

see folder for Mr
to Wright sm. Olson
6-27-84

BASALT WASTE ISOLATION PROJECT PRESENTATION TO
NUCLEAR REGULATORY COMMISSION ON
BASALT WASTE ISOLATION PROJECT
HYDROLOGIC CHARACTERIZATION PLANS/STATUS

JUNE 12-13, 1984

8407130369 B40627
PDR WASTE
WM-10 PDR

SUMMARY MEETING NOTES
DOE/NRC MEETING ON THE BWIP HYDROLOGIC CHARACTERIZATION
GAITHERSBURG, MARYLAND
JUNE 12-13, 1984

Agenda: See Attachment 1

Attendees: See Attachment 2

Developments:

BWIP presented an overview and status of the hydrologic characterization plans as they relate to developments extending from the DOE/NRC workshop on BWIP Hydrologic Characterization (July 1983). The scope of the presentations was focused on the elements of the overall hydrologic characterization program as they relate to the design, installation, and interpretation of the Large-Scale Hydrologic Stress Testing (LHS). The BWIP presentations (Attachment 3) included a brief summary of the historical developments leading to and directing the evolution of the current hydrologic characterization program, a review of the installation of the cluster piezometers (DC-19, DC-20 and DC-22) and an overview of the testing and interpretation methods. The intent of the BWIP presentation was to highlight the key elements of the LHS Testing Program with the objective of reaching a consensus on program changes reached in the "General Understanding" agreed upon during the July 1983 DOE/NRC workshop on Hydrologic Testing and their relationship to NRC Site Technical Position Paper 1.1 (STP 1.1). The program changes related in whole or in part to the BWIP conceptual approach for the establishment of groundwater level baseline criteria and interpretation of the LHS tests, the suitability of the recently constructed nested piezometers and water level measurement facilities (DC-19, DC-20 and DC-22), the use of new data to understand the uncertainties associated with existing data, and the impact of Exploratory Shaft (ES) drilling on the LHS testing.

The discussion item relative to NRC letters addressed to DOE under dates of 11/4/83, 3/2/84, 3/9/84, 4/6/84 and 5/24/84 was not covered by the DOE. The office stated that review was either preliminary or statements were not available on the letters to make a formal comment. Disposition of this agenda item is covered in Item 6 in Attachment 7.

The BWIP comments on the workshop comprise Attachment 4.

The NRC comments on the workshop comprise Attachment 5.

Comments from Other Participants Present

Yakima Indian Nation - The Yakima Indian Nation was represented by B. G. Jones and V. V. Nguyen. B. G. Jones indicated that the Tribe is currently in an observation mode and that they appreciate the opportunity to attend the meetings and participate in the discussions.

State of Washington - The State of Washington, was represented by Dr. William Brewer, State Department of Ecology. Dr. Brewer stated that it appeared that DOE and the NRC were cooperating better in data exchange and that discussions of the program and its development were worthwhile and at a significantly higher level than in the past.

U.S. Geological Survey - No comments were provided.

During the workshop, relationships were identified between discussion topics and the BWIP issues outlined in Appendix C of NUREG-0960. Attachment 6 provides a correlation between these items. Because Attachment 6 was prepared by the NRC after conclusion of the workshop, it was not reviewed by DOE.

Open Items:

Both NRC and DOE/BWIP follow-up actions are contained in Attachment 7.

James E. Mecca
James E. Mecca, DOE
June 14, 1984
Date

Robert J. Wright
Robert J. Wright, NRC
June 14, 1984
Date

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JUNE 12-13, 1984

Tuesday, June 12, 1984

8:00 - 12:00 (Break 10:00) - Overall Strategy For Future Testing

BWIP

- o Historical Development and Evolution of Groundwater Level Baseline and Hydraulic Testing Strategy
- o Major Issues To Be Resolved By Future Testing
- o Decision Logic For Future Data Collection
- o Discussion Of Observations Of Drawdown At DB-14 During Drilling Of DC-29C, DC-20C, and DC-22C
- o Open Discussion

NRC/BWIP

12:00 - 1:00 - Lunch

1:00 - 3:00 - Groundwater Level Baselines

BWIP

- o New Facilities For Data Collection
- o RRL Groundwater Level Monitoring
- o Regional Monitoring Program (USGS)
- o Criteria For Baseline Establishment

3:00 - 3:15 - Break

3:15 - 5:00 - Open Discussion

Wednesday, June 13, 1984

8:00 - 9:00 - Comparison of BWIP Plans With NRC Position Paper 1.1

BWIP

- o Overview Of Program Elements and Schedule For Implementation
- o Program Changes Since July 1983
- o Discussion Of Specific Topics In Position Paper 1.1

9:00 - 11:00 - Discussion and Development Of Updated Understanding of The BWIP Hydrologic Testing Approach As It Relates To Start Of The Exploratory Shaft

NRC/BWIP

12:00 - Lunch

1:00 - 2:00 - Discussion Of Items Contained In The NRC/DOE Letters Dated 11/4/83, 3/2/84, 3/9/84, 4/6/84, and 5/24/84, and Future Plans To Deal With The Comments Contained

2:00 - 3:00 - Comments By Other Participants Including The USGS, State Of Washington, and Affected Indian Tribes

3:00 - Adjourn

HYDROLOGY WORKSHOP
ATTENDANCE LIST
BASALT WASTE ISOLATION PROJECT
NECLAR REGULATORY COMMISSION
JUNE 12, 1984

<u>Name</u>	<u>Affiliation</u>	<u>Phone</u>
Steve Baker	Rockwell	FTS 444-7981 509/376-7981
Jim Bazemore	Rockwell	FTS 444-9188
Bill Brewer	WA St. Dept. Ecology	206/459-6670
Adrian Brown	NRC/Golder	303/973-9587
Neil Coleman	NRC	FTS 427-4677
F. R. Cook	NRC	FTS 444-1701
David H. Dahlen	USDOE-Richland	FTS 444-3022 509/376-3022
Paul Davis	Sandia Labs (NRC)	505 or FTS 846-5421
George A. Dinwiddie	USGS	FTS 928-6976 703/860-6976
Pat Domenico	DOE Consultant	409/845-0636
Glen L. Faulkner	USGS	FTS 233-2999
Charles Faust	GeoTrans (Yakima)	703/435-4400
Matthew J. Gordon	NRC/WMGT	301 or FTS 427-4240
Ron Guenther	Oregon State Univ.	503/754-4686
Bob Hudspeth	Oregon State Univ.	503/754-3631
R. L. Jackson	Rockwell	509/373-4226
B. Geoffrey Jones	GeoTrans (Yakima)	703/435-4400
L. S. Leonhart	Rockwell	509/376-2655
Walter Loo	Rockwell-Perf. Assess.	509/376-1758
Fred Marinelli	Golder ASsoc.	303/989-3800
James Mecca	USDOE-Richland	FTS 444-5038
Jeffrey Nelson	WESTON	301/963-6838
V. Joe Nguyen	EWA (Yakima)	612/559-3706
Martha Pendleton	WESTON	301/963-6847
Dale Ralston	Williams & Assoc. NRC	208/883-0153
Jay Rhoderick	USDOE-Germantown	FTS 233-5204
J. R. Rollo	USGS	FTS 928-6082
Jerry Rowe	Golder Assoc. NRC	206/827-0777
Gene Rush	USGS	FTS 234-2115
Jay L. Smith	DOE Consultant TRG	213/595-5795
Peter Stevens	USGS	FTS 928-6976
S. R. Strait	Rockwell	509/373-4226
Mike Thompson	USDOE-Richland	FTS 444-6421 509/376-6421
Teek Verma	NRC	FTS 976-5916
Kristin Westbrook	NRC	FST 427-4532
Roy E. Williams	Williams & Assoc. NRC	208/883-0153
Gerry Winter	Williams & Assoc. NRC	208/883/0153
Robert J. Wright	NRC	FTS 427-4674
Dan Youngberg	USDOE-Germantown	FTS 233-5428
Tony Zimmerman	PNL	509/376-8333

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JUNE 12-13, 1984

GOALS FOR MEETING

- o PRESENT CURRENT INFORMATION TO THE NRC STAFF SO THAT AN UNDERSTANDING OF THE BWIP HYDROLOGIC CHARACTERIZATION PROJECT IS ACHIEVED.
- o ESTABLISH AN UPDATED "GENERAL UNDERSTANDING OF TESTING STRATEGY (JULY 1983)" AS IT RELATES TO THE START OF THE LHS TESTS AND ES DRILLING.

ITEMS FOR CONSIDERATION
IN THE "UPDATED GENERAL UNDERSTANDING"

1. THE BWIP CONCEPTUAL APPROACH FOR ESTABLISHMENT OF GROUNDWATER LEVEL BASELINE CRITERIA.
2. THE BWIP CONCEPTUAL APPROACH FOR THE INTERPRETATION OF THE LHS TESTS.
3. RECONCILIATION OF DIFFERENCES BETWEEN NRC P.P. 1.1 AND CURRENT BWIP CHARACTERIZATION PROGRAM.
4. SUITABILITY OF AS-BUILTS LARGE SCALE AQUIFER TEST AND GROUNDWATER LEVEL MEASUREMENT FACILITIES.
5. USE OF NEW DATA TO UNDERSTAND THE UNCERTAINTIES ASSOCIATED WITH EXISTING (MAINLY DRILL AND TEST) DATA.
6. IMPACT OF ES DRILLING IN SADDLE MOUNTAIN AND WANAPUM BASALTS OF LHS TESTING IN THE GRANDE RONDE.

KEY PROGRAMMATIC ACTIVITIES

- | | | |
|---|--|-------|
| 0 | EVALUATE POTENTIAL IMPACT OF SHAFT ON LARGE-SCALE HYDRAULIC STRESS TESTING | 7/84 |
| 0 | REVIEW HYDROLOGIC BASELINE DATA WITH NRC | 12/84 |
| 0 | MOBILIZE EXPLORATORY SHAFT DRILLING CONTRACTOR | 12/84 |
| 0 | ISSUE BWIP ENVIRONMENTAL ASSESSMENT | 12/84 |
| 0 | PRESIDENT NOMINATES 3 SITES FOR CHARACTERIZATION | 1/85 |
| 0 | ISSUE BWIP SITE CHARACTERIZATION PLAN | 1/85 |
| 0 | ISSUE OPTION ON HYDROLOGIC BASELINE CONSENSUS | 3/85 |
| 0 | INITIATE DRILLING OF BWIP EXPLORATORY SHAFT | 3/85 |
| 0 | COMPLETE FIRST LARGE-SCALE HYDRAULIC STRESS TEST IN GRANDE RONDE BASALTS | 5/85 |
| 0 | COMPLETE SECOND LARGE-SCALE HYDRAULIC STRESS TEST | 8/85 |

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OVERALL STRATEGY FOR FUTURE TESTING

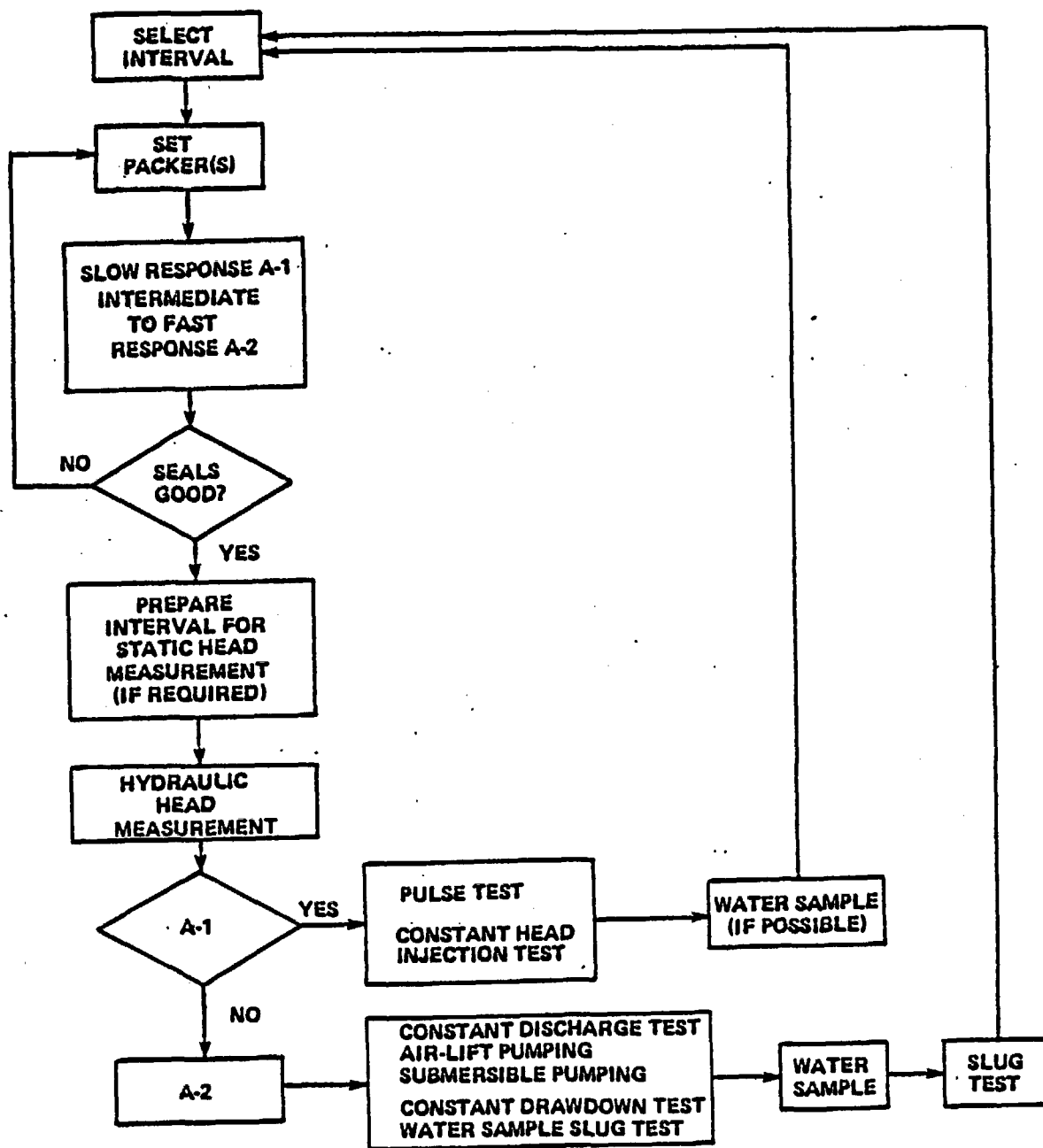
- o HISTORICAL DEVELOPMENT AND EVOLUTION OF GROUNDWATER LEVEL BASELINE AND HYDRAULIC TESTING STRATEGY.
- o MAJOR ISSUES TO BE RESOLVED BY FUTURE TESTING
- o DECISION LOGIC FOR FUTURE DATA COLLECTION
- o DISCUSSION OF OBSERVATIONS OF DRAWDOWN AT DB-14 DURING DRILLING OF DC-19C, DC-20C, AND DC-22C.
- o OPEN DISCUSSION

HYDROLOGIC CHARACTERIZATION PROGRAM CHRONOLOGY

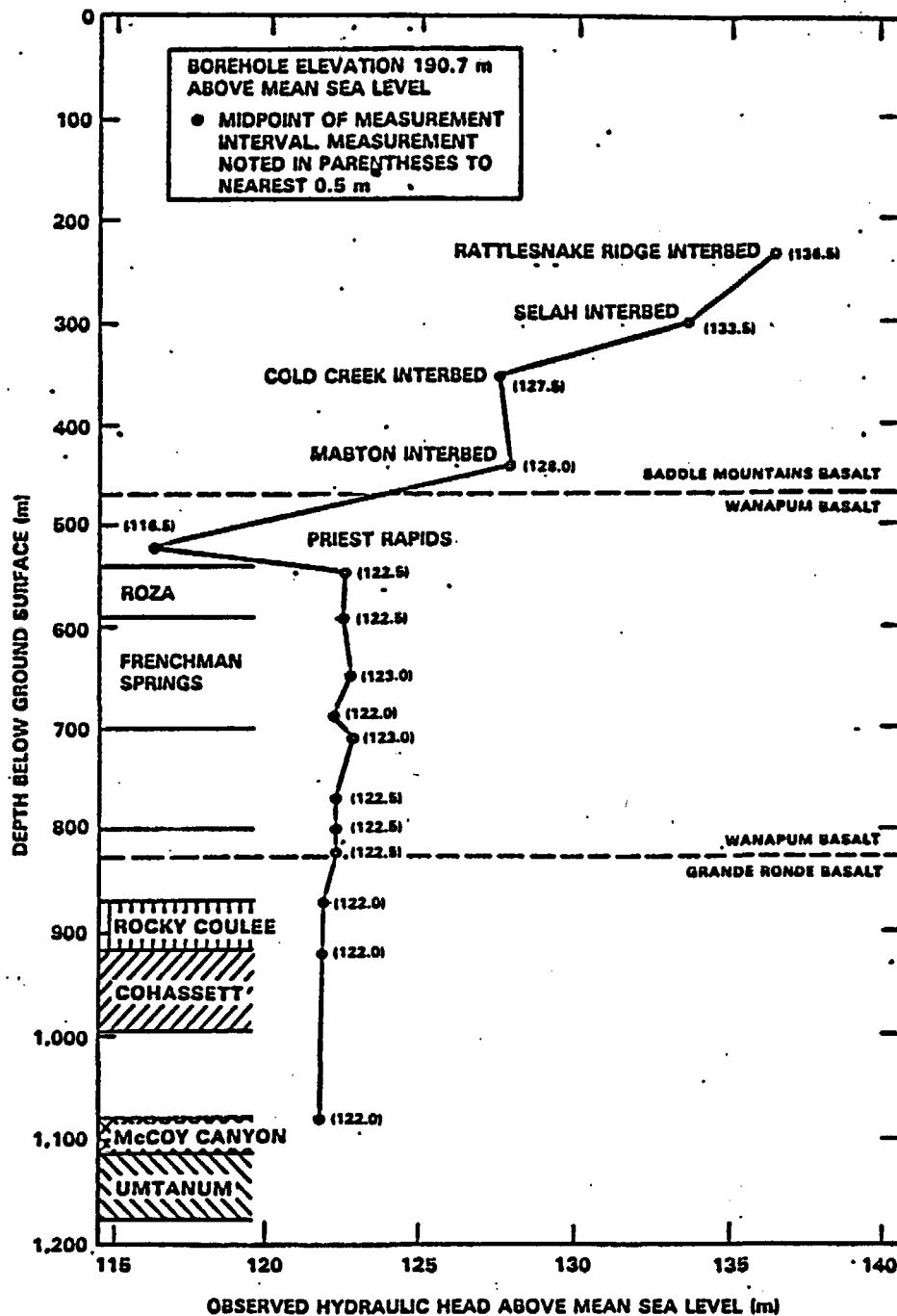
- o PERIODIC MEETINGS WITH NRC BEFORE SCR ISSUED
- o SOME USGS INVESTIGATIONS AND ANALYSES NEAR AND AT HANFORD
- o INTERAGENCY HYDROLOGY WORKING GROUP STARTS (WITH USGS AND PNL) - FEBRUARY 1982
- o NRC HYDROLOGY WORKSHOP - JULY 1982
- o SITE CHARACTERIZATION REPORT - NOVEMBER 1982
 - NRC REVIEW
 - USGS REVIEW
 - STATE OF WASHINGTON REVIEW (GOLDER)
 - PUBLIC COMMENTS
- o NWPA SIGNED - JANUARY 1983
- o BWIP RESPONSES TO REVIEW COMMENTS - SPRING 1983
- o NRC HYDROLOGY WORKSHOP - JULY 1983
- o USGS REVIEW TEAM REPORT - AUGUST 1983
- o START ADDITIONAL DRILLING - SEPTEMBER 1983
- o FINAL DESIGN OF FACILITIES - NOVEMBER 1983
- o NRC HYDROLOGY DATA GATHERING VISIT - JANUARY 1984
- o LAST PIEZOMETER INSTALLED - FEBRUARY 23, 1984
- o NRC WORKSHOP - JUNE 1984
- o SITE CHARACTERIZATION PLAN - JANUARY 1985
- o START EXPLORATORY SHAFT AND LARGE-SCALE HYDRAULIC STRESS TESTING - MARCH 1985

SUMMARY OF ISSUES RELATED TO PAST RECONNAISSANCE-LEVEL DATA

- o DATA (DRILL AND TEST TECHNIQUE)
 - QUANTITY
 - QUALITY
 - REPRESENTATIVENESS (SCALE EFFECTS)
- o ANALYSES
 - SINGLE CONCEPTUAL MODEL
 - USE OF HYDROCHEMISTRY DATA

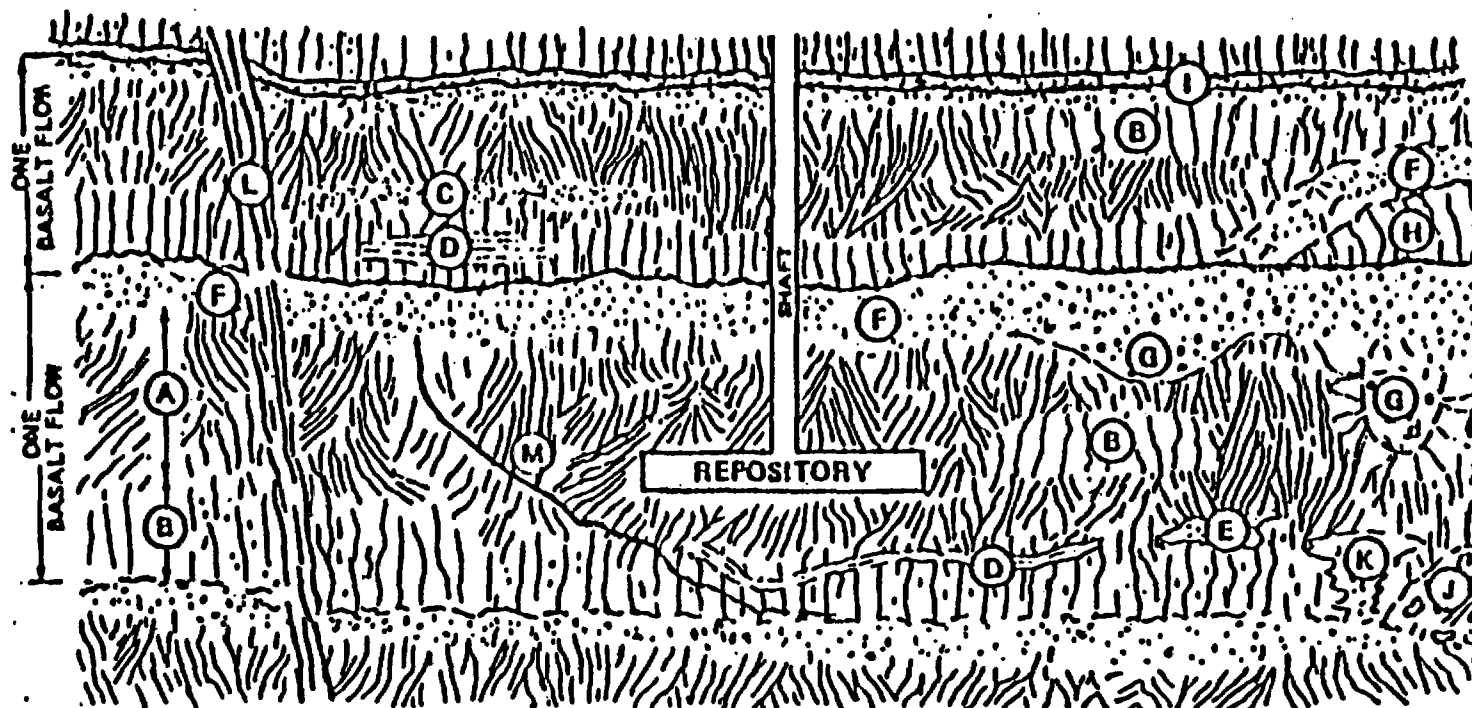


FLOWCHART OF GENERAL PROCEDURES USED IN HYDROLOGIC TESTING.



RCP8209-1388

HYDRAULIC HEAD MEASUREMENTS WITHIN THE SADDLE MOUNTAINS
AND WANAPUM BASALTS IN BOREHOLE DC-16A



*(NOTE: NO HORIZONTAL OR VERTICAL SCALE INTENDED)

EXPLANATION

FLOW INTERIOR

- A ENTABLATURE
- B COLONNADE
- C VESICULAR ZONE
- D PLATY ZONE
- E ANOMALOUSLY FRACTURED ZONE

FLOW CONTACT

- F FLOW TOP
- G LOCAL THICKENING OF FLOW TOP BRECCIA
- H FLOW TERMINATION
- I SEDIMENTARY INTERBED
- J PILLOW BRECCIA
- K SPIRICLE OR SPIRICLE-LIKE FEATURE

BEDROCK STRUCTURE

- L FAULT OR FRACTURE ZONE, HINGE OF FOLD, OR SHEAR ZONE
- M LOCALIZED TECTONIC FRACTURE

COMPOSITE HYPOTHETICAL CROSS SECTION OF GEOLOGIC FEATURES
POTENTIALLY AFFECTING GROUNDWATER FLOW PATHS

BWIP APPROACH TO ISSUE RESOLUTION

- o CONCERNS ARE VALID AND MUST BE ADDRESSED
- o INTENSIFIED INTERACTIONS TO GET EARLY INPUT FOR FUTURE DATA COLLECTION
- o WE HAVE NOT AGREED THAT OUR DATA AND CONCEPTUAL MODELS ARE INVALID
- o ADDITIONAL DATA (WITH UNCERTAINTIES) TO BE COLLECTED TO DISTINGUISH AMONG CONCEPTUAL MODELS
- o UNCERTAINTIES TO BE DETERMINED FOR PRE-SCR DATA

BWIP PROGRAM FOR ISSUE RESOLUTION

- o CONSIDER A FULL RANGE OF CONCEPTUAL MODELS
- o POST-SCR DATA COLLECTION DESIGNED TO DISTINGUISH BETWEEN CONCEPTUAL MODELS
- o USE AIR-MIST WHEN POSSIBLE FOR POST-SCR BOREHOLES
- o HYDRAULIC PROPERTIES MEASURED AT REPRESENTATIVE SCALE
- o EMPHASIS ON DOCUMENTATION OF DATA (INTERVAL REPORTS, DBMS)
- o SEQUENCED PROGRAM STARTING WITH WATER LEVEL MEASUREMENTS

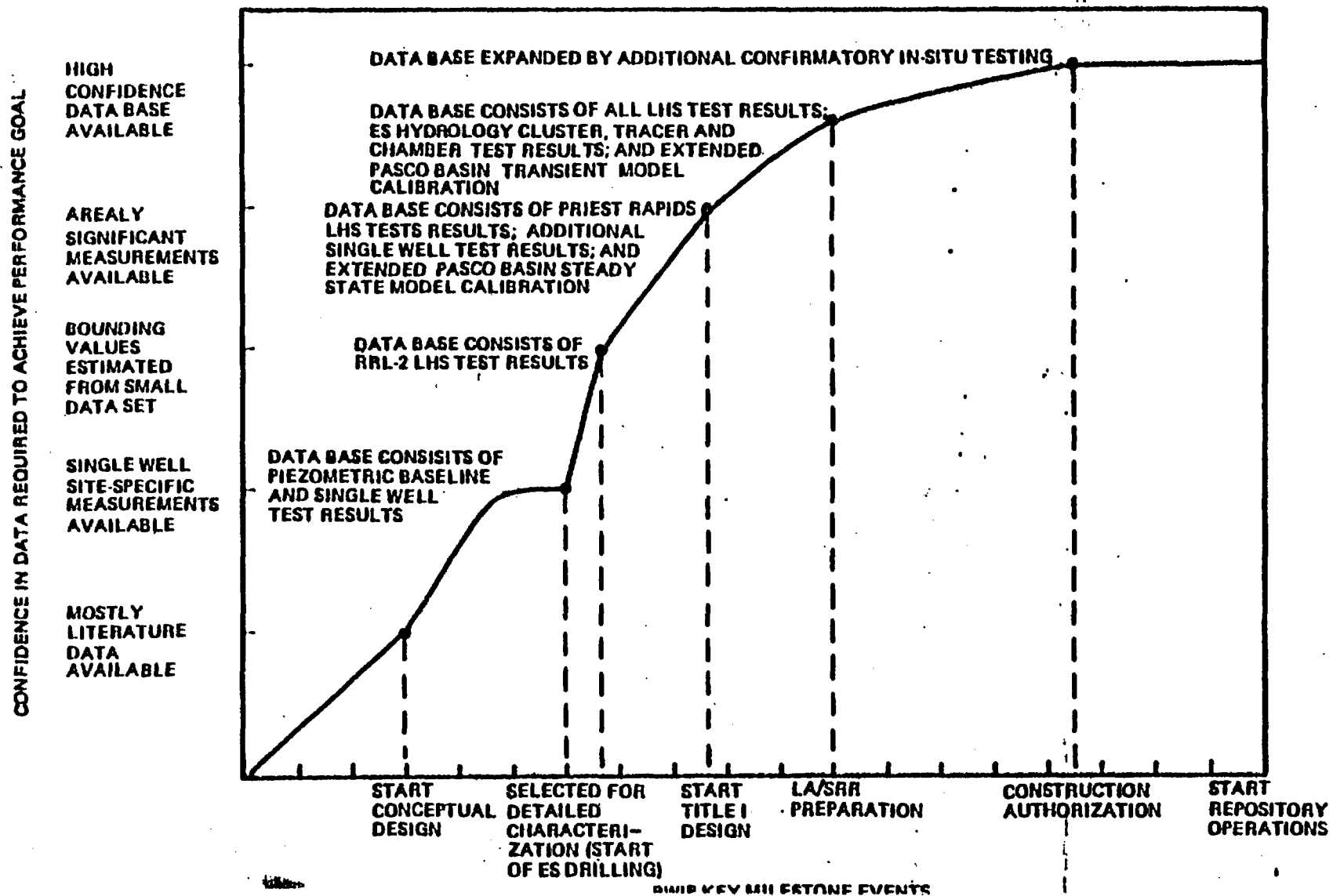
BWIP HYDROLOGIC CHARACTERIZATION STATUS

- o "RECONNAISSANCE" PHASE COMPLETED
- o PLANNING TO COMPLETE HYDROLOGIC CHARACTERIZATION IN PROGRESS (THREE TO FIVE YEAR PROGRAM)
- o HYDROLOGIC CHARACTERIZATION ACTIVITY HAS INCREASED SIGNIFICANTLY RECENTLY
 - INSTALLATION OF PIEZOMETERS
 - PLANNING FOR LHS TESTS
- o MANY TECHNICAL ORGANIZATIONS ARE INVOLVED IN PROBLEM SOLVING

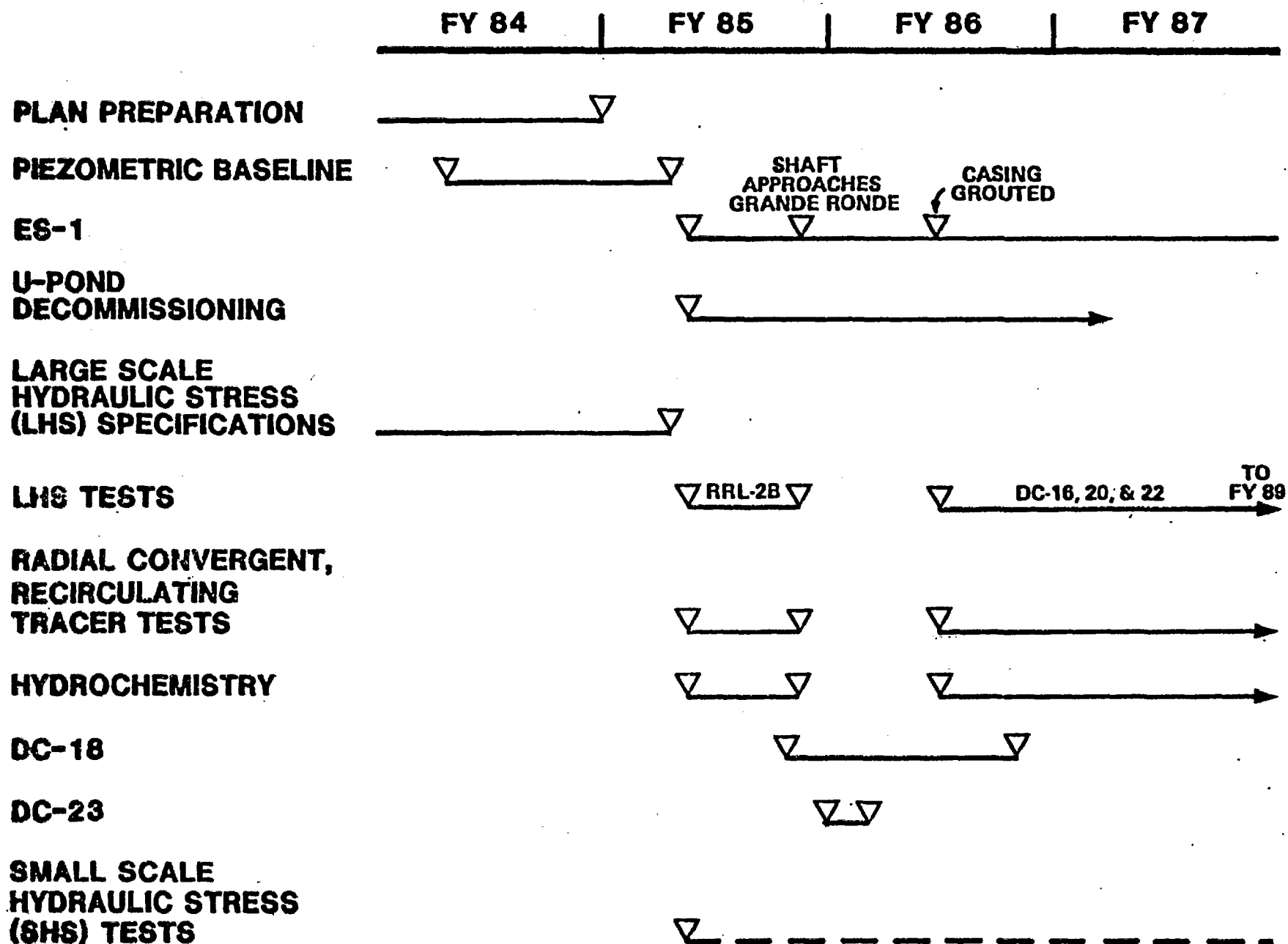
PLANNING STATUS FOR HYDROLOGIC CHARACTERIZATION

- o AGREEMENT ON "APPROACH" FOR SITE (HANFORD) DATA COLLECTION REACHED WITH NRC
- o "REGIONAL" DATA REQUIREMENTS BEING ESTABLISHED WITH USGS

