99.495	2.53	0.045	Some muck included.
04/17/85	11:10	00.27	106.465	2.80	0.039	
04/23/85	10:30	00.24	112.438	3.04	0.040	
04/30/85	13:50	00.29	119.576	3.33	0.041	
05/07/85	08:45	00.25	126.365	3.58	0.037	
05/14/85	09:40	00.24	133.403	3.82	0.034	
05/21/85	12:08	00.24	140.506	4.06	0.034	
05/29/85	09:00	00.26	148.375	4.32	0.033	
06/04/85	09:35	00.20	154.399	4.52	0.033	
06/11/85	09:15	00.23	161.385	4.75	0.033	
06/18/85	09:15	00.23	168.385	4.98	0.033	
06/25/85	09:15	00.23	175.385	5.21	0.033	
07/02/85	11:00	00.23	182.458	5.44	0.033	
07/09/85	09:29	00.22	189.395	5.66	0.032	
07/16/85	10:30	00.23	196.438	5.89	0.033	Effervesces.
07/24/85	09:39	00.24	204.402	6.13	0.030	
07/30/85	08:55	00.19	210.372	6.32	0.032	
08/06/85	09:21	00.21	217.390	6.53	0.030	
08/14/85	09:05	00.25	225.378	6.78	0.031	
08/20/85	09:50	00.19	231.410	6.97	0.031	
08/28/85	08:45	00.21	239.365	7.18	0.026	Valved leaked, some brine drained back down hole.
09/04/85	09:21	00.25	246.390	7.43	0.036	
09/10/85	09:09	00.18	252.381	7.61	0.030	
09/17/85	08:50	00.21	259.368	7.82	0.030	
09/24/85	08:48	00.21	266.367	8.03	0.030	
10/01/85	09:12	00.21	273.383	8.24	0.030	
10/08/85	12:57	00.21	280.540	8.45	0.029	Room A2 heaters turned on 10/02/85.
10/15/85	09:20	00.20	287.389	8.65	0.029	
10/23/85	09:32	00.22	295.397	8.87	0.027	
10/29/85	11:20	00.15	301.472	9.02	0.025	
11/05/85	08:28	00.21	308.353	9.23	0.031	
11/13/85	09:00	00.23	316.375	9.46	0.029	
11/21/85	10:15	00.23	324.427	9.69	0.029	
11/26/85	09:40	00.14	329.403	9.83	0.028	
12/04/85	13:45	00.20	337.573	10.03	0.024	
12/10/85	10:56	00.16	343.456	10.19	0.027	
12/17/85	13:39	00.21	350.569	10.40	0.030	
01/03/86	09:30	00.47	367.396	10.87	0.028	
01/08/86	09:50	00.15	372.410	11.02	0.030	
01/16/86	09:20	00.22	380.389	11.24	0.028	
01/23/86	09:40	00.19	387.403	11.43	0.027	
01/31/86	10:45	00.25	395.448	11.68	0.031	
02/12/86	09:40	00.34	407.403	12.02	0.028	
02/19/86	14:20	00.12	414.597	12.14	0.017	Suction soil probe was used, some fluid was left in hole.
02/28/86	14:30	00.20	423.604	12.34	0.022	Soil suction probe was used, some fluid left in hole.
03/04/86	09:00	00.15	427.375	12.49	0.040	

TABLE E.3
Inflow Data for Hole A2X01 in Room A2

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
03/06/86	09:30	00.07	429.396	12.71	0.035	Two days accumulation.
03/13/86	09:00	00.15	436.375	12.86	0.021	Soil water probe.
03/26/86	09:05	00.15	449.378	13.01	0.011	Partial evacuation, brine left in hole.
04/02/86	08:40	00.32	456.361	13.33	0.046	
04/08/86	08:50	00.19	462.368	13.52	0.032	
04/16/86	10:45	00.15	470.448	13.67	0.019	
04/24/86	09:20	00.24	478.389	13.91	0.030	Removed suction probe.
04/30/86	09:55	00.20	484.413	14.11	0.033	Resumed sampling with bailer.
05/06/86	09:25	00.13	490.392	14.24	0.022	
05/13/86	09:10	00.20	497.382	14.44	0.029	
05/20/86	09:45	00.20	504.406	14.64	0.028	
05/27/86	14:45	00.20	511.615	14.84	0.028	
06/03/86	09:10	00.19	518.382	15.03	0.028	
06/10/86	10:34	00.19	525.440	15.22	0.027	
06/17/86	09:38	00.19	532.401	15.41	0.027	
06/24/86	09:55	00.18	539.413	15.59	0.026	
07/01/86	12:17	00.19	546.512	15.78	0.027	
07/08/86	09:37	00.19	553.401	16.97	0.028	
07/16/86	09:37	00.18	561.401	16.15	0.022	
07/22/86	09:10	00.18	567.382	16.33	0.030	
07/29/86	09:50	00.18	574.410	16.51	0.026	
08/05/86	10:03	00.13	581.419	16.64	0.019	
08/12/86	09:40	00.18	588.403	16.82	0.026	
08/19/86	10:20	00.18	595.431	17.00	0.026	

TABLE E.4
Inflow Data for Hole A2X02 in Room A2

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
02/19/85	13:20	NA	49.556	0.00	0.000	Installed collecting device. First entry.
03/07/85	09:30	00.34	65.396	0.34	0.020	Moist area 1.5 ft. around the collar.
03/12/85	11:30	00.21	70.479	0.55	0.041	Back wet, 5 ft diameter.
03/20/85	13:04	00.31	78.544	0.86	0.038	
03/26/85	11:02	00.14	84.460	1.00	0.024	
04/02/85	11:58	00.12	91.499	1.12	0.017	Significant salt buildup. 4' dia. wet spot on back.
04/10/85	11:53	00.11	99.495	1.23	0.014	Reset collecting device.
04/23/85	10:30	00.01	112.438	1.24	0.001	
05/07/85	08:41	NA	126.362	0.00	0.000	Some drips missing funnel.
05/14/85	09:40	NA	133.403	0.00	0.000	Some drips missing funnel.
07/09/85	09:25	00.05	189.392	1.29	0.001	
07/16/85	10:23	00.06	196.433	1.35	0.009	
07/24/85	09:33	00.02	204.398	1.37	0.003	
08/06/85	09:22	00.01	217.390	1.38	0.001	
08/28/85	08:35	00.01	239.358	1.39	0.000	Some drips missing funnel.
09/04/85	09:18	00.08	246.387	1.47	0.011	
09/10/85	09:04	00.02	252.378	1.49	0.003	
09/17/85	08:55	00.02	259.372	1.51	0.003	
10/15/85	09:17	00.02	287.387	1.53	0.001	Room A2 heaters turned on 10/02/85.
01/31/86	10:40	00.05	395.444	1.58	0.000	
02/12/86	09:40	00.02	407.403	1.60	0.002	
03/13/86	09:00	00.01	436.375	1.61	0.000	
03/26/86	09:05	00.07	449.378	1.68	0.005	
04/02/86	08:40	00.10	456.361	1.78	0.014	High reading probably due to unplugging temporary blockage in collecting tube on 3/26/86.
04/16/86	10:45	00.09	470.448	1.87	0.006	
04/24/86	09:20	00.02	478.389	1.89	0.003	
04/30/86	09:55	00.02	484.413	1.91	0.003	
05/06/86	09:25	00.02	490.392	1.93	0.003	
05/13/86	09:10	NA	497.382	1.93	0.000	Trace collected.
05/20/86	09:45	NA	504.406	1.93	0.001	Trace collected.
06/03/86	09:10	NA	518.382	1.93	0.000	Trace.
06/10/86	10:34	NA	525.440	1.93	0.000	Trace.
06/17/86	09:38	00.01	532.401	1.94	0.000	
06/24/86	09:50	00.35	539.410	2.29	0.050	Very humid air. High reading probably due to unplugging temporary blockage in collecting tube on 6/17/86.
07/01/86	12:15	00.28	546.510	2.57	0.039	
07/08/86	09:27	00.17	553.394	2.74	0.025	
07/16/86	09:33	00.14	561.398	2.88	0.017	
07/22/86	09:09	00.05	567.381	2.93	0.008	
07/29/86	09:50	00.12	574.410	3.05	0.017	
08/05/86	09:59	00.07	581.416	3.12	0.010	
08/12/86	09:40	00.12	588.403	3.24	0.017	
08/19/86	10:20	00.11	595.431	3.35	0.016	

