See file pocket 8 for enclosure.

DOE/NRC LHST PRE-TEST CONSULTATION MEETING
DECEMBER 9 & 10, 1985
RICHLAND, WASHINGTON

WM Record File 101
WM Project 10
Docket No.
PDR ✓
LPDR ✓
Distribution:
Linehan Weber
(Return to WM, 623-SS)

Monday, December 9, 1985

8:00 - 8:30	Opening Remarks (BWI & NRC) -Meeting Objectives -Overview
8:30 - 10:00	Baseline Data Discussion (BWIP) -Hydrographs will be provided 5 working days prior to meeting.
10:00 - 11:00	Baseline Establishment (BWIP & NRC)
11:00 - 5:00	LHS Test Plan Update (BWIP) -Objectives -Pre-test hydraulic design, scale, and duration -Tracer tests -Lunch (12:00 - 1:30) -Discussion of LHS Test Plans (BWIP & NRC)

Tuesday, December 10, 1985

8:00 - 9:00	Administrative Control of LHS Tests (BWI)
9:00 - 10:00	Discussion of Administrative Control (BWI & NRC)
10:00 - 11:00	Schedule of Site Activities (BWI) -LHST -Drilling of new hydrology monitoring facilities -Drilling of geology/engineering/chemistry boreholes -ES Schedule
11:00 - 12:30	Lunch
12:30 -2:00	Integration of Site Activities (with discussion by BWI & NRC)
2:00 - 4:00	Caucus, observations, & comments (BWIP & NRC)
4:00 - 5:00	Preparation of summary meeting minutes (BWI & NRC)

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WM DOCKET CONTROL CENTER

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PDR WASTE
WM-10 PDR

Department of Energy/
Nuclear Regulatory Commission
Basalt Waste Isolation Project
Large Scale Hydraulic Stress Testing
Pre-Test Consultation Meeting
December 9-10, 1985
Richland, Washington

1627

Enclosure to DOE/NRC
LHST Pre-Test Consultation
Meeting - December 9 & 10, 1985

LHS HISTORICAL DEVELOPMENT

S. M. BAKER

NRC/DOE MEETING
RICHLAND, WASHINGTON
DECEMBER 9, 1985

DOE/NRC PRE-TEST CONSULTATION MEETING
OPENING REMARKS

PURPOSE: PROVIDE FOR CONSULTATION WITH THE NRC PRIOR TO LHS TEST STARTUP.

OBJECTIVES:

1) PROVIDE INFORMATION TO THE NRC SO THAT THEY MAY HAVE A CLEAR UP-TO-DATE UNDERSTANDING OF THE BWIP LHS TESTING PROGRAM AND SCHEDULE.

2) RECEIVE NRC COMMENTS RELATIVE TO LHS TESTING FOR CONSIDERATION IN PLANNING AND CONDUCTING THE LHS TESTS AND SUBSEQUENTLY ANALYZING THE DATA.

3) SATISFY THE INTENT OF STP 1.1 RELATIVE TO PRE-TEST CONSULTATION..

FORMAT:

1) DISCUSSION BETWEEN NRC AND DOE ARE EXPECTED TO BE A CANDID, TWO-WAY INFORMAL INTERCHANGE.

2) THE FOCUS OF THE MEETING IS TO UPDATE THE INFORMATION RELATIVE TO LHS TESTING; DISCUSSIONS, THEREFORE, SHOULD BE LIMITED TO SUBJECTS SUPPORTING LHS TESTING.

3) THIS IS A DOE/NRC CONSULTATION MEETING, NOT A WORKSHOP. AS SUCH, PARTICIPATION IN THE DISCUSSIONS IS LIMITED TO DOE/NRC AND THEIR CONSULTANTS. OBSERVERS WILL HAVE THE OPPORTUNITY TO SUBMIT COMMENTS AT THE END OF THE MEETING.

DOE/NRC LHS PRE-TEST CONSULTATION MEETING

DECEMBER 9 AND 10, 1985

RICHLAND, WASHINGTON

MONDAY, DECEMBER 9, 1985

8:00 - 8:30	Opening Remarks - Meeting Objectives - Overview	Dave Dahlem/John Linehan
8:30 - 8:45	LHS Historical Development	Steve Baker
8:45 - 10:00	Baseline Data Presentation	Steve Strait/Harvey Dove
10:00 - 11:00	Baseline Discussion	Steve Baker
11:00 - 12:00	LHS Test Plan Presentation	Phil Rogers/Randy Stone/Steve Hall
12:00 - 1:00	Lunch	
1:00 - 3:00	LHS Test Plan (Continued)	
3:00 - 5:00	LHS Test Plan Discussion	Steve Baker

DOE/NRC LHS PRE-TEST CONSULTATION MEETING

DECEMBER 9 AND 10, 1985

RICHLAND, WASHINGTON

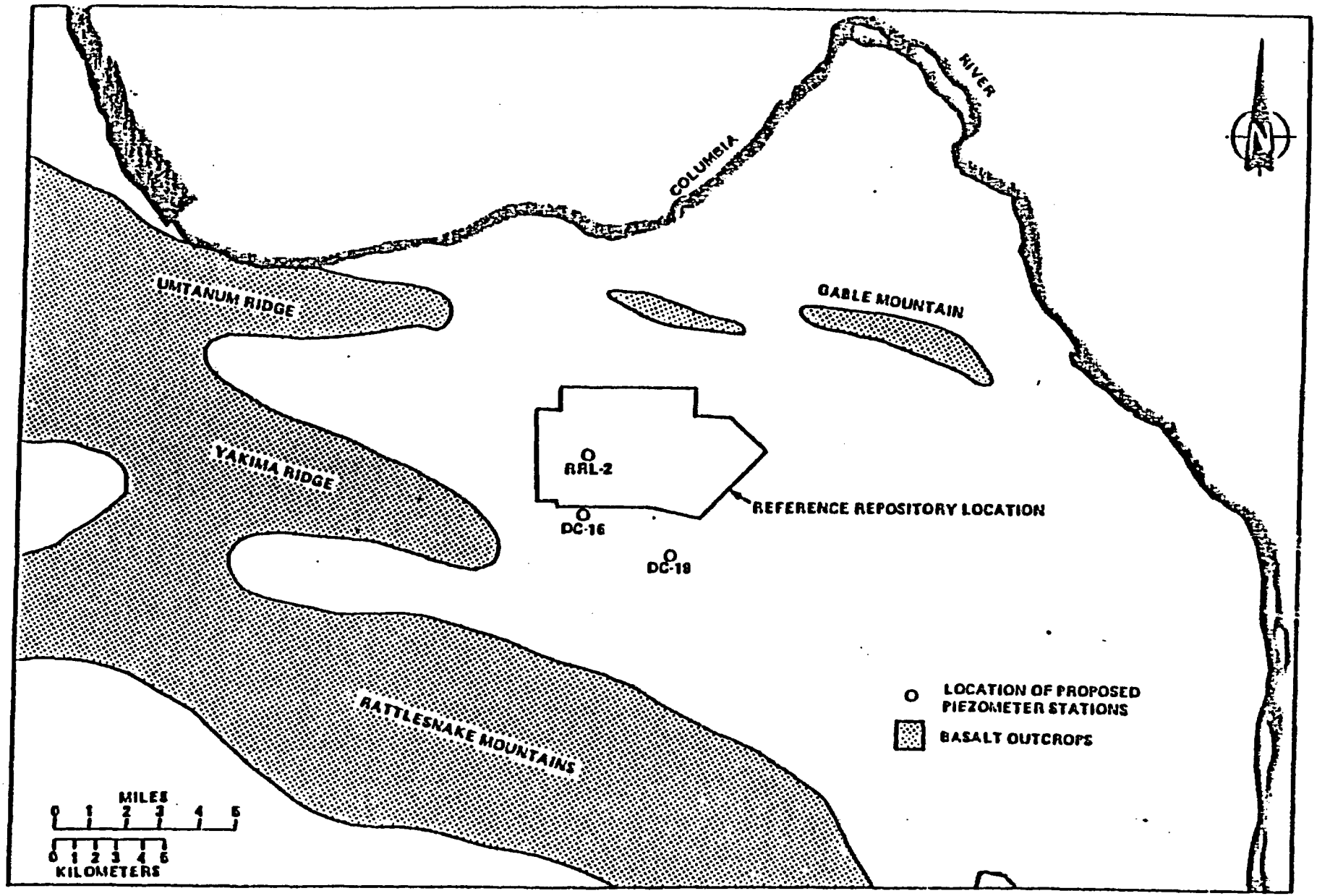
TUESDAY, DECEMBER 10, 1985

8:00 -	-	Continue Technical Discussion (if necessary)	All participants
	-	Administrative Control of LHS Tests	Mike Thompson/Steve Baker
	-	Schedule of Site Activities	Mike Thompson/Bill Price
2:00 - 2:30	-	Comments from Observers (State, Indians, USGS and Public)	As Appropriate
2:30 - 4:00	-	Caucus	
4:00 - 5:00	-	Preparation of Summary Meeting Minutes	BWIP and NRC

LARGE-SCALE HYDRAULIC STRESS TEST PROGRAM DEVELOPMENT

APRIL 1983	-	FIRST ACRS BRIEFING
JULY 1983	-	KEY HYDROLOGY WORKSHOP WITH NRC STAFF
SEPTEMBER 1983	-	SECOND ACRS BRIEFING
OCTOBER 1983	-	STARTED DRILLING FOR NESTED PIEZOMETERS
FEBRUARY 1984	-	LAST PIEZOMETER TUBE SET IN DC-22
JULY 1984	-	SITE TECHNICAL POSITION 1.1 PUBLISHED IN FEDERAL REGISTER
SUMMER 1985	-	RRL-2 B AND RRL-2C INSTALLED
FALL 1985	-	DC-23W INSTALLED
	-	WESTBAY INSTALLED IN RRL-14
DECEMBER 1985	-	CONSULTATION
	-	CONTRACTS FOR ADDITIONAL PIEZOMETERS IN PROCESS
JANUARY 1986	-	START FIRST LHS TEST (ROCKY COULEE AT RRL-2)
FALL - SUMMER 1986	-	COMPLETE FIRST LHS TEST
AUGUST 1986	-	START ES DRILLING

PROPOSED PIEZOMETER STATIONS

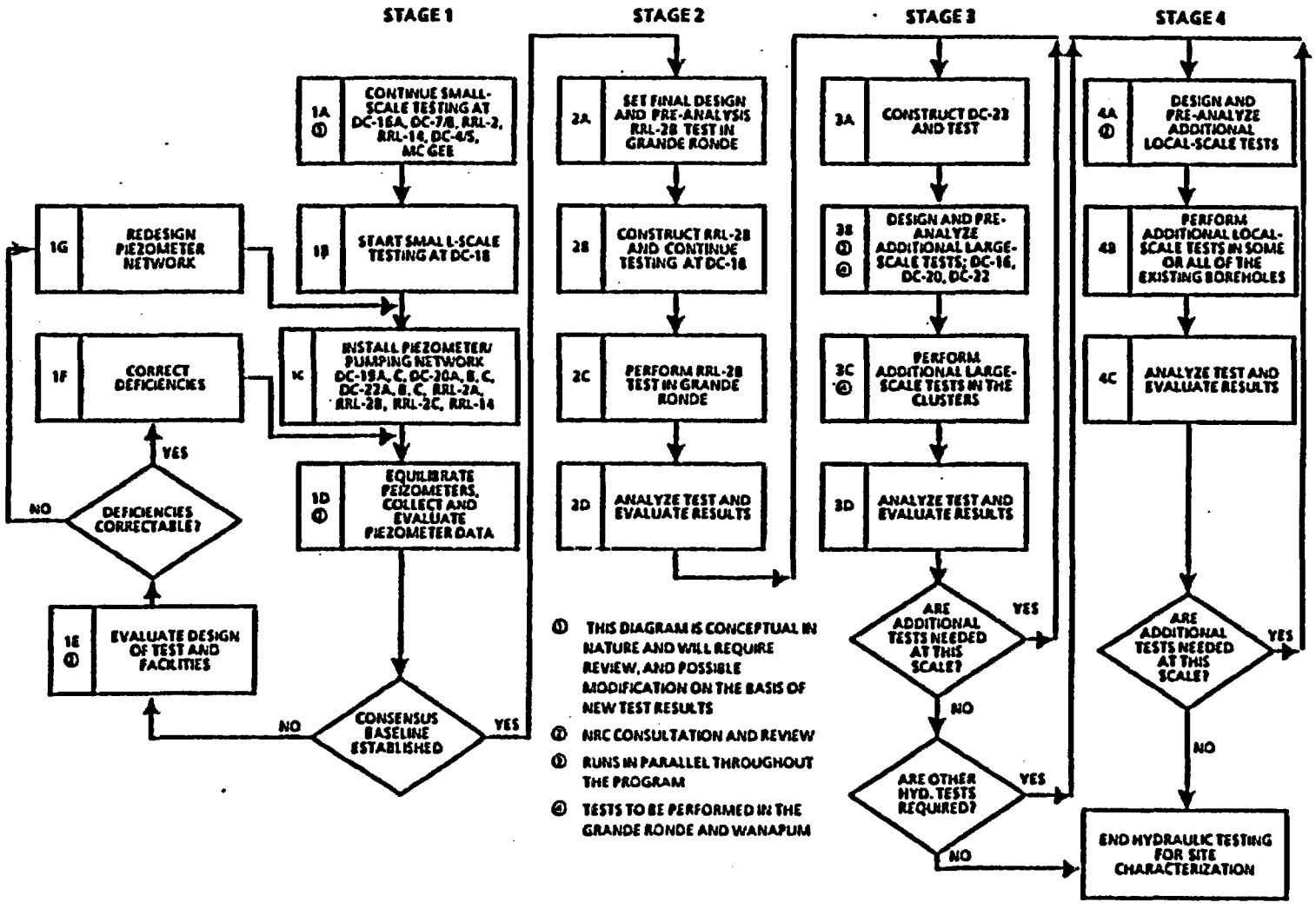


SITE TECHNICAL POSITION 1.1
CONCERNS

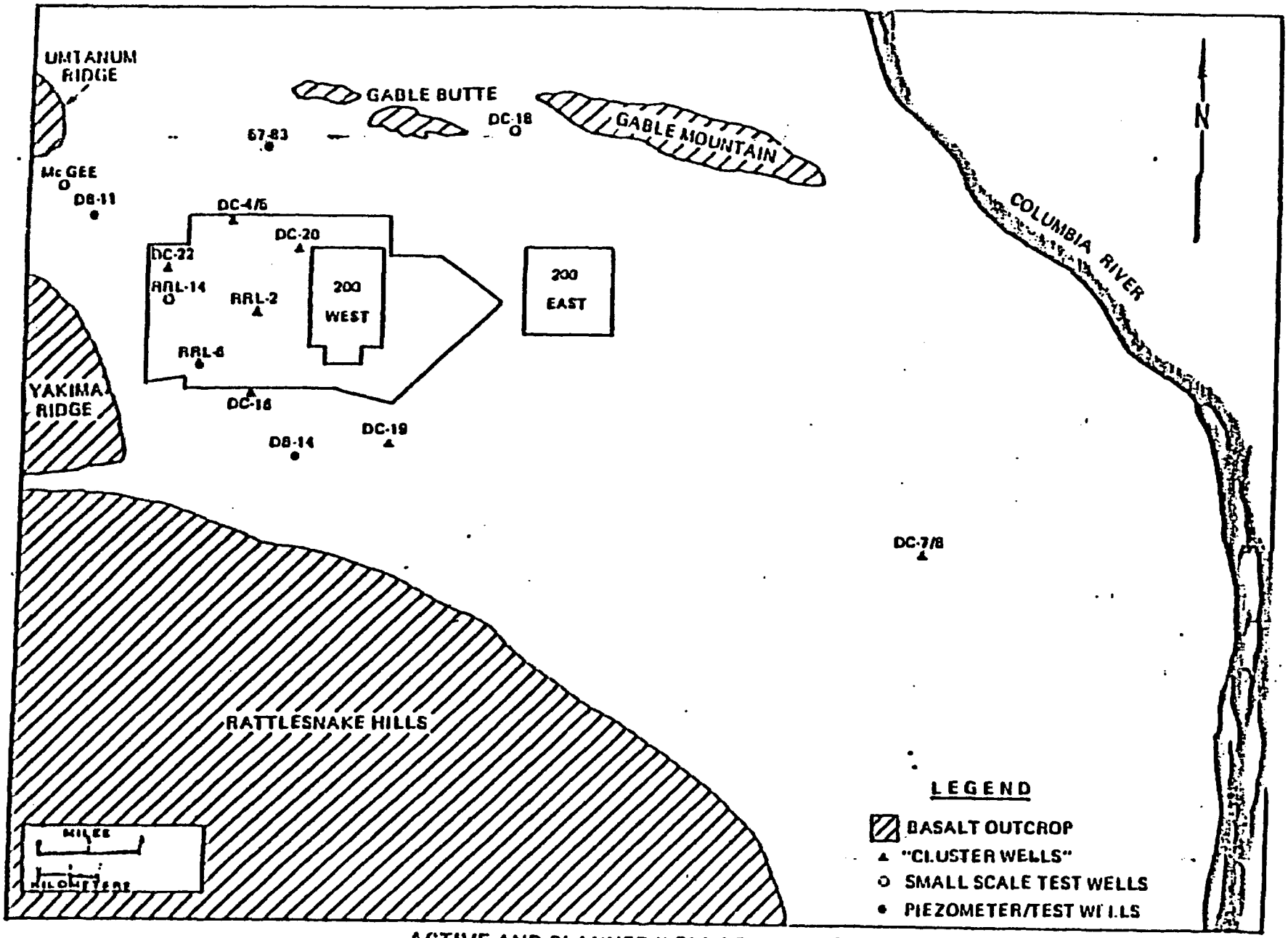
- VALIDITY OF BWIP "DRILL AND TEST" DATA.
- SCALE EFFECTS MIGHT LEAD TO INVALID CONCLUSIONS
- SMALL SCALE TESTING MIGHT MISS PREFERENTIAL PATHWAYS
- IT MIGHT NOT BE POSSIBLE TO PROPAGATE HYDRAULIC DISTURBANCE ACROSS THE RRL
- APPLICABILITY OF NUMERICAL TECHNIQUES

SITE TECHNICAL POSITION 1.1
FEATURES

- DEFENSIBLE: CONCEPTUAL MODELS, BOUNDARY CONDITIONS AND HYDRAULIC PROPERTIES
- DIRECT TESTING TO THE MAXIMUM EXTENT POSSIBLE
- PERIODIC CONSULTATION
- NON-PRESCRIPTIVE



Logic diagram for BWIP hydrologic test strategy.
(after Nuclear Regulatory Commission, 1983)



ACTIVE AND PLANNED WELL LOCATIONS

OBJECTIVES OF THIS MEETING

- PRESENT BWIP DATA, PLANS AND CONCLUSIONS
- OBTAIN NRC STAFF TECHNICAL REVIEW AND OPINIONS
- PROVIDE A SOLID BASIS FOR FUTURE CONSULTATION AND RAPID DECISION MAKING

BWIP CONCLUSIONS

- WATER LEVEL CHANGES WITH TIME ARE SMALL AND PREDICTABLE
  - ESSENTIALLY RECOVERED FROM CONSTRUCTION DISTURBANCE
  - STILL RECOVERING FROM RRL-14 AND DC-23 DISTURBANCES
- HYDRAULIC GRADIENTS ARE SMALL
- FUTURE DRILLING HAS HIGH POTENTIAL FOR INTERFERENCE WITH TESTING
- EARLIEST DATE TO START FIRST TEST: FEBRUARY 1986
- BASELINE DATE CONFIRM BWIP CONCEPTS ABOUT THE FLOW SYSTEM
  - RESPONSES PROPAGATE ACROSS THE RRL
  - VERTICAL RESPONSES:
    - ACROSS WANAPUM TO THE NORTH
    - ACROSS BASALT FLOWS IN THE UPPER WANAPUM AND THE ROCKY COULEE NEAR DC-20
    - ROCKY COULEE DENSE INTERIOR PIEZOMETER AT RRL-2C
  - PREFERENTIAL HORIZONTAL FLOW PATHWAY FROM DC-23 TO DC-19 IN THE COHASSETT FLOW TOP
  - LHS TESTS ARE LIKELY TO BE SUCCESSFUL (i.e., STAGE 4 WILL PROBABLY BE UNNECESSARY).
- BASELINE DATA ENHANCE TEST STRATEGY
  - INCREASED CONCERN ABOUT INTERFERENCE BETWEEN DRILLING AND TESTING
  - NEED TO BE ABLE TO SEE SMALL RESPONSES IN ORDER TO ASSESS VERTICAL CONNECTIONS
  - REFINED NUMERICAL MODELS TO ASSESS VERTICAL RESPONSES.

FEEDBACK DESIRED FROM NRC STAFF

- TECHNICAL READINESS TO START LHS TESTING
- INTERFERENCE BETWEEN DRILLING AND TESTING
- REVIEW OF TEST PLANS AND ANALYSES
- ADMINISTRATIVE READINESS TO START LHS TESTING
- QUALITY ASSURANCE APPROACH

BASELINE MONITORING DATA

S. R. STRAIT

DECEMBER 9, 1985

PURPOSE

- Provide overview of baseline monitoring data from DC-19, -20, -22, and RRL-2C.
- Briefly discuss baseline disturbances from constructing RRL-2C, -2B, -17, and DC-23W and bridge plug pulling at RRL-14.
- Provide up-date on Hanford Site Monitoring Network.

AGENDA

- Facilities
- Data Collection
- Hydrographs
  - perturbations
- Hanford Site Monitoring Network
- Summary

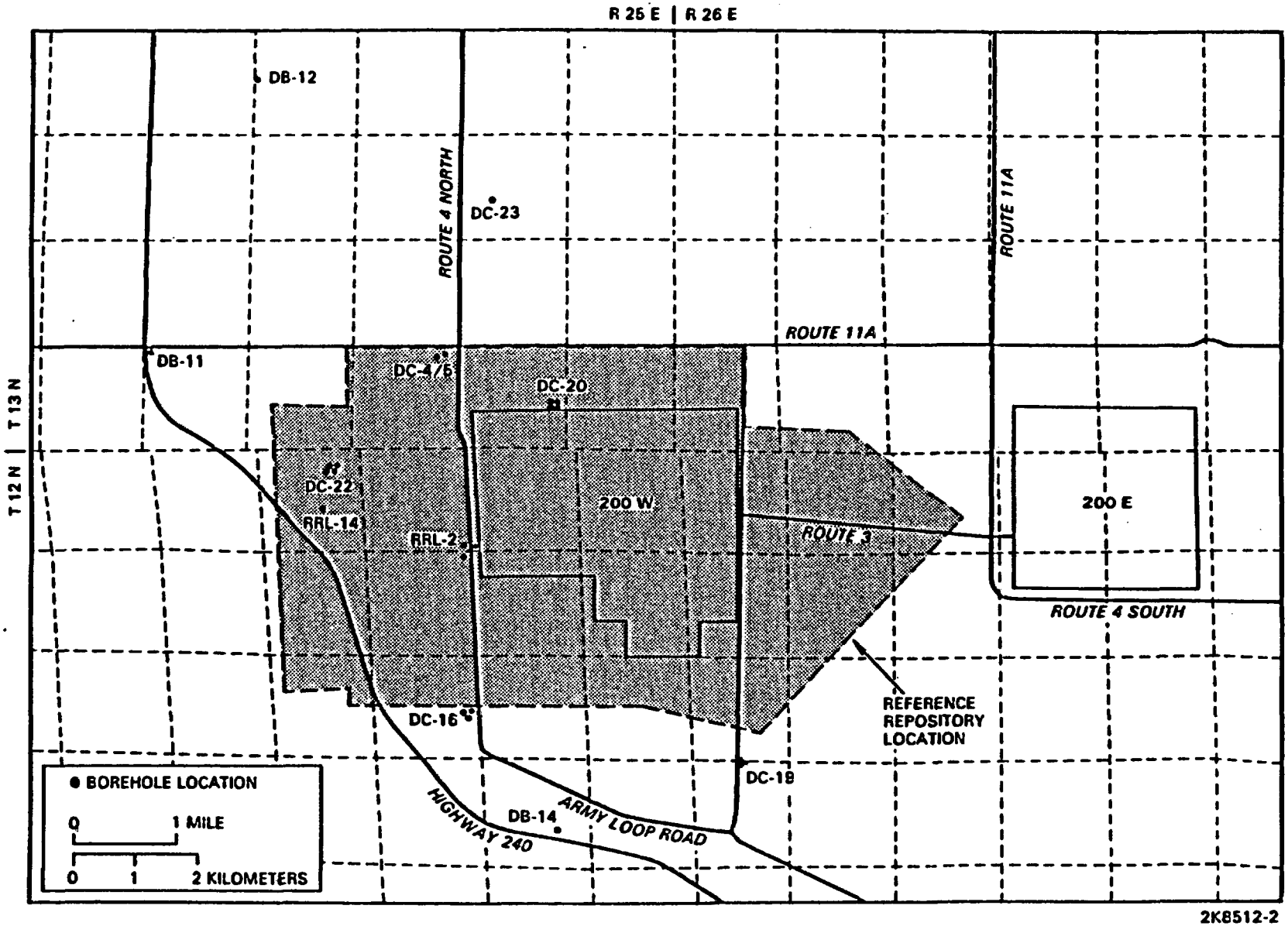
DATA COLLECTION

WATER-LEVEL MEASUREMENTS

- -CHALKED STEEL TAPE
- -RESOLUTION $\pm$0.02 FT

DOWNHOLE PRESSURE MEASUREMENT

- -DIGI-QUARTZ PRESSURE TRANSDUCER
- -RESOLUTION < $\pm$0.15 PSI


R 25 E | R 26 E
T 13 N
T 12 N
DB-12
DB-11
DC-23
DC-4/5
DC-20
DC-22
RRL-141
RRL-2
DC-16
DC-19
DB-14
ROUTE 4 NORTH
ROUTE 11A
ROUTE 11A
200 W
200 E
ROUTE 3
ROUTE 4 SOUTH
REFERENCE REPOSITORY LOCATION
ARMY LOOP ROAD
HIGHWAY 240
● BOREHOLE LOCATION
0 1 MILE
0 1 2 KILOMETERS

2K8512-2

PIEZOMETER FACILITIES

DC-19, DC-20, AND DC-22

BASAL RINGOLD
RATTLESNAKE RIDGE INTERBED
MABTON INTERBED
PRIEST RAPIDS FLOW TOP
SENTINAL GAP FLOW TOP
GINKGO FLOW TOP
ROCKY COULEE FLOW TOP
COHASSETT FLOW TOP
UMTANUM FLOW TOP

RRL-2C

ROCKY COULEE FLOW TOP
ROCKY COULEE INTERIOR
COHASSETT FLOW TOP
COHASSETT INTERIOR
GRANDE RONDE #5 FLOW TOP
GRANDE RONDE #5 INTERIOR