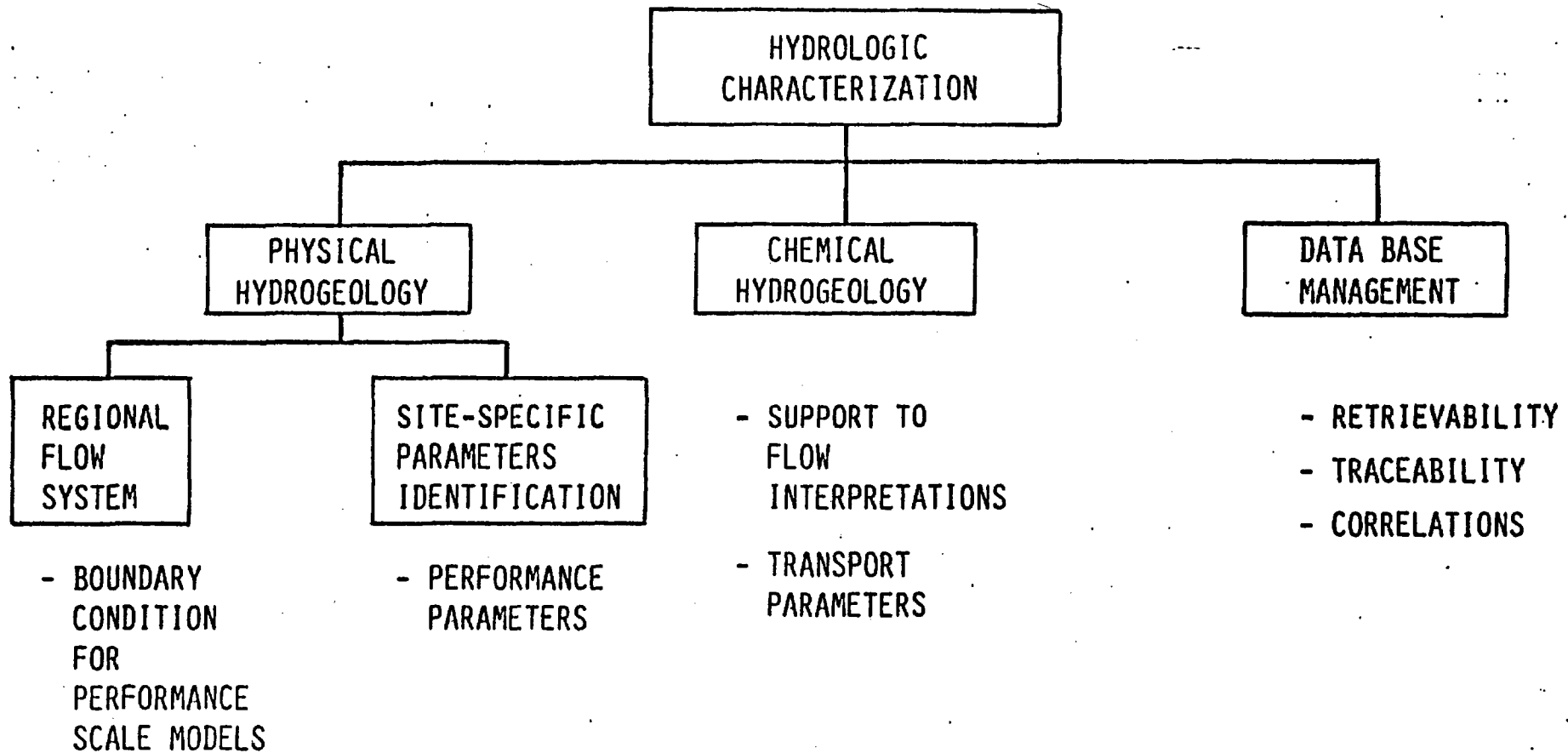
DEVELOPMENT OF REASONABLE ASSURANCE



HYDROLOGIC CHARACTERIZATION



BWIP HYDROGEOLOGY PROGRAM



MAJOR ACTIVITIES TO RESOLVE ISSUES

- o PIEZOMETRIC MONITORING
- o LARGE-SCALE HYDRAULIC STRESS (LHS) TESTING
- o DATA INTERPRETATION AND INTEGRATION
- o RELATIONSHIP OF ES HYDROLOGIC TESTING TO THE SURFACE-BASED TESTING PROGRAM
- o UTILIZATION OF HYDROCHEMISTRY DATA

PIEZOMETRIC MONITORING OBJECTIVES

- o BASELINE FOR LARGE-SCALE HYDRAULIC STRESS TEST (POSSIBLY ONE YEAR)
- o EXTENDED PASCO BASIN MODEL CALIBRATION (THREE TO FOUR YEARS)
- o HEAD GRADIENTS

OVERALL PIEZOMETER SYSTEM ERROR ANALYSIS REQUIRED

- o ACCURACY OF WELL SURVEYS
- o STRETCH OF TUBING
- o STRETCH OF TAPE
- o TRANSDUCER ACCURACY AND REPEATIBILITY
- o TEMPERATURE, TDS, COMPRESSIBILITY, BAROMETRIC PRESSURE
- o BOREHOLE DEVIATION

POTENTIOMETRIC HEADS

- o TWO MEASURES
 - WATER LEVELS
 - PRESSURE
- o POTENTIOMETRIC HEAD USUALLY ASSUMED TO BE:
 - EQUAL TO WATER LEVEL
 - EQUAL TO PRESSURE PLUS THE PRODUCT OF DENSITY, GRAVITATIONAL CONSTANT AND HEIGHT
- o NEITHER EQUATION ABOVE IS EXACT

NEED TO CORRELATE WATER LEVELS,
PRESSURES, AND HEADS

- o UTILIZE REPEATABILITY OF TRANSDUCERS TO IMPROVE MEASUREMENT
ACCURACY
- o COMPARE PIEZOMETER DATA (PRESSURE) TO REGIONAL DATA (WATER
LEVELS)

LARGE-SCALE HYDRAULIC STRESS TEST OBJECTIVES

- o THREE-DIMENSIONAL HYDRAULIC PARAMETERS (CONDUCTIVITY AND STORAGE COEFFICIENT AND EFFECTIVE POROSITY) AT SCALE APPROPRIATE FOR PERFORMANCE MODELING.
- o RESOLUTION OF SCALE RELATED QUESTIONS (I.E., COMPARISON WITH POINT DATA AND EXPLORATORY SHAFT DATA).
- o RESOLUTION OF OTHER CONCERNS (MUD EFFECTS, EQUILIBRATION AND QUALITY OF HYDROCHEMISTRY SAMPLES).

DATA INTERPRETATION AND INTEGRATION

- o INTERACTIVE RELATIONSHIP BETWEEN CONCEPTUAL AND NUMERICAL MODELS.
- o DEVELOPMENT OF INVERSE MODELING (PARAMETER IDENTIFICATION) TECHNIQUES (VALIDATION BY COMPARISON WITH ANALYTIC SOLUTIONS AND FIELD OBSERVATIONS).

INTERPRETATION OF LHS TESTS

- o ANALYTIC TECHNIQUES
- o INVERSE (PARAMETER
IDENTIFICATION)
TECHNIQUES

ANALYSIS TECHNIQUES:
ADVANTAGES AND DISADVANTAGES

ANALYTIC TECHNIQUE

ADVANTAGES

WELL ESTABLISHED AND ACCEPTED

RAPID, EASY CALCULATIONS

PARAMETER IDENTIFICATION

ADVANTAGES

FEATURES CAN BE MODELED

PARAMETER DISTRIBUTIONS CAN BE
IDENTIFIED AT SCALE OF INTEREST

DISADVANTAGES

FEATURES TO BE IDENTIFIED MUST BE
ASSUMED TO NOT EXIST

RESOLUTION FOR THE LIMITED FEATURES
THAT CAN BE ACCOMMODATED IS LIMITED

DISADVANTAGES

NOT WELL ESTABLISHED AND ACCEPTED

IDENTIFICATIONS ARE NOT UNIQUE
EXTENSIVE COMPUTER MODELING REQUIRED

BWIP PARAMETER IDENTIFICATION PROGRAM

- o DEVELOP TRIAL-AND-ERROR EXPERTISE
- o THEORETICAL ANALYSIS TO ESTABLISH APPLICATION OF CONSTRAINTS WHICH FORCE CONVERGENCE (TO UNIQUE ANSWER)
- o NUMERICAL DEMONSTRATION OF TECHNIQUES

ES HYDROLOGIC TESTING

- o PRELIMINARY CHARACTERIZATION OF FLOW PROPERTIES OF EMPLACEMENT HORIZON (FULL RELIANCE ON EMPLACEMENT HORIZON MAY NOT BE NECESSARY, BUT WOULD REQUIRE COUPLED TESTING)
- o DETERMINATION OF REPRESENTATIVE FLOW INTERIOR CHARACTERISTICS (WILL BE CORRELATED WITH LHS TEST RESULTS)

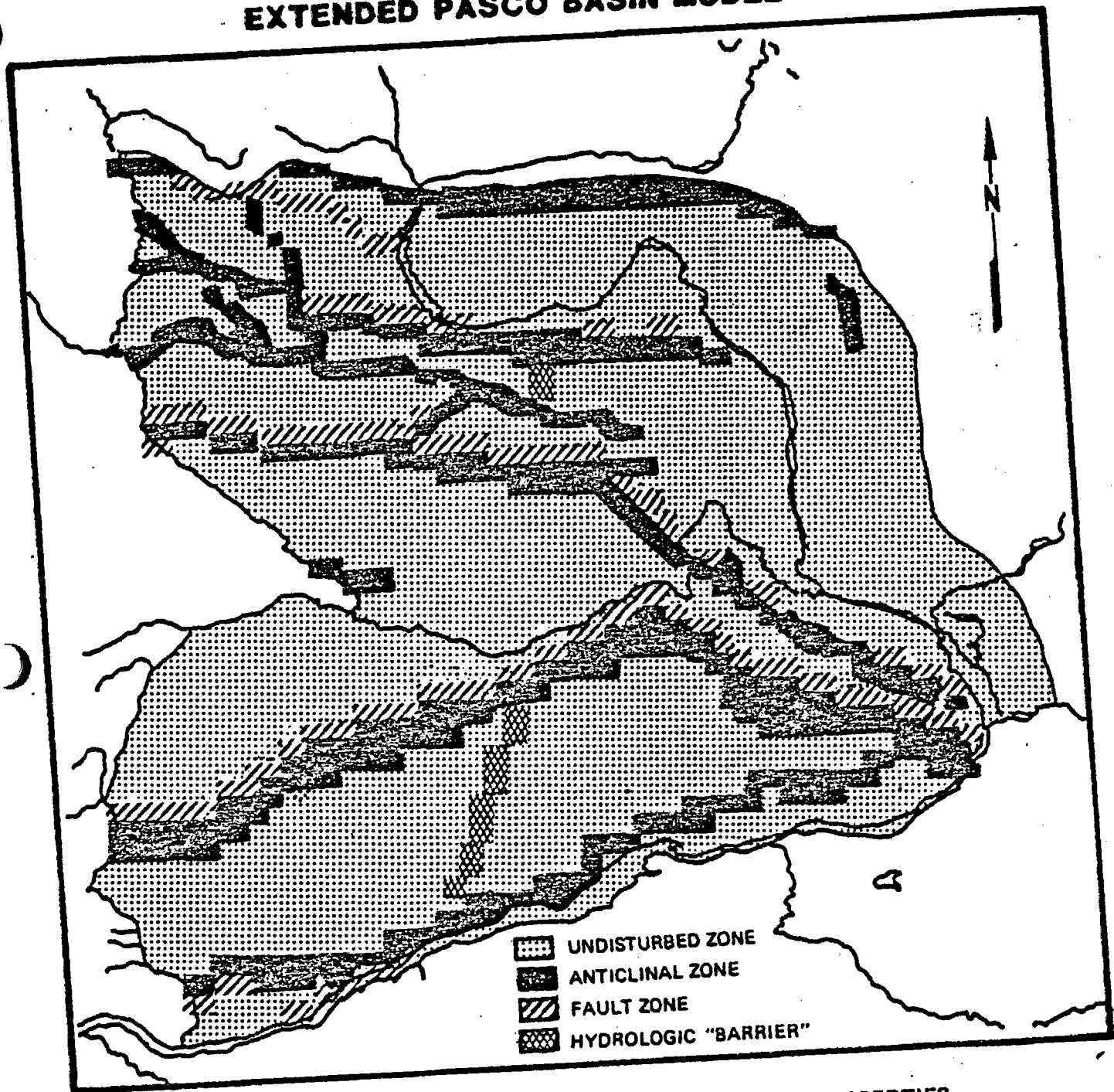
UTILIZATION OF HYDROCHEMISTRY DATA

- o SUPPORT TO GROUNDWATER FLOW SYSTEM INTERPRETATION.
- o PROGRAM FOR DETERMINATION OF SITE RADIONUCLIDE TRANSPORT PROPERTIES.

LOGIC FOR REGIONAL FLOW SYSTEM INVESTIGATION

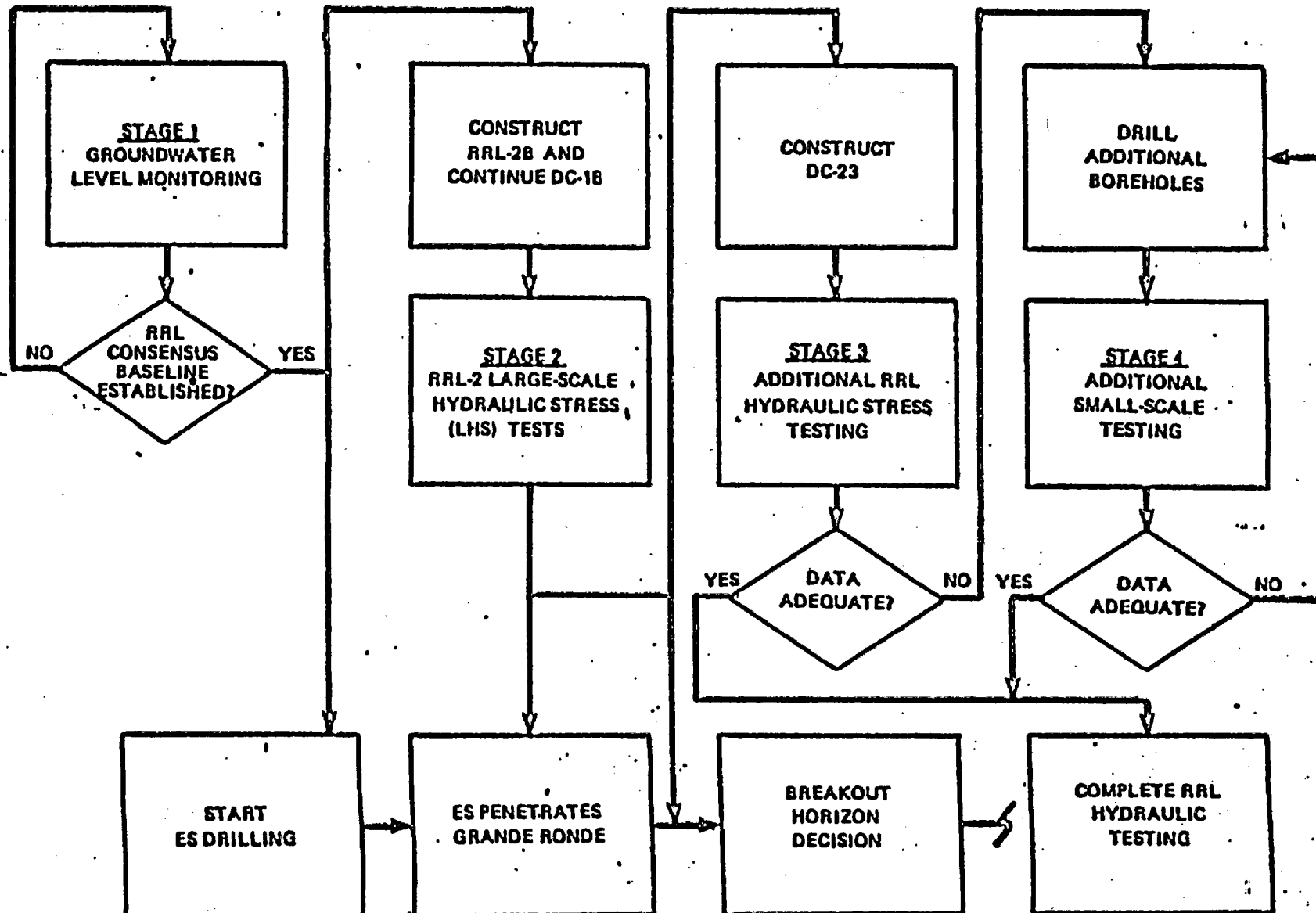
- O EXTEND PASCO BASIN MODEL
- O RELATIONSHIP TO RASA
- O PRE-DISTURBANCE (PRE-IRRIGATION) CALIBRATION (HISTORIC WATER LEVELS)
- O HISTORIC STRESSES
- O CALIBRATION TO CURRENT CONDITIONS
 - CURRENT WATER LEVELS
 - THREE YEAR CALIBRATION

**GROUNDWATER FLOW SYSTEM
(Conceptual model)
EXTENDED PASCO BASIN MODEL**

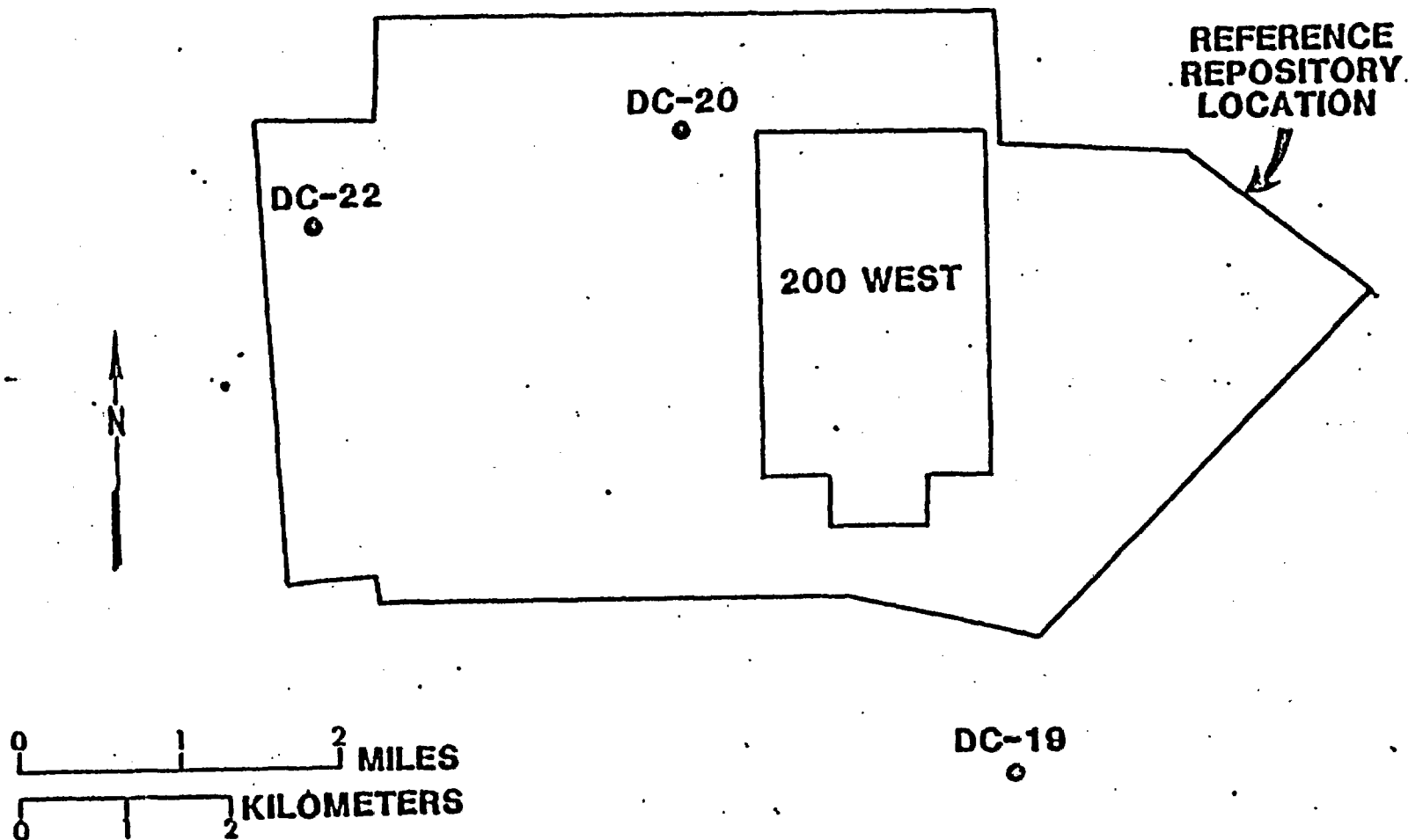


BOUNDARIES AND ZONES OF DIFFERENT HYDROLOGIC PROPERTIES

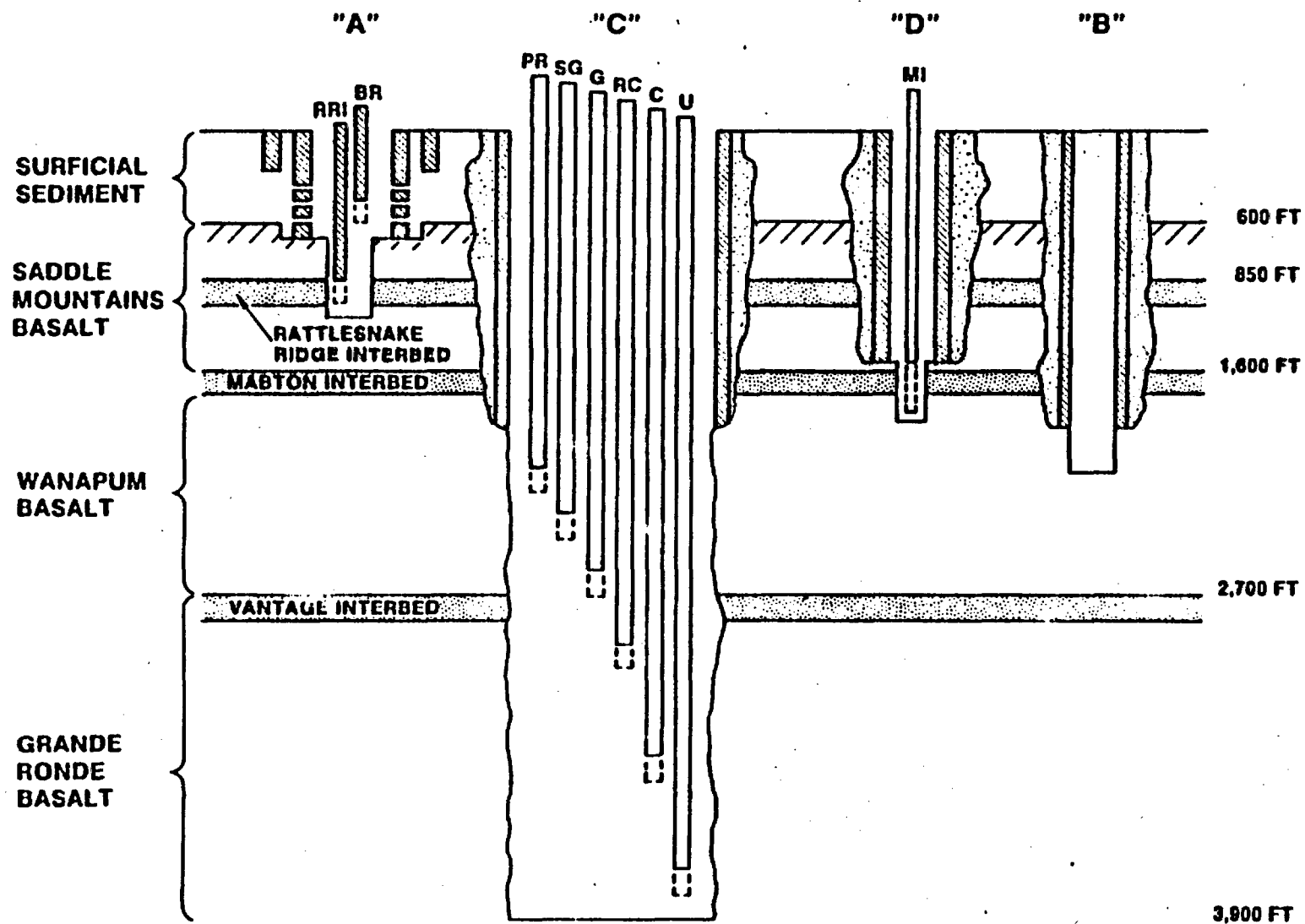
LOGIC DIAGRAM FOR RRL HYDRAULIC TESTING



BASALT WASTE ISOLATION PROJECT PIEZOMETER NETWORK



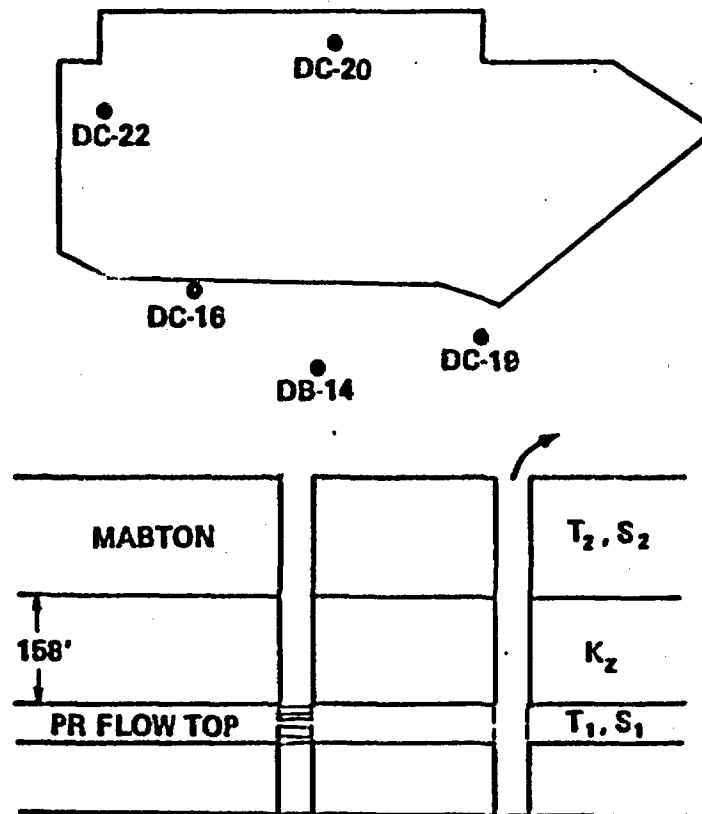
SCHEMATIC OF PIEZOMETER CLUSTER DESIGN



DISCUSSION OF OBSERVED DRAWDOWNS DURING DRILLING

- o DRAWDOWN OBSERVED AT DB-14, DC-16B, AND DC-1
- o SCOPING INTERPRETATION POSSIBLE ONLY FOR DB-14 AND DC-16B
- o DEMONSTRATION OF TRIAL-AND-ERROR TECHNIQUE
- o NOT A TEST EVALUATION
- o ANSWER NOT UNIQUE

OBSERVATION WELL CONFIGURATION



BOREHOLE NUMBER: DC-1

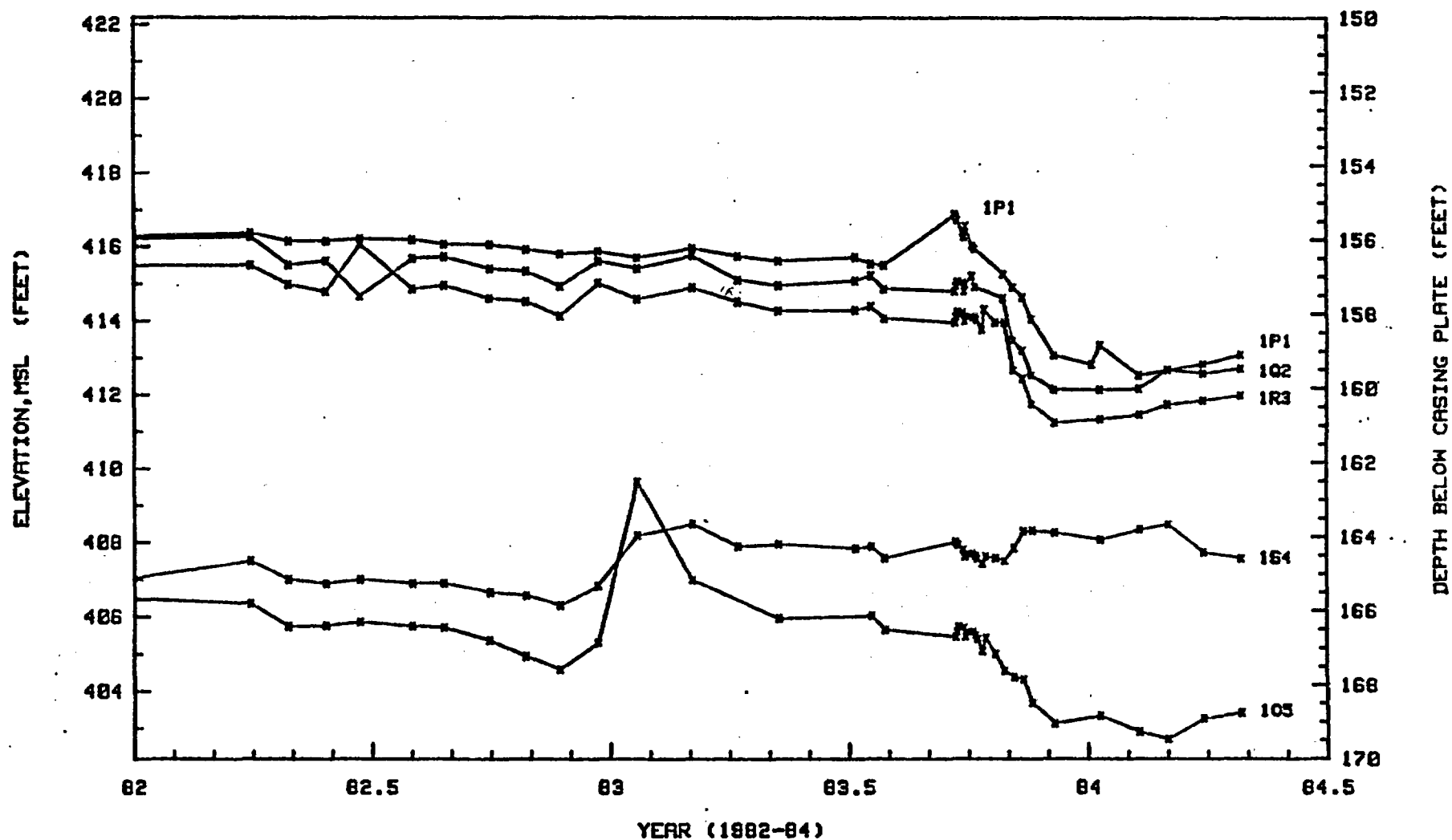
HYDROGEOLOGIC UNIT: GRANDE RONDE-SCHWANA SEQUENCE

