INEL OVERSIGHT PROGRAM

R&D 2-3 TECHNICAL FORUM #1

JUNE 27-28, 1991

FG07-91ID13042

State of Idaho
DEPARTMENT OF HEALTH AND WELFARE
INEL Oversight Program • 800/232-INEL

1410 N. Hilton • Boise, Idaho 83706
1920 E. 17th • Idaho Falls, Idaho 83401

CECIL D. ANDRUS
Governor
RICHARD P. DONOVAN
Director
Dept. of Health and Welfare
DAVID L. HUMPHREY
Oversight Coordinator
STEVE R. HILL
Administrator
208/334-0498
FAX/334-0417

June 5, 1991

Mr. Edwin Wilmot, Assistant Manager
Site Engineering & Support
DOE ID Operations
785 DOE Place, MS-1131
Idaho Falls, ID 83402-1131

Subject: Field Trip and Meeting in Support of Monitoring Agreement Supplemental Investigations

Dear Mr. Wilmot:

A two day program in support of Supplemental Investigations 2 (Unsaturated Zone Contamination and Transport Processes) and 3 (Surface Water-Ground Water Interactions) is proposed for June 27-28, 1991 (see attached tentative agenda). The goals of the two day program are:

(1) familiarize technical personnel working on the Supplemental Investigations and counterparts at INEL with each other;

(2) identify current status of activities, understanding and modeling of unsaturated zone and surface water-ground water processes; and,

(3) identify priority areas for attention cooperation/ collaboration of investigators.

Due to the breadth of subject matter and limited time available, the intention is to have informal working sessions rather than formal presentations.

Involvement of INEL technical personnel (DOE, contractors, USGS) is essential for the success of the field trip, meeting, and long-term goals of the Supplemental Investigations. This letter, then, is a request for cooperative participation in this program.

For additional information and logistical coordination, please contact Flint Hall (525-7302) in our Idaho Falls office, or Warren Barrash (334-0447) in our Boise office.

Below is a list of individuals whose involvement would be beneficial (we realize that all listed persons may not be available for all portions of the two day program --- and we encourage participation by other interested persons not identified by name):

DOE: Mike Bennett

EG&G: Tom Wood, Joel Hubbell, Marty Doornbos, Ron Arnett, Buck Sisson, Bob Baca, Shirley Rawson, John Kaminsky

WINCO: Tom Thomas, John Williams, Chris Martin, John DelDebbio

USGS: Larry Mann, John Pittman, Steve Anderson, Brennan Orr

Thank you for your assistance with this request.

Sincerely,

STEVE R. HILL, Administrator
INEL Oversight Program

SRH:wb:cjh
enclosures

cc: David L. Humphrey
Flint Hall
Warren Barrash
DOE-ID - Mike Bennett
EGG -- Tom Wood
Joel Hubble
Marty Doornbos
Ron Arnett
Buck Sisson
Bob Bacca
Shirley Rawson
John Kaminsky
WINCO -- Tom Thomas
John Williams
Chris Martin
John DelDebbio
USGS -- Larry Mann
John Pittman
Steve Anderson
Brennon Orr
Roger Jensen

Department of Energy

Idaho Operations Office
785 DOE Place
Idaho Falls, Idaho 83402

RECEIVED

JUN 21 1991

INEL
OVERSIGHT PROGRAM

June 20, 1991

Mr. Steve Hill, Administrator
INEL Oversight Program
Department of Health and Welfare
1410 North Hilton Road
Boise, Idaho 83706

SUBJECT: Field Trip and Meeting in Support of Monitoring Agreement Supplemental Investigations

Dear Mr. Hill:

We have received your letter concerning the field trip and meeting in support of two supplemental investigations now being planned by the INEL Oversight Program. We support this approach and are pleased that you are involving a number of individuals who can help identify the areas of investigation which will support our common goals of better understanding the INEL and our clean-up options.

Mike Bennett and Paul Allen from my organization will attend, and we fully support the involvement of INEL contractors in this effort as well.

I would like to note that during the afternoon of the final day of the proposed session you plan to discuss how to best utilize existing resources to facilitate understanding of physical/chemical systems and processes - and thereby contribute to clean-up of affected environments at the INEL. Please keep in mind that my organization, Site Engineering and Support, is not programmatically responsible for clean-up of the INEL although we do provide technical support on clean-up matters to the DOE-ID Environmental Restoration Division and have a keen interest in this area. Just as you have included representatives from the State Hazardous Materials Bureau who are responsible for overseeing the implementation of the CERCLA clean-up at the INEL, we believe it would benefit all involved to invite and include those at DOE who are responsible for implementing the CERCLA action. Therefore, by means of a copy, we are informing DOE's Environmental Restoration Division (ERD) of the meeting. In the future, we would encourage direct communication with ERD on such activities.

Thank you for the invitation and we look forward to the two day session. Please feel free to contact either Mr. Bennett or Mr. Allen if you have any questions, concerns or changes to the agenda.

Sincerely,

Edwin L. Wilmot, Assistant Manager
for Site Engineering and Support

cc: Lisa Green, DOE-ID, ERD
Tom Wood, EG&G
Anthony Umek, WINCO
Larry Mann, USGS
Flint Hall, IDHW
Warren Barrash, IDHW

AGENDA: State of Idaho INEL Oversight Program
Research and Development Projects 2&3 Site Visit
June 26-28, 1991

DAY 1 / **JUNE 26** — University personnel arrival, June 26th, briefing after dinner. Briefing will focus is on proposed activities for the next two days. State Oversight Program personnel and University researchers will be involved.

DAY 2 / **JUNE 27** — Site Tour
Assemble, Oversight program office, 6:45. Leave Idaho Falls at 7:00 AM
Break for lunch at approximately 11:15
Return to Idaho Falls at 5:10 PM

Roadlog

Description	Distance (miles)	Travel time (mins)	Elapsed time (hr:mins)
1. <u>Test Area North</u>			
Idaho Falls to Sage Junction (I-15)	25	25	
Sage Junction, Crest of Circular Butte (State 33)	24	30	55
Stop 1. Overlook of Birch Creek Playa, TAN description and history of TAN, Discussion Leader (DL): Jim Olsen		20	1:15
2. <u>Big Lost River Playa</u>			
Circular Butte to Junction of Lincoln and State 88	8	10	1:25
Stop 2. Overview of Big Lost River Plays from high point of road just past the northern entrance of the site, DL: Mike Bennett, DOE-ID		20	1:45

Description	Distance (miles)	Travel time (mins)	Elapsed time (hr:mins)
3. Test Reactor Area			
Junction of Lincoln and State 88 to TRA ponds	20	25	2:10
Stop 3. Description and history of TRA, description and visual inspection of ponds and associated perched water monitoring system, description of perched water system and remedial activities accomplished and planned. DL: Flint Hall, Tom Wood (EGG)		45	2:55
4. Big Lost River			
Monroe Boulevard to bridge over Big Lost River, Lincoln.	2	5	3:00
Stop 4. Turn to south, pointing out perched and aquifer monitor wells, describe observed interconnection between historic flows of Big Lost River and response in perched and aquifer wells associated with historic flows. Note Big Lost River gauging station DL: Mike Bennett, Larry Mann (USGS)		20	3:20
5. Idaho Chemical Processing Plant			
Lincoln to Chem Plant	2	5	3:25
Stop 5. Description and history of ICPP, description and visual inspection of the percolation ponds and associated perched water monitoring systems, description of perched water system, remedial activities planned. DL: Karen Marts, Chris Martin, Brent Russel (WINCO), Larry Mann		45	4:10
6. Central Facilities Area cafeteria			
Chem Plant to Lincoln to CFA Cafeteria	4	5	4:15
Lunch break		60	5:15

Description	Distance (miles)	Travel time (mins)	Elapsed time (hr:mins)
7. <u>Central Facilities Area Landfills</u>			
CFA to Lincoln to Portland	3	5	5:20
Stop 6. Description and history of landfills, description of unsaturated zone monitoring at the landfill, note observations made and data which exists. DL: EGG	30	5:50	
8. <u>Diversion Dam</u>			
Portland to US 20-26	9	15	6:00
Stop 7. Description, operation and development of INEL diversion system. Discussion of resulting impacts on the regional water table. DL: Mike Bennett		30	6:30
9. <u>USGS test trench</u>			
Dirt road from diversion dams to USGS Test Trench	2	10	6:40
Stop 8. Description of monitoring system and results from on going investigations conducted by USGS. DL: John Pittman (USGS)			
Description of Masters thesis work conducted at location adjacent to USGS test trench. DL: Jon Kaminisky (EGG)			
Description of ongoing and previous investigations at RWMC. DL: Buck Sisson, Tom wood (EGG), Dave Hovland (Idaho HMB)		1:30	8:10
Return to Idaho Falls	55	1:00	9:10

DAY 3, JUNE 28 **Overview R&D program, discussion of modeling, monitoring, and possible areas of research**
Conference room 1, Idaho Falls Public Library

Convene at 8:00 AM
Break for lunch when convenient
Conclude by 4 - 5:00 PM

AGENDA

Morning Session:

- Introduction to the State's Oversight Program's evaluating environmental monitoring at the INEL - how that role: meshes with other State activities (IAG, monitoring for compliance), includes "R and D", and compliments research by site contractors. [30 minutes]

- Range and status of data collected from unsaturated zone monitoring systems and from engineering and special studies. Compilation into one data base. [90 minutes]

- Break [15 minutes]

- Description and discussion of previous efforts and codes used to model flow and contaminant transport in the unsaturated zone (including perched zones and surface water ground water interactions) at the INEL. [120 minutes]

Lunch [60 minutes]

Afternoon Session:

- Explore methods to best utilize existing resources to facilitate understanding of physical/chemical systems and processes - and thereby contribute to cleanup of affected environments at the INEL. [120 minutes]

The site visit will conclude with an open discussion on possible topics and directions for focused investigations based on information presented.

Parties involved over two-day visit:

State of Idaho,

- INEL OP
  - Warren Barrash
  - Flint Hall
  - Jim Olsen
  - Karen Marts
  - Mary Higgman
- HMB
  - Dean Nygard
  - Dave Hovland
  - Shawn Rosenburger
  - Rod Ariwte
- WQB
  - Phil Bandy
  - Gerry Winter
- DWR
  - Lin Cambell

DOE-ID
- Mike Bennett
- Paul Allen

EGG

Individuals necessary to address: monitoring and activities at TRA, CFA, RWMC, modeling. Tom Wood, Jon Kaminsky, Buck Sisson, Swen Magnuson

USGS

Individuals to address: surface water-ground water, perched zones, unsaturated zone, RWMC. Larry Mann, John Pittman

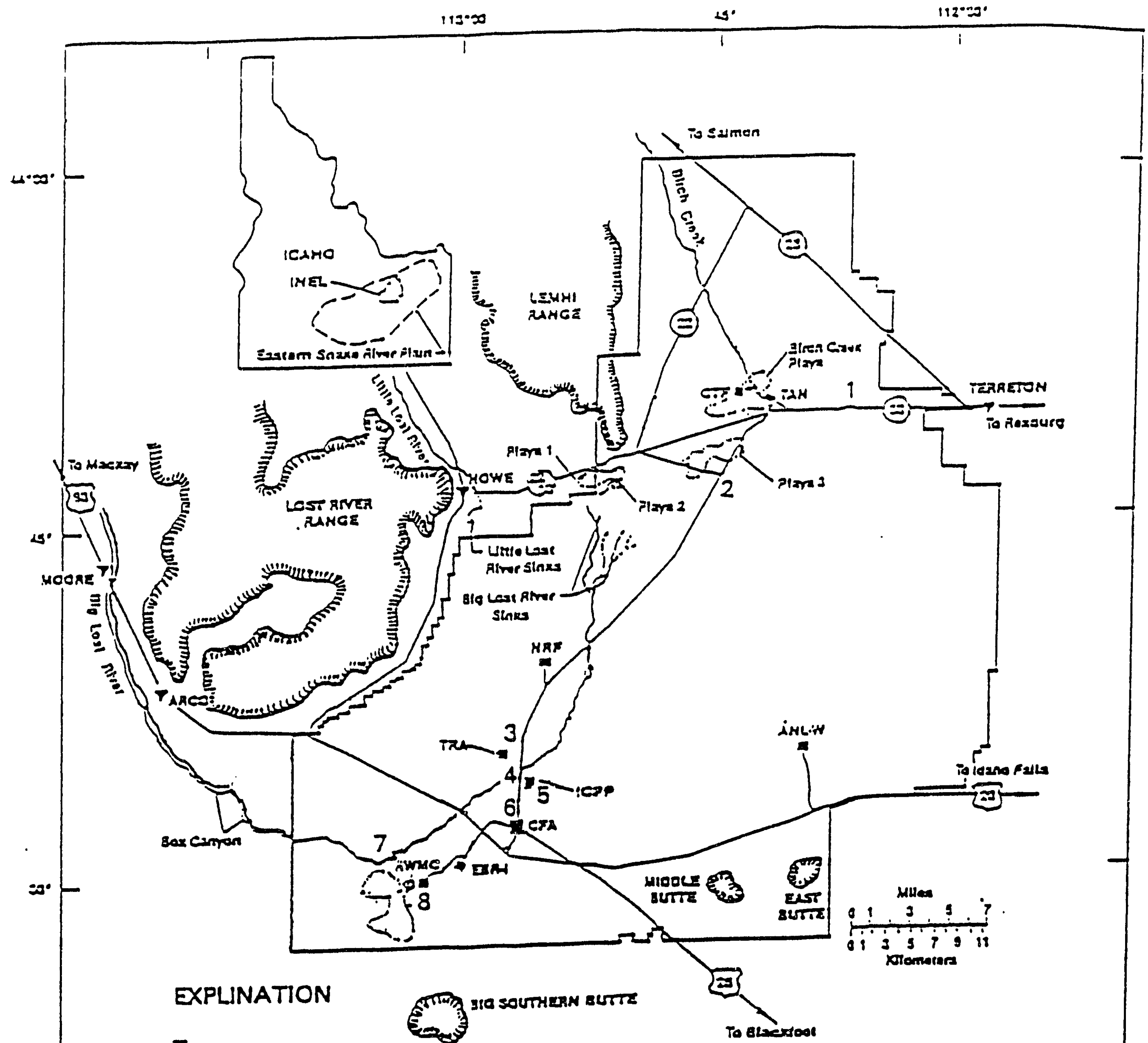
WINCO

Individuals to address: perched zone and modeling at ICPP. Chris Martin, (WINCO), Brent Russel (Golder)

University of Idaho
- George Bloomsburg
- John Finnie
- Dennis Horn
- Behzad Izadi
- Bradley King
- Chyr Pyng Liou

Idaho State University
- Mike McCurry
- Jeanne Jepson

Idaho Geological Survey
- John Welhan



EXPLINATION

▾ Towns

▪ Facilities

ANL-W	Argonne National Laboratory - West		Stops:	
CFA	Central Facilities Area		1	Test Area North/Birch Creek Playa
CTF	Contained Test Facility		2	Big Lost River Playa
EBR1	Experimental Breeder Reactor 1		3	Test Reactor Area
ICPP	Idaho Chemical Processing Plant		4	Big Lost River
NRF	Naval Reactors Facility		5	Idaho Chemical Processing Plant
RWMC	Radioactive Waste Management Complex		6	Central Facilities Area Landfills
TAN	Test Area North		7	Big Lost River Diversion Dam
TRA	Test Reactor Area		8	USGS Test Trench

Figure 1. Map of INEL with stops for Site Visit, 6/27/91 identified.

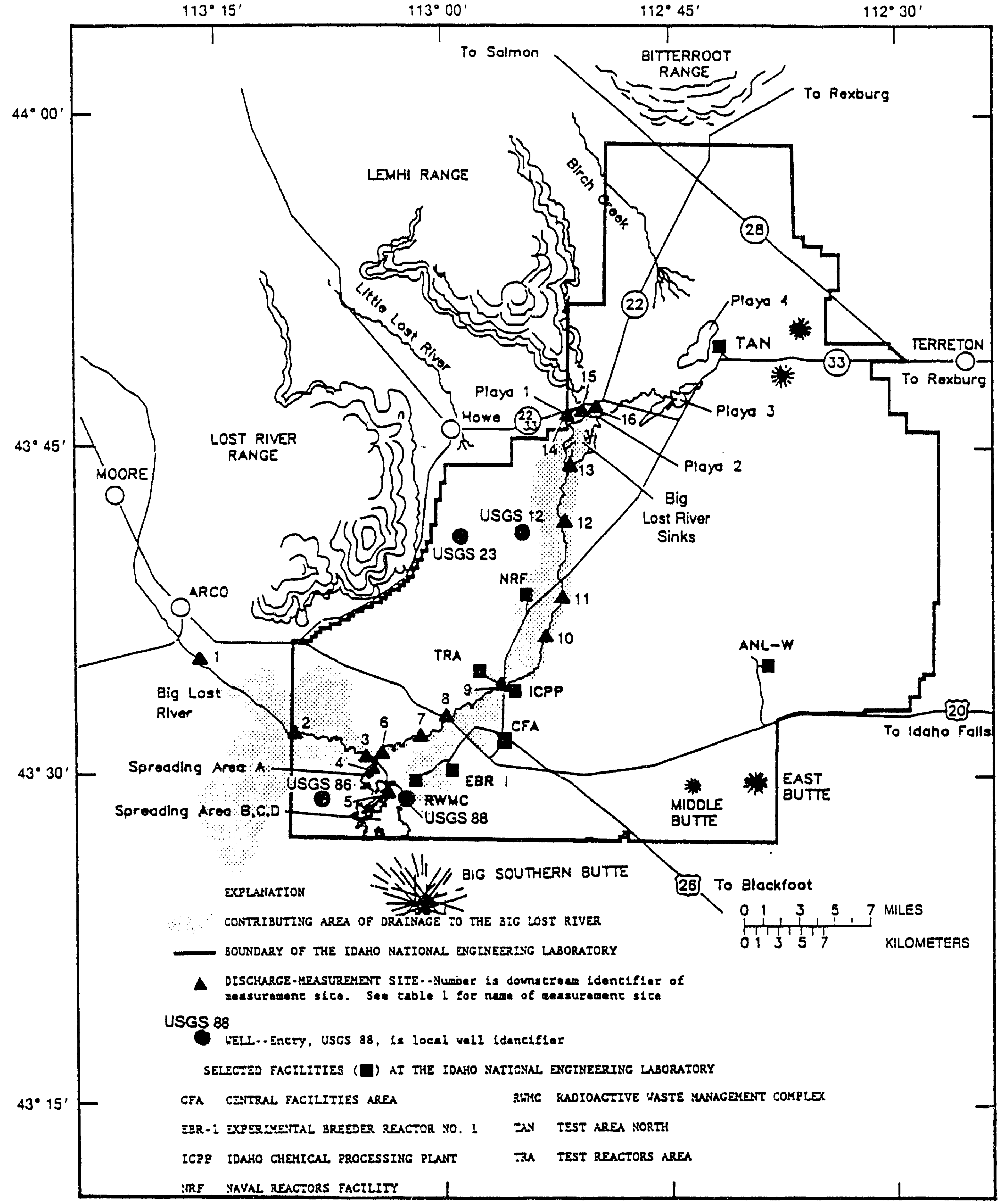


Figure 2.--Location of selected discharge measurement sites, selected wells, and approximate contributing drainage area to the Big Lost River at the Idaho National Engineering Laboratory

Table 11.--Summary of selected physical and chemical characteristics and discharge measurements for Big Lost River stations between Arco and playas 1 and 2, May 6-8 and November 6-7, 1985

[Measurement site No.: see figure 2 for location of measurement sites. °C -- degrees Celsius. µS/cm -- microsiemen per centimeter at 25 degrees Celsius. mg/L -- milligrams per liter. ft³/s -- cubic feet per second.]

Measurement-site No.	Date	Water temperature (°C)	Air temperature (°C)	pH (units)	Specific conductance (µS/cm)	Chloride (mg/L)	Alkalinity as HCO_3^- (mg/L)	Discharge (ft³/s)
1	May 6	10	25	7.8	323	5	188	372
	Nov.6	--	--	--	--	--	--	62.0
2	May 6	12	31	7.9	323	5	185	366
	Nov.6	--	--	--	--	--	--	46.7
4	May 6	--	--	--	--	--	--	25.7
	Nov.6	--	--	--	--	--	--	dry
6	May 6	12	18	7.9	322	5	183	307
	Nov.6	--	--	--	--	--	--	39.8
8	May 7	13	21	8.0	323	5	181	310
	Nov.6	--	--	--	--	--	--	31.0
9	May 7	15	26	7.9	320	5	188	276
	Nov.6	--	--	--	--	--	--	25.0
11	May 7	16	20	7.8	318	5	190	265
	Nov.6	--	--	--	--	--	--	21.7
12	May 7	16	21	7.9	319	5	178	257
13	May 8	12	24	7.8	323	5	--	240
	Nov.6	--	--	--	--	--	--	20.8
14	May 8	18	21	8.5	314	5	154	50
	Nov 7	--	--	--	--	--	--	.58
15	May 8	19	26	8.3	--	--	183	35
	Nov 7	--	--	--	--	--	--	6.21
16	May 8	--	--	--	--	--	--	0
	Nov 7	--	--	--	--	--	--	0

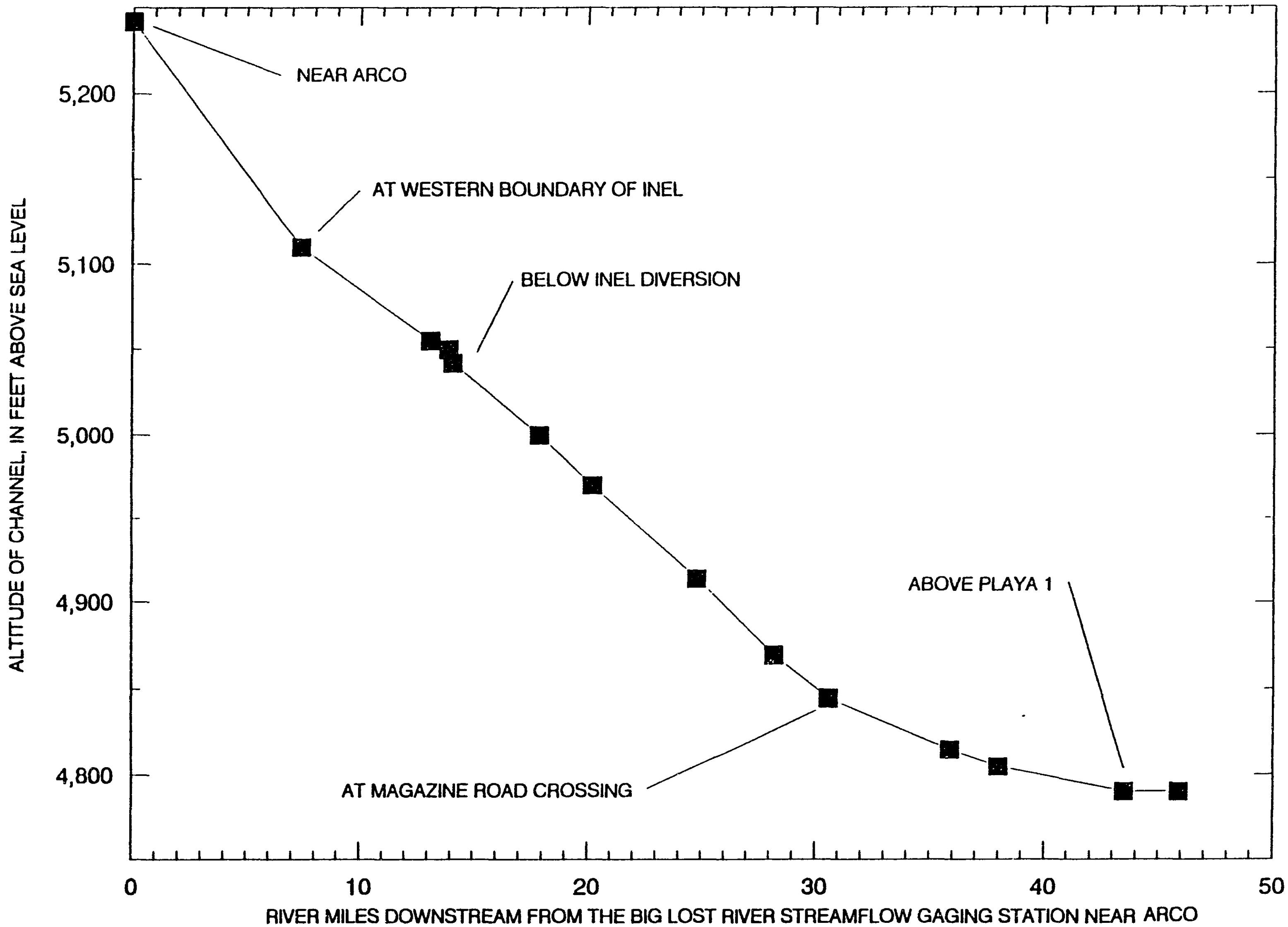


Figure 13.--Gradient of the Big Lost River channel between streamflow gaging stations from Arco to playa 1.