TABLE E.5
Inflow Data for Hole A3X01 in Room A3

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
02/05/85	11:10	NA	35.465	0.00	0.000	Moist muck at the bottom.
02/19/85	13:40	00.30	49.569	0.30	0.020	Some oil. First time bailed.
02/26/85	13:20	00.23	56.556	0.53	0.033	Brine and oil.
03/07/85	09:45	00.26	65.406	0.79	0.029	
03/12/85	11:45	00.17	70.490	0.96	0.033	
03/20/85	13:14	00.19	78.551	1.15	0.024	Valve leaked. Some brine drained back down hole.
03/26/85	11:12	00.22	84.467	1.37	0.037	
04/02/85	12:00	00.21	91.500	1.58	0.030	
04/10/85	12:00	00.23	99.500	1.81	0.029	
04/17/85	11:20	00.20	106.472	2.01	0.029	
04/23/85	10:41	00.16	112.445	2.17	0.027	
04/30/85	13:35	00.20	119.566	2.37	0.028	
05/07/85	08:55	00.20	126.372	2.57	0.029	
05/14/85	09:56	00.17	133.414	2.74	0.024	
05/21/85	12:00	00.20	140.500	2.94	0.028	
05/29/85	09:25	00.21	148.392	3.15	0.027	
06/04/85	09:55	00.16	154.413	3.31	0.027	
06/11/85	09:25	00.18	161.392	3.49	0.026	
06/18/85	09:27	00.18	168.394	3.67	0.026	
06/25/85	09:30	00.19	175.396	3.86	0.027	
07/02/85	11:00	00.19	182.458	4.05	0.027	
07/09/85	09:50	00.17	189.410	4.22	0.024	
07/16/85	10:50	00.18	196.451	4.40	0.026	Effervesces.
07/24/85	09:47	00.21	204.408	4.61	0.026	
07/30/85	09:30	00.15	210.396	4.76	0.025	
08/06/85	09:30	00.17	217.396	4.93	0.024	
08/14/85	09:21	00.20	225.390	5.13	0.025	
08/20/85	10:08	00.16	231.422	5.29	0.027	
08/28/85	09:05	00.21	239.378	5.50	0.026	
09/04/85	09:29	00.17	246.395	5.67	0.024	
09/10/85	09:20	00.15	252.389	5.82	0.025	
09/17/85	09:06	00.16	259.379	5.98	0.023	
09/24/85	09:03	00.17	266.377	6.15	0.024	
10/01/85	09:18	00.18	273.387	6.33	0.026	
10/08/85	12:35	00.18	280.524	6.51	0.025	Room A3 heaters turned on 10/02/85.
10/15/85	09:35	00.16	287.399	6.67	0.023	
10/23/85	09:40	00.19	295.403	6.86	0.024	
10/29/85	11:11	00.14	301.466	7.00	0.023	
11/05/85	08:42	00.16	308.362	7.16	0.023	
11/13/85	09:30	00.19	316.396	7.35	0.024	
11/21/85	10:30	00.19	324.438	7.54	0.024	
11/26/85	09:55	00.10	329.413	7.64	0.020	
12/04/85	14:03	00.18	337.585	7.82	0.022	
12/10/85	10:46	00.14	343.449	7.96	0.024	
12/17/85	13:55	00.14	350.580	8.10	0.020	
01/03/86	10:00	00.39	367.417	8.49	0.023	
01/08/86	10:10	00.11	372.424	8.60	0.022	
01/16/86	09:35	00.18	380.399	8.78	0.023	
01/23/86	10:00	00.15	387.417	8.93	0.021	
01/31/86	10:55	00.18	395.455	9.11	0.022	
02/12/86	10:00	00.27	407.417	9.38	0.023	
02/19/86	10:40	00.15	414.444	9.53	0.021	
02/28/86	14:20	00.22	423.597	9.75	0.024	
03/06/86	09:50	00.14	429.410	9.89	0.024	

TABLE E.5
Inflow Data for Hole A3X01 in Room A3

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
03/13/86	09:20	00.15	436.389	10.04	0.021	
03/26/86	09:15	00.30	449.385	10.34	0.023	
04/02/86	08:50	00.16	456.368	10.50	0.023	
04/08/86	09:05	00.14	462.378	10.64	0.023	
04/16/86	11:25	00.18	470.476	10.82	0.022	
04/24/86	09:30	00.18	478.396	11.00	0.023	
04/30/86	10:00	00.14	484.417	11.14	0.023	
05/06/86	09:35	00.14	490.399	11.28	0.023	
05/13/86	09:20	00.15	497.389	11.43	0.021	
05/20/86	10:10	00.15	504.424	11.58	0.021	
05/27/86	15:00	00.16	511.625	11.74	0.022	
06/03/86	09:20	00.15	518.389	11.89	0.022	
06/10/86	10:42	00.16	525.446	12.05	0.023	
06/17/86	09:51	00.12	532.410	12.17	0.017	
06/24/86	10:05	00.16	539.420	12.33	0.023	
07/01/86	12:35	00.16	546.524	12.49	0.023	
07/08/86	09:57	00.15	553.415	12.64	0.022	
07/16/86	09:47	00.19	561.408	12.83	0.024	
07/22/86	09:23	00.14	567.391	12.97	0.023	
07/29/86	10:00	00.14	574.417	13.11	0.020	
08/05/86	10:15	00.18	581.427	13.29	0.026	
08/12/86	09:50	00.16	588.410	13.45	0.023	
08/19/86	10:35	00.16	595.441	13.61	0.023	

TABLE E.6
Inflow Data for Hole A3X02 in Room A3

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
02/05/85	11:10	NA	35.465	0.00	0.000	No drips noticed.
02/19/85	13:40	00.11	49.569	0.11	0.007	First time collected.
02/26/85	13:20	00.11	56.556	0.22	0.016	Wet spot within 1.5 ft. radius.
03/07/85	09:45	00.21	65.406	0.43	0.024	Moist area on back, approximately 1 ft radius.
03/12/85	11:45	00.11	70.490	0.54	0.022	Wet spot on back 3 ft diameter.
03/20/85	13:14	00.01	78.551	0.55	0.001	
03/26/85	11:12	00.28	84.467	0.83	0.047	Tube found plugged. Brine in tubing.
04/02/85	12:00	00.08	91.500	0.91	0.011	
04/10/85	12:02	00.05	99.501	0.96	0.006	Tube plugged.
04/17/85	11:20	00.11	106.472	1.07	0.016	
04/23/85	10:40	00.09	112.444	1.16	0.015	
04/30/85	13:29	00.12	119.562	1.28	0.017	
05/07/85	08:50	00.13	126.368	1.41	0.019	
05/14/85	09:53	00.13	133.412	1.54	0.018	
05/21/85	11:55	00.13	140.497	1.67	0.018	
05/29/85	09:20	00.14	148.389	1.81	0.018	
06/04/85	09:50	00.10	154.410	1.91	0.017	
06/11/85	09:20	00.13	161.389	2.04	0.019	
06/18/85	09:25	00.12	168.392	2.16	0.017	
06/25/85	09:25	00.13	175.392	2.29	0.019	
07/02/85	11:00	00.10	182.458	2.39	0.014	
07/09/85	09:44	00.02	189.406	2.41	0.003	
07/16/85	10:46	00.02	196.449	2.43	0.003	
07/24/85	09:45	00.19	204.406	2.62	0.024	High reading probably due to unplugging temporary blockage in collecting tube on 7/16/85.
07/30/85	09:25	00.08	210.392	2.70	0.013	
08/06/85	09:28	00.08	217.394	2.78	0.011	
08/14/85	09:10	00.10	225.382	2.88	0.013	
08/20/85	10:00	00.08	231.417	2.96	0.013	
08/28/85	08:58	00.09	239.374	3.05	0.011	
09/04/85	09:26	00.09	246.393	3.14	0.013	
09/10/85	09:14	00.08	252.385	3.22	0.013	
09/17/85	09:05	00.09	259.378	3.31	0.013	
09/24/85	09:03	00.08	266.377	3.39	0.011	
10/01/85	09:15	00.07	273.385	3.46	0.010	
10/08/85	12:33	00.09	280.523	3.55	0.013	
10/15/85	09:31	00.06	287.397	3.61	0.009	
10/23/85	09:37	00.07	295.401	3.68	0.009	
10/29/85	11:09	00.08	301.465	3.76	0.013	
11/05/85	08:39	00.04	308.360	3.80	0.006	
11/13/85	09:28	00.08	316.394	3.88	0.010	
11/21/85	10:25	00.05	324.434	3.93	0.006	
12/04/85	13:56	00.10	337.581	4.03	0.008	
12/10/85	10:42	00.05	343.446	4.08	0.009	
12/17/85	13:50	00.03	350.576	4.11	0.004	
01/03/86	10:00	00.13	367.417	4.24	0.008	
01/08/86	10:10	00.03	372.424	4.27	0.006	
01/16/86	09:35	00.05	380.399	4.32	0.006	
01/31/86	10:55	00.01	395.455	4.33	0.001	Trace <00.01
04/24/86	09:30	00.01	478.396	4.34	0.000	
05/06/86	09:35	00.02	490.399	4.36	0.002	

TABLE E.6
Inflow Data for Hole A3X02 in Room A3

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
05/27/86	15:00	NA	511.625	4.36	0.000	Trace.
06/03/86	09:20	00.03	518.389	4.39	0.001	
06/10/86	10:42	NA	525.446	4.39	0.000	Trace.
06/17/86	09:51	NA	532.410	4.39	0.000	Trace.
07/01/86	12:32	00.03	546.522	4.42	0.001	
07/08/86	09:57	00.01	553.415	4.43	0.001	
07/29/86	10:00	NA	574.417	4.43	0.000	Trace.
08/12/86	09:50	NA	588.410	4.43	0.000	Dry.
08/19/86	10:33	NA	595.440	4.43	0.000	Dry.

TABLE E.7
Inflow Data for Hole BX01 in Room B

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
01/26/85	10:00	NA	25.417	0.00	0.000	Hole drilled. Wet core and brine encountered at 35 to 36.5 feet.
02/05/85	11:00	00.39	35.458	0.39	0.035	First time bailed.
02/11/85	12:00	00.72	41.500	1.11	0.119	
02/19/85	13:00	00.70	49.542	1.81	0.087	
02/26/85	12:45	00.61	56.531	2.42	0.087	
03/07/85	09:15	00.70	65.385	3.12	0.079	
03/12/85	11:45	00.41	70.490	3.53	0.080	
03/20/85	12:50	00.61	78.535	4.14	0.076	
03/26/85	10:45	00.45	84.448	4.59	0.076	
04/02/85	11:44	00.51	91.489	5.10	0.072	
04/10/85	11:38	00.55	99.485	5.65	0.069	
04/17/85	11:00	00.45	106.458	6.10	0.065	
04/23/85	10:05	00.38	112.420	6.48	0.064	Room B heaters turned on 4/23/85.
05/01/85	11:40	00.46	120.486	6.94	0.057	
06/04/85	09:30	02.00	154.396	8.94	0.059	First check in several weeks.
07/16/85	10:15	02.34	196.427	11.28	0.056	Effervesces.
08/26/85	13:56	02.38	237.581	13.66	0.058	Room temp. 98 degrees F. at collar, 103 F. in center of room.
10/08/85	12:00	02.27	280.500	15.93	0.053	
11/21/85	10:05	02.42	324.420	18.35	0.055	
12/04/85	13:35	00.69	337.566	19.04	0.052	
01/31/86	10:25	02.95	395.434	21.99	0.051	
02/12/86	09:30	00.80	407.396	22.79	0.067	
04/16/86	11:00	03.45	470.458	26.24	0.055	
04/30/86	09:45	00.73	484.406	26.97	0.052	
05/06/86	09:18	00.30	490.387	27.27	0.050	
06/10/86	10:20	01.85	525.431	29.12	0.053	
08/19/86	10:50	03.21	595.451	32.33	0.046	

TABLE E.8
Inflow Data for Hole BX02 in Room B

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
02/05/85	11:00	NA	35.458	0.00	0.000	No drips noticed. Finished drilling 2/01/85.
02/19/85	13:00	NA	49.542	0.00	0.000	Tubing plugged.
03/12/85	11:45	NA	70.490	0.00	0.000	Trace, few drops in jug.
03/20/85	12:50	00.10	78.535	0.10	0.002	
03/26/85	10:45	00.12	84.448	0.22	0.020	
04/02/85	11:44	00.10	91.489	0.32	0.014	
04/10/85	11:38	00.21	99.485	0.53	0.026	
04/17/85	11:00	00.13	106.458	0.66	0.019	
04/23/85	10:05	00.01	112.420	0.67	0.002	Room B heaters turned on 4/23/85. Low reading probably due to partial blockage of collecting tube.
05/01/85	11:31	00.12	120.480	0.79	0.015	
06/04/85	09:25	00.50	154.392	1.29	0.015	First check in several weeks.
07/16/85	10:00	00.16	196.417	1.45	0.004	Changed funnel.
10/08/85	12:00	00.04	280.500	1.49	0.000	
01/17/86	09:00	00.26	381.375	1.75	0.003	Changed funnel.
01/31/86	10:15	NA	395.427	1.75	0.000	
04/16/86	11:00	NA	470.458	1.75	0.000	Trace in plastic tube, salt build up in tube and container.
08/19/86	10:50	NA	595.451	1.75	0.000	Dry.
10/01/86	11:05	00.00	638.462	1.75	0.000	Dry.