LOCATION: 13/26-35G1

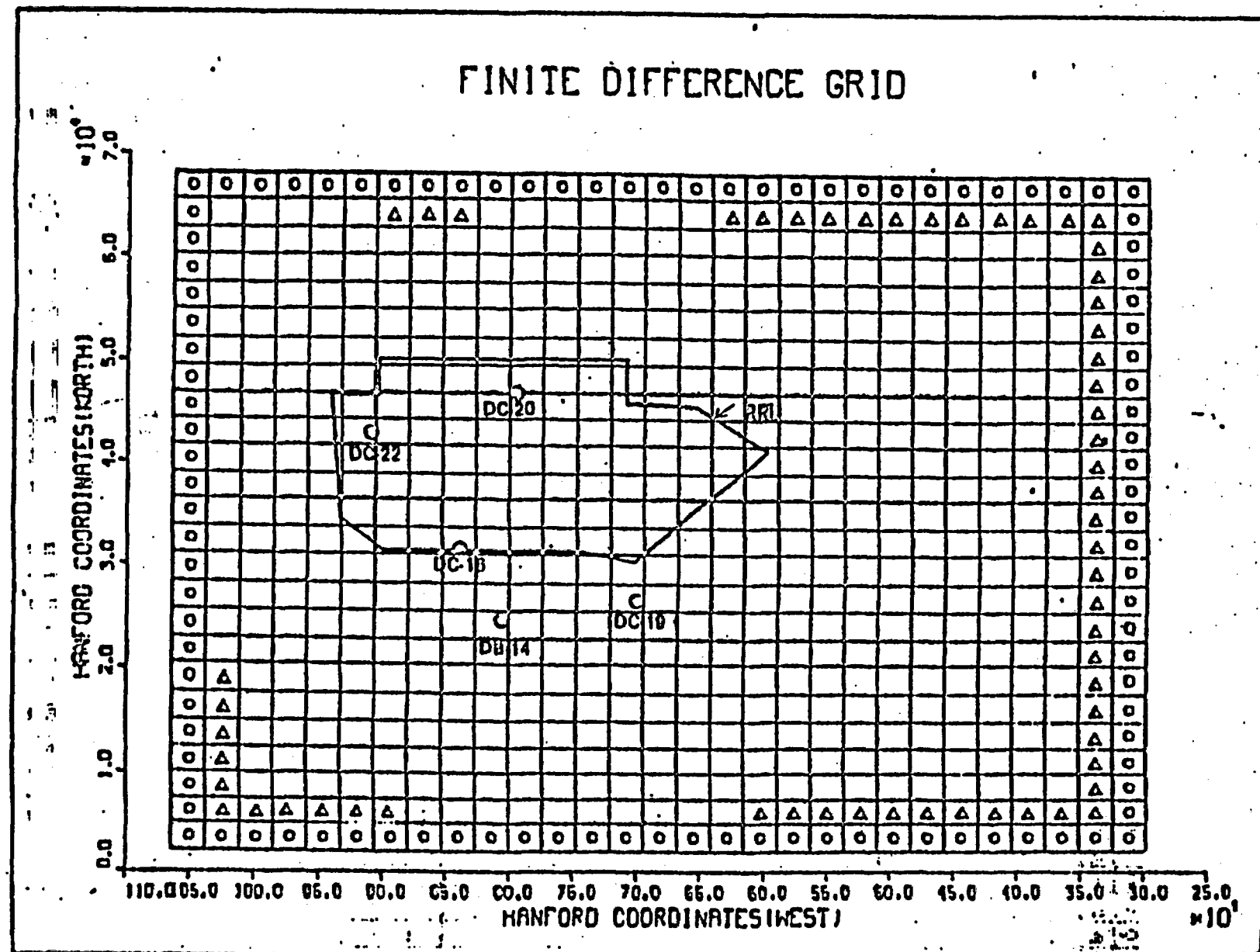
MEASURING POINT: CASING PLATE

MEASURING POINT ELEVATION (ft): 572.180

BOREHOLE DEPTH (ft): 4833.00

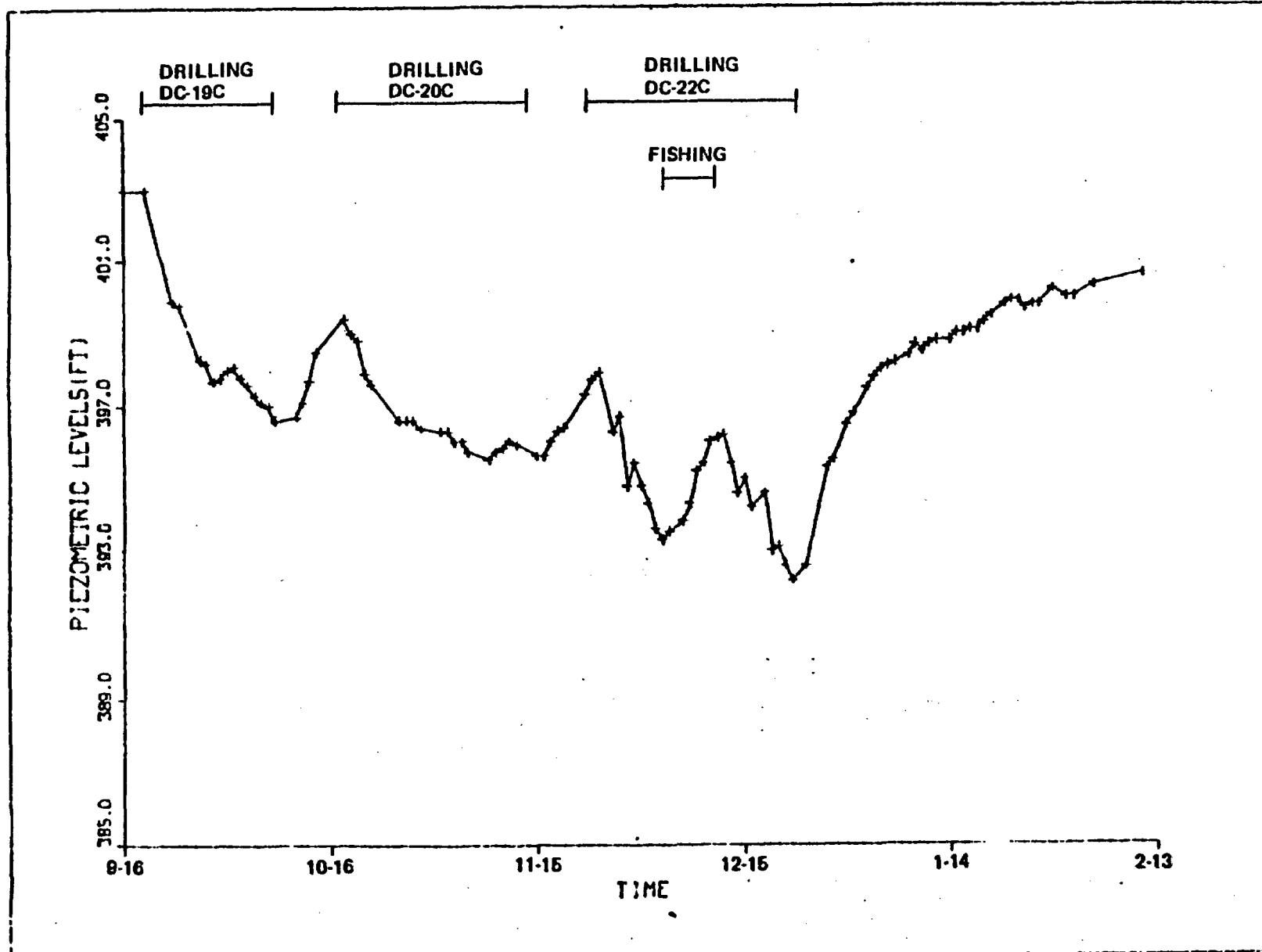


HYDROGRAPH FOR BOREHOLE NUMBER DC-1



Plan View of Finite Difference Grid, RRL Boundary, and Well Locations. Indicates a Constant Potential Boundary and 0 Impermeable Boundary.

WATER LEVELS DB-14



WATER LEVELS AT BOREHOLE DB-14 IN THE PRIEST RAPIDS INTERFLOW DURING AIR MIST
 DRILLING OF DC-19C, DC-20C AND DC-22C

DRILLING DC-18C | DRILLING DC-20C | DRILLING DC-22C
FISHING

404.0
403.6
403.2
402.8
402.4
402.0

PIEZOMETRIC LEVELS (FT)

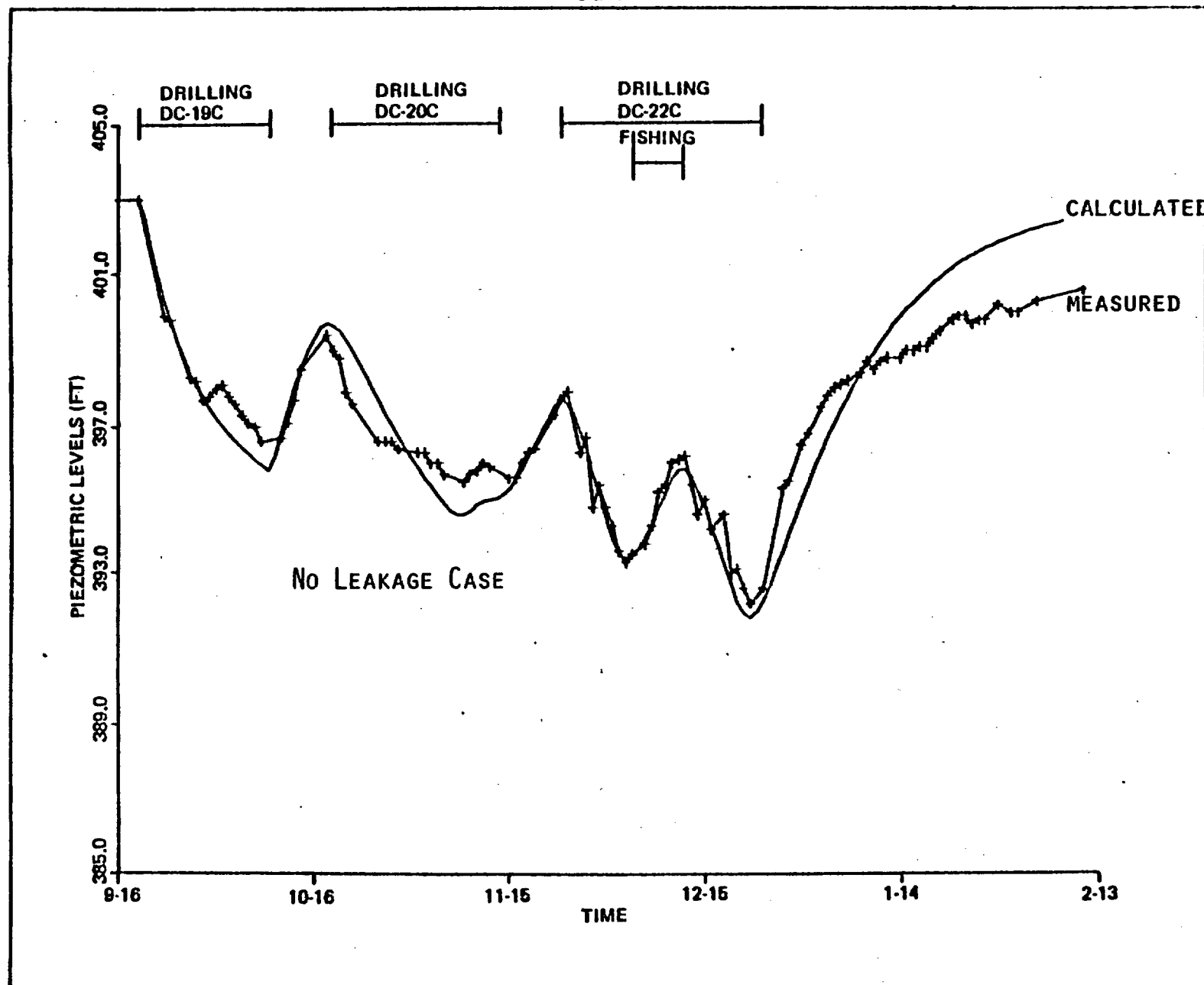
9-16 10-16 11-16 12-15 1-14 2-13

TIME

ONE FT.

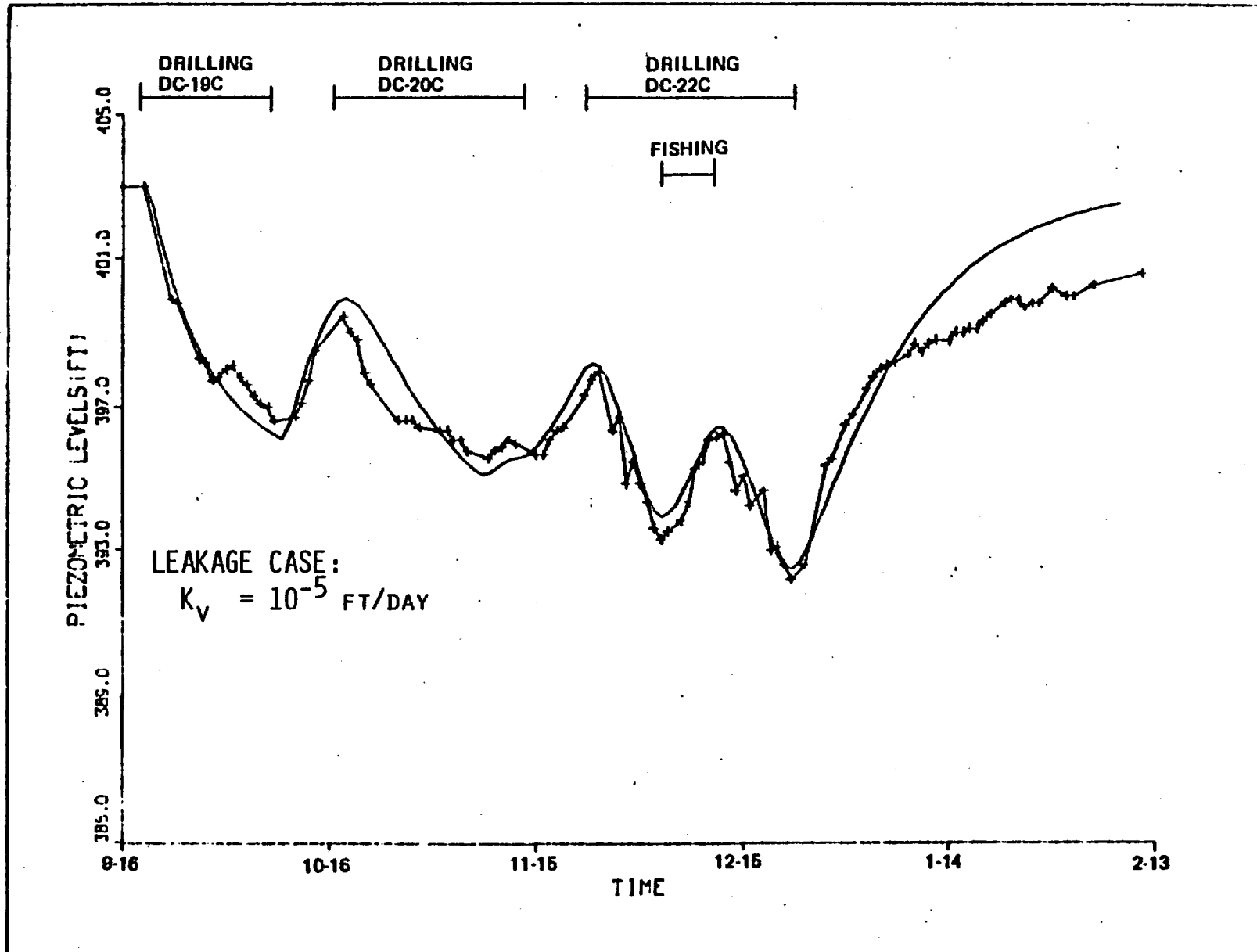
WATER LEVELS AT BOREHOLE DC-16B IN THE MABTON INTER-
BED DURING AIR MIST DRILLING OF DC-19C, DC-20C AND
DC-22C

DB-14



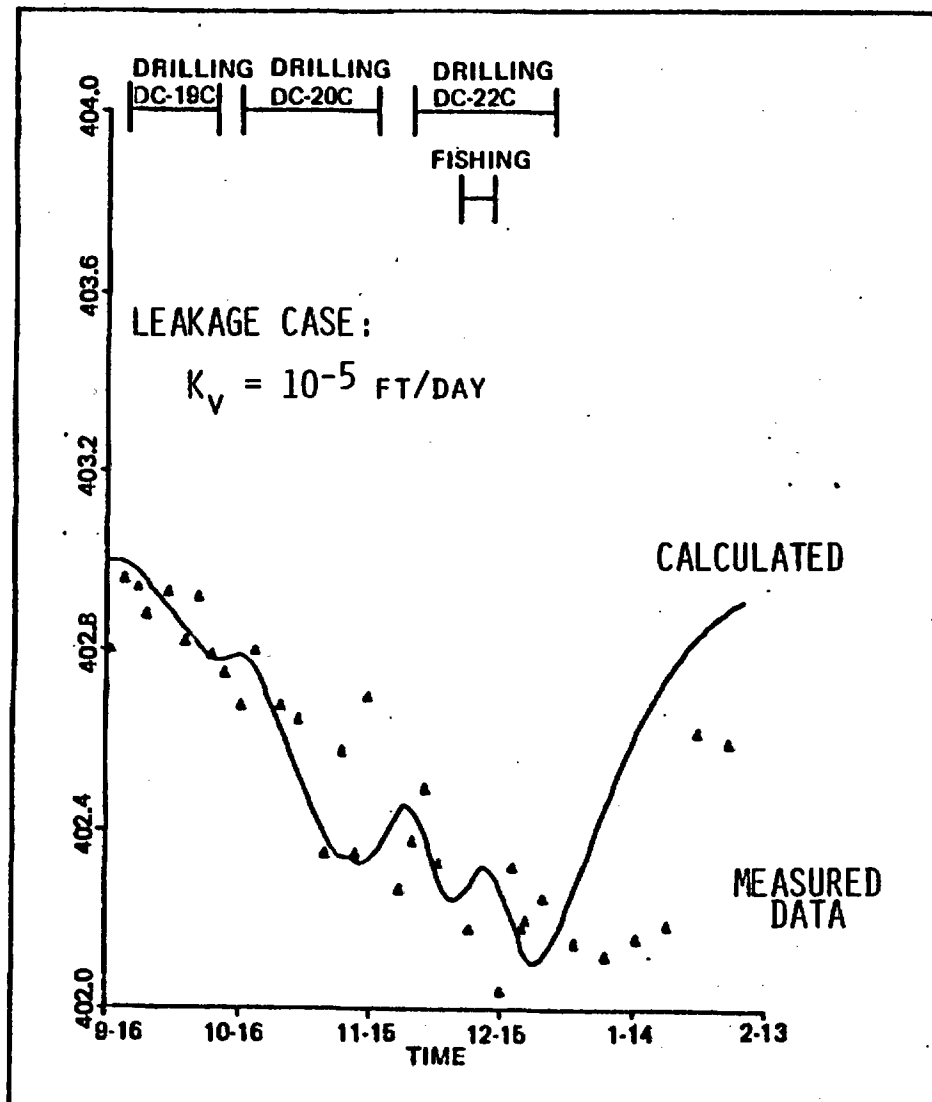
COMPARISON OF CALCULATED AND MEASURED WATER LEVELS AT DB-14. CALCULATED VALUES
 ASSUME: $T = 210 \text{ FT}^2/\text{DAY}$, $S = 8 \times 10^{-6}$, $Q (\text{DC-19C}) = 39 \text{ GPM}$, $Q (\text{DC-20C}) = 105 \text{ GPM}$,
 AND $Q (\text{DC-22C}) = 146 \text{ GPM}$

WATER LEVELS DB-14



COMPARISON OF CALCULATED AND MEASURED WATER LEVELS AT DB-14, CALCULATED VALUES ASSUME:
 $T = 180$ FT 2 /DAY, $S = 8.10^{-5}$, Q (DC-19C) = 39 GPM Q (DC-20C) = 105 GPM, AND Q (DC-22C) = 146 GPM

DB-16B WATER LEVELS



COMPARISON AT CALCULATED AND MEASURED WATER LEVELS AT DC-16B. CALCULATED VALUES ASSUME:
 T (MABTON) = 360 FT 2/DAY, T (PRIEST RAPIDS) = 180 FT 2/DAY, S (MABTON AND PRIEST RAPIDS) =
 8.10^{-6} , Q (DC-19C) = 39 GPM, Q (DC-20C) = 105 GPM, AND Q (DC-22C) = 146 GPM

L. S. LEONHART
BASALT WASTE ISOLATION PROJECT
GROUNDWATER LEVEL
BASELINES

GROUNDWATER LEVEL BASELINES

- o RRL GROUNDWATER LEVEL MONITORING
 - A. DECISION PROCESS FOR SELECTING MONITORING SITES AND UNITS TO BE MONITORED (LEONHART)
 - B. CONSTRUCTION DETAILS (JACKSON)
 - C. RESULTS TO DATE (JACKSON)

PURPOSE AND GOAL OF
PRESENTATION

- PURPOSES:
1. TO DESCRIBE EXISTING PROGRAM FOR PIEZOMETRIC BASE-LINING IN TERMS OF THE PLANS FORMULATED IN THE JULY 1983 WORKSHOP
 2. TO DESCRIBE BWIP APPROACH TO ESTABLISHING BASELINE CRITERIA

GOAL: TO GAIN FEEDBACK FROM NRC ON THE ADEQUACY OF BWIP'S APPROACH TO DEVELOPING A PIEZOMETRIC BASELINE FOR THE RRL.

RRL MONITORING PROGRAM

PROPOSED JULY 1983

DC-19, -20, -22

RRL-2 MLP

RRL-14 MPP

DC-23

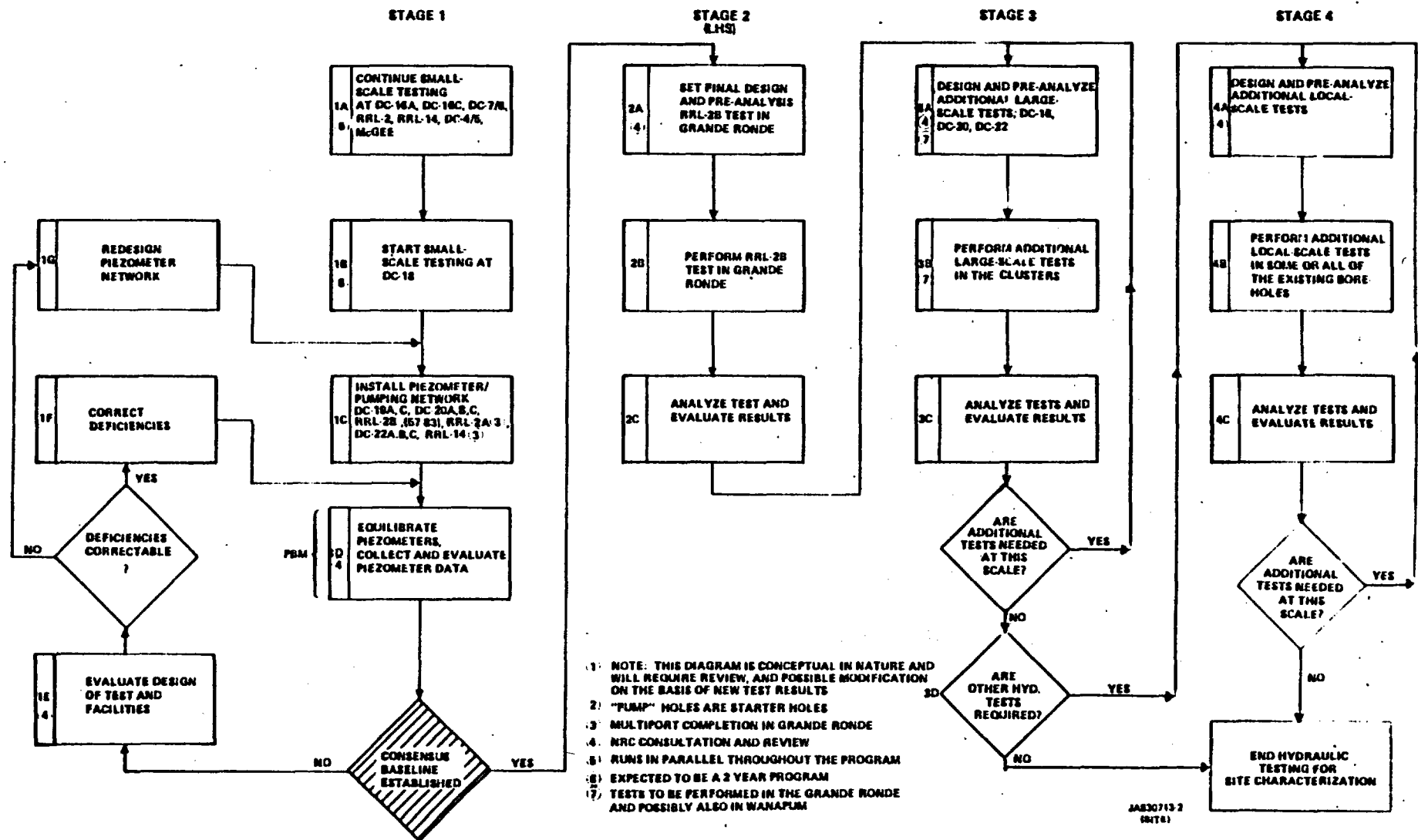
IN PLACE JUNE 1984

DC-19A,C,D; DC-20A,C,D,, DC-22A,C,D

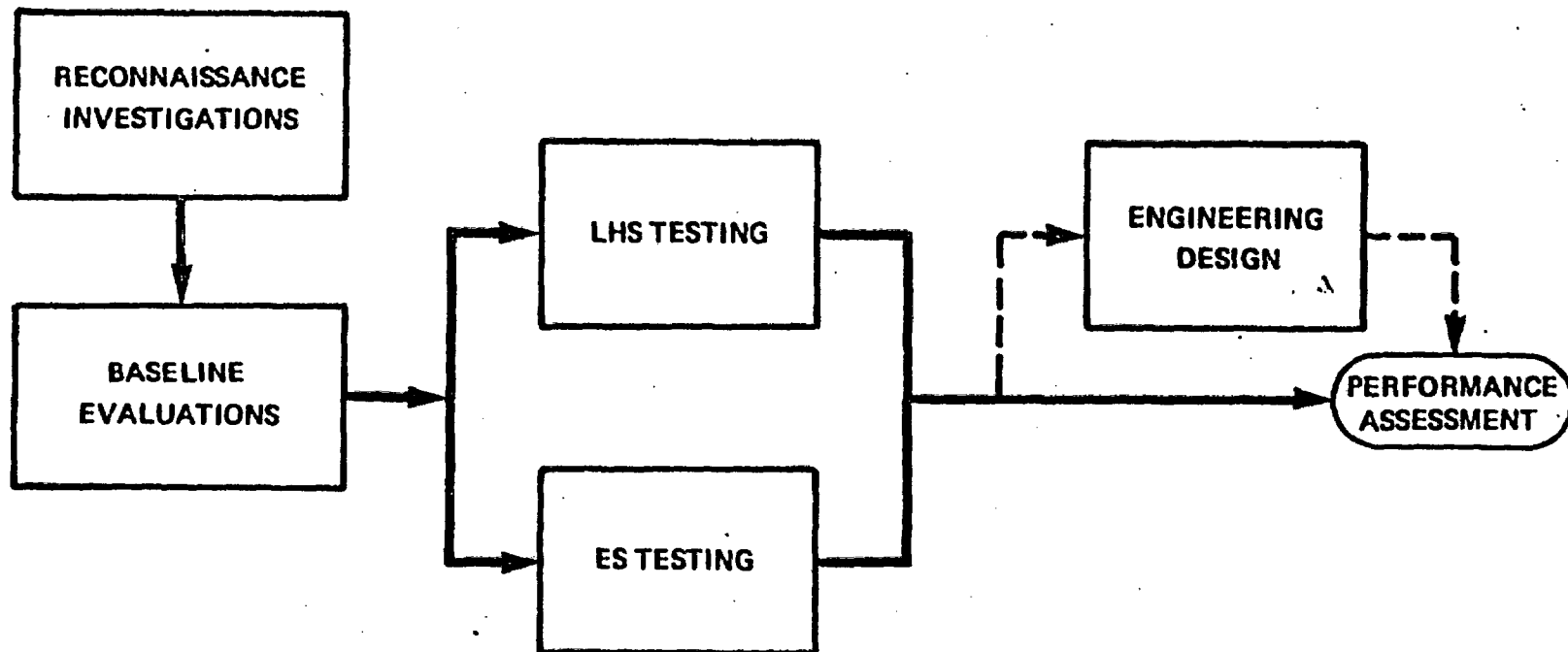
BRIDGE PLUGS DC-4, -5, -16A, -16C, RRL-2, RRL-6, RRL-14

MLP SYSTEM PROTOTYPE (OUT FOR BID)

LOGIC DIAGRAM FOR BWIP BOREHOLE: HYDROLOGIC TEST STRATEGY



PRIMARY FLOW OF HYDROLOGIC CHARACTERIZATION DATA



JUSTIFICATION OF MONITORING PROGRAM (1983)

1. TECHNICAL CONCERNS

- o TIME-VARIANCE
- o 4-DIMENSIONAL PHENOMENA
- o MODEL CALIBRATION
- o DATA VALIDATION

2. PRACTICAL CONCERNS

- o EXISTING FACILITIES WITHOUT MODIFICATION CANNOT FULFILL
HYDROLOGIC CHARACTERIZATION NEEDS (E.G., NUMBER OF HORIZONS,
SPATIAL DISTRIBUTION, INTEGRITY, ETC.)
- o SCHEDULING OF TESTING AT EXISTING FACILITIES

CRITERIA FOR
MINIMUM NUMBER OF SITES REQUIRED AT THIS TIME
(1983)

CONSIDERATIONS

1. A MINIMUM OF THREE SITES ARE REQUIRED TO DETERMINE HYDRAULIC GRADIENTS IF POTENTIOMETRIC SURFACE IS PLANAR
2. MORE THAN THREE SITES ARE PROBABLY UNWARRANTED AT THIS TIME BASED ON:
 - o UNCERTAINTIES
 - o THE POTENTIAL FOR USING TESTING DATA FROM OTHER BOREHOLES TO SUPPLEMENT PIEZOMETER DATA AND REFINE POTENTIOMETRIC SURFACES

RECOMMENDATION

INSTALL A MINIMUM OF THREE NEW, DEDICATED PIEZOMETER SITES AT STRATEGIC LOCATIONS ACROSS THE RRL.