DC-23W

PRIEST RAPIDS FLOW TOP
SENTINAL GAP FLOW TOP
GINKGO FLOW TOP

MULTI-LEVEL PACKERS

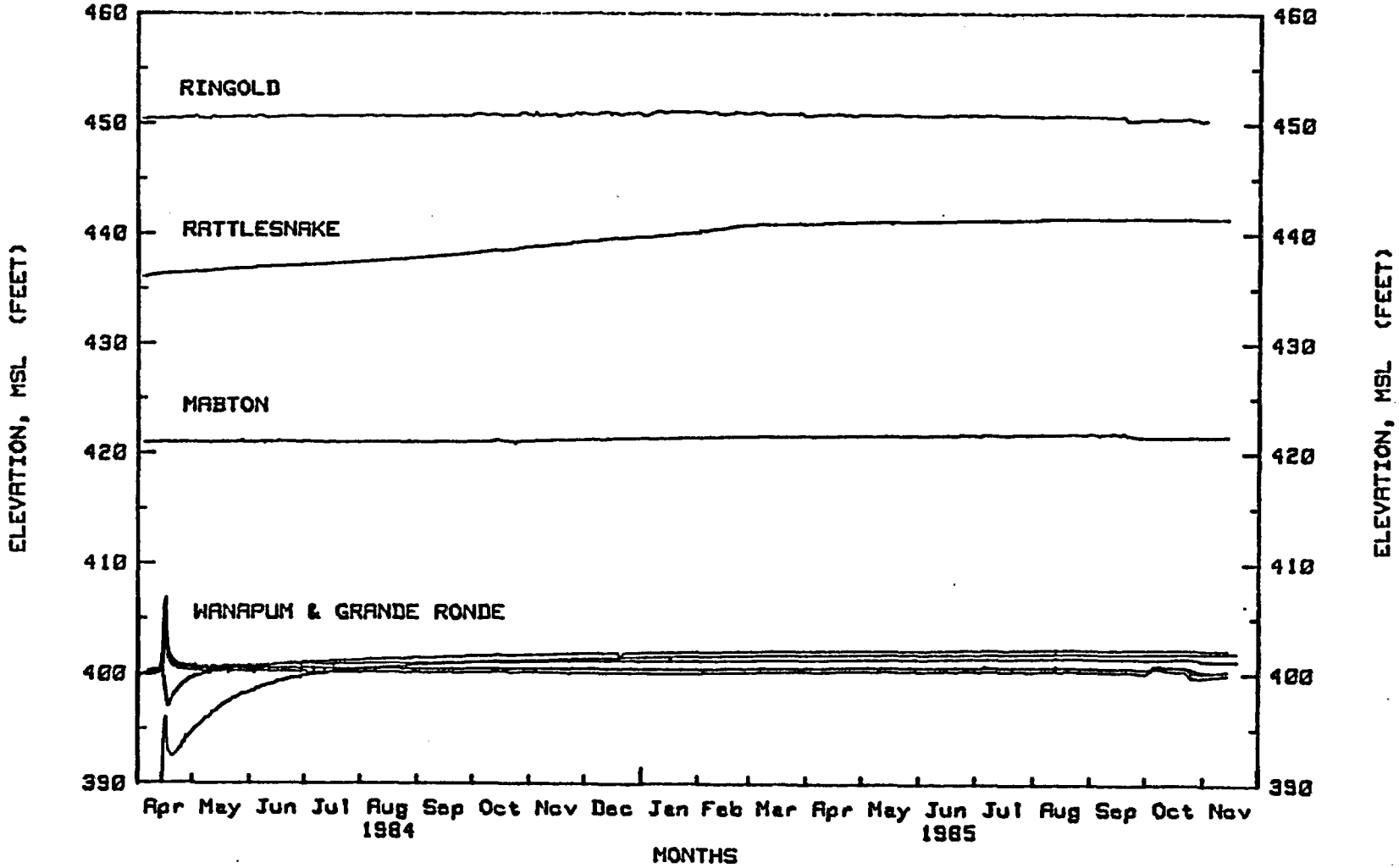
RRL-14

ROCKY COULEE FLOW TOP
COHASSETT FLOW TOP
COHASSETT VESICULAR ZONE
GRANDE RONDE #5 FLOW TOP
UMTANUM FLOW TOP

BOREHOLE: DC-19 HYDROGEOLOGIC UNIT: SADDLE MNT/WANAPUM/GRANDE RONDE

LOCATION: HANFORD SITE DATUM ELEVATION: MEAN SEA LEVEL

ADJUSTED TO A CONSTANT ATMOSPHERIC PRESSURE OF 14.347 PSI



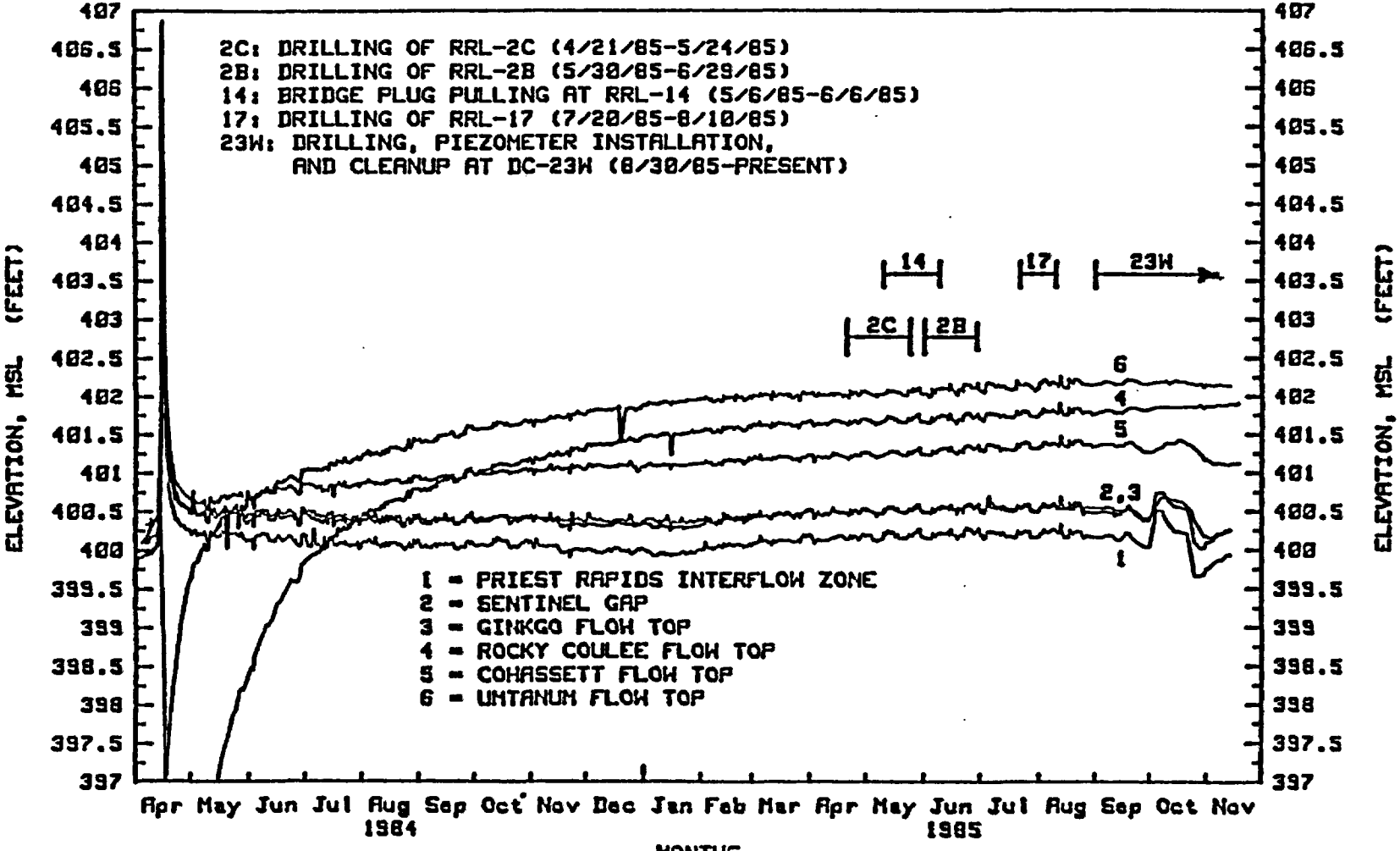
HYDROGRAPH PRODUCED BY

Program WHYDAT Rev 4.7 FILE: X19SBR85

BOREHOLE: DC-19C HYDROGEOLOGIC UNIT: GRANDE RONDE & WANAPUM

LOCATION: N 433,933 E 2,225,012 DATUM ELEVATION: MEAN SEA LEVEL

ADJUSTED TO A CONSTANT ATMOSPHERIC PRESSURE OF 14.347 PSI



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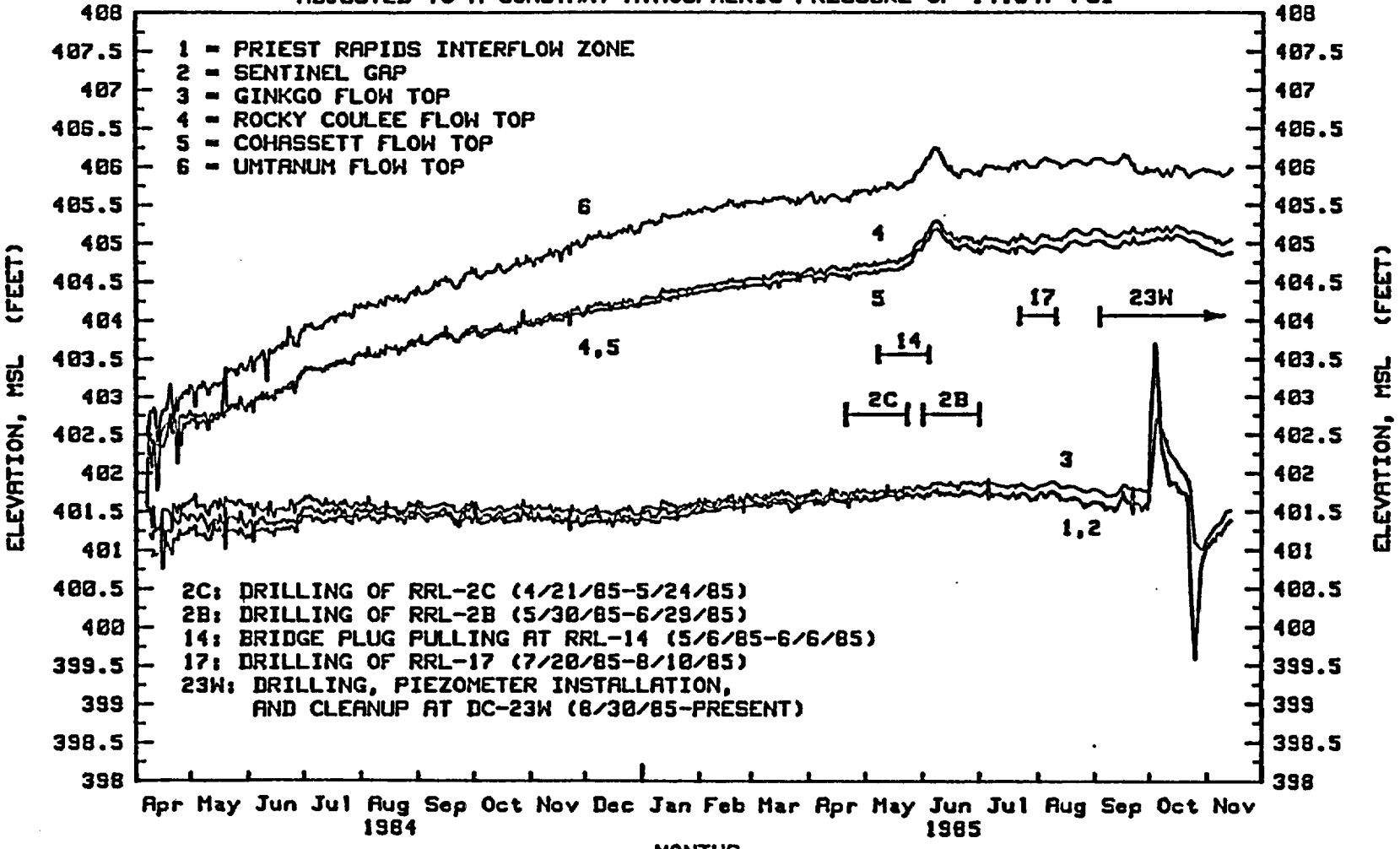
Program WHYDAT Rev 4.7 FILE: X19WPR85

BOREHOLE: DC-20C HYDROGEOLOGIC UNIT: GRANDE RONDE & WANAPUM

LOCATION: N 451,884 E 2,215,288 DATUM ELEVATION: MEAN SEA LEVEL

ADJUSTED TO A CONSTANT ATMOSPHERIC PRESSURE OF 14.347 PSI



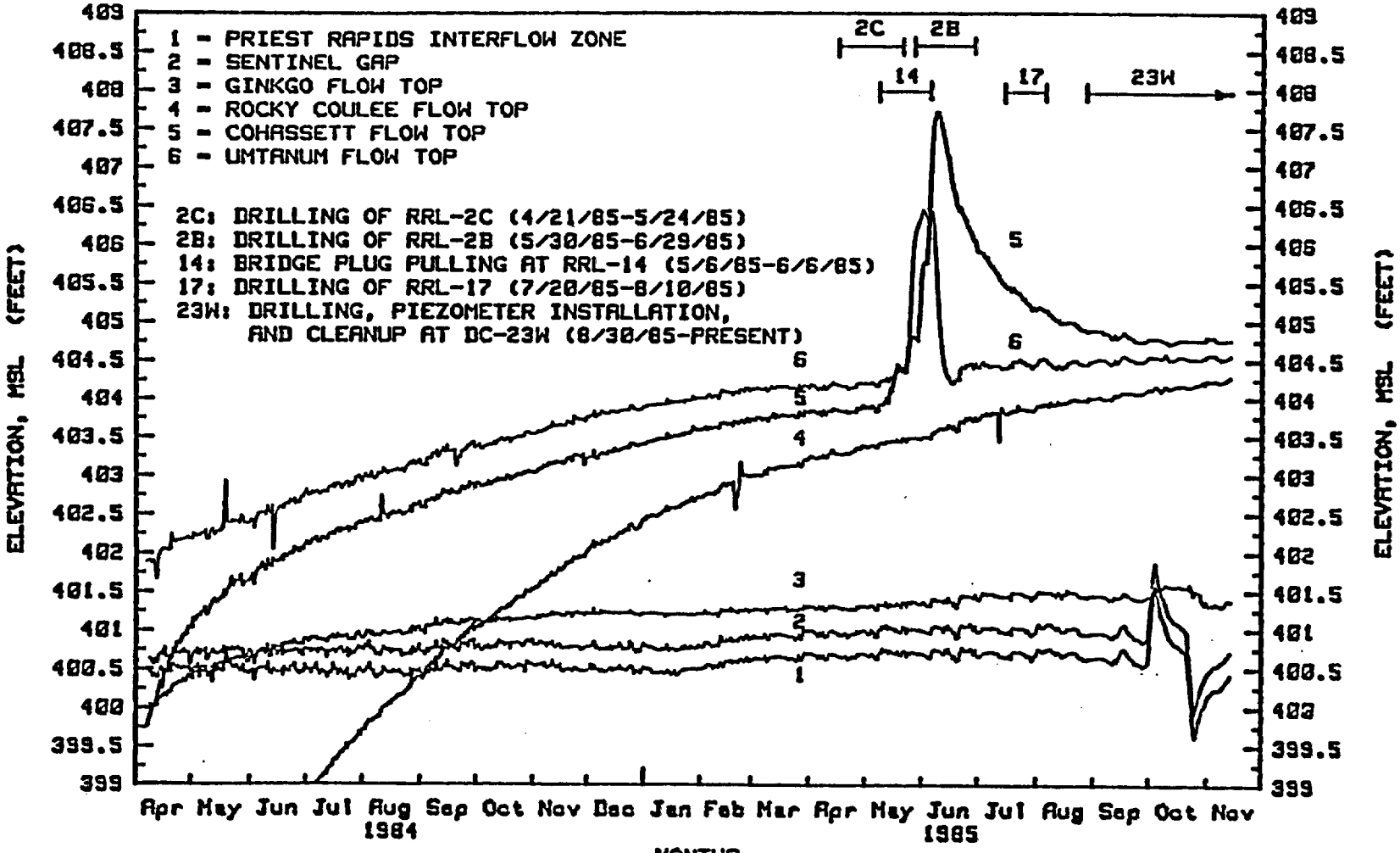
HYDROGRAPH PRODUCED BY

Program WHYDAT Rev 4.7 FILE: N20WPR85

BOREHOLE: DC-22C HYDROGEOLOGIC UNIT: GRANDE RONDE & WANAPUM

LOCATION: N 448,600 E 2,204,188 DATUM ELEVATION: MEAN SEA LEVEL

ADJUSTED TO A CONSTANT ATMOSPHERIC PRESSURE OF 14.347 PSI

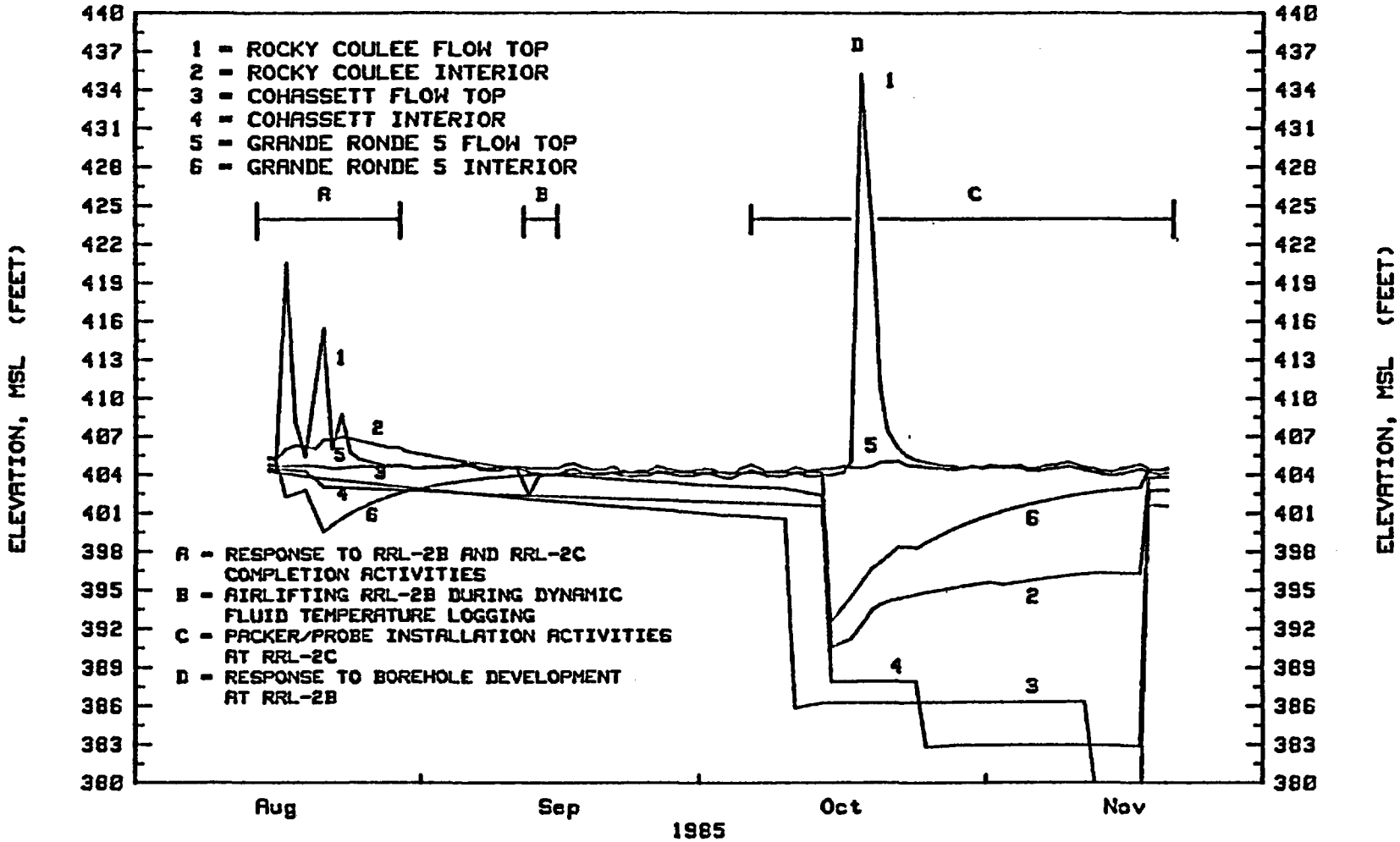


HYDROGRAPH PRODUCED BY
Program WHYDAT Rev 4.7 FILE: N22WPR03

BOREHOLE: RRL-2C HYDROGEOLOGIC UNIT: GRANDE RONDE

LOCATION: HANFORD SITE DATUM ELEVATION: MEAN SEA LEVEL

NOT ADJUSTED FOR ATMOSPHERIC EFFECTS



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Program WHYDAT Rev 4.7 FILE: 02CGRI85

FLUID LOSS SUMMARY

RRL-2C

UNCONFINED/SADDLE MTNS/WANAPUM	417	BBLS	MUD
GRANDE RONDE NO. 5 FLOW TOP	3,288	BBLS	WATER

RRL-2B

SADDLE MTNS/WANAPUM	723	BBLS	MUD
ROCKY COULEE FLOW TOP	15	BBLS	WATER

RRL-14

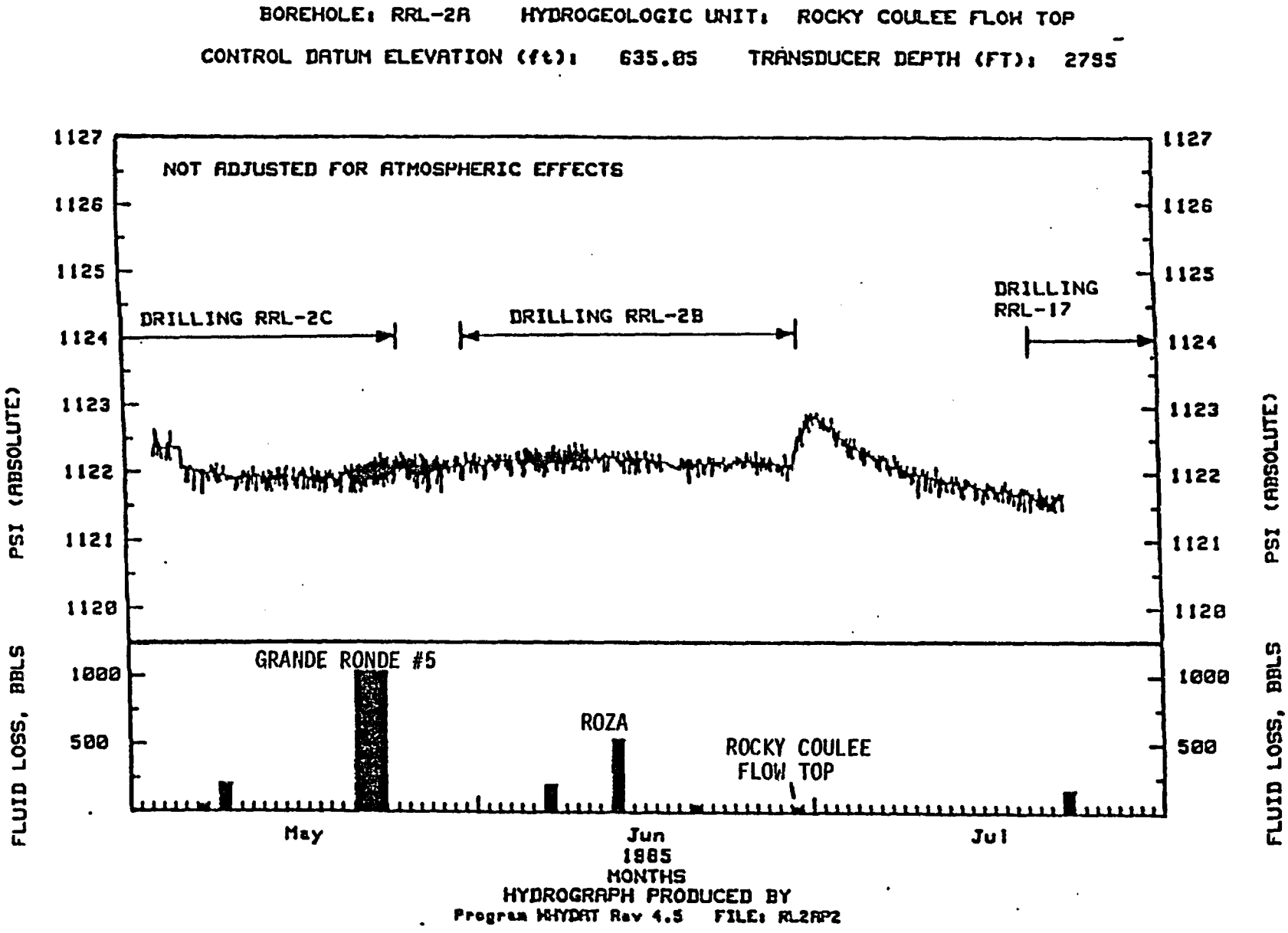
COMPOSITE GRANDE RONDE	3,586	BBLS	WATER

RRL-17

UNCONFINED/WANAPUM	610	BBLS	MUD

DC-23W

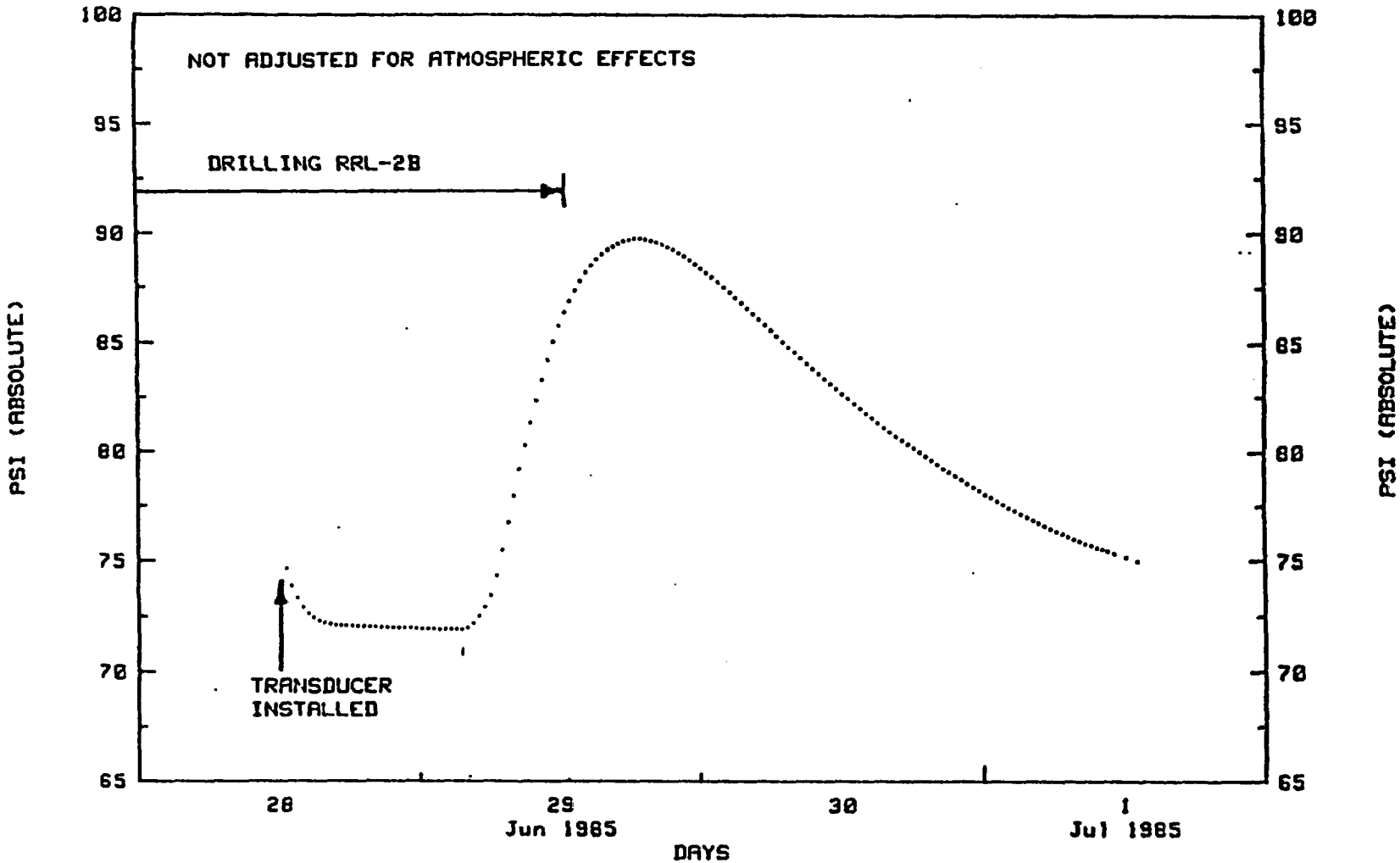
UNCONFINED	909	BBLS	MUD
SADDLE MTNS/UPPER WANAPUM	5,288	BBLS	MUD
COMPOSITE WANAPUM	28,137	BBLS	WATER



Hydrograph borehole RRL-2A, Rocky Coulee Flow Top, May through July, 1985

BOREHOLE: RRL-2C HYDROGEOLOGIC UNIT: ROCKY COULEE FLOW TOP

CONTROL DATUM ELEVATION (ft): N/A TRANSDUCER DEPTH (FT): 400 ±

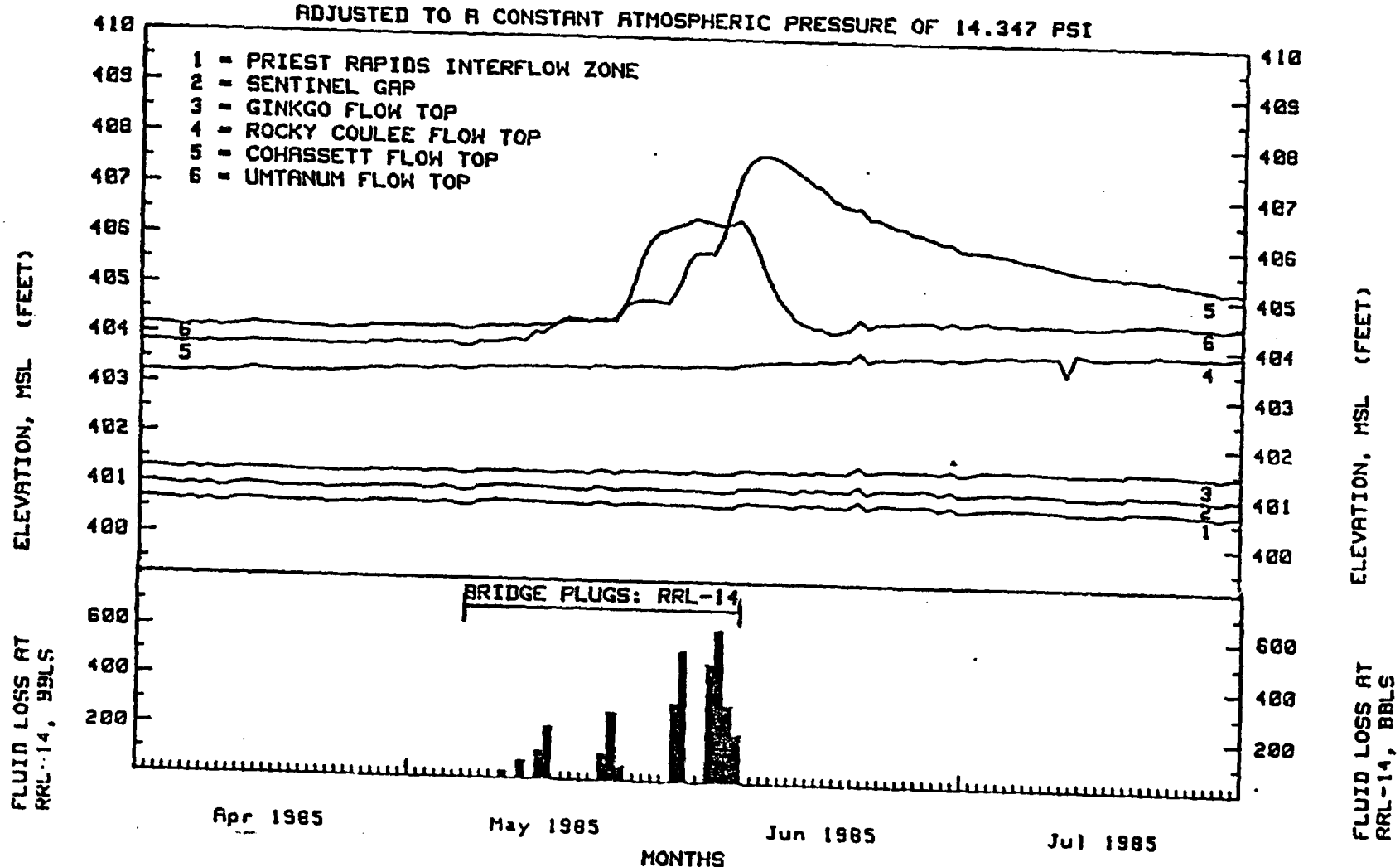


HYDROGRAPH PRODUCED BY
Program WHYDAT Rev 4.5 FILE: RRL-2C

Hydrograph borehole RRL-2C, Rocky Coulee Flow Top, June 28 through July 1, 1985

BOREHOLE: DC-22C HYDROGEOLOGIC UNIT: GRANDE RONDE & WANAPUM

LOCATION: N 448,600 E 2,204,188 DATUM ELEVATION: MEAN SEA LEVEL



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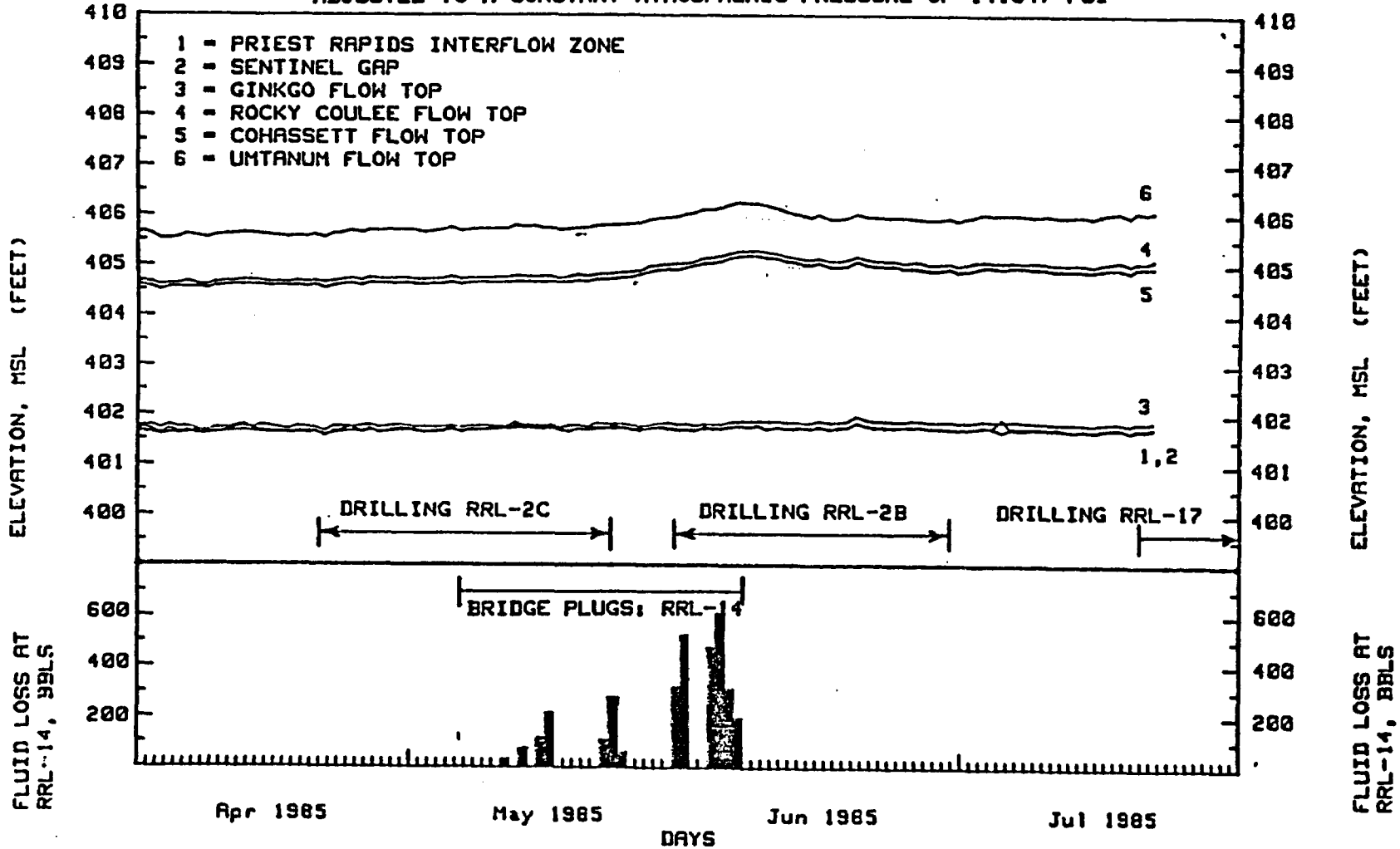
Program WHYDAT Rev 4.5 FILE: N22HPR