TABLE E.9
Inflow Data for Hole DH35 in Room G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
02/05/85	11:15	NA	35.469	0.00	0.000	Started to drip.
03/05/85	10:00	00.19	63.417	0.19	0.007	Salt crystals in container. First time collected.
03/12/85	10:00	00.17	70.417	0.36	0.024	Salt crystals in container.
03/20/85	10:26	00.19	78.435	0.55	0.024	
03/26/85	09:45	00.13	84.406	0.68	0.022	
04/02/85	10:15	00.15	91.427	0.83	0.021	Salt crystals in container.
04/10/85	10:14	00.19	99.426	1.02	0.024	
04/23/85	11:46	00.12	112.490	1.14	0.009	
04/30/85	11:09	00.16	119.465	1.30	0.023	Clay in container.
05/07/85	09:53	00.14	126.412	1.44	0.020	
05/14/85	10:48	00.16	133.450	1.60	0.023	
05/21/85	10:42	00.15	140.446	1.75	0.021	
05/29/85	10:00	00.15	148.417	1.90	0.019	
06/11/85	10:10	00.02	161.424	1.92	0.002	
07/09/85	11:10	00.06	189.465	1.98	0.002	
07/16/85	11:48	00.13	196.492	2.11	0.019	
07/24/85	10:37	00.12	204.442	2.23	0.015	
07/30/85	10:17	00.08	210.428	2.31	0.013	Clay in container.
08/06/85	10:37	00.08	217.442	2.39	0.011	Clay chunks in container.
08/14/85	10:53	00.11	225.453	2.50	0.014	
08/20/85	11:05	00.09	231.462	2.59	0.015	
08/28/85	10:00	00.14	239.417	2.73	0.018	
09/04/85	10:30	00.11	246.438	2.84	0.016	
09/10/85	10:38	00.11	252.443	2.95	0.018	
09/17/85	09:40	00.12	259.403	3.07	0.017	
09/24/85	09:48	00.07	266.408	3.14	0.010	
10/08/85	10:44	00.08	280.447	3.22	0.006	
10/15/85	10:17	00.06	287.428	3.28	0.009	
10/29/85	09:42	00.06	301.404	3.34	0.004	
11/05/85	09:24	00.08	308.392	3.42	0.011	
11/13/85	10:06	00.11	316.421	3.53	0.014	
11/21/85	11:32	00.07	324.481	3.60	0.009	
11/26/85	11:25	00.05	329.476	3.65	0.010	Changed collecting container.
01/23/86	10:40	00.06	387.444	3.71	0.001	Clay in container. Entry has been restricted due mining activities since 12/10/85.
01/31/86	12:16	00.06	395.511	3.77	0.007	
02/12/86	10:55	00.09	407.455	3.86	0.008	
02/19/86	11:45	00.07	414.490	3.93	0.010	
02/28/86	13:20	00.06	423.556	3.99	0.007	
03/06/86	10:45	00.03	429.448	4.02	0.005	
03/13/86	10:10	00.07	436.424	4.09	0.010	
03/26/86	10:20	NA	449.431	4.09	0.000	Funnel broken, 5 inch stalactite formed from collar.
04/02/86	09:40	NA	456.403	4.09	0.000	Installed new funnel.
05/27/86	15:45	NA	511.656	4.09	0.000	Trace.
06/03/86	10:08	00.01	518.422	4.10	0.000	
06/10/86	11:35	00.02	525.483	4.12	0.003	
06/17/86	10:58	00.01	532.457	4.13	0.001	
06/24/86	10:57	00.02	539.456	4.15	0.003	
07/01/86	14:03	00.02	546.585	4.17	0.003	
07/08/86	10:37	00.02	553.442	4.19	0.003	
07/16/86	10:36	00.03	561.442	4.22	0.004	
07/22/86	10:05	NA	567.420	4.22	0.000	Trace of brine, cleaned soft clay out of funnel.

TABLE E.9
Inflow Data for Hole DH35 in Room G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
07/29/86	10:35	00.01	574.441	4.23	0.001	
08/05/86	11:13	00.03	581.467	4.26	0.004	
08/12/86	10:35	00.03	588.441	4.29	0.004	
08/19/86	11:35	00.01	595.483	4.30	0.001	

TABLE E.10
Inflow Data for Hole DH36 in Room G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
01/28/85	09:00	NA	27.375	0.00	0.000	Moist muck at the bottom.
02/05/85	11:15	02.50	35.469	2.50	0.275	About 1 ft. muck, brine and hydraulic fluid. First time bailed.
02/11/85	11:00	01.51	41.458	4.01	0.252	Brine, muck, hydraulic fluid.
02/19/85	12:10	01.78	49.507	5.79	0.221	Some muck.
02/26/85	10:45	01.48	56.448	7.27	0.213	Brine and muck.
03/05/85	10:00	01.76	63.417	9.03	0.253	
03/12/85	10:00	01.55	70.417	10.58	0.221	
03/20/85	10:26	01.59	78.435	12.17	0.198	
03/26/85	09:45	01.35	84.406	13.52	0.226	
04/02/85	10:15	01.58	91.427	15.10	0.225	
04/10/85	10:25	01.71	99.434	16.81	0.214	
04/17/85	13:30	01.49	106.562	18.30	0.209	
04/23/85	11:46	01.45	112.490	19.75	0.245	
04/30/85	11:21	01.49	119.473	21.24	0.213	
05/07/85	09:58	01.55	126.415	22.79	0.223	
05/14/85	10:54	01.77	133.454	24.56	0.251	
05/21/85	10:45	01.61	140.448	26.17	0.230	
05/29/85	10:00	01.50	148.417	27.67	0.188	
06/04/85	11:33	01.40	154.481	29.07	0.231	
06/11/85	11:15	01.55	161.469	30.62	0.222	
06/18/85	10:17	01.58	168.428	32.20	0.227	
06/25/85	10:40	01.43	175.444	33.63	0.204	
07/02/85	11:00	01.59	182.458	35.22	0.227	
07/09/85	11:15	01.54	189.469	36.76	0.220	
07/16/85	11:50	01.58	196.493	38.34	0.225	Effervesces.
07/24/85	10:46	01.78	204.449	40.12	0.224	
07/30/85	10:20	01.39	210.431	41.51	0.232	
08/06/85	10:43	01.70	217.447	43.21	0.242	
08/14/85	11:02	01.58	225.460	44.79	0.197	Valve leaked, some brine drained back down hole.
08/20/85	11:11	01.42	231.466	46.21	0.236	
08/28/85	10:00	01.94	239.417	48.15	0.244	
09/04/85	10:32	01.69	246.439	49.84	0.241	
09/10/85	10:35	01.41	252.441	51.25	0.235	
09/17/85	09:42	01.53	259.404	52.78	0.220	
09/24/85	09:50	01.53	266.410	54.31	0.218	
10/01/85	09:55	01.58	273.413	55.89	0.226	
10/08/85	10:52	01.63	280.453	57.52	0.232	
10/15/85	10:30	01.58	287.438	59.10	0.226	
10/23/85	10:23	01.82	295.433	60.92	0.228	
10/29/85	09:51	01.36	301.410	62.28	0.228	
11/05/85	09:27	01.63	308.394	63.91	0.233	
11/13/85	10:14	01.79	316.426	65.70	0.223	
11/21/85	11:36	01.91	324.483	67.61	0.237	
11/26/85	11:30	01.01	329.479	68.62	0.202	
12/03/85	13:35	01.50	336.566	70.12	0.212	
12/10/85	12:15	01.52	343.510	71.64	0.219	
01/23/86	11:00	09.30	387.458	80.94	0.212	Entry restricted since 12/10/85 due to mining activities.
01/31/86	12:20	01.38	395.514	82.32	0.171	
02/12/86	11:00	03.02	407.458	85.34	0.253	
02/19/86	11:45	01.55	414.490	86.89	0.220	
02/28/86	13:20	01.85	423.556	88.74	0.204	

TABLE E.10
Inflow Data for Hole DH36 in Room G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
03/06/86	10:45	01.30	429.448	90.04	0.221	Volume was estimated.
03/13/86	10:10	01.50	436.424	91.54	0.215	
03/26/86	10:20	02.56	449.431	94.10	0.197	
04/02/86	09:40	01.75	456.403	95.85	0.251	
04/08/86	09:45	00.97	462.406	96.82	0.162	
04/16/86	12:25	01.65	470.517	98.47	0.203	
04/24/86	10:20	02.00	478.431	100.47	0.253	
04/30/86	10:55	01.21	484.455	101.68	0.201	
05/06/86	10:14	01.20	490.426	102.88	0.201	
05/13/86	11:13	01.42	497.467	104.30	0.202	
05/20/86	11:10	01.50	504.465	105.80	0.214	
05/27/86	15:45	01.40	511.656	107.20	0.195	
06/03/86	10:10	01.38	518.424	108.58	0.204	
06/10/86	11:35	01.24	525.483	109.82	0.176	Valve leaked, some brine drained back down hole.
06/17/86	11:00	01.65	532.458	111.47	0.237	
06/24/86	11:00	01.45	539.458	112.92	0.207	
07/01/86	14:05	01.55	546.587	114.47	0.217	
07/08/86	10:45	01.40	553.448	115.87	0.204	
07/16/86	10:45	01.76	561.448	117.63	0.220	
07/22/86	10:07	01.29	567.422	118.92	0.216	
07/29/86	10:40	01.45	574.444	120.37	0.206	
08/05/86	11:20	01.46	581.472	121.83	0.208	
08/12/86	10:37	01.50	588.442	123.33	0.215	
08/19/86	11:35	01.38	595.483	124.71	0.196	