CRITERIA FOR
SELECTION OF HORIZONS FOR MONITORING
(1983)

CONSIDERATIONS

1. 80 LAYERS (I.E. FLOWS AND INTERBEDS)
2. HYDRAULIC HEAD AND HYDROCHEMICAL BREAKS
3. MODELING DATA NEEDS
4. TRANSMISSIVITY
5. RELATIONSHIP TO CANDIDATE HORIZON
6. IDENTIFIABLE FROM GEOPHYSICAL LOGS

RECOMMENDATION - NINE HORIZONS

- | | |
|-------------------------|------------------------------|
| o TOB (BASAL RINGOLD) | o RATTLESNAKE RIDGE INTERBED |
| o MABTON INTERBED | o PRIEST RAPIDS #2 FLOW TOP |
| o SENTINEL GAP FLOW TOP | o GINKGO FLOW TOP |
| o ROCKY COULEE FLOW TOP | o COHASSETT FLOW TOP |
| o UMTANUM FLOW TOP | |

CRITERIA FOR
SELECTION OF STRATIGRAPHIC HORIZONS
(1983)

<u>FORMATION</u>	<u>STRATIGRAPHIC UNIT</u>	<u>RATIONALE</u>
SADDLE MOUNTAINS	1. TOP OF BASALT (BASAL RINGOLD)	0 MODEL BOUNDARY
		0 MOST DYNAMIC
		0 ARTIFICIAL RECHARGE
	2. RATTLESNAKE RIDGE INTERBED	0 UPPER SADDLE MOUNTAINS
		0 OTHER DATA AVAILABLE
		0 ARTIFICIAL RECHARGE
	3. MABTON INTERBED	0 HYDRAULIC AND HYDROCHEMICAL "BREAKS"
		0 DATA AVAILABLE THROUGHOUT BASIN
		0 LOWER SADDLE MOUNTAINS
WANAPUM	1. PRIEST RAPIDS	0 HIGHER PRODUCER
		0 UPPER WANAPUM
		0 HYDRAULIC AND HYDROCHEMICAL "BREAKS"
	2. SENTINEL GAP	0 AQUIFER PRODUCTIVITY
		0 POSSIBLE TRANSITION
	3. GINKGO	0 ISOLATION OF GRANDE RONDE
		0 HYDRAULIC AND HYDROCHEMICAL "BREAKS"
GRANDE RONDE	1. ROCKY COULEE	0 CANDIDATE HORIZON
		0 ISOLATION ABOVE COHASSETT
		0 HYDRAULIC AND HYDROCHEMICAL "BREAKS"
		0 GRADIENT ACROSS CANDIDATE HORIZON
	2. COHASSETT	0 CANDIDATE HORIZON
	3. UNTANUM	0 CANDIDATE HORIZON
		0 GRADIENT ACROSS CANDIDATE HORIZON

SITING OF PUMPING WELLS
(1983)

- o POSITION RELATIVE TO MULTILEVEL OBSERVATION POINTS
- o POSITION RELATIVE TO ES
- o POSITION RELATIVE TO OTHER POTENTIAL OBSERVATION SITES
- o LOCATION OF POSSIBLE STRUCTURES OR ANOMALIES
- o PREDICTED RADII OF INFLUENCE
- o OTHER CONSIDERATIONS

BWIP/NRC HYDROLOGY WORK SHOP
WASHINGTON, D. C.
JUNE 12 THROUGH 13, 1984

RONALD L. JACKSON
ROCKWELL HANFORD OPERATIONS
DRILLING AND TESTING GROUP

AGENDA

MULTI-LEVEL PIEZOMETER CLUSTERS DC-19, DC-20 AND DC-22

INTRODUCTION

DRILLING

**PIEZOMETER INSTALLATION
BOREHOLE PREPARATION
INSTALLATION
PIEZOMETER DEVELOPMENT**

RRL HEAD MONITORING

**INSTRUMENTATION
DOCUMENTATION**

GOALS

- O PROVIDE NRC WITH AN OVERVIEW OF DC-19, DC-20, AND DC-22
PIEZOMETER CONSTRUCTION**

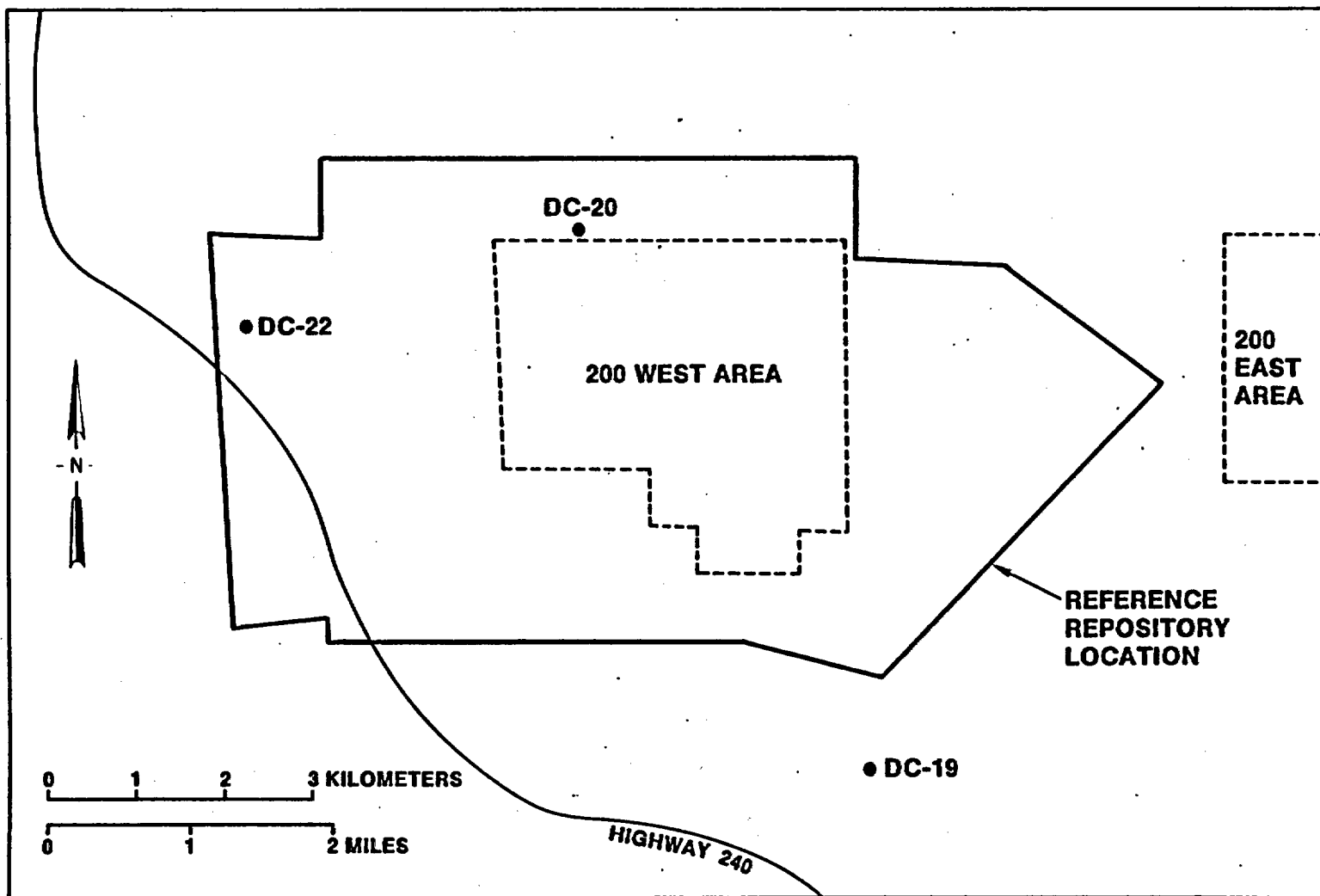
- O IDENTIFY DATA REQUIREMENTS NEEDED TO EXPEDIENTLY EVALUATE
THE BASELINE REQUIRED FOR START OF EXPLORATORY SHAFT AND
LARGE-SCALE HYDRAULIC STRESS (LHS) TESTING**

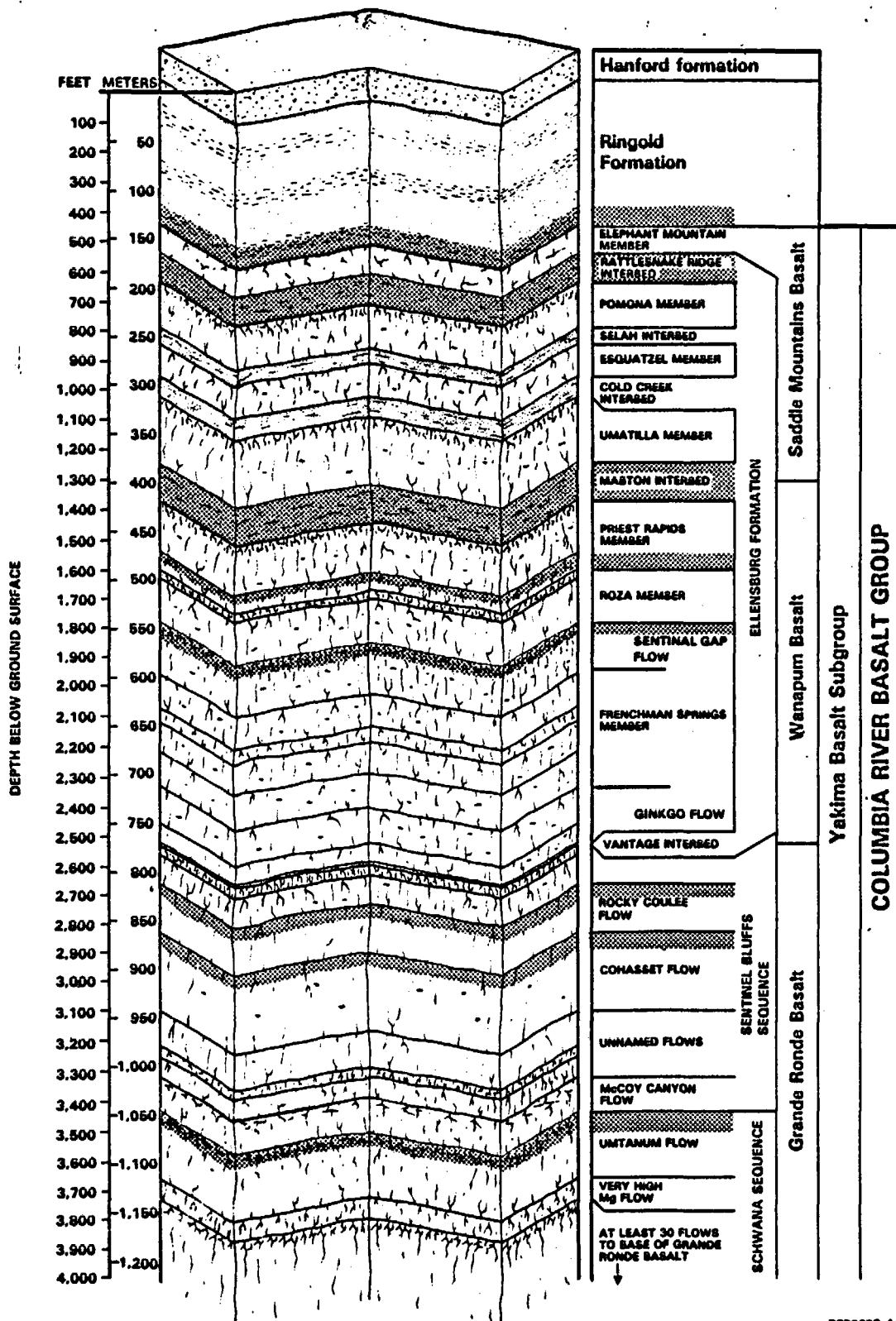
STATUS

- O ROCKWELL PREPARED SPECIFICATION REPORT (SD-BWI-TC-016) TO GUIDE INSTALLATION OF PIEZOMETER
- O DRILLING AND PIEZOMETER INSTALLATION COMPLETED FEBRUARY 23, 1984
- O ROCKWELL PREPARED PROCEDURE FOR MONITORING PIEZOMETERS (C-2.12)
- O INTERIM DATA COLLECTION AND HANDLING IN PLACE
- O FINAL DATA COLLECTION AND HANDLING TO BE IN PLACE JUNE 4, 1984
- O MONTHLY DATA PACKAGES BEING WRITTEN TO FACILITATE DATA DISTRIBUTION
- O ISSUED WATER-LEVEL DATA PACKAGE FOR APRIL 1984 (SD-BWI-DP-045)
- O WILL ISSUE PIEZOMETER COMPLETION REPORT ON JULY 15, 1984 (SD-BWI-TI-226)
- O WILL ISSUE INTERGRITY TESTING REPORT IN FALL 1984

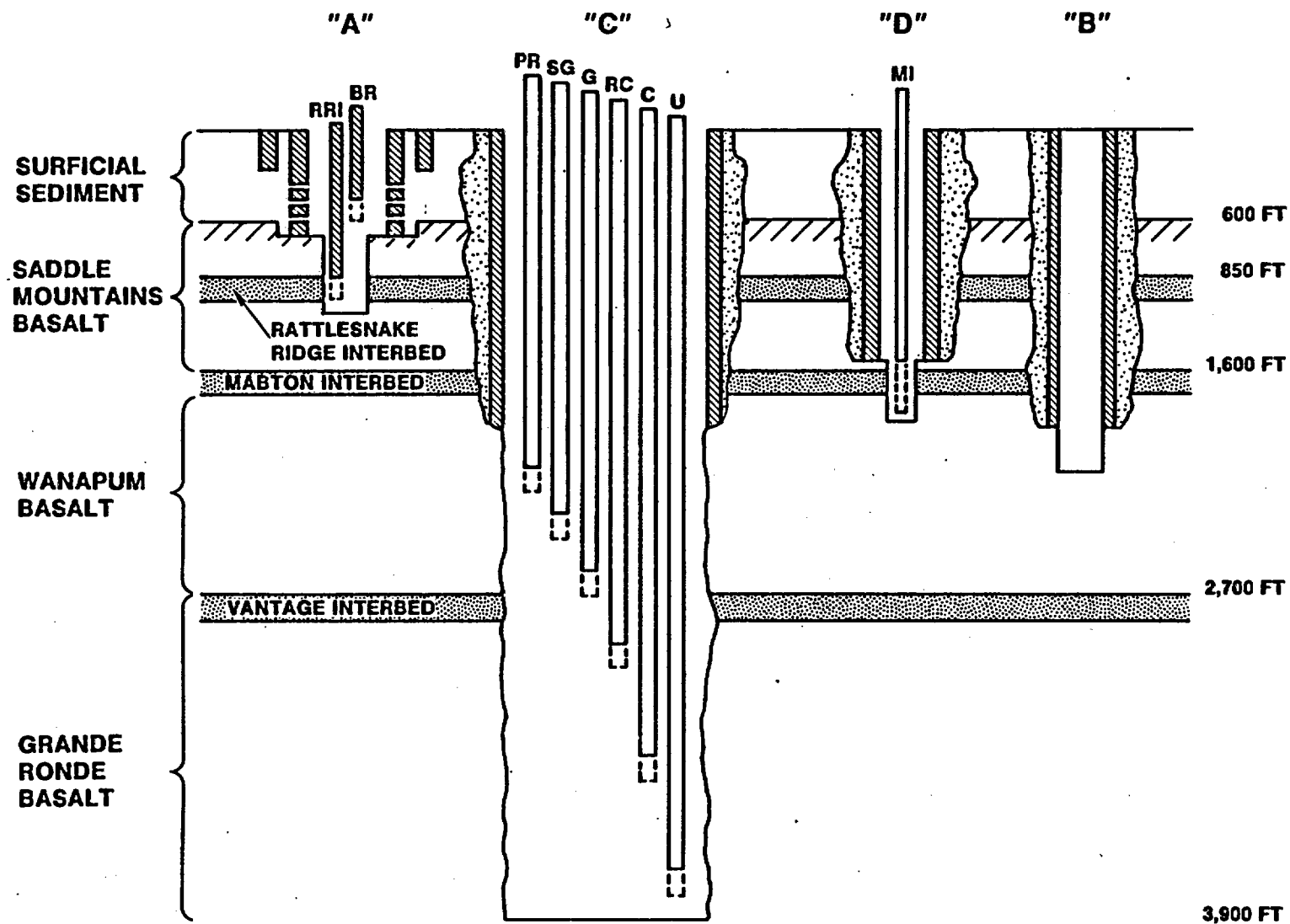
NEW MULTILEVEL PIEZOMETER FACILITIES
FOR DATA COLLECTION

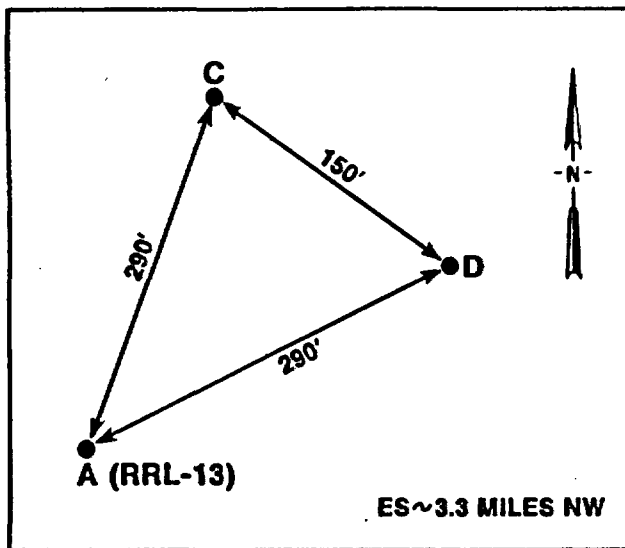
BOREHOLE CLUSTER SITES



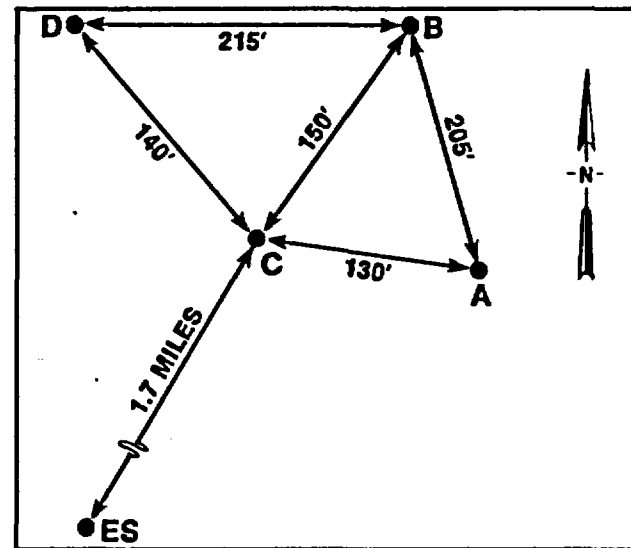


SCHEMATIC OF PIEZOMETER CLUSTER DESIGN

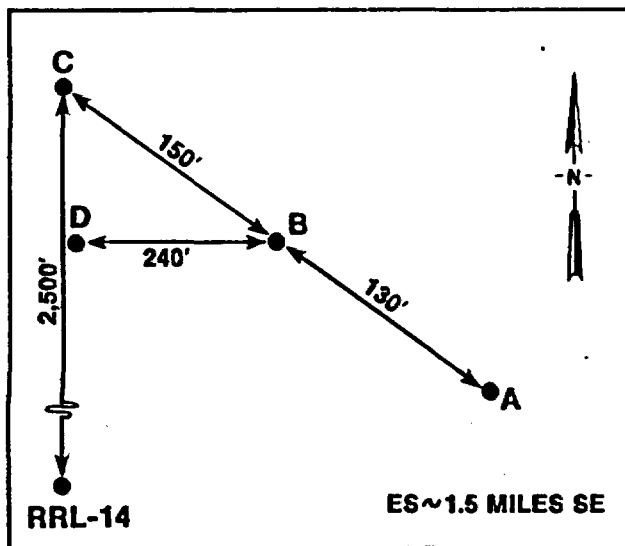




DC-19



DC-20



DC-22

CLUSTER BOREHOLE SITE PLANS

CABLE TOOL
ALL STARTER HOLES
A-SERIES TO TOP OF BASALT

CORE ROTARY
A- SERIES

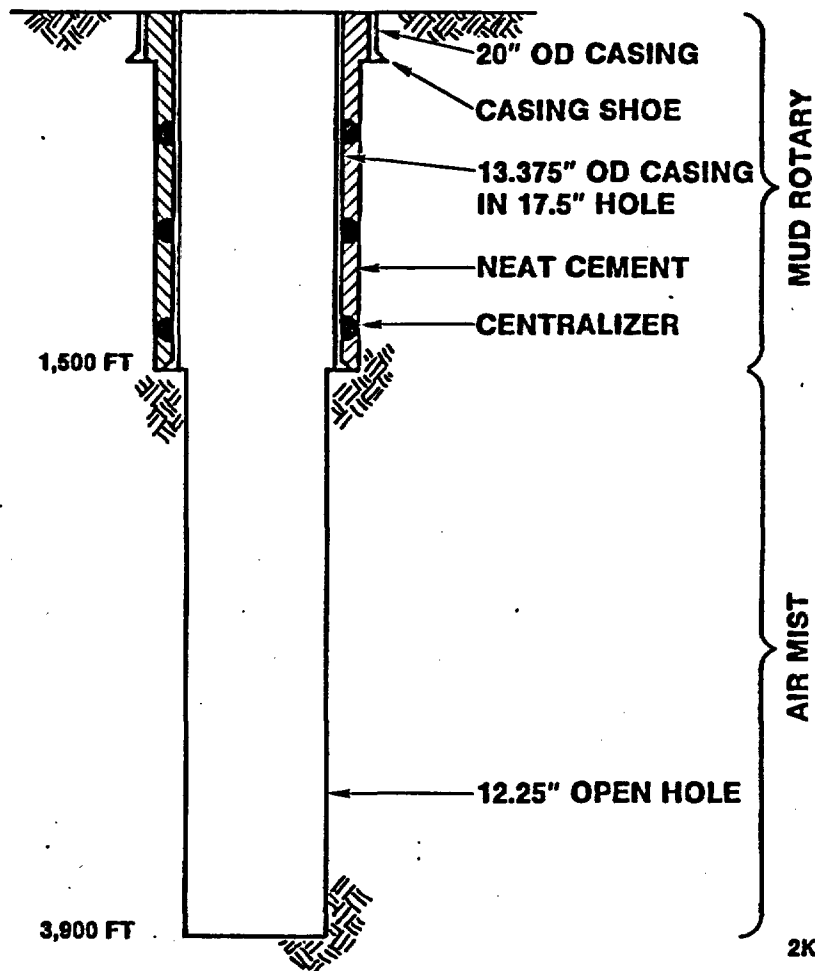
MUD ROTARY
B- AND C-SERIES THROUGH MABTON
D-SERIES

AIR-MIST ROTARY
C-SERIES

AS-BUILT OF TYPICAL C-SERIES BOREHOLE

MONITORING HORIZON	
HANFORD & RINGOLD FORMATION	GROUND SURFACE
	TOP OF BASALT
SADDLE MOUNTAINS BASALT	
WANAPUM BASALT	PRIEST RAPIDS INTERFLOW
	SENTINEL GAP
GRANDE RONDE BASALT	GINGKO
	ROCKY COULEE FLOW TOP
	COHASSETT FLOW TOP
	UMTANUN FLOW TOP

PRE-PIEZOMETER INSTALLATION



2K8405-7.0

BOREHOLE PREPARATION

PURPOSE

- 0 DEVELOPED THE FORMATION WITH EMPHASIS ON
THE MONITORING HORIZONS.
- 0 CONFIRM THE SUITABILITY OF THE HORIZONS FOR HEAD
MONITORING (E.G., WATER-YIELDING CAPABILITY).

METHODOLOGY (C-SERIES ONLY)

o TWO PUMPING PHASES

FIRST PHASE INVOLVED COMPOSITE PUMPING WITH LINE SHAFT TURBINE PUMP - NO DATA ANALYSIS.

SECOND PHASE INVOLVED ISOLATING HORIZONS WITH STRADDLE PACKER AND PUMPING BY THE AIR-LIFT OR SUBMERSIBLE PUMPING METHODS.

o MONITORING HORIZONS STRADDLED AND DEVELOPED

DC-19C: ALL 6 HORIZONS

DC-20C: 4 OF 6 HORIZONS

DC-22C: 3 OF 6 HORIZONS

PIEZOMETER INSTALLATION

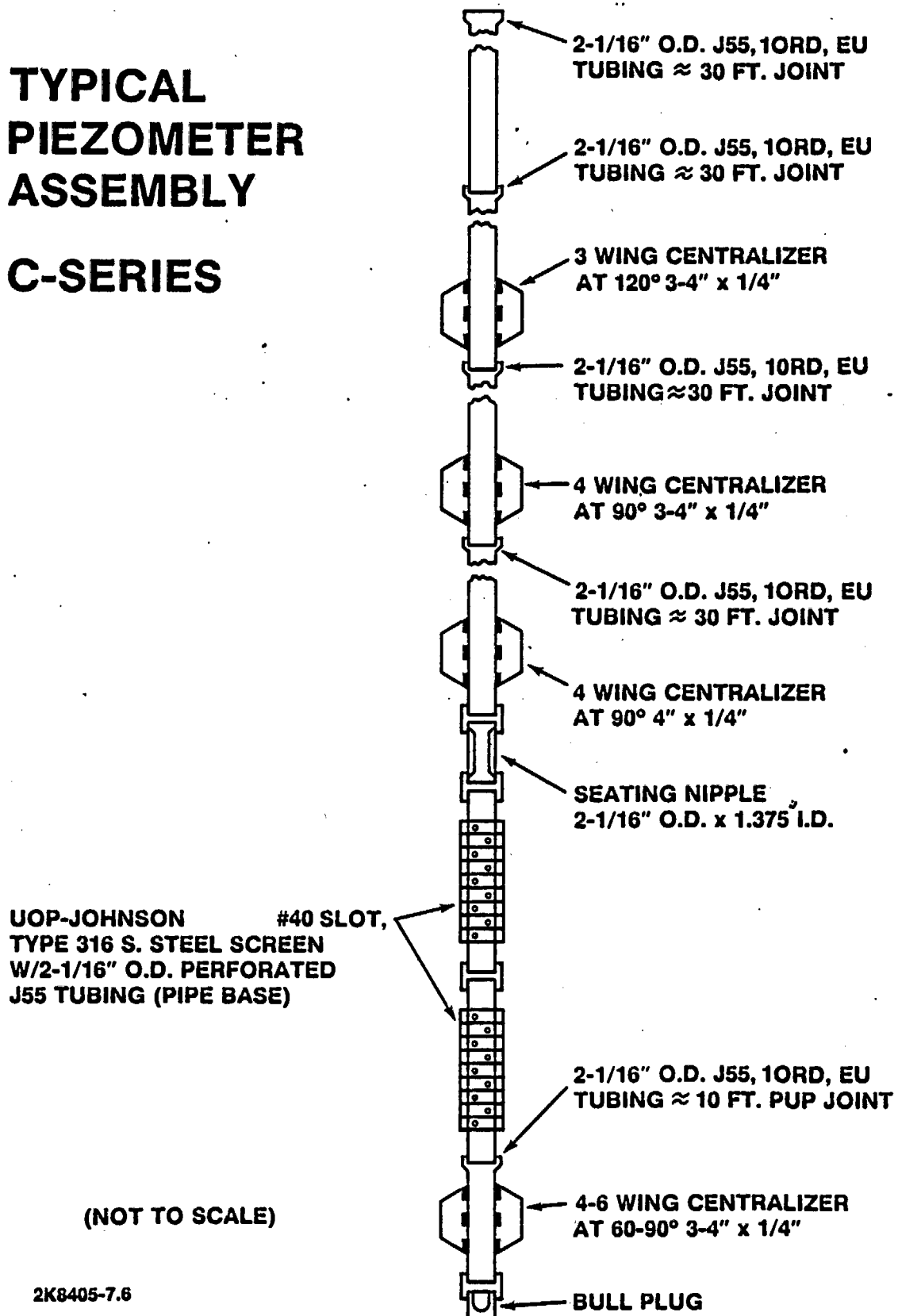
PROCEDURES

STAGED APPROACH

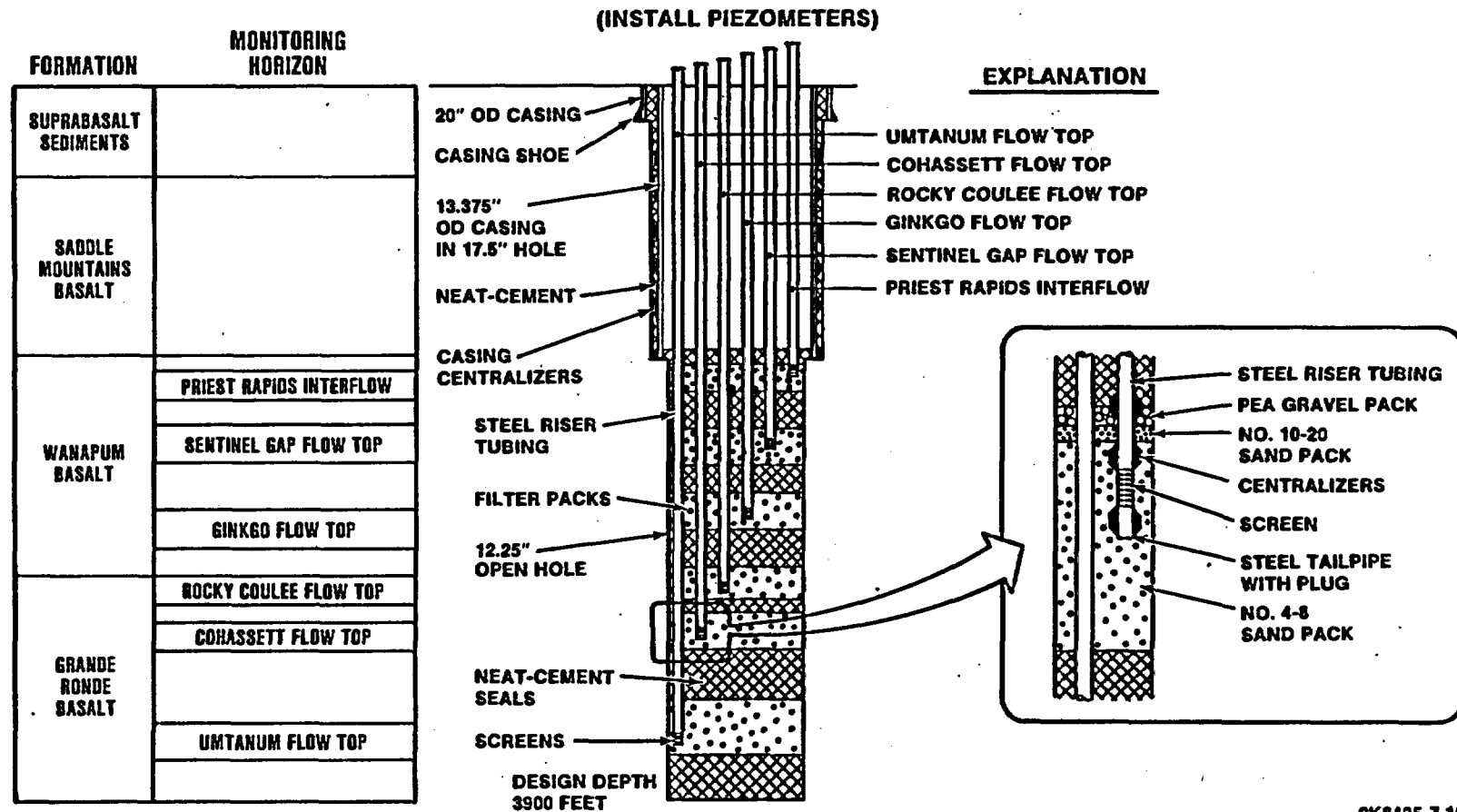
START FROM BOTTOM TO TOP

TREMIE PIPE, NEAT CEMENT SLURRY AND
FILTER PACK MATERIAL

TYPICAL PIEZOMETER ASSEMBLY C-SERIES



AS BUILT OF TYPICAL "C" SERIES MULTILEVEL PIEZOMETER



QUALITY CONTROL

PIEZOMETER STRING AND WORKING TUBING LENGTH

- 0 EACH JOINT OR STAND MEASURED WITH STEEL TAPE

TUBING INTEGRITY

- 0 STEAM CLEANED
- 0 JOINTS INSPECTED
- 0 JOINTS TIGHTEN POWER TONGS OR APPROPRIATE SIZE WRENCHS
- 0 JOINTS TEFLON TAPED
- 0 RAN "RABBIT" TO INSURE NO BLOCKAGE
- 0 TUBING TEST

SCREENS

- 0 INSPECTED FOR DEFECTS AND APPROPRIATE SLOT OPENING

NEAT CEMENT AND FILTER PACKS

- 0 PREVOLUME CALCULATION BASED ON CALIPER LOG PRIOR TO PLACEMENT
- 0 VOLUMES RECHECKED PRIOR TO PLACEMENT
- 0 DEPTHS DETERMINED BY WORKING TUBING
- 0 VERIFY SEALS WITH FLUID TEMPERATURE
- 0 SLURRY WEIGHTS MONITORED WITH SCALE AND CONTINUOUS RECORDER
- 0 SEALS PLACED REPUTABLE CEMENTING SERVICE COMPANY

FIELD DOCUMENTATION DURING CONSTRUCTION OF PIEZOMETER FACILITIES

DRILLING

- o SHIFT REPORTS
- o DRILLER LOGS
- o BOREHOLE GEOPHYSICAL LOGGING
- o GEOLOGIC LOGS
- o DRILLING FLUID ENGINEER'S REPORT
- o AIR CHARTS
- o BOREHOLE DEVIATION

BOREHOLE PREPARATION AND PIEZOMETER DEVELOPMENT

- o CONTROL NOTEBOOKS
- o HYDROLOGIC TESTING FORMS
- o SHIFT REPORT

PIEZOMETER INSTALLATION

- o CONTROL NOTEBOOKS
- o SHIFT REPORTS
- o BOREHOLE GEOPHYSICAL LOGS
- o AS-BUILTS OF PIEZOMETER

DC-20C INSTALLATION EXCEPTIONS

- o SECTION OF STUCK WORKING TUBING WAS INCORPORATED IN THE NEAT-CEMENT FOR THE GINKGO SEAL AT DC-20C. NO IMPACT ON MONITORING CAPABILITIES.
- o A PARTIAL CONSTRICTION IN THE UMTANUM AND COHASSETT RISER TUBING OCCURRED WHEN THE WORKING TUBING WAS INADVERTENTLY DROPPED WHILE REMOVING IT SHORTLY AFTER CEMENTING THE FIRST STAGE OF THE SENTINEL GAP SEAL. DOWNHOLE PRESSURE MONITORING CANNOT BE PERFORMED AT DEPTH IN THE COHASSETT PIEZOMETER TUBE.

PIEZOMETER DEVELOPMENT

PURPOSE

REMOVE BULK PARTICULATE MATERIAL
CONFIRMATORY INFORMATION ON PIEZOMETER OPERATION
INTEGRITY TESTING

METHODOLOGY

AIR-LIFT PUMPING
27 PIEZOMETERS
HEAD MONITORING WITH SURFACE BASED EQUIPMENT

RESULTS OF PIEZOMETER DEVELOPMENT

- o PARTICULATE MATERIAL WAS REMOVED BY PUMPING
- o OBSERVED GOOD DYNAMIC RESPONSE IN PIEZOMETER EXCEPT SLOW RESPONSE OBSERVED IN BASAL RINGOLD AT DC-22A
- o OBSERVED WATER-LEVEL REVERSAL IN MULTI-LEVEL INSTALLATIONS, E.G., A- AND C-SERIES MULTI-LEVEL NEST.
 - POSSIBLE CAUSES: 1) TEMPERATURE EFFECTS
 - 2) NOORDBERGUM EFFECT
 - 3) OTHER
- o OBSERVED DRAWDOWN IN COHASSETT PIEZOMETER WHILE AIR-LIFT PUMPING THE ROCKY COULEE PIEZOMETER.
 - POSSIBLE CAUSES: 1) LOCAL COMMUNICATION THROUGH ROCKY COULEE FLOW
 - 2) FAULTY SEAL
 - 3) PHYSICAL RESPONSE TO PRESSURE CHANGE WHICH IS NOT UNDERSTOOD

INSTRUMENTATION

DOWNHOLE DIGIQUARTZ PRESSURE TRANSDUCERS COUPLED TO THERMISTORS

3000 PSIA

ACCURACY: 1.5 PSI

RESOLUTION: .15 PSI

OUTSIDE DIAMETER: 1.44 IN. AND 1.00 IN.