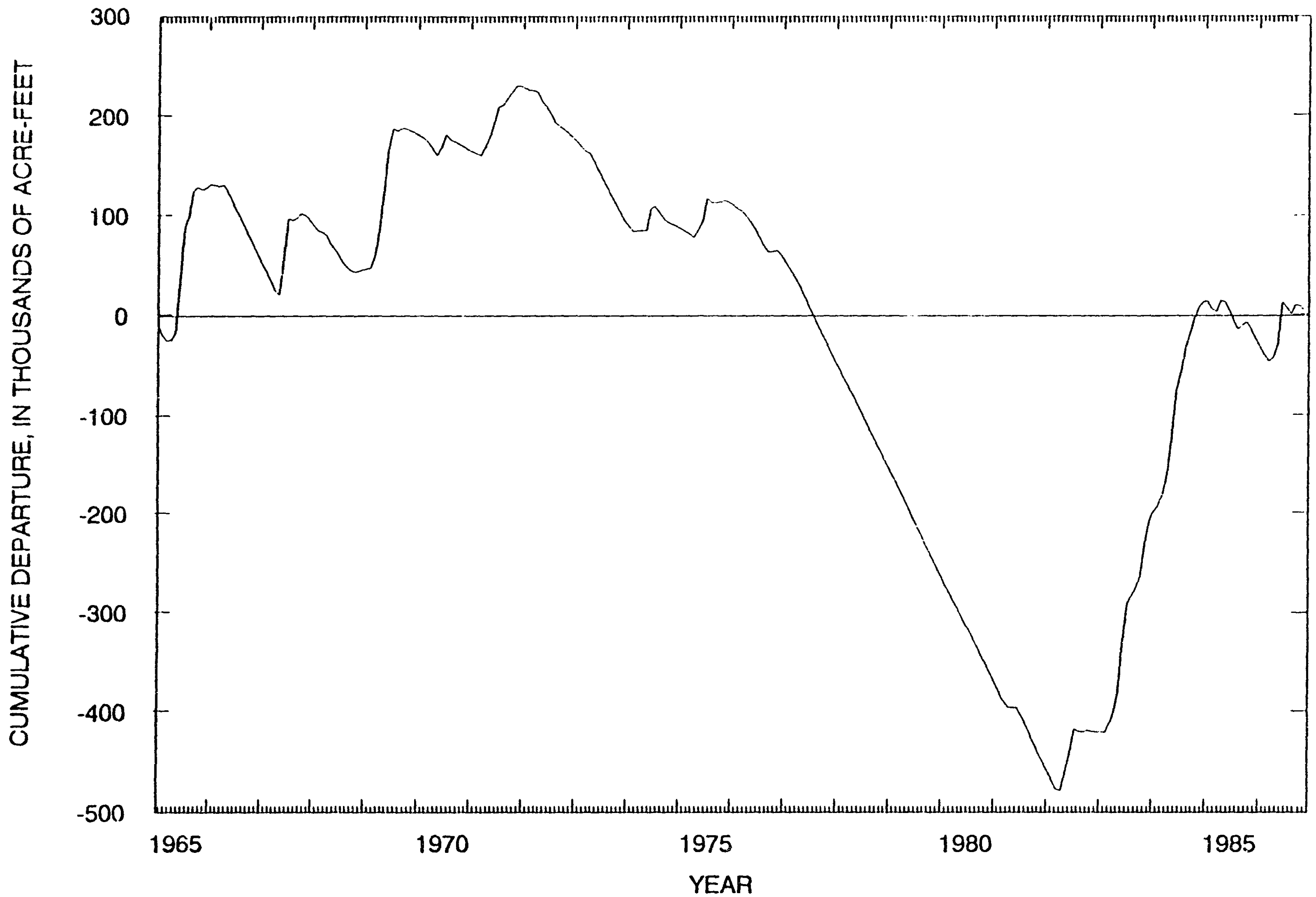


Figure 18.--Cumulative departure from average monthly flow of the Big Lost River below the INEL diversion, 1965-86.

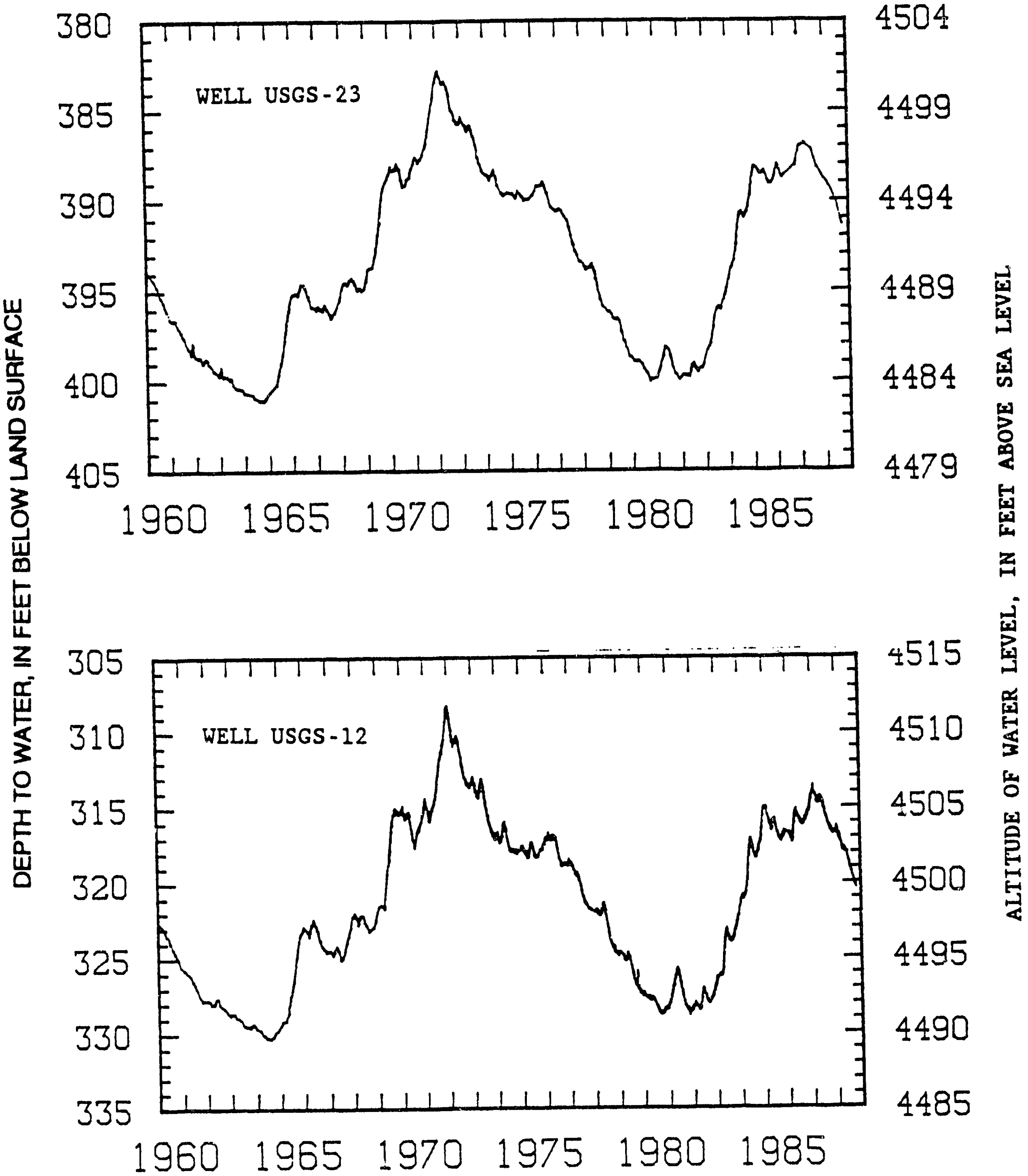


Figure 17.--Water-level hydrographs for wells USGS 12 and USGS 23.

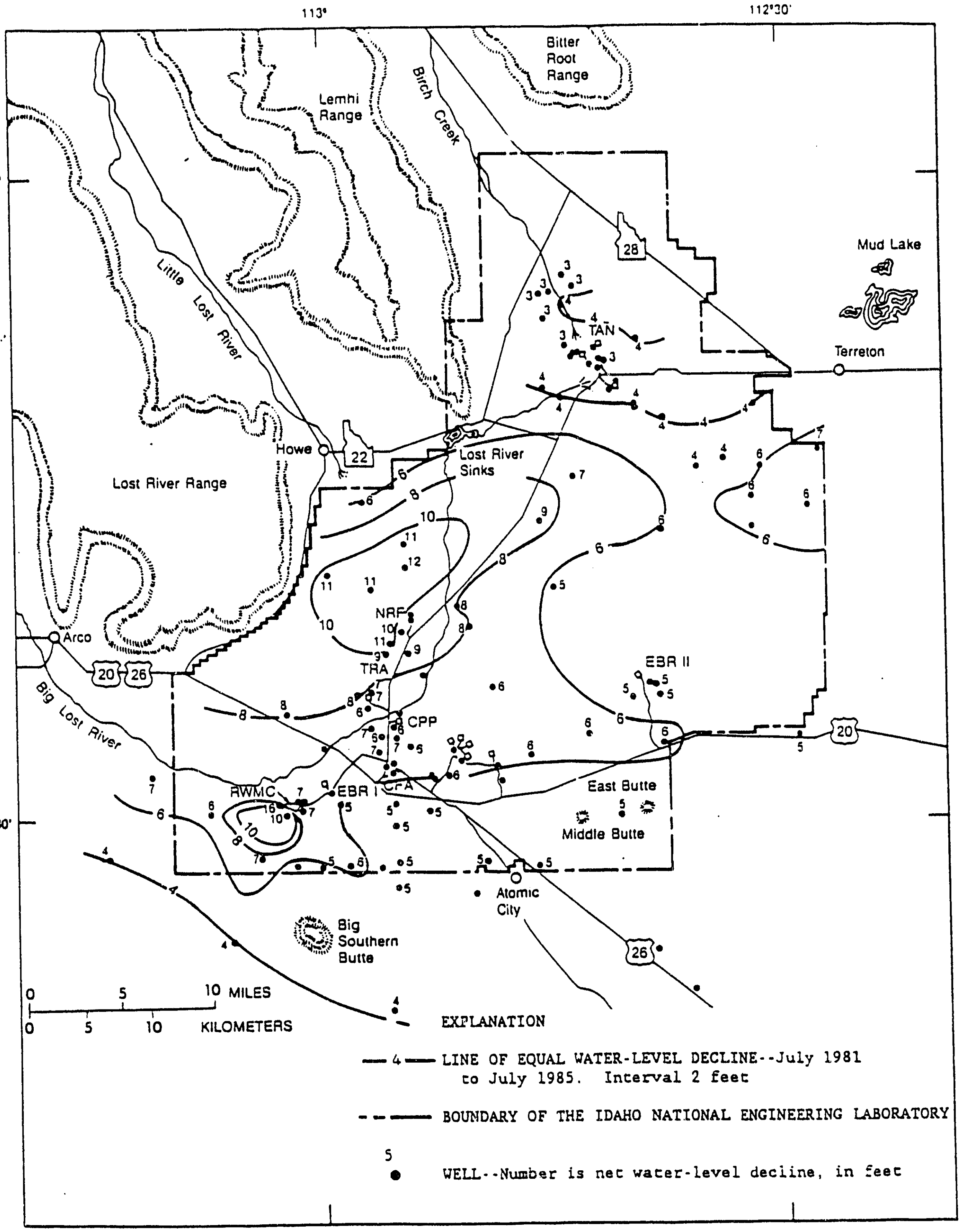


Figure 15.--Generalized net increase of the regional water table, Snake River Plain aquifer, at the Idaho National Engineering Laboratory, July 1981 to July 1985 (from Pittman and others, 1988, figure 10).

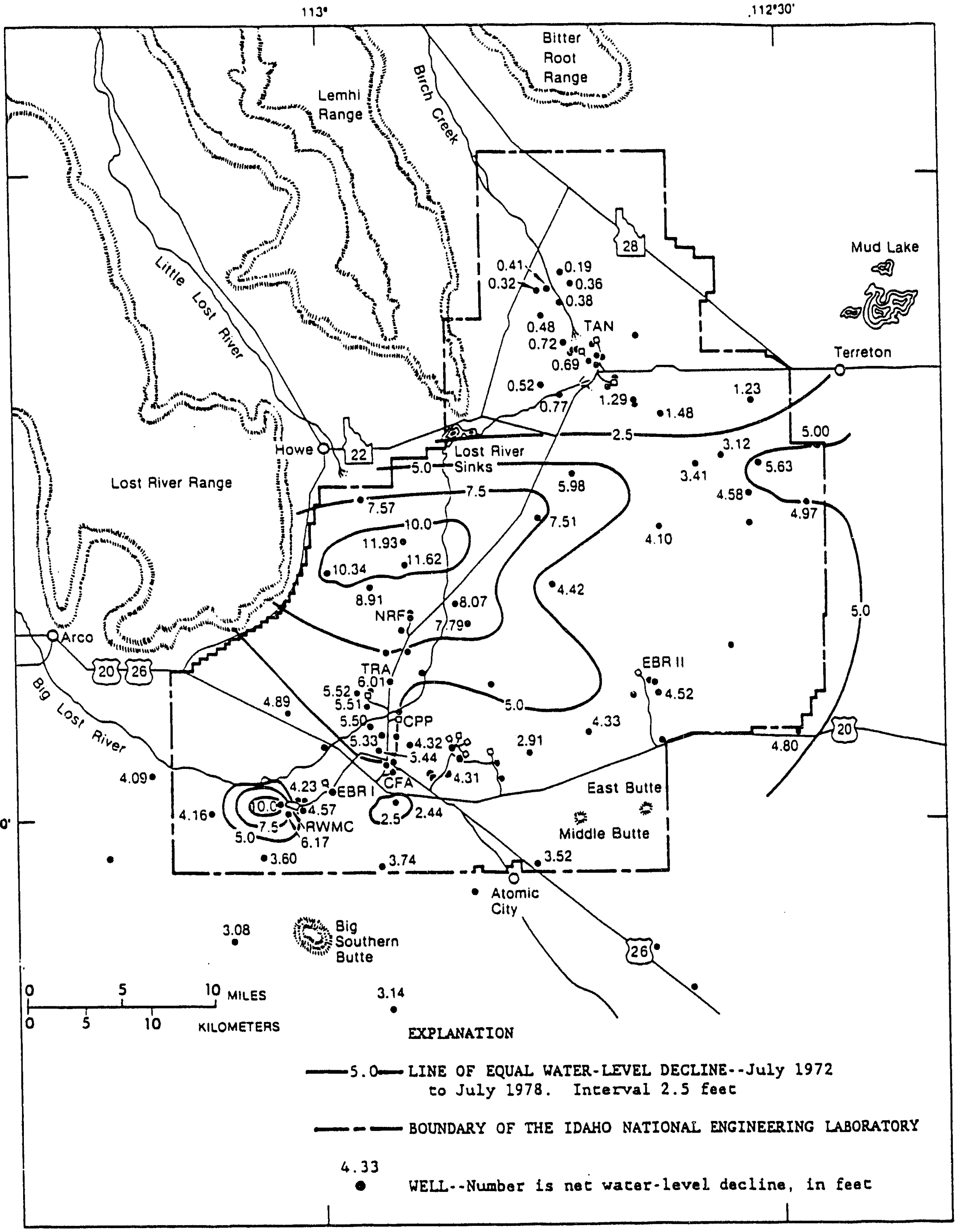


Figure 14.--Generalized net decline of the regional water table, Snake River Plain aquifer, at the Idaho National Engineering Laboratory, July 1972 to July 1978 (from Barraclough and others, 1981, figure 9).

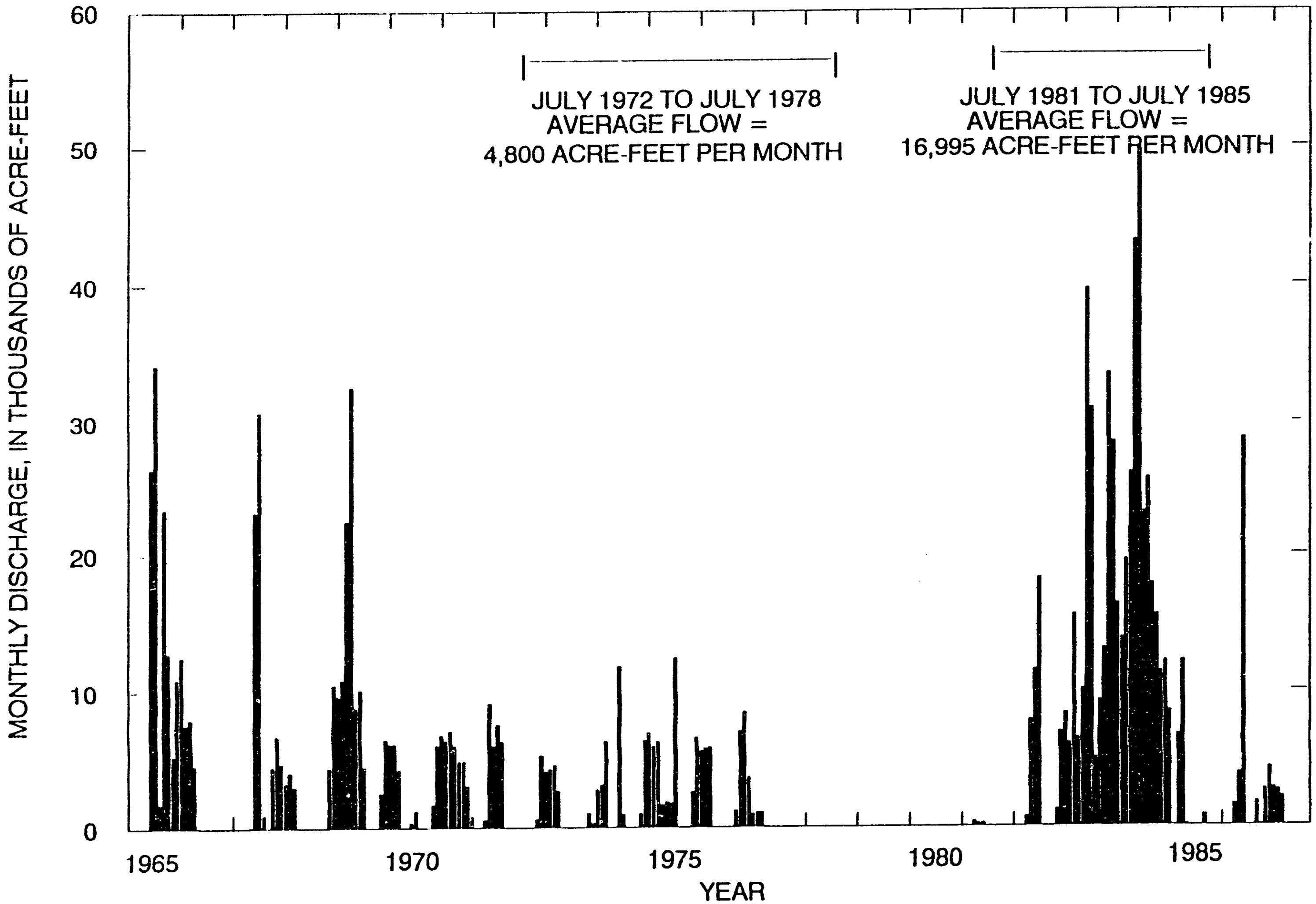


Figure 6.--Monthly discharge from the Big Lost River to spreading areas above the INEL diversion, 1965-87.

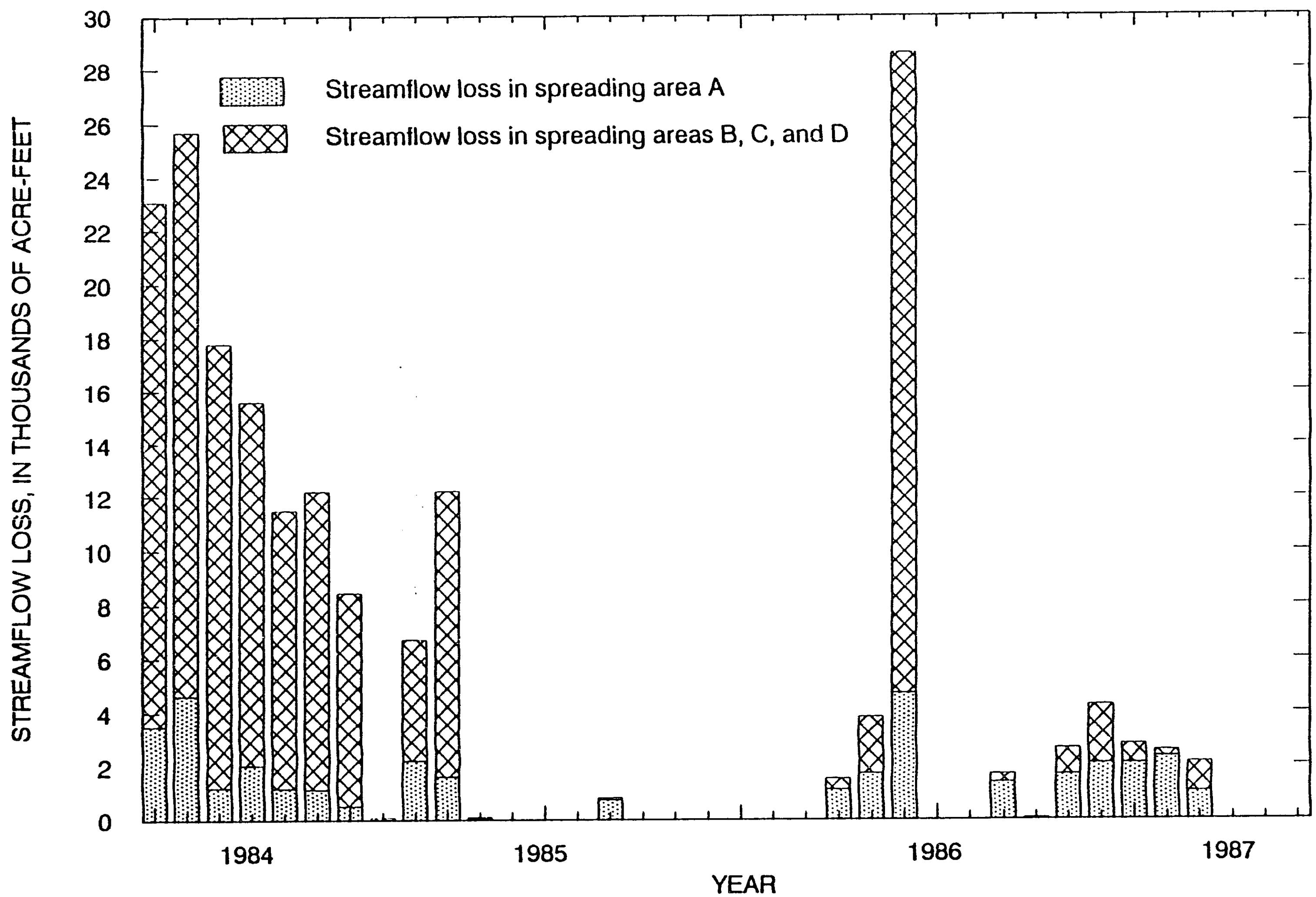


Figure 7.-- Streamflow-infiltration losses between spreading area A and spreading areas B, C, and D, 1984-87.

Partial Summary of Unsatzone Monitoring or Investigations at the INEL:

Test Area North

The TAN has housed a number of projects, among these are the Aircraft Nuclear Propulsion (ANP), Loss of Fluid Test (LOFT), and most recently, the Special Manufacturing Capability (SMC) project. Current prime contractor is Rockwell. Wells were completed in the unsaturated zone to support gas injection work in the 60's - 70's. There are also augering surrounding disposal ponds. Auger holes were completed around ponds within TSF disposal pond with perched water being found in at least two of the borings.

1988: Surface soil samples were collected from around infiltrations ponds within TSF disposal ponds. Borings B-1 - 4 were planned for 1989.

IDO-22049 1966, Baraclough, J.T., W.E. Teasdale, and R.G. Jensen; Hydrology of the National Reactor Testing Station.

EGG-ER-8405 Closure Plan for the Test Area North Technical Support facility Disposal Pond (COCA Unit TSF-07)

Naval Reactor Facility

The NRF is operated by Department of Defence and includes reactors and reactor mock-ups to train personnel for naval reactor operations.