TABLE E.11
Inflow Data for Hole DH37 in Room G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
02/05/85	11:15	NA	35.469	0.00	0.000	Started to drip.
03/05/85	10:10	00.06	63.424	0.06	0.002	Stalactite.
03/12/85	10:00	00.06	70.417	0.12	0.009	Salt crystals.
03/26/85	09:50	NA	84.410	0.12	0.000	Trace, none collected.
04/17/85	13:30	00.06	106.562	0.18	0.002	
04/23/85	11:41	00.04	112.487	0.22	0.007	
04/30/85	10:50	00.03	119.451	0.25	0.004	
05/07/85	09:45	00.06	126.406	0.31	0.009	
05/14/85	10:37	00.07	133.442	0.38	0.010	
05/21/85	10:31	00.06	140.438	0.44	0.009	
05/29/85	10:00	00.06	148.417	0.50	0.008	
06/04/85	11:22	00.05	154.474	0.55	0.008	
06/11/85	10:32	00.05	161.439	0.60	0.007	
06/18/85	10:05	00.08	168.420	0.68	0.011	Stalactites formed at collar.
06/25/85	10:44	00.05	175.447	0.73	0.007	
07/02/85	11:00	00.04	182.458	0.77	0.006	
07/09/85	11:00	00.03	189.458	0.80	0.004	
07/16/85	11:40	00.06	196.486	0.86	0.009	
07/24/85	10:33	00.06	204.440	0.92	0.008	
07/30/85	10:11	00.02	210.424	0.94	0.003	
08/06/85	10:32	00.01	217.439	0.95	0.001	
08/14/85	10:49	00.02	225.451	0.97	0.002	
08/20/85	10:56	00.03	231.456	1.00	0.005	
08/28/85	09:55	00.04	239.413	1.04	0.005	
09/04/85	10:21	00.02	246.431	1.06	0.003	
09/10/85	10:14	00.03	252.426	1.09	0.005	
09/17/85	09:35	00.02	259.399	1.11	0.003	
09/24/85	09:45	00.02	266.406	1.13	0.003	
10/01/85	09:50	00.01	273.410	1.14	0.001	
10/15/85	10:10	00.01	287.424	1.15	0.001	
10/23/85	10:17	00.02	295.428	1.17	0.002	
10/29/85	09:35	00.02	301.399	1.19	0.003	
07/01/86	14:00	00.02	546.583	1.21	0.000	

TABLE E.12
Inflow Data for Hole DH38 in Room G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
01/28/85	09:00	NA	27.375	0.00	0.000	Dry.
02/05/85	11:15	NA	35.469	0.00	0.000	Wet at bottom.
02/19/85	12:10	00.80	49.507	0.80	0.035	Brine and fine muck.
02/26/85	10:45	01.26	56.448	2.06	0.182	Brine and fine muck.
03/05/85	10:00	00.45	63.417	2.51	0.065	
03/12/85	10:00	00.39	70.417	2.90	0.056	
03/20/85	10:37	00.45	78.442	3.35	0.056	
03/26/85	09:50	00.36	84.410	3.71	0.060	
04/02/85	10:25	00.41	91.434	4.12	0.058	Some muck.
04/10/85	10:31	00.44	99.438	4.56	0.055	
04/17/85	13:30	00.41	106.562	4.97	0.058	
04/23/85	11:41	00.34	112.487	5.31	0.057	
04/30/85	11:05	00.39	119.462	5.70	0.056	
05/07/85	09:50	00.42	126.410	6.12	0.060	
05/14/85	10:45	00.41	133.448	6.53	0.058	
05/21/85	10:35	00.41	140.441	6.94	0.059	
05/29/85	11:35	00.47	148.483	7.41	0.058	
06/04/85	11:25	00.35	154.476	7.76	0.058	
06/11/85	10:35	00.40	161.441	8.16	0.057	
06/18/85	10:09	00.39	168.423	8.55	0.056	
06/25/85	10:50	00.42	175.451	8.97	0.060	
07/02/85	11:00	00.44	182.458	9.41	0.063	
07/09/85	11:05	00.43	189.462	9.84	0.061	
07/16/85	11:45	00.43	196.490	10.27	0.061	Effervesces.
07/24/85	10:35	00.49	204.441	10.76	0.062	
07/30/85	10:14	00.38	210.426	11.14	0.063	
08/06/85	10:34	00.42	217.440	11.56	0.060	
08/14/85	10:51	00.49	225.452	12.05	0.061	
08/20/85	11:02	00.37	231.460	12.42	0.062	
08/28/85	10:00	00.51	239.417	12.93	0.064	
09/04/85	10:23	00.44	246.433	13.37	0.063	
09/10/85	10:19	00.39	252.430	13.76	0.065	
09/17/85	09:37	00.44	259.401	14.20	0.063	
09/24/85	09:45	00.44	266.406	14.64	0.063	
10/01/85	09:53	00.44	273.412	15.08	0.063	
10/08/85	10:38	00.46	280.443	15.54	0.065	
10/15/85	10:15	00.44	287.427	15.98	0.063	
10/23/85	10:20	00.49	295.431	16.47	0.061	
10/29/85	09:40	00.39	301.403	16.86	0.065	
11/05/85	09:14	00.43	308.385	17.29	0.062	
11/13/85	10:00	00.52	316.417	17.81	0.065	
11/21/85	11:29	00.47	324.478	18.28	0.058	
11/26/85	11:20	00.33	329.472	18.61	0.066	
12/03/85	13:30	00.42	336.562	19.03	0.059	
12/10/85	12:30	00.41	343.521	19.44	0.059	
01/23/86	11:20	02.70	387.472	22.14	0.061	Entry restricted since 12/10/85 due to mining activities.
01/31/86	12:10	00.53	395.507	22.67	0.066	
02/12/86	10:50	00.75	407.451	23.42	0.063	
02/19/86	11:40	00.43	414.486	23.85	0.061	
02/28/86	13:15	00.17	423.552	24.02	0.019	Lost substantial volume due to brake in suction line. Brine flowed back down into hole.
03/06/86	10:35	00.65	429.441	24.67	0.110	
03/13/86	10:05	00.43	436.420	25.10	0.062	

TABLE E.12
Inflow Data for Hole DH38 in Room G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
03/26/86	10:10	00.59	449.424	25.69	0.045	
04/02/86	09:35	00.58	456.399	26.27	0.083	
04/08/86	09:40	00.35	462.403	26.62	0.058	
04/16/86	12:10	00.50	470.507	27.12	0.062	
04/24/86	10:12	00.47	478.425	27.59	0.059	
04/30/86	10:50	00.35	484.451	27.94	0.058	
05/06/86	10:14	00.31	490.426	28.25	0.052	
05/13/86	11:05	00.41	497.462	28.66	0.058	
05/20/86	11:05	00.40	504.462	29.06	0.057	
05/27/86	15:40	00.38	511.653	29.44	0.053	
06/03/86	10:05	00.44	518.420	29.88	0.065	
06/10/86	11:22	00.43	525.474	30.31	0.061	
06/17/86	10:50	00.37	532.451	30.68	0.053	
06/24/86	10:52	00.50	539.453	31.18	0.071	
07/01/86	14:01	00.40	546.584	31.58	0.056	
07/08/86	10:30	00.38	553.438	31.96	0.055	
07/16/86	10:34	00.43	561.440	32.39	0.054	
07/22/86	09:58	00.35	567.415	32.74	0.059	
07/29/86	10:40	00.38	574.444	33.12	0.054	
08/05/86	11:10	00.39	581.465	33.51	0.056	
08/12/86	10:30	00.40	588.438	33.91	0.057	
08/19/86	11:30	00.41	595.479	34.32	0.058	

TABLE E.13
Inflow Data for Hole DH40 in Room G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
01/28/85	09:00	NA	27.375	0.00	0.000	Dry.
02/05/85	11:15	NA	35.469	0.00	0.000	Moist at bottom.
03/12/85	10:10	NA	70.424	0.00	0.000	Moist muck.
03/26/85	09:55	NA	84.413	0.00	0.000	Moist muck.
04/17/85	13:30	00.98	106.562	0.98	0.012	Brine,muck and oil.
04/23/85	11:33	00.26	112.481	1.24	0.044	Brine and muck.
04/30/85	10:49	00.11	119.451	1.35	0.016	Feel something spongy in bottom of hole.
05/07/85	09:42	00.10	126.404	1.45	0.014	
05/14/85	10:40	00.09	133.444	1.54	0.013	
05/21/85	10:26	00.07	140.435	1.61	0.010	
05/29/85	11:30	00.08	148.479	1.69	0.010	
06/04/85	11:15	00.10	154.469	1.79	0.017	Contained a lot of salt muck.
06/11/85	10:30	00.05	161.438	1.84	0.007	
06/18/85	10:01	00.09	168.417	1.93	0.013	
06/25/85	11:00	00.08	175.458	2.01	0.011	
07/02/85	11:00	00.09	182.458	2.10	0.013	
07/09/85	10:45	00.12	189.448	2.22	0.017	
07/16/85	11:38	00.09	196.485	2.31	0.013	
07/24/85	10:31	00.07	204.438	2.38	0.009	
07/30/85	10:08	00.07	210.422	2.45	0.012	
08/06/85	10:20	00.06	217.431	2.51	0.009	
08/14/85	10:43	00.07	225.447	2.58	0.009	
08/20/85	10:50	00.05	231.451	2.63	0.008	
08/28/85	09:53	00.08	239.412	2.71	0.010	
09/04/85	10:18	00.03	246.429	2.74	0.004	
09/10/85	10:11	00.04	252.424	2.78	0.007	
09/17/85	09:31	00.03	259.397	2.81	0.004	
09/24/85	09:40	00.06	266.403	2.87	0.009	
10/01/85	09:47	00.06	273.408	2.93	0.009	
10/08/85	10:32	00.04	280.439	2.97	0.006	
10/15/85	10:05	00.09	287.420	3.06	0.013	
10/23/85	10:13	00.04	295.426	3.10	0.005	
10/29/85	09:32	00.07	301.397	3.17	0.012	
11/05/85	09:10	00.04	308.382	3.21	0.006	
11/13/85	09:55	00.07	316.413	3.28	0.009	
11/21/85	11:24	00.02	324.475	3.30	0.002	
12/03/85	13:20	00.08	336.556	3.38	0.007	
12/10/85	12:40	00.04	343.528	3.42	0.006	
01/23/86	11:25	00.24	387.476	3.66	0.005	Entry restricted since 12/10/85 due to mining.
01/31/86	12:10	00.02	395.507	3.68	0.002	
02/19/86	11:20	00.14	414.472	3.82	0.007	
02/28/86	13:10	00.05	423.549	3.87	0.006	
03/13/86	10:00	00.02	436.417	3.89	0.002	
04/24/86	10:05	00.13	478.420	4.02	0.003	
05/20/86	11:05	00.10	504.462	4.12	0.004	
06/03/86	09:58	00.20	518.415	4.32	0.014	