HEWLETT PACKARD/SELING SURFACE RECORDING SYSTEM

RRL MONITORING

DAILY DEPTH TO WATER MEASUREMENT WITH STEEL TAPE

HOURLY DOWNHOLE PRESSURE MEASUREMENT

HOURLY ATMOSPHERIC PRESSURE MEASUREMENT

DATA RECORDED ON MAGNETIC TAPE/DISK AND PAPER COPY

STEEL TAPE MEASUREMENTS STORED ON DISK (HP-9845)

DATA TRANSFERRED TO STORAGE FILES ON PRIME COMPUTER

MONTHLY DATA PACKAGES PRODUCED FOR DATA DISTRIBUTION

**TIME TABLE OF CONSTRUCTION AND MONITORING ACTIVITIES AT
CLUSTER SITES DC-19, DC-20 AND DC-22**

CLUSTER SITE	DRILLING COMPLETED	PIEZOMETER INSTALLATION COMPLETED	MONITORING UNDER WAY IN ALL ZONES	PRESSURE TRANSDUCER INSTALLATION COMPLETE
DC-19	01/14/84	02/01/84	02/06/84	04/09/84
DC-20	01/31/84	02/23/84	02/24/84	05/18/84
DC-22	02/14/84	02/21/84	02/23/84	04/16/84

RRL MONITORING SUMMARY DC-19, DC-20, AND DC-22 SITES

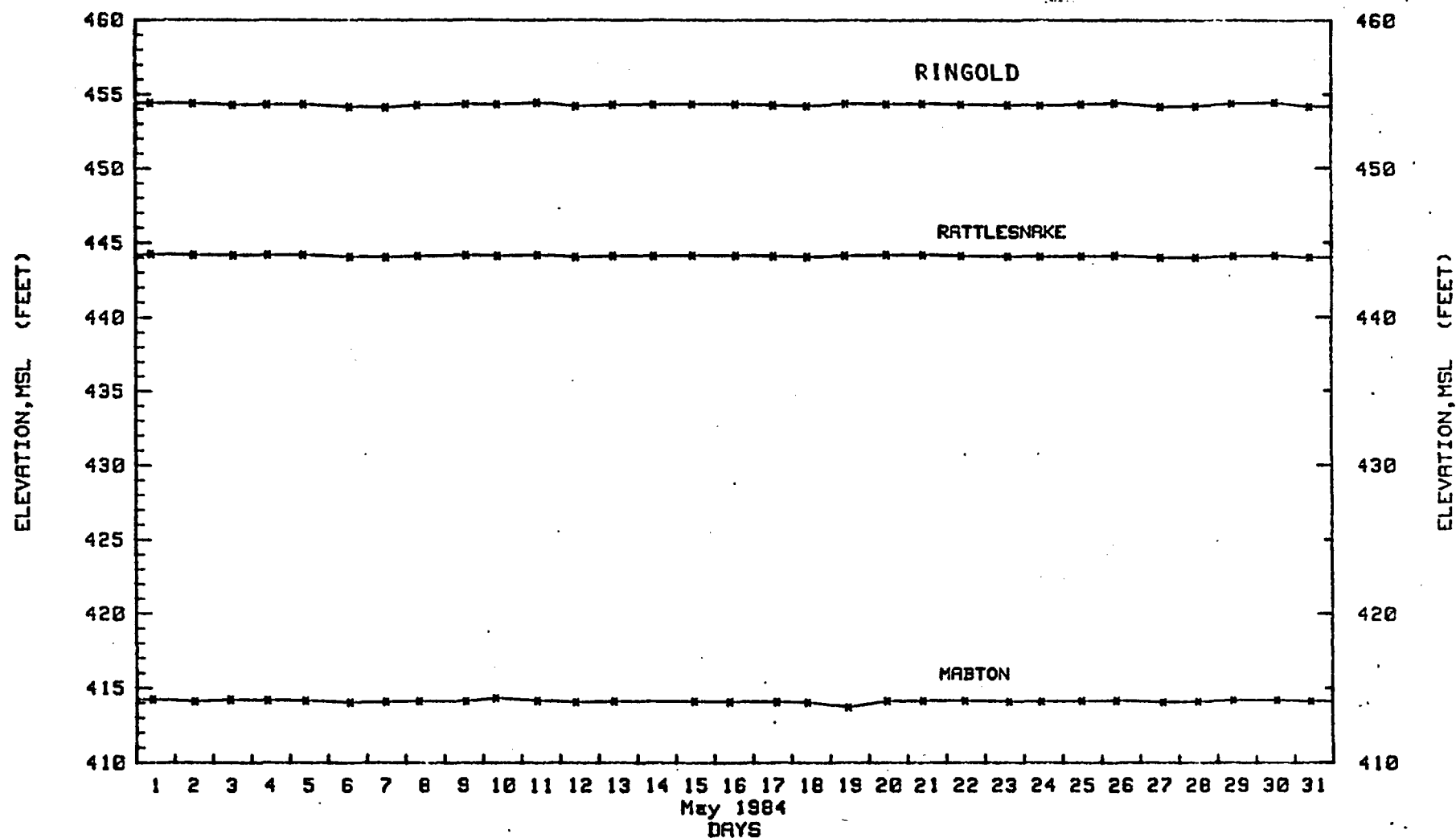
- O MONITORING INITIATED UPON INSTALLATION OF PIEZOMETERS (ALL BY LATE FEBRUARY 1984)
- O OBSERVED WATER-LEVEL CHANGES WERE LESS THAN 1 FOOT DURING THE MONTH OF MAY 1984, EXCEPT ROCKY COULEE PIEZOMETERS AT DC-19, AND DC-22.
- O OBSERVED HEADS AT DC-19C AND DC-20C WITHIN RANGE OF PREDICTED VALUES, DC-22C HEADS ARE APPROXIMATELY 5 FEET LOWER THAN PREDICTED. DC-20A HEADS AND BASAL RINGOLD AT DC-19A CURRENTLY FALL OUTSIDE PREDICTED RANGE.
- O DOWNWARD GRADIENT IN SADDLE MOUNTAINS (BASED ON OBSERVED HYDRAULIC HEAD).
- O LOW HORIZONTAL AND VERTICAL GRADIENT WITHIN THE WANAPUM AND GRANDE RONDE BASALT (BASED ON OBSERVED HYDRAULIC HEAD).

BOREHOLE NUMBER: DC-28

HYDROGEOLOGIC UNIT: RINGOLD/RATTLE/MABTON

LOCATION: HANFORD SITE

MEASURING POINT: MEAN SEA LEVEL



HYDROGRAPH FOR BOREHOLE NUMBER DC-28
Program HYDAT Rev 4.3

BOREHOLE NUMBER: DC-20C

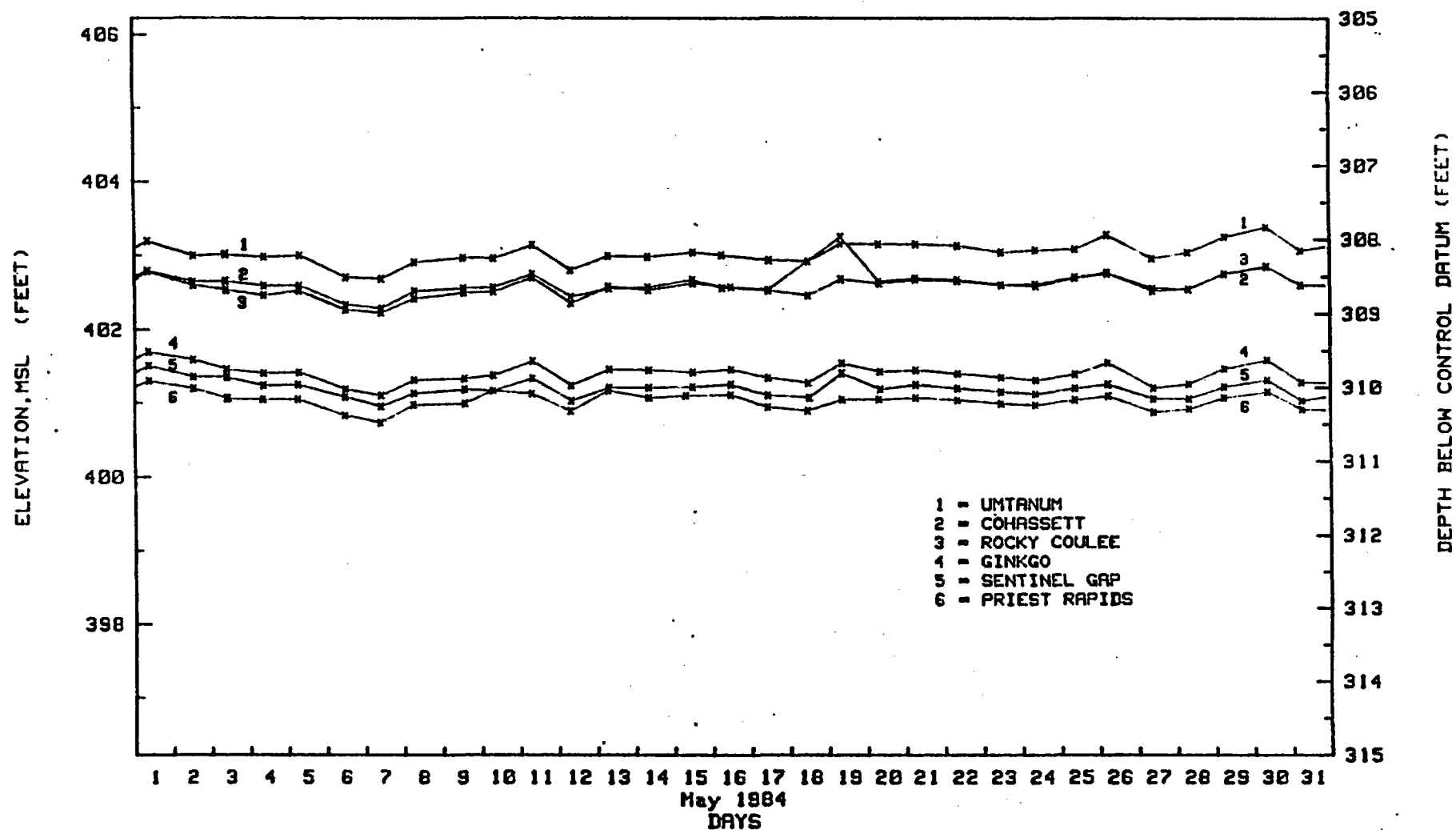
HYDROGEOLOGIC UNIT: WANAPUM/GRANDE RONDE BASALTS

LOCATION: N46786.17 W79919.48

CONTROL DATUM: BRASS CAP

CONTROL DATUM ELEVATION (ft): 711.22

BOREHOLE DEPTH (ft): 3871.0



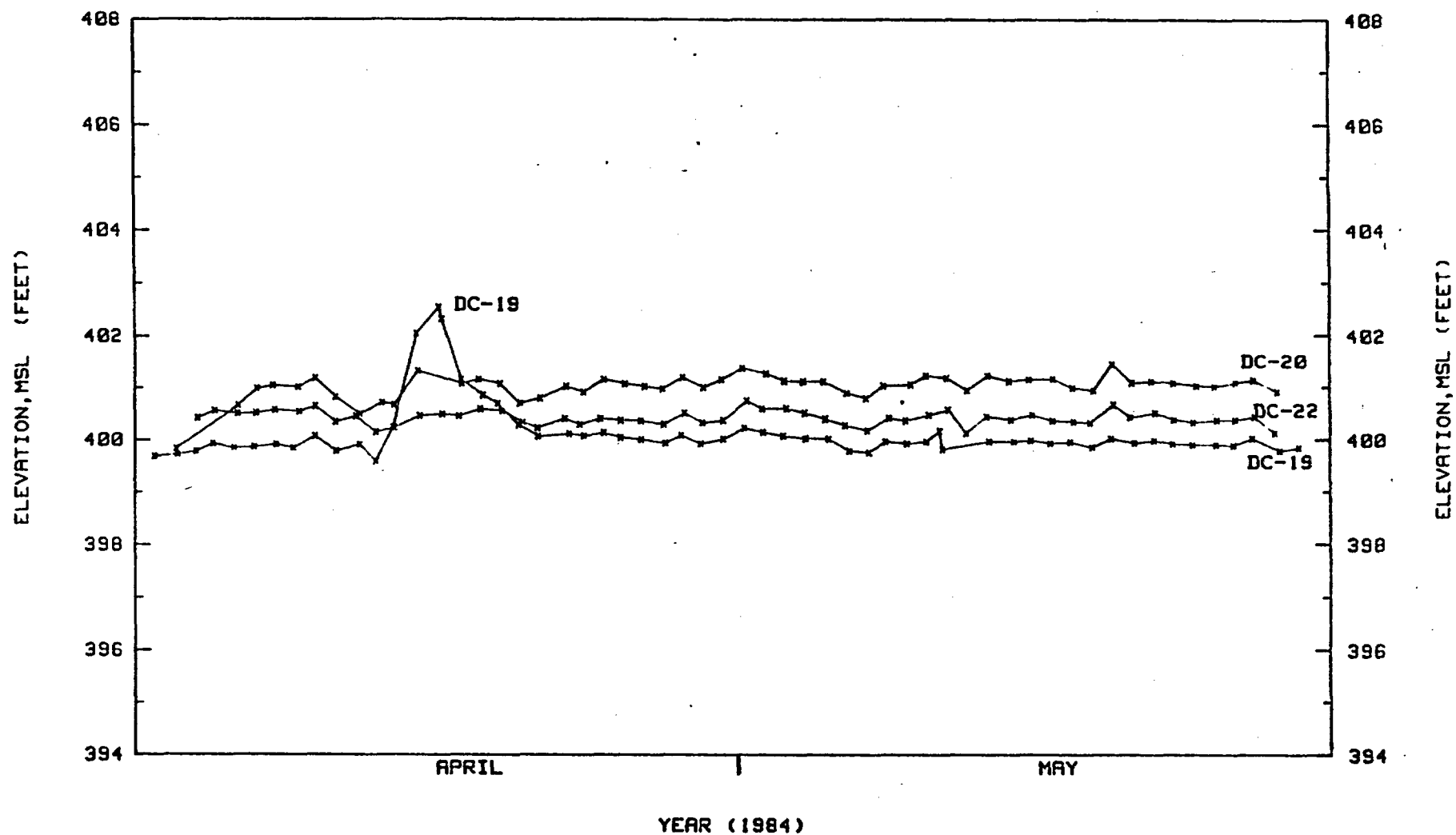
HYDROGRAPH FOR BOREHOLE NUMBER DC-20C
Program HYDAT Rev 4.3

BOREHOLE NUMBER: DC-19, 20, 22

HYDROGEOLOGIC UNIT: PRIEST RAPIDS

LOCATION: HANFORD SITE

MEASURING POINT: MEAN SEA LEVEL



HYDROGRAPH FOR BOREHOLE NUMBER DC-19, 20, 22
Program WHYDAT Rev 4.2 FILE: 19C-PR

GOAL

DETERMINE ADEQUACY OF DATA PACKAGES

EXISTING DOCUMENTATION

MONTHLY REPORTING OF WATER-LEVEL MEASUREMENTS AND DOWNHOLE PRESSURE AND TEMPERATURE DATA AT BOREHOLE CLUSTER SITES DC-19, -20, AND -22 IN DATA PACKAGE (E.G., SD-BWI-DP-045)

CONTENTS OF DATA PACKAGE

- o INTRODUCTION
- o DATA SOURCE
- o DATA LIMITATIONS
- o DATA DESCRIPTION (HYDROGRAPHS)
- o REFERENCES
- o APPENDIX
 - WATER-LEVEL DATA
 - PRESSURE AND TEMPERATURE DATA
 - ATMOSPHERIC PRESSURE DATA

5 May 3:10: 6 pm

Borehole Number: DC-19A
Borehole location: N29530.58 W70338.91
Latitude: N 46.3108514
Longitude: W 119.3623616
Hydrogeologic unit: RINGOLD
Borehole depth: 804.1 feet
Measuring point elevation: 630.06 feet
Control Datum elevation: 627.35 feet
Control datum description: BRASS CAP
Monitored interval: 497 - 577 feet
Comments: STEEL TAPE READINGS. DEPTH BELOW DATUM.
Records in file: 31

rec. no.	date	depth	rec. no.	date	depth
1	84.04021125	177.14	17	84.04171454	176.38
2	84.04030938	177.16	18	84.04181700	176.82
3	84.04031421	177.14	19	84.04191032	176.36
4	84.04041523	177.09	20	84.04200938	177.19
5	84.04051433	176.96	21	84.04210911	177.21
6	84.04060913	176.95	22	84.04210920	177.30
7	84.04070916	177.01	23	84.04222107	177.24
8	84.04081138	176.94	24	84.04231444	177.17
9	84.04090950	177.06	25	84.04241402	177.07
10	84.04101052	176.87	26	84.04250950	177.04
11	84.04111118	177.10	27	84.04261020	177.06
12	84.04121020	177.04	28	84.04271435	177.13
13	84.04131004	177.32	29	84.04280859	177.02
14	84.04140629	177.26	30	84.04290751	177.04
15	84.04151013	177.04	31	84.04301036	177.05
16	84.04161230	177.01			

WORK ACCOMPLISHED

- o DRILLED 11 BOREHOLES
 - TOTAL LINEAR FEET: 18,500 FEET
- o INSTALL 27 PIEZOMETERS
 - TOTAL NEAT CEMENT: 300 CUBIC YARDS
 - FILTER PACK MATERIAL: 96 CUBIC YARDS
 - TOTAL PIEZOMETERS TUBING: 55,600 FEET
- o INSTRUMENTATION
 - DOWNHOLE PRESSURE TRANSDUCERS
 - SURFACE RECORDING EQUIPMENT
- o HEAD MONITORING
- o DOCUMENTATION

BRIDGE PLUG INSTALLATION

OBJECTIVE

- o To LIMIT INTERCOMMUNICATION IN OPEN BOREHOLES LOCATED IN AND AROUND THE RRL.
- o PROVIDING HEAD MONITORING IN UPPERMOST HORIZON, E.G., ROCKY COULEE.

METHOD

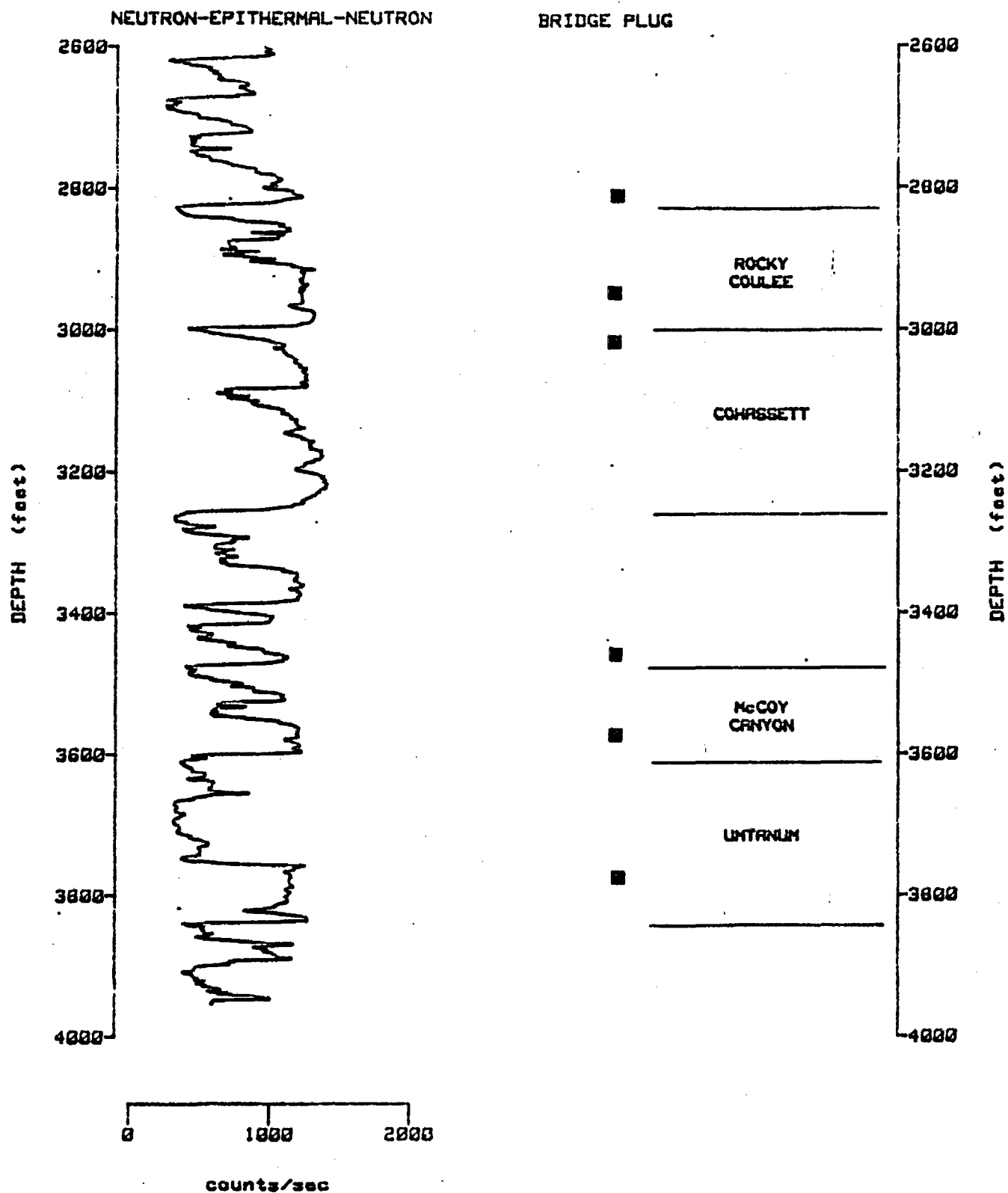
- o ISOLATE SAME HORIZONS WITH BRIDGE PLUGS AT THE BOREHOLE CLUSTER SITES.

BOREHOLES CONTAINING BRIDGE PLUGS

- o RRL-2
- o RRL-6
- o RRL-14
- o DC-4/5
- o DC-16A AND DC-16C

BRIDGE PLUG LOCATIONS

BOREHOLE: RRL-2



PREDICTED AND OBSERVED HYDRAULIC HEADS FOR PIEZOMETERS
AT CLUSTER SITES DC-19, DC-20 AND DC-22

<u>INTERVAL</u>	DC-19		DC-20		DC-22	
	<u>PREDICTED</u>	<u>OBSERVED*</u>	<u>PREDICTED</u>	<u>OBSERVED*</u>	<u>PREDICTED</u>	<u>OBSERVED*</u>
BASAL RINGOLD FORMATION	425-435	450	410-420	454	445-455	443
RATTLESNAKE RIDGE INTERBED	435-445	437	413-423	444	445-455	442
MABTON INTERBED	415-425	421	405-415	414	415-425	410
PRIEST RAPIDS INTERFLOW	395-405	400	400-410	401	405-415	400
SENTINEL GAP FLOW TOP	395-405	400	400-410	401	405-415	400
GINKGO FLOWTOP	395-405	400	400-410	401	405-415	400
ROCKY COULEE FLOW TOP	395-405	398	400-410	403	405-415	397
COHASSETT FLOW TOP	395-405	400	400-410	403	405-415	401
UMTANUM FLOW TOP	395-405	400	400-410	403	405-415	402

*OBSERVATION DATE MAY 27, 1984

BOREHOLE NUMBER: DC-19C

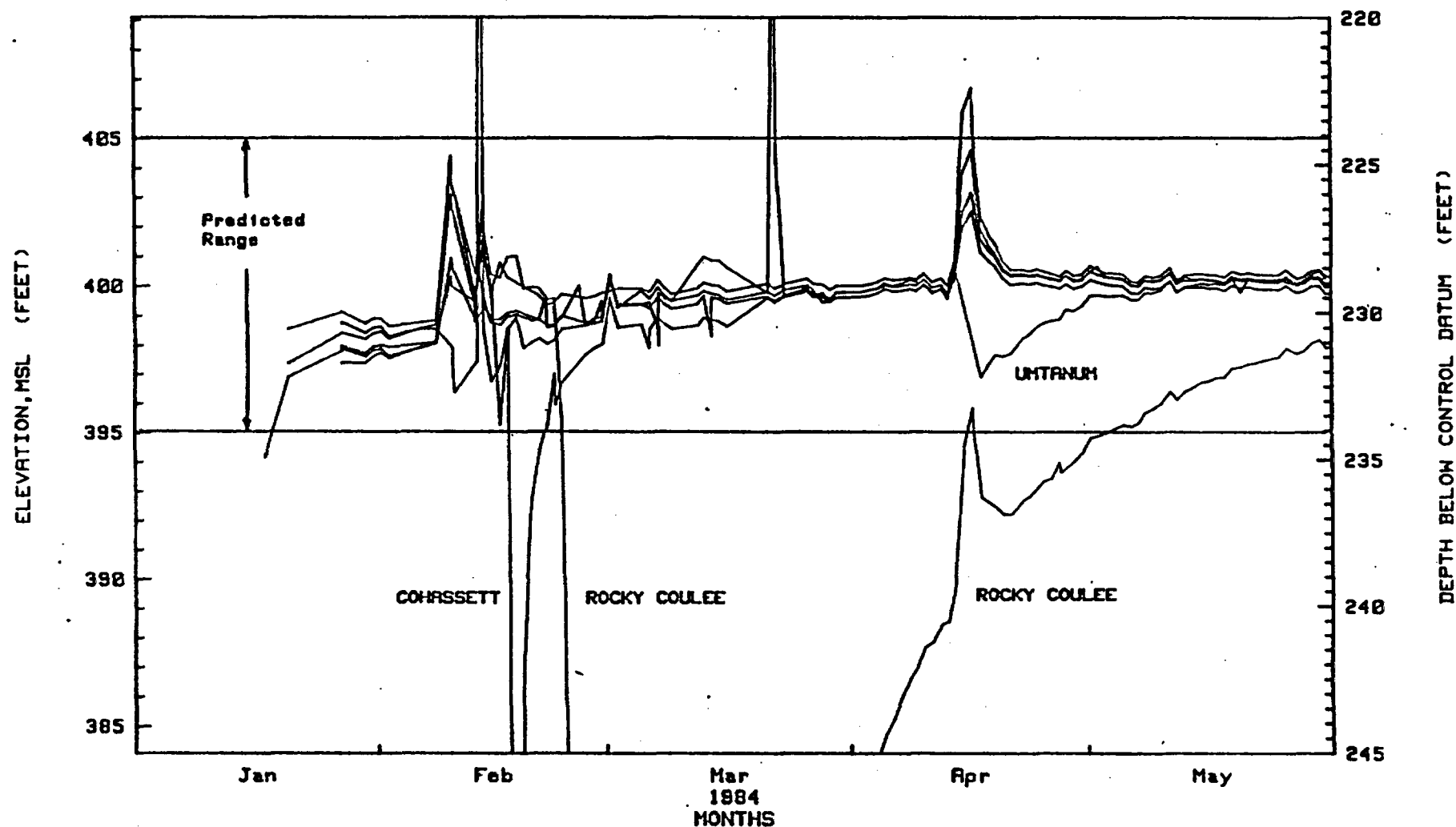
HYDROGEOLOGIC UNIT: WANAPUM/GRANDE RONDE BASALTS

LOCATION: N28888.11 W70243.98

CONTROL DATUM: BRASS CAP

CONTROL DATUM ELEVATION (ft): 629.10

BOREHOLE DEPTH (ft): 3983.0



HYDROGRAPH FOR BOREHOLE NUMBER DC-19C
Program HYDAT Rev 4.3

BOREHOLE NUMBER: DC-28C

HYDROGEOLOGIC UNIT: SEE BELOW

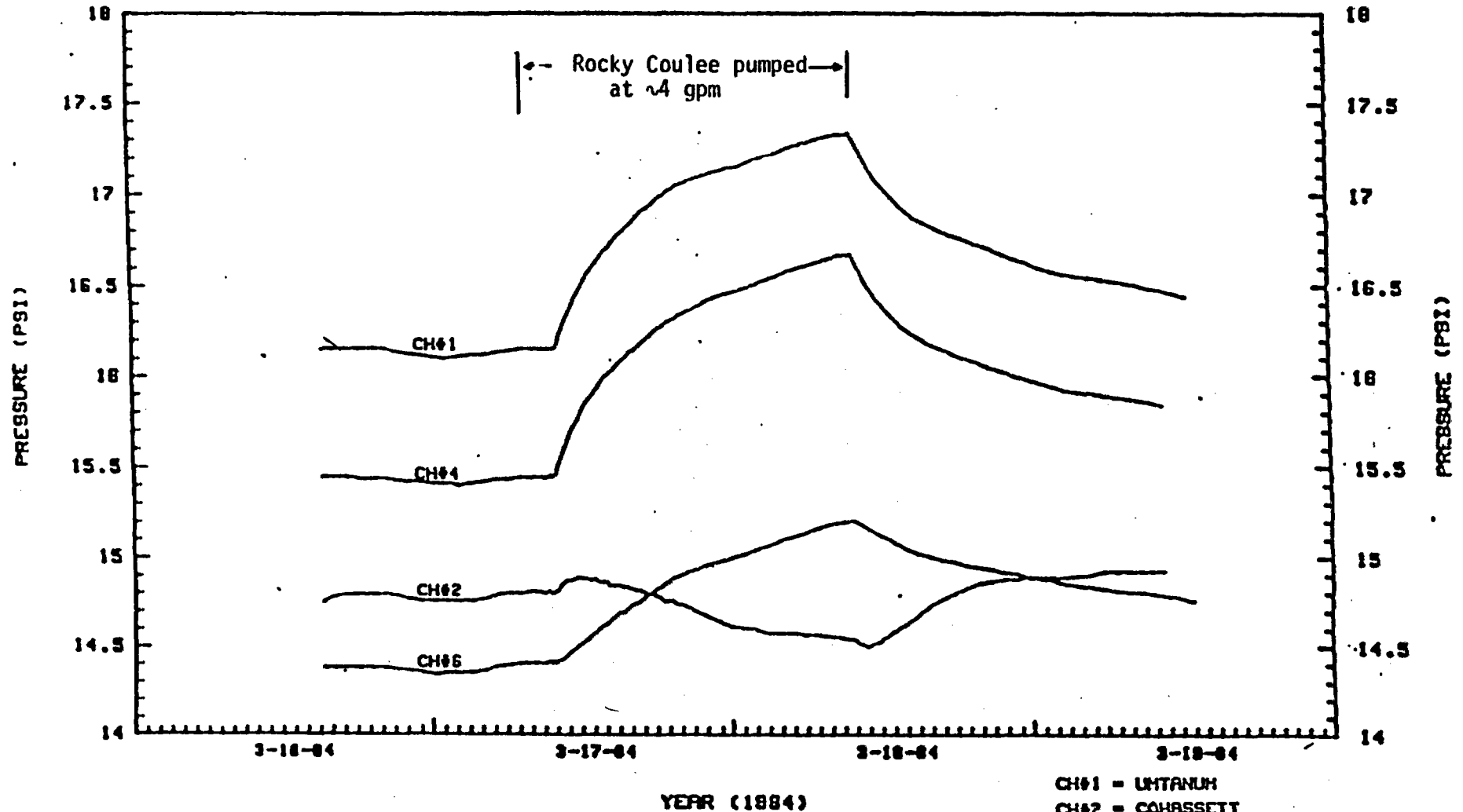
LOCATION: N46788.17 W78818.48

MEASURING POINT: TRANSDUCERS

MEASURING POINT ELEVATION (ft):