1965: 4 holes were augered at the NRF sewage lagoons, wells 65-1 - 4. Wells were completed with PVC. All were dry.

IDO-22048 1965, Baraclough, J.T., W.E. Teasdale, and R.G. Jensen; Hydrology of the National Reactor Testing Station.

Test Reactor Area

TRA is operated by EG&G. At the TRA, dilute chemical and radioactive wastes have been disposed of in surface ponds since 1952. Perched water bodies have formed as a result. Perched water has been identified at approximately 50 and 110 ft depths.

1960-61:	19 cable-tool hole were completed between 100 - 210 ft. USGS-53 - 56, 60 - 64, 68 - 75, 78, 80.
1962:	26 augered holes were completed with 2" pipe, slotted last 5 feet, to the basalt-sediment interface, A-1 - A-26.
1963:	18 augered holes were completed with 2" pipe, slotted last 5 feet, to the basalt-sediment interface, A-27 - A-42.
1965:	18 augered holes were completed with 2" pipe, slotted last 5 feet, to the basalt-sediment interface, A43 - A-60.
1968:	27 augered holes were completed with 2" pipe, slotted last 5 feet, to basalt-sediment interface, A-61 - A-88.
1982:	9 augered holes were completed to the basalt-sediment interface around the Cold Waste Pond, CWP1 - 9.
1986:	6 air-rotary holes completed in the lower perched zone, about 140-200 ft, PW-1, 5 - 9.
1990:	Wells PW-10 through PW-14 were drilled, probably air-rotary. The SB- series of holes were augered and completed at the basalt-alluvium interface, 1990. Perched water was found in SB01,2, and 4.

Wells A-1 - A-88 surround the Warm and Chemical Waste Ponds, Wells CWP-1 - 9 surround the Cold Waste Ponds, Wells PW-1 - 14 are distributed across the inferred extent of the sedimentary interbeds forming the deeper perched zone, TRA-ICPP area. Wells are monitored on quarterly to annual basis by USGS and EGG ERP. A number of these wells are dry. Diesel product was encountered during drilling of PW-13.

Idaho Chemical Processing Plant

The ICPP is operated by Westinghouse Idaho Nuclear Inc. (WINCO). Wastes from fuel reprocessing are treated and stored at the Tank Farm within the ICPP. Service wastes are disposed of in infiltration ponds. Perched bodies have formed as a result of previous disposal activities, leaks, and failure of the waste injection well. Most radioactive wastes were disposed of through injection directly to the aquifer until the practice was discontinued in 1984. Use of percolation ponds, beginning in 1984, resulted in formation of significant perched water. Perched water has been encountered in three zones, the basalt-surficial sediment interface, approximately 110 ft, and 330 ft.

1983: At least 12 holes were augered to the basalt-sediment interface around the percolation ponds. These wells have been destroyed. CCP A1-12

1983-84 approximately 50 holes were augered to the basalt-sediment interface around the percolation ponds. SWPP-1 - 27, a.

1986: 3 air-rotary holes completed in the lower perched zone, about 140-200 ft, PW-2,3,4

1990: Boreholes 1 - 5 have were completed immediately surrounding the Tank Farm. At least 4 were to be completed with vacuum lysimeters, 2 at the surfical sediment-basalt interface about 40 ft. depth, and at least 2 completed in the basalt above the 110 ft. sedimentary interbed.

The USGS and WINCO's contractor, Golder and Assoc. sample perched waters in the vicinity of the ICPP. One perched well was noted as being monitored quarterly in a 1965 USGS report.

IDO-22044 1962, Hydrology of Waste Disposal, NTRS; Annual Progress Report

IDO-22048 1965, Barraclough, J.T., W.E. Teasdale, and R.G. Jensen; Hydrology of the NRTS

Central Facilities Area Landfills

Neutron access tubes, augered holes instrumented with heat dissipation sensors, salinity sensors, and gas sampling ports were installed, 1987-88 to aid in the hydrologic characterization of Landfills II and III.

1987-88: 5 neutron access tubes installed by driving to approximately the basalt interface, 18-24 ft depth. One tube is completed through landfill wastes. Nine holes 11 - 31 ft depth were completed with: heat dissipation blocks installed at 5 ft intervals, salinity blocks installed at the base and 5 ft above the base of the augerings, and gas sampling ports were installed at the base of the holes. Two holes were completed by driving through wastes at LF-2. These holes have single completions at the base of the holes, below wastes.

Materials testing was conducted for augerings concurrent with completions. There are also At least 5 wells completed in the aquifer at these locations.

Data collection monthly from neutron access tubes, heat dissipation blocks, and salinity blocks beginning in January 1988 and continued until January 1991. Data has not been used and currently resides in Dbase 3 format.

EGG-ER-8291 1988, Ansley, S.A., L.C. Hull, and S.M. Burns; Shallow drilling report for Landfills II and III, FY-88, Characterization of surficial sediments.

EGG-ER-8496 1989, Wood, T.R., L.C. Hull, and M.H. Doornbos; Groundwater monitoring plan and interim status report for Central Facilities Area Landfill II

EGG-ER-8521 1989, Wood, T.R., L.C. Hull, and M.H. Doornbos; Groundwater monitoring plan and interim status report for Central Facilities Area Landfill III

Radioactive Waste Management Complex

Subsurface disposal at the RWMC began in 1952. The facility is operated by EG&G and has received low-level and mixed- wastes from site activities and other DOE operations. Perched water bodies are present. Current investigations focus on remediation of volatile organics and characterization of vadose zone soils and basalt.

1975: Wells 93A, 96A, and 96B were drilled to approximately 230 ft, being cored from about 30 ft. to 230 ft depth. Bores were then cemented.

1976-77: Wells 76-1 - 6 were drilled to about 250 ft depth and then backfilled with cement to the surface. Cores and water encountered were sampled. Well 77-1 was cored to 600 ft depth, and then cemented back to 400 ft depth an completed with gas-samplers., 77-2 was completed at perched water, 87.7 ft.

1978-79: Wells 78-1 79-3 are completed to about 80 ft, wells 78-2,3 and 79-1,2 are completed to the 240 ft. interbed, well 78-4 is compiled to 350 ft. interbed. Wells 78-4 and 79-2 were completed with gas-sampling ports in 1988-89.

1985-86: 2 test trenches were installed in 1985. Trenches were instrumented with thermocouple psycrometers, temperature sensors, and tensiometers. Neutron probe access tubes were installed adjacent to the trenches. A weather station was also installed.

1988-89: 5 wells, 8801D,T, 8802D, 8901D, and 8902D were drilled to about 250 ft and completed with multiple gas-sampling ports. Well 8901D was completed as the vapor-vac. extraction well.

1989: Well WWW-1 was completed with gas sampling ports.

TREE-1171 1978, Humphrey, T.G., and F.H. Tingey, The subsurface migration of radionuclides at the RWMC

EGG-WM-9301, 1991, Sisson, J.B., and G.C. Ellis, Summary Report of Results of the Vapor Vacuum Extraction Test at the RWMC.

A SUMMARY OF HYDROGEOLOGIC TASKS

AT THE

IDAHO CHEMICAL PROCESSING PLANT

HYDROGEOLOGIC INVESTIGATION TASKS

CURRENT INITIATIVES

- COMPREHENSIVE GROUNDWATER MONITORING PLAN IN DRAFT.
- REQUISITION TO CONDUCT GEOTECHNICAL TESTING OF TANK FARM CORES HAS BEEN ISSUED.
- PENDING VALIDATED RESULTS FROM SECOND SAMPLING OF RCRA GROUNDWATER MONITORING FROM PERCHED WATER, AND EXISTING WELLS.
- PRELIMINARY CONCEPTUAL MODEL FOR GROUNDWATER FLOW THROUGH THE VADOSE ZONE.
- PRELIMINARY FENCE DIAGRAM AND CROSS-SECTION OF THE TANK FARM AREA:
  INITIAL REVIEW SHOWS A CORRELATION BETWEEN THE UPPER BASALT SURFACE (40' BLS) AND THAT AT 110 FEET BLS.

HYDROGEOLOGIC INVESTIGATION TASKS

CURRENT INITIATIVES
(CONTINUED)

- PREPARED A GROUNDWATER FIELD SAMPLING PROCEDURE
- COMPLETED EVALUATION OF AVAILABLE BACKGROUND DATA FOR THE ICPP
- CONTINUING SITE CHARACTERIZATION AND SUBSEQUENT SUBSURFACE DATA COLLECTION.
- INSTALLATION AND SAMPLE COLLECTION FROM POROUS CUP LYSIMETERS IN UNSATURATED INTERBED MATERIAL, AND INITIAL SOIL/BASALT INTERFACE.

HYDROGEOLOGIC INVESTIGATION TASKS

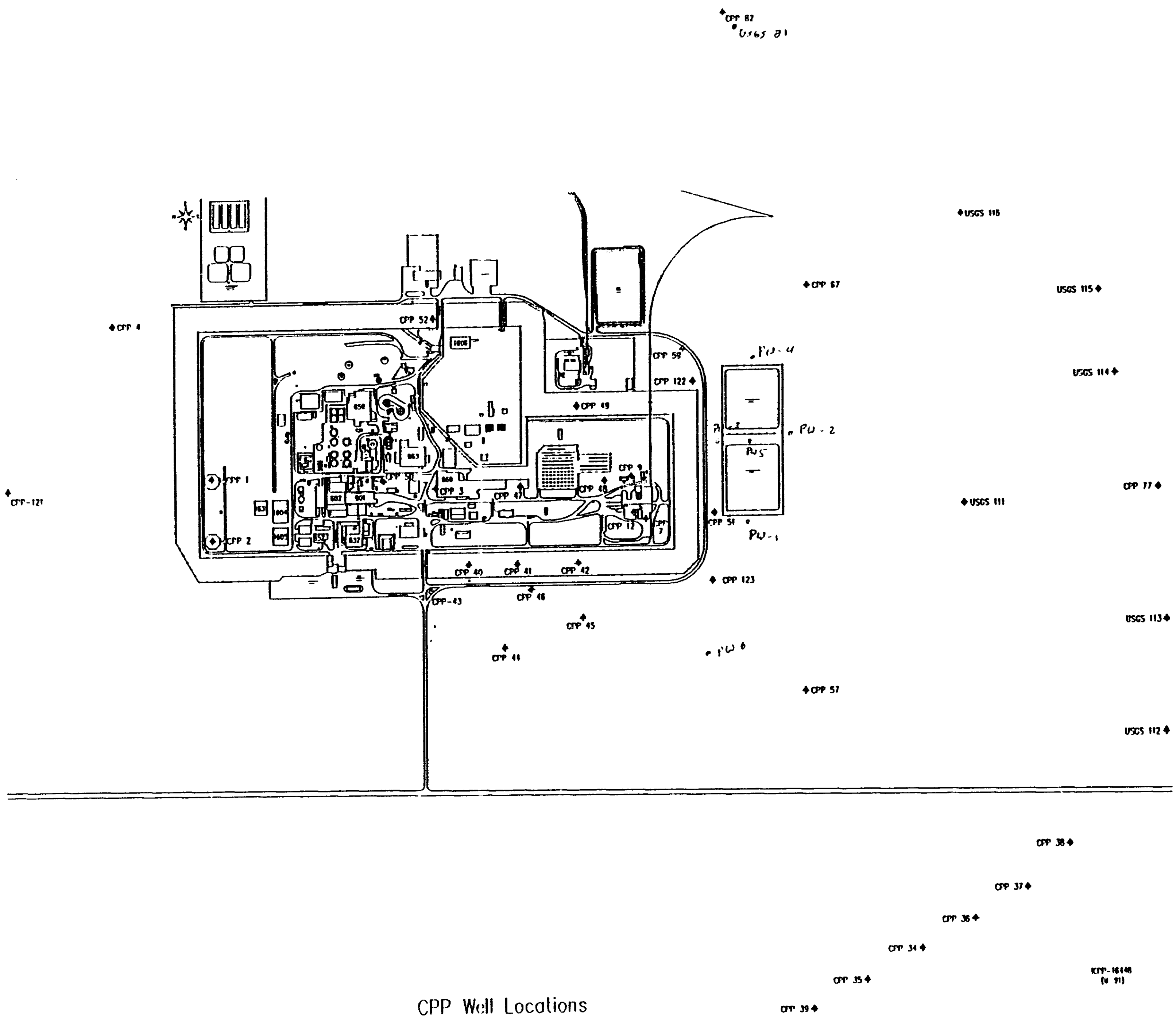
PLANNED INITIATIVES

- CONTINUE INVESTIGATION OF PERCHED WATER AT THE 110' LEVEL WITH CHARACTERIZATION ACTIVITIES.
- COMPLETE COMPREHENSIVE GROUNDWATER MONITORING PLAN.
- COMPLETE WELL EVALUATION SO THAT AN ISSUE PAPER CAN BE PREPARED, AND WAIVER FROM THE STATE OF IDAHO ON ACCEPTABILITY OF CONSTRUCTION OBTAINED.
- DEVELOP HYPOTHESIS REGARDING CONTAMINATION OBSERVED AT 110' BLS AND FORMULATE TESTS TO EVALUATE (E.G. PERCHED WATER WELL PUMP/INTERFERENCE TESTS)

HYDROGEOLOGIC INVESTIGATION TASKS

ITEMS FOR RESEARCH CONSIDERATION

- VADOSE ZONE MONITORING, WITH EMPHASIS ON FRACTURED MEDIA.
- EVALUATION OF GEOPHYSICAL TECHNIQUES:
  - RESENT RESULTS SUGGEST THAT NEW TECHNIQUES MAY PROVIDE MORE INFORMATION THAN PAST METHODS HAVE PROVIDED.
- FATE AND TRANSPORT OF CONTAMINANTS (E.G. SORPTION COEFFICIENTS) IN THE VADSOSE AND SATURATED ZONES:
  - OF INTEREST TO THE ICPP ARE RADIONUCLIDES AND HEAVY METALS (CR, HG, PB, CD)
- FRACTURE FLOW CHARACTERISTICS OF THE AQUIFER:
  - FLOW VELOCITY AND DIRECTION
  - DELINEATION OF SPECIFIC FLOW ZONES
- HORIZONTAL DRILLING TECHNIQUES FOR:
  - CHARACTERIZATION
  - FRACTURE DENSITIES AND ORIENTATIONS
  - REMEDIATION OF THIN PERCHED ZONES



CPP Well Locations

TRA Facilities, Waste Streams and Environment
INEL Oversight Program R&D 2&3 Site Visit
June 26-28

Operating or operable reactors:

Advanced Testing Reactor, (ATR)
Advanced Testing Reactor, Critical (ATRC)

Reactors in standby condition or decommissioned:

Engineering Testing Reactor, (ETR)
Engineering Testing Reactor, Critical (ETRC)
Materials Testing Reactor

The TRA can be divided into a reactor and a limited area. The reactor area contains the ETR, ATR, ATRC ETRC facilities, and two Advanced Reactivity Measurement Facilities (ARMF), along with their supporting offices, warehouses, and maintenance facilities. The Limited areas contain non-nuclear support and utility facilities.

The MTR is the oldest INEL test reactor, beginning operation in 1952 and was shutdown in 1970. The ETR facility began operation in the late 1950's with the last testing concluding in 1981. The facility is now inactive. The ATR facility achieved full power in 1969, and is currently in operation. These facilities were designed to test the effects of high neutron flux on structural and fuel materials under simulated operating conditions. The high neutron flux produced provides for production of radioisotopes and fundamental experimentation in nuclear physics.

Waste Streams:

Currently, liquid wastes are disposed of in four separate ponds, the Warm Waste Pond, Cold Waste Pond, the Chemical Waste Pond, and the Sanitary Waste Pond.

The **Warm Waste Pond** is a collection of three connected cells constructed 1952, 1957, and 1964. These cells received all non-sanitary liquid waste streams from 1952 - 1962. After 1962, wastes from the demineralization plant and other cold waste stream were directed to the Chemical Waste pond, leaving just the radioactive waste stream as effluent.

The radioactive waste stream includes tritium as titrated water is the most abundant radionuclide, followed in order by ^{51}Cr, ^{60}Co, ^{90}Sr, and ^{137}Cs. Chromium was used as a corrosion inhibiter from 1952 - September 1972. After this time and up to the present, a phosphate-based corrosion inhibitor is used. Historically, Discharge to the pond exceeded 400 gpm and 3,000 Ci per year. Current discharge is approximately 4.5 gpm and 300 Ci per year.

INEL - RADIOACTIVE WASTE MANAGEMENT COMPLEX (RWMC)

RWMC -

- Established in 1952
- 144 acre site
- RWMC consists of:
  - 56 acre Transuranic Storage Area (TSA)
  - 88 acre Subsurface Disposal Area (SDA)

DISPOSAL AND STORAGE HISTORY AT THE RWMC

- <u>SDA</u>

1952 - 1970	Boxes and drums of TRU and LLW buried in numerous shallow pits and trenches
After 1970	Only LLW buried at the SDA

An estimated total of 6.3 million cubic feet of TRU and LLW were buried at the SDA. In addition, about 88,400 gallons of liquid hazardous waste disposed at SDA prior to 1970; consisting of carbon tetrachloride, lubricating oil and other organic compounds such as trichloroethylene. Also, an unknown volume of acid liquid was disposed of in the acid pit.

- <u>TSA</u>

After 1970	TRU waste stored in drums in above-ground pads on an interim basis until they can be shipped to a permanent federal repository.

WASTE DEFINITIONS

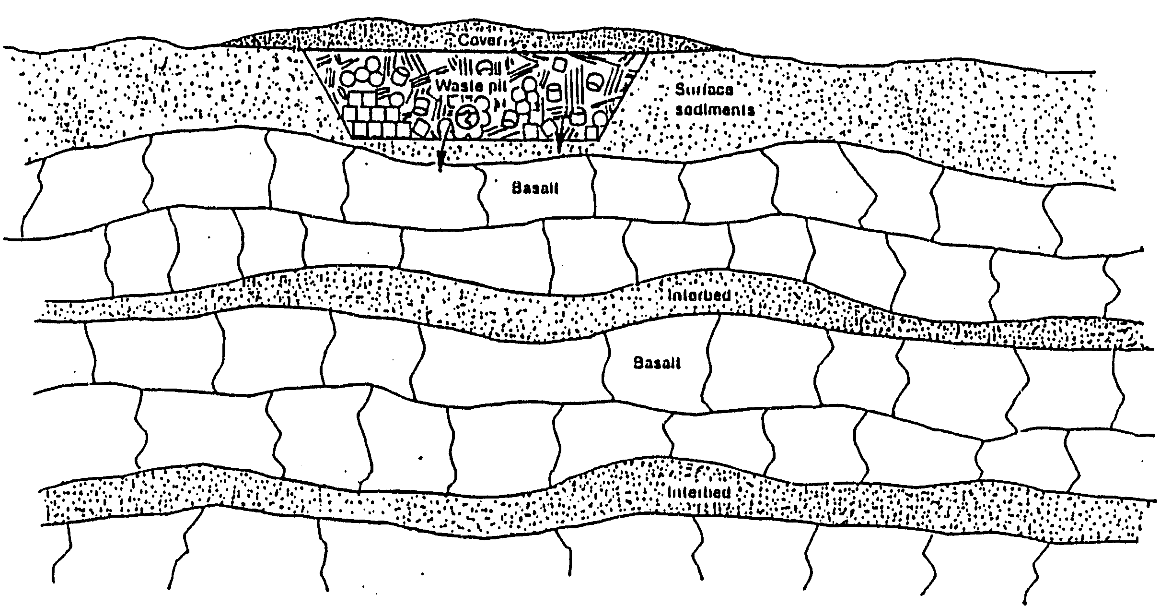
- Low-level Waste (LLW) - Contaminated equipment, paper, rags and similar materials with low to moderate levels of beta- and gamma radiation that decay within a few hundred years to levels normally existing in the environment.

- Transuranic (TRU) Waste - Waste containing alpha-emitting radioactive elements heavier than uranium (i.e., with an atomic number greater than 92). Radioactivity may take up to hundreds of thousands of years to decay. Produced primarily from reprocessing spent reactor fuel and from the use of plutonium in fabrication of nuclear weapons.

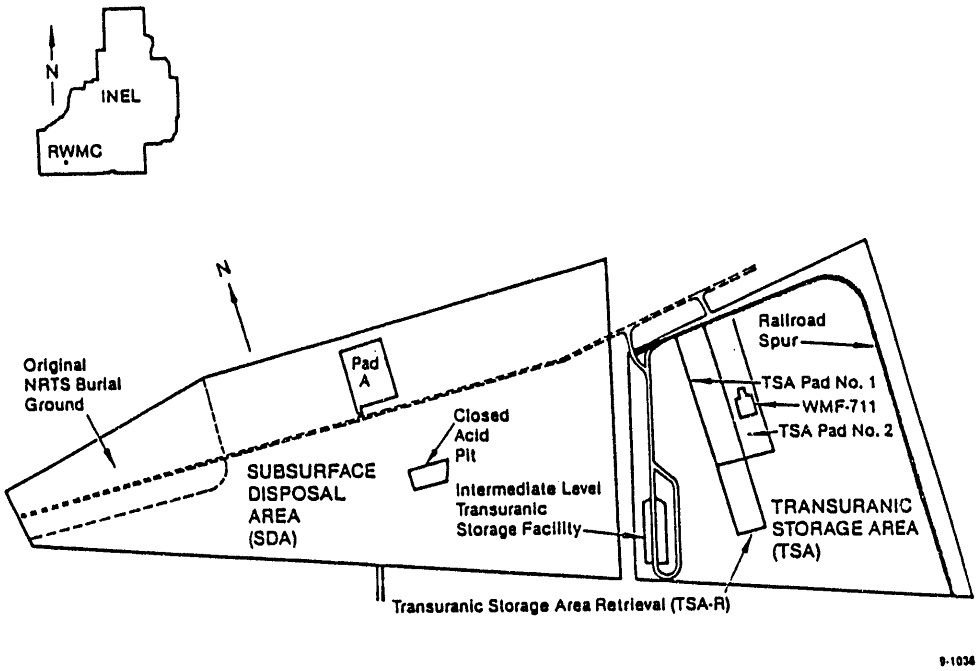
- Mixed Waste - Radioactive waste that also contains hazardous chemical wastes such as volatile organics and metals.

REMEDIAL TECHNOLOGIES UNDER CONSIDERATION

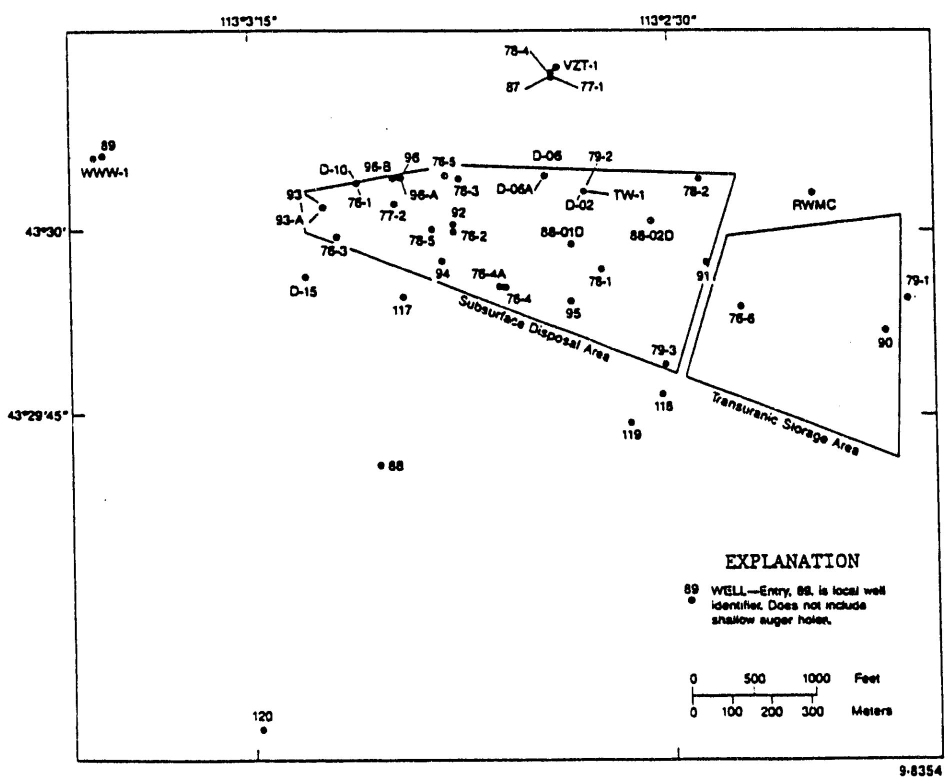
Remedial Technology	Target Wastes
In Situ Vitrification	Mixed Wastes/organics
Vapor Vacuum Extraction	Volatile organics
Thermal Processes	Mixed waste/organics
Robotic Technologies	Materials handling/remote drilling
Cryogenics (i.e., freezing)	Containment of wastes
Separation Techniques	Materials handling
Pump-and-treat groundwater	Metals and organics
Mining technology and processing with selective extraction techniques	Metals/mixed waste



Conceptual cross section of interbedded sediments and basalts beneath the SDA.