TABLE E.14
Inflow Data for Hole DH42 in ROOM G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
01/28/85	09:00	NA	27.375	0.00	0.000	Moist muck at the bottom.
02/05/85	11:15	00.27	35.469	0.27	0.030	First time collected.
02/11/85	11:00	00.30	41.458	0.57	0.050	
02/19/85	13:10	00.33	49.549	0.90	0.041	
02/26/85	10:45	00.26	56.448	1.16	0.038	
03/05/85	10:00	00.28	63.417	1.44	0.040	
03/12/85	10:20	00.25	70.431	1.69	0.036	
03/20/85	10:54	00.25	78.454	1.94	0.031	Valve leaked, some brine drained back down hole.
03/26/85	10:06	00.28	84.421	2.22	0.047	
04/02/85	10:45	00.26	91.448	2.48	0.037	
04/10/85	10:45	00.29	99.448	2.77	0.036	
04/17/85	13:30	00.24	106.562	3.01	0.034	
04/23/85	13:23	00.04	112.558	3.05	0.007	Significant volume of brine lost back down hole.
04/30/85	10:31	00.38	119.438	3.43	0.055	
05/07/85	09:25	00.33	126.392	3.76	0.047	
05/14/85	10:30	00.25	133.438	4.01	0.035	
05/21/85	10:17	00.26	140.428	4.27	0.037	
05/29/85	10:10	00.30	148.424	4.57	0.038	
06/04/85	10:45	00.22	154.448	4.79	0.037	
06/11/85	10:10	00.25	161.424	5.04	0.036	
06/18/85	09:53	00.25	168.412	5.29	0.036	
06/25/85	11:15	00.25	175.469	5.54	0.035	
07/02/85	11:00	00.24	182.458	5.78	0.034	
07/09/85	10:30	00.25	189.438	6.03	0.036	
07/16/85	11:08	00.25	196.464	6.28	0.036	Effervesces.
07/24/85	10:19	00.28	204.430	6.56	0.035	
07/30/85	09:57	00.22	210.415	6.78	0.037	
08/06/85	10:13	00.26	217.426	7.04	0.037	
08/14/85	10:59	00.27	225.458	7.31	0.034	
08/20/85	10:45	00.21	231.448	7.52	0.035	
08/28/85	09:45	00.29	239.406	7.81	0.036	
09/04/85	10:12	00.25	246.425	8.06	0.036	
09/10/85	09:56	00.21	252.414	8.27	0.035	
09/17/85	09:26	00.28	259.393	8.55	0.040	
09/24/85	09:37	00.24	266.401	8.79	0.034	
10/01/85	09:44	00.24	273.406	9.03	0.034	
10/08/85	10:25	00.23	280.434	9.26	0.033	
10/15/85	10:00	00.23	287.417	9.49	0.033	
10/23/85	10:07	00.26	295.422	9.75	0.032	
10/29/85	09:16	00.24	301.386	9.99	0.040	
11/05/85	09:05	00.22	308.378	10.21	0.031	
11/13/85	09:46	00.26	316.407	10.47	0.032	
11/21/85	10:53	00.26	324.453	10.73	0.032	
11/26/85	10:59	00.16	329.458	10.89	0.032	
12/03/85	13:10	00.20	336.549	11.09	0.028	
12/10/85	12:50	00.22	343.535	11.31	0.031	
01/23/86	11:30	01.32	387.479	12.63	0.030	Entry restricted since 12/10/85 due to mining.
01/31/86	12:05	00.30	395.503	12.93	0.037	
02/12/86	10:35	00.38	407.441	13.31	0.032	
02/19/86	11:10	00.22	414.465	13.53	0.031	
02/28/86	13:00	00.31	423.542	13.84	0.034	
03/06/86	10:30	00.17	429.438	14.01	0.029	
03/13/86	09:53	00.21	436.412	14.22	0.030	

TABLE E.14
Inflow Data for Hole DH42 in ROOM G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
03/26/86	10:00	00.39	449.417	14.61	0.030	
04/02/86	09:25	00.20	456.392	14.81	0.029	
04/08/86	09:30	00.20	462.396	15.01	0.033	
04/16/86	11:55	00.24	470.497	15.25	0.030	
04/24/86	09:55	00.21	478.413	15.46	0.027	
04/30/86	10:41	00.17	484.445	15.63	0.028	
05/06/86	10:10	00.19	490.424	15.82	0.032	
05/13/86	10:00	00.20	497.417	16.02	0.029	
05/20/86	11:00	00.20	504.458	16.22	0.028	
05/27/86	15:35	00.20	511.649	16.42	0.028	
06/03/86	09:50	00.20	518.410	16.62	0.030	
06/10/86	11:13	00.17	525.467	16.79	0.024	
06/17/86	10:40	00.20	532.444	16.99	0.029	
06/24/86	10:40	00.18	539.444	17.17	0.026	
07/01/86	13:45	00.20	546.573	17.37	0.028	
07/08/86	10:22	00.20	553.432	17.57	0.029	
07/16/86	10:15	00.30	561.427	17.87	0.038	
07/22/86	09:50	00.16	567.410	18.03	0.027	
07/29/86	10:25	00.20	574.434	18.23	0.028	
08/05/86	11:00	00.22	581.458	18.45	0.031	
08/12/86	10:20	00.20	588.431	18.65	0.029	
08/19/86	11:20	00.18	595.472	18.83	0.026	

TABLE E.15
Inflow Data for Hole DH42A in Room G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
01/28/85	09:00	NA	27.375	0.00	0.000	Brine in hole. This hole is a redrill of DH42 to obtain better core.
02/05/85	11:15	00.85	35.469	0.85	0.093	First time collected.
02/11/85	11:00	00.99	41.458	1.84	0.165	
02/19/85	12:10	01.45	49.507	3.29	0.180	
02/26/85	10:45	01.18	56.448	4.47	0.170	
03/05/85	10:00	01.24	63.417	5.71	0.178	
03/12/85	10:20	01.29	70.431	7.00	0.184	
03/20/85	11:00	01.45	78.458	8.45	0.181	
03/26/85	10:10	01.07	84.424	9.52	0.179	
04/02/85	10:45	01.15	91.448	10.67	0.164	
04/10/85	10:45	01.45	99.448	12.12	0.181	
04/17/85	13:30	01.32	106.562	13.44	0.186	
04/23/85	13:23	01.07	112.558	14.51	0.178	
04/30/85	10:23	01.35	119.433	15.86	0.196	
05/07/85	09:23	01.39	126.391	17.25	0.200	
05/14/85	10:25	01.34	133.434	18.59	0.190	
05/21/85	10:14	01.29	140.426	19.88	0.184	
05/29/85	10:30	01.28	148.438	21.16	0.160	
06/04/85	10:50	01.03	154.451	22.19	0.171	
06/11/85	10:15	01.19	161.427	23.38	0.171	
06/18/85	09:51	01.18	168.410	24.56	0.169	
06/25/85	11:05	01.16	175.462	25.72	0.164	
07/02/85	11:00	01.12	182.458	26.84	0.160	
07/09/85	10:25	01.12	189.434	27.96	0.161	Gas effervescing from sample.
07/16/85	11:10	01.11	196.465	29.07	0.158	Effervesces.
07/24/85	10:25	01.23	204.434	30.30	0.154	
07/30/85	09:54	00.94	210.412	31.24	0.157	
08/06/85	10:10	01.05	217.424	32.29	0.150	
08/14/85	10:33	01.11	225.440	33.40	0.138	
08/20/85	10:14	00.92	231.426	34.32	0.154	
08/28/85	09:40	01.17	239.403	35.49	0.147	
09/04/85	10:10	00.99	246.424	36.48	0.141	
09/10/85	09:55	00.83	252,413	37.31	0.139	
09/17/85	09:25	00.92	259.392	38.23	0.132	
09/24/85	09:25	00.94	266.392	39.17	0.134	
10/01/85	09:40	00.93	273.403	40.10	0.133	
10/08/85	10:24	00.96	280.433	41.06	0.137	
10/15/85	10:15	00.81	287.427	41.87	0.116	
10/23/85	10:10	01.02	295.424	42.89	0.128	
10/29/85	09:20	00.75	301.389	43.64	0.126	
11/05/85	09:00	00.86	308.375	44.50	0.123	
11/13/85	09:44	01.03	316.406	45.53	0.128	
11/21/85	10:50	00.94	324.451	46.47	0.117	
11/26/85	10:55	00.61	329.455	47.08	0.122	
12/03/85	13:05	00.78	336.545	47.86	0.110	
12/10/85	12:50	00.86	343.535	48.72	0.123	
01/23/86	11:40	05.13	387.486	53.85	0.117	Entry restricted since 12/10/85 due to mining.
01/31/86	12:00	00.92	395.500	54.77	0.115	
02/12/86	10:40	01.36	407.444	56.13	0.114	
02/19/86	11:15	00.80	414.469	56.93	0.114	
02/28/86	12:55	00.90	423.538	57.83	0.099	
03/06/86	10:25	00.70	429.434	58.53	0.119	
03/13/86	09:48	00.73	436.408	59.26	0.105	