8.888

BOREHOLE DEPTH (ft): 3871.00



HYDROGRAPH FOR BOREHOLE NUMBER DC-28C CH# 3
Program HYDNT Rev 4.2 FILE: RCH3

CH#1 = UMTANUK
CH#2 = COHASSETT
CH#4 = LOWER FRENCHMAN SPRINGS
CH#6 = PRIEST RAPIDS

BOREHOLE NUMBER: DC-19C

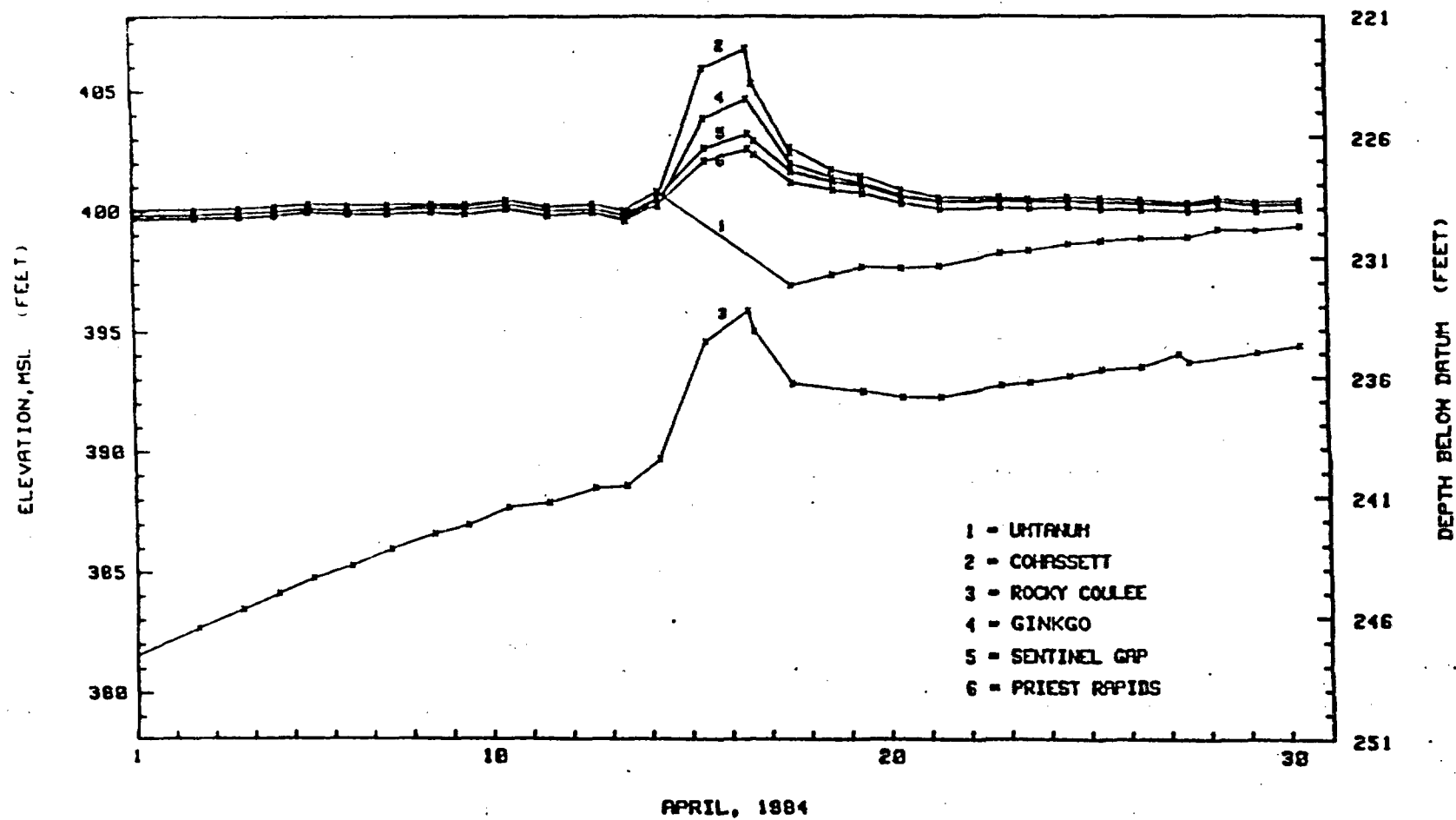
HYDROGEOLOGIC UNIT: WANAPUM/GRANDE RONDE BASALTS

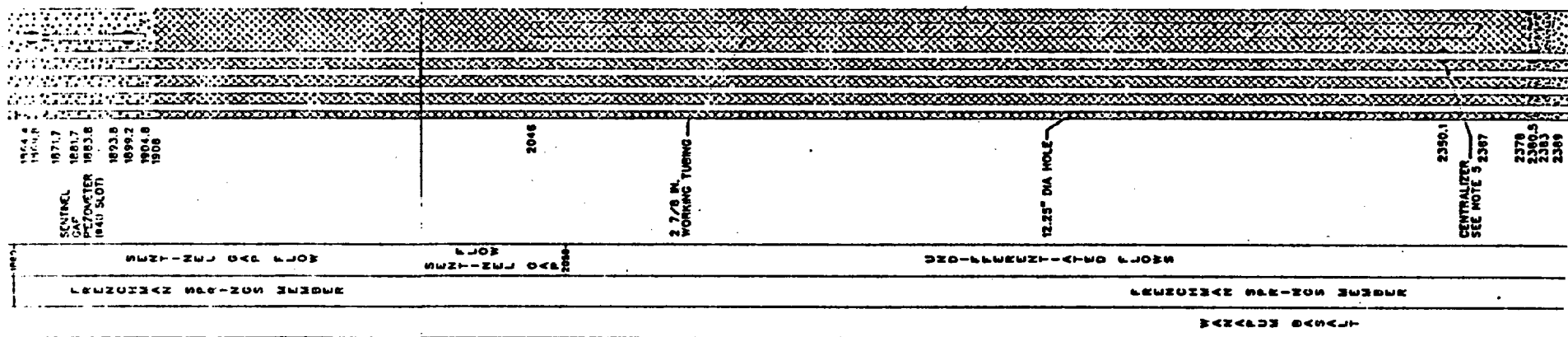
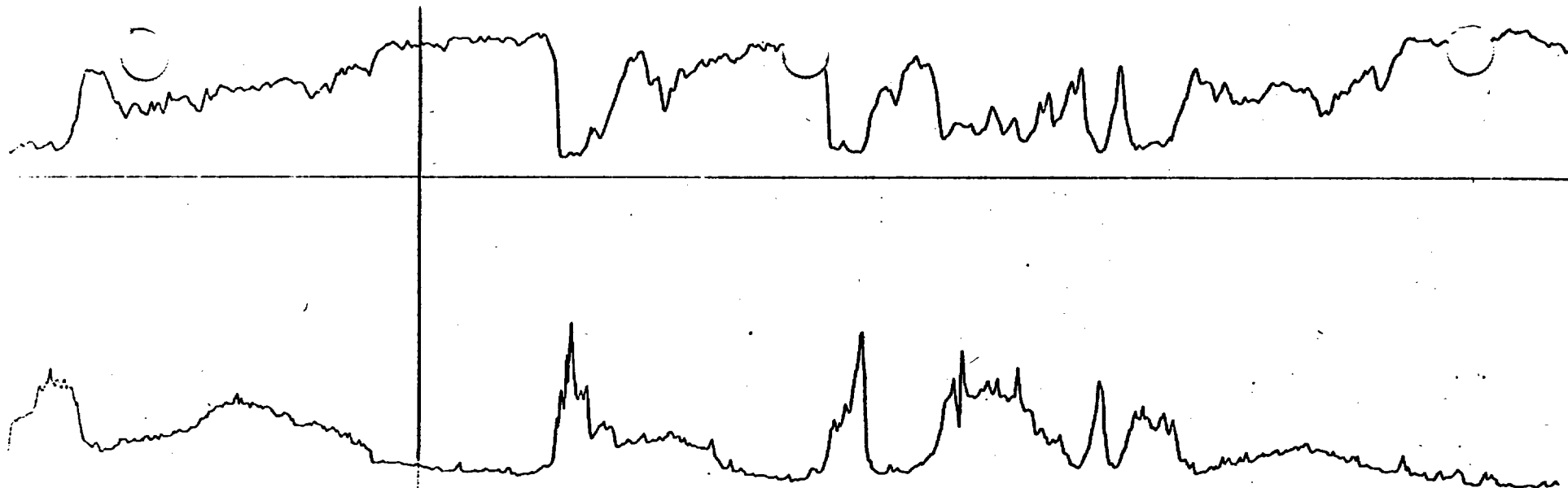
LOCATION: N28888.11 W78243.88

DATUM: BRASS CAP AT GROUND SURFACE

DATUM ELEVATION (ft): 629.18

BOREHOLE DEPTH (ft): 3883.08





1900

2

2000

2100

2200

2300

ISSUED FOR APPROVAL
U.S. DEPARTMENT OF ENERGY
RICHLAND OPERATIONS OFFICE
KAISER ENGINEERS MANFORD CO.

CIVIL
AS BUILT
DC-20C
MULTILEVEL PIEZOMETER

PROJECT TITLE: BASALT WASTE ISOLATION PROJECT
NO. 4828
DATE: 11/1/80
DRAWING NUMBER: H-6-1513
SHEET: 1

NOTE:
1. FOR DC-20C NOTES SEE
DRAWING H-6-1513 SM 1.

REV.	DATE	BY	APP'D.
1	11/1/80	J. CONNER	
2	11/1/80	J. CONNER	
3	11/1/80	J. CONNER	
4	11/1/80	J. CONNER	
5	11/1/80	J. CONNER	
6	11/1/80	J. CONNER	
7	11/1/80	J. CONNER	
8	11/1/80	J. CONNER	
9	11/1/80	J. CONNER	
10	11/1/80	J. CONNER	
11	11/1/80	J. CONNER	
12	11/1/80	J. CONNER	
13	11/1/80	J. CONNER	
14	11/1/80	J. CONNER	
15	11/1/80	J. CONNER	
16	11/1/80	J. CONNER	
17	11/1/80	J. CONNER	
18	11/1/80	J. CONNER	
19	11/1/80	J. CONNER	
20	11/1/80	J. CONNER	

NONE

NOT RECD

DC-20C-100

1

7

6

5

11/1/80

L. S. LEONHART
BASALT WASTE ISOLATION PROJECT
GROUNDWATER LEVEL
BASELINES

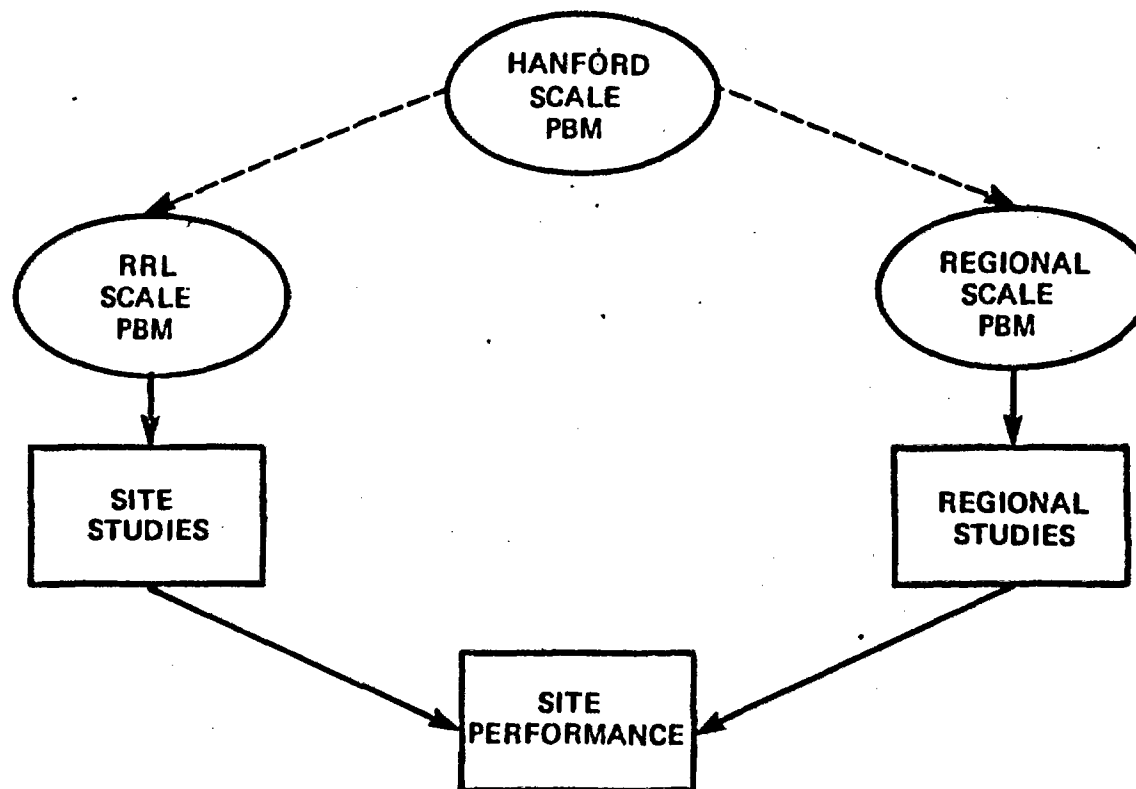
GROUNDWATER LEVEL BASELINES

- o REGIONAL MONITORING PROGRAM (USGS)
 - A. RELATIONSHIP TO THE REGIONAL AQUIFER SYSTEM ANALYSIS PROGRAM
 - B. LOCATION OF WELLS
 - C. MONITORING SCHEDULE

PURPOSES OF
PBM VS. SPHERES OF ASSESSMENT

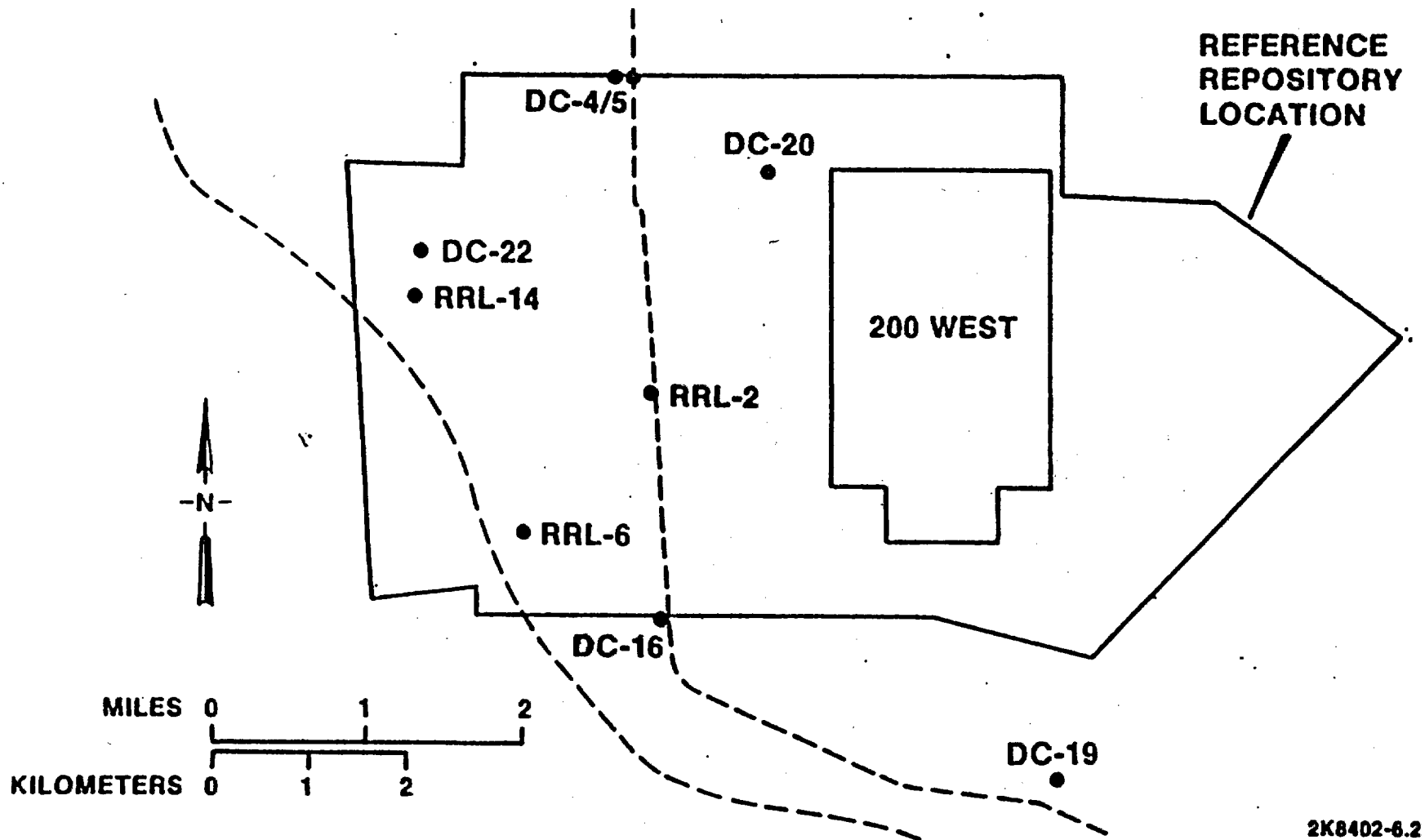
<u>PURPOSE</u>	<u>SPHERE</u>
o PRE-TEST/PRE-ES BASELINING	o RRL AND ADJACENT AREA
o GENERAL SITE CHARACTERIZATION	o HANFORD SITE
o REGIONAL GROUNDWATER FLOW MODEL CALIBRATIONS	o REGIONAL (EXTENDED PASCO BASIN AND BEYOND)

INTERRELATIONSHIPS OF SCALE APPLIED TO BWIP HYDROLOGIC CHARACTERIZATION STUDIES

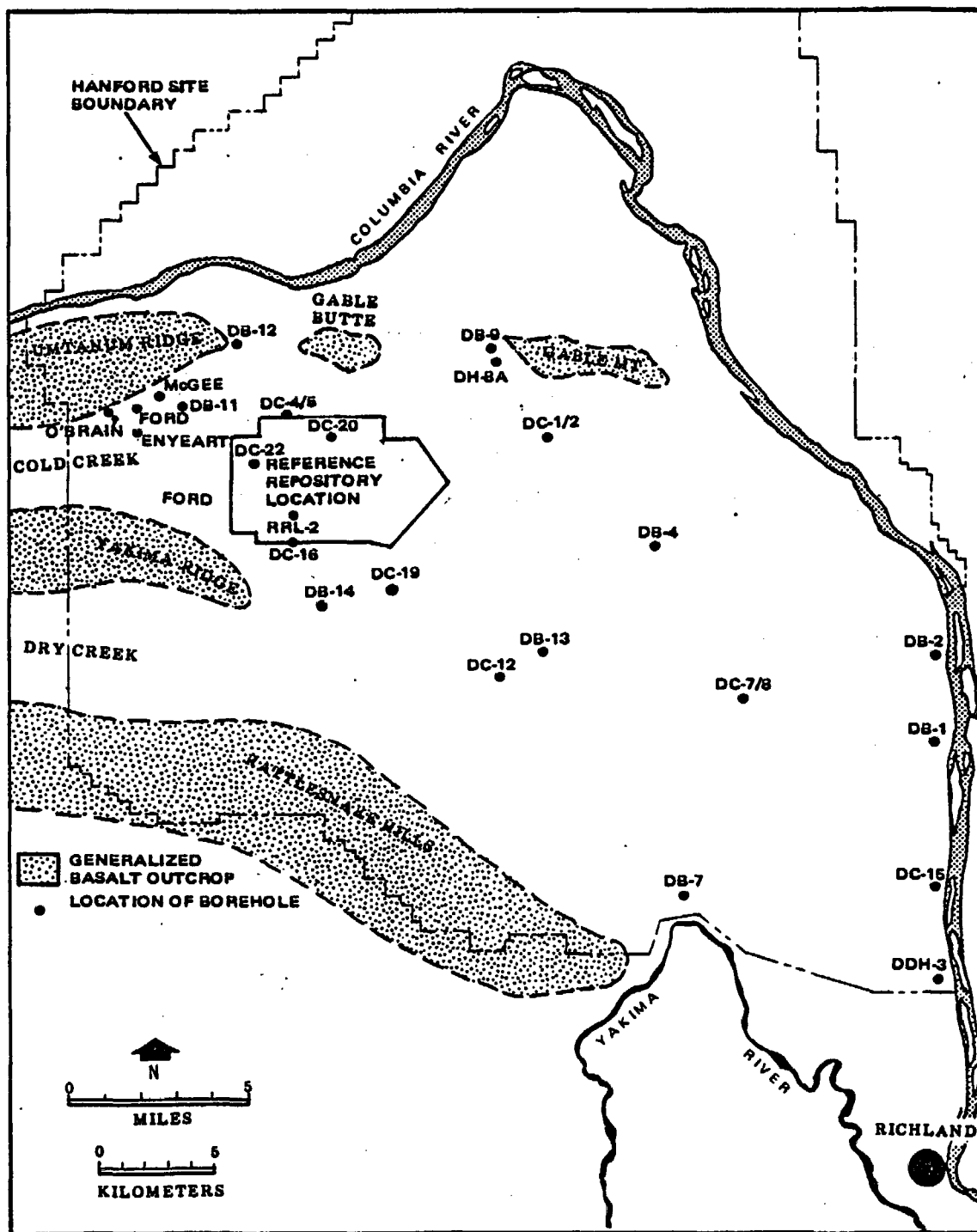


BASALT WASTE ISOLATION PROJECT

PIEZOMETER NETWORK

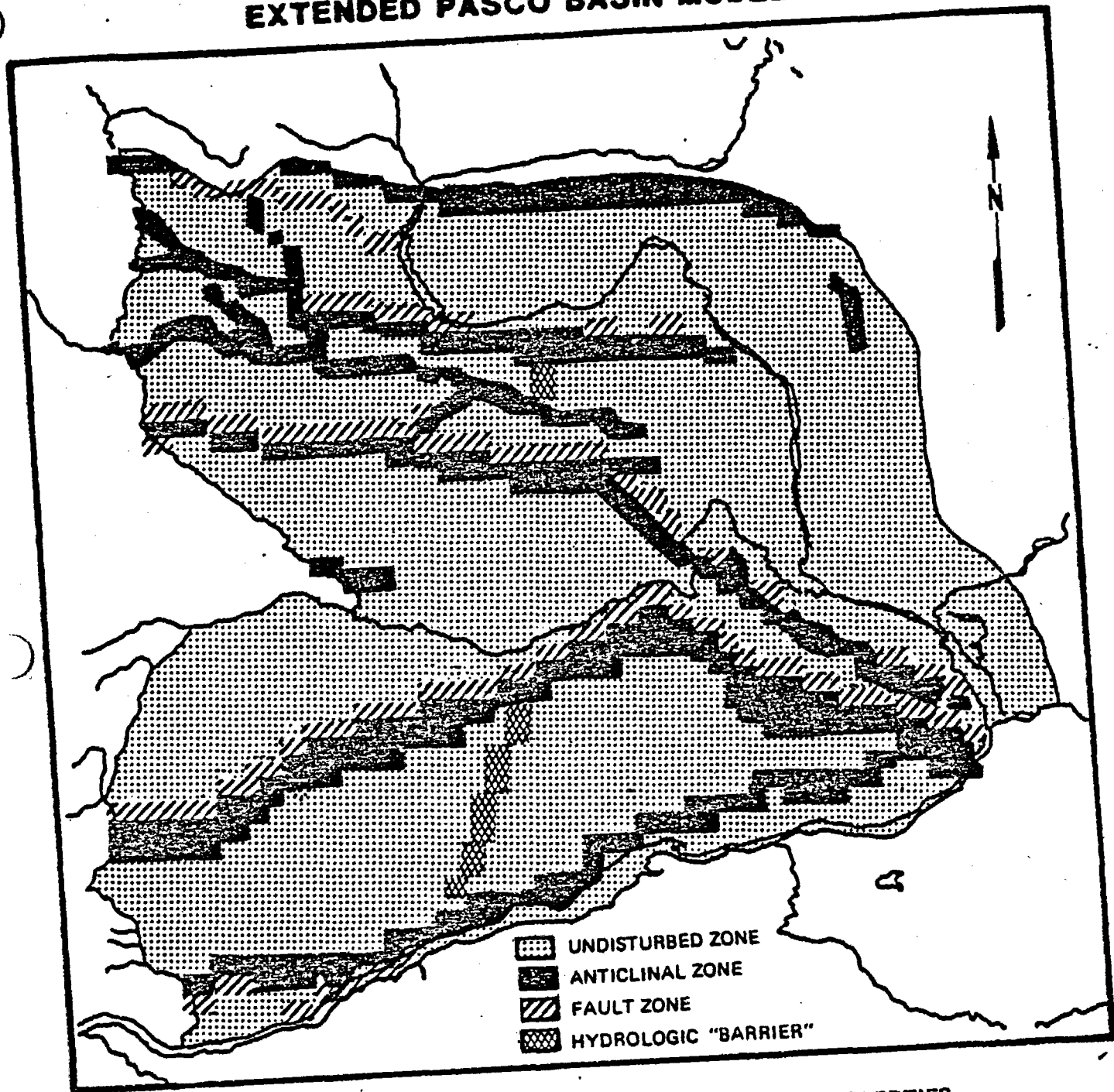


2K8402-6.2

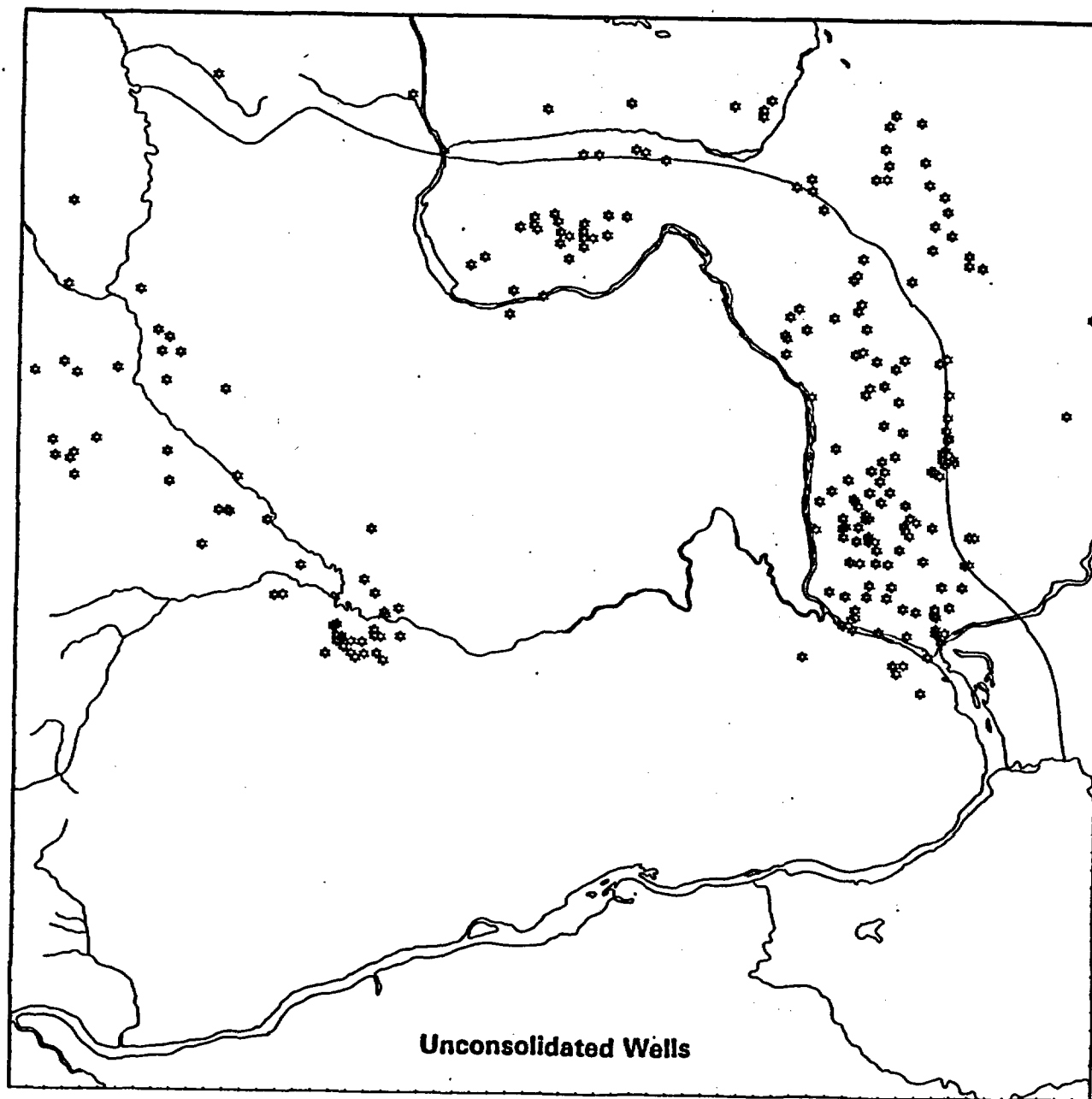


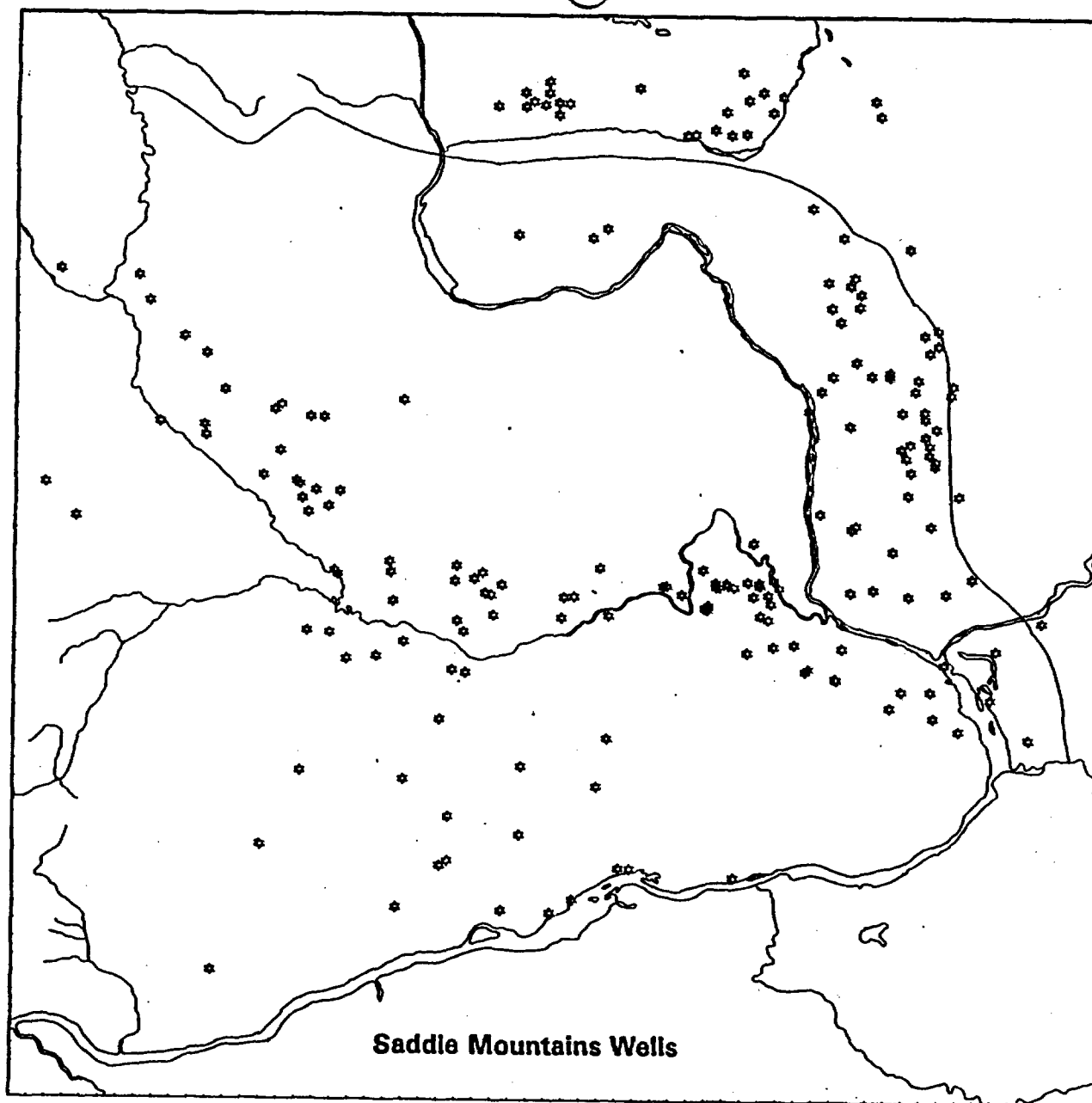
LOCATION OF BASALT BOREHOLES ON THE HANFORD SITE FOR WHICH WATER LEVEL DATA ARE PRESENTLY BEING OBTAINED.