BOREHOLE: DC-20C HYDROGEOLOGIC UNIT: GRANDE RONDE & WANAPUM

LOCATION: N 451,884 E 2,215,288 DATUM ELEVATION: MEAN SEA LEVEL

ADJUSTED TO A CONSTANT ATMOSPHERIC PRESSURE OF 14.347 PSI



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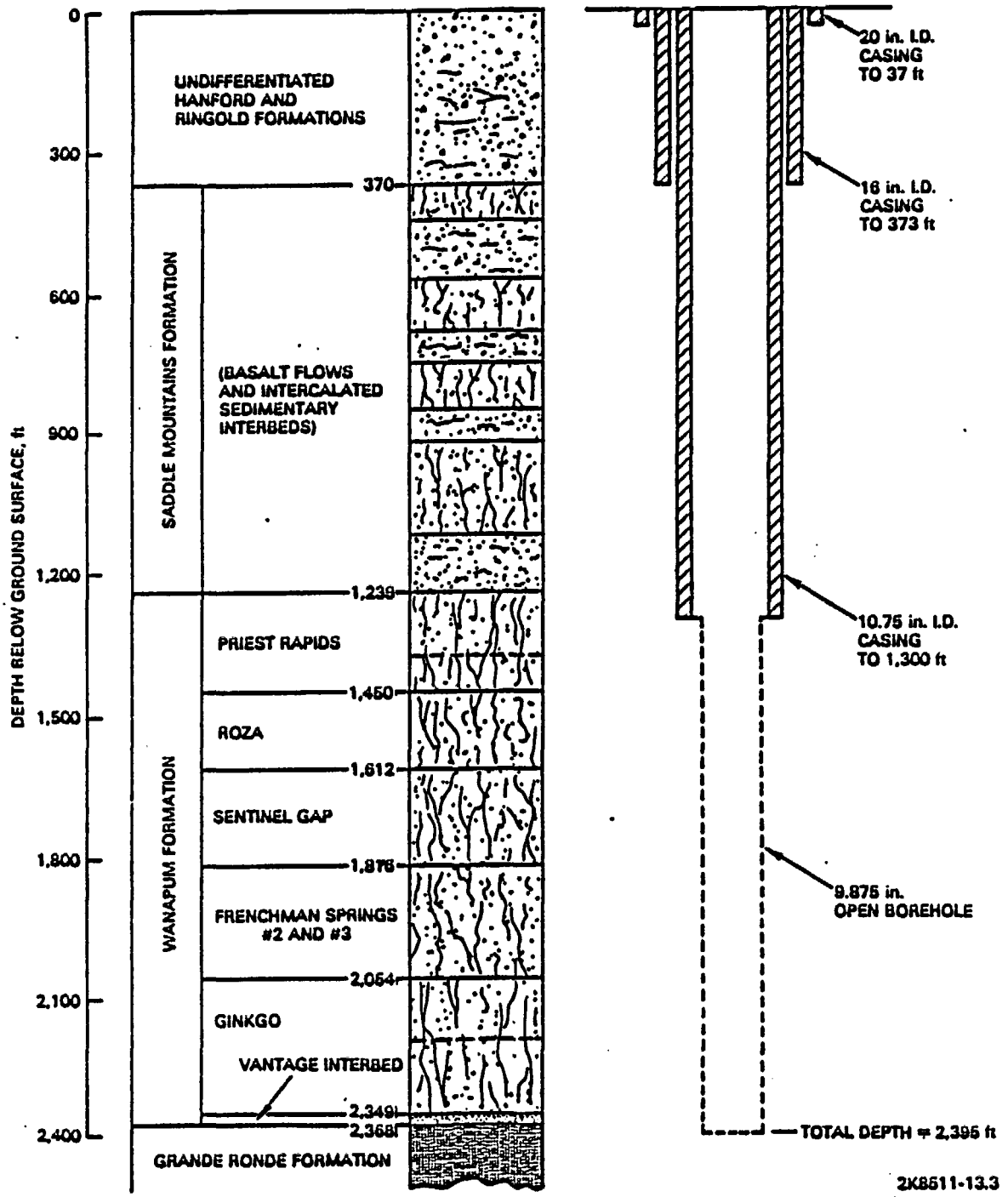
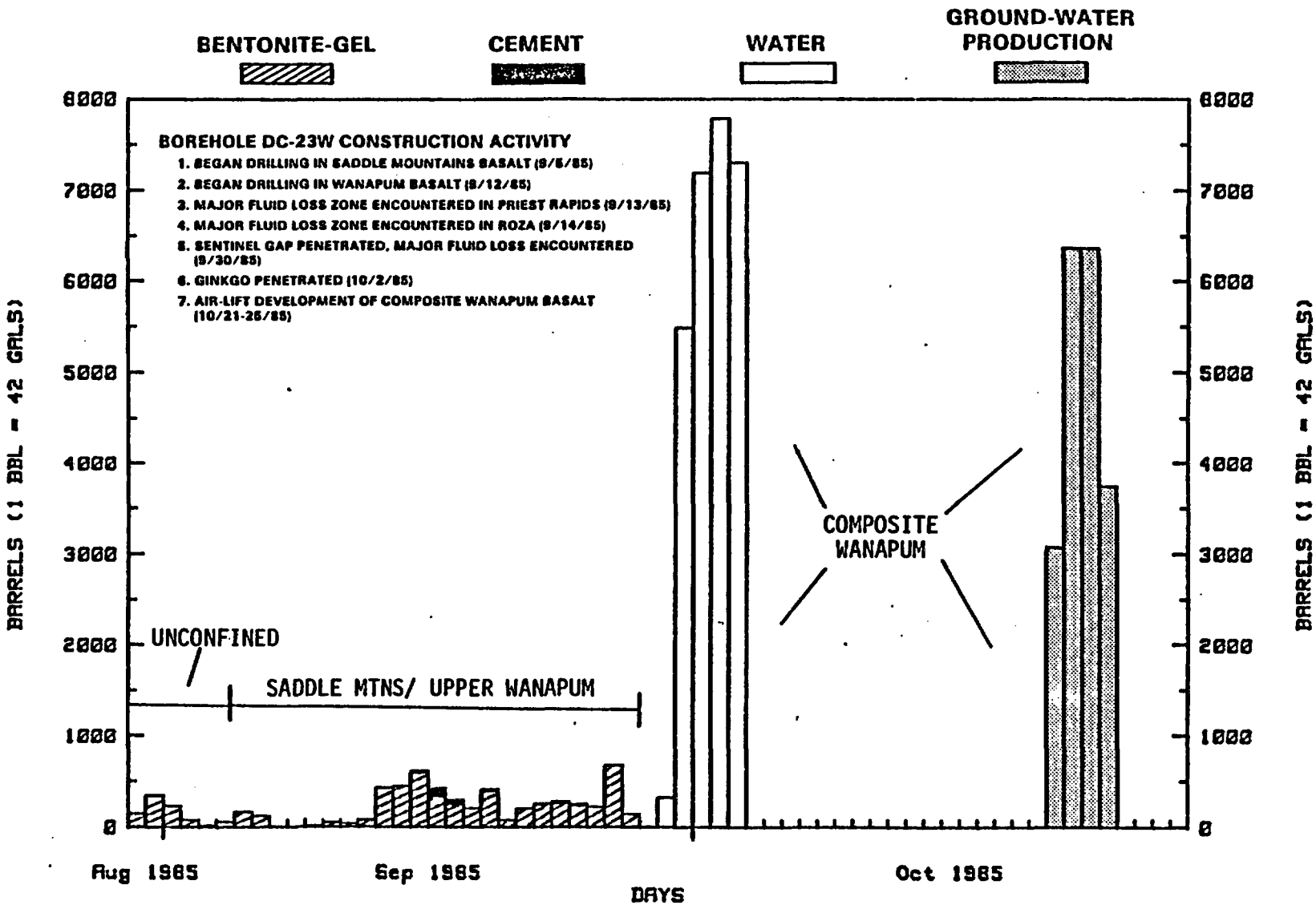


FIGURE 2. As-Built Diagram and General Stratigraphy of Borehole DC-23W.

DRILLING FLUID

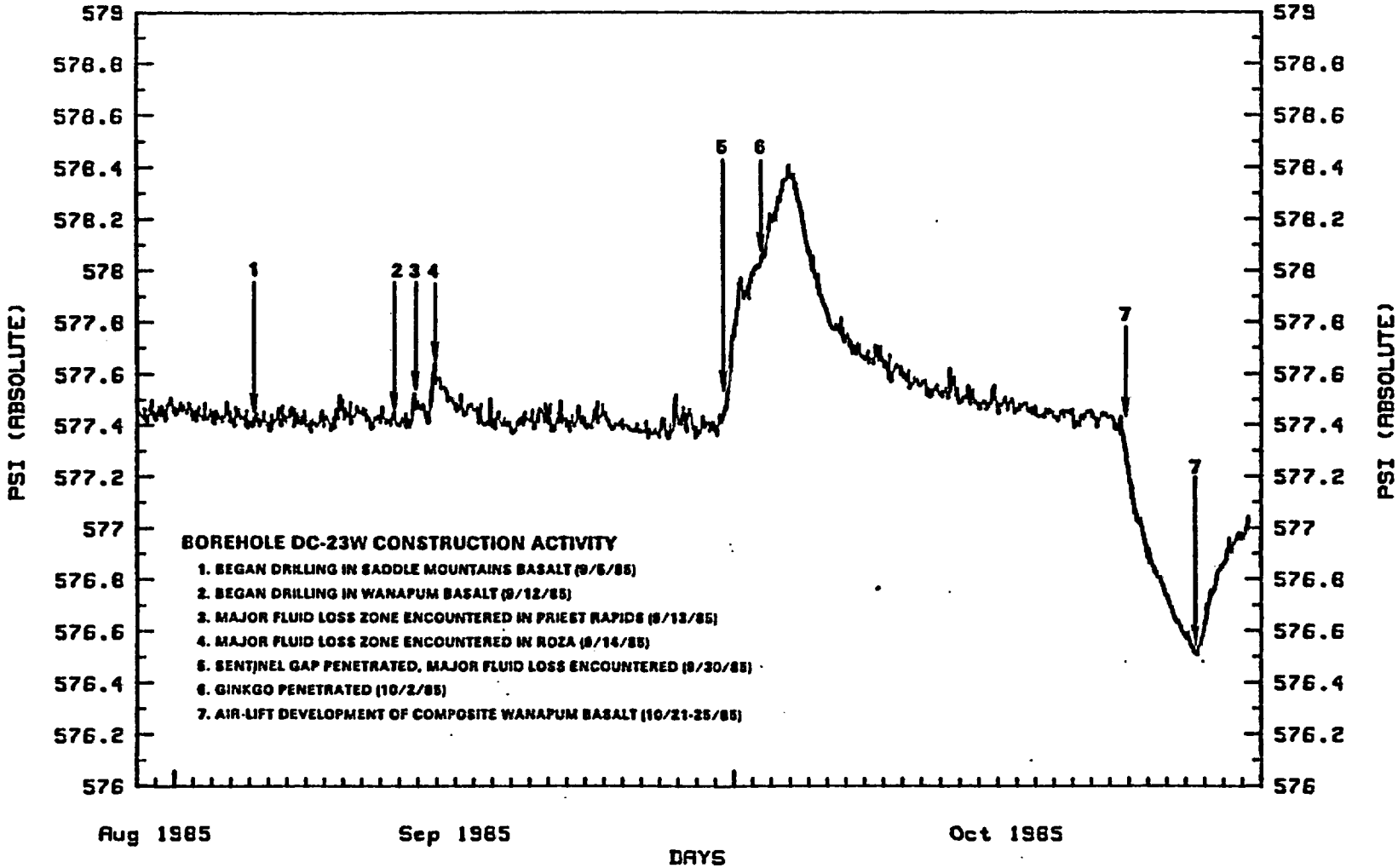


BAR-GRAPH PRODUCED BY
Program WHYBAR Rev 5.0 FILE: DC-23W

BOREHOLE: DC-20C HYDROGEOLOGIC UNIT: PRIEST RAPIDS

CONTROL DATUM ELEVATION (ft): 711.31 PROBE SEAT DEPTH (ft): 1617

ADJUSTED TO A CONSTANT ATMOSPHERIC PRESSURE OF 14.347 PSI



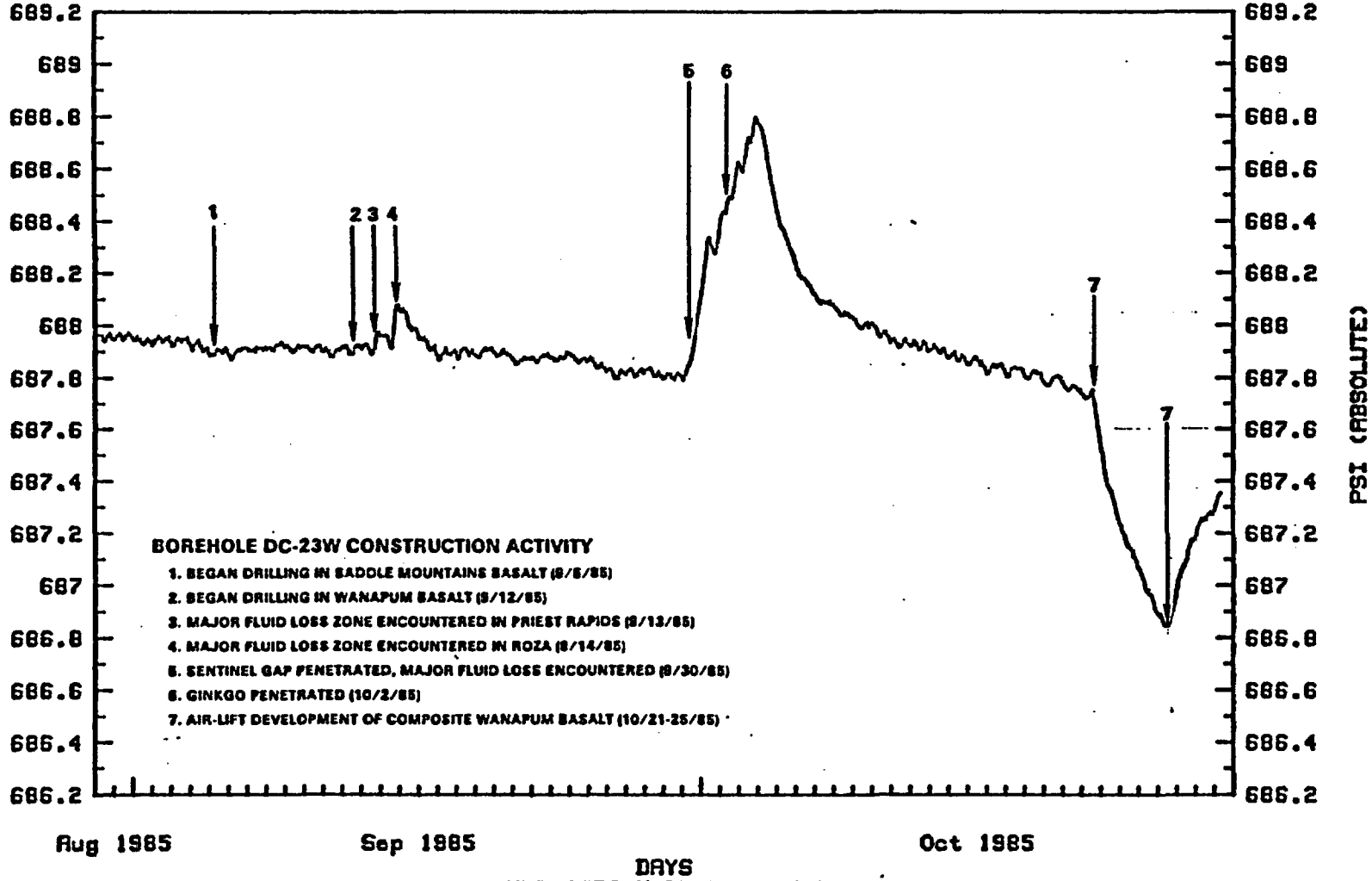
HYDROGRAPH PRODUCED BY
Program WHYDAT Rev 4.5 FILE: N20PR

FIGURE 4. Downhole Pressure Hydrograph, DC-20C Priest Rapids-Rosalia; 8/30 - 10/28/85.

BOREHOLE: DC-20C HYDROGEOLOGIC UNIT: SENTINEL GAP

CONTROL DATUM ELEVATION (ft): 711.31 PROBE SEAT DEPTH (ft): 1870

ADJUSTED TO A CONSTANT ATMOSPHERIC PRESSURE OF 14.347 PSI



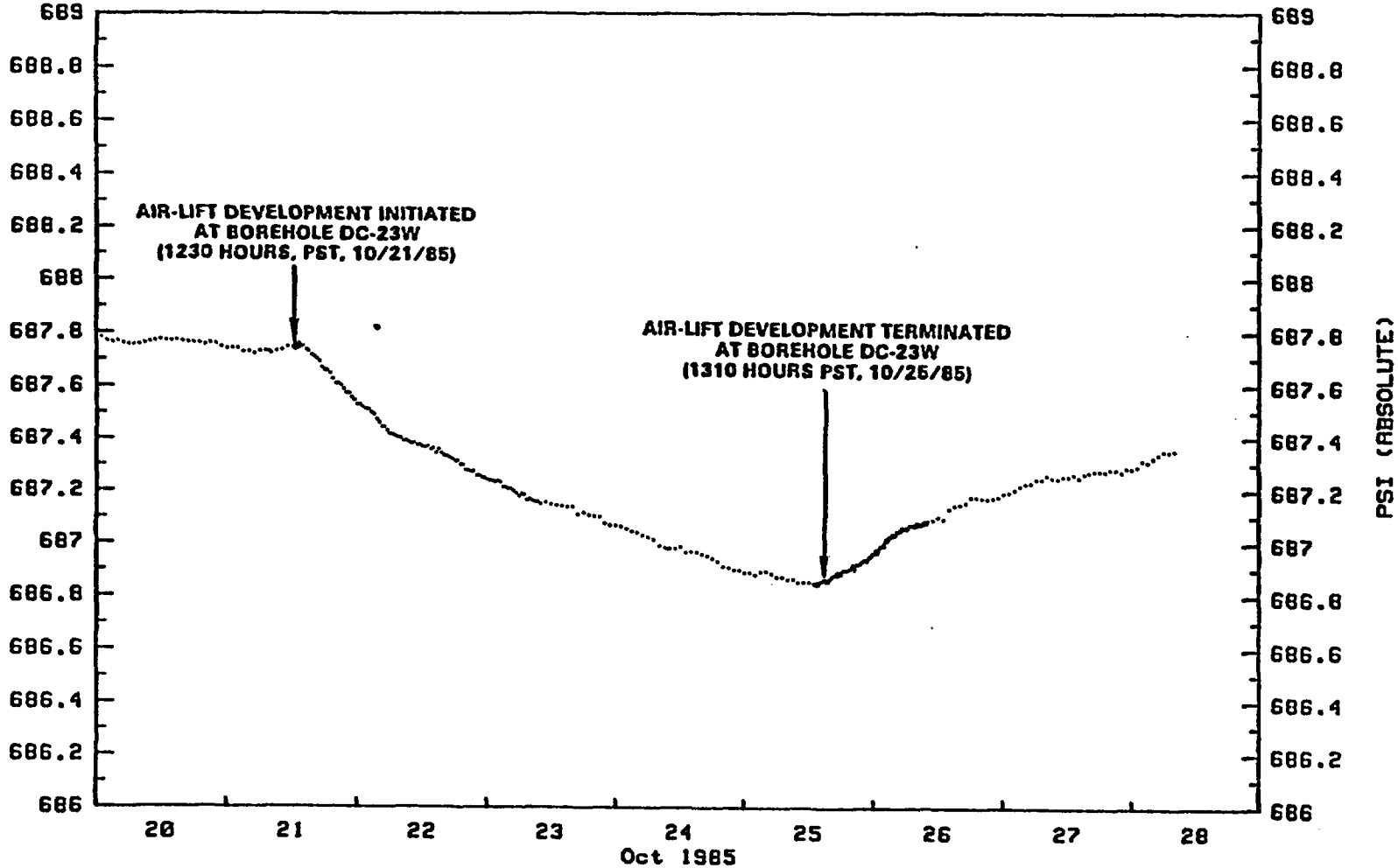
HYDROGRAPH PRODUCED BY
Program WHYDAT Rev 4.5 FILE: N20SG

FIGURE 5. Downhole Pressure Hydrograph, DC-20C Sentinel Gap; 8/30 - 10/28/85.

BOREHOLE: DC-20C HYDROGEOLOGIC UNIT: SENTINEL GAP

CONTROL DATUM ELEVATION (ft): 711.31 PROBE SEAT DEPTH (ft): 1870

ADJUSTED TO A CONSTANT ATMOSPHERIC PRESSURE OF 14.347 PSI



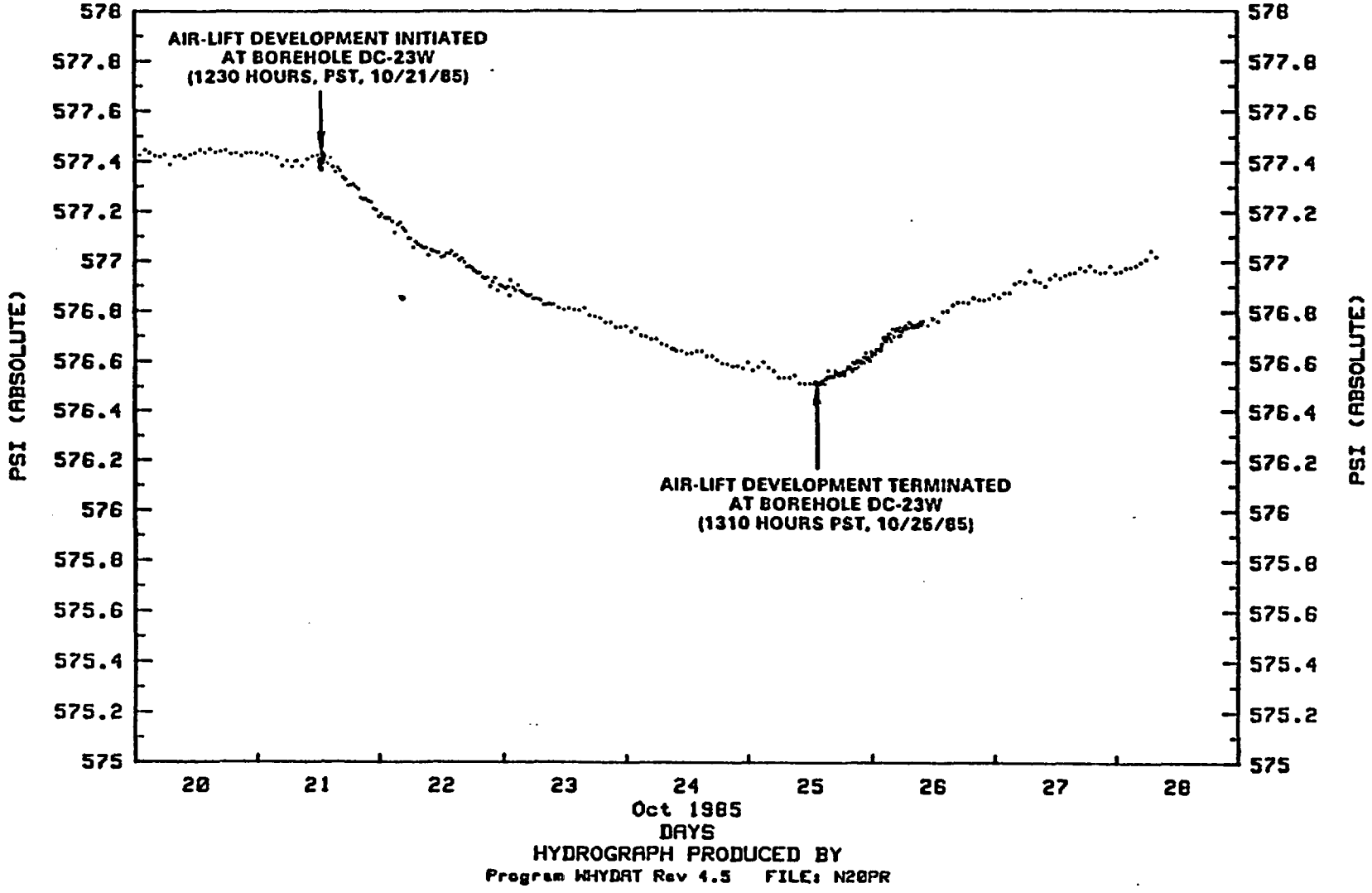
HYDROGRAPH PRODUCED BY
Program WHYDAT Rev 4.5 FILE: N20SG

FIGURE 8. Expanded Downhole Pressure Hydrograph, DC-20C Sentinel Gap; 10/20 - 28/85.

BOREHOLE: DC-20C HYDROGEOLOGIC UNIT: PRIEST RAPIDS

CONTROL DATUM ELEVATION (ft): 711.31 PROBE SEAT DEPTH (ft): 1617

ADJUSTED TO A CONSTANT ATMOSPHERIC PRESSURE OF 14.347 PSI



HYDROGRAPH PRODUCED BY
Program WHYDAT Rev 4.5 FILE: N20PR

FIGURE 7. Expanded Downhole Pressure Hydrograph, DC-20C Priest Rapids-Rosalia; 10/20-28/85.

HANFORD SITE MONITORING NETWORK

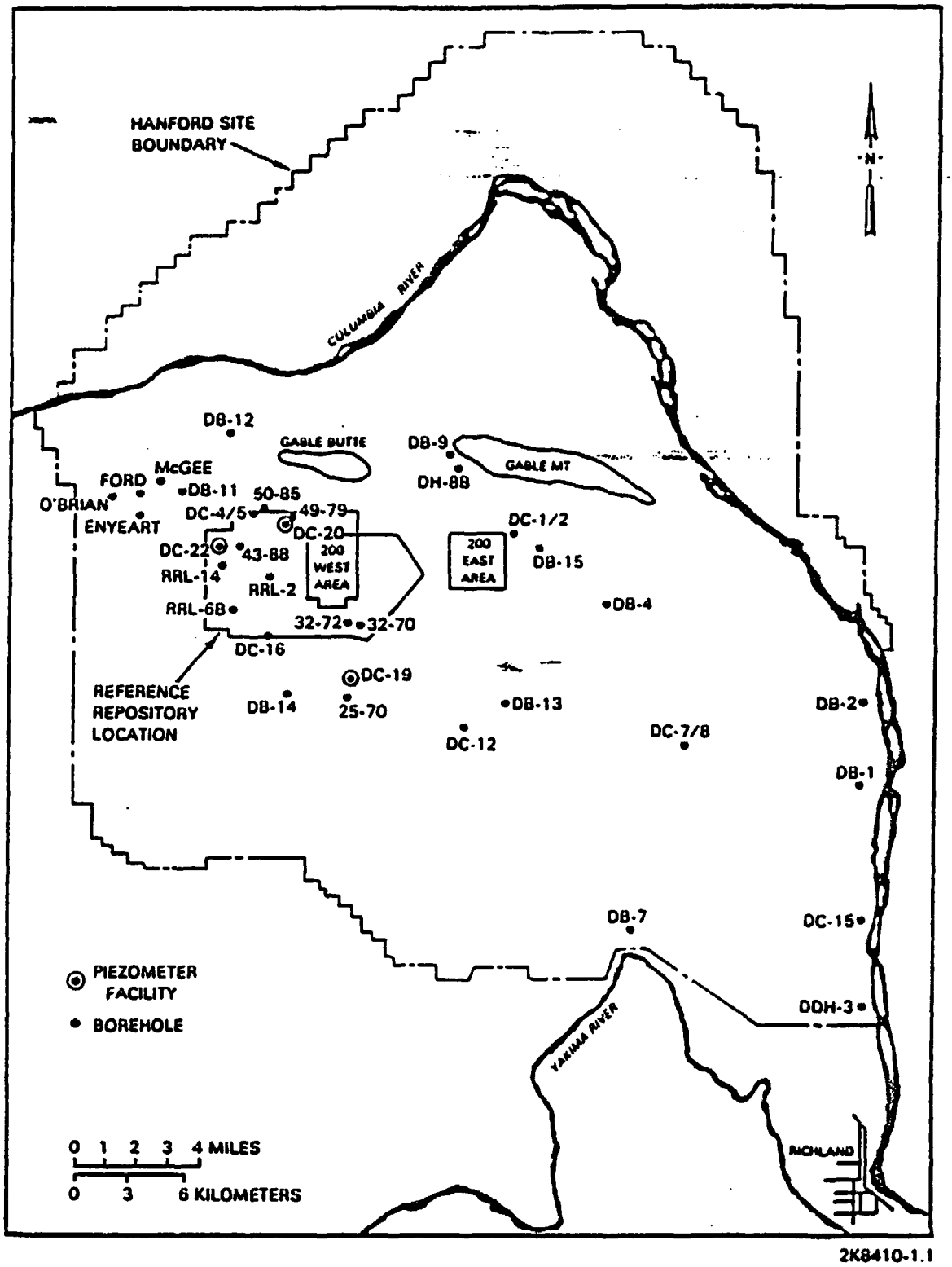


FIGURE 1. Location Map of the Hanford Site Monitoring Network Boreholes and the DC-19, DC-20 and DC-22 Piezometer Facilities.