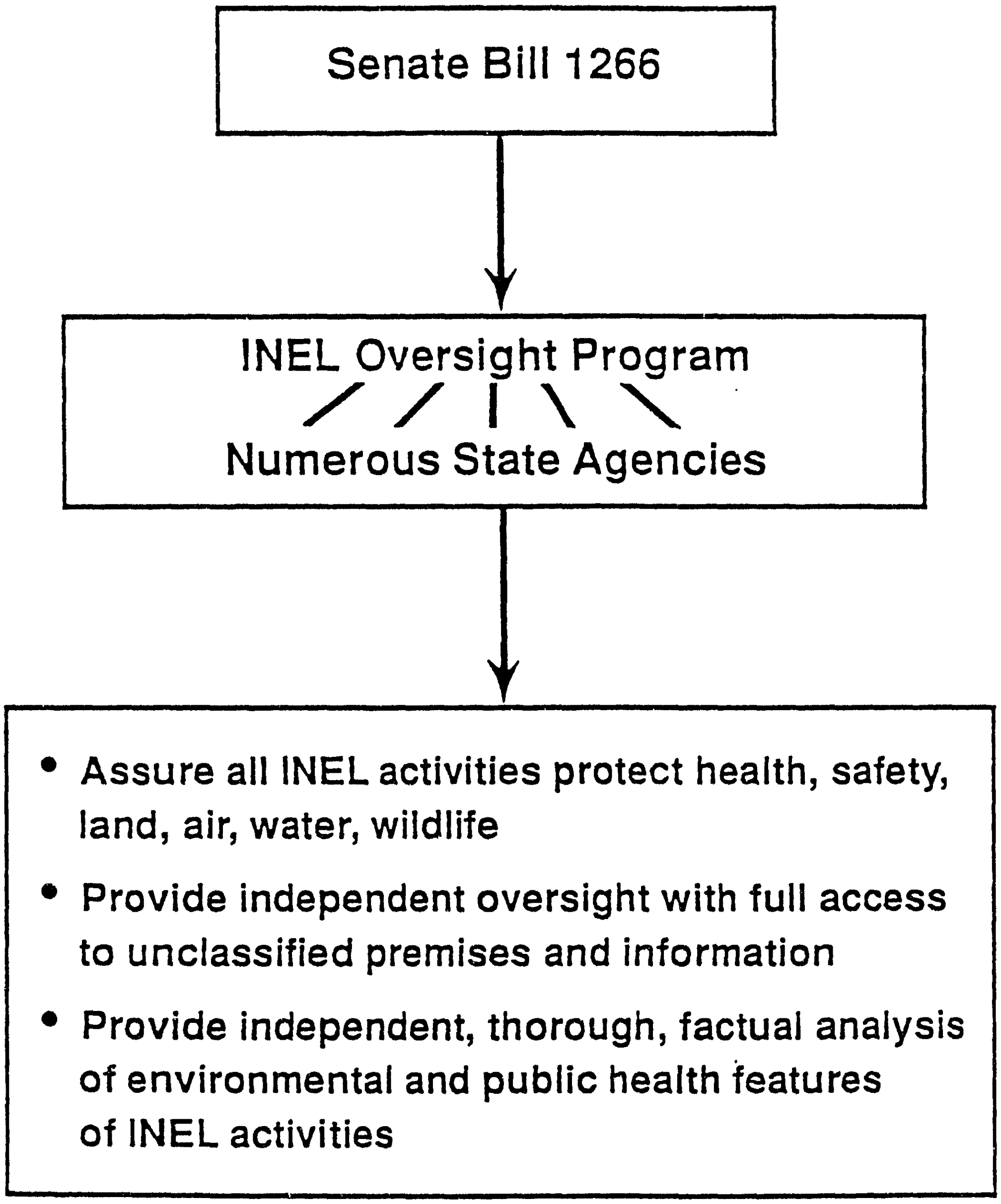
Layout of the RWMC.

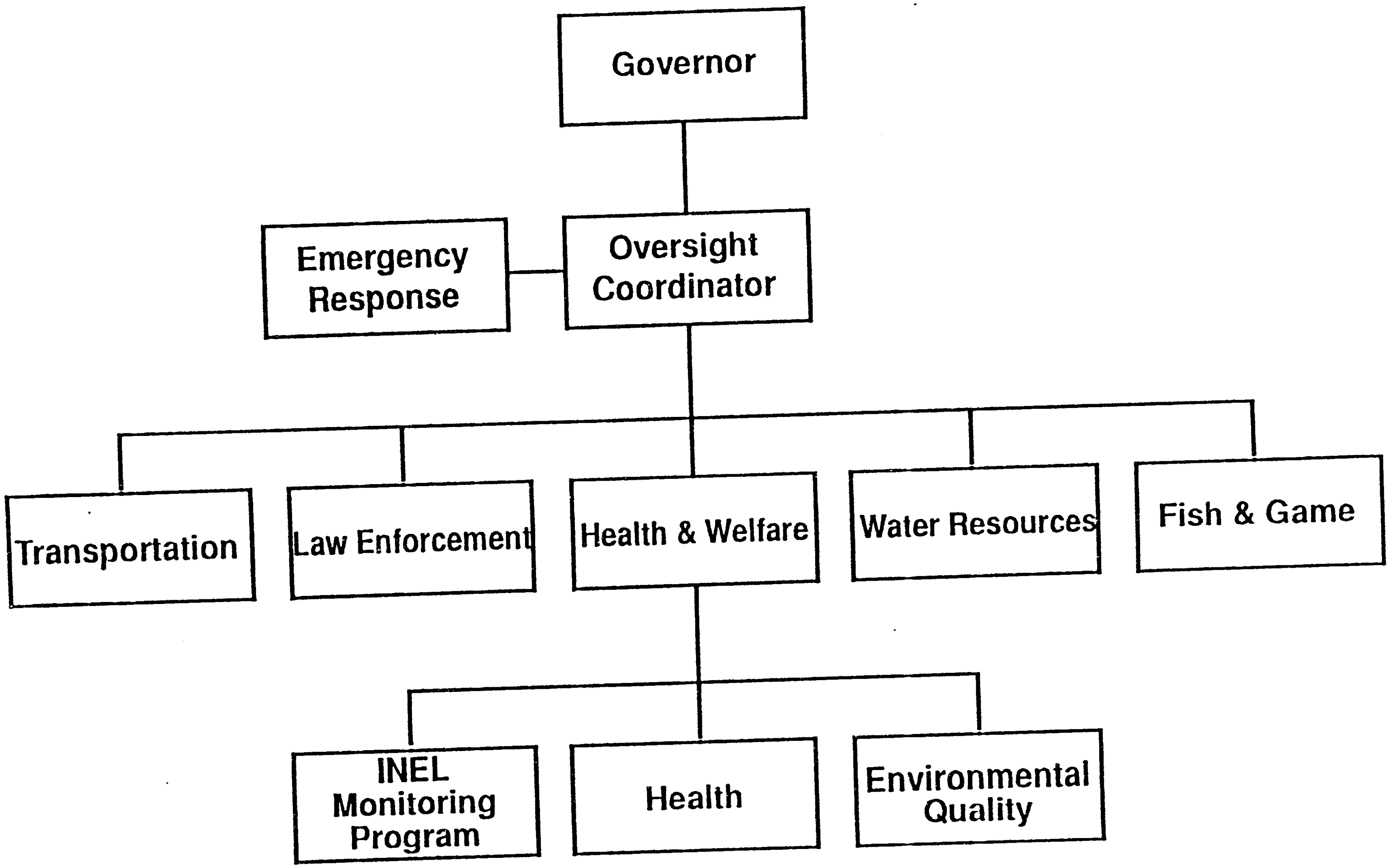


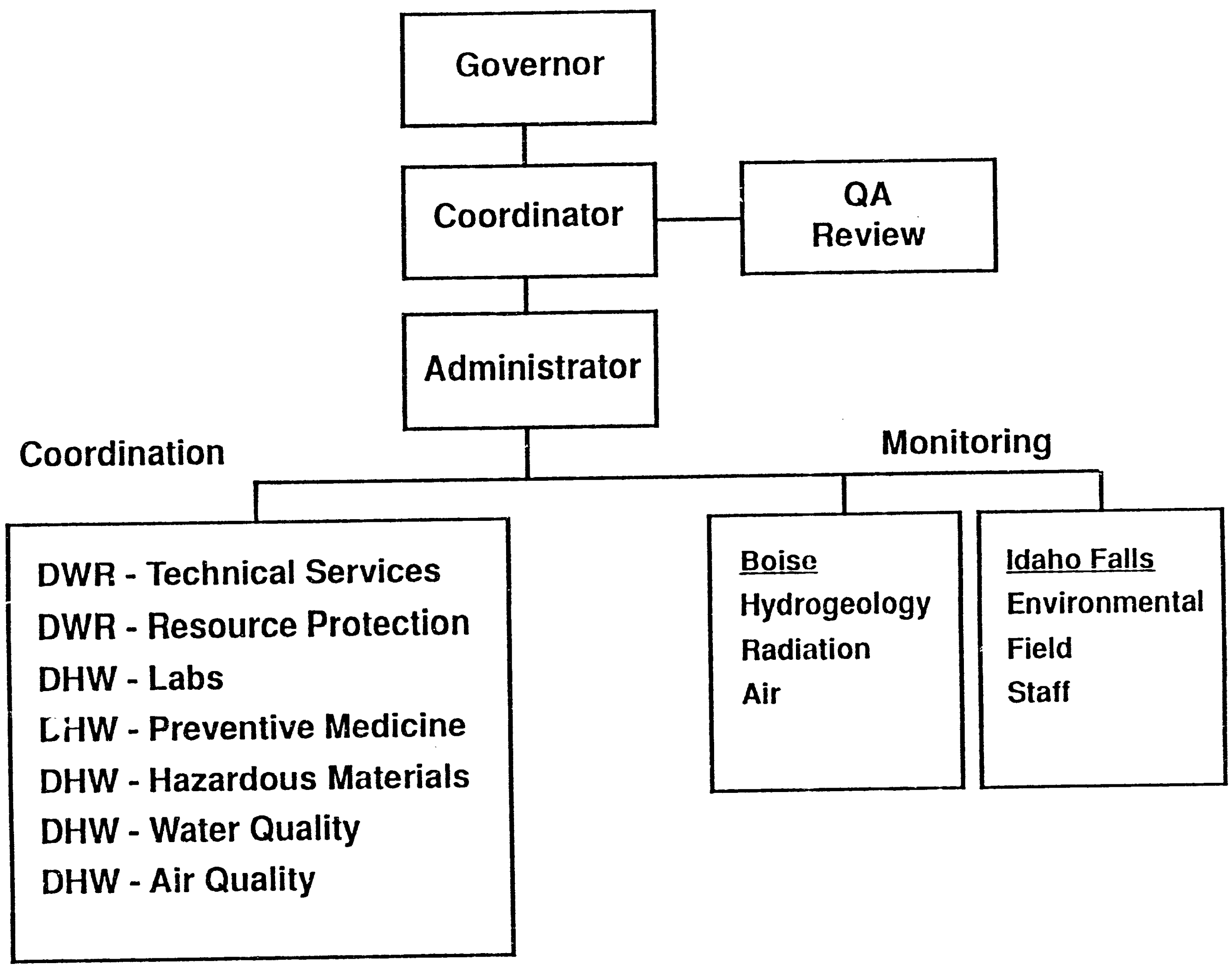
--Location of wells at the Radioactive Waste Management Complex.

State of Idaho

INEL OVERSIGHT PROGRAM


Senate Bill 1266
INEL Oversight Program
Numerous State Agencies
• Assure all INEL activities protect health, safety, land, air, water, wildlife
• Provide independent oversight with full access to unclassified premises and information
• Provide independent, thorough, factual analysis of environmental and public health features of INEL activities


Governor
Oversight Coordinator
Emergency Response
Transportation
Law Enforcement
Health & Welfare
Water Resources
Fish & Game
INEL Monitoring Program
Health
Environmental Quality


Governor
Coordinator
QA Review
Administrator
Coordination
Monitoring
DWR - Technical Services
DWR - Resource Protection
DHW - Labs
DHW - Preventive Medicine
DHW - Hazardous Materials
DHW - Water Quality
DHW - Air Quality
Boise
Hydrogeology
Radiation
Air
Idaho Falls
Environmental
Field
Staff

"R & D"

- Supplement to Monitoring Agreement
- 4 Projects Funded

1. SRPA - Straddle-packer sampling and testing in wells open through large intervals (5 yr)

* 2. Unsaturated Zone, Contamination and Transport (3 yr)

* 3. Surface-Groundwater Interaction (2 yr)

4. Air Monitoring Network (5 yr)

CONCERNS

- Major region of INEL environment, inherently complex, many contamination and/or transport scenarios
- Limited staff
- Dispersed information
  - literature, data
  - assist evaluations
- Modeling
  - assumptions, codes, data sets
  - assist evaluations

OBJECTIVES

- Literature review
- Data compilation, index to parameters
- Modeling review and recommendations for model improvements
- Identification of key or most-sensitive parameters for better understanding/modeling of processes in the unsaturated zone at INEL
- Evaluate existing monitoring systems; make recommendations for improvements

APPROACH

- Involve highly qualified State of Idaho personnel and avoid developing a research program in the Department of Health and Welfare

  (3 yr limited program)

- Broaden resident informed expertise in Idaho on restoration-related environmental issues

  (follow-up involvement in research applied to INEL problems)

- Cooperative vs oversight relationship with INEL

- Accelerate the review process far beyond what could be achieved with INEL Oversight Program staff alone

INEL OVERSIGHT PROJECT

DRAFT

SUMMARY OF PRELIMINARY

LITERATURE REVIEW

June 5, 1991

INTRODUCTION

The INEL (Idaho National Engineering Laboratory) is operated by the U.S. Department of Energy primarily to build, operate, and test nuclear reactors. In addition, the INEL supports other government-sponsored projects such as energy, defense, environmental, and ecological research.

The INEL covers about 890 mi^2 of the eastern Snake River Plain in southeastern Idaho (Fig. 1). The plain is a structural and topographic basin about 200 mi long and 50 to 70 mi wide. Thickness of surficial sediment deposits at the INEL ranges from 0 to 345 ft. Thin basaltic lava flows, rhyolitic rocks, and interbedded sedimentary deposits underlie the plain to depths of 2,000 to 10,000 ft. Basaltic rocks and interbedded sedimentary deposits in the upper 1,000 to 2,000 ft combine to form the Snake River Plain aquifer--a major source of water in southeastern Idaho; the INEL obtains its entire water supply from the aquifer. Aqueous chemical and radioactive wastes have been discharged to deep wells and shallow ponds at the INEL since 1952 and have affected the quality of the ground-water in the underlying Snake River Plain aquifer. Many of these waste constituents entered the aquifer either directly through disposal wells or indirectly following percolation from the ponds through the unsaturated zone.

REGIONAL HYDROLOGY

The eastern Snake River Plain is underlain by the Snake River Plain aquifer, a vast ground-water reservoir that may contain more than 1 billion acre-ft of water (Barraclough et al, 1981). The flow of ground water in the aquifer is chiefly to the south-southwest (Fig. 1) at velocities of 5 to 20 ft/d (Robertson et al, 1974). The transmissivity of the aquifer generally ranges from 134,000 to 13,400,000 ft^2/day (Robertson et al, 1974).

Basaltic lava flows and interbedded sedimentary deposits are the main rock units that make up the aquifer. Water is contained in and moves through intercrystalline and intergranular pores, fractures, cavities, interstitial voids, interflow zones, and lava tubes. Openings in the rock units and their degree of interconnection complicate the movement of groundwater in the aquifer.

Ground-water inflow to the aquifer at the INEL consists mainly of underflow from the northeastern part of the plain and from drainages on the west and north. Most of the groundwater is recharged in the uplands to the northeast, moves southwestward through the aquifer, and is discharged to springs along the Snake River near Hagerman (Fig. 1). Lesser amounts of water are derived from local precipitation on the plain. Part of the precipitation evaporates, but part infiltrates the ground surface and percolates downward to the aquifer. At the INEL, significant recharge is derived from intermittent flows in the Big Lost River.

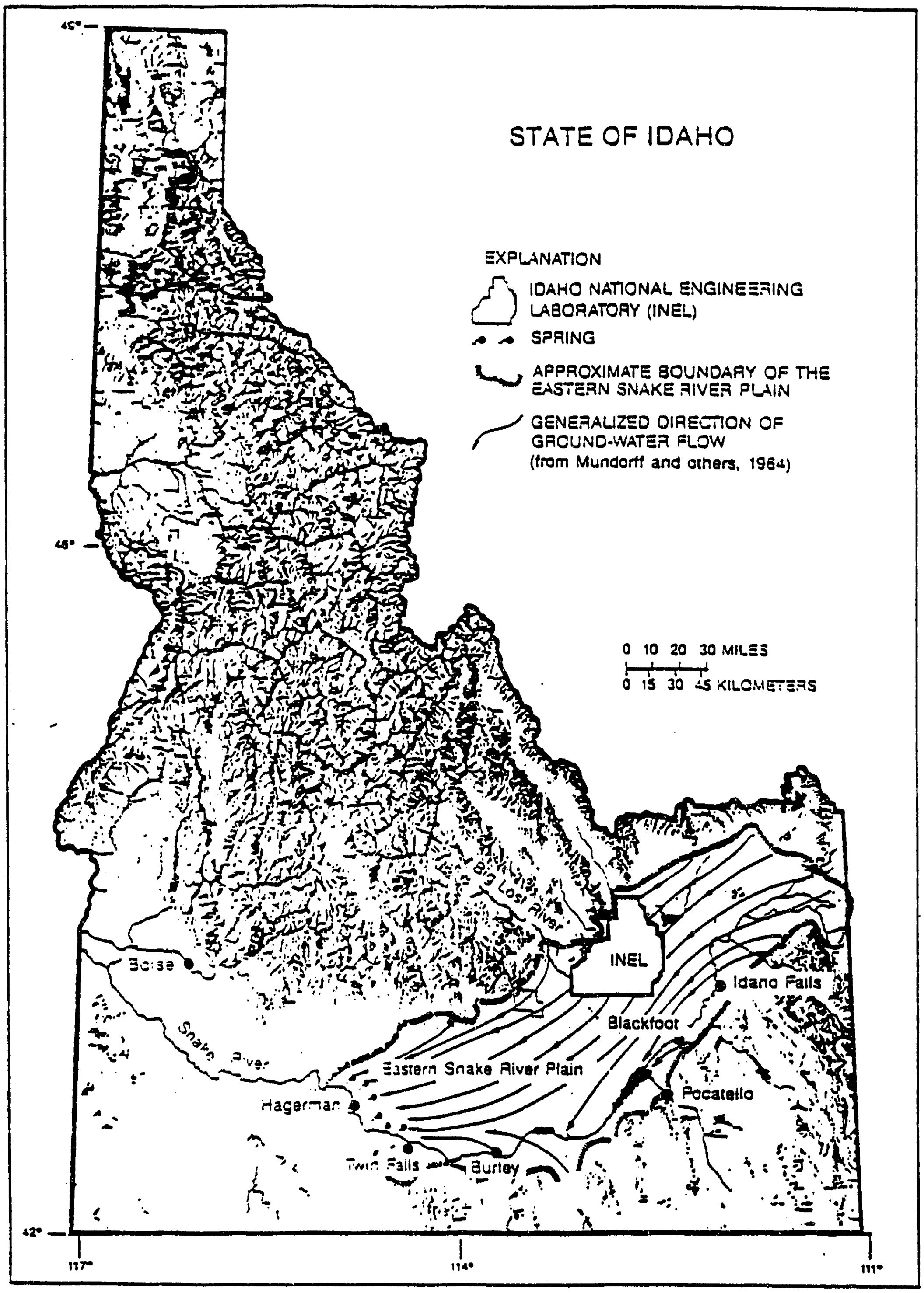


Fig. 1. Locations of the INEL and Snake River Plain, and generalized direction of ground water flow in the aquifer (Barraclough et al, 1981).

Surface Water

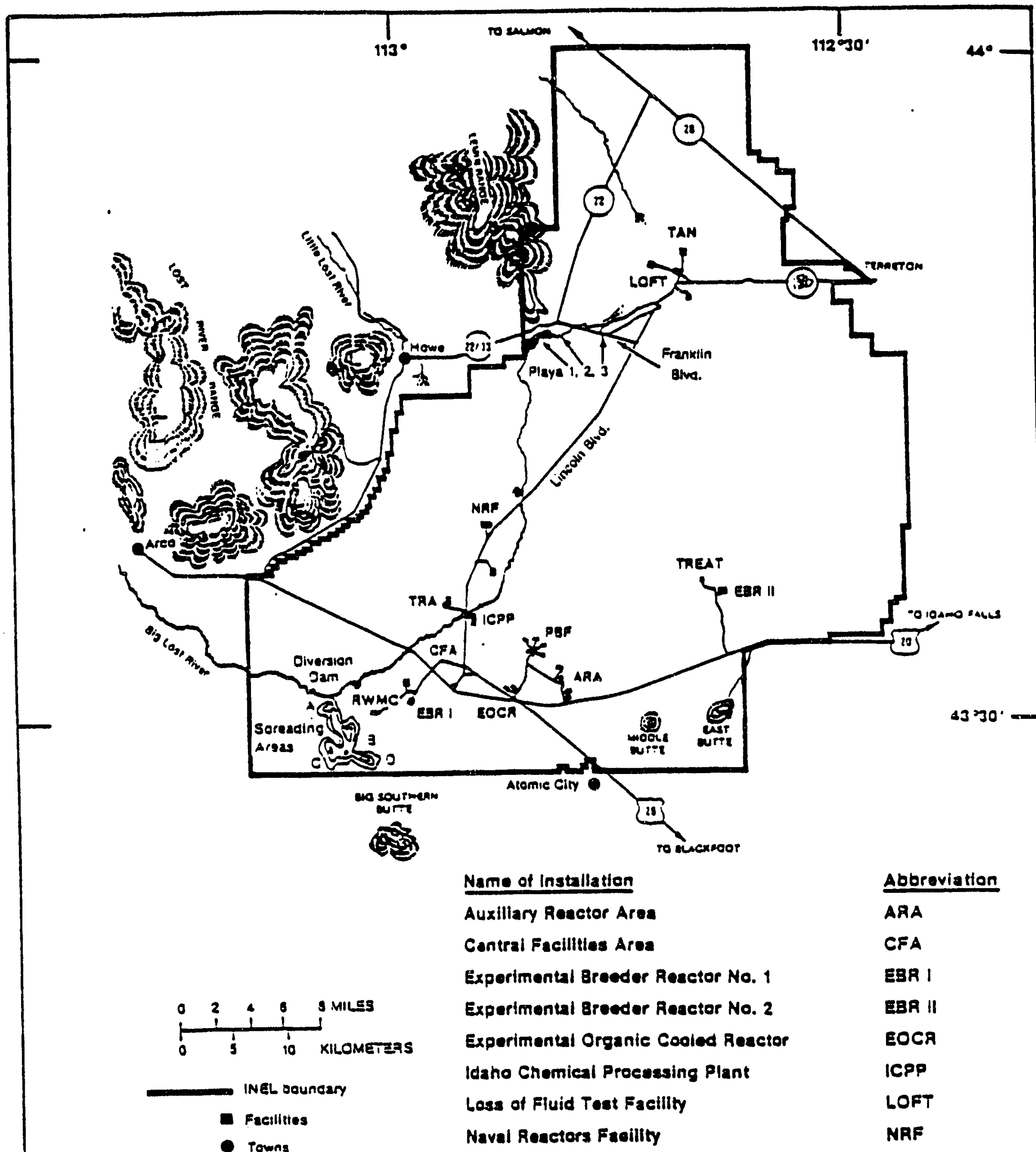
Streams draining the mountains and valleys to the west and north of the INEL (Fig. 2) are a source of irrigation water in agricultural areas adjacent to the INEL. Snowmelt and rainfall contribute to surface water, especially in the spring. The Big Lost River is an important source of ground-water recharge at the INEL. The Big Lost River flows southeastward in its valley past Arco, onto the Snake River Plain, and then turns northeastward through the INEL to its termination in three playas (Fig. 2). The river loses water by infiltration through the channel bottom as it flows onto the plain. As flow approaches the playas, the channel branches into many distributaries, and the flow spreads over several flooding and ponding areas (Barraclough et al, 1967). Recharge to the Snake River Plain aquifer from flow in the river during wet years is significant. During dry periods, streamflow does not reach the INEL because of upstream diversions for irrigation.