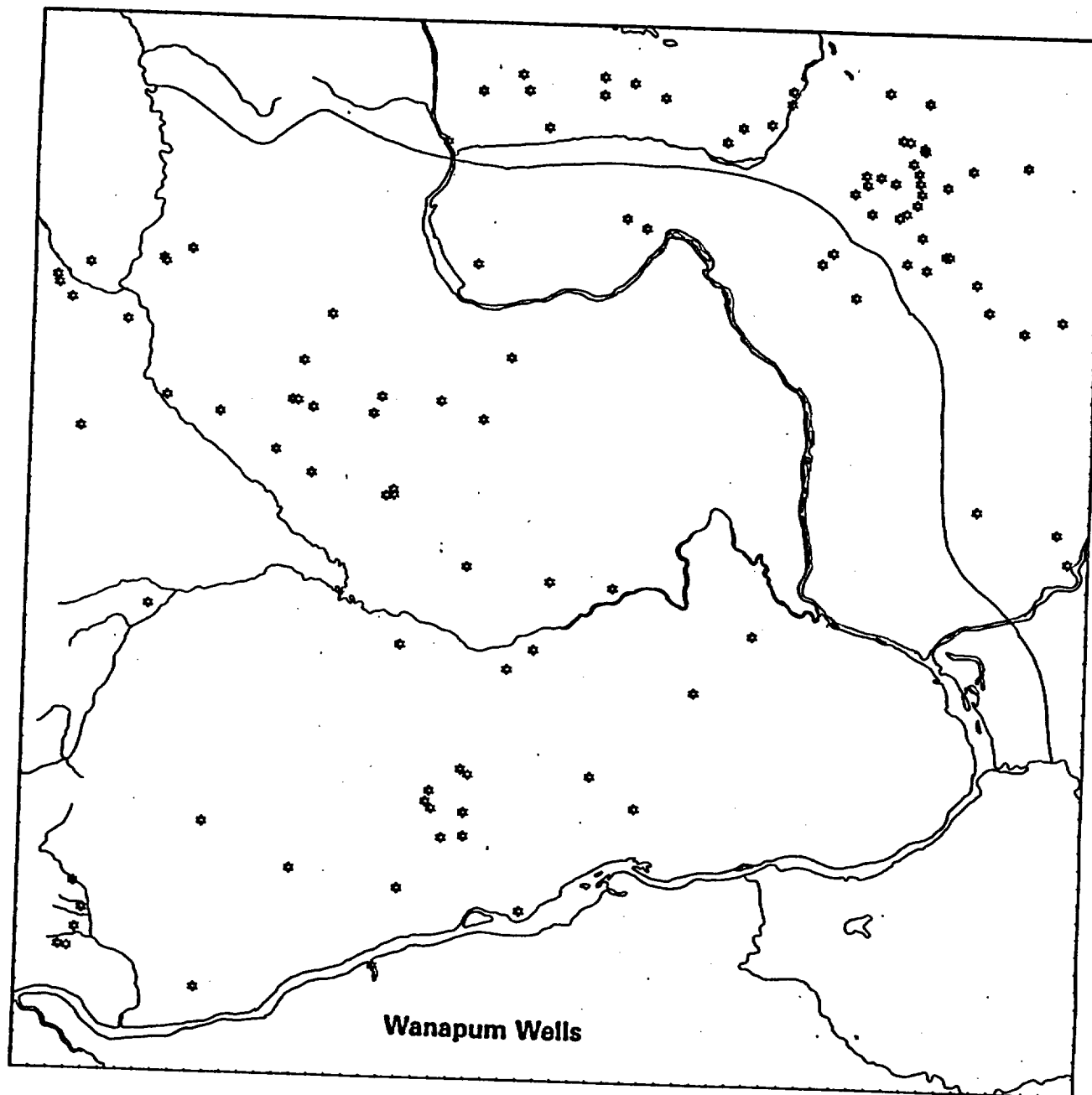
**GROUNDWATER FLOW SYSTEM
(Conceptual model)
EXTENDED PASCO BASIN MODEL**

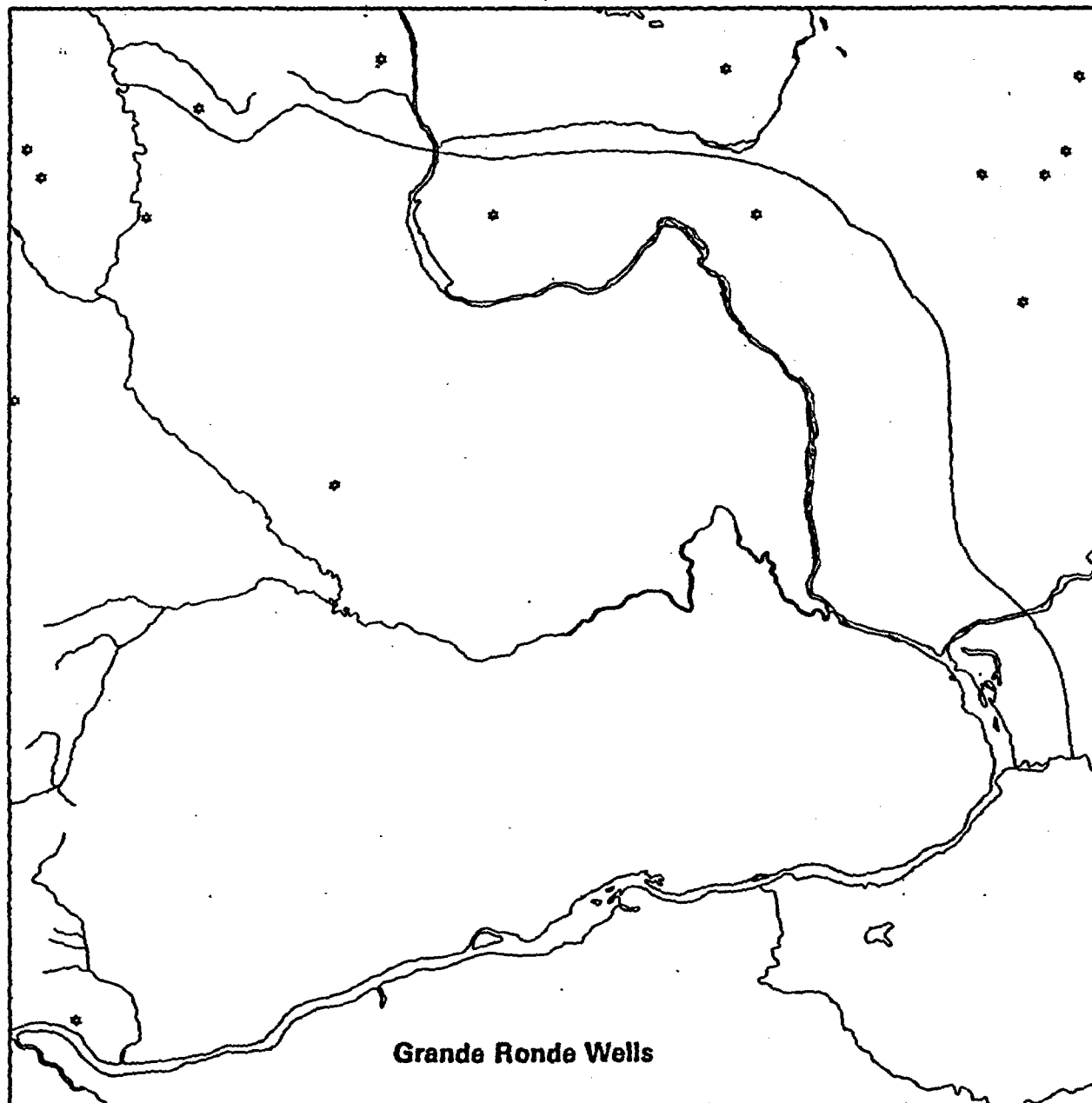


BOUNDARIES AND ZONES OF DIFFERENT HYDROLOGIC PROPERTIES









Grande Ronde Wells

COLLATERAL PROGRAMS

- o HANFORD SITE SHALLOW GROUNDWATER SYSTEM ASSESSMENT
- o WATSTORE/NAWDEX DATA BASE
- o USGS/WSDOE DATA ACQUISITION

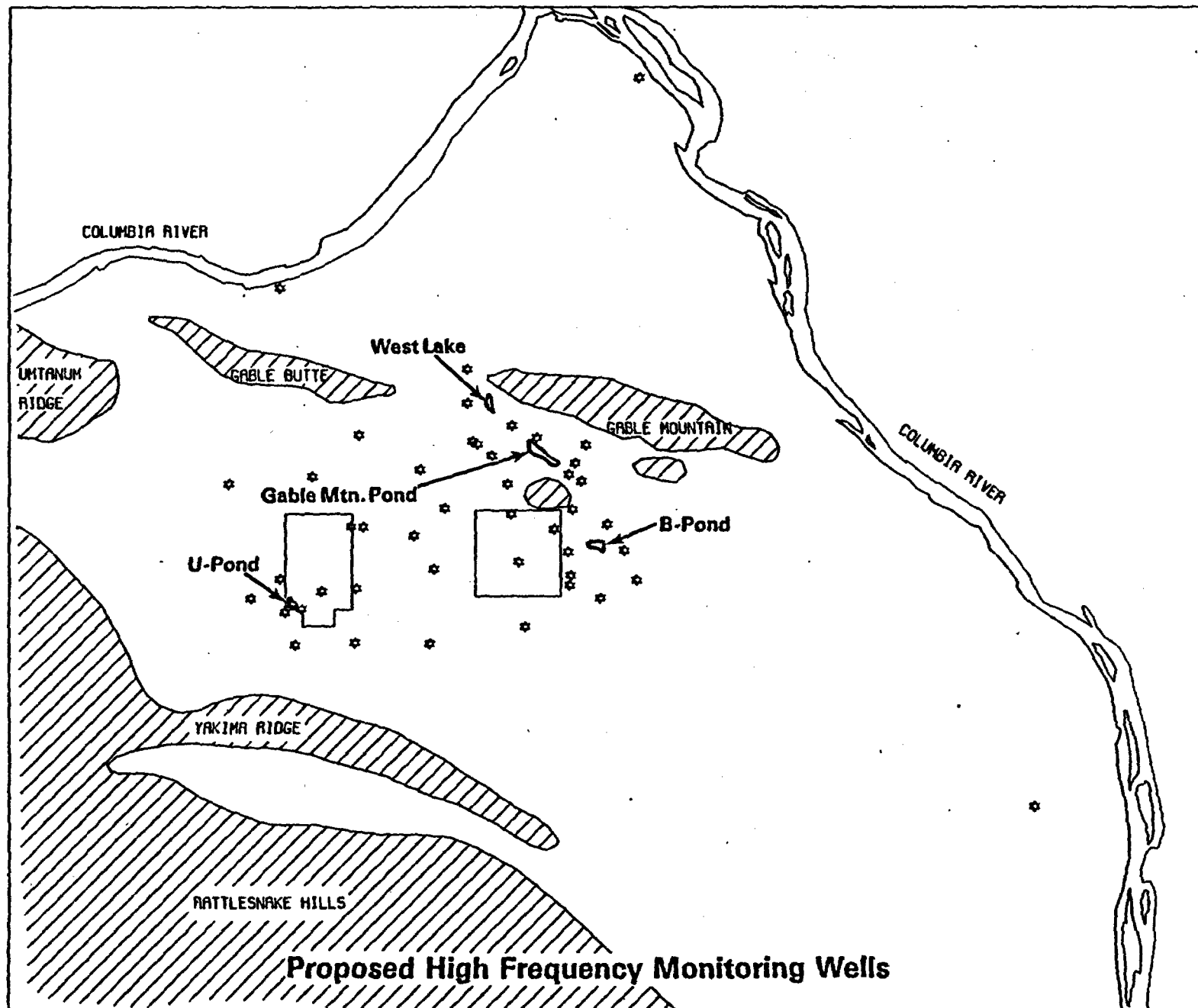
HANFORD SITE SHALLOW GROUNDWATER SYSTEM ASSESSMENT

PURPOSE: TO ASSESS THE EXTENT TO WHICH HANFORD SITE WATER USE/MANAGEMENT ACTIVITIES IMPACT BASALT GROUNDWATER FLOW SYSTEMS AND THE IMPACT OF SUCH FINDINGS ON OUR CONCEPTUAL UNDERSTANDING OF THE GROUNDWATER FLOW SYSTEM

INVESTIGATORS: ROCKWELL - BWIP
WASTE MANAGEMENT
PNL

TASKS:

1. MONITOR "SHALLOW" BOREHOLES ADJACENT TO WATER USE/DISPOSAL SITES
2. INVENTORY (PRESENT AND PAST) HANFORD SITE WATER USE/BALANCE
3. MODEL EVALUATIONS
4. MANAGEMENT OF RESULTING DATA



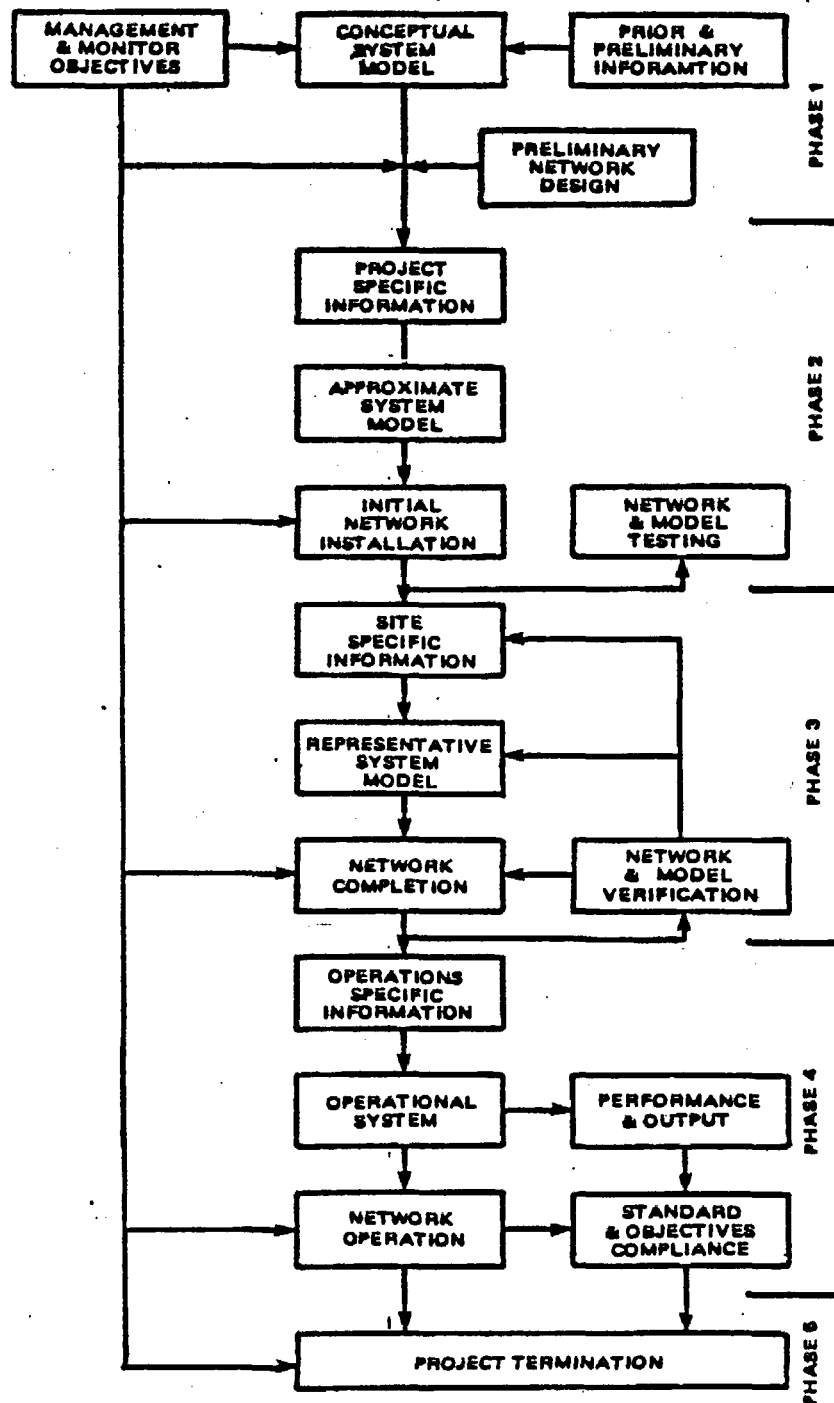
USGS/WSDOE COOPERATION

- o DATA BASE
 - WATSTORE/NAWDEX
- o REGIONAL WATER LEVELS
 - RASA
 - SODIUM STUDY
 - OTHER STUDIES
- o STRESS HISTORY
 - WELL EFFICIENCIES
 - POWER USE
 - REMOTE SENSING EVALUATIONS WITH PNL
- o SURFACE WATER DATA
- o IHWG

GROUNDWATER LEVEL BASELINES

- o CRITERIA FOR BASELINE ESTABLISHMENT
 - A. CRITERIA FOR START OF LARGE-SCALE HYDRAULIC STRESS TESTS
 - B. CRITERIA FOR CALIBRATION OF EXTENDED PASCO BASIN MODEL

FLOW DIAGRAM OF NETWORK DESIGN PROCESS. **(AFTER PFANNKUCH AND LABNO, 1976)**

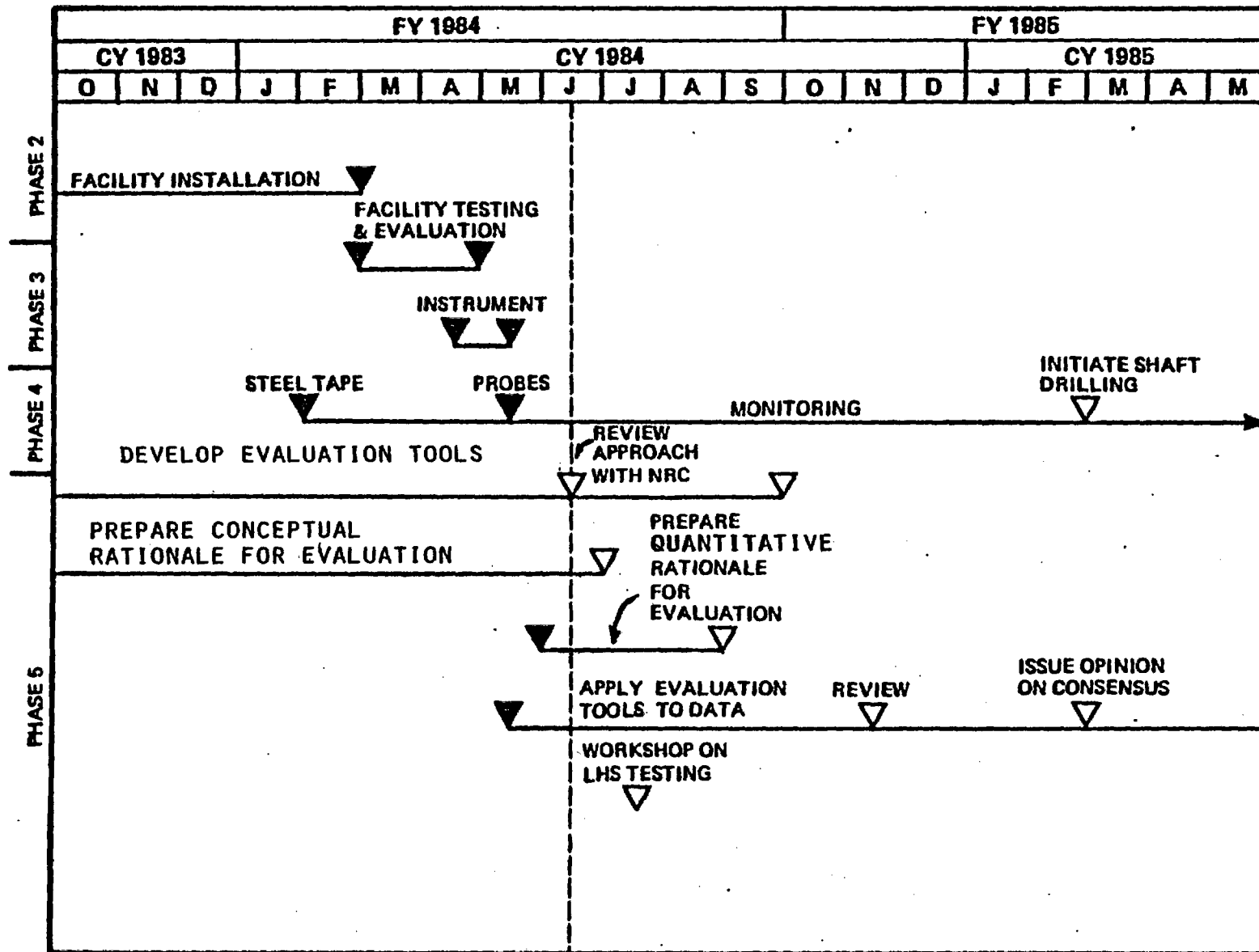


DESIGN STRATEGY FOR MONITORING NETWORKS

(AFTER PFANNKUCH AND LABNO, 1976)

<u>PHASE</u>	<u>DESCRIPTION</u>
1	PRELIMINARY NETWORK DESIGN AND INFORMATION GATHERING
2	INITIAL INSTALLATION AND TESTING
3	COMPLETION AND VERIFICATION
4	OPERATION
5	TERMINATION

PROPOSED PLAN FOR REACHING TERMINATION STEP ON RRL BASELINE MONITORING



NETWORK DESIGN FACTORS

DATA OBJECTIVES

PHENOMENOLOGICAL CHARACTERISTICS

ASSOCIATED MEASUREMENT REQUIREMENTS

LEVEL OF RESOLUTION REQUIRED

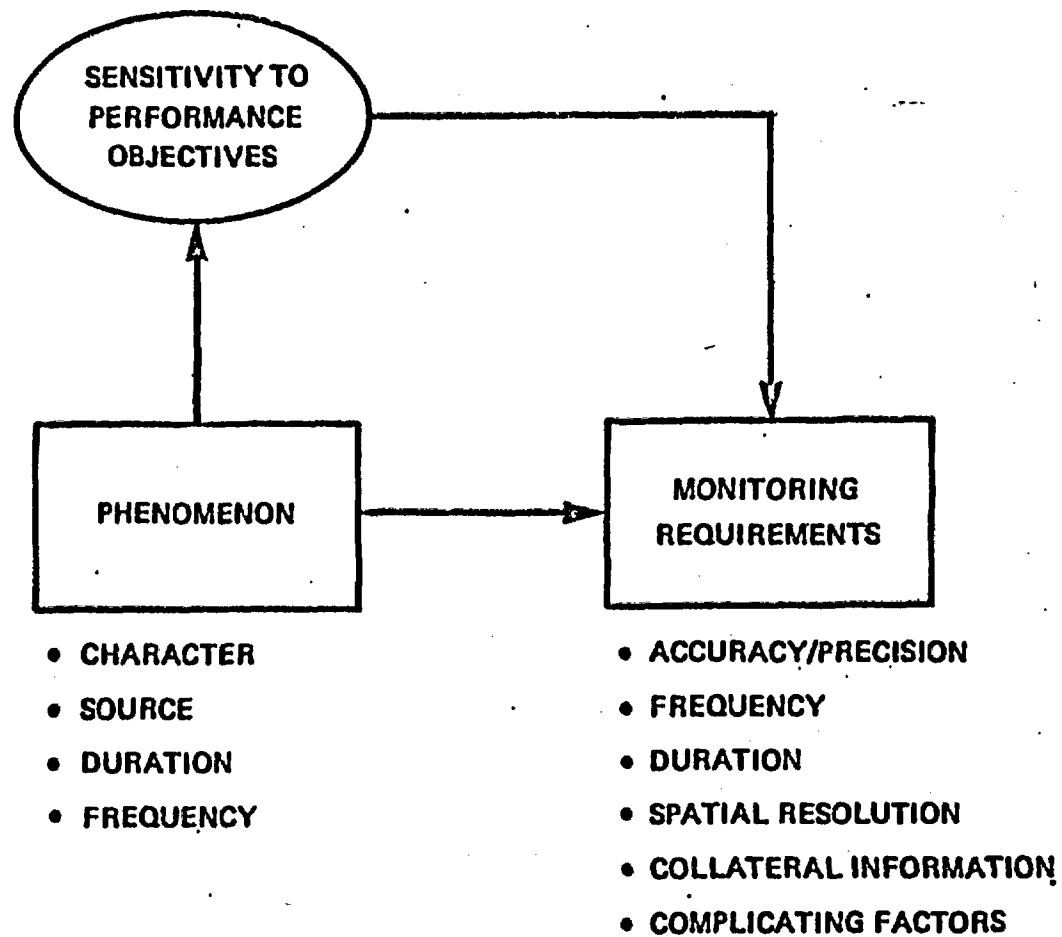
RISK FACTORS

MITIGATING FACTORS

OBJECTIVES OF PBM PROGRAM

OBJECTIVE	PRIMARY IMPACT		
	TEMPORAL	SPATIAL	BOTH
TIME-VARIANT BEHAVIOR	X		
HYDRAULIC GRADIENTS		X	
WORTH OF EXISTING DATA		X	
POTENTIOMETRIC MAPPING		X	
HISTORICAL DYNAMICS	X		
HYDROGEOLOGIC PROPERTIES		X	
AREAL COMPARISON OF DYNAMICS			X
IMPACT ASSESSMENTS			X
ERROR ANALYSES			X

RELATIONSHIP BETWEEN PHENOMENOLOGICAL CHARACTERISTICS AND IMPLICIT MONITORING REQUIREMENTS



MEASUREMENT REQUIREMENTS

- o FREQUENCY
- o DURATION
- o ACCURACY/SENSITIVITY
- o SPATIAL DISTRIBUTION
- o COLLATERAL INFORMATION

LEVELS OF PARAMETER RESOLUTION

- o RECOGNITION
- o CHARACTERIZATION
- o QUANTIFICATION
- o PREDICTION

RISK FACTORS

- o MISINTERPRETATION
- o OVERSIGHT
- o UNPREDICTABILITY

MITIGATING FACTORS

- o SCHEDULE
- o IMPACT OF UNCERTAINTIES
- o RELATIVE DYNAMICS
- o ALTERNATIVE OPPORTUNITIES

APPROACHES TO SATISFYING TERMINATION CRITERIA

1. SENSITIVITY DRIVEN

- A. EVALUATE SENSITIVITY OF PERFORMANCE TO TARGETED PARAMETERS
- B. DESIGN MEASUREMENT PROGRAM ACCORDING TO RESULTS
- C. PERFORM MEASUREMENTS
- D. CONFIRMATION

2. CHARACTERIZATION OF ERROR

- A. DESIGN MEASUREMENT SYSTEM/PROGRAM FOR "MAXIMUM" RESOLUTION ACHIEVABLE
- B. PERFORM MEASUREMENTS
- C. CHARACTERIZE ERROR
- D. PERFORM SENSITIVITY EVALUATIONS

TERMINATION STEP
EVALUATION "TOOLS"

- PARAMETRIC SENSITIVITY EVALUATIONS
- CORROBORATIVE DATA
- STATISTICS (TIME-SERIES, PREDICTION, CORRELATION, ETC.)
- CORRELATIONS WITH STRESS DATA
- RATE AND CHARACTERISTICS OF CHANGE
- ERROR CHARACTERIZATION

PARAMETRIC SENSITIVITY EVALUATIONS

OBJECTIVE: TO DETERMINE THE SENSITIVITY OF PERFORMANCE -
RELATED FACTORS TO ERRORS IN THE INITIAL HEAD
DISTRIBUTIONS

APPROACH: CONDUCT INVERSE SIMULATIONS TO ASCERTAIN THE DEGREE
TO WHICH ERRORS PROPAGATE FROM SITE CHARACTERIZATION
TO PERFORMANCE PREDICTION

**BASELINE
ERROR
(PBM)**

**PARAMETER
ESTIMATION
(LHS)**

**PREDICTION
ERROR
(PA)**

PARAMETRIC SENSITIVITY

EXAMPLE

STAGE 1

DETERMINE TOLERANCES FOR INDIVIDUAL PARAMETERS IN TERMS OF PERFORMANCE OBJECTIVES.

$$\text{E.G., } TT = \frac{L}{V} = F(N, K_H, K_V, \frac{DH}{DL}, L, \text{ ETC.})$$

STAGE 2

DETERMINE SENSITIVITY OF PARAMETER ESTIMATION TO ERRORS IN BASELING.

E.G., GIVEN: BASELINE DATA: $H(X, Y, Z, T)$

TEST CONDITIONS: $R, Q, T_p, B.C.$

DETERMINE: SENSITIVITY OF $S, K_V, T, \text{ ETC.}$
TO ERRORS IN $H(X, Y, Z, T)$

STAGE 3

DETERMINE SENSITIVITY OF PERFORMANCE CRITERION TO ERRORS IN PARAMETER ESTIMATION.

E.G., GIVEN: ERRORS OF $S, K_V, T, \text{ ETC.,}$ ARISING FROM ERRORS IN $H(X, Y, Z, T)$

DETERMINE: ERROR IN GROUNDWATER TRAVEL TIME ESTIMATES

STAGE 4

COMPARE WITH TOLERANCES DETERMINED IN STAGE 1.

CORROBORATIVE DATA

- o RELATIONSHIP TO TRENDS/PATTERNS OBSERVED
IN ADJACENT AREAS
- o ALTERNATIVE CONCEPTUAL MODELS
- o AREAL MAPS
- o GRADIENT

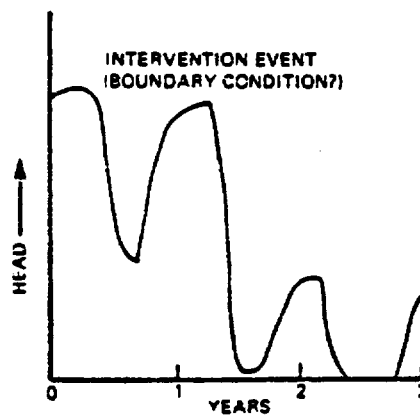
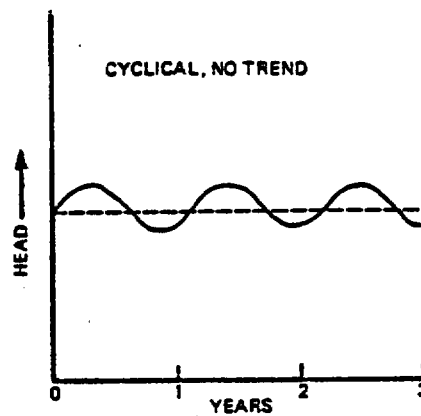
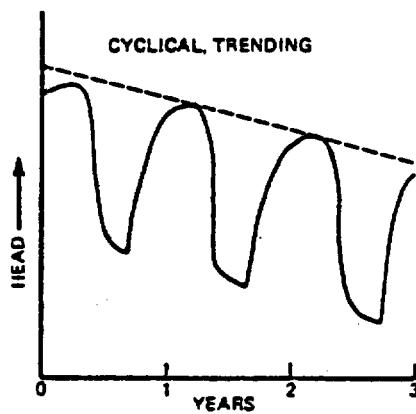
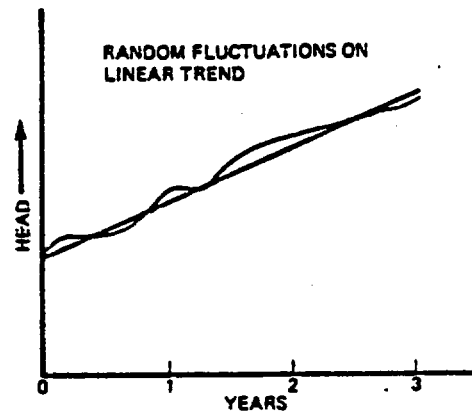
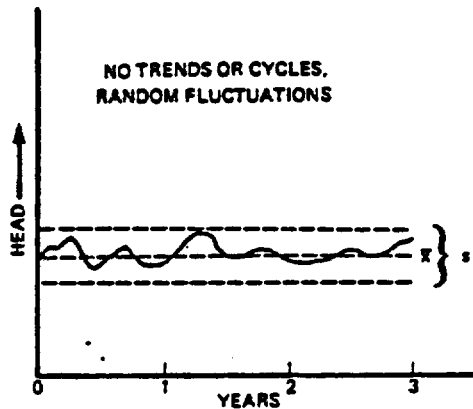
STATISTICS

- o REGRESSION AND CORRELATION COEFFICIENTS
- o CONFIDENCE (ERROR) BANDS
- o PREDICTIVE MODEL VALIDATIONS
- o TREND REMOVAL/RESIDUAL ANALYSIS

CORRELATION WITH STRESS DATA

- o HANFORD SITE WATER BALANCE
- o IRRIGATION CYCLES
- o BAROMETRIC CYCLES
- o RIVER STAGE
- o OTHER(S)?