MONITORING HORIZONS
HANFORD SITE MONITORING NETWORK

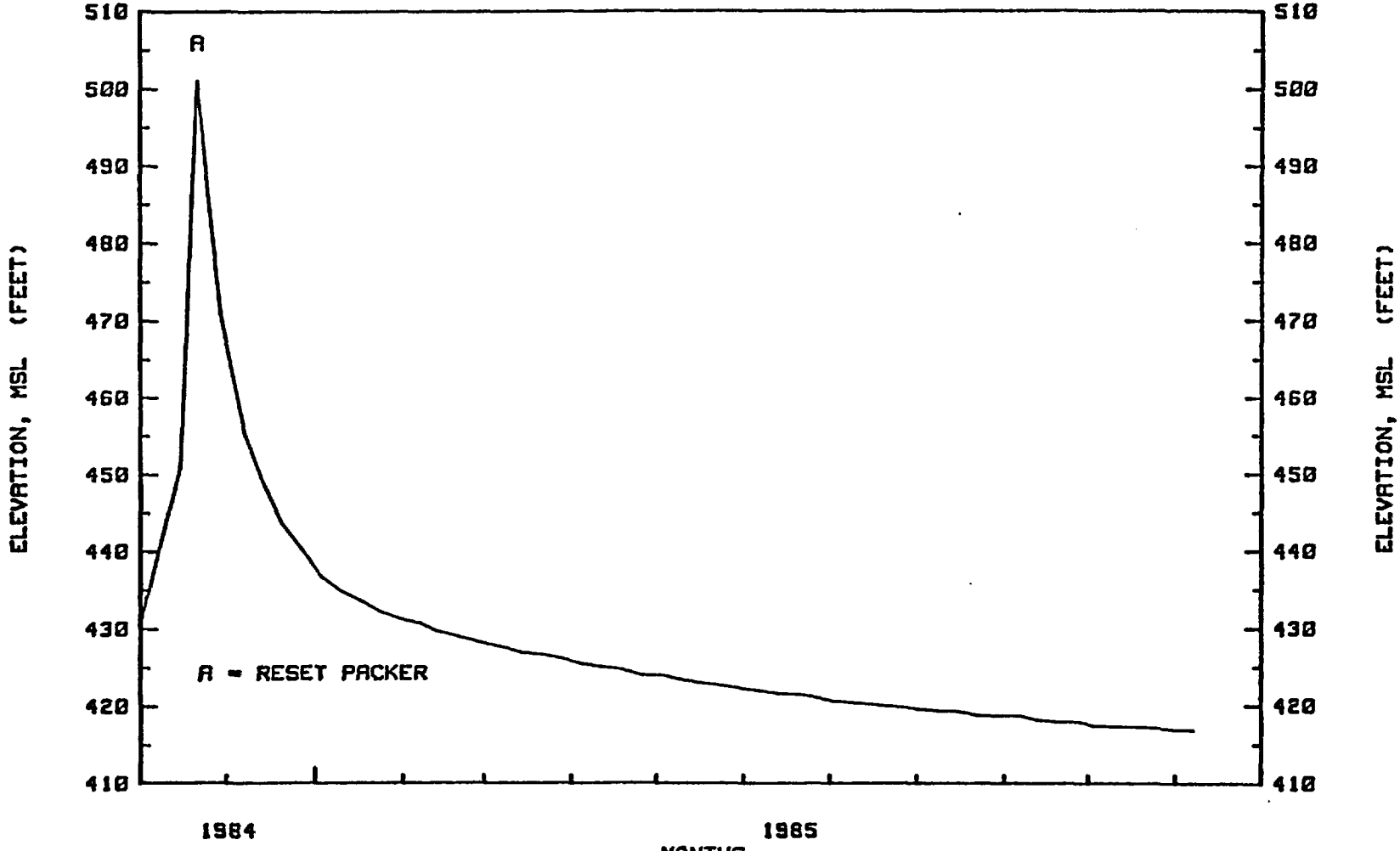
UNCONFINED	MABTON INTERBED	PRIEST RAPIDS INTERFLOW
25-70	DC-16B	O'BRIAN
32-70	DB-9	FORD
32-72	DH-8B	ENYEART
43-88	DB-13	DB-12
49-79	DB-7	DB-14
50-85	DB-4	DC-16C
		DB-1
		DB-11

WANAPUM	GINKGO FLOW TOP	ROCKY COULEE FLOW TOP	GRANDE RONDE
DB-2	DDH-3	RRL-6B	DC-7/8
DB-15		RRL-2A	DC-12
DC-1		DC-4/5	DC-15
McGee		McGee	DC-1
			DC-2

BOREHOLE: DC-4 HYDROGEOLOGIC UNIT: ROCKY COULEE

LOCATION: N 454,467 E 2,209,995 DATUM ELEVATION: MEAN SEA LEVEL

NOT ADJUSTED FOR ATMOSPHERIC EFFECTS

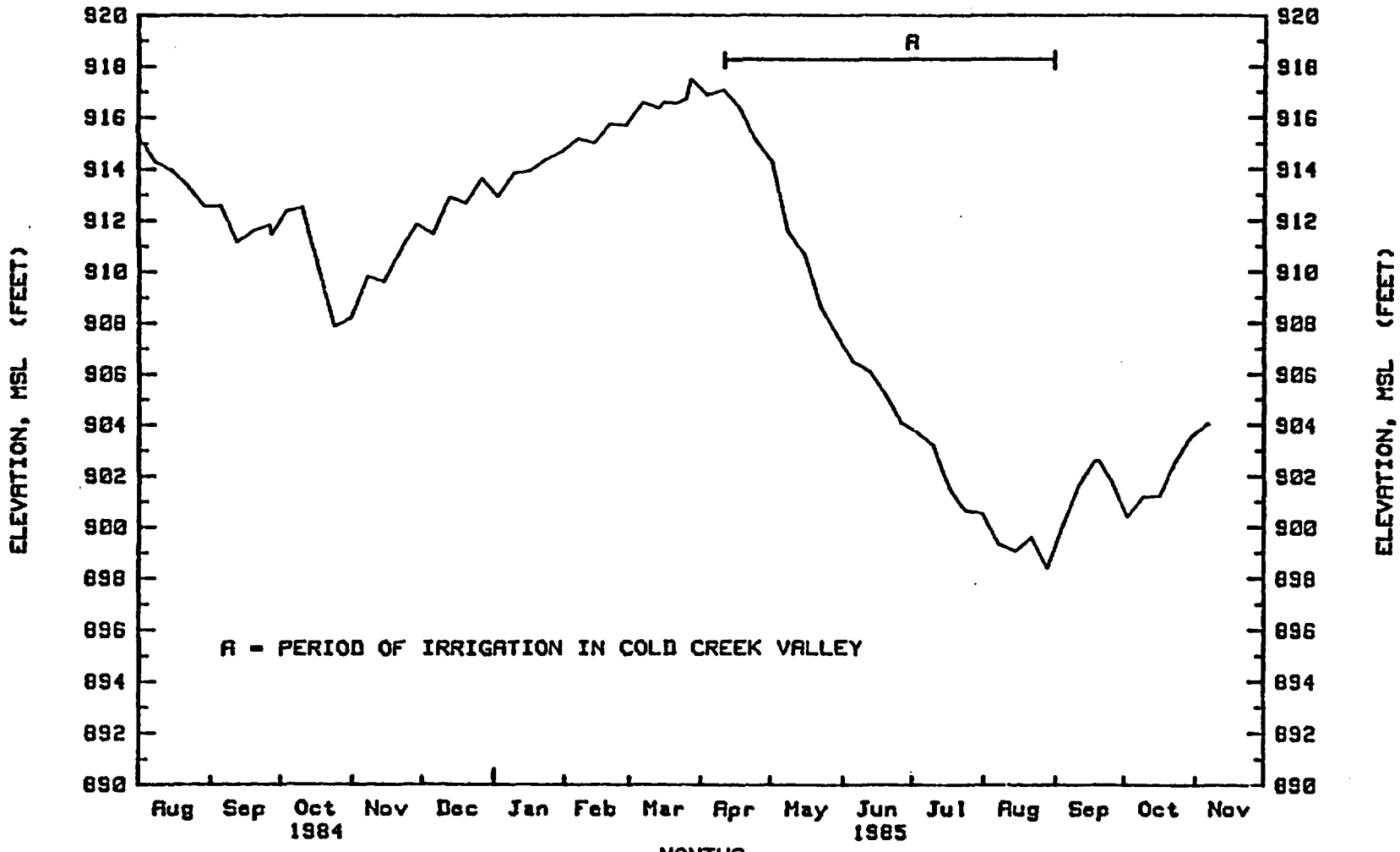


HYDROGRAPH PRODUCED BY
Program WHYDAT Rev 4.7 FILE: DC-4B

BOREHOLE: OBRIAN HYDROGEOLOGIC UNIT: PRIEST RAPIDS FLOW TOP

LOCATION: N 454,404 E 2,183,767 DATUM ELEVATION: MEAN SEA LEVEL

NOT ADJUSTED FOR ATMOSPHERIC EFFECTS

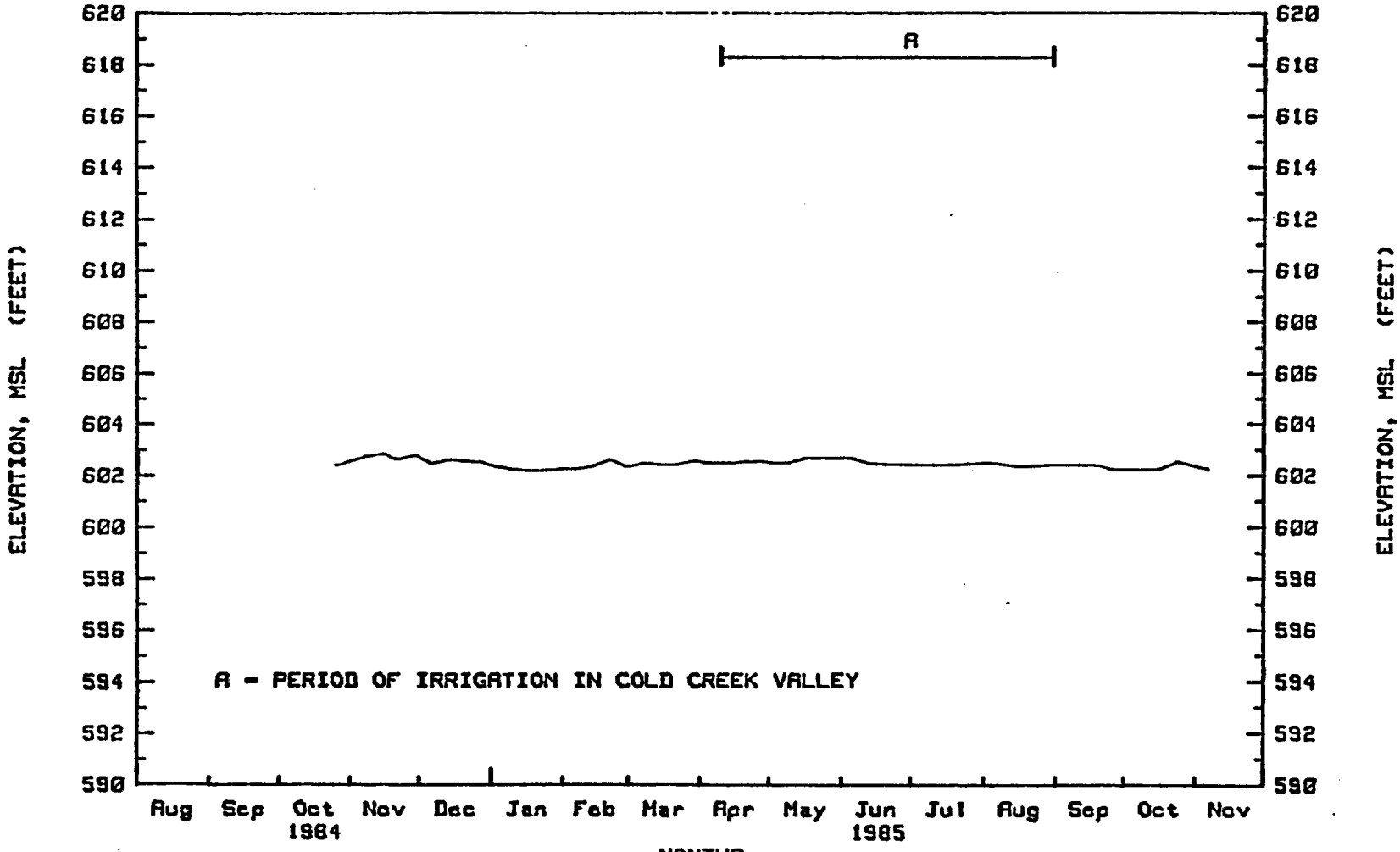


HYDROGRAPH PRODUCED BY
Program WHYDAT Rev 4.7 FILE: OBRIAN

BOREHOLE: MCGEE HYDROGEOLOGIC UNIT: ROCKY COULEE FLOW TOP

LOCATION: N 457,773 E 2,191,775 DATUM ELEVATION: MEAN SEA LEVEL

NOT ADJUSTED FOR ATMOSPHERIC EFFECTS

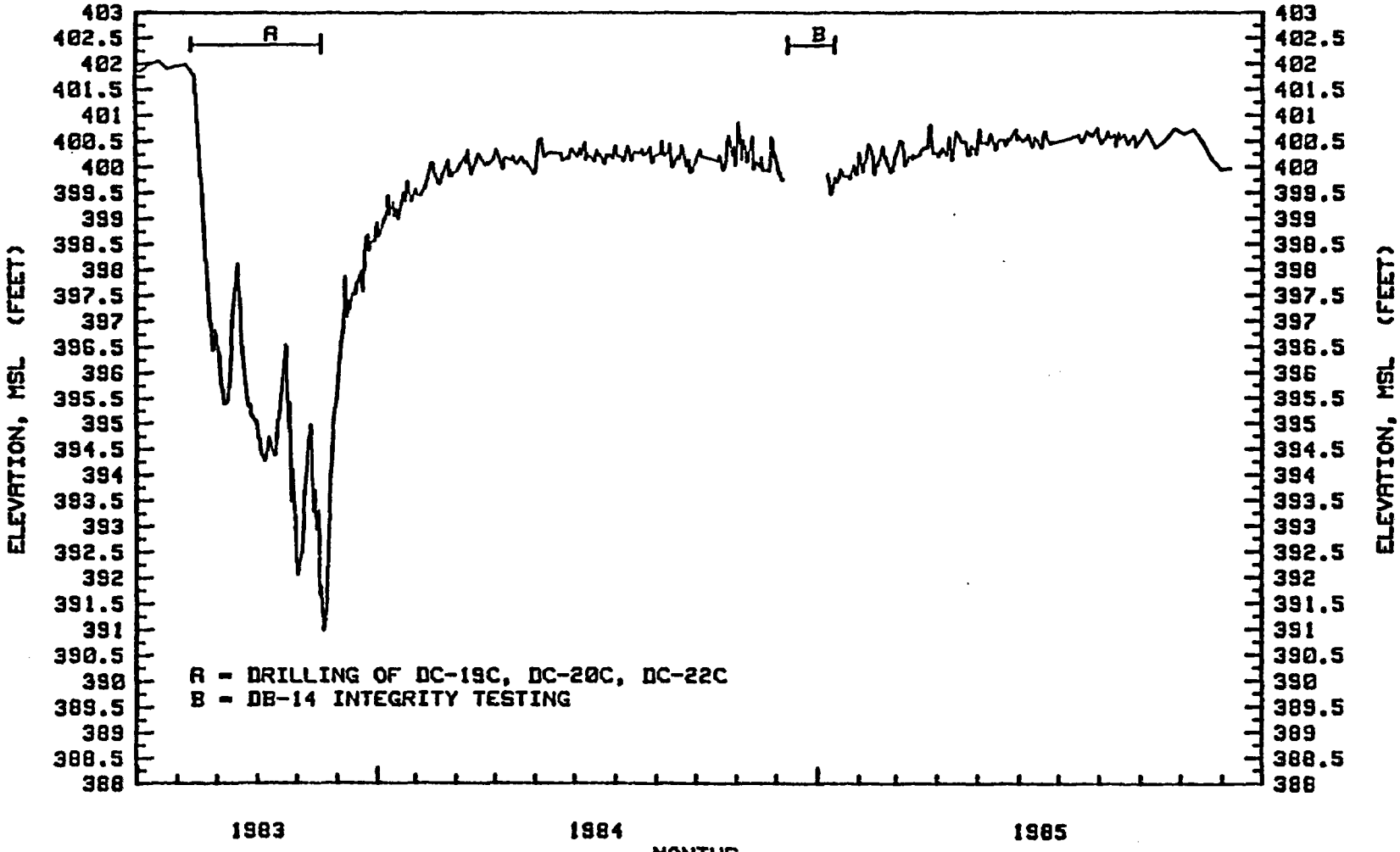


HYDROGRAPH PRODUCED BY
Program WHYDAT Rev 4.7 FILE: MCGRC

BOREHOLE: DB-14 HYDROGEOLOGIC UNIT: PRIEST RAPIDS

LOCATION: N 430,190 E 2,215,764 DATUM ELEVATION: MEAN SEA LEVEL

NOT ADJUSTED FOR ATMOSPHERIC EFFECTS



HYDROGRAPH PRODUCED BY
Program WHYDAT Rev 4.7 FILE: DB-14

SUMMARY

1. WATER-LEVEL PERTURBATIONS OCCUR FROM DRILLING / CONSTRUCTION ACTIVITIES.

   - GRANDE RONDE IN DC-20 AND -22 FROM RRL-14 BRIDGE PLUG PULLING ACTIVITIES
   - ROCKY COULEE FLOW TOP IN RRL-2A AND -2C DURING DRILLING OF RRL-2B
   - WANAPUM AT DC-19, -20, AND -22 FROM DC-23W CONSTRUCTION ACTIVITIES
   - APPARENT UPPER GRANDE RONDE IN DC-19 AND -20 DURING DC-23W CONSTRUCTION ACTIVITIES

   EXCEPTIONS:

   - DRILLING OF RRL-2B AND -2C APPEARS TO HAVE NEGLIGIBLE EFFECTS ON DC-19, -20, AND -22
   - NO APPARENT EFFECTS IN MONITORED HORIZONS FROM DRILLING OF RRL-17 TO TOP OF GRANDE RONDE

2. HYDROLOGIC RESPONSE WITHIN MIDDLE AND LOWER WANAPUM WAS OBSERVED PRIOR TO THEIR PENETRATION AT DC-23W.

3. ROCKY COULEE AT MCGEE WELL DOES NOT RESPOND TO OFF-SITE IRRIGATION IN PRIEST RAPIDS.

WATER-LEVEL PREDICTIONS

F. H. DOVE

NRC/DOE MEETING
RICHLAND, WASHINGTON
DECEMBER 9, 1985

- WATER-LEVEL PREDICTIONS ARE AVAILABLE
- MOST NATURAL DEVIATIONS LESS THAN 0.2 FEET
- REFINEMENTS IN PREDICTIONS ARE LIKELY

ANALYTICAL PROCESS

CALIBRATION → PREDICTION → VALIDATION

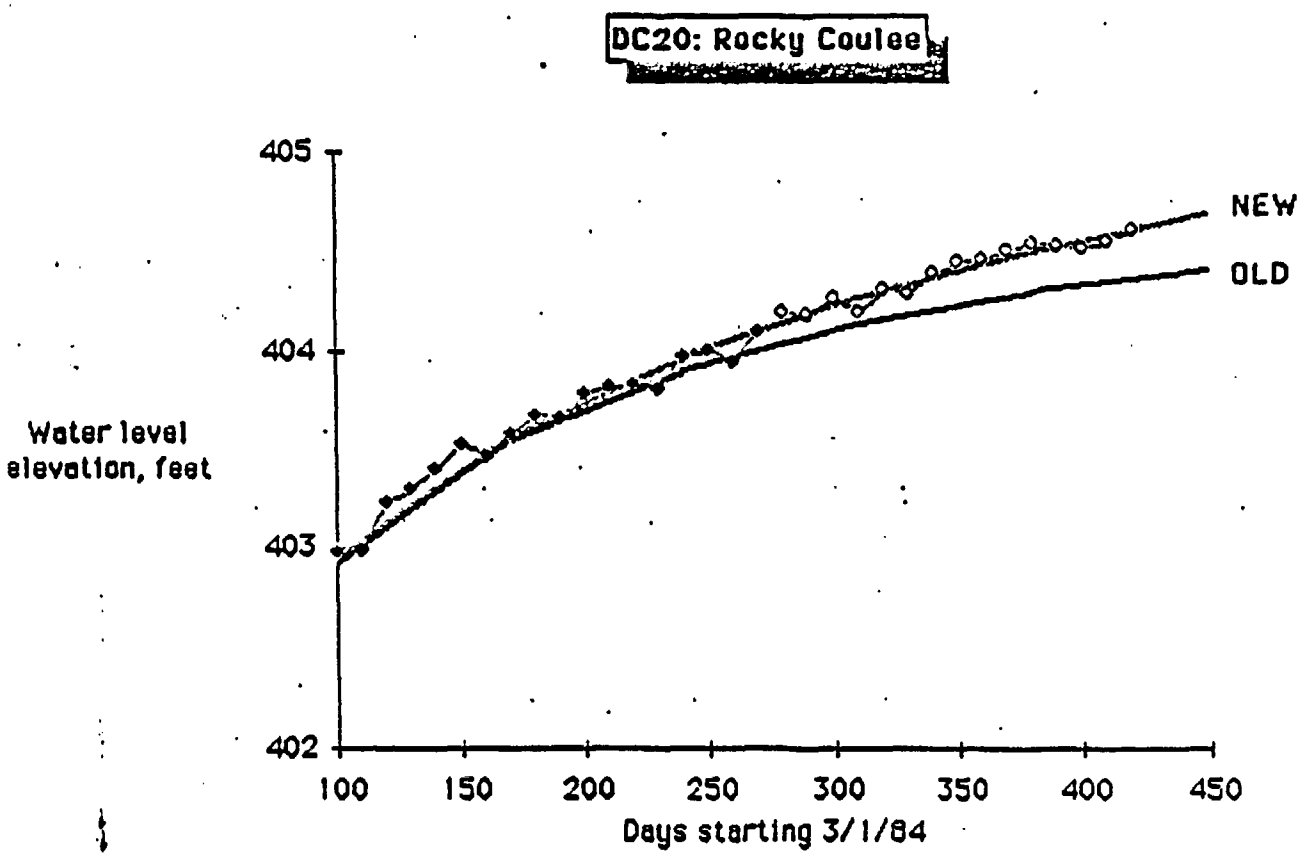


Figure 3.12: Comparison of models for DC-20: Rocky Coulee

SUMMARY OF RESULTS

- CALIBRATED WITH JUNE 1 TO NOVEMBER 30, 1984 DATA
  - PROJECTIONS TO APRIL 1, 1985
  - STRICT VALIDATION FOR 25 OR 27 WATER LEVELS
  - THEIS RECOVERY - TYPE CURVE IN GRANDE RONDE
  - LINEAR FIT ABOVE GRANDE RONDE
- CALIBRATED WITH DATA THROUGH MAY 19, 1985
- PROJECTIONS THROUGH JUNE, 1986

Table 3.6 (continued):

Rocky Coulee

	Date	Linear (Forecast ± SE_f)	Theis (Forecast ± SE_f)	Mixed (Forecast ± SE_f)
DC-19	6/1/85	402.29 ± .34	401.77 ± .11	401.70 ± .11
	9/1/85	402.93 ± .36	401.90 ± .10	401.77 ± .12
	12/1/85	403.56 ± .38	402.00 ± .10	401.80 ± .14
	6/1/86	404.83 ± .41	402.13 ± .10	401.79 ± .18
	12/1/86	406.11 ± .45	402.21 ± .10	401.72 ± .23
	12/1/87	408.66 ± .52	402.31 ± .10	401.52 ± .34
DC-20	6/1/85	404.93 ± .10	404.72 ± .07	404.79 ± .05
	9/1/85	405.38 ± .10	404.92 ± .07	405.10 ± .05
	12/1/85	405.82 ± .11	405.09 ± .08	405.40 ± .05
	6/1/86	406.71 ± .12	405.36 ± .10	405.98 ± .05
	12/1/86	407.60 ± .13	405.58 ± .12	406.55 ± .05
	12/1/87	409.38 ± .15	405.90 ± .16	407.67 ± .05
DC-22	6/1/85	404.42 ± .38	403.64 ± .06	403.63 ± .13
	9/1/85	405.84 ± .40	404.19 ± .06	404.16 ± .16
	12/1/85	407.24 ± .42	404.62 ± .07	404.56 ± .19
	6/1/86	410.05 ± .46	405.27 ± .08	405.14 ± .30
	12/1/86	412.87 ± .50	405.74 ± .09	405.51 ± .45
	12/1/87	418.50 ± .58	406.37 ± .10	405.91 ± .85

Table 3.6 (continued):

Cohasset

	Date	Linear (Forecast ± SE_f)	Theis (Forecast ± SE_f)	Mixed (Forecast ± SE_f)
DC-19	6/1/85	401.33 ± .07	401.24 ± .07	401.28 ± .26
	9/1/85	401.52 ± .08	401.33 ± .08	401.42 ± .29
	12/1/85	401.71 ± .08	401.40 ± .09	401.55 ± .34
	6/1/86	402.09 ± .09	401.52 ± .11	401.79 ± .50
	12/1/86	402.47 ± .09	401.61 ± .14	402.02 ± .73
	12/1/87	403.23 ± .11	401.76 ± .20	402.46 ± 1.35
DC-20	6/1/85	404.79 ± .09	404.60 ± .07	404.67 ± .15
	9/1/85	405.21 ± .10	404.79 ± .07	404.95 ± .17
	12/1/85	405.62 ± .10	404.95 ± .08	405.23 ± .19
	6/1/86	406.45 ± .11	405.20 ± .10	405.77 ± .24
	12/1/86	407.28 ± .12	405.40 ± .12	406.29 ± .29
	12/1/87	408.93 ± .14	405.70 ± .16	407.22 ± .40
DC-22	6/1/85	404.24 ± .11	403.96 ± .05	404.02 ± .11
	9/1/85	404.81 ± .12	404.22 ± .05	404.35 ± .13
	12/1/85	405.37 ± .12	404.43 ± .06	404.64 ± .16
	6/1/86	406.49 ± .13	404.77 ± .07	405.17 ± .23
	12/1/86	407.62 ± .14	405.04 ± .09	405.65 ± .32
	12/1/87	409.87 ± .17	405.44 ± .12	406.51 ± .57

Table 3.6 (continued):

Umtanum

	Date	Linear (Forecast ± SE_f)	Theis (Forecast ± SE_f)	Mixed (Forecast ± SE_f)
DC-19	6/1/85	402.36 ± .14	402.13 ± .07	402.12 ± .16
	9/1/85	402.75 ± .14	402.27 ± .08	402.24 ± .19
	12/1/85	403.14 ± .15	402.38 ± .08	402.32 ± .23
	6/1/86	403.92 ± .16	402.54 ± .09	402.42 ± .36
	12/1/86	404.71 ± .18	402.66 ± .10	402.45 ± .55
	12/1/87	406.27 ± .20	402.80 ± .11	402.41 ± 1.05
DC-20	6/1/85	406.00 ± .13	405.72 ± .09	405.80 ± .17
	9/1/85	406.58 ± .13	405.99 ± .10	406.15 ± .20
	12/1/85	407.16 ± .14	406.21 ± .11	406.46 ± .25
	6/1/86	408.32 ± .15	406.57 ± .13	407.04 ± .39
	12/1/86	409.48 ± .16	406.85 ± .16	407.56 ± .60
	12/1/87	411.80 ± .19	407.28 ± .22	408.51 ± 1.12
DC-22	6/1/85	404.54 ± .11	404.32 ± .06	404.34 ± .06
	9/1/85	405.02 ± .12	404.54 ± .06	404.59 ± .08
	12/1/85	405.49 ± .12	404.72 ± .07	404.81 ± .12
	6/1/86	406.44 ± .13	405.00 ± .09	405.18 ± .23
	12/1/86	407.39 ± .14	405.23 ± .10	405.51 ± .38
	12/1/87	409.29 ± .17	405.56 ± .13	406.06 ± .77

Large-Scale Hydraulic Stress Tests at Borehole RRL-2

Objectives and Hydraulic Design

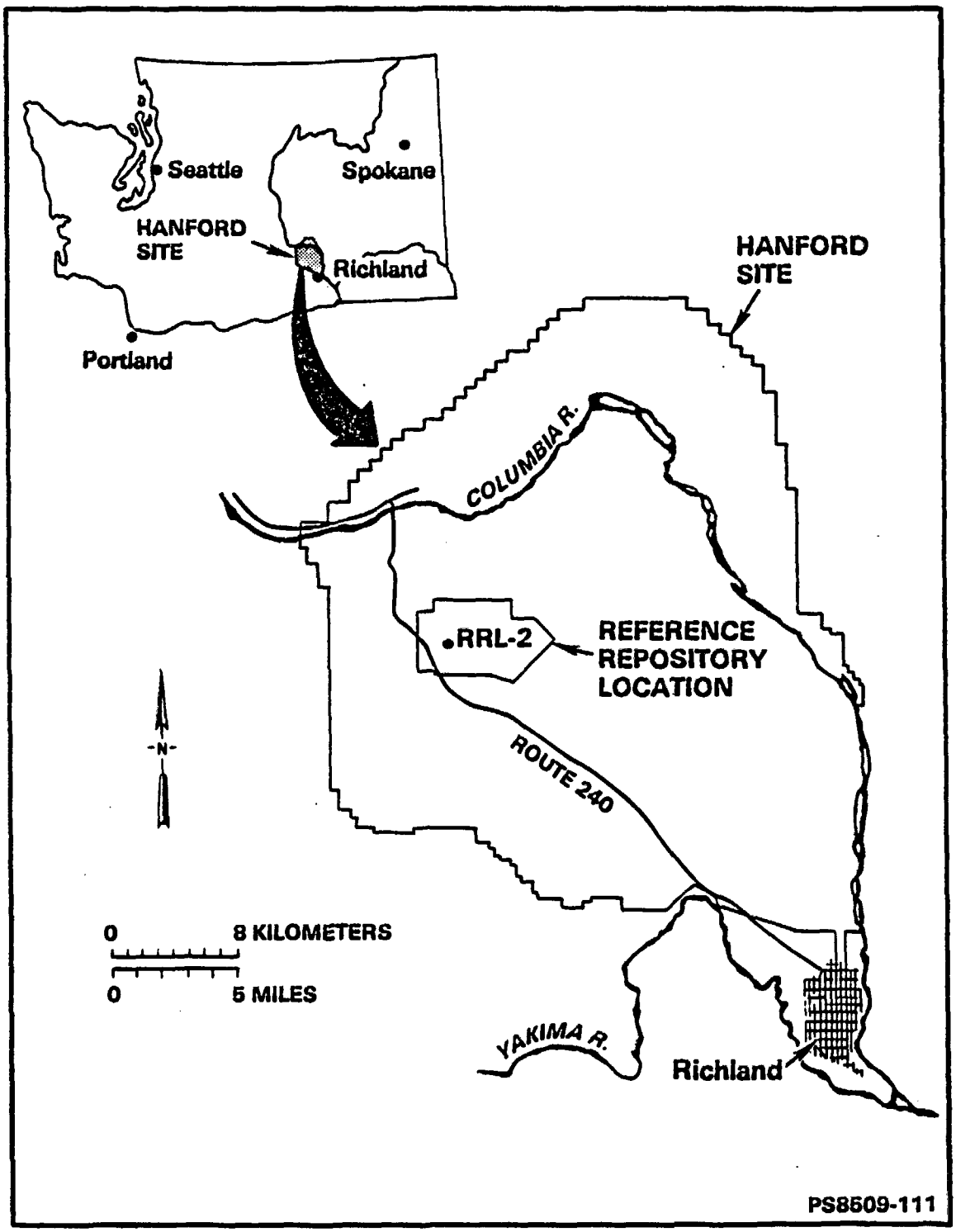
Phillip M. Rogers

NRC/DOE Meeting
Richland, Washington
December 9-10, 1985

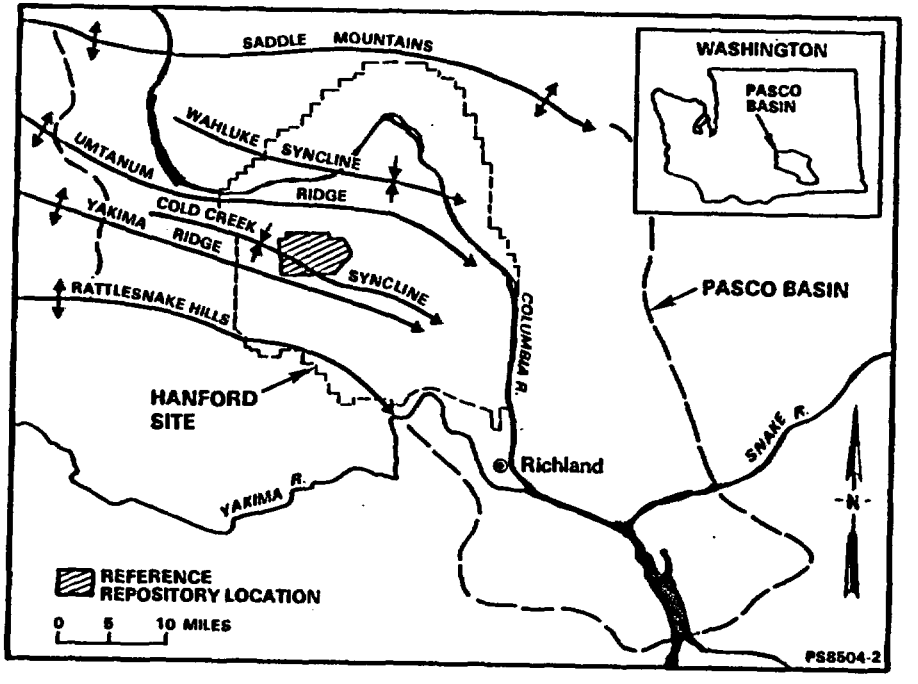
TOPICS

- SITE DESCRIPTION
- TEST OBJECTIVES
- TEST DESIGN
  - SIMULATIONS WITH NUMERICAL MODELS
  - SIMULATIONS WITH ANALYTICAL MODELS
- CONDUCT OF TEST