Mackay Dam, 30 mi upstream from Arco, and the flood-control diversion dam in the southwestern part of the INEL (Fig. 2) affect flow in the Big Lost River. The flood-control diversion dam was constructed in 1958 to reduce the threat of flooding at INEL facilities near the Big Lost River. The diversion dam diverts flow from the river channel into spreading areas A, B, C, and D (Fig. 2). During winter months, nearly all flow is diverted to avoid accumulation of ice in the main channel, thus reducing the possibility of flooding at INEL facilities.

From 1965 to 1985, the annual flows of the Big Lost River below Mackay Reservoir generally were higher than those prior to 1965. In order of decreasing magnitude, 1984, 1965, 1969, 1983, 1967, and 1982 were the six highest annual flows of record. Three of the six highest annual flows occurred in three consecutive years--1982, 1983, and 1984--with 1984 being the highest since records began. Annual flows from 1982 to 1985 were 328,000, 372,000, 476,000, and 262,000 acre-ft, respectively, and exceeded the 69-year average of 227,500 acre-ft.

GROUND WATER MONITORING NETWORKS

Following is a brief description of the ground water monitoring program from Pittman et al (1988). Two ground water monitoring networks have operated at the INEL: a water-level network and a water-quality network. Data collected from these networks are on file at the U.S. Geological Survey's INEL project office. The water-level network is designed to determine the changes in hydraulic gradient that influence the rate and direction of ground water and radionuclide movement, identify sources of recharge, and measure the areal extent of the effects of recharge. Water levels are measured in both the Snake River Plain aquifer and perched ground water zones. The location of observation wells and the



Name of Installation	Abbreviation
Auxiliary Reactor Area	ARA
Central Facilities Area	CFA
Experimental Breeder Reactor No. 1	EBR I
Experimental Breeder Reactor No. 2	EBR II
Experimental Organic Cooled Reactor	EOCR
Idaho Chemical Processing Plant	ICPP
Loss of Fluid Test Facility	LOFT
Naval Reactors Facility	NRF
Power Burst Facility	PBF
Radioactive Waste Management Complex	RWMC
Test Area North	TAN
Test Reactors Area	TRA
Transient Reactor Test Facility	TREAT

Fig. 2. Location of selected INEL facilities (Pittman et al, 1988).

frequencies of water-level measurements are shown in Figs. 3 and 4.

The chemical and radiochemical character of ground water at the INEL is determined from analyses of water samples collected as part of a comprehensive sampling program. The type, frequency, and depth of sampling depends on the information needed in a specific area. The program includes analyses for tritium, strontium-90, cobalt-60, chromium-51, cesium-137, plutonium-238, plutonium-239, -240 (undivided), americium-241, total chromium, specific conductance, sulfate, chloride, nitrate, and 28 other chemical constituents or properties.

Water samples are collected at the INEL and adjacent areas to define the chemical character of ground water entering and leaving the INEL. In addition, nearby surface water sites are sampled to document the chemical quality of water that recharges the ground water system. Numerous samples are collected near areas of detailed study, such as the Test Reactors Area (TRA) and the Idaho Chemical Processing Plant (ICPP), to identify the contaminant concentrations and to define the pattern of waste migration in the Snake River Plain aquifer and perched ground water zones. The location of well and surface water sites, and the frequency of sampling on or near the INEL are shown in Figs. 5 and 6.

REVIEW OF UNSATURATED ZONE LITERATURE

Following is a summary of information found in the literature relating to the objectives of this project. In general, this information is taken from a series of reports prepared by the U.S. Geological Survey which report the hydrological conditions at the INEL throughout its years of operation. The disposal of low-level radioactive waste water by permitting it to infiltrate into the ground was done under the assumption that the waste water eventually will reach the regional water table, but that the lapse of time, ion-exchange with earth materials, and dilution would reduce the radioactivity to the extent that it would not cause serious deterioration of the quality of the regional ground water supply. Waste water disposal at the Test Reactors Area (TRA), Idaho Chemical Processing Plant (ICPP) and the Naval Reactor Facility (NRF) comprises 80 to 90 percent of the total waste water at the INEL and have the best documentation. Waste water disposal at the TRA and the ICPP comprise 70 to 80 percent of the total waste water at the INEL. A good summary of waste water disposal activities and their influence on the geochemistry of the water at the INEL from 1952 to 1970 is presented by Robertson et al (1974). Tritium as a radioactive waste product was not detected until 1960 although it was present from the start of operations. The volume and chemical constituents in waste water discharged from 1952 to about 1958 are not accurately known. However since 1959, the volume and chemical constituents in waste water discharged to various points are generally available. Until the mid 1960's, there was difficulty in

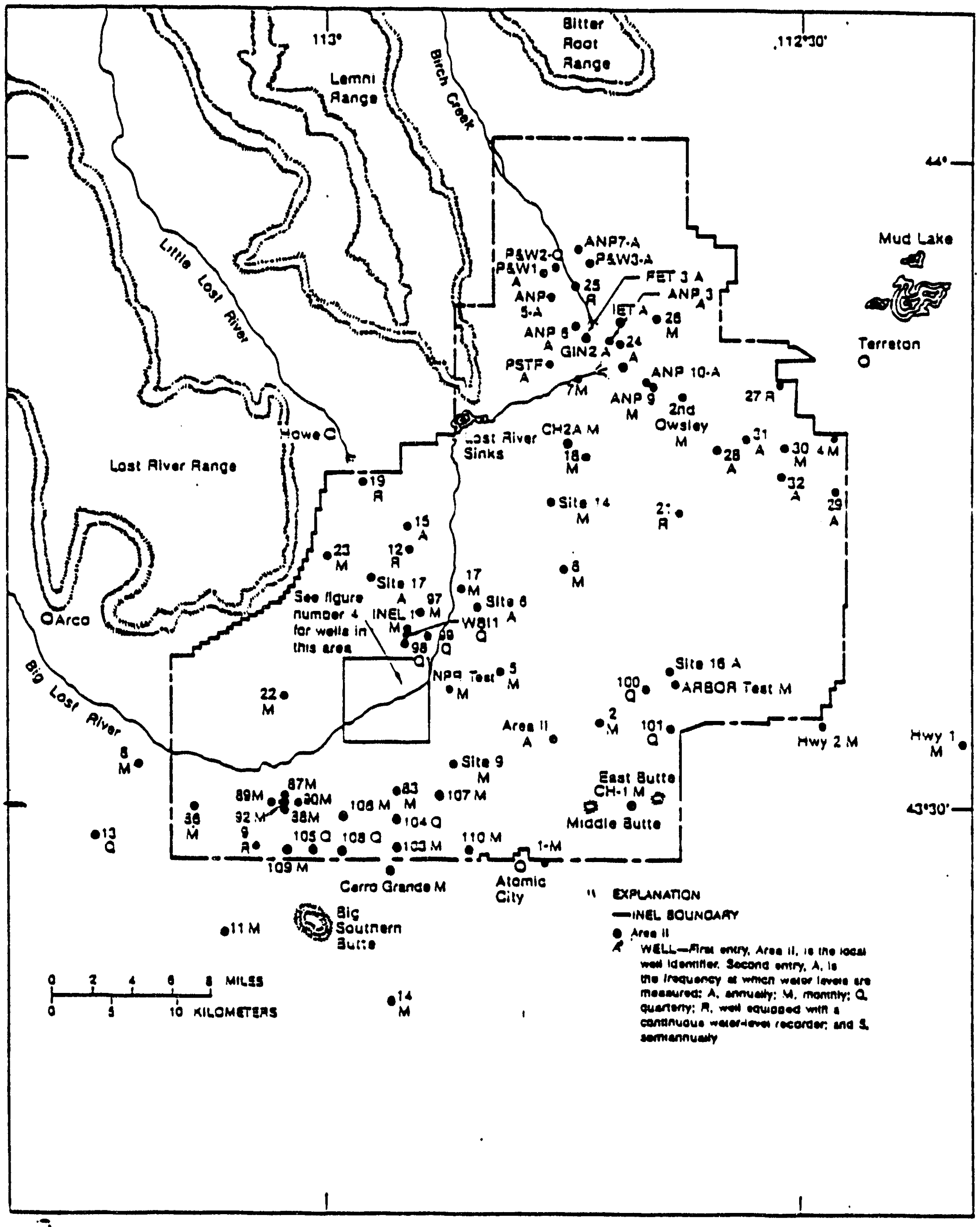


Fig. 3. Locations of wells and frequencies of water-level measurements at the INEL and vicinity (Pittman et al, 1988).

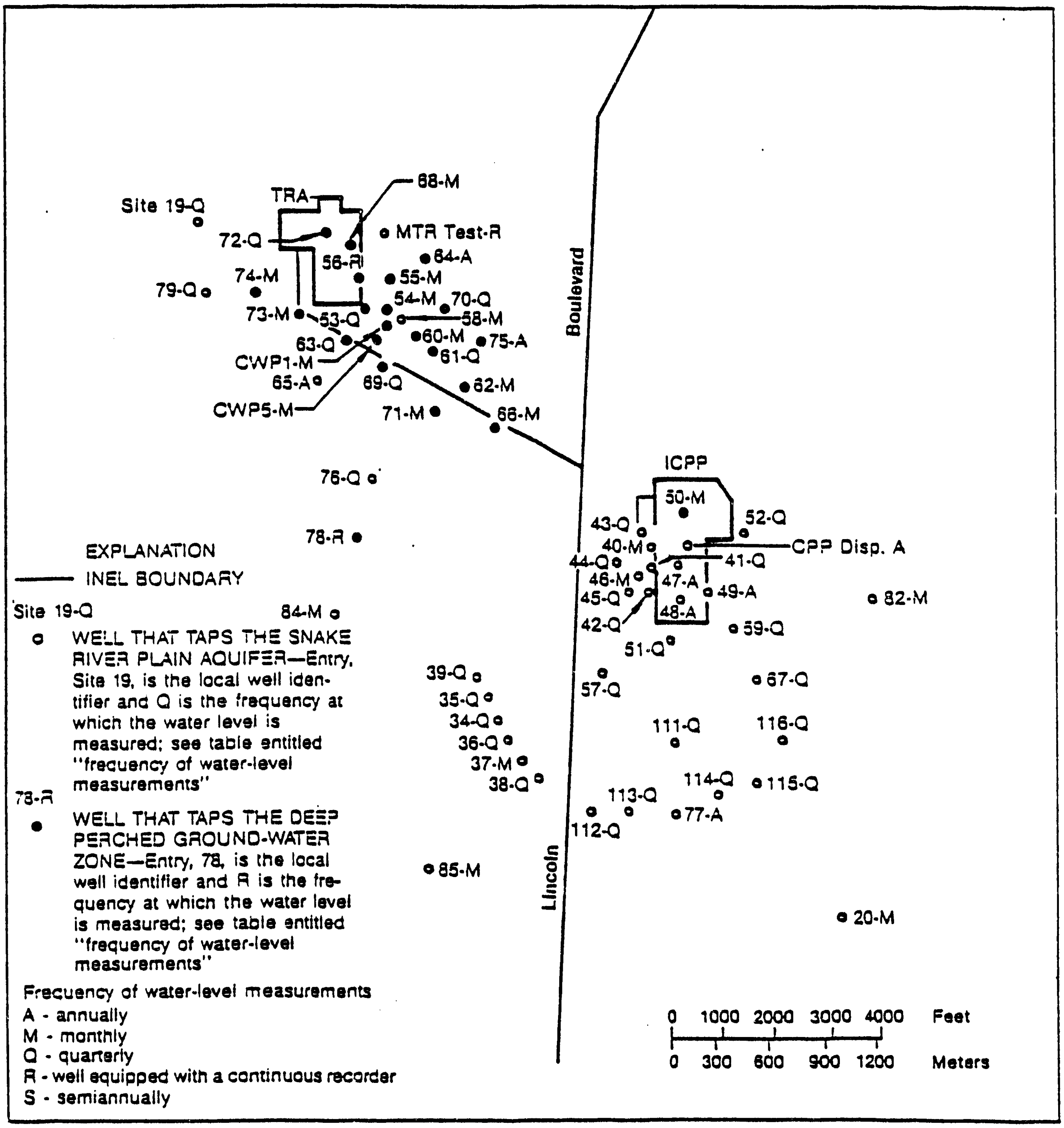


Fig. 4. Locations of wells and freqencies of water-level measurements in the TRA-ICPP area (Pittman et al, 1988).

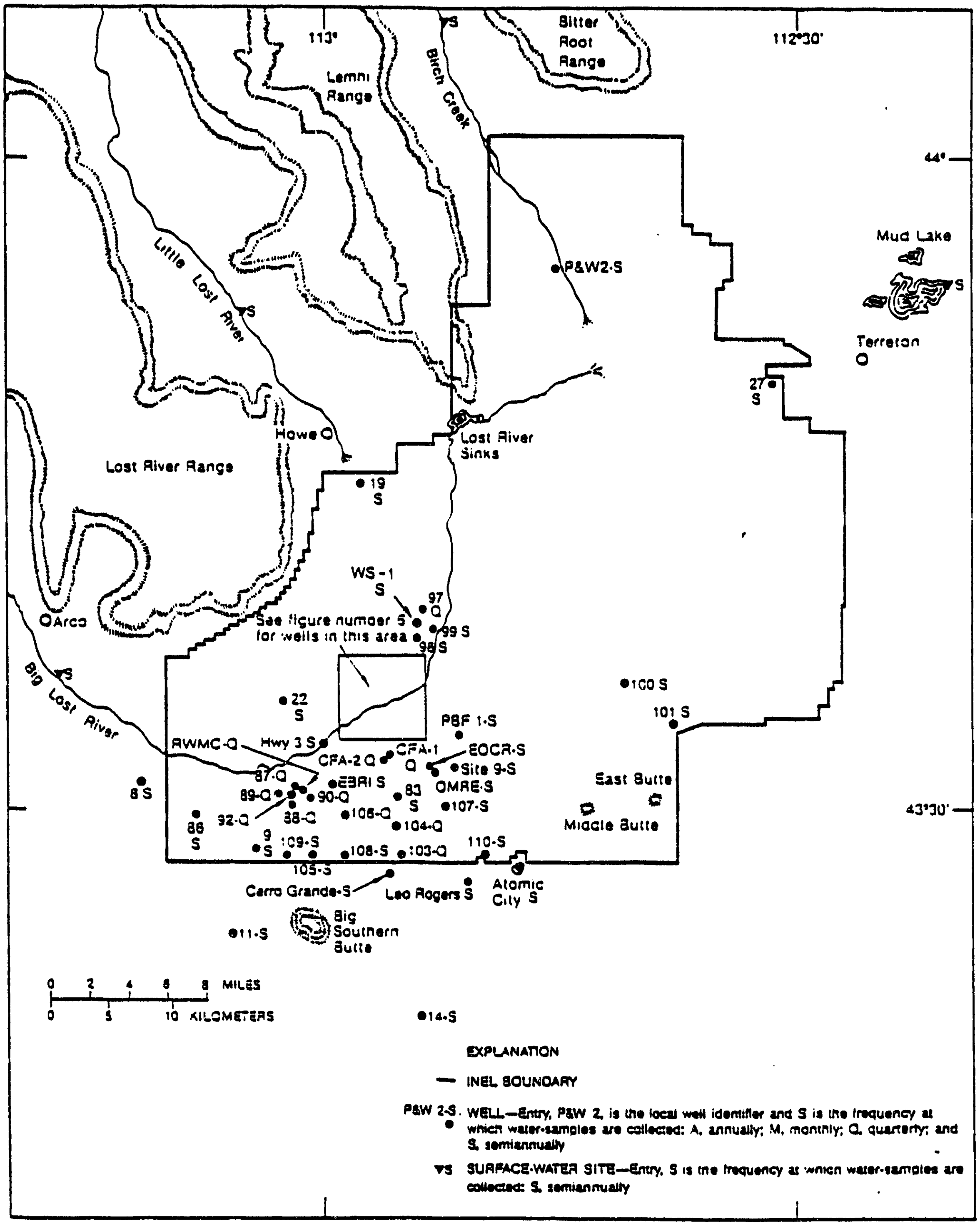


Fig. 5. Locations of wells and freqencies of water-sample collections at the INEL (Pittman et al, 1988).

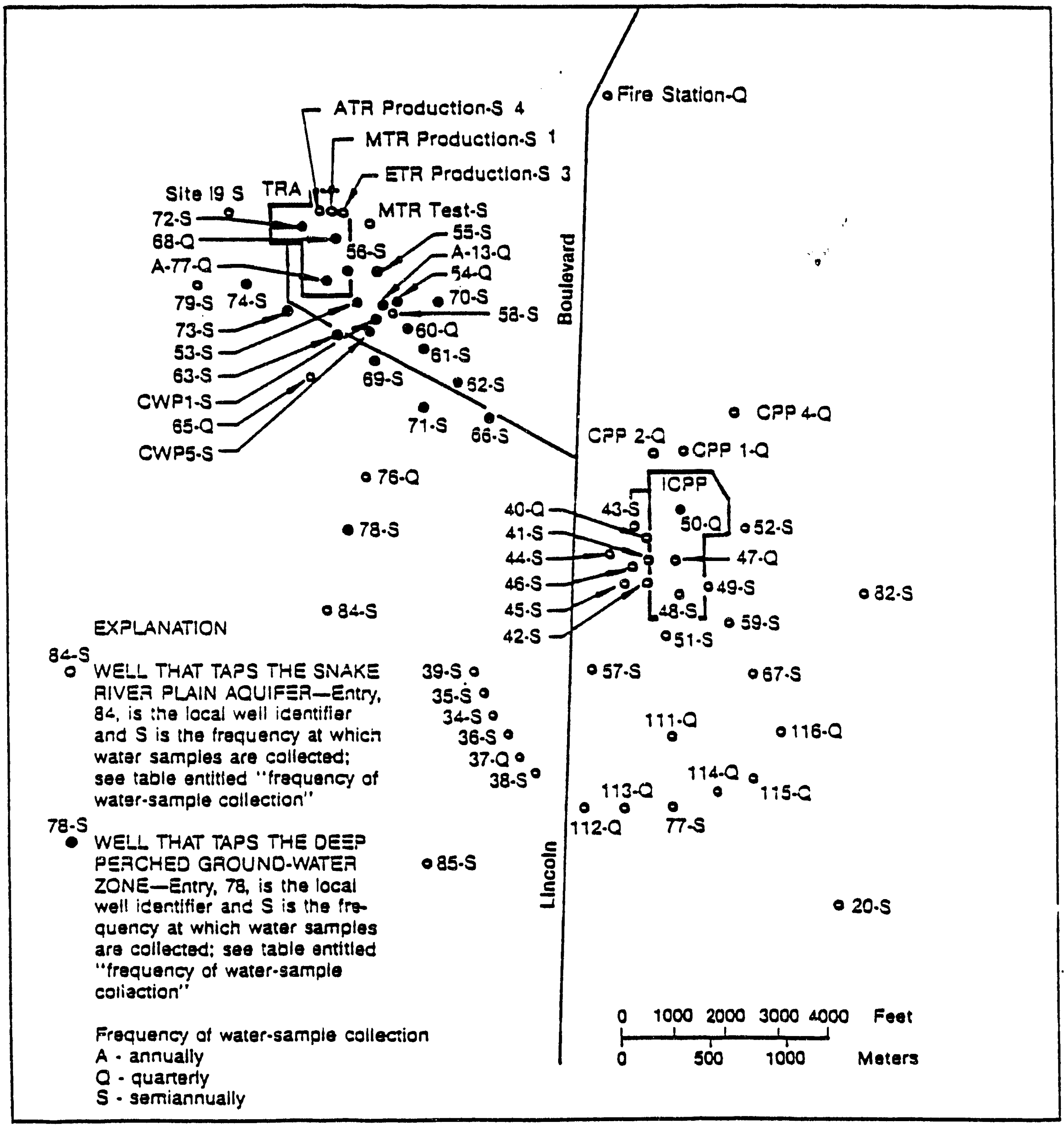


Fig. 6. Locations of well and freqencies of water-sample collections in the TRA-ICPP area (Pittman et al, 1988).

measuring trace tritium concentrations, hence reported concentrations are uncertain. The series of annual reports published by the U.S. Geological Survey during the period of 1962 through 1966 contain information relating to the influence of recharge from various surface waters on perched and ground water levels. These reports also contain information about studies undertaken to determine travel times from waste water ponds and surface water recharge to perched water tables and the regional ground water table. The reports published by the U.S. Geological Survey from 1970 to 1985 concentrate on monitoring the location and form of perched and ground water tables and mapping of plumes of radioactive and chemical wastes in the perched and ground water tables. Since 1985, considerable effort has been expended in characterizing the Radioactive Waste Management Complex (RWMC).

Test Reactors Area (TRA)

Liquid low-level radioactive and chemical waste have been discharged to the subsurface at the TRA through ponds; chemical wastes have been discharged to a deep disposal well. The use of the deep disposal well was discontinued in March 1982. Infiltration from waste water disposal ponds has formed a perched water body beneath the TRA facility. The water percolates almost vertically downward from the ponds through gravel, sand and silt to a basalt layer about 50 feet below the surface. The basalt layer retards the downward movement and forms a shallow perched water body. Water from this body seeps into the basalt and spreads to form a larger perched water body. The downward movement of the perched water in this body is retarded by a layer of clay and silt about 150 feed below the surface and 300 feet above the regional ground water table.

The layout of the TRA area disposal ponds prior to 1970 and year of construction is shown in Fig 7. Initially, only one pond was used for waste water disposal (except sanitary). Additional ponds were added over time due to reduction in pond infiltration rates and/or expansion of operations.

Jones (1961) describes the stratigraphy of the MTR-ETR area as evidenced by the drilling of 16 wells and 22 moisture-meter access holes in the vicinity of the radioactive waste pond. Water level data from the wells is used to construct a map showing the contour of the perched water table. No distinction between the perched water table bodies in the alluvium and basalt is made. It was noted that in a number of perched water wells, water was not evident as the hole was deepened through hard, dense basalt. But, when the bit entered an underlying bed of scoria, cinders, or fractured basalt, the water entered the well and rose several feet, where it came to stand. In at least one instance, the height of rise was so great that the level stood above a bed of dry scoria and cinders above the dense basalt layer, and in a short time the water level declined to a new level as a consequence of drainage into the upper bed. To determine whether other perched water zones exist beneath the first extensive sediment bearing bed, and to investigate the possibility that waste water from the pond had reached the regional ground water reservoir in the vicinity of the pond, well 58 was cased through the zone of perched water and deepened to 475 feet -- about 15 feet below the regional water table. No other zones of saturation were found above the regional water table. Samples of water collected from the regional ground water reservoir at well 58 did not indicate contamination by MTR-ETR waste water.

Morris et al (1963) describes an extensive study of the hydrology of the radioactive waste ponds. As part of the study, tests were conducted to evaluate the travel time for waste water from the radioactive waste ponds. Travel time was estimated by monitoring tritium concentrations in the pond water and wells. The results indicated average travel rates of 1 to 10 ft/day. Flourescein dye was used to determine the rates of horizontal movement within the perched water body in the alluvium. The dye was detected in wells 35 feet away in less than one-half hour after injection. The dye was detected in a well 75 feet away in two waves, 3-1/2 hours and 7-1/2 hours after injection. A total of 37 shallow test holes augured to the basalt layer near the radioactive waste pond were completed by the end of 1962. Samples of the bore-hole materials from the wells were analyzed for physical characteristics including particle size distribution and laboratory saturated hydraulic conductivity. Lithologic logs and material characteristics were presented for selected auger holes. The auger holes were used to monitor water levels, contaminant levels, soil moisture and radioactivity. A neutron probe was used to monitor soil moisture levels in the auger holes. Gamma ray logs of the holes were made to determine and monitor the location and extent of radioactivity. The combination of soil moisture profiles and radioactivity profiles were used to evaluate the behavior of unsaturated flow from the ponds. Contours of the perched water bodies in the alluvium and the basalt layer were made as well as a plum contour for tritium from the radioactive waste water pond. The results showed that leakage was occurring within the TRA compound and that the total volume of waste water was not known. On about November 10, 1962, demineralized waste water (acid and chemical wastes) was diverted to a separate pond.