TABLE E.15
Inflow Data for Hole DH42A in Room G

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
03/26/86	09:40	01.39	449.403	60.65	0.107	
04/02/86	09:20	00.80	456.389	61.45	0.115	
04/08/86	09:28	00.63	462.394	62.08	0.105	
04/16/86	11:50	00.89	470.493	62.97	0.110	
04/24/86	09:50	00.67	478.410	63.64	0.085	
04/30/86	10:36	00.76	484.442	64.40	0.126	
05/06/86	10:00	00.55	490.417	64.95	0.092	
05/13/86	10:00	00.73	497.417	65.68	0.104	
05/20/86	11:00	00.70	504.458	66.38	0.099	
05/27/86	15:35	00.65	511.649	67.03	0.090	
06/03/86	09:50	00.66	518.410	67.69	0.098	
06/10/86	11:15	00.54	525.469	68.23	0.076	
06/17/86	10:31	00.65	532.438	68.88	0.093	
06/24/86	10:45	00.63	539.448	69.51	0.090	
07/01/86	13:50	00.71	546.576	70.22	0.100	
07/08/86	10:25	00.63	553.434	70.85	0.092	
07/16/86	10:00	00.66	561.417	71.51	0.083	
07/22/86	09:48	00.61	567.408	72.12	0.102	
07/29/86	10:25	00.71	574.434	72.83	0.101	
08/05/86	10:55	00.66	581.455	73.49	0.094	
08/12/86	10:23	00.63	588.433	74.12	0.090	
08/19/86	11:22	00.68	595.474	74.80	0.097	

TABLE E.16
Inflow Data for Hole DH215 at S1950-E140

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
04/20/84	NA	NA	0.000	0.00	0.000	Experimental collecting device installed.
01/15/85	11:00	00.05	14.458	0.05	0.050	First data entry in BTP Phase I collection program.
01/22/85	12:00	00.08	21.500	0.13	0.011	
01/29/85	12:00	00.08	28.500	0.21	0.011	
02/05/85	12:00	00.04	35.500	0.25	0.006	
02/11/85	13:00	00.06	41.542	0.31	0.010	
02/14/85	11:00	00.03	44.458	0.34	0.010	Replace collecting device.
02/19/85	10:35	00.07	49.441	0.41	0.014	
02/26/85	12:10	00.09	56.507	0.50	0.013	
03/07/85	10:30	00.12	65.438	0.62	0.013	
03/12/85	12:30	00.10	70.521	0.72	0.020	
03/20/85	14:00	00.11	78.583	0.83	0.014	
03/26/85	11:30	00.05	84.479	0.88	0.008	
04/02/85	13:00	00.05	91.542	0.93	0.007	
04/10/85	13:00	00.09	99.542	1.02	0.011	
04/17/85	14:00	00.03	106.583	1.05	0.004	Drip missing funnel.
04/23/85	14:30	00.10	112.604	1.15	0.017	
04/30/85	09:09	00.08	119.381	1.23	0.012	
05/07/85	10:50	00.09	126.451	1.32	0.013	Salt crystals in container.
05/14/85	13:06	00.11	133.546	1.43	0.016	
05/21/85	12:15	00.08	140.510	1.51	0.011	
05/29/85	11:00	00.09	148.458	1.60	0.011	
06/04/85	13:15	00.09	154.552	1.69	0.015	Salt crystals in container.
06/11/85	13:10	00.13	161.549	1.82	0.019	
06/18/85	11:22	00.13	168.474	1.95	0.019	
06/25/85	12:55	00.12	175.538	2.07	0.017	
07/02/85	11:00	00.10	182.458	2.17	0.014	
07/09/85	12:39	00.09	189.527	2.26	0.013	
07/16/85	12:37	00.11	196.526	2.37	0.016	Salt crystals in container.
07/24/85	12:39	00.14	204.527	2.51	0.017	
07/30/85	11:09	00.10	210.465	2.61	0.017	
08/06/85	11:20	00.11	217.472	2.72	0.016	
08/14/85	13:17	00.17	225.553	2.89	0.021	
08/20/85	12:57	00.10	231.540	2.99	0.017	
08/26/85	14:36	00.12	237.608	3.11	0.020	
09/04/85	11:35	00.14	246.483	3.25	0.016	
09/10/85	12:05	00.09	252.503	3.34	0.015	
09/17/85	10:00	00.12	259.417	3.46	0.017	
09/24/85	11:11	00.13	266.466	3.59	0.018	
10/01/85	10:55	00.12	273.455	3.71	0.017	Salt crystals in container.
10/08/85	12:00	00.10	280.500	3.81	0.014	
10/15/85	11:31	00.20	287.480	4.01	0.029	
10/23/85	11:54	00.33	295.496	4.34	0.041	
10/29/85	11:54	00.12	301.496	4.46	0.020	
11/13/85	11:18	00.18	316.471	4.64	0.012	Floor being lowered in E140 north of this location.
12/04/85	15:00	00.35	337.625	4.99	0.017	Floor lowered at this location 11/19/85, downhole DH216 destroyed. Cross-drift excavation initiated toward east on 11/20/85.
12/10/85	13:05	00.11	343.545	5.10	0.019	
12/17/85	14:20	00.40	350.597	5.50	0.057	
01/03/86	11:00	01.00	367.458	6.50	0.059	Brine overflowing container, unknown amount not collected.

TABLE E.16
Inflow Data for Hole DH215 at S1950-E140

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
01/08/86	11:25	00.36	372.476	6.86	0.072	
01/16/86	11:00	00.70	380.458	7.56	0.088	
01/23/86	12:00	00.63	387.500	8.19	0.089	
01/31/86	13:50	00.45	395.576	8.64	0.056	Cross-drift extended toward west starting 1/29/86.
02/12/86	12:25	00.27	407.517	8.91	0.023	Stalactites removed from container.
02/19/86	13:15	00.26	414.552	9.17	0.037	
03/06/86	12:20	00.96	429.514	10.13	0.064	Floor lowered in E140 south of this location starting 2/28/86.
03/13/86	11:30	00.40	436.479	10.53	0.057	
03/26/86	11:15	00.72	449.469	11.25	0.055	
04/02/86	10:30	00.30	456.438	11.55	0.043	
04/08/86	11:00	00.15	462.458	11.70	0.025	
04/16/86	13:00	00.40	470.542	12.10	0.049	
04/24/86	11:00	00.26	478.458	12.36	0.033	
04/30/86	11:35	00.16	484.483	12.52	0.027	
05/06/86	11:05	00.21	490.462	12.73	0.035	
05/13/86	10:10	00.29	497.424	13.02	0.042	
05/20/86	11:45	00.20	504.490	13.22	0.028	
05/27/86	16:00	00.20	511.667	13.42	0.028	
06/03/86	11:05	00.27	518.462	13.69	0.040	
06/10/86	12:10	00.33	525.507	14.02	0.047	
06/17/86	11:47	00.23	532.491	14.25	0.033	
06/24/86	11:50	00.10	539.493	14.35	0.014	
07/01/86	14:32	00.15	546.606	14.50	0.021	
07/08/86	11:30	00.14	553.479	14.64	0.020	About 1 lb. of salt encrustation was removed from funnel on 7/07/86.
07/16/86	11:45	00.10	561.490	14.74	0.012	
07/22/86	10:31	00.06	567.438	14.80	0.010	
07/29/86	11:27	00.13	574.477	14.93	0.018	
08/05/86	11:59	00.14	581.499	15.07	0.020	
08/12/86	11:40	00.13	588.486	15.20	0.019	
08/19/86	12:00	00.04	595.500	15.24	0.006	

TABLE E.17
Inflow Data for Hole IG201 in ROOM 2

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
11/30/84	12:00	63.10	-31.500	63.10	0.000	Hole was evacuated dry first time, 63.10 litres had been removed. First time bailed.
01/08/85	12:00	01.52	7.500	64.62	0.000	Partialy evacuated.
01/09/85	10:00	02.48	8.417	67.10	2.704	Some fluid was lost. Should add 1.52 liters from partial evacuation day before to this volume for liters/day calculation
01/15/85	09:10	00.33	14.382	67.43	0.055	
01/22/85	10:10	00.38	21.424	67.81	0.054	
01/29/85	10:44	00.25	28.447	68.06	0.036	
02/05/85	09:20	00.30	35.389	68.36	0.043	
02/11/85	09:45	00.24	41.406	68.60	0.040	
02/19/85	11:15	00.32	49.469	68.92	0.040	
02/26/85	09:45	00.26	56.406	69.18	0.037	
03/05/85	09:22	00.25	63.390	69.43	0.036	
03/12/85	09:00	00.25	70.375	69.68	0.036	
03/20/85	09:38	00.17	78.401	69.85	0.021	
03/26/85	09:10	00.27	84.382	70.12	0.045	
04/02/85	09:30	00.24	91.396	70.36	0.034	
04/10/85	09:30	00.26	99.396	70.62	0.033	
04/17/85	13:40	00.26	106.569	70.88	0.036	
04/23/85	12:00	00.23	112.500	71.11	0.039	
04/30/85	11:41	00.21	119.487	71.32	0.030	
05/07/85	10:30	00.23	126.438	71.55	0.033	
05/14/85	11:00	00.24	133.458	71.79	0.034	
05/21/85	11:09	00.23	140.465	72.02	0.033	
05/29/85	10:00	00.30	148.417	72.32	0.038	
06/04/85	11:45	00.16	154.490	72.48	0.026	
06/11/85	11:20	00.22	161.472	72.70	0.032	
06/18/85	10:42	00.21	168.446	72.91	0.030	
06/25/85	09:55	00.22	175.413	73.13	0.032	
07/02/85	11:00	00.23	182.458	73.36	0.033	
07/09/85	11:33	00.24	189.481	73.60	0.034	Effervesces.
07/16/85	12:00	00.27	196.500	73.87	0.038	Effervesces.
07/24/85	11:02	00.31	204.460	74.18	0.039	
07/30/85	10:40	00.24	210.444	74.42	0.040	
08/06/85	10:49	00.24	217.451	74.66	0.034	
08/14/85	12:04	00.28	225.503	74.94	0.035	
08/20/85	11:24	00.26	231.475	75.20	0.044	
08/28/85	10:00	00.21	239.417	75.41	0.026	
09/04/85	10:52	00.16	246.453	75.57	0.023	
09/10/85	11:16	00.12	252.469	75.69	0.020	
09/17/85	10:11	00.15	259.424	75.84	0.022	
09/24/85	10:08	00.16	266.422	76.00	0.023	
10/01/85	10:20	00.13	273.431	76.13	0.019	
10/08/85	11:09	00.18	280.465	76.31	0.026	
10/15/85	10:45	00.17	287.448	76.48	0.024	
10/23/85	10:52	00.19	295.453	76.67	0.024	
10/29/85	10:37	00.14	301.442	76.81	0.023	
11/05/85	09:38	00.19	308.401	77.00	0.027	
11/13/85	10:40	00.24	316.444	77.24	0.030	
11/21/85	11:48	00.25	324.492	77.49	0.031	
11/26/85	10:35	00.15	329.441	77.64	0.030	
12/10/85	11:10	00.35	343.465	77.99	0.025	