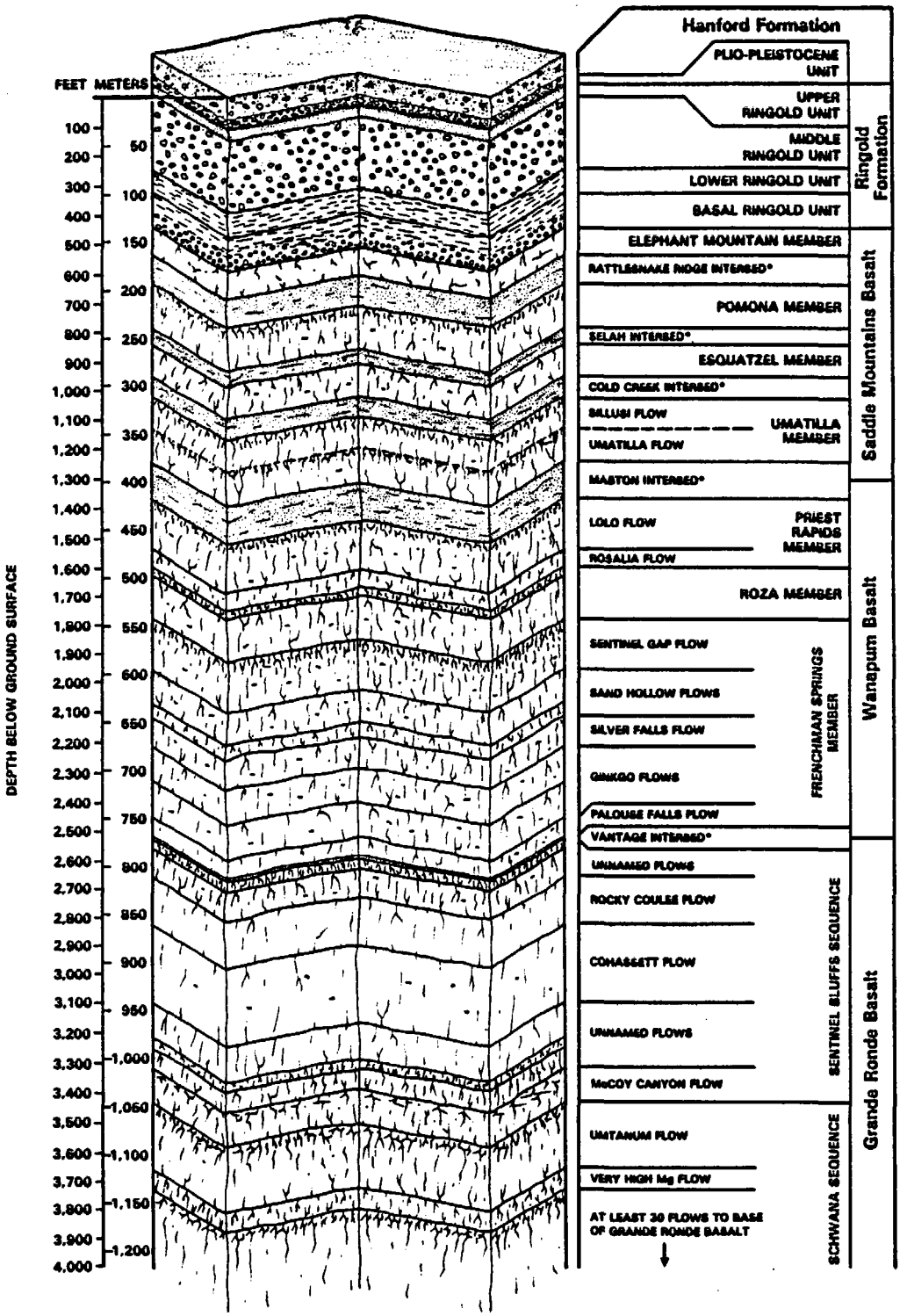
LOCATION MAP



PRINCIPAL FOLD STRUCTURES OF THE PASCO BASIN



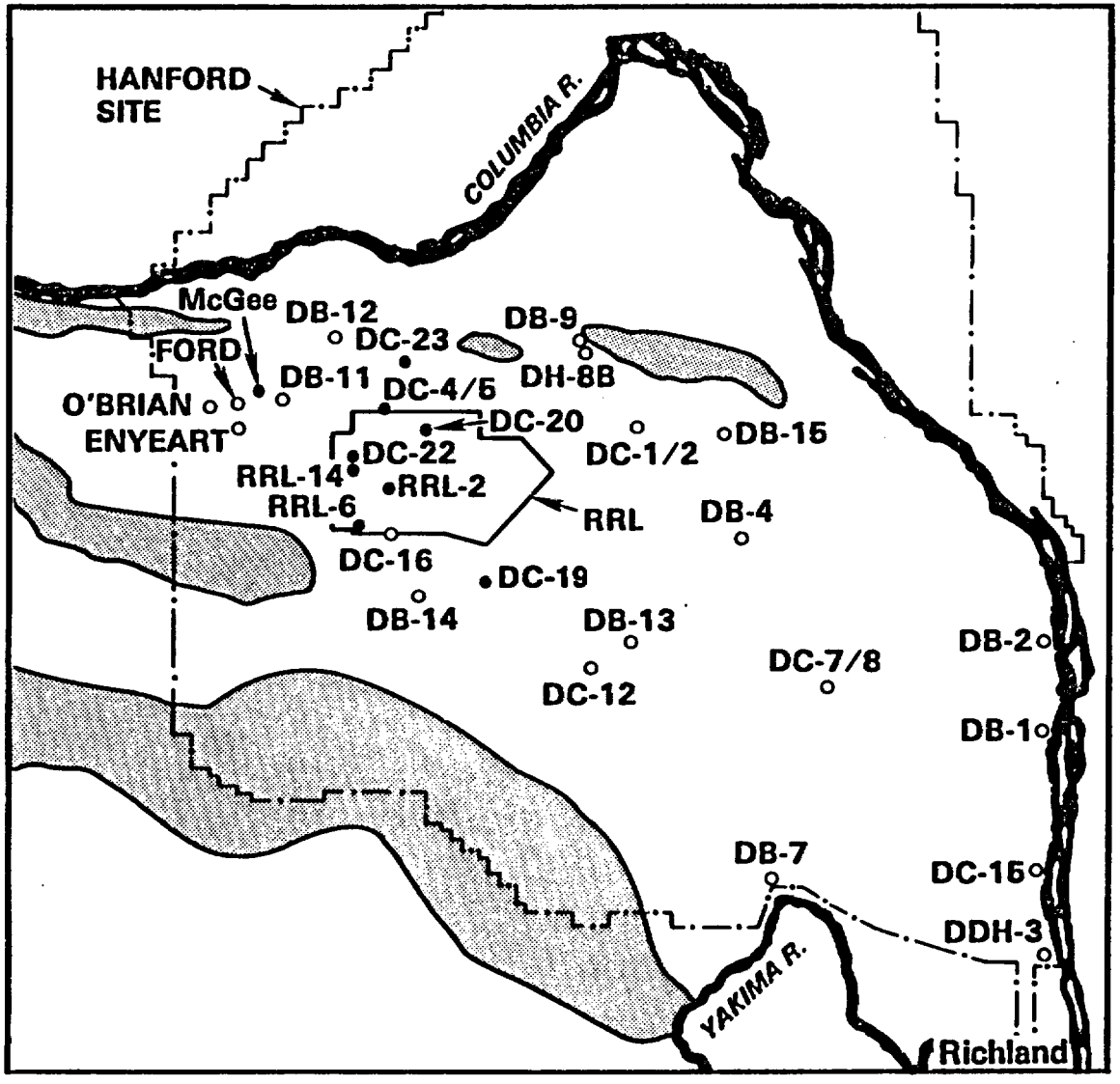
REFERENCE REPOSITORY LOCATION STRATIGRAPHY



*INTERBEDS ARE STRATIGRAPHICALLY CONTAINED IN THE ELLENSBURG FORMATION

RCP8207-4K

HANFORD SITE MAP



RRL = REFERENCE REPOSITORY LOCATION

BASALT OUTCROP

● PRINCIPAL MONITORING SITE

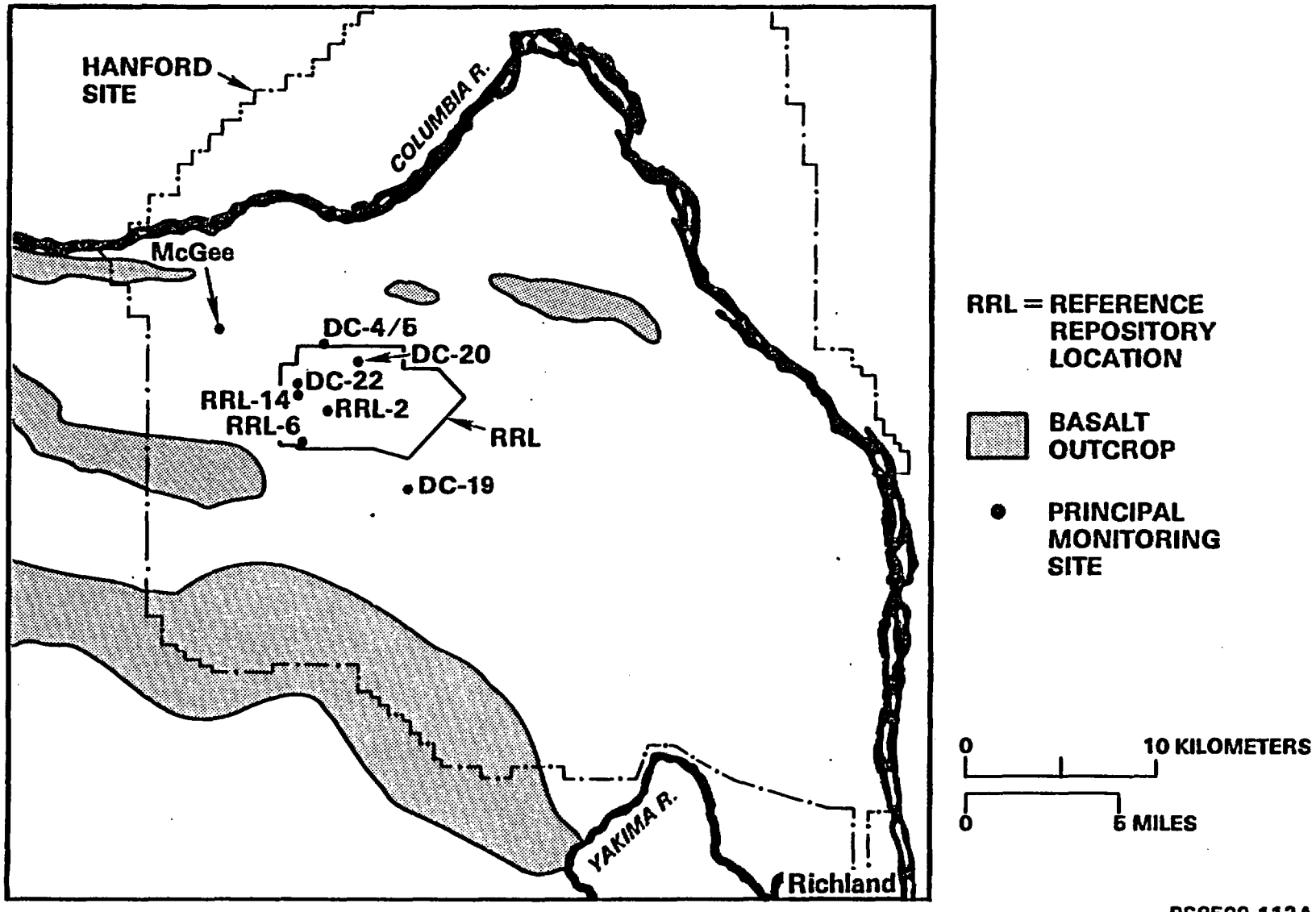
○ OTHER MONITORING SITE

0 — 10 KILOMETERS

0 — 5 MILES

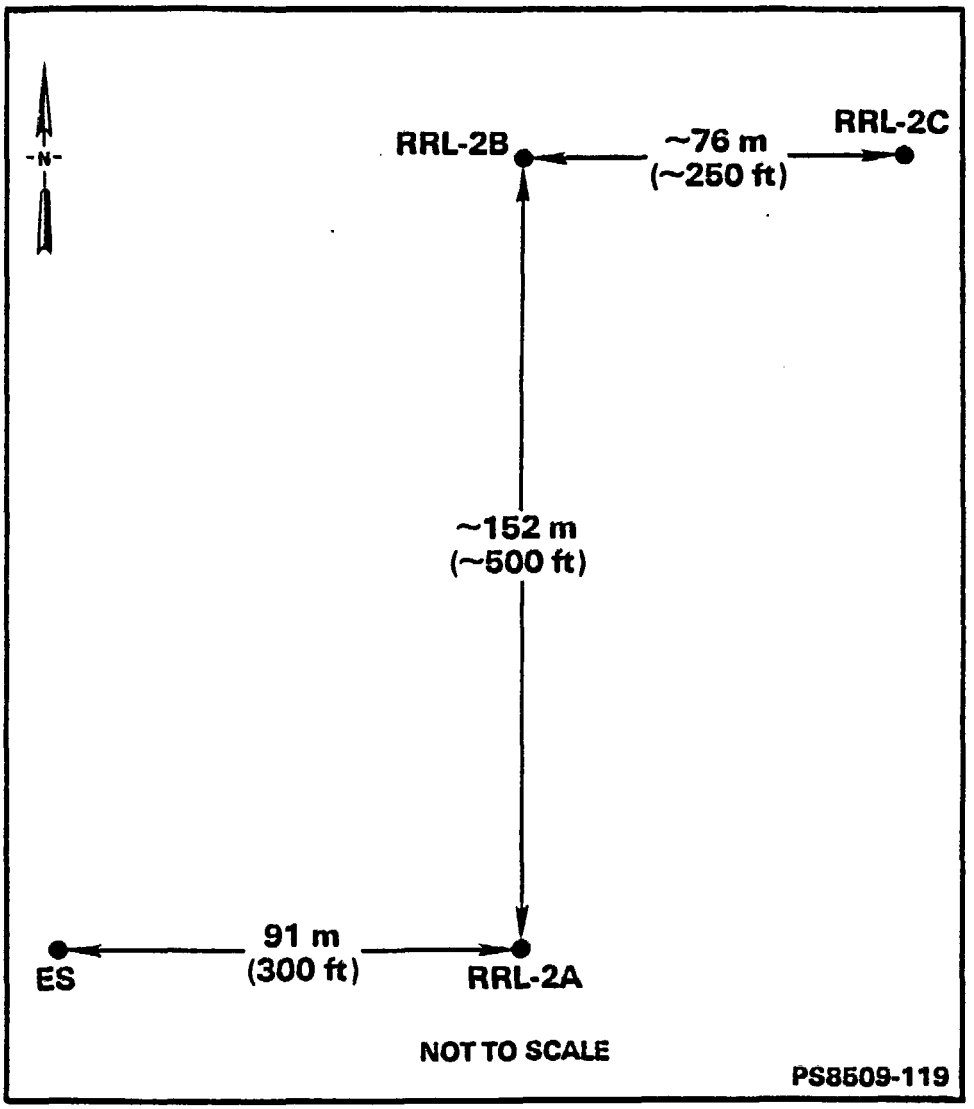
PS8509-112

HANFORD SITE MAP

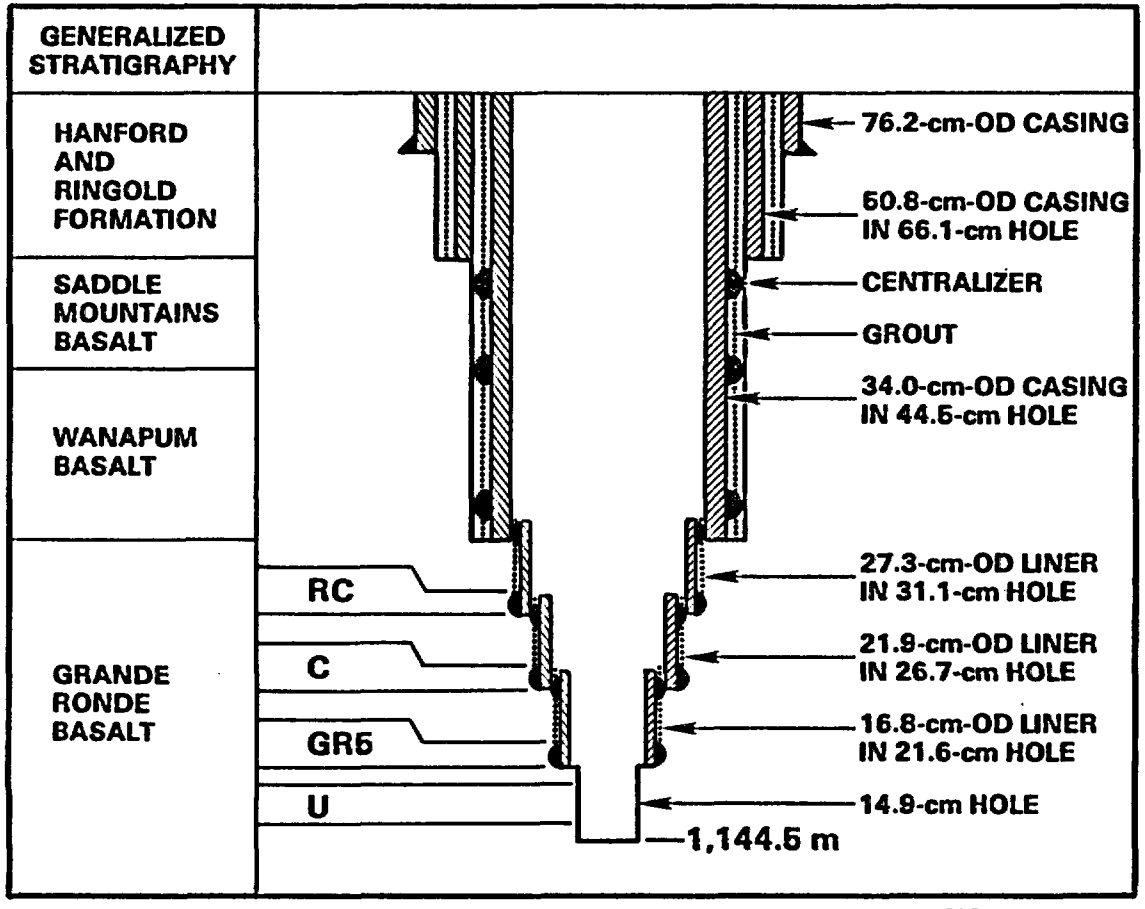


PS8509-112A

PLAN VIEW OF THE RRL-2 SITE



DESIGN OF WELL RRL-2B



RC = ROCKY COULEE FLOW TOP

C = COHASSETT FLOW TOP

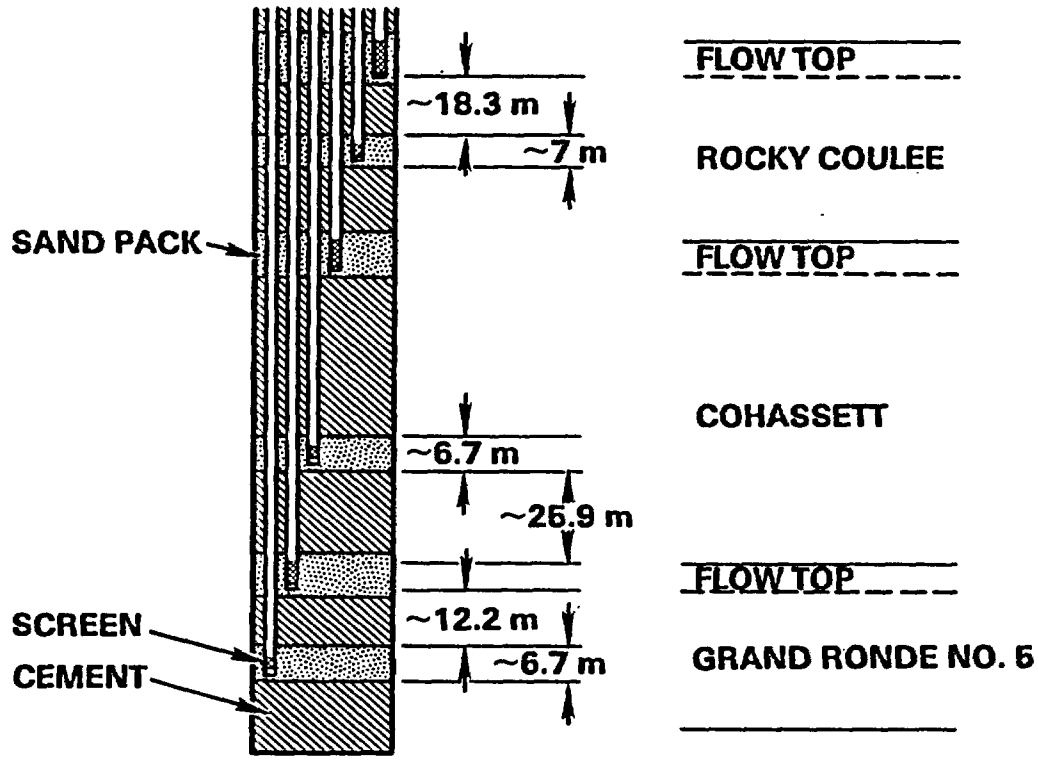
GR5 = GRANDE RONDE NO. 5 FLOW TOP

U = UMTANUM FLOW TOP

NOT TO SCALE

PS8509-115

PIEZOMETER COMPLETIONS IN WELL RRL-2C



PS8509-116

OBJECTIVES FOR LARGE-SCALE HYDRAULIC STRESS TESTING AT THE RRL-2 SITE

- FACILITATE THE DESIGN OF SUBSEQUENT LARGE-SCALE HYDRAULIC STRESS TESTS
- ASSESS TRANSMISSIVITY (T) AND STORATIVITY NEAR THE RRL-2 SITE FOR INPUT INTO EXPLORATORY SHAFT CONSTRUCTION AND OPERATION
- EVALUATE THE VERTICAL HYDRAULIC CONDUCTIVITY OF DENSE FLOW INTERIORS USING ANALYTICAL AND PARAMETER VARIATION TECHNIQUES
- ASSESS THE DEGREE OF LEAKAGE INTO THE TEST INTERFLOW ZONE FROM ADJACENT FLOW INTERIORS
- EVALUATE THE LATERAL HYDRAULIC CONDUCTIVITY AND STORATIVITY OF INTERFLOW ZONES

OBJECTIVES FOR LARGE-SCALE HYDRAULIC STRESS TESTING AT THE RRL-2 SITE (CONT.)

- EVALUATE EFFECTIVE POROSITY AND LONGITUDINAL DISPERSIVITY OF INTERFLOW ZONES USING RADIAL CONVERGENT TRACER TESTS CONCURRENT WITH THE PUMPING TEST
- ASSESS THE AREAL REPRESENTATIVENESS OF PARAMETER VALUES OBTAINED BY PREVIOUS SINGLE-WELL TESTS
- EVALUATE THE CHEMICAL CHARACTERISTICS OF GRANDE RONDE BASALT GROUNDWATER
- EVALUATE THE HYDRAULIC CONTINUITY OF INTERFLOW ZONES
- IDENTIFY AND CLASSIFY HYDRAULIC BOUNDARIES

PURPOSE

1) INCREASE THE LIKELIHOOD THAT ALL OF THE TEST (EXPERIMENT) OBJECTIVES WILL BE ACCOMPLISHED AND
2) RECOGNIZE THE NATURE AND EXTENT OF POTENTIAL NEGATIVE EFFECTS OF TESTING ON OTHER SITE CHARACTERIZATION ACTIVITIES (e.g., DELAY IN OBTAINING SYNCHRONOUS HEAD MEASUREMENTS)

APPROACH TO HYDRAULIC DESIGN

- SIMULATIONS WITH NUMERICAL MODELS
  - QUASI 3-DIMENSIONAL, FINITE DIFFERENCE
  - AXISYMMETRICAL, FINITE ELEMENT
- ANALYTICAL ESTIMATES

APPLICATION

- A 3-DIMENSIONAL MODEL WAS USED TO ESTIMATE THE AREAL RESPONSE IN THE PUMPED (ROCKY COULEE INTERFLOW ZONE ONLY) AND ADJACENT INTERFLOW ZONES
- AN AXISYMMETRICAL MODEL WAS USED TO ESTIMATE RESPONSES IN BOTH INTERFLOW ZONES AND INTERVENING DENSE INTERIORS
- THEIS SOLUTION AND RATIO METHOD (NEUMAN AND WITHERSPOON 1969) USED TO PROVIDE UPDATED (BASED ON DRILLING/DEVELOPMENT INFORMATION AND ACTUAL PIEZOMETER CONSTRUCTION DIMENSIONS) ESTIMATES OF RESPONSE IN INTERFLOW ZONES AND ADJACENT DENSE INTERIORS AT THE RRL-2 SITE

CONCEPTUAL MODELS

- SEVERAL WERE CONSIDERED; THE PRIMARY DIFFERENCE WAS THE DEGREE OF COMPLEXITY
  - THE MOST COMPLEX INCLUDE HETEROGENEITIES AND ASSUMED BOUNDARY CONDITIONS BASED ON GEOLOGIC STRUCTURE
  - THE SIMPLIFIED VERSION THAT WAS ADOPTED INCORPORATES THE ASSUMPTIONS OF HOMOGENEOUS AND ISOTROPIC HYDRAULIC PROPERTY DISTRIBUTION. THIS IS BELIEVED TO BE MORE COMMENSURATE WITH AVAILABLE DATA

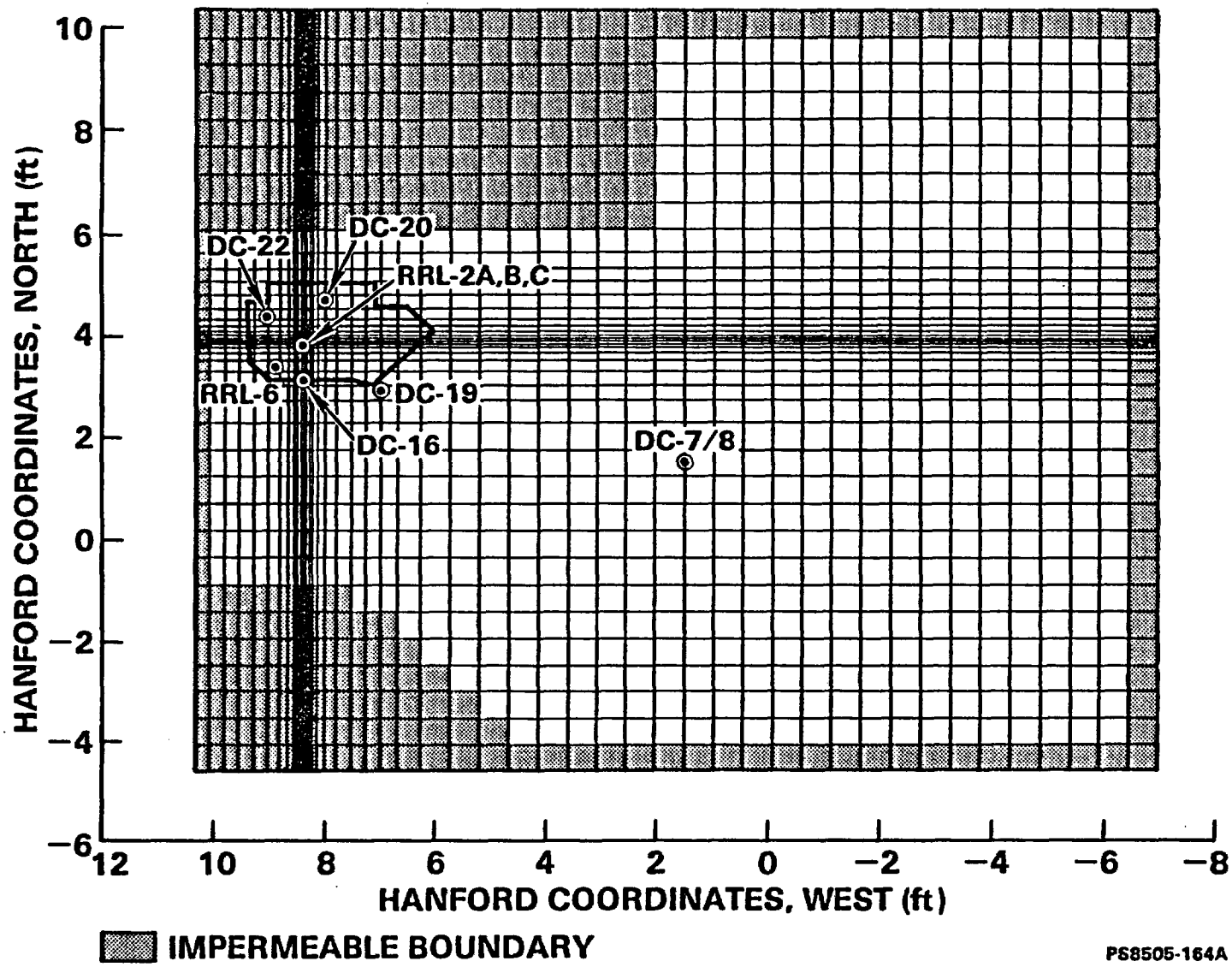
THREE-DIMENSIONAL MODEL

- AREAL BOUNDARY CONDITIONS
  - NO-FLOW BOUNDARIES CORRESPOND TO:
    UMTANUM RIDGE TO THE NORTH,
    RATTLESNAKE RIDGE TO THE SOUTH, AND
    "YAKIMA BARRICADE BARRIER" TO THE WEST
  - EFFECTIVELY AN INFINITE BOUNDARY TO THE EAST
- VERTICAL BOUNDARY CONDITIONS--TWO CASES
  - THREE-LAYER WITH NO-FLOW VERTICAL BOUNDARY
  - FIVE-LAYER WITH OUTERMOST LAYERS SET TO CONSTANT HEAD

MODEL SET-UP

- 44 ROWS x 50 COLUMNS
- VARIABLE GRID SPACING FROM 183 ft TO 1 mi
- TOTAL AREA OF 32 x 28 = 896 mi^2

QUASI-3 DIMENSIONAL MODEL WITH WELL LOCATIONS AND BOUNDARY CONDITIONS



PS8505-164A

HYDRAULIC PARAMETERS

- ASSUME S = 10^{-5} FOR ALL LAYERS
- THREE VALUES OF TRANSMISSIVITY OF THE ROCKY COULEE FLOW TOP ARE CONSIDERED:
  - 2.6 ft^2/d GEOMETRIC MEAN OF SINGLE-WELL TEST VALUES (0.24 m^2/d)
  - 54 ft^2/d GEOMETRIC MEAN PLUS ONE STANDARD DEVIATION (5.0 m^2/d)
  - 0.124 ft^2/d GEOMETRIC MEAN MINUS ONE STANDARD DEVIATION (0.01 m^2/d)
- ASSUME T = 0.22 ft^2/d (0.02 m^2/d) FOR THE ADJACENT FLOW TOPS (GRANDE RONDE-2 AND COHASSETT). THIS IS THE GEOMETRIC MEAN VALUE OF THE RESULTS OF SINGLE-WELL TESTS IN THE COHASSETT FLOW TOP

TRANSMISSIVITY ESTIMATED FROM SMALL-SCALE TESTS AND THEIR DERIVED PARAMETERS

	WELL	TRANSMISSIVITY[a]	X = ln T	$X_m = \frac{\sum_{i=1}^{n} X_i}{n}$	$\sigma_x = \left(\frac{\sum_{i=1}^{n} (X_i - X_m)}{n-1}\right)^2$	GEOMETRIC MEAN[b] $T_m = e^{X_m}$
ROCKY COULEE FLOW TOP	RRL-2A DC-19C DC-22C DC-12	10 0.5 0.1 90	2.30 −0.69 −2.30 4.50	N = 4 0.95	3.0	2.6 (0.24)
COHASSETT FLOW TOP	DC-16A DC-4 RRL-14 RRL-2 RRL-6	2.8 0.12 5 0.042 0.005	1.03 −2.12 1.61 −3.17 −5.30	N = 5 −1.59	4.2	0.21 (0.02)
COHASSETT FLOW BOTTOM	DC-16A RRL-14 RRL-2 RRL-6	0.05 5 830 0.05	−3.00 1.61 6.72 −3.00	N = 4 0.59	3.6	1.8 (0.17)
UMTANUM FLOW TOP	DC-19 DC-6 RRL-2 DC-15 DC-16A RRL-6 RRL-14 DC-20C	50 10 480 25 50 0.5 5 0.5	3.91 2.30 6.17 3.22 3.91 −0.69 1.61 −0.69	N = 8 2.47	2.7	11.8 (1.1)
GRANDE RONDE FLOW TOPS				N = 21 0.85	3.3	2.35 (0.22)

[a] Values in ft^2/d. [b] Values in ft^2/d (m^2/d).