Morris et al (1964) presents a contour map of specific conductance of the perched water table. A large leak in the pipeline carrying radioactive waste to the ponds was found. Several perched water table contour maps are presented showing the change in the perched water table preceding and following the repair of the pipeline. As a result of fixing the leak the pond level rose several feet prompting the need for an additional pond. It was concluded that the leak had occurred for years and that the volume of radioactive waste water for previous years was not known. A volume balance analysis on the perched water tables revealed that the perched water table in the alluvium (25% effective porosity) was only large

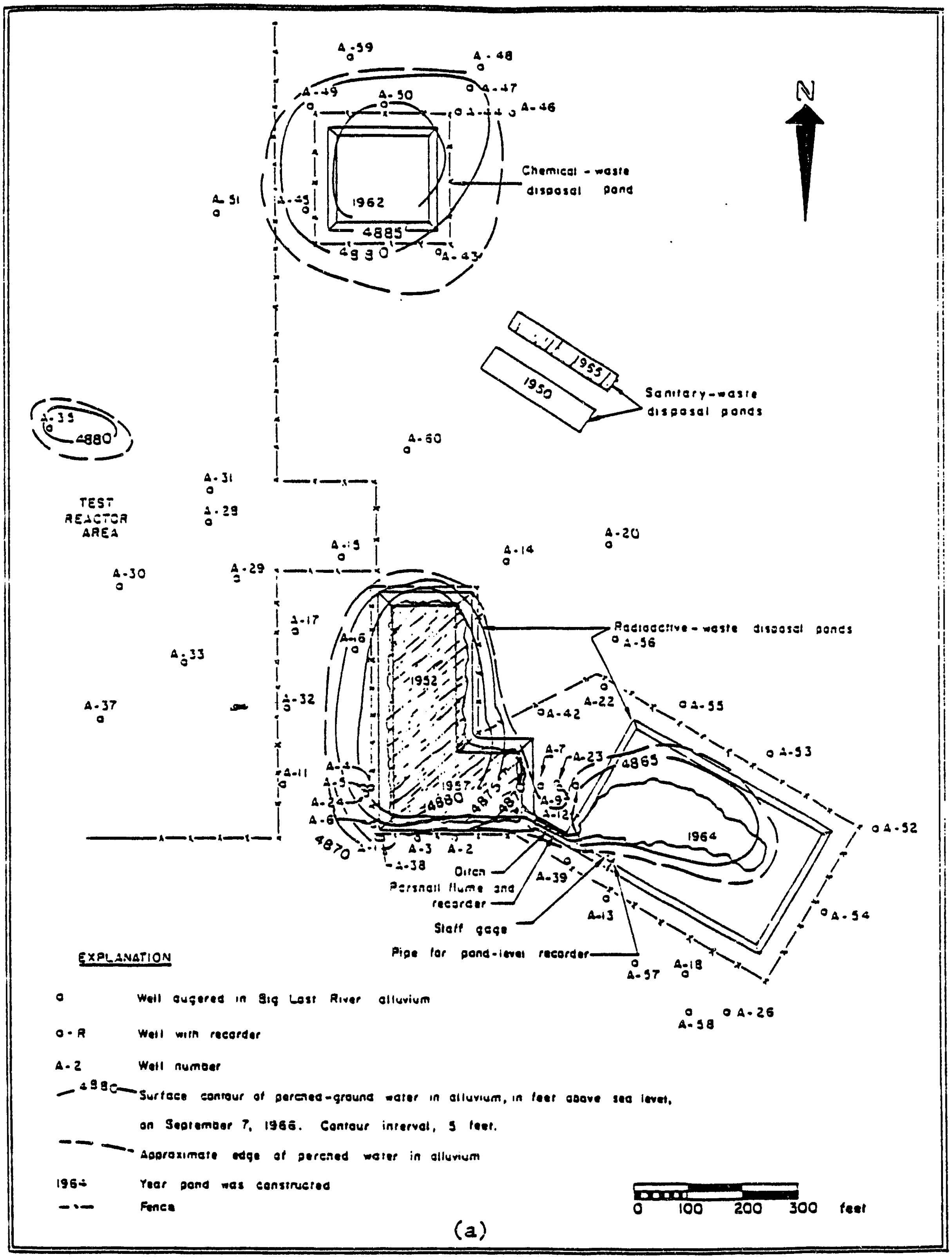


Fig. 7. Map of the TRA showing the location of disposal ponds, auger holes, and the extent and water-leve contours of the perched water table in the alluvium on Sept. 7, 1966 (Robertson et al, 1974).

enough to hold about two to three weeks worth of waste and the perched water table in the basalt (3.5% effective porosity) was equal to about 1-1/2 years of waste discharge and at most (10% effective porosity) 4 years of waste discharge. Thus, it was concluded that leakage to the regional water table probably has been occurring for years through the sedimentary beds and down well bores. On February 23, 1963, a fission break occurred at the facility causing the release of high radioactivity to the waste ponds. The waste contained Ce^{141}, Te^{132}, I^{132}, Ba^{140}, La^{140}, I^{131}, and Sr^{90}. This surge in radioactivity was monitored in several wells to investigate the migration of this radioactive surge. These data were presented but no resulting conclusions were made. TRA disposal well was placed in service in October 1963.

Morris et al (1965) present changes and trends in water quality at the TRA. Radioactive waste water entered a newly constructed pond on June 30, 1964. Site selection was based on the high permeability of the soil and the need to avoid installed deep wells. The pond was designed for a long-term infiltration rate of 10 gpd/ft^2. The inferred infiltration rate during the last half of 1964 was from 20 to 33 gpd/ft^2. Water table rises in wells around the new pond as a result of water first entering the pond gave an effective travel time of about 50 feet per day. Perched water table contour maps for the alluvium and the basalt both before and after startup of the new pond are presented. Leakage within the TRA compound was again noted. It was also noted that since 1960, chemical waste had been injected into well 53 which is 90 feet deep. Injection of about 100 gpm (nearly 150,000 gpd) occurred from November 1960 to January 1962, from June 1963 to August 1963, and from November 1963 to September 1964. The water level rose from 20 to 40 feet above the static water level during injection indicating a specific capacity of about 2.5 to 5 gpm per foot of injection head. Successful recompletion of the TRA disposal well made it capable of disposing of as much as 1,000 gpm of cold waste. The well is 1,271 feet deep, cased to the bottom, and perforated at various intervals from 512 to 1,267 feet. Further injection into well 53 was not expected. It was noted that well 66 apparently taps a perched water body 100 feet below the main perched water body.

Barraclough et al (1966) states that the infiltration from the chemical waste pond has caused a substantial change in the mineral content of the waters in wells 8 and MTR Test, penetrating a perched-water table and the regional-water table, respectively. A second sanitary waste disposal pond was excavated and put in to service in 1965. The waste disposal well was used to dispose of 147 million gallons of waste during 1965, more liquid waste than any of the ponds. Eighteen new wells were augured to the top of the basalt to define the shallow perched water near the radioactive waste disposal and chemical waste ponds. Perched water table contours for the alluvium and basalt are presented. Leakage within the TRA compound was still evident. The relationship between pond discharge and the water level in certain wells is presented. The relationship between recharge from the Big Lost River and the water level in certain wells is also presented. Travel times for recharge to various wells can be determined from the data collected. Maps of the tritium concentration and specific conductance in the regional ground water and the perched ground water are presented. Infiltration rates for the Big Lost River channel, playas and spreading areas are given as a result of the largest flow on record for the Big Lost River during 1965.

Barraclough et al (1967) presents perched water contours for the alluvium and basalt. Additional observations of the interaction between the perched water bodies and the recharge from the Big Lost River are reported. Tritium contamination plumes in the regional aquifer and the perched water in the basalt are presented. A chromium contamination plume in the regional aquifer also is shown.

Robertson et al (1974) summarizes the influence of waste disposal at the TRA on the local hydrology. This includes volumes and concentrations of radioactive and non-radioactive discharges, relationships between pond discharge, recharge from the Big Lost River and the levels and extent of perched water bodies. Contours of the perched water bodies in the alluvium and basalt are presented. A generalized stratigraphic cross-section of the TRA from the report is shown in Fig. 8. Well 66 is shown in Fig 8 to intercept a deeper perched water body. A brief description of ion exchange and sorption for Sr^{90}, Cs^{137}, and Co^{60} are presented along with a discussion of the effect on migration of these radionuclides. Similarly, a brief discussion is presented regarding chemical equilibrium reactions with regards to Cr(III) and Cr(VI).

Barraclough and Jensen (1976) summarize waste disposal activities for the period 1971 to 1973 and present contours of the perched water bodies in the alluvium and the basalt under the disposal ponds. The perched water body was found to contain tritium, Cr^{51}, Co^{60}, Sr^{90}, Ce^{137} and other non-radioactive chemicals. Plume contours for tritium, Cr^{51}, Co^{60} and Sr^{90} in the perched water table in the basalt are presented.

Barraclough et al (1981) summarize waste disposal activities for the period 1974 to 1978 and present contours of the perched water bodies in the alluvium and the basalt under the disposal ponds. The perched ground water body contains radioactive and non-radioactive wastes. Plume contours for tritium, Cr^{51}, Co^{60}, Sr^{90}, specific conductance, sodium, chromium, chloride and sulfate in the perched water table in the basalt are presented.

Lewis and Jensen (1984) summarize waste disposal activities for the period 1979 to 1981 and present a contour of the perched water body in the basalt under the disposal ponds. The perched ground water body contains radioactive and non-radioactive wastes. Plume contours for tritium, Cr^{51}, Co^{60}, Sr^{90},

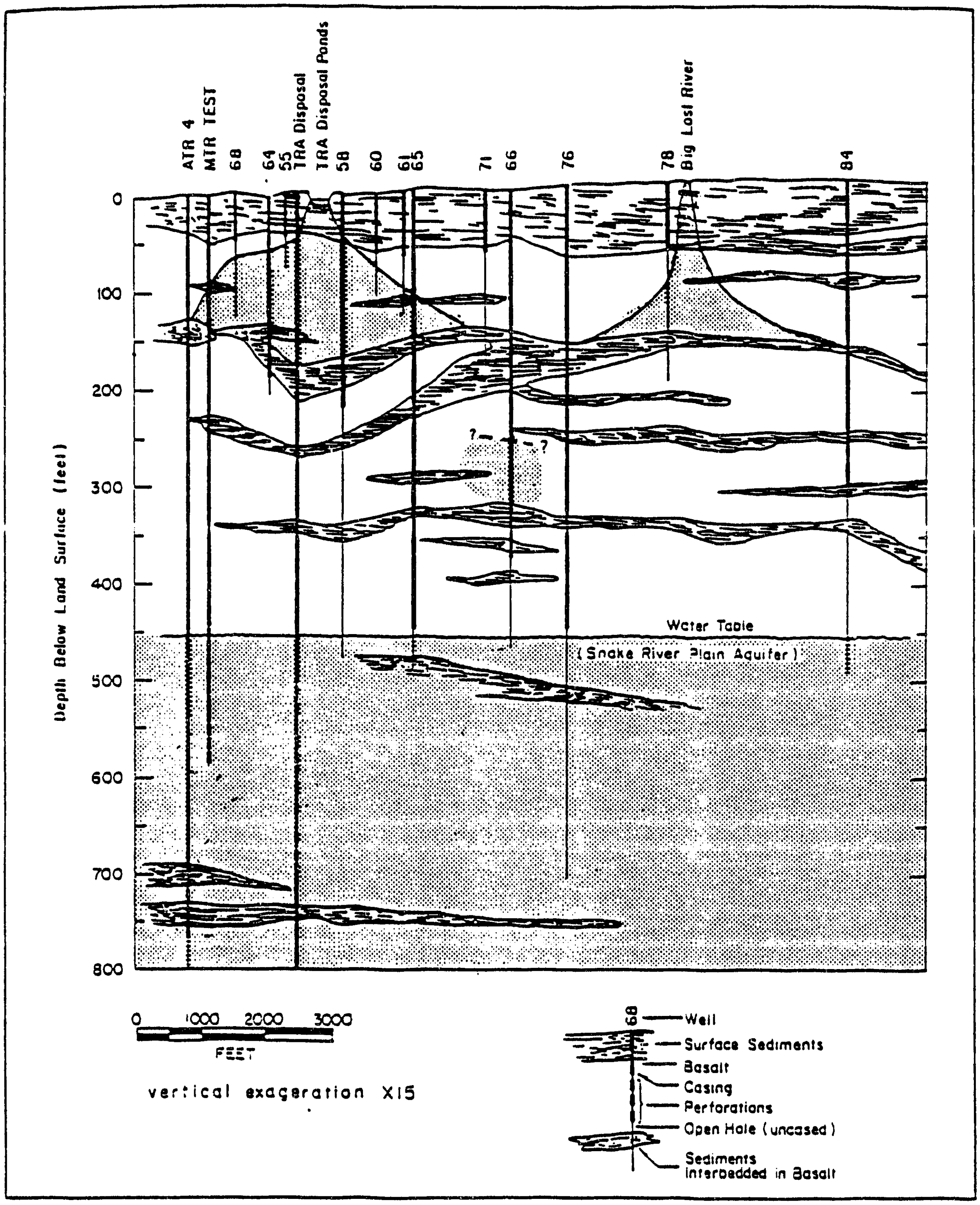


Fig. 8. Generalized stratigraphy of the TRA showing perched water, well and regional water table (Robertson et al, 1974).

specific conductance, sodium, total chromium, chloride, sulfate, nitrate and phosphate in the perched water table in the basalt are presented.

Lewis et al (1985) provides a good summary of the aqueous radioactive- and industrial-waste disposal activities (volumes and radioactivity) at the INEL (all significant sites) through 1982.

Pittman et al (1988) summarizes waste disposal activities for the period 1982 to 1985. The character and radioactivity of the waste gradually changed from previous years. Water discharged to the radioactive waste ponds from 1974 to 1979 contained an average of about 2,250 Ci/year of activation and fission products. From 1980 to 1985, the average annual discharge of activation and fission products was reduced to about 288 Ci. Prior to 1980, about 70 percent of these products had a half-life of several weeks or less. The average amount of tritium discharged to the ponds from 1977 to 1981 was about 140 Ci/year. In 1982, 515 Ci of tritium were discharged; from 1983 to 1985 an average of 208 Ci/year of tritium were discharged. Between 1974 and 1979, tritium comprised about 10 percent of the total liquid radioactive waste. In 1980, tritium was about 50 percent and from 1981 to 1985 it was about 90 percent of the total amount of radioactivity discharged to the disposal ponds. From 1982 to 1985, 1,140 Ci of tritium were discharged to the radioactive waste disposal ponds. The average disposal rate was 285 Ci/year which is a 98 percent increase over the 1979-81 disposal rate of 144 Ci/year. The disposal well was used from 1964 to March 1982 to dispose of about 250 million gal/year of non-radioactive waste water. Since March 1982, two ponds each about 200 by 400 ft in size have been used to dispose of the waste water. The location of the new cold waste ponds relative to the other ponds is shown in Fig. 9. Most of the cold waste is from cooling tower blowdown, and contains a yearly average of about 510,000 lbs of sulfate and 50,000 lbs of other chemicals. For several years, hexavalent chromium was used as a corrosion inhibitor in the cooling tower and was discharged to the well. Hexavalent chromium was replaced by a polyphosphate beginning in October 1972. The extent and contour of the perched ground water in the alluvium and the deep perched ground water zone are presented. Plume contours for tritium, Co^{60}, total chromium, sodium, chloride, sulfate, nitrate and physical characteristics specific conductance and temperature in the deep perched ground water are presented.

Information regarding the hydrologic conditions at the TRA since 1985 have not been found.

Idaho Chemical Processing Plant (ICPP)

Waste water at the ICPP was discharged to a deep disposal well from 1953 to February 1984. Since then, unlined seepage ponds have been the main mechanism for waste water disposal at the ICPP,

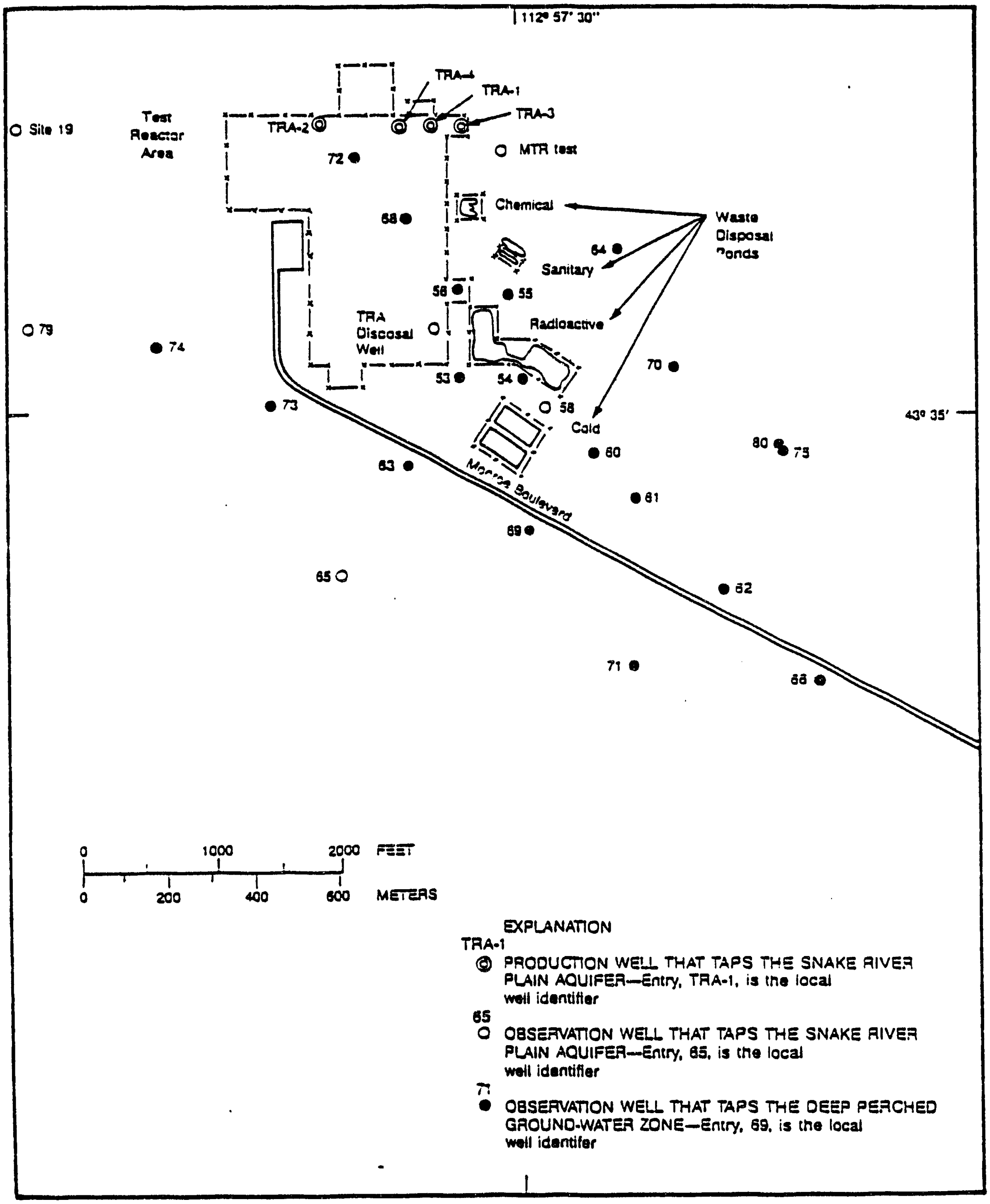


Fig. 9. Locations of obserservation wells, production wells and waste disposal ponds at the TRA (Pittman et al, 1988).

although the disposal well was available for use in emergency situations from 1984 to 1986 (Pittman et al, 1988).

Peckham (1959) states that for several years liquid wastes have been discharged to the ground through a disposal well and a shallow open-bottom manhole. Discharge from the plant through the disposal well averages about twenty-seven million gallons per month. This water is a complex solution of plant wastes, containing large amounts of sodium chloride used to regenerate four water-softening units. The disposal well is 598 feet deep, mainly in the Snake River basalt, and extends about 150 feet below the regional water table, which in this area is about 450 feet below land surface. The well is cased and gravel-packed throughout; about 40 feet of the casing is perforated above and about 100 feet is perforated below the regional water table to permit the waste to escape outward into the basalt aquifer. Sanitary wastes amounting to about one million gallons per month are discharged through a second open-bottom manhole and a sewage effluent seepage basin. The open-bottom manholes are located near the cutting facility at the south end of the compound. The wastes disposed of in these and the seepage basin percolate downward through the alluvial gravel and sand of the Big Lost River and further through joints and other fractures in the basalt to the regional water table.

Jones (1961) briefly describes the stratigraphy of the ICPP area. The area is characterized as having 50 feet or less of alluvial material comprising the Big Lost River flood plain. Deposits beneath the alluvium, above the water table, include three groups of lava flows and flow units representing successive volcanic episodes. Beneath most of the ICPP area, these principal groups are separated by sedimentary beds.

Morris et al (1964) describes an investigation of radioactive wastes in the alluvium from the shallow disposal well with emphasis on the migration of Sr^{90} relative to Cs^{137}. The main isotopes present in the disposal waste water are tritium, Sr^{90} and Cs^{137}. Waste water goes directly into an intermediate manhole about 11 feet deep and then to the adjacent disposal well which is about 15 feet deep and five feet in diameter. Sewage and other plant wastes are passed through a septic tank, by passing the manhole into the disposal well. A total of 27 one-half inch observation holes were augured through the alluvium to basalt in the immediate area. The data are used to prepare contour maps of the perched water table, the configuration of the underlying basalt surface, and the areal distribution of radioactivity. The shallow disposal well is drilled into gravelly alluvium containing lenticular zones of fine-grained sediments or cemented gravels. The average thickness of the alluvium in the immediate vicinity is 33 feet. A water table contour map of the perched water body suggests two water tables, one about 10-15 feet higher than the other. Cross-sections of the area are presented showing the perched water bodies relative to the basalt. The areal extent and distribution of radioactivity in the immediate area is also presented. A waste water volume balance in the alluvium led to the conclusion that water was entering the basalt layer.

Barraclough et al (1967) summarize waste disposal activities for 1966 at the ICPP. Radioactive waste water disposal to the seepage pit was discontinued in September 1966.

Robertson et al (1974) provide a good summary of waste water disposal activities at the ICPP over the years 1952 to 1970. The amount of tritium discharged before 1961 is not known because it was undetected. The seepage pit was reportedly discontinued in September 1966. However, the continued expansion of the perched water table and increase in radioactivity of the perched water body led to the conclusion that this was not the case. During the period of 1967 to 1968, the deep disposal well had unknowingly collapsed and subsequently injected waste water at the 226 foot of the unsaturated zone leading to the contamination of the CPP-1 well. Periodic occurrences of contaminants in ICPP production wells has lead to the speculation of the source. Contours of the perched water table on various dates are presented. The general stratigraphy of the area is also presented, Fig 10.

Adamic et al (1984) reported the concentrations of mercury and cadmium in surface soils within the ICPP compound. Sampling depth was to 40 cm.

The hydrologic assessment report by Hull (1987) provides some interesting material. The seepage pit was reportedly abandoned in February 1984 and waste water is now being sent to infiltration ponds just south of the ICPP. This water is beginning to create perched water tables both in the surficial sediments and in the basalt. This perched water table is reportedly being monitored by the USGS. Stratigraphy of the ICPP area and the results of a simulation study by Thomas et al (1986) are discussed but the reference is not included in the report. Reference to a modeling study (Robertson 1977, not yet reviewed) under seepage ponds at the TRA and related data on the hydrologic properties of the unsaturated zone used in the study are presented. The following quote is taken from the report:

> "There is a very thick unsaturated zone at the INEL, which ranges from 200 to 1000 feet thick. This unsaturated zone is a complex sequence of basalt flows, breccia zones, and sedimentary interbeds. There is probably no movement of water through this zone under unsaturated conditions. The fractures and breccia zones in the basalt probably present too large a pore size for there to be a continuity of path under unsaturated conditions. Water probably moves down in discrete packets that saturate a small portion of the basalt. Drilling in the basalts in areas remote from discrete sources of recharge occasionally encounter areas of wet basalt. The quantities and rates of movement of this water are unknown."