TABLE E.17
Inflow Data for Hole IG201 in ROOM 2

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
12/17/85	14:10	00.23	350.590	78.22	0.032	
01/03/86	10:20	00.42	367.431	78.64	0.025	
01/08/86	10:30	00.20	372.438	78.84	0.040	
01/16/86	10:10	00.16	380.424	79.00	0.020	
01/23/86	10:20	00.15	387.431	79.15	0.021	
01/31/86	12:38	00.17	395.526	79.32	0.021	
02/12/86	11:30	00.25	407.479	79.57	0.021	
02/19/86	12:00	00.17	414.500	79.74	0.024	
02/28/86	13:45	00.30	423.573	80.04	0.033	
03/06/86	11:00	00.19	429.458	80.23	0.032	
03/13/86	10:27	00.20	436.435	80.43	0.029	
03/26/86	10:25	00.31	449.434	80.74	0.024	
04/02/86	10:05	00.16	456.420	80.90	0.023	
04/08/86	10:15	00.13	462.427	81.03	0.022	
04/16/86	12:30	00.15	470.521	81.18	0.019	
04/24/86	10:35	00.13	478.441	81.31	0.016	
04/30/86	11:14	00.10	484.468	81.41	0.017	Last time sampled. Guide tube became too distorted by shear and would not allow sampler to pass.

TABLE E.18
Inflow Data for Hole IG202 in Room 1

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
11/30/84	12:00	52.00	-31.500	52.00	0.000	Hole was evacuated dry. First time sampled.
01/08/85	12:00	12.58	7.500	64.58	0.323	
01/15/85	09:25	00.59	14.392	65.17	0.086	
01/22/85	12:00	00.34	21.500	65.51	0.048	
01/29/85	12:00	00.33	28.500	65.84	0.047	
02/05/85	10:17	00.41	35.428	66.25	0.059	
02/11/85	09:30	00.27	41.396	66.52	0.045	
02/19/85	12:00	00.32	49.500	66.84	0.039	
02/26/85	12:00	00.25	56.500	67.09	0.036	
03/05/85	09:03	00.20	63.377	67.29	0.029	
03/12/85	08:58	00.23	70.374	67.52	0.033	
03/20/85	09:16	00.25	78.386	67.77	0.031	
03/26/85	09:00	00.18	84.375	67.95	0.030	
04/02/85	09:10	00.19	91.382	68.14	0.027	
04/10/85	09:19	00.21	99.388	68.35	0.026	
04/17/85	13:56	00.18	106.581	68.53	0.025	
04/23/85	12:12	00.14	112.508	68.67	0.024	
04/30/85	13:00	00.15	119.542	68.82	0.021	
05/07/85	10:40	00.14	126.444	68.96	0.020	
05/14/85	11:16	00.14	133.469	69.10	0.020	
05/21/85	11:30	00.14	140.479	69.24	0.020	
05/29/85	10:00	00.15	148.417	69.39	0.019	
06/04/85	12:10	00.11	154.507	69.50	0.018	
06/11/85	11:40	00.12	161.486	69.62	0.017	Hole entry becoming tight due to shear closure of guide tube.
06/18/85	10:55	00.12	168.455	69.74	0.017	
06/25/85	09:50	00.11	175.410	69.85	0.016	
07/02/85	11:30	00.11	182.479	69.96	0.016	
07/09/85	11:15	00.09	189.469	70.05	0.013	Effervesces.
07/16/85	12:19	00.07	196.513	70.12	0.010	Effervesces.
07/24/85	11:15	00.11	204.469	70.23	0.014	
08/06/85	11:08	00.18	217.464	70.41	0.014	
08/14/85	12:17	00.09	225.512	70.50	0.011	
08/20/85	11:00	00.06	231.458	70.56	0.010	
08/28/85	10:00	00.13	239.417	70.69	0.016	
09/04/85	10:00	00.09	246.417	70.78	0.013	
09/10/85	11:35	00.09	252.483	70.87	0.015	
09/17/85	10:00	00.13	259.417	71.00	0.019	
09/24/85	10:00	00.10	266.417	71.10	0.014	
10/01/85	10:35	00.08	273.441	71.18	0.011	
10/08/85	11:15	00.10	280.469	71.28	0.014	Last time sampled. Guide tube too distorded due to shear closure to allow sampler to pass.

TABLE E.19
Inflow Data for Hole L1X00 in ROOM L1

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
05/14/85	11:24	11.46	133.475	11.46	0.000	First time collected. Brine & muck.
05/21/85	12:33	00.31	140.523	11.77	0.044	
05/29/85	10:00	00.23	148.417	12.00	0.029	About 1 lb. of salt removed with brine during bailing.
06/04/85	09:25	00.17	154.392	12.17	0.028	
06/11/85	09:00	00.23	161.375	12.40	0.033	About 2 lbs. of salt removed with brine during bailing.
06/18/85	09:05	00.23	168.378	12.63	0.033	
06/25/85	08:55	00.21	175.372	12.84	0.030	
07/02/85	11:00	00.23	182.458	13.07	0.032	
07/09/85	09:10	00.21	189.382	13.28	0.030	
07/16/85	09:12	00.21	196.383	13.49	0.030	
07/24/85	09:29	00.22	204.395	13.71	0.027	
07/30/85	08:42	00.18	210.363	13.89	0.030	
08/06/85	09:07	00.18	217.380	14.07	0.026	
08/14/85	08:53	00.23	225.370	14.30	0.029	
08/20/85	08:58	00.16	231.374	14.46	0.027	
08/28/85	08:25	00.23	239.351	14.69	0.029	
09/04/85	09:09	00.19	246.381	14.88	0.027	
09/10/85	08:53	00.16	252.370	15.04	0.027	
09/17/85	08:25	00.21	259.351	15.25	0.030	
09/24/85	08:40	00.21	266.361	15.46	0.030	
10/01/85	08:52	00.17	273.369	15.63	0.024	
10/08/85	09:55	00.19	280.413	15.82	0.027	
10/15/85	08:45	00.16	287.365	15.98	0.023	
10/23/85	09:09	00.20	295.381	16.18	0.025	
10/29/85	11:30	00.18	301.479	16.36	0.030	
11/05/85	08:17	00.16	308.345	16.52	0.023	
11/13/85	08:47	00.18	316.366	16.70	0.022	
11/21/85	10:00	00.17	324.417	16.87	0.021	
11/26/85	09:25	00.12	329.392	16.99	0.024	
12/03/85	14:35	00.14	336.608	17.13	0.019	
12/10/85	12:55	00.14	343.538	17.27	0.020	
12/17/85	13:02	00.15	350.543	17.42	0.021	
01/03/86	09:05	00.38	367.378	17.80	0.023	
01/08/86	09:25	00.11	372.392	17.91	0.022	
01/16/86	09:00	00.18	380.375	18.09	0.023	
01/23/86	09:15	00.14	387.385	18.23	0.020	
01/31/86	09:45	00.18	395.406	18.41	0.022	
02/12/86	08:50	00.30	407.368	18.71	0.025	
02/19/86	09:40	00.16	414.403	18.87	0.023	
02/28/86	11:20	00.24	423.472	19.11	0.026	
03/06/86	09:10	00.12	429.382	19.23	0.020	
03/13/86	08:30	00.16	436.354	19.39	0.023	
03/26/86	08:35	00.29	449.358	19.68	0.022	
04/02/86	08:15	00.17	456.344	19.85	0.024	
04/08/86	08:26	00.15	462.351	20.00	0.025	
04/16/86	10:20	00.19	470.431	20.19	0.024	
04/24/86	08:50	00.16	478.368	20.35	0.020	
04/30/86	09:20	00.16	484.389	20.51	0.027	
05/06/86	08:50	00.15	490.368	20.66	0.025	
05/13/86	08:48	00.18	497.367	20.84	0.026	
05/20/86	09:20	00.18	504.389	21.02	0.026	
05/27/86	14:20	00.17	511.597	21.19	0.024	
06/03/86	08:43	00.15	518.363	21.34	0.022	

TABLE E.19
Inflow Data for Hole L1X00 in ROOM L1

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
06/10/86	09:20	00.21	525.389	21.55	0.030	
06/17/86	09:12	00.14	532.383	21.69	0.020	
06/24/86	09:15	00.22	539.385	21.91	0.031	
07/01/86	11:53	00.22	546.495	22.13	0.031	
07/08/86	09:10	00.22	553.382	22.35	0.032	
07/16/86	09:00	00.21	561.375	22.56	0.026	
07/22/86	08:45	00.17	567.365	22.73	0.028	
07/29/86	09:08	00.18	574.381	22.91	0.026	
08/05/86	09:33	00.20	581.398	23.11	0.029	
08/12/86	09:05	00.20	588.378	23.31	0.029	
08/19/86	09:49	00.20	595.409	23.51	0.028	