PARAMETER VALUES USED IN SIMULATED PUMPING TEST OF ROCKY COULEE FLOW TOP

VALUE	SYMBOL	CASE 1 (3 LAYER)	CASE 2 (3 LAYER)	CASE 3 (3 LAYER)	CASE 4 (5 LAYER)	CASE 5 (5 LAYER)	CASE 56 (5 LAYER)
TRANSMISSIVITY IN ROCKY COULEE FLOW TOP (ft^2/d)	T2	2.6	54	0.124	2.6	54	0.124
TRANSMISSIVITY IN GRANDE RONDE-2 AND COHASSETT FLOW TOP (ft^2/d)	T1, T3	0.22	0.22	0.22	0.22	0.22	0.22
STORAGE COEFFICIENTS	S1, S2, S3	10^{-5}	10^{-5}	10^{-5}	10^{-5}	10^{-5}	10^{-5}
VERTICAL CONDUCTIVITY	K'_v	10^{-5}	10^{-5}	10^{-5}	10^{-5}	10^{-5}	10^{-5}
INTER-AQUIFER TRANSFER COEFFICIENT (TCF)	TCF_{01}, TCF_{12}, TCF_{23}, TCF_{34}	-- 8×10^{-8} 1.3×10^{-7} --	-- 8×10^{-8} 1.3×10^{-7} --	-- 8×10^{-8} 1.3×10^{-7} --	8×10^{-8} 8×10^{-8} 1.3×10^{-7} 1.3×10^{-7}	8×10^{-8} 8×10^{-8} 1.3×10^{-7} 1.3×10^{-7}	8×10^{-8} 8×10^{-8} 1.3×10^{-7} 1.3×10^{-7}
PUMPING RATE (gal/min)	Q	8	40	0.5	8	40	0.5
TOTAL DRAWDOWN AT PUMPING WELL AFTER 50 days (ft)	s	864.4	244.3	934.1	864.4	244.3	934.1

DRAWDOWN AT VARIOUS PARAMETER VALUES AFTER 50 DAYS OF PUMPING, 3-LAYER ASSUMPTION

DRAW-DOWN (d)	WELLS	CASE 1 T = 2.6 ft²/d Q = 8 gal/min				CASE 2 T = 54 ft²/d Q = 40 gal/min				CASE 3 T = 0.124 ft²/d Q = 0.5 gal/min			
		RRL-2C	DC-20	DC-19	DC-22	RRL-2C	DC-20	DC-19	DC-22	RRL-2C	DC-20	DC-19	DC-22
10	CHFT	7.524	.001	0.0	.001	4.27	.294	.044	.372	1.60	0.0	0.0	0.0
	RCFT	154.21	.012	0.0	.043	71.66	7.28	1.45	8.88	38.77	0.0	0.0	0.0
	GR-2	12.27	.001	0.0	.002	6.94	.480	.072	.608	2.62	0.0	0.0	0.0
20	CHFT	15.77	.008	0.0	.02	8.54	1.05	.258	1.28	4.04	.001	0.0	0.0
	RCFT	180.62	.183	.001	.446	78.21	12.0	3.83	14.41	63.82	0.0	0.0	0.0
	GR-2	25.26	.013	0.0	.033	13.59	1.69	.416	2.06	6.52	.001	0.0	.001
30	CHFT	23.36	.043	.001	.094	12.48	2.03	.615	2.46	6.37	.001	0.0	.001
	RCFT	194.05	.647	.003	1.28	81.82	14.8	5.65	17.95	77.93	.001	0.0	.001
	GR-2	36.78	.069	.001	.150	19.48	3.19	.975	3.87	10.17	.001	0.0	.001
50	CHFT	36.64	.267	.003	.478	19.51	4.24	1.58	5.15	10.44	.001	0.0	.001
	RCFT	209.04	2.11	.027	3.45	86.32	18.47	8.20	22.53	93.25	.001	.001	.001
	GR-2	55.89	.416	.004	.745	29.32	6.42	2.42	7.80	16.30	.001	.001	.001
110	CHFT	23.34	1.69	.076	2.40	12.90	5.73	3.05	7.01	6.81	.003	.002	.005
	RCFT	16.72	3.80	.317	4.8	5.98	4.99	3.75	6.08	13.01	.003	.002	.004
	GR-2	28.99	2.38	.112	3.32	15.24	7.21	4.0	8.83	9.25	.003	.002	.005

NOTE: Assumes no storage in dense interior. This allows for an immediate response whereas the effects of storage will create a lag in the response.

CHFT = Cohassett flow top.
RCFT = Rocky Coulee flow top.
GR-2 = Grande Ronde flow #2.

DRAWDOWN AT VARIOUS PARAMETER VALUES AFTER 50 DAYS OF PUMPING, 5-LAYER ASSUMPTION

DRAW-DOWN (d)	WELLS	CASE 4 T = 2.6 ft²/d Q = 8 gal/min				CASE 5 T = 54 ft²/d Q = 40 gal/min				CASE 6 T = 0.124 ft²/d Q = 0.5 gal/min			
		RRL-2C	DC-20	DC-19	DC-22	RRL-2C	DC-20	DC-19	DC-22	RRL-2C	DC-20	DC-19	DC-22
10	CHFT	7.28	0.0	0.0	.001	4.11	.286	.043	.362	1.56	0.0	0.0	0.0
	RCFT	154.19	.012	0.0	.043	71.66	7.28	1.45	8.88	38.77	0.0	0.0	0.0
	GR-2	11.64	.001	0.0	.002	6.54	.459	.069	.580	2.51	0.0	0.0	0.0
20	CHFT	14.86	.008	.001	.002	7.98	.997	.247	1.21	3.85	.001	0.0	.001
	RCFT	180.51	.183	.001	.445	78.18	12.0	3.82	14.40	63.78	.001	0.0	.001
	GR-2	22.97	.014	.001	.033	12.19	1.55	.389	1.88	6.05	.001	0.0	.001
30	CHFT	21.46	.042	.002	.091	11.32	1.86	.575	2.26	5.97	.001	0.0	.001
	RCFT	193.74	.646	.003	1.28	81.72	14.8	5.63	17.89	77.81	.001	0.0	.001
	GR-2	32.16	.071	.003	.145	16.71	2.81	.881	3.39	9.18	.001	.001	.001
50	CHFT	32.05	.251	.007	.440	16.75	3.69	1.40	4.48	9.35	.002	.001	.002
	RCFT	207.94	2.09	.029	3.42	85.97	18.26	8.10	22.28	91.22	.001	.001	.002
	GR-2	45.57	.391	.018	.667	22.28	5.24	2.05	6.33	13.5	.004	.002	.003
110	CHFT	14.36	1.29	.097	1.77	7.64	3.73	2.14	4.50	4.72	.007	.005	.008
	RCFT	12.63	3.32	.325	4.12	4.60	.395	3.08	4.76	11.17	.007	.004	.007
	GR-2	14.29	1.67	.170	2.21	7.14	4.04	2.54	4.78	5.56	.013	.008	.013

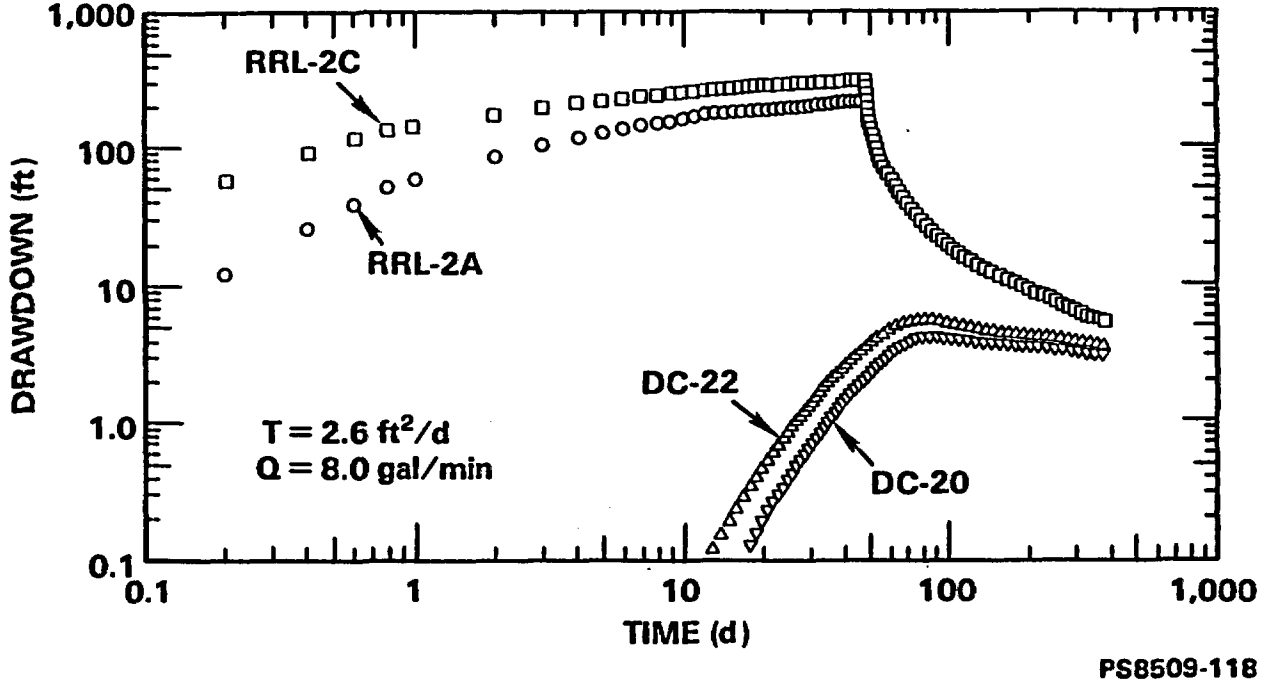
NOTE: Assumes no storage in dense interior. This allows for an immediate response whereas the effects of storage will create a lag in the response.

CHFT = Cohassett flow top.
RCFT = Rocky Coulee flow top.
GR-2 = Grande Ronde flow #2.

SIMULATION RESULTS FOR ROCKY COULEE TEST

- FOR T = 2.6 ft^2/d (0.24 m^2/d)
  - Q = 8 gal/min
  - s_w = 865 ft @ t = 30 d
  - MEASURABLE RESPONSE OCCURS AT DC-22 AND DC-20 (SEE s VERSUS t PLOT)
- FOR T = 0.124 ft^2/d (0.01 m^2/d)
  - Q = 0.5 gal/min
  - s_w = 934 ft @ t = 30 d
  - MEASURABLE RESPONSE AT THE RRL-2 SITE ONLY

SIMULATED RESPONSE TO PUMPING IN THE ROCKY COULEE FLOW TOP



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GENERAL CONCLUSIONS FROM 3-DIMENSIONAL SIMULATIONS

- VERTICAL BOUNDARY CONDITIONS
  - EFFECT ON RESPONSE IN PUMPED UNIT
    - VERY LITTLE EFFECT DURING PUMPING
    - MEASURABLE DIFFERENCE DURING RECOVERY
  - EFFECT ON RESPONSE IN ADJACENT FLOW TOPS
    - MEASURABLE DIFFERENCE IN RESPONSE DURING BOTH PUMPING AND RECOVERY
- TRANSMISSIVITY
  - IF T = GEOMETRIC MEAN (GM) = 2.6 ft^2/d, RESPONSE AT DC-20 AND DC-22 IS EXPECTED FOR A 30-d PUMPING PERIOD AT 8 gal/min
  - IF T = GM - 1 STANDARD DEVIATION (0.124 ft^2/d), RESPONSE IS EXPECTED ONLY IN VICINITY OF THE RRL-2 SITE (BASICALLY A THREE-WELL TEST) FOR A PUMPING PERIOD OF 30 d AND A RESULTANT DRAWDOWN IN RRL-2B OF ABOUT 930 ft

AXISYMMETRICAL SIMULATIONS

AXISYMMETRICAL MODEL

- THE SYSTEM MODELED CONSISTS OF ALTERNATING DENSE INTERIOR AND INTERFLOW ZONES OF THE GRANDE RONDE BASALT
- THE MESH EXTENDS TO A DISTANCE OF 46,000 ft; THUS, WITH THE TEST CASES CONSIDERED, AN AREALLY INFINITE HYDROGEOLOGIC SYSTEM IS SIMULATED
- THE MESH IS VERY FINE NEAR THE PUMPED WELL AND BECOMES COARSER WITH INCREASING DISTANCE FROM THE WELL
- A 773-ft-VERTICAL PROFILE IS REPRESENTED BY THE MODEL
- THE UPPER AND LOWER BOUNDARIES OF THE MODEL ARE TREATED AS CONSTANT HEAD
- A TOTAL OF 1,036 NODES AND 972 ELEMENTS WERE UTILIZED

HYDRAULIC PARAMETERS

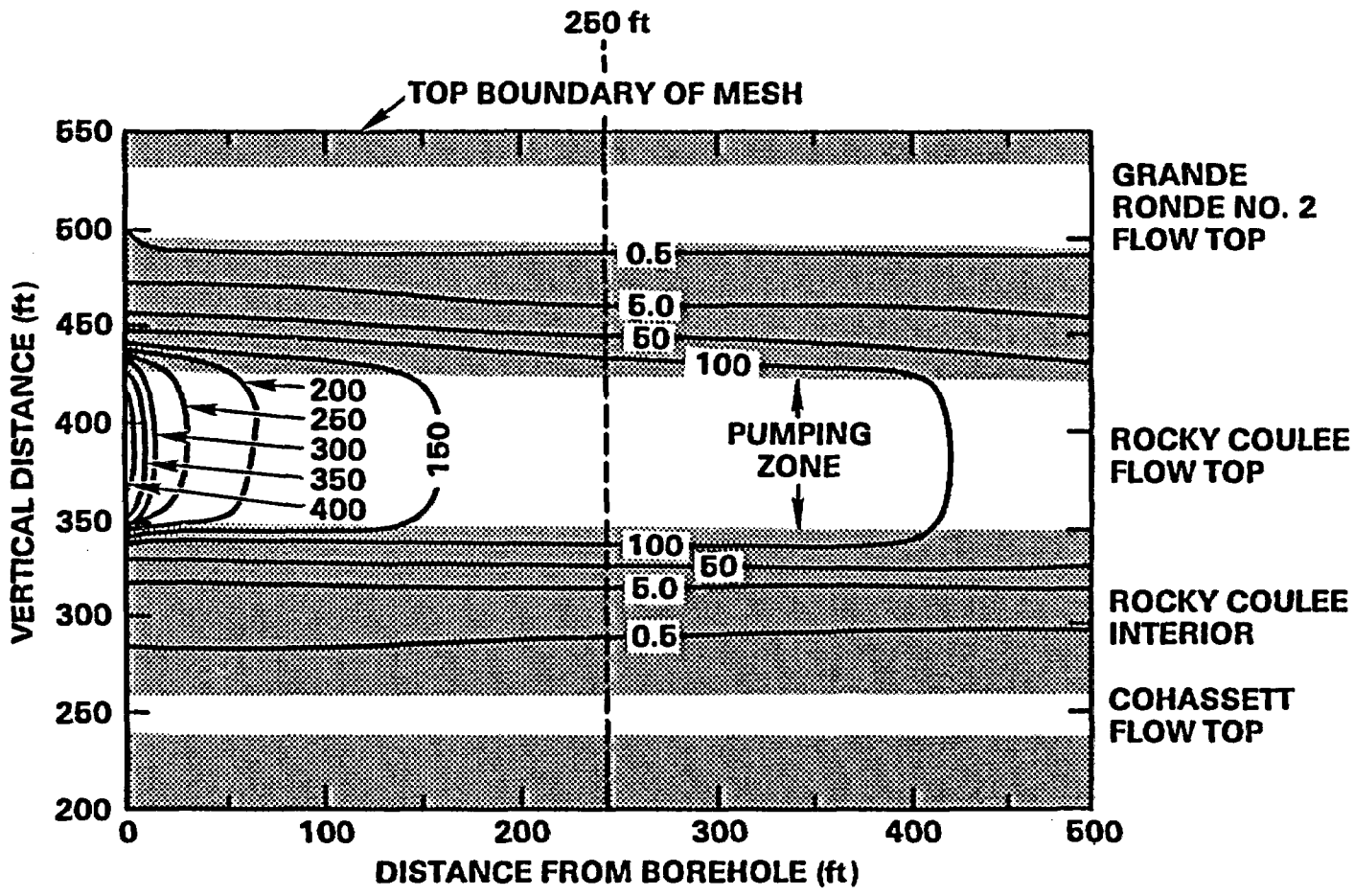
- CASE 1 - TRANSMISSIVITY BASED ON SINGLE-WELL TEST RESULTS FROM TESTS IN RRL-2A (SEE FOLLOWING TABLE)
- CASE 2 - TRANSMISSIVITY (OF FLOW TOPS) BASED ON GEOMETRIC MEAN OF THE SINGLE-WELL TEST VALUES. SAME UNIT THICKNESSES AS CASE 1, WHICH IS BASED ON RRL-2A
- ASSUMPTIONS FOR BOTH CASES:
  - FOR FLOW TOPS, $K'_v = K_h$, $S_s = 3.1 \times 10^{-7}$ ft^{-1}
  - FOR DENSE INTERIORS, $K'_v = 10K_h$, $S_s = 1.1 \times 10^{-7}$ ft^{-1}
- THREE VALUES OF α' (= K'_v/S'_s) WERE CONSIDERED FOR CASE 1:
  - 91 ft^2/d
  - 910 ft^2/d
  - 9.1 ft^2/d
- ONE VALUE OF α' WAS USED FOR CASE 2:
  - 91 ft^2/d

MODEL GEOMETRY AND BASE CASE PARAMETERS
(UNIT THICKNESS AND K_h FROM SD-BWI-TI-113, TABLE 1)

UNIT	TOP OF UNIT DEPTH (ft)	THICKNESS (ft)	K_h (ft/d)	K_v (ft/d)	S_s (/ft)	COMMENTS
VANTAGE	2,683	4				NOT INCLUDED IN MESH
GR-1 FT	2,687	15	UPPER BOUNDARY			TREAT AS CONSTANT HEAD
GR-1 D	2,702	19	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-2 FT	2,721	40	2.5×10^{-3}	2.5×10^{-3}	3.1×10^{-7}	
GR-2 D	2,761	62	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-3 FT (ROCKY COULEE)	2,823	82	1.2×10^{-1}	1.2×10^{-1}	3.1×10^{-7}	
GR-3 D (ROCKY COULEE)	2,905	88	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-4 FT (COHASSETT)	2,993	17	2.5×10^{-3}	2.5×10^{-3}	3.1×10^{-7}	
GR-4 D (COHASSETT)	3,010	73	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-4 VES (COHASSETT)	3,083	24	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-4 D (COHASSETT)	3,107	148	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-5 FT	3,255	80	1.0×10^{-1}	1.0×10^{-1}	3.1×10^{-7}	
GR-5 D	3,335	53	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-6 FT	3,388	9	1.2×10^{-1}	1.2×10^{-1}	3.1×10^{-7}	
GR-6 D	3,397	21	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-7 FT	3,418	24	1.2×10^{-1}	1.2×10^{-1}	3.1×10^{-7}	
GR-7 D	3,442	33	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-8 FT	3,475	21	LOWER BOUNDARY			TREAT AS CONSTANT HEAD

GR = GRANDE RONDE
FT = FLOW TOP
D = DENSE INTERIOR
VES = VESICULAR.

SIMULATED RESPONSE IN VERTICAL SECTION BASE CASE WITH $\alpha = 9.1\ ft^2/d$



t = 10 d
Q = 17 gal/min
FLOW TOP TRANSMISSIVITY, T = 10 ft^2/d

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MODEL GEOMETRY AND BASE CASE GEOMETRIC MEAN PARAMETERS

UNIT	TOP OF UNIT DEPTH (ft)	THICKNESS (ft)	K_h (ft/d)	K_v (ft/d)	S_s (/ft)	COMMENTS
VANTAGE	2,683	4				NOT INCLUDED IN MESH
GR-1 FT	2,687	15	UPPER BOUNDARY			TREAT AS CONSTANT HEAD
GR-1 D	2,702	19	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-2 FT	2,721	40	1.3×10^{-2}	1.3×10^{-2}	3.1×10^{-7}	
GR-2 D	2,761	62	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-3 FT (ROCKY COULEE)	2,823	82	3.2×10^{-2}	3.2×10^{-2}	3.1×10^{-7}	
GR-3 D (ROCKY COULEE)	2,905	88	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-4 FT (COHASSETT)	2,993	17	1.3×10^{-2}	1.3×10^{-2}	3.1×10^{-7}	
GR-4 D (COHASSETT)	3,010	73	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-4 VES (COHASSETT)	3,083	24	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-4 D (COHASSETT)	3,107	148	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-5 FT	3,255	80	2.3×10^{-2}	2.3×10^{-2}	3.1×10^{-7}	
GR-5 D	3,335	53	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-6 FT	3,388	9	3.2×10^{-2}	3.2×10^{-2}	3.1×10^{-7}	
GR-6 D	3,397	21	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
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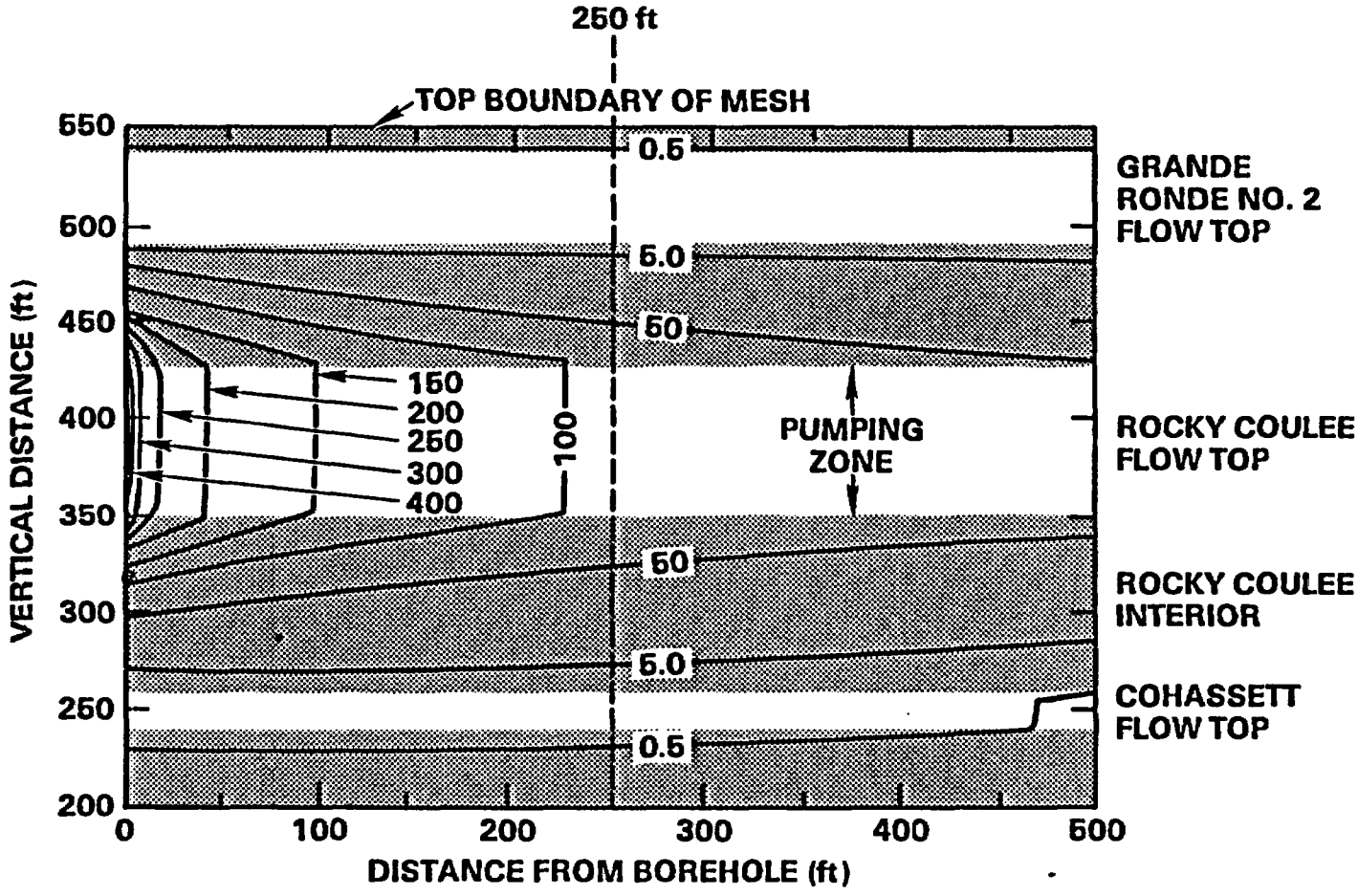
GR-7 D	3,442	33	1.0×10^{-6}	1.0×10^{-5}	1.1×10^{-7}	
GR-8 FT	3,475	21	LOWER BOUNDARY			TREAT AS CONSTANT HEAD

GR = GRANDE RONDE
FT = FLOW TOP
D = DENSE INTERIOR
VES = VESICULAR.

RESPONSE IN VERTICAL SECTION
GEOMETRIC MEAN CASE



t = 10 d
Q = 5 gal/min
FLOW TOP TRANSMISSIVITY, T = 2.6 ft^2/d
$\alpha' = 91\ ft^2/d$

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SUMMARY OF AXISYMMETRICAL MODEL SIMULATION RESULTS

- BASE CASE, T = 10 ft^2/d, PUMPING FROM THE ROCKY COULEE INTERFLOW
  - FOR r = 250 ft, t = 10 d, AND $\alpha' = 91$ AND 910 ft^2/d
    - PRESSURE RESPONSE @ z = 60 ft INTO ROCKY COULEE >50 ft
    - PRESSURE RESPONSE IN COHASSETT INTERFLOW ZONE >25 ft
  - FOR r = 250 ft, t = 10 d, AND $\alpha' = 9.1$ ft^2/d
    - PRESSURE RESPONSE @ z = 60 ft INTO ROCKY COULEE IS ~0.5 ft
    - PRESSURE RESPONSE IN COHASSETT INTERFLOW ZONE IS BELOW DETECTION
- GEOMETRIC MEAN, CASE 2, T = 2.6 ft^2/d, PUMPING FROM THE ROCKY COULEE INTERFLOW ZONE
  - FOR r = 250 ft, t = 10 d, AND $\alpha' = 91$ ft^2/d
    - PRESSURE RESPONSE @ z = 60 ft INTO ROCKY COULEE >25 ft
    - PRESSURE RESPONSE IN COHASSETT INTERFLOW ZONE >2 ft

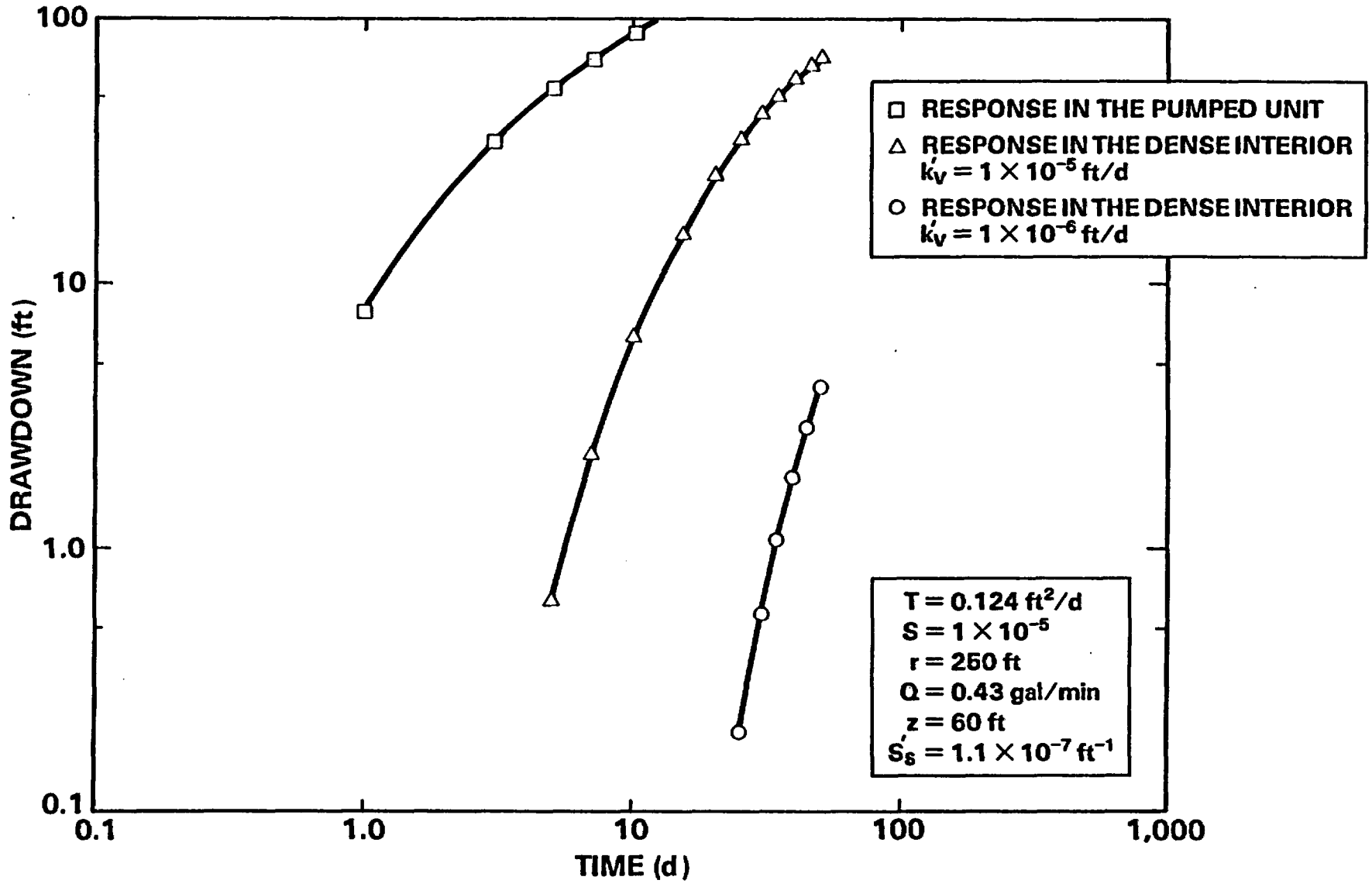
PURPOSE

- PROVIDE ESTIMATES OF DENSE INTERIOR RESPONSES USING ACTUAL "AS-BUILT" DIMENSIONS AND UPDATED ESTIMATES OF NEAR-FIELD TRANSMISSIVITY