Reportedly the probability of flooding at the ICPP site due to high precipitation or from the Big Lost River has not been evaluated. Summary data on the physical properties (mineralogy, CEC and sorption

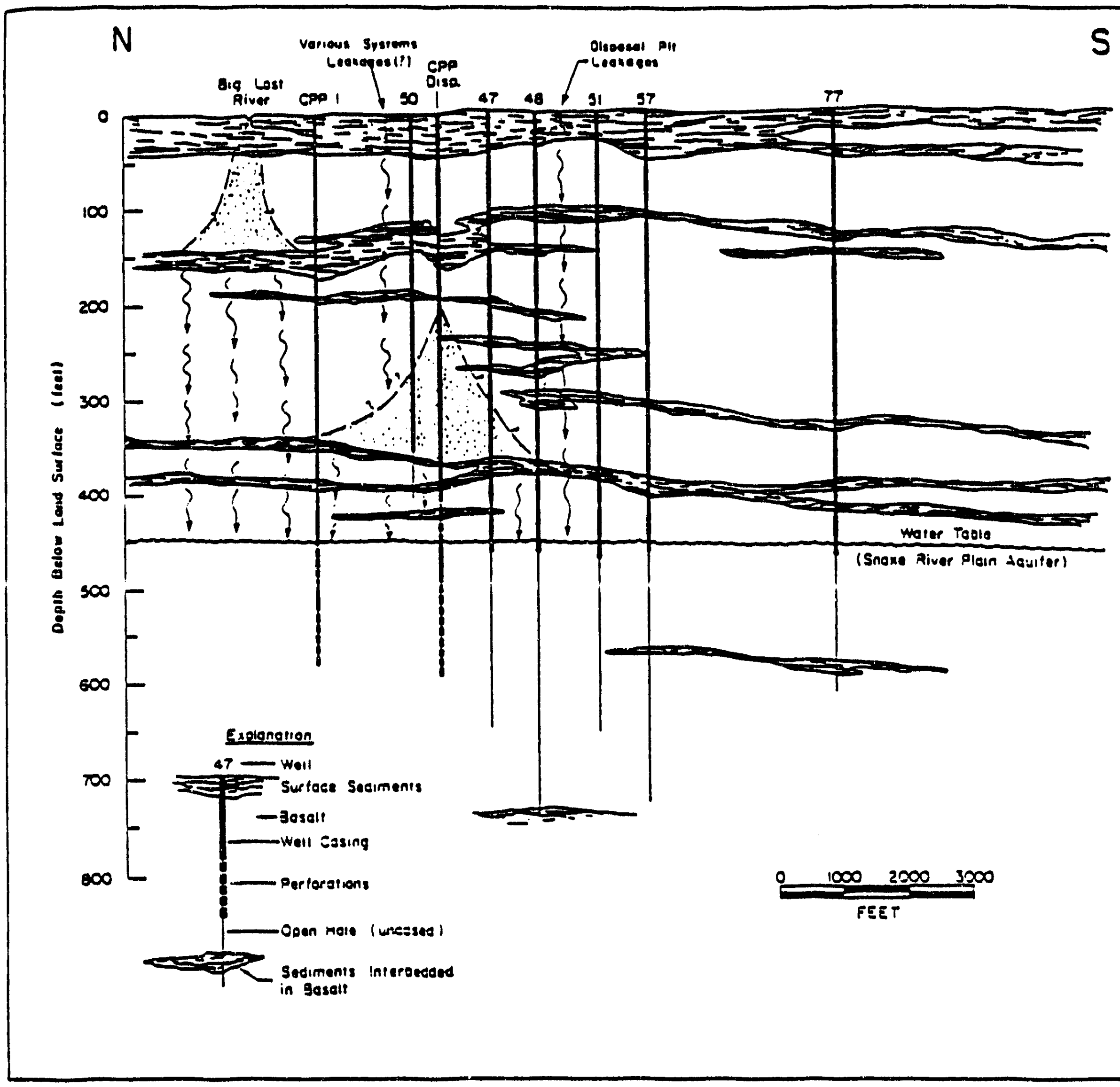


Fig. 10. Generalized stratigraphy of the ICPP area showing perched water, well and regional water table (Robertson et al, 1974).

coeff, grain size distribution) of the alluvium at the ICPP are presented. Hydrologic data for alluvium at various sites in the INEL are also included.

Information regarding the hydrologic conditions at the ICPP facility since 1985 have not been found.

Naval Reactors Facility (NRF)

The NRF has used unlined seepage ponds and a waste ditch since 1953 (Pittman et al, 1988).

Morris et al (1964) reports the results of an investigation into the subterranean distribution of radioactivity at the NRF. The NRF facility reportedly disposes of its radioactive waste water by permitting it to percolate into the ground by means of two infiltration ponds. The ponds are excavated into gravelly alluvium, which is a little more than 30 feet thick at one site and 10 to 20 feet thick at the other. The regional water table is a little more than 360 feet below the land surface at the NRF. The general locations of the ponds with respect to the NRF are shown in Fig 11. The S1W pond is located at the southeast corner of the NRF. The ECF-A1W pond is west of the NRF. Cross-sections through the ponds are presented. Twenty-five holes were augured through the alluvium to the basalt, 13 near the S1W pond and 12 by the ECF-A1W pond, to determine the extent of the radioactive contamination. These data are used to construct contour maps showing the configuration of the basalt surface and the perched water table. Samples of soil and water from the holes were used to prepare cross-sections showing the vertical distribution of radioactivity. The existence or use of a seepage ditch is not mentioned in the report.

Morris et al (1965) reports that four, 30-foot auger holes were drilled near the NRF sewage lagoon to aid in exploration of the movement of fluids in the vicinity. The location of the sewage lagoons relative to the NRF facility is shown in Fig. 12.

Barraclough et al (1966) reported that the holes drilled near the sewage lagoons were dry at the completion of drilling and again when checked in January 1966. The lagoon was built with an impervious bottom, and the dry holes indicate that little leakage occurs.

Robertson et al (1974) summarize waste disposal activities and investigations at the NRF. Reportedly since 1965, the S1W pond has been used almost exclusively, with the ECF-A1W pond being used only occasionally for unusual operational wastes. In addition to perched water under the ponds, it was deemed likely that it also occurs beneath the liquid industrial waste drainage-seepage ditch northwest of the NRF. The location of the drainage-seepage ditch relative to the NRF is shown in Fig. 13. This was the first report to mention the seepage ditch.

Lewis and Jensen (1984) reported that the NRF uses a ditch to dispose of waste water, nearly 125 million gallons annually for 1979 through 1981. The waste water averages about 168,000 lbs of sodium, 217,000 lbs of chloride and 366,000 lbs of sulfate annually. The volume of liquid waste decreased in later years. Seepage ponds are used for sewage disposal.

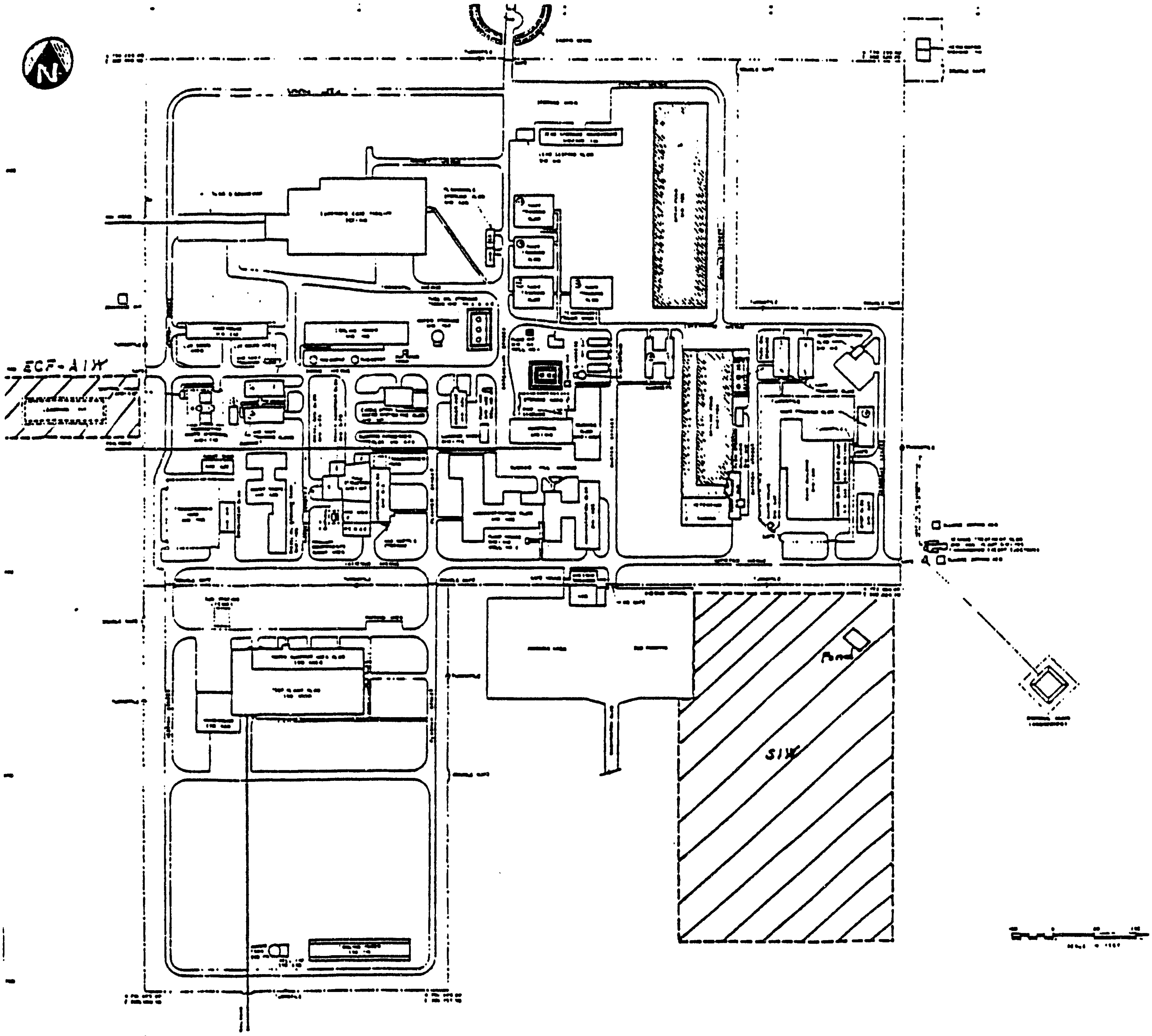


Fig. 11. Location of seepage ponds at the NRF (Morris et al, 1964).

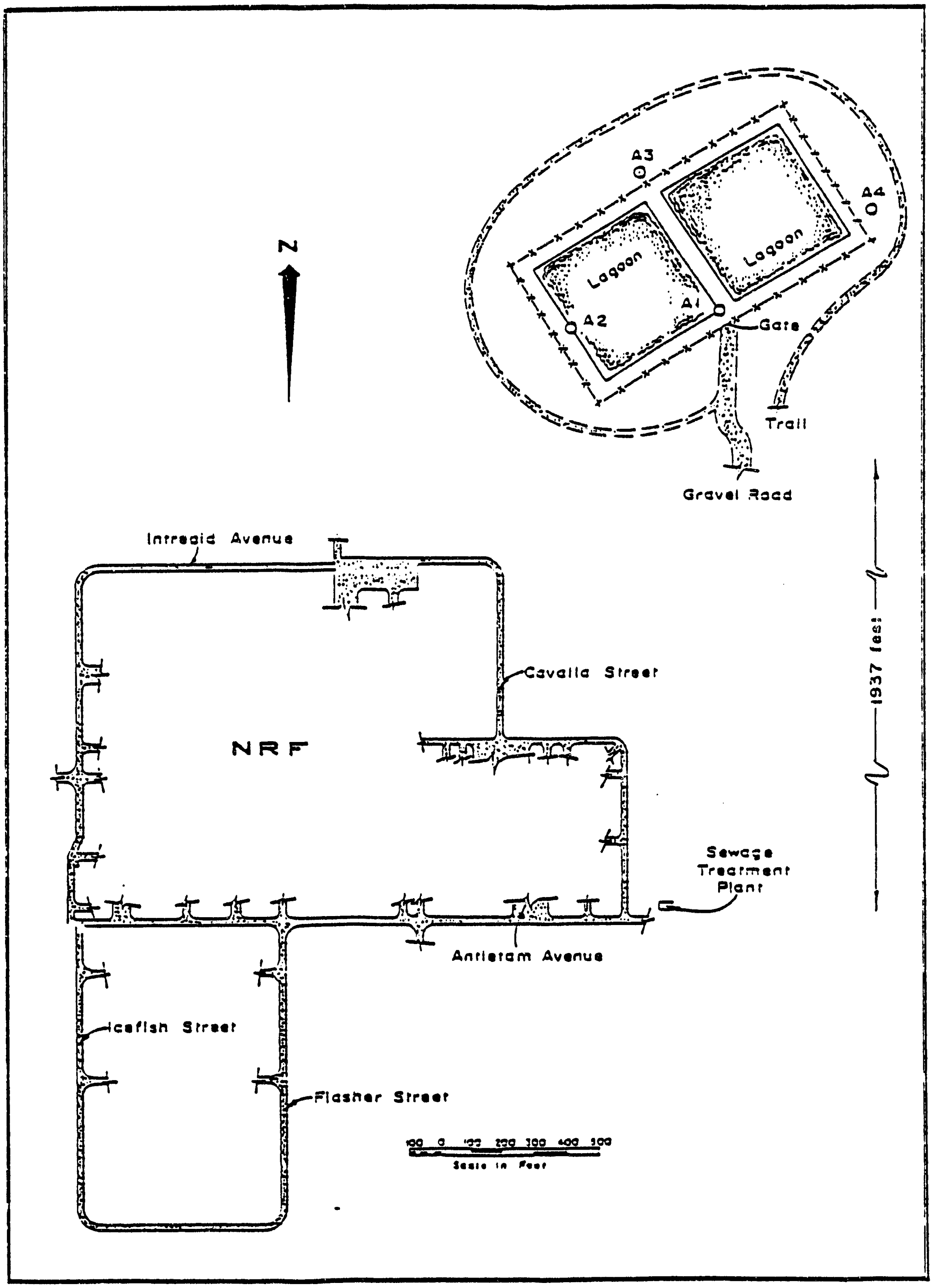


Fig. 12. Location of sewage lagoon area at the NRF (Morris et al, 1965).

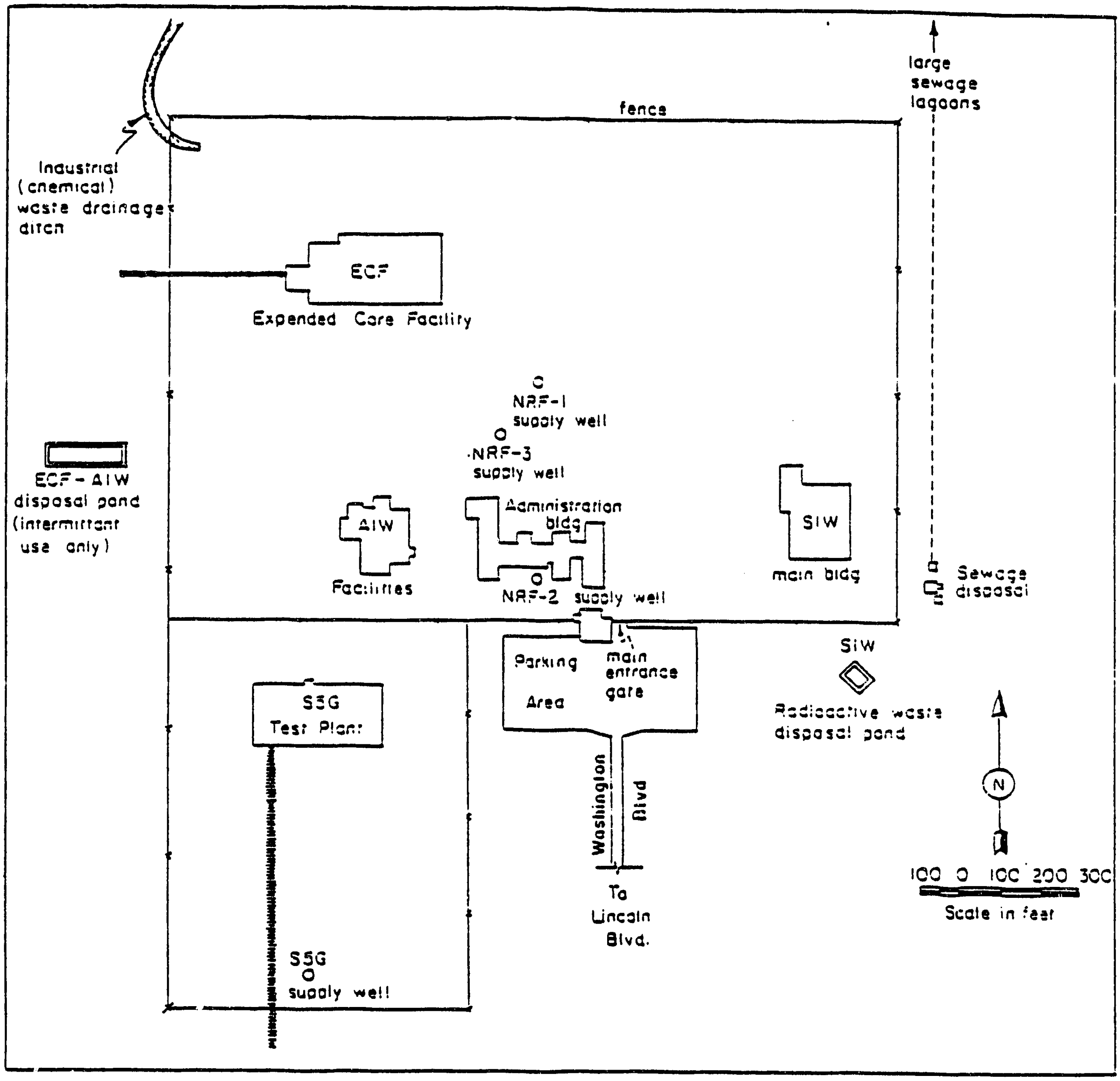


Fig. 13. Location of waste drainage ditch at the NRF (Robertson et al, 1974).

Lewis et al (1985) reported chemical wastes have dominated the effluent over the later period of record with little or no radioactive wastes having been discharged.

Pittman (1988) reported the NRF uses a 3-mile long ditch to dispose of most waste water, although ponds are used for sewage disposal. The major chemical constituents in the waste water are sulfate, chloride, and sodium.

Information regarding the hydrologic conditions at the NRF since 1985 have not been found.

Other Facilities

Morris et al (1964) presents the results of a study of the geology and hydrology of the LOFT-TAN area. This includes results of drilling and corresponding physical properties of the material (grain size, saturated hydraulic conductivity, etc). Similar results for other scattered sites around the INEL are also presented.

Morris et al (1965) presents the results from drilling five wells in the TAN area to investigate the feasibility of injecting radioactive gas underground for temporary storage. The physical properties of the materials obtained from the wells are given. The physical properties from drilling at other scattered sites around the INEL are also presented.

Barraclough et al (1967) reported that radioactive liquid waste discharges occurred at EBR-II, Spert and TAN but details of the disposal facilities are not presented. The results of gas injection tests in the Birch Creek Playa are presented.

Robertson et al (1974) reports that liquid waste discharges occur at CFA, EBR-II, TAN, SPERT and ARA. At the EBR-II, site liquid wastes are discharged to seepage ponds. The discharges are relatively low so that any perched water system would be correspondingly small. Future discharges of liquid wastes are likely to occur at the PBF near the SPERT area. PBF will use two shallow wells, 110 and 115 feet deep, to dispose of low-level radioactive wastes and corrosive liquid wastes, respectively. The wells are purposely designed to allow the waste water to perch, thus retarding percolation to the regional ground water table, which is about 450 feet deep. The LOFT at TAN will use a seepage pond for disposal of its low-level radioactive and chemical wastes.

Lewis et al (1985) reports that at the CFA, radioactive- and chemical-waste effluent from a laundering process was processed and diluted in a sewage treatment plant. From here, the liquid wastes are discharged to a shallow drain field to percolate to the regional water table about 480 feet below. The PBF utilized two shallow wells, 110 the 115 ft deep for low-level radioactive waste and corrosive liquids. However, now lined evaporation ponds are used.

Radioactive Waste Management Complex (RWMC)

The RMWC occupies 144 acres of the INEL. From 1952 to 1970, low-level radioactive and transuranic waste were buried in pits and trenches excavated into a veneer of surficial sediment. Since 1970, low-level radioactive waste has been buried and the transuranic waste has been stored on above-ground asphalt pads in retrievable containers. From 1952 to 1986, about 180,000 m^3 of low-level and transuranic radioactive waste containing about 9.5 million curies of radioactivity were buried at the RWMC. An estimated 335,000 liters of organic waste were also buried before 1970 (Pittman, 1989). The RWMC has been flooded by snowmelt in 1962, 1969 and 1982.

Nace et al (1956b) presents logs of test holes and test pits in and near the Burial Ground.

Rightmire and Lewis (1987) present the results of prior studies in their analysis of the hydrogeology and geochemistry of the unsaturated zone of the RWMC. Data from drilling programs is used to estimate the areal extent of each sedimentary unit and their physical characteristics. The location of wells in the RMWC is shown in Fig 14. Three main sedimentary interbeds (9, 34 and 73 meters) and thirteen basalt flows separate the land surface from the regional water table at a depth of about 180 meters. The 9 m interbed is thin but locally continuous under the RMWC. The 34 m interbed is absent under the older part of the subsurface disposal area. The 73 m interbed is of irregular thickness and is continuous under the entire RWMC and possibly much of the southeastern part of the INEL. The vertical hydraulic conductivity of the sedimentary interbed material is estimated to be in the range of 1.6×10^{-7} to 3.0 m/day. The horizontal hydraulic conductivity in the cinder zones may be up to 5 or 6 m/day. Perched water bodies were encountered in numerous coreholes above the interbeds. Perched water samples were chemically analyzed and the results suggest that the water is due to lateral movement on the interbeds from the adjacent spreading areas of the Big Lost River.

Pittman (1989) reported the collection of hydrological and meteorological data for the unsaturated zone near the RWMC. The data are being collected to field calibrate a mathematical model to predict the long-term migration of radionuclides in the unsaturated zone. Two test trenches were installed in the surficial sediment adjacent to the RWMC to collect hydrologic data from undisturbed and disturbed soil. Hydrologic data collected during 1985 and 1986 includes measurements, taken every 12 hours, of soil temperature, soil-water potential from 30 sensors placed at selected depths to about 6 meters using thermocouple psychrometers; and soil moisture content measurements collected weekly in 9 neutron-probe access holes with a neutron moisture depth gage. Meteorological data are averaged every 6 hours include wind speed, wind direction, relative humidity, air temperature; solar radiation and precipitation are totaled over the 6-hour period. Construction and instrumentation of the test trenches is also presented.

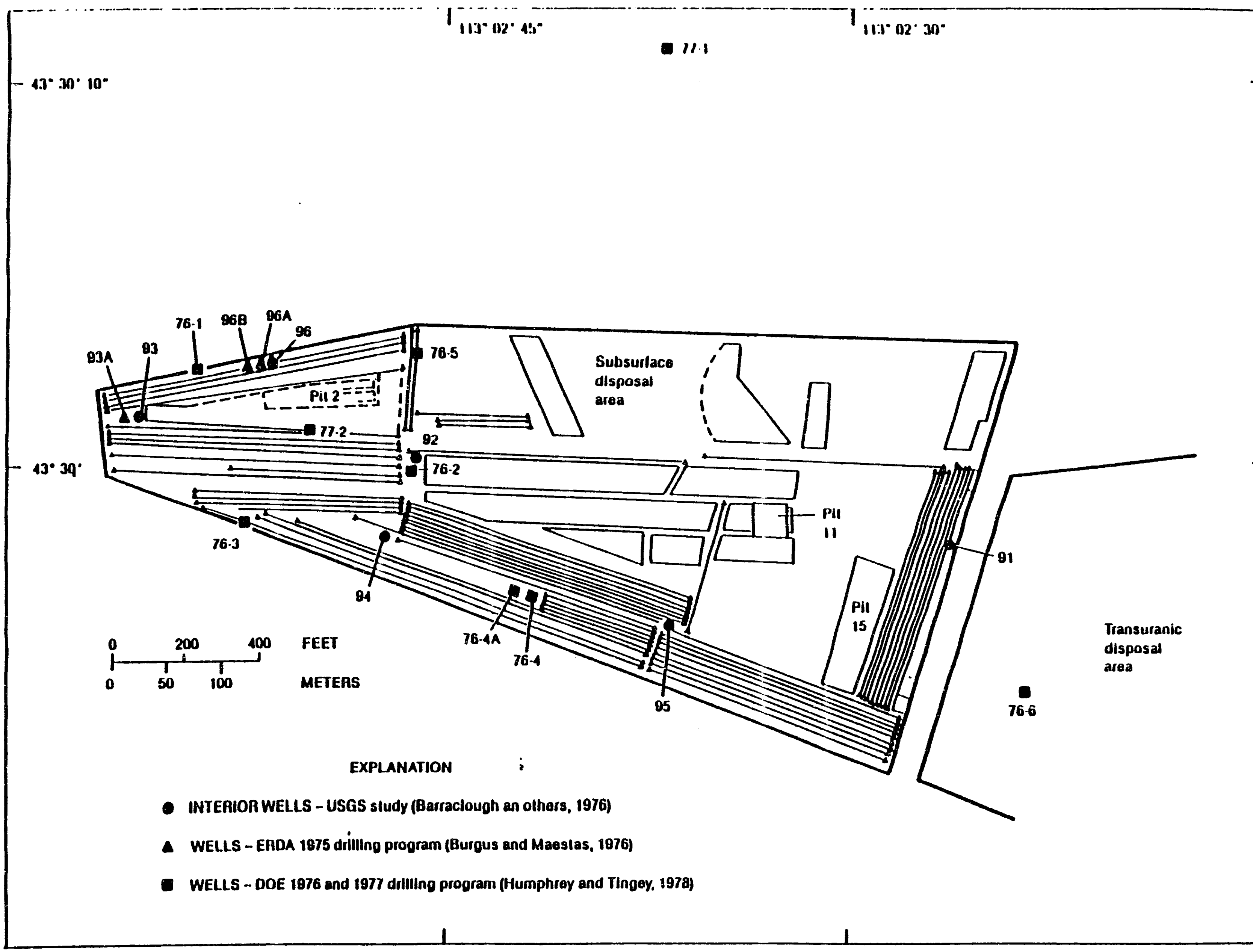


Fig. 14. Location of wells and waste disposal pits and trenches at the RWMC (Rightmire and Lewis, 1987).