SCENARIOS FOR TIME-SERIES HEAD OBSERVATIONS



ERROR CHARACTERIZATION

- o FACILITY DESIGN
- o INSTRUMENTATION
- o OPERATOR
- o NATURAL

SUMMARY

- o FACILITIES/NETWORK BEING USED FOR ACTIVITY HAVE HIGH DEGREE OF INTEGRITY AND MEASUREMENT CAPABILITY
- o QUALITY DATA ACQUISITION PROGRAM HAS BEEN INITIATED
- o EFFORTS IN PLACE TO FACILITATE EXTERNAL RELEASE OF DATA
- o EVALUATION TOOLS BEING DEVELOPED AND WILL BE APPLIED ITERATIVELY

BASALT WASTE ISOLATION PROJECT PRESENTATION TO
NUCLEAR REGULATORY COMMISSION ON
BASALT WASTE ISOLATION PROJECT
HYDROLOGIC CHARACTERIZATION PLANS/STATUS

JUNE 12-13, 1984

COMPARISON OF BWIP PLANS WITH NRC POSITION PAPER 1.1

COMPARISON OF BWIP PLANS
WITH NRC POSITION PAPER 1.1

- o POSITION PAPER 1.1 FOCUSES ON PERFORMANCE PARAMETER DETERMINATION
- o PROGRAM TO OBTAIN BOUNDARY CONDITIONS ALSO NECESSARY

POSITION PAPER 1.1. FEATURES

- o DEFENSIBLE CONCEPTUAL MODELS, BOUNDARY CONDITIONS, AND HYDRAULIC PARAMETERS
- o REGULATORY GUIDANCE SHOULD PROVIDE AN "ENVELOPE" OF APPROACHES AND SHOULD NOT BE PRESCRIPTIVE
- o RELY TO THE MAXIMUM EXTENT POSSIBLE ON "DIRECT TESTING" (SCALE AND COMPLETENESS)
- o START WITH GRANDE RONDE: ADJUST SUBSEQUENT PROGRAM TO ACCOMMODATE EARLY RESULTS
- o CONTINUING CONSULTATION

GENERAL DIFFERENCES BETWEEN NRC POSITION PAPER 1.1
AND BWIP PROGRAM

POSITION PAPER

PEIZOMETER STRINGS

CONTINUOUS WATER LEVEL RECORDERS

NEW WELL DC-X

BWIP PROGRAM

NESTED PIEZOMETERS

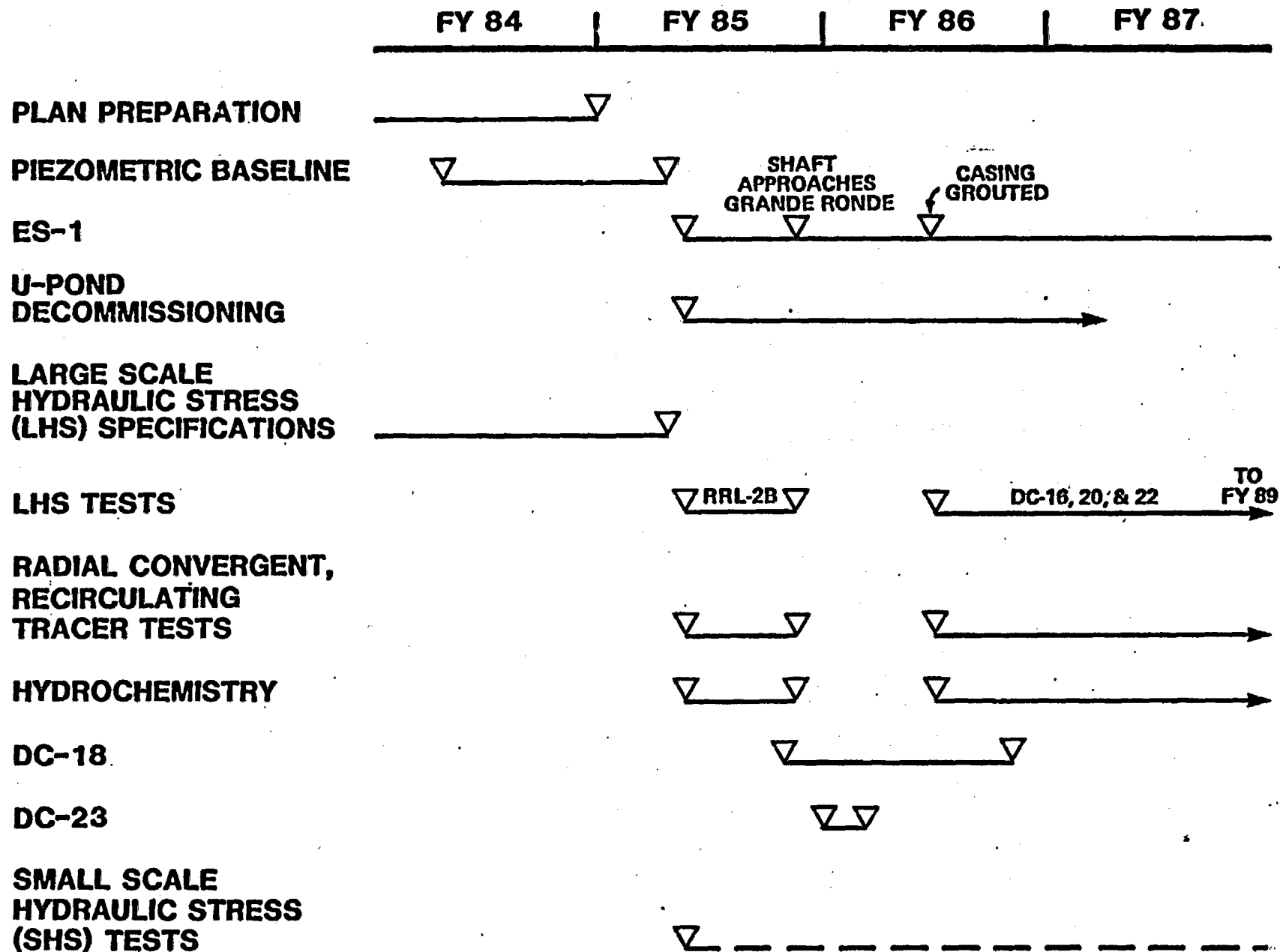
MEASUREMENT FREQUENCY DEPENDS
ON WELL

WATER LEVEL AND PRESSURE AT
SOME WELLS

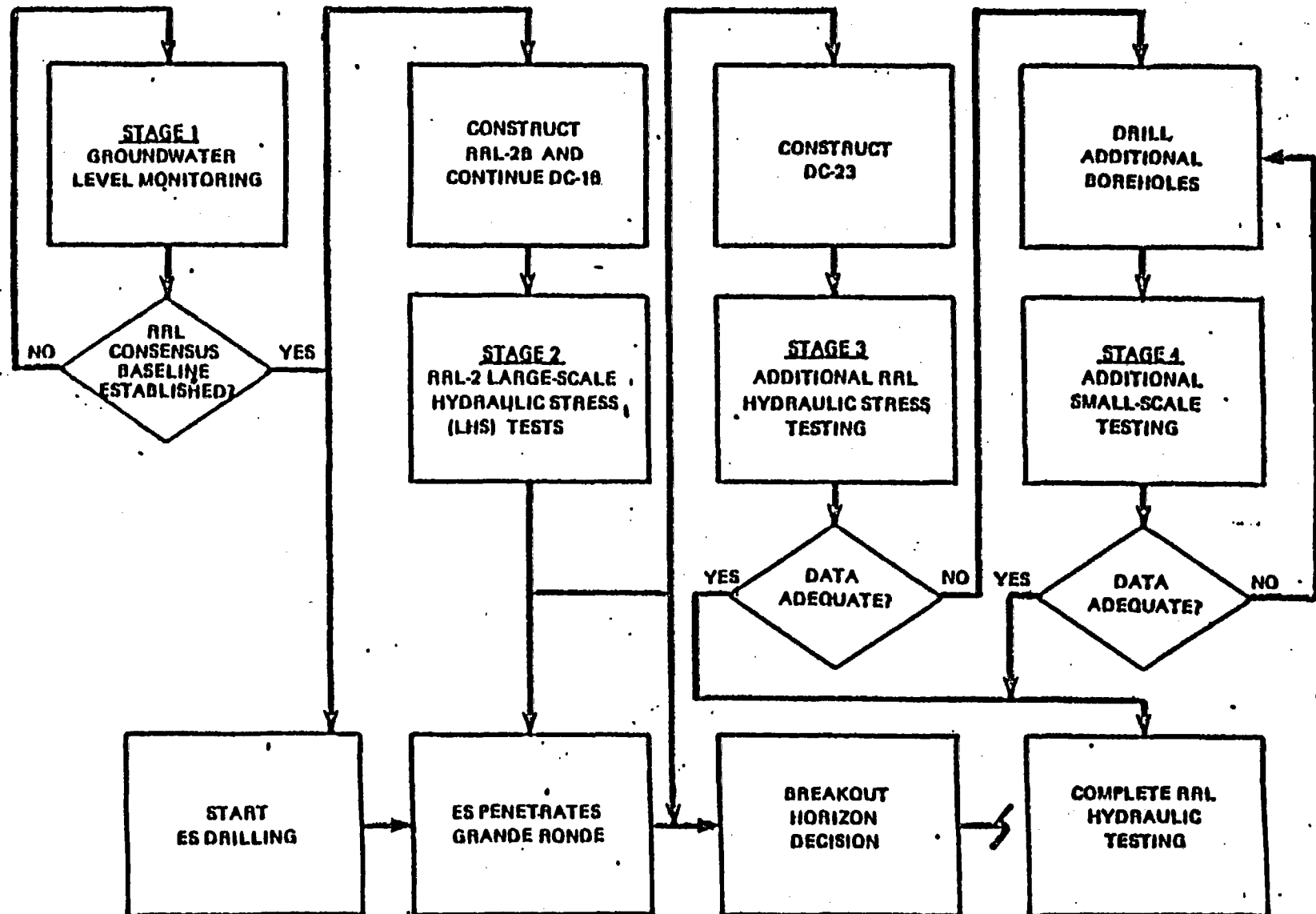
NEW WELL DC-23

POSSIBLE ADDITIONAL BOREHOLES

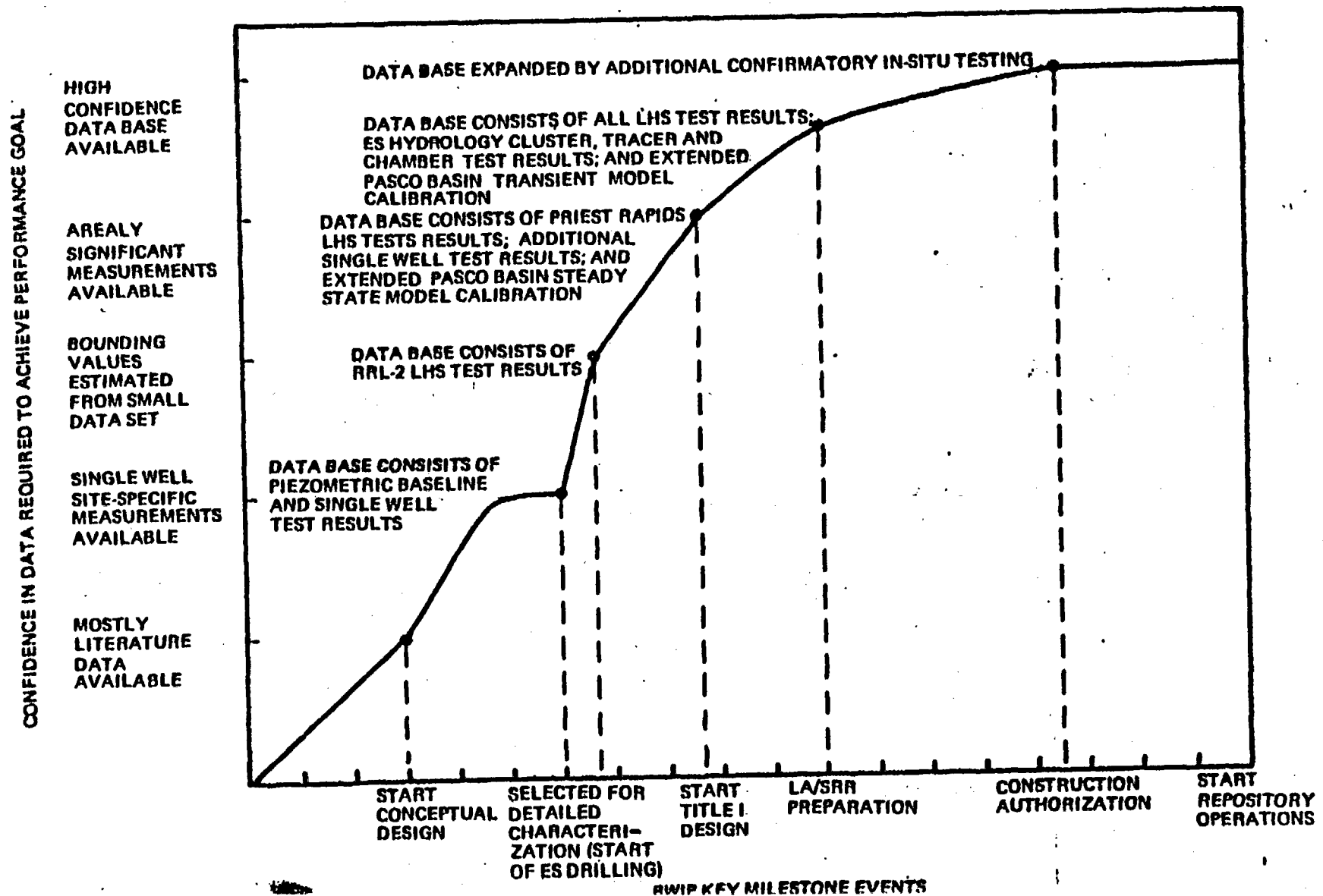
HYDROLOGIC CHARACTERIZATION



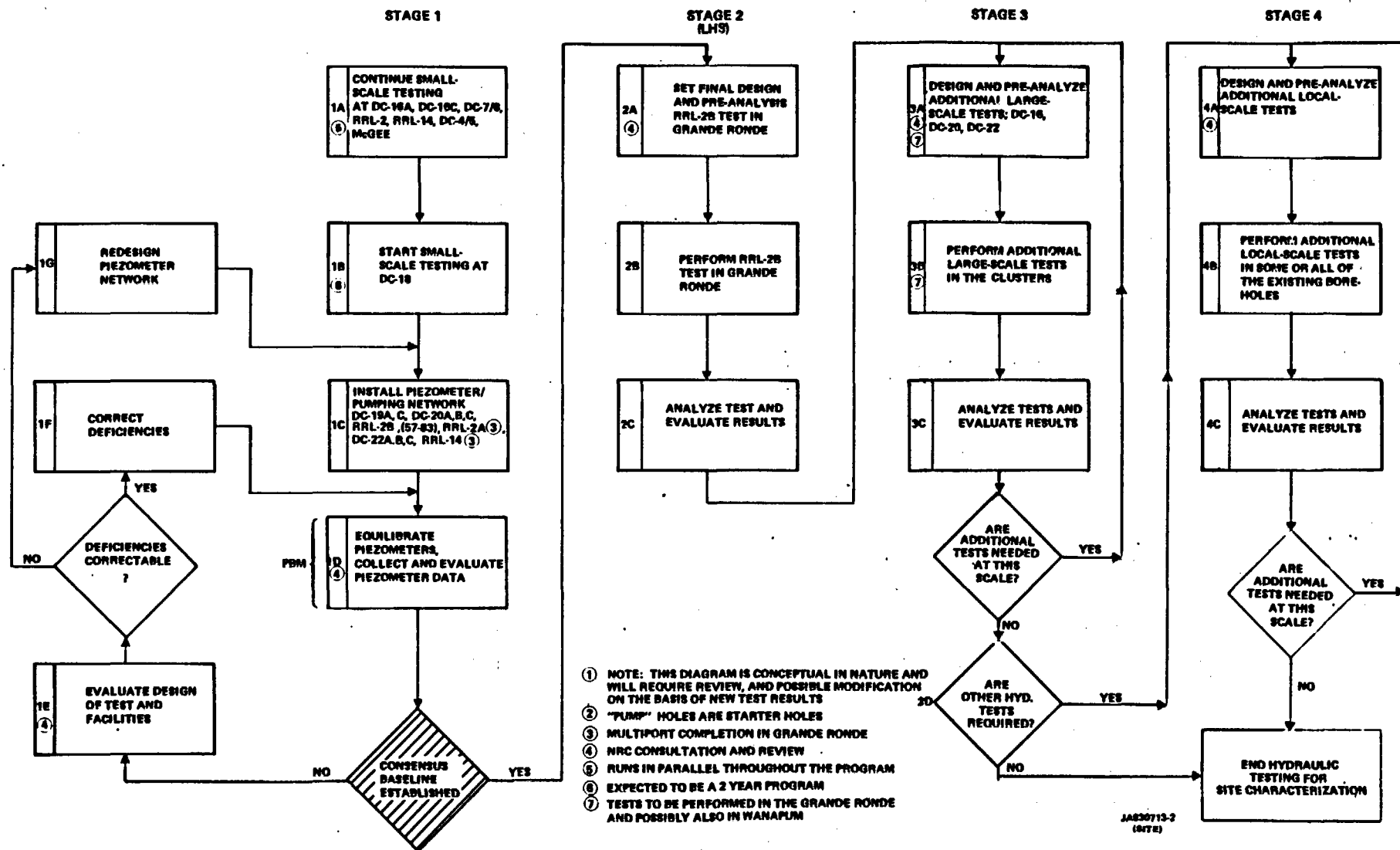
LOGIC DIAGRAM FOR RRL HYDRAULIC TESTING



DEVELOPMENT OF REASONABLE ASSURANCE



LOGIC DIAGRAM FOR BWIP BOREHOLE: HYDROLOGIC TEST STRATEGY ^①



PROPOSED HYDROLOGIC CHARACTERIZATION PROGRAM
(JULY 1983)

- o CONTINUE SMALL-SCALE TESTING
- o DC-18, MULTI-PURPOSE DRILL AND TEST BOREHOLE AT GABLE GAP
- o DC-19, DC-20, DC-22, PIEZOMETER CLUSTERS
- o BRIDGE PLUGS DC-4, -5, -16A, -16C, RRL-6, TO ISOLATE MONITORED ZONES
- o RRL-2B, LARGE SCALE PUMPING BOREHOLE
- o RRL-2 MLP, MONITORING/OBSERVATION POINTS
- o RRL-14 MPP, MONITORING/OBSERVATION POINTS
- o DC-23, OBSERVATION POINT NORTH OF RRL

MODIFIED HYDROLOGIC CHARACTERIZATION PROGRAM
(JUNE 1984)

- o DC-19, -20, -22
- o BRIDGE PLUGS DC-4, -5, -16A, RRL-2, RRL-6, RRL-14 (ADDITIONAL PACKERS TO COMPENSATE FOR LACK OF MLP AND MPP)
- o RRL-2B DELAYED UNTIL MARCH 1985 (SCHEDULE RISK)
- o MLP's AND MPP's DEFERRED (DATA NOT AVAILABLE FOR BASELINE)
- o DC-18 DEFERRED (DELAY IN ADDITIONAL DATA, SCHEDULE RISK)
- o DC-23 DELAYED UNTIL FY86 (DATA NOT AVAILABLE FOR BASELINE, SCHEDULE RISK)
- o SMALL-SCALE TESTING DEFERRED (LITTLE IMPACT)

OVERALL IMPACT OF CHANGES

- o MODIFIED PROGRAM MEETS INTENT OF THE POSITION PAPER
- o MAJOR IMPACT IS INCREASED PROGRAMMATIC RISK
- o ALL ASPECTS OF ORIGINAL PROGRAM WILL BE IMPLEMENTED (SOME LATER THAN ORIGINALLY PLANNED)
- o INITIAL RRL-2B LHS TESTS WILL BE PERFORMED WITH FEWER OBSERVATION POINTS THAN ORIGINALLY PLANNED (I.E., RRL-2, RRL-14 AND DC-23)

BWIP-NRC GENERAL UNDERSTANDING ON
TESTING STRATEGY
JULY 14, 1983

1.0 GENERAL

- A. ADDITIONAL DATA ARE REQUIRED FOR HYDROLOGIC CHARACTERIZATION OF THE REFERENCE REPOSITORY LOCATION (RRL).
 - o CONTINUOUS HEAD MEASUREMENTS ARE REQUIRED.
 - o LARGE-SCALE HYDRAULIC TESTING IS NECESSARY.
 - o SMALL-SCALE TESTING SHOULD BE CONTINUED AT THE DESIGNATED WELLS.
 - o SHORT-DURATION, LOW STRESS INTERFERENCE TESTS SHOULD BE CONTINUED.
 - o THE COMPLETION OF A PUMPING WELL NEAR RRL-2 WILL PROVIDE IMPORTANT INFORMATION.
- B. PERIODIC CONSULTATION BETWEEN DOE AND NRC SHOULD BE CONTINUED PRIOR TO DECISION POINTS IN THE PROGRAM. THESE DISCUSSIONS WILL BE HELD SUFFICIENTLY EARLY SO THAT ANY CHANGES THAT NRC COMMENTS MAY ENTAIL CAN BE DULY CONSIDERED BY DOE IN A MANNER NOT TO DELAY DOE ACTIVITIES.
- C. HYDROCHEMISTRY IS PRINCIPALLY USED TO CONFIRM GROUNDWATER FLOW SYSTEMS AS DETERMINED FROM HYDRAULIC DATA.

2.0 INSTALLATIONS

- A. THE PROPOSED LARGE-SCALE AQUIFER TEST FACILITIES ARE APPROPRIATE IN NUMBER AND LOCATION.
- B. THE SELECTION OF THE 9 DESIGNATED UNITS TO BE MONITORED APPEARS APPROPRIATE.
- C. INSTALLATION OF A PUMPING WELL (RRL-2B) NEAR RRL-2 WILL PROVIDE USEFUL INFORMATION.
- D. MULTIPOINT EQUIPMENT FOR SPECIFIC APPLICATIONS IN CORED HOLES SHOULD BE QUALIFIED.
- E. CEMENT OFF ONLY THOSE ZONES IN THE GRANDE RONDE THAT ARE NECESSARY FOR WELL CONSTRUCTION, ALLOWING FOR MAXIMUM POTENTIAL FOR FUTURE TESTING.

3.0 HEAD MEASUREMENT

- A. PLANS (AS PRESENTED) FOR INSTALLING PIEZOMETERS ARE APPROPRIATE AND SHOULD BE IMPLEMENTED AS SOON AS POSSIBLE. SPECIFICALLY, THE NUMBER, LOCATION AND AIR MIST DRILLING METHODS FOR THE PIEZOMETERS INCLUDING USE OF DRILLING MUD THROUGH THE MABTON, ARE APPROPRIATE.
- B. THE USE OF MULTIPLE-COMPLETION STANDPIPE PIEZOMETERS FOR LONG-TERM HEAD MEASUREMENTS IS APPROPRIATE.
- C. THE VIEWGRAPH ENTITLED "VALIDITY OF HEAD DATA" OUTLINES THREE APPROACHES TO CORRELATION OF NEW HEAD DATA AND EXISTING HEAD DATA. TWO OF THESE USE DATA FROM RRL-2 AND DC-16A AND INVOLVE CORRELATIONS WITH INTERPOLATED AND EXTRAPOLATED NEW HEAD DATA. IT IS UNLIKELY THAT THESE TWO APPROACHES WILL BE HIGHLY CONVINCING IN VALIDATING THE EXISTING HEAD DATA. CONTINUING THOUGHT SHOULD BE GIVEN TO OTHER POSSIBLE MEANS FOR QUALIFYING THE EXISTING HEAD DATA.

4.0 LARGE SCALE TESTS

- A. THE INITIAL LARGE-SCALE TEST SHOULD BE PERFORMED AFTER INITIAL PIEZOMETRIC DATA ARE OBTAINED SUCH THAT PRE-EMPLACEMENT CONDITIONS CAN BE REASONABLY WELL-DEFINED.
- B. THE GRANDE RONDE FORMATION IS THE PRIMARY TARGET FOR LARGE-SCALE HYDRAULIC PROPERTY TESTING, BUT THE MAJOR AQUIFERS IN THE WANAPUM SHOULD ALSO BE TESTED.
- C. THE BURDEN OF PROVING THE HYDRAULIC CONTINUITY OF ROCK UNITS ACROSS THE RRL CANNOT BE PUT ON HYDRAULIC TESTING OF HYDRAULIC PARAMETERS THAT DO NOT ALLOW LONG DISTANCE RESPONSE (SAY, 1-3 km). IF LARGE SCALE TESTS DO NOT WORK, LOCAL-SCALE TESTS MAY BE NECESSARY TO CHARACTERIZE HYDROLOGIC CONDITIONS.
- D. THE LARGE SCALE PUMP TESTS MAY PROVIDE OPPORTUNITIES TO QUALIFY EXISTING HORIZONTAL CONDUCTIVITY VALUES. VALUES FROM INTERFERENCE TESTS SHOULD BE COMPARED WITH VALUES FROM EARLIER SINGLE-HOLE TESTS.
- E. THE APPROACH TO TESTING PRESENTED FOR THE DC-16 BOREHOLE CLUSTER TEST SPECIFICATION SEEMS APPROPRIATE.
- F. THE TESTS PROPOSED UNDER "LARGE SCALE MULTIPLE WELL AQUIFER TESTING" IN VIEWGRAPH "MAJOR ACTIVITIES REQUIRED FOR HYDROLOGIC CHARACTERIZATION" MAY NOT PROVIDE ADEQUATE INFORMATION ABOUT THE GROUNDWATER SYSTEM NEAR THE REPOSITORY. AN UNDERSTANDING OF THIS PART OF THE SYSTEM IS NEEDED TO PREDICT PRE-EMPLACEMENT GROUNDWATER TRAVEL TIME, AS REQUIRED BY 10 CFR 60. THE PROPOSED PUMP TEST AT RRL-2B, AND RELATED TESTS IN THE RRL, WILL ADDRESS THIS MATTER.

5.0 MUD EFFECTS

- A. IN INVESTIGATING POSSIBLE EFFECTS OF DRILLING MUD ON HYDRAULIC PROPERTIES, ATTENTION SHOULD BE GIVEN NOT ONLY TO HIGH AND LOW PERMEABILITY UNITS BUT ALSO TO INTERMEDIATE PERMEABILITY UNITS - SAY, 10^{-6} TO 10^{-8} m/s.
- B. THE DB-2 TEST SPECIFICATION SHOULD BE MODIFIED TO BETTER SIMULATE DRILLING CONDITIONS.
- C. MUD LOSS IN BOREHOLES WILL BE REPORTED AS CUMULATIVE GALLONS WITH DEPTH.

6.0 TRACER TESTS

- A. THE TWO HOLE TRACER TESTS SHOULD BE CONDUCTED IN WELLS NEAR THE RRL. THEY SHOULD INCLUDE, AT A MINIMUM, DETERMINATION OF EFFECTIVE POROSITY AND LONGITUDINAL DISPERSIVITY.

BWIP COMMENTS

General

1. The hydrologic characterization program described by the BWIP meets the intent of NRC STP 1.1. The BWIP will take under advisement the seven exceptions noted by NRC in their comment #1.
2. BWIP/DOE will provide by early July a schedule and plan to address the comments, questions, and issues identified in NRC letters:

11/4/83 (Applicability of the Van der Kamp method in slug test analysis)
3/2/84 (Numerical modeling of parametric uncertainties)
3/9/84 (Comments on the exploratory shaft test plan)
4/6/84 (Analysis of two-well tracer tests with a pulse input)
5/25/84 (Comments on hydrogeologic test data)

Ground-Water Level Baseline

3. Ground-water level data will be collected throughout the BWIP hydrologic characterization program to provide a basis for model calibrations.
4. The BWIP intends to develop criteria for establishing a ground-water level baseline prior to Large-Scale Hydraulic Stress (LHS) Testing utilizing data from as-built facilities (DC-19, DC-20, and DC-22) using the following evaluation tools:
 - parametric sensitivity evaluations
 - corroborative data (e.g., head data, RRL-6, DC-16, RRL-14, etc.)
 - statistics
 - correlations with stress data
 - rate and characteristics of observed change
 - error characterization
5. The piezometer monthly data reports discussed in the BWIP presentation will provide a technical basis for performing the baseline evaluation required for the start of LHS testing.

Large Scale Hydraulic Stress Testing (LHS)

6. Both analytical and numerical parameter identification techniques are appropriate to interpret LHS test results.
7. The new data to be collected will provide a basis for evaluating the quality of existing drill and test data (conductivity and heads).

8. The potential for interference between Exploratory Shaft (ES) drilling and LHS test interpretation will be evaluated.
9. Details regarding the design of LHS tests will be provided to NRC as they are developed.

NRC COMMENTS

1. Current and Proposed Testing Strategy

Objective: (NRC Point of View)

The purpose of the field hydrogeology program is to allow evaluation of the hydrology aspects of repository performance in order to provide reasonable assurance of meeting (or failing to meet) the requirements of 10 CFR 60.

Needs:

To achieve the objective above, the following will need to be evaluated:

- travel times
- fluxes
- radionuclide transport

Modeling Data Needs:

"Predictive modeling of groundwater flow will require:

- defensible conceptual models of the flow system
- defensible boundary conditions
- defensible hydraulic parameters"

(Ref. STP 1.1, p. 3)

General Statement:

"Hydrogeologic characterization of the Hanford Site should rely to the maximum extent possible on direct testing of the hydraulic response of the site to an induced hydraulic stress."

(Ref. STP 1.1, p.4)

Development of Assurance:

"The approach recognizes that direct testing of the groundwater flow system's hydraulic performance subsequently extrapolated to spatial and temporal scales appropriate to licensing assessments is more convincing than is performance modeling without direct testing of the site's hydraulic response."

(Ref. STP 1.1, p.4)

Evaluation of Testing Strategy:

Based on presentations during the workshop, we consider that the current testing strategy is consistent with the objectives of STP 1.1, with the following significant exceptions:

1. Lack of an adequate test program for RRL-2B (i.e., testing only two intervals in a limited time period concurrently with shaft construction may be inadequate.)
2. Lack of facilities for characterization of hydraulic responses near the pumping well RRL-2B (i.e., lack of monitoring and observation opportunities in RRL-2).
3. Existing bridge packer installations in RRL-6 and RRL-14 fail to take advantage of multi-level monitoring opportunities within the RRL.
4. No description has been provided of how BWIP will take advantage of existing monitoring opportunities outside of the RRL (i.e., other holes with bridge packers and other holes not mentioned).
5. A strategy for hydrologic boundary evaluation, including wells and intervals to be tested, has not been delineated.
6. A strategy for field measurement of vertical permeability, including wells and intervals to be tested, has not been delineated.
7. A strategy for definition of possible transport pathways (i.e., hydraulic continuity), including wells and intervals to be tested, has not been delineated.

Evaluation of DC-19, -20 and -22 installations:

Based on presentations during the workshop, we consider that the cluster wells DC-19, -20 and -22 have been installed in a manner consistent with the agreement reached during the July 11-15, 1983 workshop. However, we note that these cluster wells may not provide the data suitable for calculations of vertical hydraulic conductivity.

2. Reasonable Assurance.

BWIP viewgraph "Development of Reasonable Assurance" appears to represent a constructive approach in linking site characterization activities to the level of confidence in system performance. This is needed to identify the level of confidence that is needed to support licensing decisions which are based on "reasonable assurance," as discussed in 10 CFR 60.

3. Measurement of Fluid Potential.

A defensible, consistent method of determining representative formation fluid potential is required. If water levels are used to measure fluid potential, then it should be demonstrated that fluid density effects in the well column are either unimportant or can be evaluated when water level measurements and pressure measurements are correlated and used interchangeably.

4. Monthly Data Package.

We consider the proposed delivery of a monthly hydrologic data package to be a positive development in terms of providing current data for the NRC staff's site characterization review activities.

5. Drawdown Data from DB-14 and DC-16B.

The presentation of hydrologic data from DB-14 and DC-16B during drilling of DC-19C serves as a non-quantitative evaluation that suggests that the hydraulic testing approach of STP 1.1 may be feasible for the hydrogeologic conditions at the BWIP.

6. Consensus on Establishment of Hydraulic Head Baseline.

NRC agrees, in principle, with the four-stage approach suggested by BWIP for development of a consensus on establishment of a static hydraulic head baseline. However, we consider that BWIP has not sufficiently addressed in this workshop's presentations the major task in developing a consensus on baseline head establishment: identifying the magnitude of the "errors in baseline" (see viewgraph "Parametric Sensitivity"), such as those due to limited time data. The estimation of the range of possible error in observed average head or long-term head trend is probably the most difficult task with regard to this issue.

7. Limitations of STP 1.1 in Providing Guidance on All Hydrologic Information Necessary for Licensing.

We consider that the head baseline establishment and the large scale pump tests, as proposed, will not yield the complete set of hydrologic data needed for a licensing review. In particular, certain factors relevant to radionuclide transport (e.g., effective porosity, fracture flow parameters) will need to be addressed through a program supplementary to that described during this workshop. Our position on this matter today is consistent with that stated in Section 2.4 of STP 1.1.

8. Data Quality.

NRC considers that in the development of hydrologic test plans, target data quality needs (i.e., accuracy, precision and frequency of specific data collection) should be established for all testing irrespective of the type of instrument being used. These needs should be related to the objective of the various tests to obtain data in support of identified analytical needs relative to requirements of 10 CFR 60. This is a matter for further discussion during future interactions on quality assurance.

9. Regional Flow System.

Because the BWIP Site Characterization Plan (SCP) is due for release in early 1985, it is necessary for NRC to complete preparation for its analysis

of the SCP by that time. An important part of this preparation is the updating of NRC's groundwater modeling capability for the Pasco Basin. This makes it necessary for NRC to have in hand, no later than January 1, 1985, the regional flow system model (and data) under development by the "interagency hydrology working group." This regional information is essential to the Pasco Basin model, because it is used to set the boundary conditions. To permit its independent evaluation and interpretation of the basic data, it is necessary for NRC to have access to the complete data set used for modeling.

CORRELATION OF DISCUSSIONS WITH ISSUES IDENTIFIED IN
APPENDIX C, NUREG-0960

NRC prepared the following correlation for the purpose of relating the workshop discussion to the BWIP issues identified in NUREG-0960. Issue numbers refer to the tabulation on pages C-12, -13, -14 and -15 of NUREG-0960.

<u>Issue No.</u>	<u>Workshop Discussion</u>
1.1.1	Presentations were made on testing plans, the water level responses to the air mist rotary drilling, and numerical simulation of these responses.
1.1.2	Recharge and discharge to the groundwater system were discussed with respect to BWIP modeling of the Pasco Basin hydrology.
1.1.3	Boundary conditions were discussed in light of the expected output from the "interagency hydrology working group."
1.1.4	Structural discontinuities were discussed as a needed input to modeling and as a possible influence on conceptual models.
1.1.5	Stratigraphic and lithologic discontinuities were discussed as a needed input to modeling and as a possible influence on conceptual models.
1.1.7	BWIP is considering variations to the single, original, conceptual model. These variations take into account features such as vesicular zones, flow top thickness variations and flow termination.
1.1.8	The USGS model by Trescott was mentioned with respect to recent modeling efforts.
1.5	Human-induced changes on groundwater flow paths were discussed in one secondary and two primary aspects. The primary changes discussed included the groundwater recharge activities on the Hanford Site from DOE water disposal activities and the groundwater fluxes induced in the vicinity of Richland. Agriculture-related withdrawals and recharge were discussed in the context of long-term water level trends and groundwater modeling efforts.

Open Items.

1. During July 1984, NRC will provide preliminary comments on SD-BWI-TC-016, Drilling, Piezometer Design, and Testing Specifications for the DC-19, DC-20 and DC-22 Borehole Clusters and RRL-2B. Written comments will be provided during August 1984.
2. During August 1984, DOE will describe its strategy for field measurement of vertical hydraulic conductivity, including wells and intervals involved in testing.
3. Before the start of testing, DOE will prepare and submit comprehensive drawings, or other appropriate data presentation materials, showing all observation wells for each LHS test for each interval. The plans and drawings should show the completion characteristics for all wells that penetrate any of the zones that are to be tested. These plans or drawings should facilitate the analysis of hydraulic continuity and the hydraulic properties of the tested interval and the confining layer.
4. Target data quality needs for hydrologic tests will be discussed in the context of future quality assurance interactions.
5. The NRC comment number 8 on quality assurance (QA) elicited some discussion from the group as a whole and was identified as an open item because of its generic flavor. It will be addressed as appropriate when the opportunity arises in a pending QA workshop. Because the comment is of concern to all projects it will be discussed with DOE Headquarters and the other projects.
6. The discussion item relative to NRC letters addressed to DOE under dates of 11/4/83, 3/2/84, 3/9/84, 4/6/84 and 5/24/84 was not covered by the DOE. The office stated that review was either preliminary or statements were not available on the letters to make a formal comment. DOE will provide a plan and schedule for addressing the letters by July 1984.