RESPONSE IN ROCKY COULEE DENSE INTERIOR BASED ON RATIO METHOD

- THREE INTERFLOW ZONE TRANSMISSIVITIES WERE CONSIDERED
  - 0.124 ft^2/d
  - 1.45 ft^2/d
  - 2.6 ft^2/d
- TWO VALUES OF VERTICAL HYDRAULIC CONDUCTIVITY WERE CONSIDERED
  - 1×10^{-5} ft/d
  - 1×10^{-6} ft/d
- PUMPING RATES WERE SELECTED TO RESULT IN ABOUT 800 ft OF DRAWDOWN AT THE PUMPING WELL AFTER 30 d. THESE RATES CORRESPOND TO THE ABOVE T VALUES:
  - 0.43 gal/min
  - 4.5 gal/min
  - 8.0 gal/min

DRAWDOWN vs. TIME IN ROCKY COULEE FLOW TOP AND DENSE INTERIOR FOR Q = 0.43 gal/min



NOTE: SIMULATED WITH THE RATIO METHOD AND THEIS SOLUTIONS

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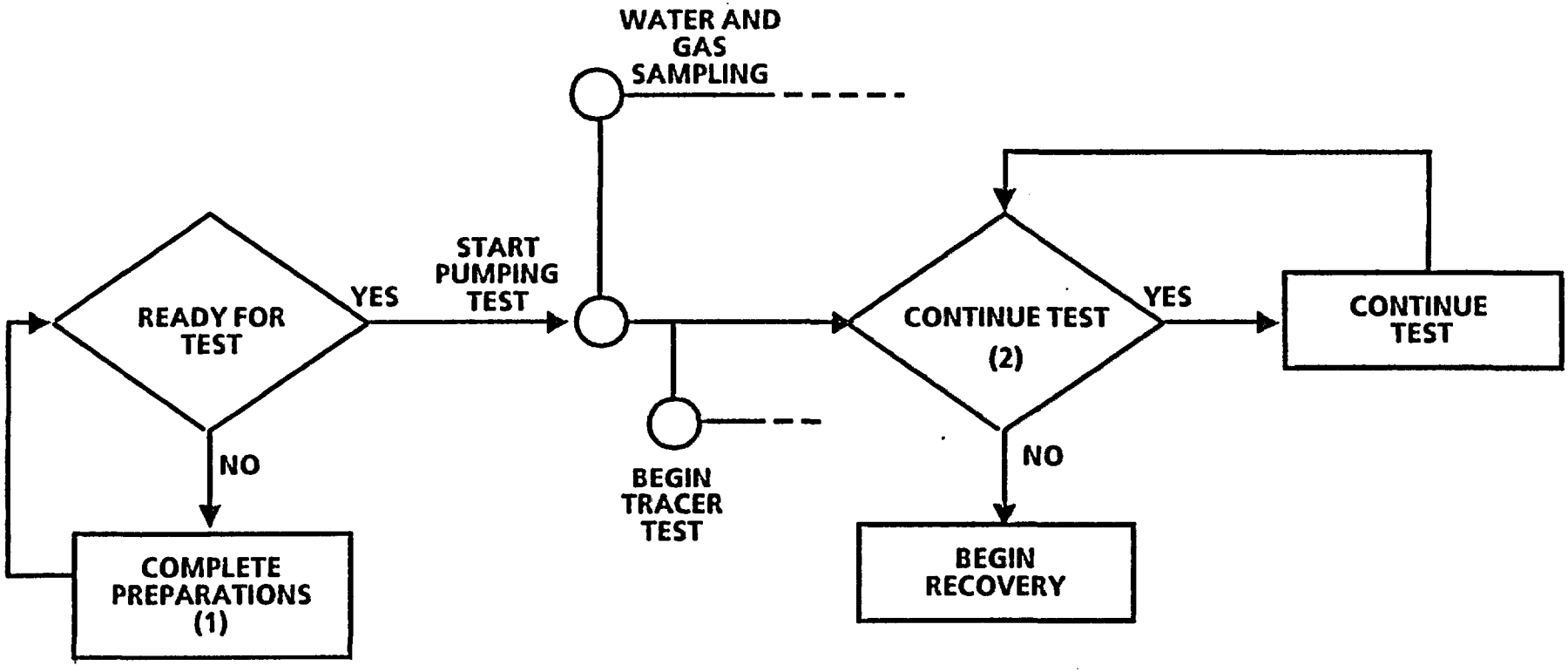
CONCLUSIONS

- LARGE-SCALE HYDRAULIC STRESS TEST OF THE ROCKY COULEE INTERFLOW
  - FOR THE THREE SCENARIOS CONSIDERED, A MEASURABLE RESPONSE OCCURS AT THE LOCATION OF THE PIEZOMETER (z = 60 ft) IN THE ROCKY COULEE DENSE INTERIOR WITHIN A PUMPING PERIOD OF 50 d

CONDUCT OF TEST

CONDUCT OF TEST



(1) ADMINISTRATIVE AND/OR TECHNICAL INCLUDING ADDITIONAL MONITORING

(2) SEE FOLLOWING GRAPHIC, <u>PROCESS FOR DECIDING WHEN TO STOP PUMPING</u>

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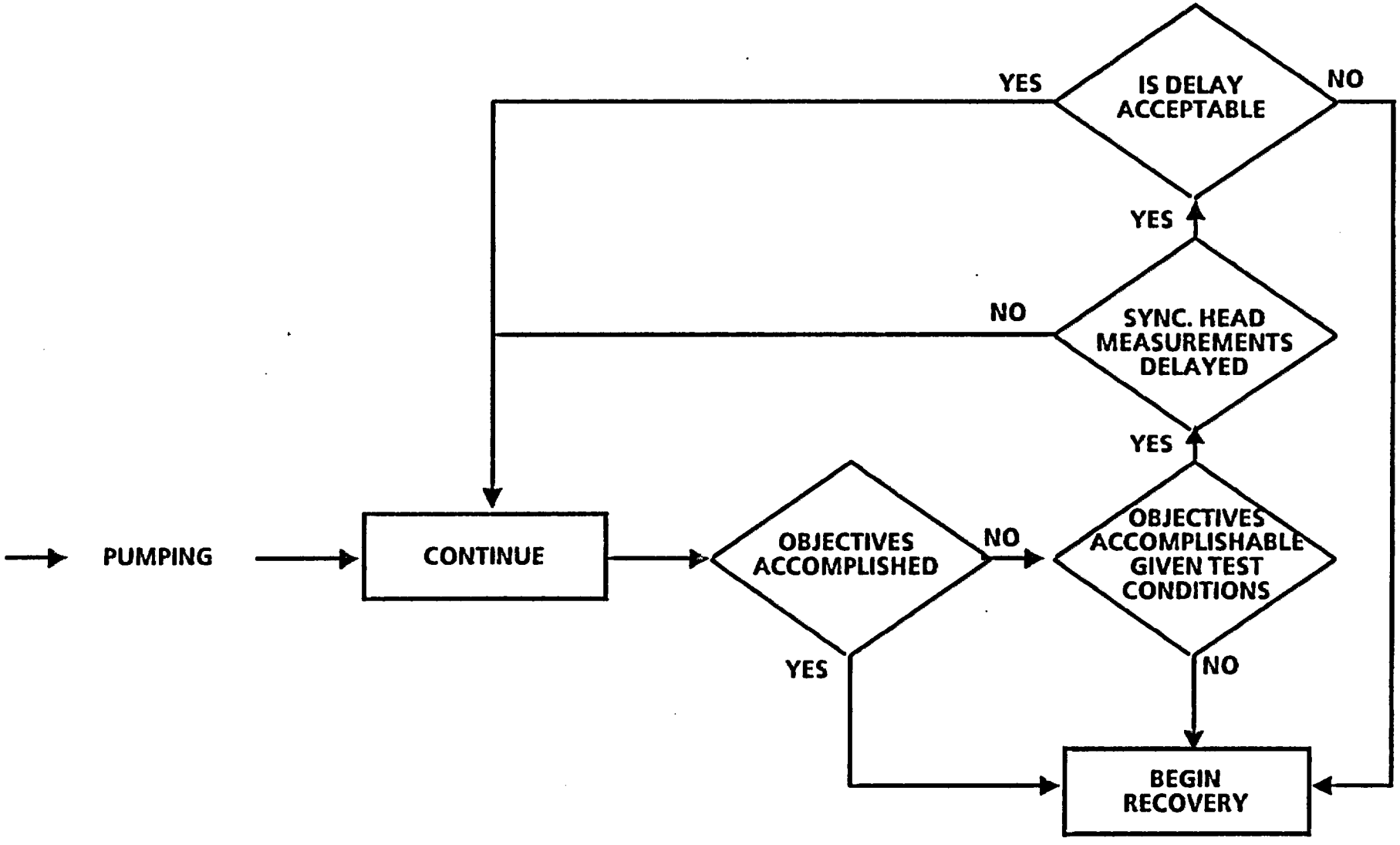
PROCESS FOR DECIDING WHEN TO STOP PUMPING



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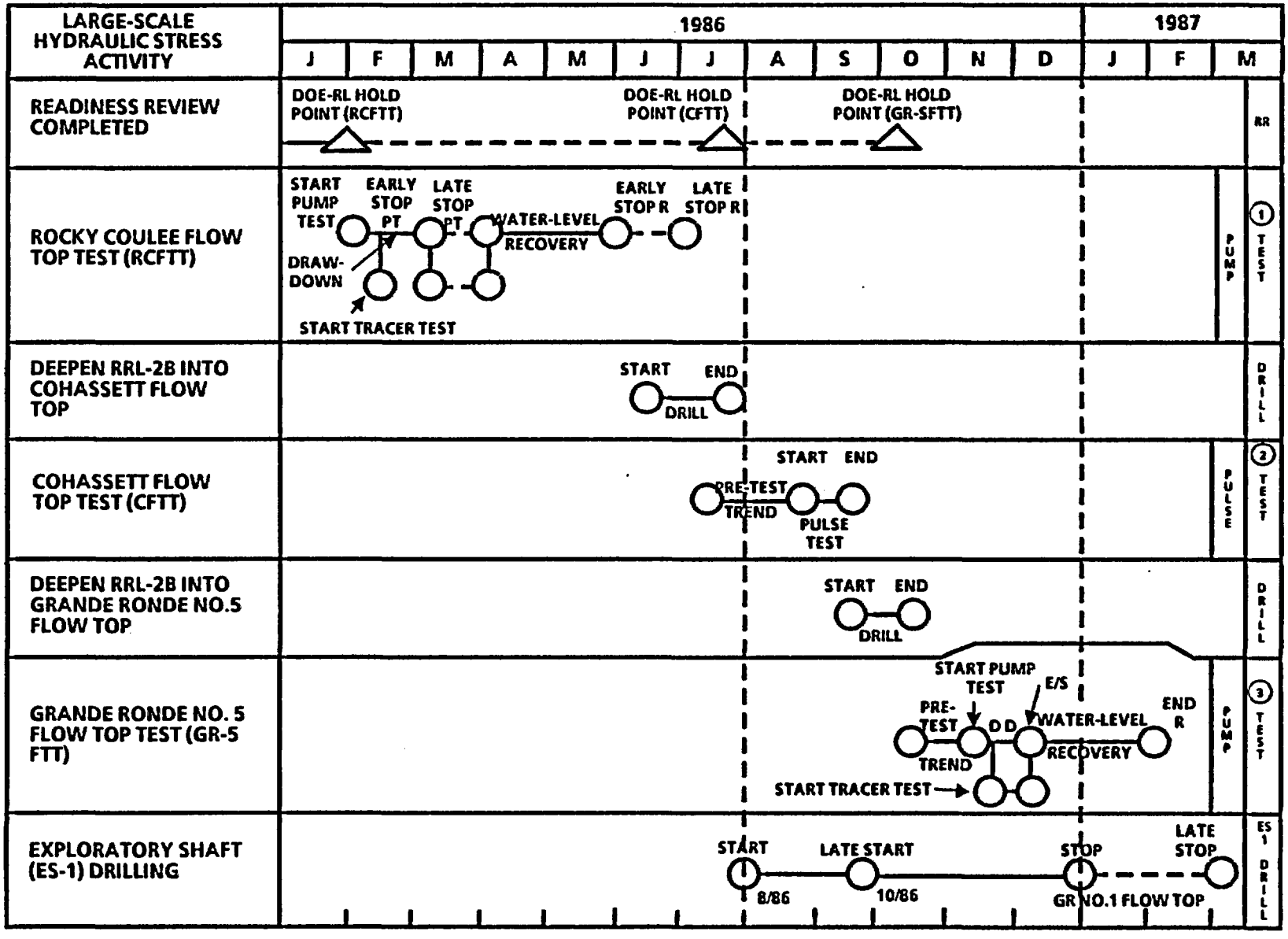
GENERAL CRITERIA FOR TEST TERMINATION

- ACCOMPLISH ALL TEST OBJECTIVES POSSIBLE
- ELIMINATE OR MINIMIZE PERTURBATION TO THE BASELINE DATA COLLECTION EFFORT

REQUIRED EVALUATIONS FOR TEST TERMINATION

- STATUS OF LARGE-SCALE HYDRAULIC STRESS TEST--WHICH OBJECTIVES HAVE BEEN ACCOMPLISHED AND WHICH ONES HAVE NOT?
- DRILLING SCHEDULE FOR ADDITIONAL MONITORING WELLS
- ESTIMATED RECOVERY (DUE TO LARGE-SCALE HYDRAULIC STRESS TEST) AT DC-19, DC-20, DC-22, AND RRL-2C

SCHEDULE FOR THREE LARGE-SCALE HYDRAULIC STRESS TESTS IN GRANDE RONDE FLOW TOPS AT RRL-2 SITE



P586-2018-29

CONVERGENT PULSE TRACER TEST DESIGN

RANDOLPH STONE

NRC/DOE MEETING
RICHLAND, WASHINGTON
DECEMBER 9, 1985

OBJECTIVES OF MULTIPLE WELL CONVERGENT PULSE TRACER TESTS:

1) PROVIDE MEANS TO ESTIMATE <u>EFFECTIVE POROSITY</u> OF FLOW TOPS AND OTHER INTERFLOW ZONES.

2) PROVIDE MEANS TO ESTIMATE <u>DISPERSIVITY</u> OF FLOW TOPS AND OTHER INTERFLOW ZONES.

THE VOLUME OF WATER PUMPED FROM A WELL DURING TIME T_0 IS

$$V = Qt_0 = \pi x^2 hn$$

WHERE

Q= PUMPED DISCHARGE RATE

H= THICKNESS OF THE PORTION OF FLOW TOP THAT CARRIES FLOW

X= DISTANCE BETWEEN INJECTION AND PUMPING WELL

N= EFFECTIVE POROSITY OF FLOW TOP

T_0= MEAN TRANSIT TIME OF TRACER PULSE FROM INJECTION TO PUMPED WELL.

KNOWLEDGE OF TRACER PULSE TRANSIT TIME PERMITS ESTIMATION OF FLOW TOP EFFECTIVE POROSITY.

AN EQUATION COMMONLY USED TO DESCRIBE THE UNIDIMENSIONAL TRANSPORT OF A NON-REACTIVE TRACER IN STEADY GROUND-WATER FLOW IS

$$\boxed{\frac{\partial c}{\partial t} = D\frac{\partial^2 c}{\partial x^2} - \bar{V}\frac{\partial c}{\partial x}}$$

WHERE

C= TRACER CONCENTRATION IN THE WATER

D= THE COEFFICIENT OF DISPERSION

V= MEAN INTERSTITIAL GROUND WATER FLOW SPEED

LENDA AND ZUBER (1970) SOLVED THE ABOVE, USING APPROPRIATE INITIAL AND BOUNDARY CONDITIONS, FOR THE TRACER CONCENTRATION IN WATER FROM A PUMPING WELL RESULTING FROM AN INSTANTANEOUS TRACER INJECTION INTO THE SAME HORIZON IN ANOTHER WELL.

THEIR APPROXIMATE SOLUTION IS GIVEN BY:

$$\boxed{\frac{cx^2hn}{m} = \frac{1}{\pi}\frac{1}{\sqrt{4\pi\frac{D}{\bar{V}x}\left(\frac{t}{t_0}\right)^3}}\exp\left[-\frac{(1-t/t_0)^2}{4\frac{D}{\bar{V}x}\frac{t}{t_0}}\right]}$$

WHERE

M= MASS OF INJECTED TRACER.

VARIOUS TRACER BREAKTHROUGH CURVES CAN BE DERIVED USING THE APPROXIMATE SOLUTION OF THE TRANSPORT EQUATION:

USING THE APPROXIMATE SOLUTION OF THE TRANSPORT EQUATION AND THE BREAKTHROUGH CURVES, IT IS POSSIBLE TO ESTIMATE THE QUANTITY OF TRACER MATERIAL THAT MUST BE INJECTED FOR A MEASUREABLE OUTPUT AT THE PUMPING WELL.

MUST HAVE ESTIMATES OF FLOW TOP

- DISPERSIVITY (α)
- EFFECTIVE THICKNESS (HN),

AS WELL AS WELL SPACING AND PUMPED WELL DISCHARGE RATE.

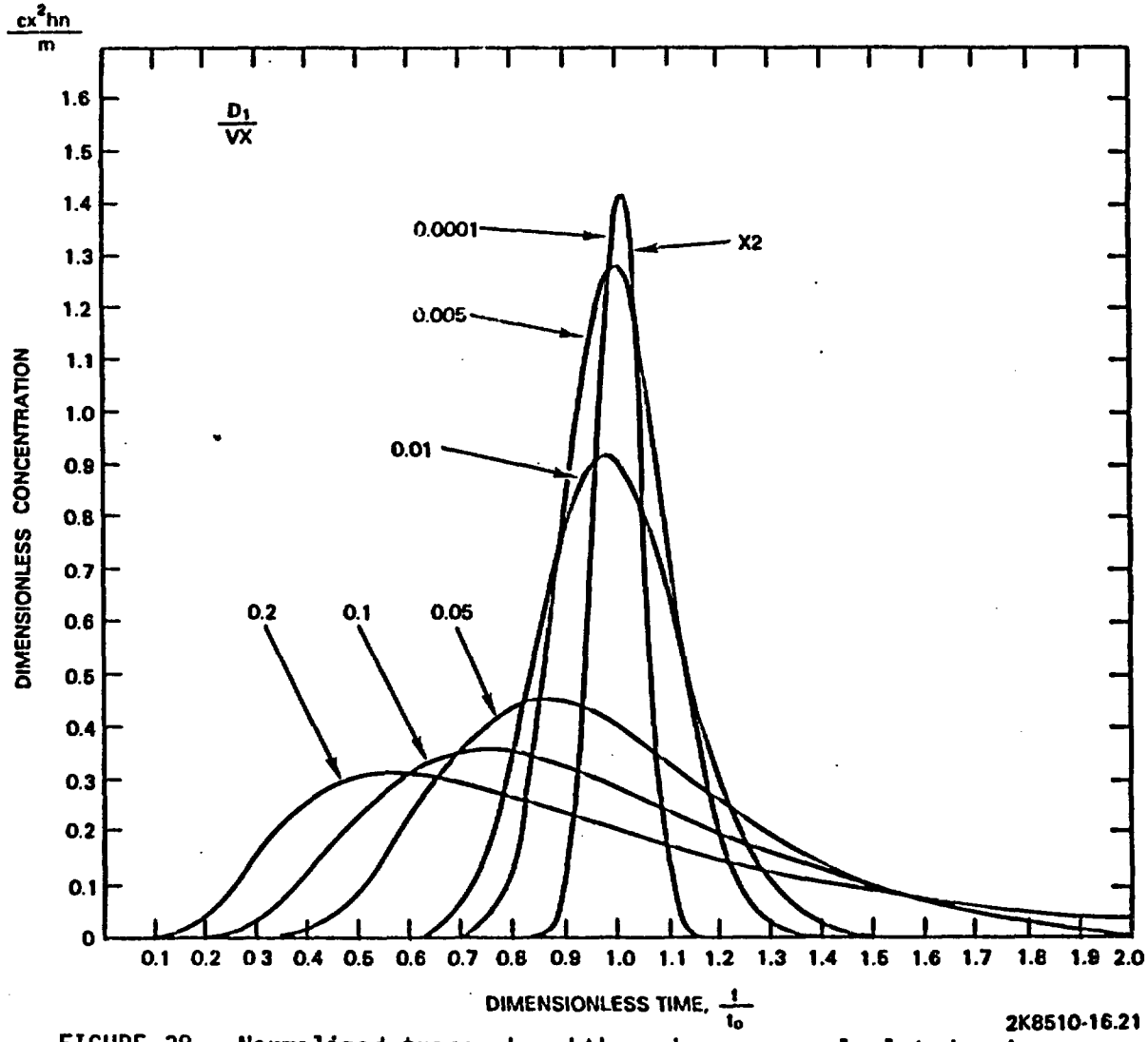
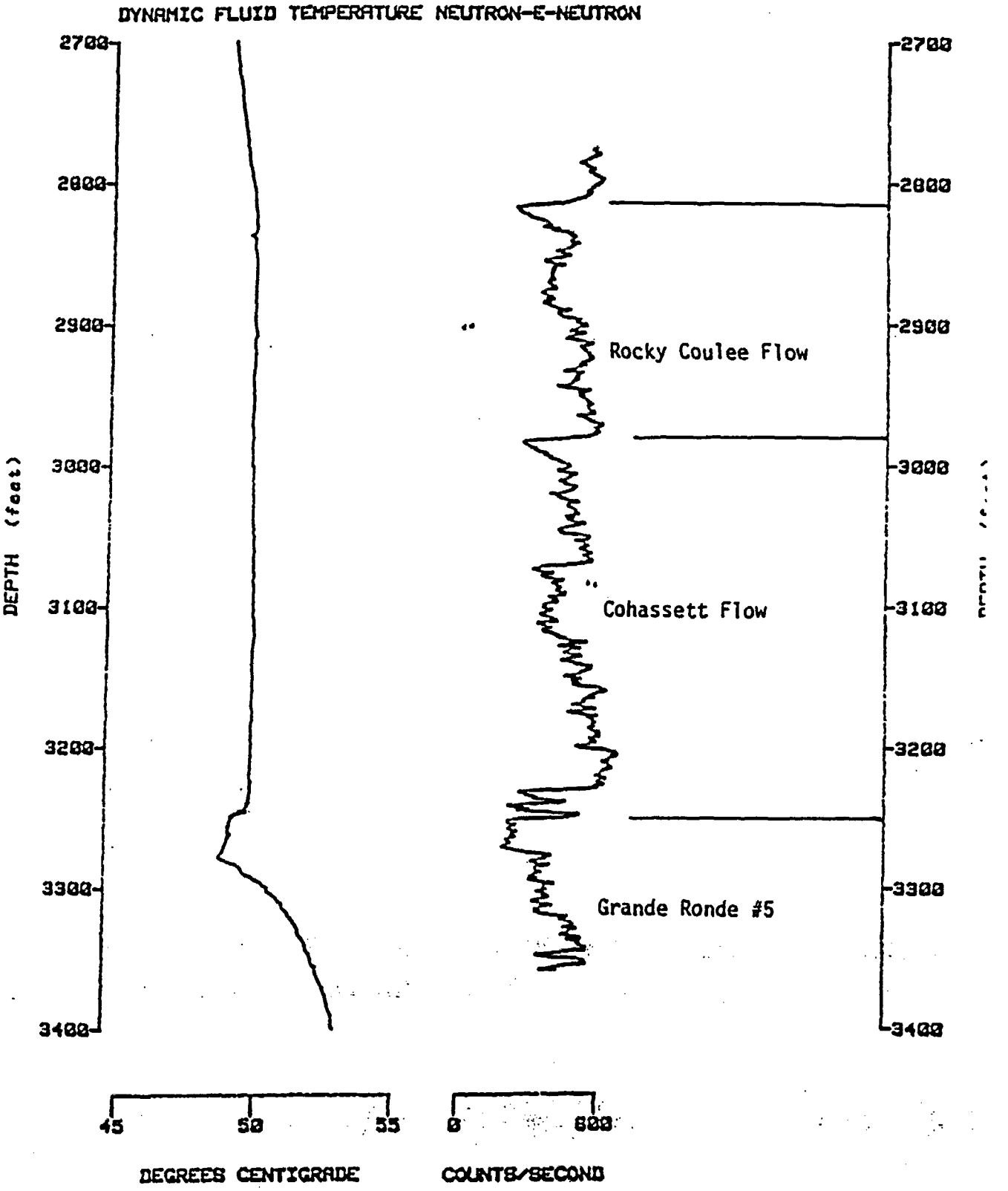


FIGURE 38. Normalized tracer breakthrough curves calculated using equation (3) (from Lenda and Zuber,1970).

BOREHOLE GEOPHYSICAL LOGS
BOREHOLE: RRL-2C



PARAMETER VALUES ASSUMED FOR TRACER TEST DESIGN:

α = 0.84M

X = 76M, 152M

HN = 0.003M, 0.027M, (N=0.003; H=1M, 9M)

Q = 0.45, 0.9, L.8, LL.3, 22.7, 45.4 M^3/HR
(2, 4, 8, 50, 100, 200 GPM)

MEAN TRACER TRANSIT TIME CAN BE ESTIMATED USING:

$$t_o = \frac{\pi x^2 hn}{Q}$$

MEAN TRACER TRANSIT TIME, DAYS

Q, M^3/HR	x=76M	x=152M
ROCKY COULEE FLOW TOP		
0.45	5	20
0.9	2.5	10
1.8	1.3	·5
GRANDE RONDE No. 5		
FLOW TOP		
11.3	1.8	7.2
22.7	0.9	3.6
45.4	0.45	1.8

A REARRANGEMENT OF THE APPROXIMATE SOLUTION OF THE TRANSPORT EQUATION IS USED TO ESTIMATE THE MASS OF TRACER TO BE INJECTED INTO GRANDE RONDE FLOW TOPS:

$$m = \frac{c x^2 h n}{\frac{1}{\pi} \frac{1}{\sqrt{4\pi \frac{D}{\bar{v}x} \left(\frac{t}{t_o}\right)^3}} \exp\left[- \frac{(1 - t/t_o)^2}{4 \frac{D}{\bar{v}x} t/t_o} \right]}$$

TRACERS WILL INCLUDE SCN^- AND BR^-. BACKGROUND CONCENTRATION OF BR^- IS ABOUT 1 MG/L; DETECTION LIMIT FOR SCN^- IS THE SAME. PFB AND TFMB WILL BE USED ALSO. THEIR DETECTION LIMITS ARE BOTH ABOUT 0.1 MG/L.

VALUES OF $D/\bar{v}x$ ARE CALCULATED USING:

$$\bar{v} = \frac{x}{t_o} \quad \text{and} \quad D = \alpha \bar{v}.$$

THE APPROPRIATE VALUE OF T/T_0 WAS SCALED FROM THE CONCENTRATION PEAK OF THE THEORETICAL BREAKTHROUGH CURVE CORRESPONDING TO THE ESTIMATED VALUE OF $D/\bar{v}x$.

PARAMETERS OF TRACER TEST DESIGN
(ROCKY COULEE FLOW TOP)

Injection Point, Tracer (s)	Mass To Be Injected, kg	Volume, L, and Concentration of Tracer Solution, mg/L
RRL-2A		
LiBr	1.0[A]	130, 7700
Deuterium	2.2[B]	130, 17,000
RRL-2C		
NH_4SCN	0.4[A]	60, 7000

[A] Adequate to provide 10x background or detection limit at peak in RRL-2B.

[B] Adequate to provide 2+x background at peak in RRL-2B.

PARAMETERS OF TRACER TEST DESIGN
(GRANDE RONDE NO. 5 FLOW TOP)

Injection Point Tracer	Mass to be Injected, kg	Volume, L, and Concentration of Tracer Solution, mg/L
RRL-2A		
PFB	1.25	200, 6250
RRL-2C		
TFMB	0.5	100, 5000

NOTE: Tracer mass adequate to provide 25x detection limit at peak in RRL-2B.

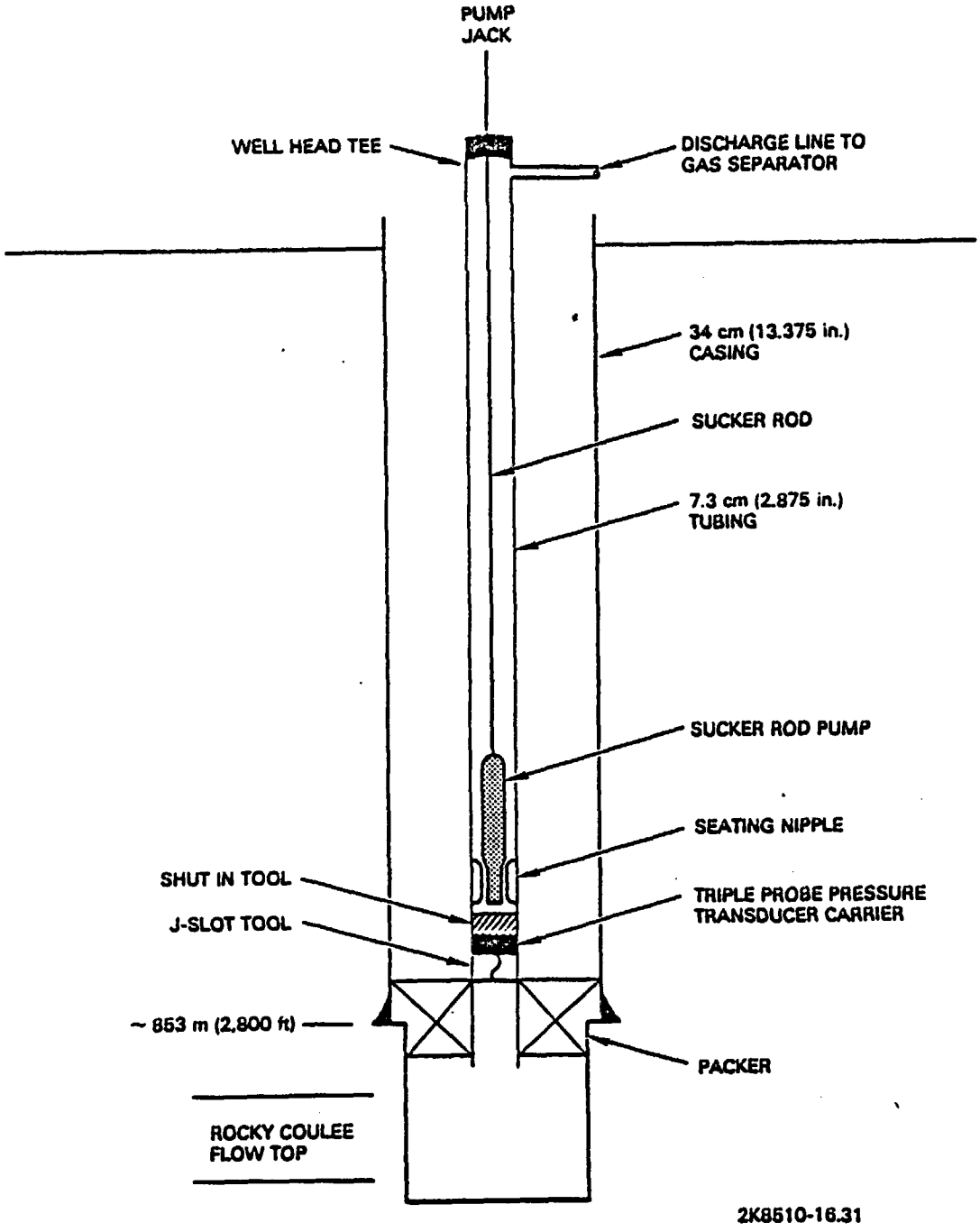


FIGURE 8. Configuration of well RRL-2B for testing the Rocky Coulee basalt flow top.