Tensiometers also were installed but soil conditions were too dry for them to work. The location of the test trench area relative to the RWMC is shown in Fig 15. A schematic of the west test trench is shown in Fig 16.

Anderson and Lewis (1989) present the stratigraphy of the unsaturated zone at the RWMC describing in detail the characteristics of each basalt flow unit and sedimentary interbed.

Davis and Pittman (1990) present hydrological, meteorological, and geohydrological data collected during 1989 from the installed test trench described by Pittman (1989). Hydrological data collected from both disturbed and undisturbed soil include measurements of soil temperature and soil-water potential from 28 thermocouple psychrometers recorded hourly and averaged every 12 hours. Soil-moisture content measurements are collected biweekly in nine neutron-probe access holes. One additional neutron-probe access hole was installed in November 1987 to extend the area of coverage. Meteorological data collected hourly and summarized daily included incoming and emitted long-wave radiation; incoming and reflected short-wave radiation; air temperature, relative humidity, and windspeed at 1 and 2 m above land surface; wind direction; and precipitation. Samples of surficial sediment were collected and used to describe gain-size distribution with depth and other physical characteristics.

Hubbell et al (1990) reported on the sampling and analysis plan for a field infiltration test of surficial sediments at the RWMC. The objective of the study is to estimate the unsaturated hydraulic conductivity of the surficial sediments at the USGS test trench site. The hydraulic properties are to be described using the van Genuchten functions. The experiment include an infiltration, drainage and evaporation phase. Thermocouple psychrometers, tensiometers and neutron probe access holes are to be used to monitor soil moisture and tension.

SUMMARY

During the early years of the INEL, the USGS conducted extensive studies (sitewide drilling program) of the geology and hydrology of the area collecting varied data over the years. The data appear to be scattered and incomplete in most cases. Indexing it would be a monumental task if at all possible. It certainly would require going through all USGS files. The unsaturated zone has not received much attention over the years. The studies that have been done are a result of problems or concerns arising from liquid radioactive waste disposal. The TRA facility has the most information published about its waste disposal activities. The ICPP has less data about the unsaturated zone due to the fact that most waste water disposal has been to a well. Little is known about the effect of waste water disposal at the NRF on the unsaturated zone. Essentially no information was found about waste disposal activities

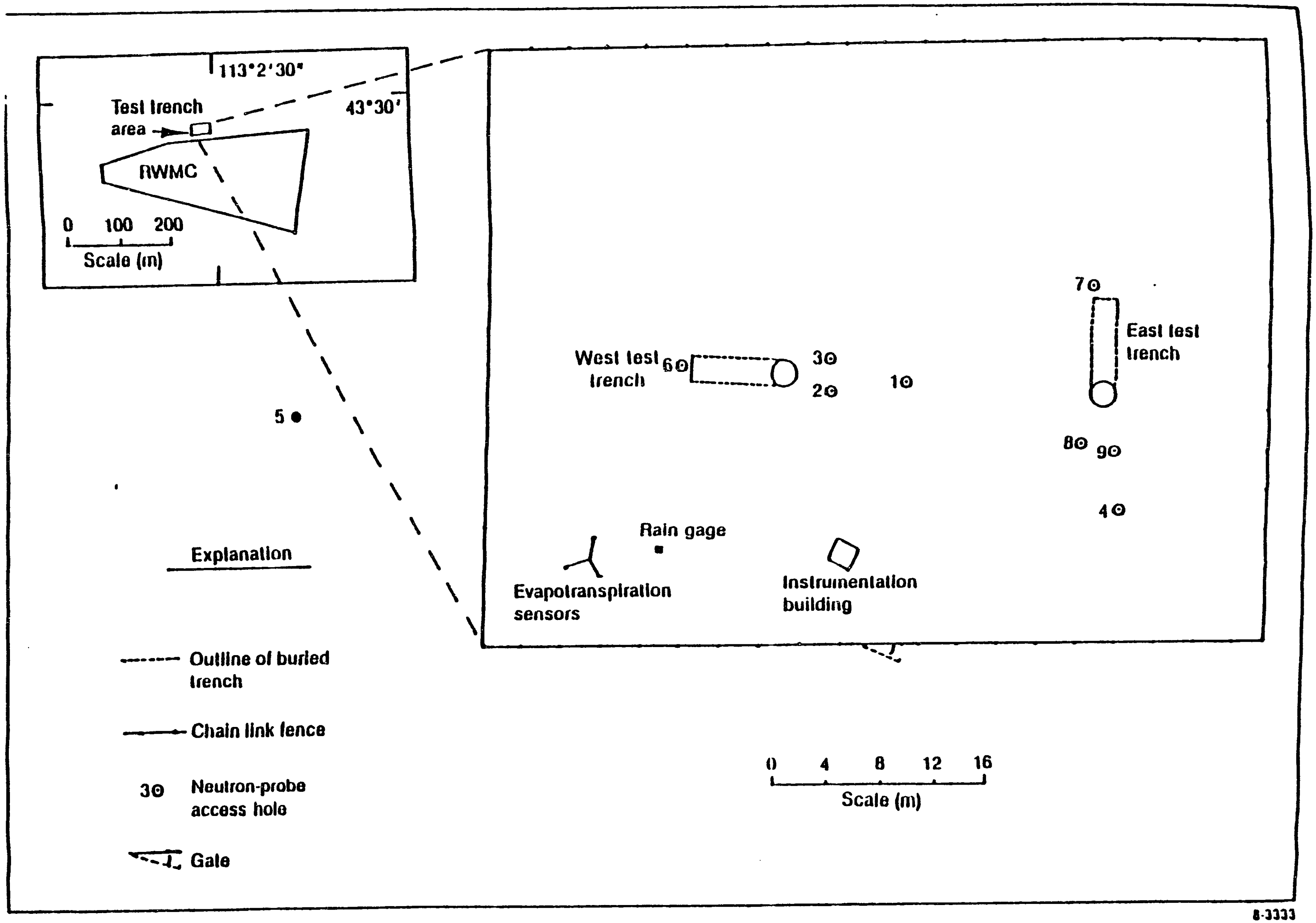


Fig. 15. Location of the test trenches near the RWMC (Pittman, 1989).

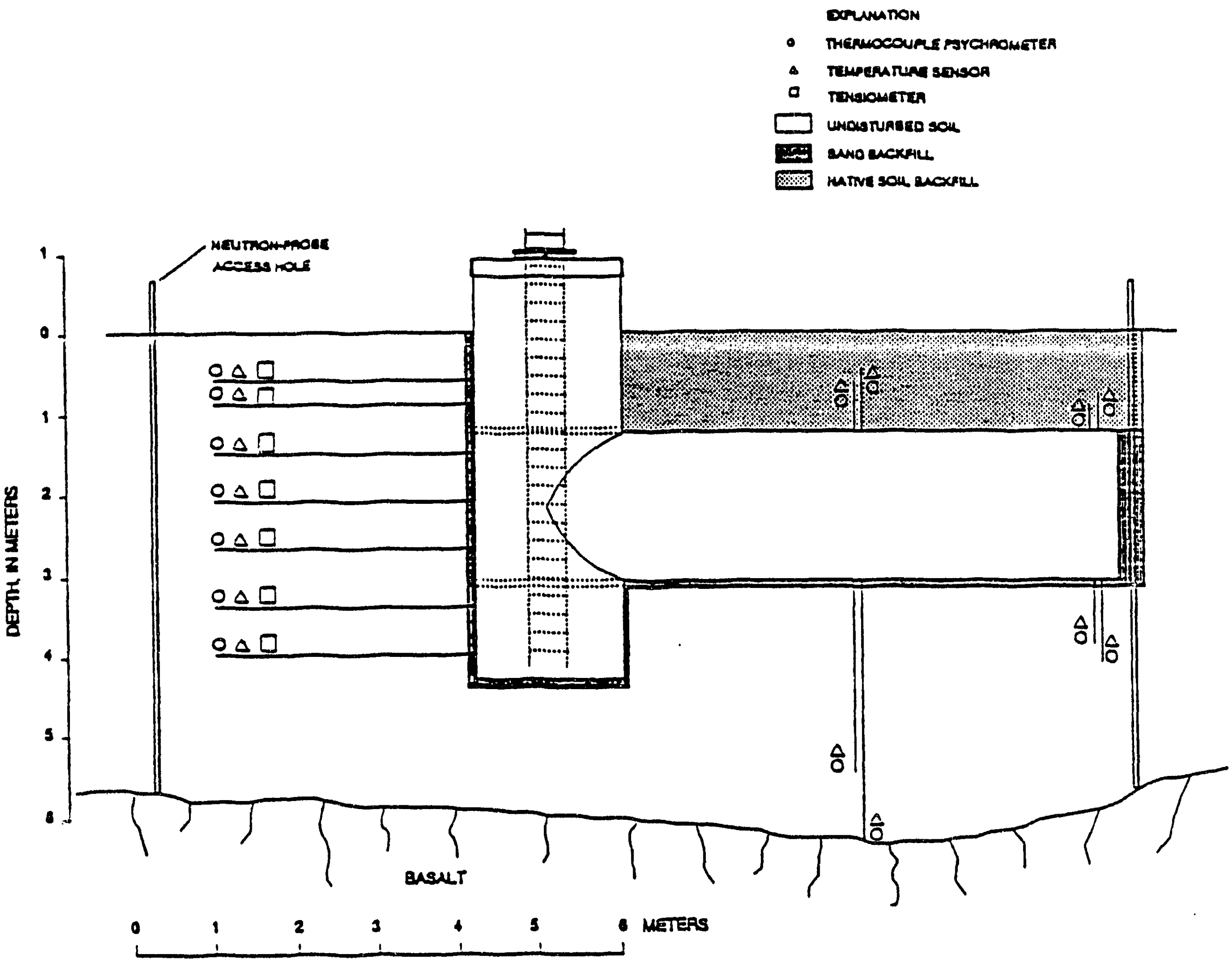


Fig. 16. Cross-section of west test trench.

at other facilities. Primarily because there does not appear to be any reported problems associated with waste water disposal at these locations. The RWMC has received much attention in the last few years as result of being priority No. 1 in the superfund clean up of the INEL. A considerable amount of data are available describing the unsaturated zone at the RWMC. These data have been collected to field calibrate a radionuclide migration model for the RWMC.

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[R] Requested publication through John in WRRI office.
[O] Publication on file in WRRI office.

Physical Constants of Interest

Radio Isotope	Half-Life
Tritium	7.2 yr
Strontium-90	28 yr
Iodine-131	8.14 days
Cesium-137	33 yr
Zirconium-95	65 days
Niobium-95	35 days

99 percent of the radio isotope will decay within 7.2 half-lives.

Summary of Monitoring or Investigations Which Includes the Unsatzone:

TAN

There are some auger holes surrounding the SMC pond. Gas injection work was done in 60's - 70's resulting in wells completed in the unsaturated zone. There should also be augering surrounding disposal ponds.

NRF

1965: 4 holes were augered at the NRF sewage lagoons, wells 65-1 - 4. Wells were completed with PVC. All were dry.

IDO-22048 1965, Baraclough, J.T., W.E. Teasdale, and R.G. Jensen; Hydrology of the National Reactor Testing Station.

TRA

Dilute chemical and radioactive wastes have been disposed of since 1952. Perched water bodies have formed as a result. Perched water has been identified at approximately 50 and 140 ft depths.

1960-61: 19 cable-tool hole were completed between 100 - 210 ft. USGS-53 - 56, 60 - 64, 68 - 75, 78, 80.

1962: 26 augered holes were completed with 2" pipe, slotted last 5 feet, to the basalt-sediment interface, A-1 - A-26.
1963: 18 augered holes were completed with 2" pipe, slotted last 5 feet, to the basalt-sediment interface, A-27 - A-42.
1965: 18 augered holes were completed with 2" pipe, slotted last 5 feet, to the basalt-sediment interface, A43 - A-60.
1968: 27 augered holes were completed with 2" pipe, slotted last 5 feet, to basalt-sediment interface, A-61 - A-88.
1982: 9 augered holes were completed to the basalt-sediment interface around the Cold Waste Pond, CWP1 - 9.
1986: 6 air-rotary holes completed in the lower perched zone, about 140-200 ft, PW-1, 5 - 9.
1990: Wells PW-10 through at least PW-13 were drilled, probably air-rotary.

Wells A-1 - A-88 surround the Warm and Chemical Waste Ponds, Wells CWP-1 - 9 surround the Cold Waste Ponds, Wells PW-1 - 9 are distributed across the inferred extent of the deeper perched zone. Wells are monitored on quarterly to annual basis by USGS and EGG ERP. A number of these wells are dry. Diesel product was encountered during drilling of PW-13.

ICPP

Wastes from fuel reprocessing are treated and stored at the Tank Farm within the ICPP. Service wastes are disposed of in infiltration ponds. Perched bodies have formed as a result of previous disposal activities, leaks, and failure of the waste injection well. Most radioactive wastes were disposed of through injection directly to the aquifer until the practice was discontinued in 1984. Use of percolation ponds, beginning in 1984, resulted in formation of significant perched water. Perched water has been encountered at the basalt surficial sediment interface, approximately 110 ft, and 330 ft.

1983:	At least 12 holes were augered to the basalt-sediment interface around the percolation ponds. These wells have been destroyed. CCP A1-12
1983-84	approximately 50 holes were augered to the basalt-sediment interface around the percolation ponds. SWPP-1 - 27, a.
1986:	3 air-rotary holes completed in the lower perched zone, about 140-200 ft, PW-2,3,4
1990:	Boreholes 1 - 5 have were completed immediately surrounding the Tank Farm. At least 4 were to be completed with vacuum lysimeters , 2 at the surfical sediment-basalt interface about 40 ft. depth, and at least 2 completed in the basalt above the 110 ft. sedimentary interbed.

The USGS and WINCO contractor, Golder and Assoc. samples perched waters in the vicinity of the ICPP. One perched well was noted as monitored quarterly in a 1965 USGS report.

IDO-22044 1962, Hydrology of Waste Disposal, NTRS; Annual Progress Report

IDO-22048 1965, Barraclough, J.T., N.E. Teasdale, and R.G. Jensen; Hydrology of the NRTS

Central Facilities Area Landfills

Neutron access tubes, augered holes instrumented with heat dissipation sensors, salinity sensors, and gas sampling ports were installed, 1987-88 to aid in the hydrologic characterization of Landfills II and III.

5 neutron access tubes installed by driving to approximately the basalt interface, 18-24 ft depth. One tube is completed through landfill wastes.

9 holes 11 - 31 ft depth were completed with: heat dissipation blocks installed at 5 ft intervals, salinity blocks installed at the base and 5 ft above the base of the augerings, and gas sampling ports were installed at the base of the holes. Two holes were completed by driving through wastes at LF-2. These holes have single completions at the base of the holes, below wastes.

Materials testing was conducted for augerings concurrent with completions.

There are also At least 5 wells completed in the aquifer at these locations.

References:

EGG-ER-8291 1988, Ansley, S.A., L.C. Hull, and S.M. Burns; Shallow drilling report for Landfills II and III, FY-88, Characterization of surficial sediments.

EGG-ER-8496 1989, Wood, T.R., L.C. Hull, and M.H. Doornbos; Groundwater monitoring plan and interim status report for Central Facilities Area Landfill II

EGG-ER-8521 1989, Wood, T.R., L.C. Hull, and M.H. Doornbos; Groundwater monitoring plan and interim status report for Central Facilities Area Landfill III

RWMC

Subsurface disposal at the Radioactive Waste Management Complex began in 1952. The facility has received low-level and chemical solid wastes from site activities and other DOE operations. Perched water bodies are present. Current investigations focus on remediation of volatile organics and characterization of vadose zone soils and basalt.

1975: Wells 93A, 96A, and 96B were drilled to approximately 230 ft, being cored from about 30 ft. to 230 ft depth. Bores were then cemented.

1976-77: Wells 76-1 - 6 were drilled to about 250 ft depth and then backfilled with cement to the surface. Cores and water encountered were sampled. Well 77-1 was cored to 600 ft depth, and then cemented back to 400 ft depth an completed with gas-samplers., 77-2 was completed at perched water, 87.7 ft.

1978-79: Wells 78-1 79-3 are completed to about 80 ft, wells 78-2,3 and 79-1,2 are completed to the 240 ft. interbed, well 78-4 is compiled to 350 ft. interbed. Wells 78-4 and 79-2 were completed with gas-sampling ports in 1988-89.

1985-86: 2 test trenches were installed in 1985. Trenches were instrumented with thermocouple psycrometers, temperature sensors, and tensiometers. Neutron probe access tubes were installed adjacent to the trenches. A weather station was also installed.

1988-89: 5 wells, 8801D,T, 8802D, 8901D, and 8902D were drilled to about 250 ft and completed with multiple gas-sampling ports. Well 8901D was completed as the vapor-vac. extraction well.

1989: Well WWW-1 was completed with gas sampling ports.

Neutron wells

TREE-1171 1978, Humphrey, T.G., and F.H. Tingey, The subsurface migration of radionuclides at the RWMC

EGG-WM-9301, 1991, Sisson, J.B., and G.C. Ellis, Summary Report of Results of the Vapor Vacuum Extraction Test at the RWMC.

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July 3, 1991

Mike Bennett
Technical Support Division
785 DOE Place
Idaho Falls, Idaho 83402-1131

Subject: Summary of Site tour and discussions sponsored by the INEL Oversight Program, June 27 & 28.

Dear Mike:

Following is a summary of the 2-day site visit in support of the Research and Development grants 2 (Unsaturated Zone Contamination and Transport Processes) and 3 (Surface Water-Groundwater Interactions and Regional Groundwater Flow) sponsored by the State Oversight program.

The group assembled at the Weston Inn in Idaho Falls and proceeded north to TAN, leaving town at 7:00 AM. Larry Mann, (USGS) joined the group at the junction of I-15 and SH-33. The first stop was at the point where SH-33 crests Circular Butte. Discussions included: description and history of waste disposal and unsaturated zone investigations at TAN, Steve Anderson's Snake River Plain volcanic stratigraphy, the lack of information concerning underflow from Medicine Lodge, Birch Creek, and the Big and Little Lost River valleys. Maps with the location of TAN-area wells were distributed.

The next stop was Howe Point (on SH-22/33), where discussions focused on playas and infiltration rates for the Big Lost River and waste water infiltration ponds. A handout consisting of figures and tables from M.Bennett's recent report (DOE/ID-22091) concerning groundwater response to Big Lost River flow events was distributed.

At the following stop, TRA, a summary of basic TRA operations and waste disposal was distributed. Tom Wood (EG&G) described the TRA perched water systems and their relationship to regional groundwater flow, and perched system response to changing waste water volumes and chemistry.

A scheduled stop where Lincoln Boulevard crosses the Big Lost River was omitted and the group moved on to the ICPP Percolation ponds. Chris Martin (WINCO) and Brent Russell (Golder) discussed ongoing investigations and the current conceptual model for hydrogeology and shallow stratigraphy at the ICPP. The group stopped to observe drilling operations on the east side of the facility (the "Alligator Pit"). A handout summarizing current hydrogeologic tasks and areas for research consideration at the ICPP was distributed. Brent Russell presented fence diagrams for ICPP and entertained questions during the lunch break.

Following lunch, the group went to the INEL diversion area east of the RWMC where discussions centered on historic Big Lost River flow events and associated response in RWMC-area perched water.

The final stop was at the RWMC. The group first went to the overlook west of the facility. Discussions focussed on nature of wastes, flooding events, perched water monitoring, and the Vapor Vacuum Extraction system and test. The group then stopped at the USGS Test Trench site, where John Pittman (USGS) and Jon Kaminisky (EG&G) described vadose zone monitoring being conducted. A handout illustrating instrumentation at the site and early data from this network was distributed. The handout is a collection of figures from a USGS report (DOE/ID 22089). The group departed for Idaho Falls at approximately 4:00 p.m.

The group reconvened at 8:00 AM, Friday (6/28), at Conference Room 1, Idaho Falls Public Library. Warren Barrash, INEL Oversight Program, presented a series of transparencies outlining organization of the Oversight Program within the State of Idaho and how the Oversight Program interacts with other State agencies. Warren outlined concerns which lead to development of State sponsored R&D projects, and described the objectives and approach to be take for R&D projects 2 and 3.

Luke White (EG&G Environmental Waste Management Computing), head programmer for ERIS, described the intent of the ERIS system, which is to be a repository of environmental parameters to aid investigations and cleanup of INEL waste sites. He described the system as a distributed database designed to allow joined-queries. Information in ERIS resided in several databases. A joined query is where information from more than one database is required to fill a request. An example query is: collect organic analyses for wells within certain INEL grid coordinates. To do this, first the wells are located in the wells database, then chemical analyses for those wells are identified in the chemical database. Luke also summarized data currently in ERIS: (wells data - construction, location, etc.) several hundred thousand chemical analyses from the past few years, meteorological data from RESL, a digital elevation model for the INEL, roads and utilities outside facilities, and facility plots.

Luke mentioned the need for streamlining communication between the State and ERIS. Tom Wood interjected the comment that communication between the State and contractors could be streamlined if the request or query is focused. Paul Allen added that direct communication between the state, universities and contractors is encouraged, but requests for documents must be processed through DOE.

Swen Magnuson and Jeff Sondrup (EG&G) presented overviews of modeling efforts at TAN (model validation using 1968-69 USGS gas injection testing at TAN), TRA (2D modeling of perched system), and RWMC (modeling to aid design of VVE system). Videos of the computer simulations were viewed during the lunch break.

Plans for a follow-up meeting in early fall to define data needs and research direction were discussed. Present at the meeting should be EG&G, RESL, USGS, and WINCO researchers. Plans for a meeting focusing on models, parameters, and model sensitivities were also discussed.

Following lunch, the State and university researchers reconvened to discuss possible directions of research. They emphasized that the focus should be on the fundamental processes governing transport. Their first step is to fully assess the information that they already have.

Your assistance with planning and security matters, and discussion during the tour was greatly appreciated. Attached are sign up sheets passed around during the tour Thursday and discussions Friday.

Sincerely,

L. Flint Hall

L. Flint Hall
Senior Ground Water Quality Analyst

LFH:cdh
Attachment
cc: Warren Barrash, INEL Oversight Program, Boise
Chris Martin (WINCO)
Larry Mann (USGS)
File - 002.4/Correspondence

Oversight Site Visit
June 27 ?

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Oversight K&DC T?
Site Visit June 28

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July 3, 1991

MEMORANDUM

TO: Warren Barrash, Environmental Hydrogeologist

FROM: Flint Hall, Senior Groundwater Quality Analyst
Idaho Falls Field Office

SUBJECT: INEL Site Visit in support of R&D projects 2&3, June 27-28.

I was pleased with how the site visit last Thursday and Friday progressed. The tour Thursday provided an excellent forum for discussions of INEL hydrogeology, and efforts to understand how the hydrogeologic system operates. Friday's exchange helped to: explain the Oversight Program's mission, identify data gaps, present current modeling efforts, and suggest areas of investigation which should aid understanding of vadose zone and contaminant transport processes.

The proceedings were productive largely due to the time and effort spent in preparation by individuals representing EG&G, USGS, WINCO and DOE-ID. I feel their time was well spent.

Attached is a copy of the sign-up sheet which was circulated in the meeting Friday morning, June 28.

LFH:cdh
Attachment

cc: Dave Hoveland
Dean Nygard
Phil Bandy
Gerry Winters
Matt Nelsen
Lin Campbell
John Finnie
Behzad Izadi
Bradley King
Dennis Horn
George Bloomsburg
Jim Liou
Erik Coats
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Swen Magneson
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Oversight K+D C.T.> Site Visit June 28

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END

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8/20/93