TABLE E.20
Short-Term Inflow Data for NG 252 in Room 2

DATE	TIME	ELAPSED TIME REF. 0	RISE IN STATIC LEVEL(FT)	EQUIVALENT VOLUME (LITERS)
01/08/85	09:43	0.00	0.00	0.00
01/08/85	10:45	1.03	0.32	0.11
01/08/85	11:37	1.90	0.41	0.14
01/08/85	12:45	3.03	0.57	0.20
01/08/85	13:45	4.03	0.65	0.23
01/08/85	15:05	5.37	0.75	0.26
01/08/85	16:30	6.78	0.86	0.30
01/09/85	04:02	18.32	1.51	0.52
01/09/85	08:38	22.92	1.69	0.59
01/09/85	12:45	27.03	1.83	0.64
01/09/85	14:10	28.45	1.87	0.65
01/09/85	16:50	31.12	1.91	0.66
01/09/85	21:00	35.28	1.99	0.69
01/10/85	08:26	46.72	2.16	0.75
01/10/85	17:00	55.28	2.35	0.82
01/11/85	01:25	63.70	2.54	0.88
01/11/85	09:42	71.98	2.61	0.91
01/11/85	16:15	78.53	2.71	0.94
01/12/85	01:14	87.52	2.88	1.00
01/12/85	09:35	95.87	3.04	1.06
01/12/85	17:23	103.67	3.21	1.12
01/13/85	04:38	114.92	3.50	1.22
01/13/85	10:17	120.57	3.58	1.24
01/13/85	17:24	127.68	3.77	1.31
01/14/85	01:31	135.80	4.00	1.39
01/14/85	09:15	143.53	4.19	1.46
01/14/85	17:14	151.52	4.38	1.52
01/15/85	01:19	159.60	4.58	1.59
01/15/85	09:00	167.28	4.83	1.68
01/15/85	12:45	171.03	4.93	1.71
01/15/85	17:17	175.57	5.05	1.75
01/16/85	00:30	182.78	5.12	2.04
01/16/85	08:57	191.23	5.16	2.26
01/16/85	18:02	200.32	5.17	2.32
01/17/85	00:20	206.69	5.18	2.37
01/17/85	09:40	215.95	5.26	2.82
01/17/85	11:40	217.95	5.29	2.98
01/17/85	16:55	223.20	5.30	3.04
01/18/85	01:25	231.70	5.35	3.32
01/18/85	09:18	239.58	5.36	3.37
01/18/85	17:45	248.03	5.40	3.59
01/19/85	00:32	254.82	5.45	3.87
01/19/85	09:50	264.12	5.47	3.98
01/19/85	17:00	271.28	5.50	4.15
01/20/85	00:45	279.03	5.53	4.32
01/20/85	09:33	287.83	5.55	4.43
01/20/85	16:40	294.95	5.58	4.60
01/21/85	01:00	303.28	5.60	4.71
01/21/85	09:16	311.55	5.61	4.76
01/21/85	16:45	319.03	5.65	4.98
01/22/85	01:00	327.28	5.67	5.10
01/22/85	17:50	343.37	5.72	5.37
01/23/85	09:24	359.68	5.73	5.43
01/23/85	17:50	368.12	5.77	5.65
01/24/85	02:19	376.60	5.79	5.76
01/24/85	09:12	383.48	5.80	5.82
01/24/85	17:44	392.02	5.82	5.93
01/25/85	01:11	399.47	5.83	5.99
01/27/85	08:37	454.90	5.90	6.37
01/27/85	20:30	466.78	5.94	6.60
01/28/85	11:20	481.62	5.96	6.71
01/28/85	17:51	488.13	5.99	6.88
01/29/85	08:43	503.00	6.03	7.10
01/29/85	11:01	505.30	6.03	7.10

TABLE E.20
Short-Term Inflow Data for NG 252 in Room 2

DATE	TIME	ELAPSED TIME REF. 0	RISE IN STATIC LEVEL(FT)	EQUIVALENT VOLUME (LITERS)
01/30/85	00:50	519.12	6.06	7.26
01/30/85	12:00	530.28	6.09	7.43
01/30/85	18:15	536.53	6.09	7.43
01/31/85	12:37	554.90	6.08	7.38
01/31/85	18:23	560.67	6.09	7.43
02/01/85	17:08	583.42	6.08	7.38
02/02/85	00:40	590.95	6.08	7.38
02/02/85	08:56	599.22	6.09	7.43
02/02/85	17:05	607.37	6.08	7.38
02/03/85	00:55	615.20	6.08	7.38
02/03/85	09:05	623.37	6.09	7.43
02/03/85	17:07	631.40	6.10	7.49
02/04/85	00:47	639.07	6.10	7.49
02/04/85	08:30	646.78	6.10	7.49
02/04/85	16:18	654.58	6.10	7.49
02/05/85	01:23	663.67	6.10	7.49
02/05/85	09:00	671.28	6.10	7.49

TABLE E.21
Inflow Data for Hole NG252 in ROOM 2

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
12/19/84	12:00	04.60	-12.500	4.60	0.000	Partial removal. First time collected.
12/20/84	09:00	04.35	-11.625	8.95	0.000	Pumped dry. Inflow rate about 2 cc/hr.
01/08/85	09:43	08.19	7.405	17.14	0.430	Pumped dry.
02/05/85	09:30	08.48	35.396	25.62	0.303	Gas bubbles.
02/14/85	10:33	04.14	44.440	29.76	0.458	
02/19/85	10:18	03.92	49.429	33.68	0.786	
03/07/85	10:57	03.83	65.456	37.51	0.239	
03/12/85	09:10	03.41	70.382	40.92	0.692	
03/20/85	10:00	03.71	78.417	44.63	0.462	
03/26/85	09:30	03.24	84.396	47.87	0.542	
04/02/85	10:00	03.38	91.417	51.25	0.481	
04/10/85	10:02	03.29	99.418	54.54	0.411	
04/17/85	13:50	03.57	106.576	58.11	0.499	
04/23/85	12:00	02.58	112.500	60.69	0.436	
04/30/85	11:39	03.28	119.485	63.97	0.470	
05/07/85	10:25	02.96	126.434	66.93	0.426	
05/14/85	11:05	02.83	133.462	69.76	0.403	
05/21/85	11:12	03.01	140.467	72.77	0.430	Brine degassing from jar.
05/29/85	10:00	03.45	148.417	76.22	0.434	
06/04/85	11:50	02.90	154.493	79.12	0.477	
06/11/85	11:35	03.06	161.483	82.18	0.438	
06/18/85	10:47	02.82	168.449	85.00	0.405	
06/25/85	10:00	03.34	175.417	88.34	0.479	
07/02/85	11:00	03.50	182.458	91.84	0.497	
07/09/85	11:30	03.46	189.479	95.30	0.493	Effervesces.
07/16/85	12:09	03.43	196.506	98.73	0.488	Effervesces.
07/24/85	11:10	03.83	204.465	102.56	0.481	
07/30/85	10:45	02.79	210.448	105.35	0.466	
08/06/85	10:58	03.05	217.457	108.40	0.435	
08/14/85	12:10	03.48	225.507	111.88	0.432	
08/20/85	11:31	03.15	231.480	115.03	0.527	
08/28/85	10:00	03.11	239.417	118.14	0.392	
09/04/85	10:58	03.17	246.457	121.31	0.450	
09/10/85	11:23	03.04	252.474	124.35	0.505	
09/17/85	10:16	02.68	259.428	127.03	0.385	
09/24/85	10:20	02.98	266.431	130.01	0.426	
10/01/85	10:25	03.19	273.434	133.20	0.456	
10/08/85	11:05	03.36	280.462	136.56	0.478	
10/15/85	10:46	02.64	287.449	139.20	0.378	
10/23/85	10:58	02.93	295.457	142.13	0.366	
10/29/85	10:45	02.64	301.448	144.77	0.441	
11/05/85	09:40	02.16	308.403	146.93	0.311	10 days after brine was removed from 36" hole in Room 3.
11/13/85	10:45	02.72	316.448	149.65	0.338	
11/21/85	11:50	02.88	324.493	152.53	0.358	
11/26/85	10:40	02.28	329.444	154.81	0.461	
12/03/85	14:15	02.45	336.594	157.26	0.343	
12/10/85	13:41	02.34	343.570	159.60	0.335	
12/17/85	14:15	02.73	350.594	162.33	0.389	
01/03/86	10:30	04.03	367.438	166.36	0.239	Partial removal only.
01/08/86	10:40	03.00	372.444	169.36	0.599	High amount due to only partial removal on 1/03/86.
01/16/86	10:10	03.90	380.424	173.26	0.489	

TABLE E.21
Inflow Data for Hole NG252 in ROOM 2

Date	Time	Liters Removed	Days Since 1/01/85	Cumulative Liters Collected	Liters per Day	Remarks
01/23/86	10:20	02.84	387.431	176.10	0.405	
01/31/86	12:45	02.94	395.531	179.04	0.363	
02/12/86	11:30	02.87	407.479	181.91	0.240	
02/19/86	12:13	02.85	414.509	184.76	0.405	
03/06/86	11:00	04.10	429.458	188.86	0.274	
03/13/86	10:30	02.78	436.438	191.64	0.398	
03/26/86	10:25	03.50	449.434	195.14	0.269	
04/02/86	10:10	02.67	456.424	197.81	0.382	
04/08/86	10:15	02.00	462.427	199.81	0.333	
04/16/86	12:30	02.52	470.521	202.33	0.311	
04/24/86	10:40	01.93	478.444	204.26	0.244	
04/30/86	11:20	02.10	484.472	206.36	0.348	
05/06/86	10:45	01.80	490.448	208.16	0.301	
05/13/86	11:35	01.33	497.483	209.49	0.189	
05/20/86	11:25	01.22	504.476	210.71	0.174	
05/27/86	16:10	01.60	511.674	212.31	0.222	
06/03/86	10:45	01.49	518.448	213.80	0.220	
06/10/86	11:45	02.18	525.490	215.98	0.310	
06/17/86	11:21	02.65	532.473	218.63	0.379	
06/24/86	11:15	01.77	539.469	220.40	0.253	
07/01/86	14:20	01.80	546.597	222.20	0.253	
07/08/86	10:55	01.50	553.455	223.70	0.219	
07/16/86	11:00	01.88	561.458	225.58	0.235	
07/22/86	10:22	01.94	567.432	227.52	0.325	
07/29/86	10:55	02.16	574.455	229.68	0.308	
08/05/86	11:33	01.92	581.481	231.60	0.273	
08/12/86	10:50	01.90	588.451	233.50	0.273	
08/19/86	11:45	01.82	595.490	235.32	0.259	