TRACER INJECTION INTO ROCKY COULEE FLOW TOP

AT RRL-2A AND RRL-2C

- DETAILS OF THE MECHANICS OF TRACER INJECTION WILL BE FOUND IN APPLICABLE PROCEDURES.

- TRACER SOLUTION WILL BE FOLLOWED BY ROCKY COULEE "CHASE" WATER TO FORCE TRACER INTO FLOW TOP AND TO FLUSH IT FROM THE BOREHOLE AND SAND PACK.

- "CHASE" WATER VOLUME WILL BE ABOUT TWO TIMES THE BOREHOLE OR WELL DEAD VOLUME. ABOUT 60 LITERS OF WATER WILL BE USED AT BOREHOLE RRL-2A. ABOUT 400 LITERS OF WATER WILL BE USED AT PIEZOMETER NEST RRL-2C.

- THE TRACER SOLUTION AND "CHASER" WILL BE INJECTED UNDER 250M OF APPLIED PRESSURE HEAD. TRACER SOLUTION TO BE INJECTED IN ABOUT 4 MINUTES AT RRL-2A AND IN ABOUT 3 MINUTES AT RRL-2C.

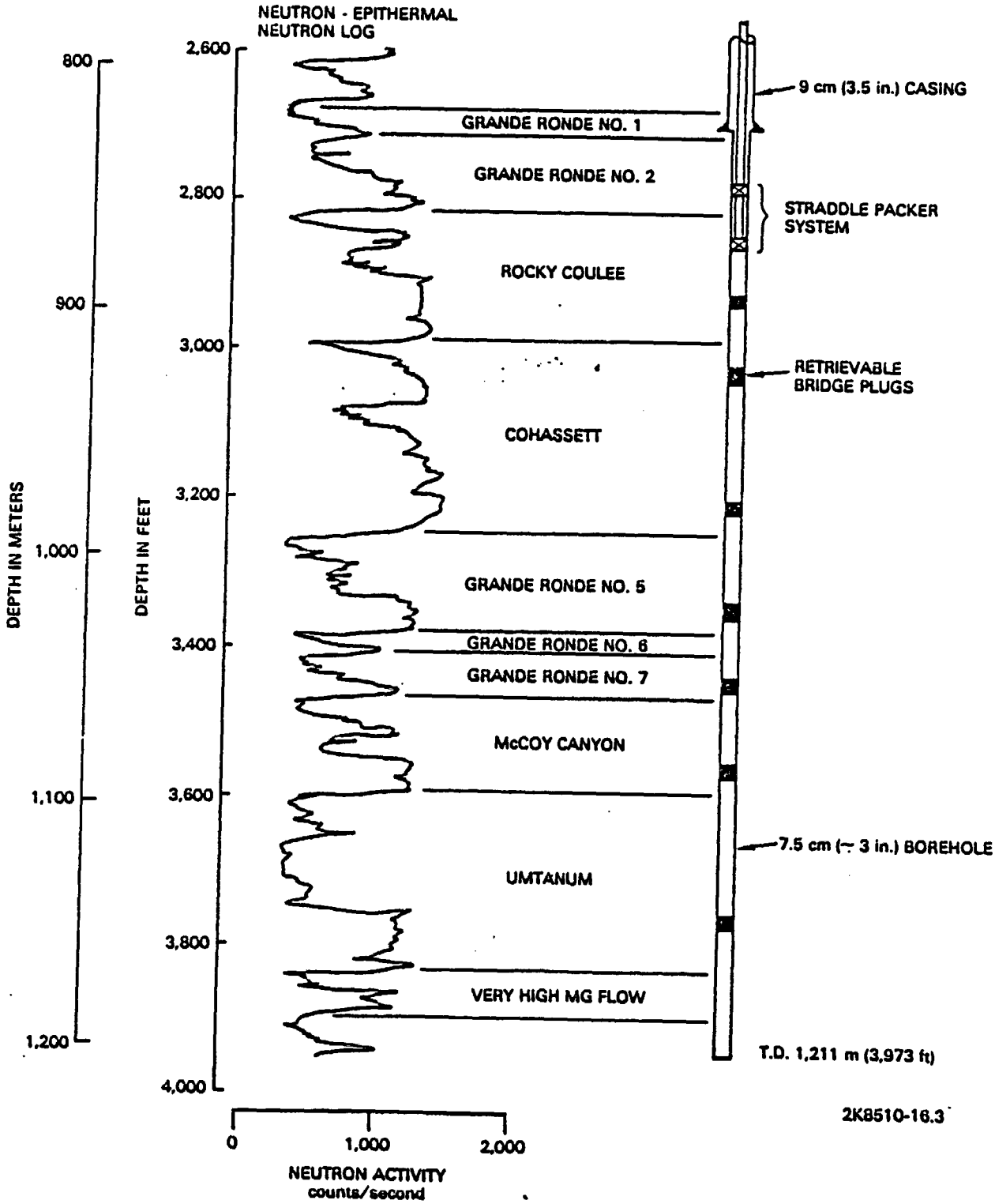
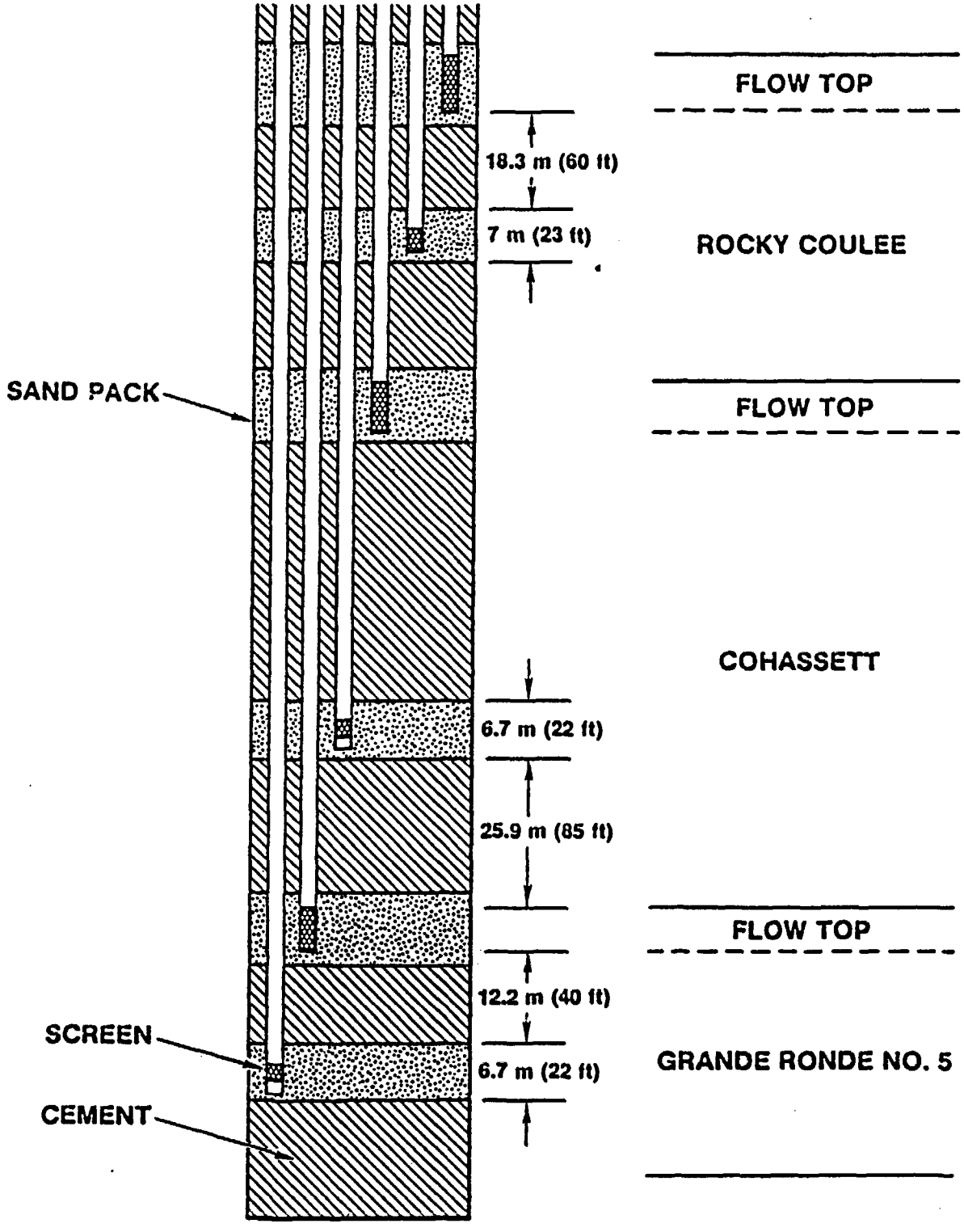


FIGURE 12. Configuration of borehole RRL-2A for hydraulic tests of the Rocky Coulee flow top. (Bridge plugs and packers not to vertical scale).

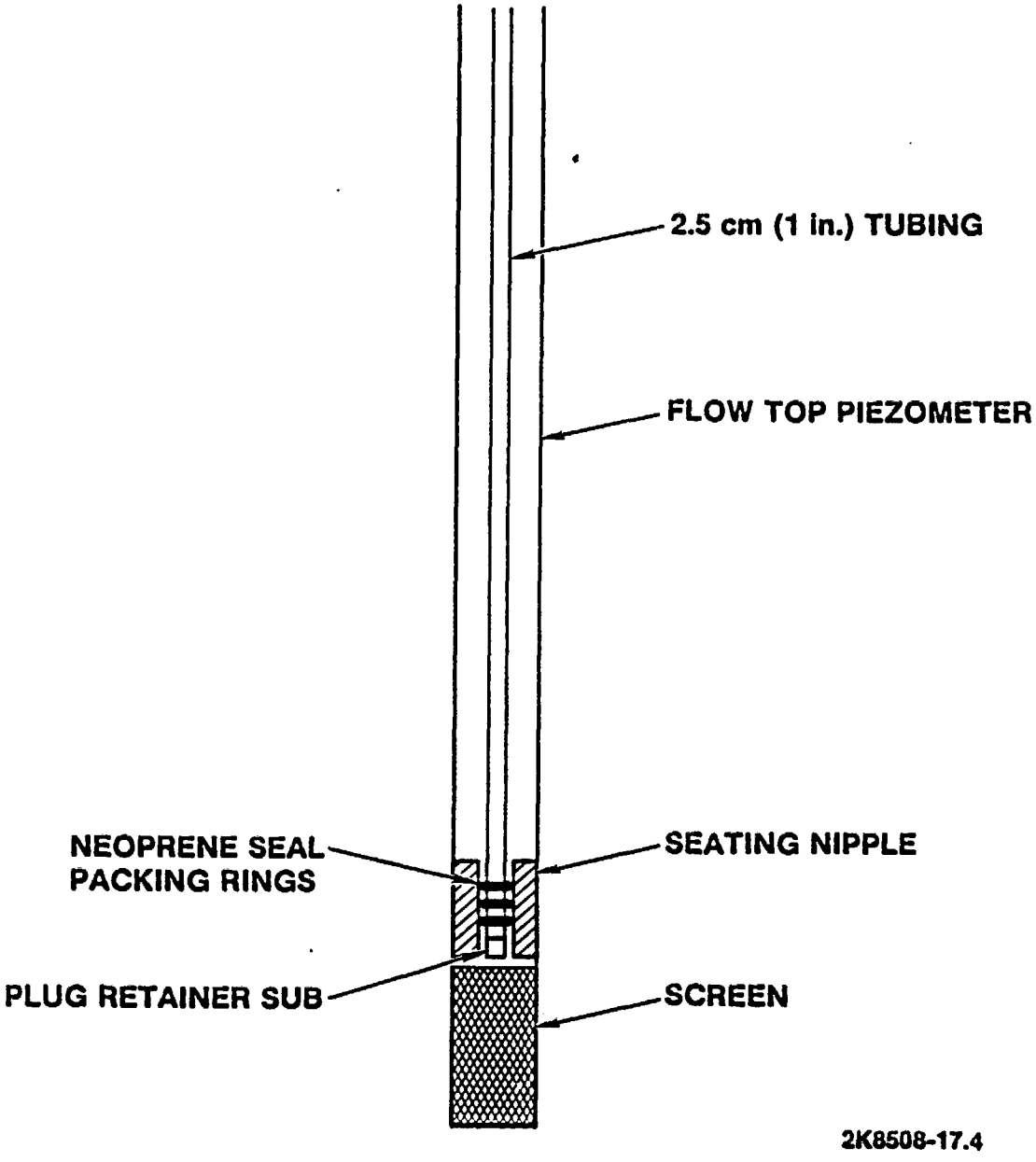
Schematic of Well RRL-2C Completions in Grande Ronde Basalt



(Dimensions are approximate)

2K8508-17.5

Tracer Injection at Well RRL-2C



SAMPLING AND ANALYSIS OF TRACER CONTENT

IN WATER PUMPED FROM WELL RRL-2B

- SAMPLES WILL BE ANALYZED IN THE FIELD AT ONE-HALF HOUR INTERVALS BETWEEN TRACER INJECTION AND THE FIRST APPEARANCE OF TRACER IN WATER FROM RRL-2B.

- AFTER FIRST APPEARANCE OF TRACER, SAMPLES WILL BE ANALYZED IN THE FIELD EVERY 20 MINUTES AND SAMPLES WILL BE TAKEN EVERY 12 MINUTES FOR POSSIBLE LATER ANALYSIS.

- BROMIDE, THIOCYANATE, AND THE FLUORINATED BENZOATES WILL BE DETERMINED IN THE FIELD USING HIGH PERFORMANCE LIQUID-CHROMATOGRAPHY.

- THIOCYANATE WILL ALSO BE DETERMINED IN THE FIELD USING A DOUBLE BEAM SPECTROPHOTOMETER.

TRACER TEST ANALYSIS

- THE INITIAL APPROACH TO TRACER TEST ANALYSIS WILL BE TO COMPARE THE OBSERVED TRACER BREAKTHROUGH CURVES WITH THOSE PREDICTED BY THE ANALYTICAL MODEL (LENDA AND ZUBER, 1970) TO DERIVE ESTIMATES OF EFFECTIVE POROSITY OR EFFECTIVE THICKNESS, AND LONGITUDINAL DISPERSIVITY.

HYDROCHEMICAL SAMPLING STRATEGY FOR LHS TESTING

S. H. HALL

HYDROCHEMISTRY GOALS

- Provide baseline analysis
- Provide input for waste package design
- Evaluate radionuclide retardation mechanisms
- Develop flow models based on:

  Solutes
  Stable isotopes
  Radionuclide age-dating

LHS CONSIDERATIONS

- Extended pumping periods

  Best chance for uncontaminated samples
  Daily monitoring opportunity
  Potential drilling fluid crossover from RRL-2a, c

- Isolated producing zones

  Stratigraphic resolution

- Pumping well drilled with water only

  Minimum initial contamination

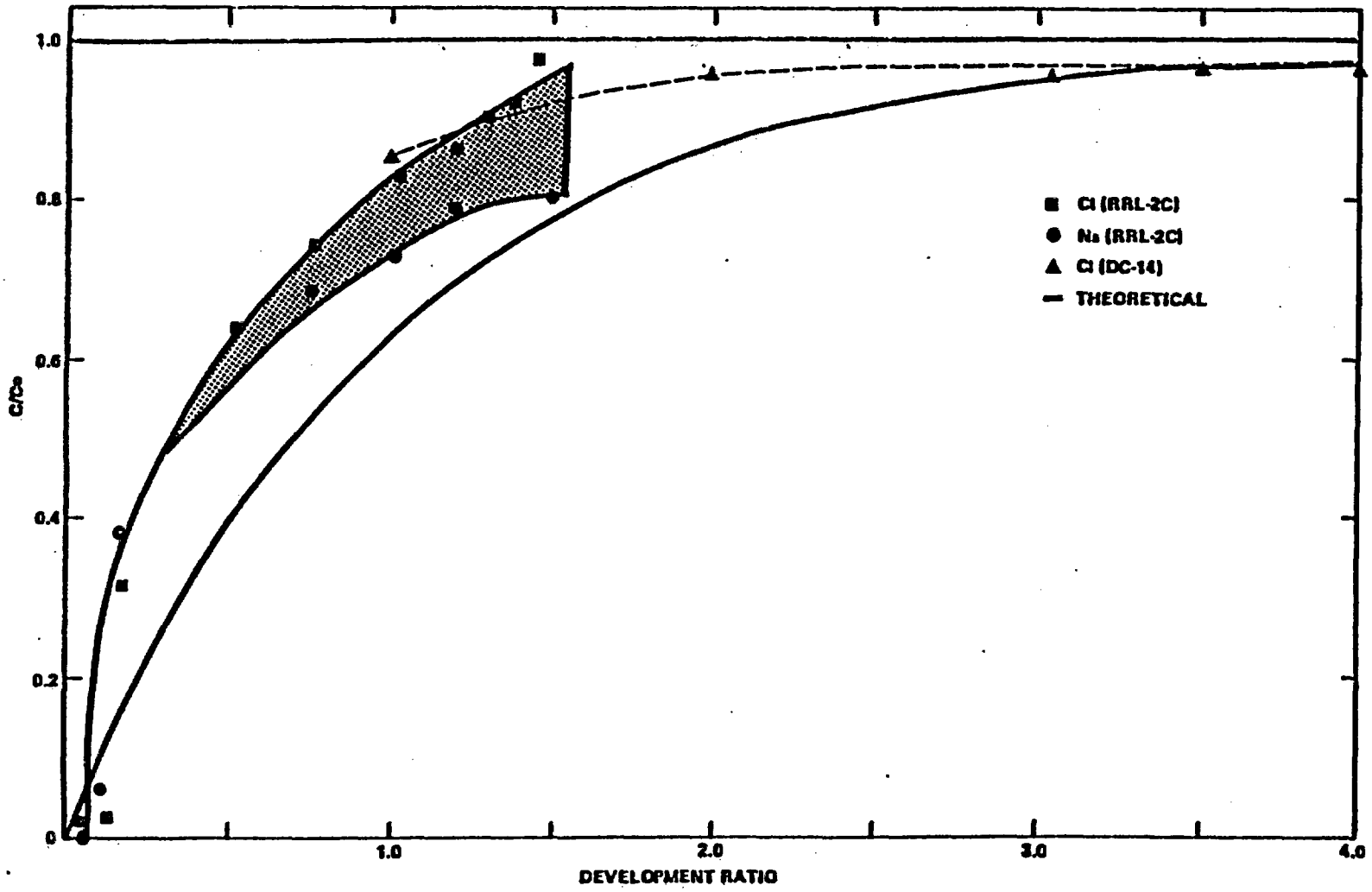
DEVELOPMENT CRITERIA

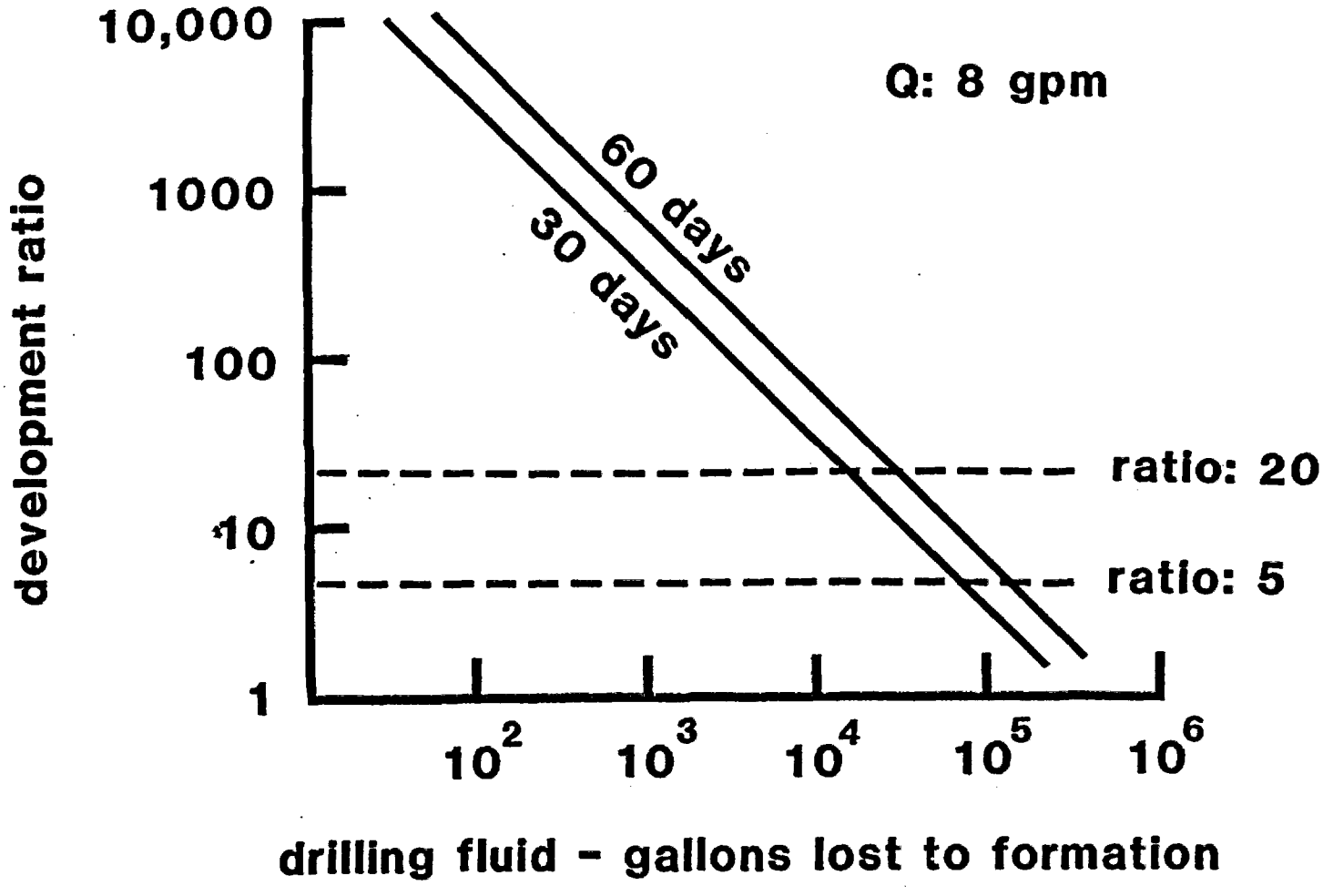
- Tracer attenuation - Tritium
- Stabilization of hydrochemical parameters
- Development ratio

DEVELOPMENT CHEMISTRY
(DAILY)

Field	Laboratory
pH	Sodium
Conductivity	Tritium
Temperature	TOC
Turbidity	
ORP	
Alkalinity	
Dissolved oxygen	
Chloride	

HYDROCHEMICAL RECOVERY IN BWIP BOREHOLES (GRANDE RONDE FORMATION)




Q: 8 gpm
60 days
30 days
ratio: 20
ratio: 5
10,000
1000
100
10
1
development ratio
10^2
10^3
10^4
10^5
10^6
drilling fluid - gallons lost to formation

FORMAL SAMPLES

All development/field determinations

Major cations

Major anions

Trace elements/redox couples

Stable isotope ratios (^{2}H, ^{18}O, ^{13}C, ^{34}S)

Radioisotopes (^{14}C, ^{36}Cl, ^{129}I, ^{99}Tc, ^{3}H)

Uranium/thorium disequilibrium series

Dissolved gases (including isotopes)

Gross Beta, Alpha

(Exsolved gases)

ADMINISTRATIVE CONTROL OF LHS TESTS

K. M. THOMPSON
S. M. BAKER

NRC/DOE MEETING
RICHLAND, WASHINGTON
DECEMBER 9, 1985

DOE/NRC LHS PRE-TEST CONSULTATION MEETING

DECEMBER 9 AND 10, 1985

RICHLAND, WASHINGTON

TUESDAY, DECEMBER 10, 1985

8:00 -	-	Continue Technical Discussion (if necessary)	All participants
	-	Administrative Control of LHS Tests	Mike Thompson/Steve Baker
	-	Schedule of Site Activities	Mike Thompson/Bill Price
2:00 - 2:30	-	Comments from Observers (State, Indians, USGS and Public)	As Appropriate
2:30 - 4:00	-	Caucus	
4:00 - 5:00	-	Preparation of Summary Meeting Minutes	BWIP and NRC

READINESS REVIEW

1) SYSTEMATIC APPROACH TO DETERMINE STATUS OF AN ACTIVITY

2) PROVIDES TO MANAGEMENT VISIBLE OBJECTIVE, WELL ORGANIZED, EVIDENCE DEMONSTRATING THE READINESS FOR INITIATION OF AN ACTIVITY.

3) PROVIDES FOR AN INDEPENDENT THOROUGH FINAL REVIEW PRIOR TO ACTIVITY AUTHORIZATION.

4) PROVIDE FOR A MECHANISM TO IDENTIFY DEFICIENCIES THAT COULD RESULT IN DELAYS.

PRIMARY GOALS OF LHST READINESS REVIEW

1) ASSURE DOE-RL THAT DATA GENERATED FROM LHS TESTING ARE SUITABLE FOR FUTURE LICENSING PURPOSES

   a) QUALITY ASSURANCE

   b) TECHNICALLY SOUND

2) ASSURE DOE-RL THAT ALL NECESSARY ACTIVITIES AND ACTIONS HAVE BEEN SATISFACTORILY COMPLETED PRIOR TO AUTHORIZATION TO PROCEDE.

3) TAILOR RR PLAN FOR GEOHYDROLOGIC INVESTIGATION; MOST RR EXPERIENCE IS FOR PROCESSESS AND FACILITIES.

DOE-RL READINESS REVIEW PLAN

PLAN PROVIDES:

1) DEFINITION OF ORGANIZATION AND FUNCTIONAL RESPONSIBILITIES, OBJECTIVES AND DETAILED INSTRUCTIONS FOR CONDUCT OF RR.

2) DOE-RL START-UP APPROVAL FOR LHST

3) DOE-RL READINESS REVIEW TEAM

4) DOE-RL ASSURANCE OF READINESS BY AUDIT OF SELECTED ELEMENTS OF CONTRACTOR RR AND BY DIRECT CONCURRENT OBSERVATION OF CONTRACTOR RR ACTIVITIES.

5) DOE-RL REVIEW COORDINATOR TO ACT AS LIAISON BETWEEN DOE-RL AND CONTRACTOR.

6) AUDITABLE RECORD OF DOE-RL READINESS ACTIVITIES

STATUS: SECOND DRAFT IS BEING WRITTEN

PREPARATION FOR THE FIRST LHS TEST PROGRAM TO BE CONDUCTED AT RRL-2 IN THE ROCKY COULEE FLOW TOP

OBJECTIVES

- IN EARLY 1986, START LARGE-SCALE HYDRAULIC TEST DESIGNED TO OBTAIN HYDRAULIC DATA REQUIRED TO PERFORM QUANTITATIVE MODELING OF THE GROUNDWATER FLOW SYSTEM AT THE PROPOSED REPOSITORY.
- DATA WILL BE USABLE FOR LICENSING.

PROJECT STATUS

- ROCKWELL IS OPERATING WITH APPARENTLY CONFLICTING GUIDANCE

LITERALLY INTERPRET AND APPLY NRC QA REVIEW PLAN	IMPLEMENT THE INTENT OF STP 1.1
DATA COLLECTION ACTIVITIES TO BE CONTROLLED AS AN ENGINEERING SPECIFICATION PROCESS	SCIENTIFIC DISCOVERY OF THE PROPERTIES OF THE NATURAL SYSTEM.

- APPROACH TO CONDUCT of THE TEST IS WELL ESTABLISHED.
- FACILITIES REQUIRED TO CONDUCT THE TEST ARE IN PLACE.
- EQUIPMENT TO CONDUCT TESTS BEING PURCHASED AND INSTALLED.
- GROUNDWATER BASELINE ADEQUATE TO START TEST.
- A DRAFT TEST PLAN FOR THE FIRST LHS TEST HAS BEEN PREPARED.

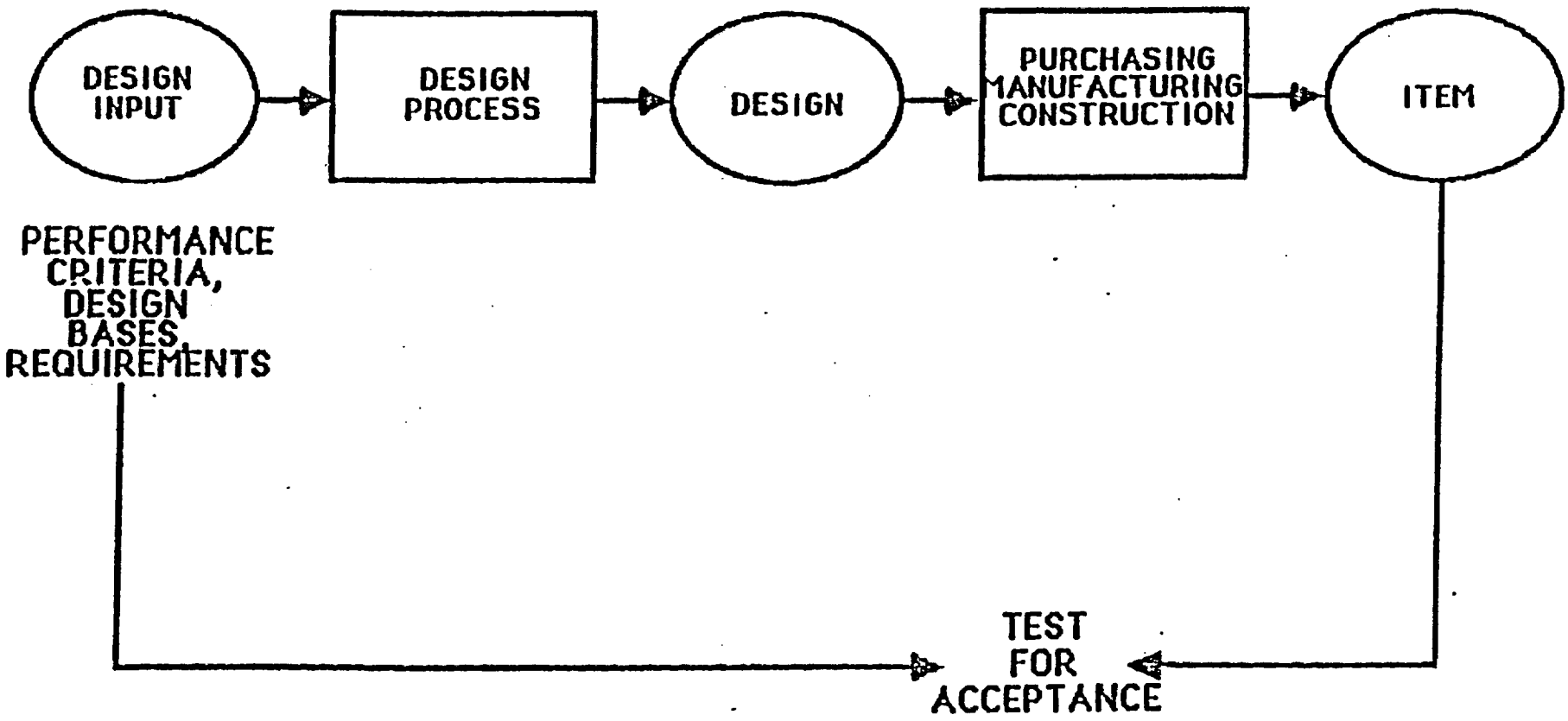
STRATEGY

- PREPARE A "LHS TEST CONTROL MANUAL" TO BE THE LINE ORGANIZATION'S PART OF THE QA PROGRAM FOR THE FIRST LHS TEST. THIS DOCUMENT CANNOT FULLY COMPLY WITH EXISTING QA REQUIREMENTS.
- DATA FROM TEST WILL BE EVALUATED AFTER COMPREHENSIVE QA PROGRAM IS IN PLACE TO DETERMINE ITS USABILITY FOR LICENSING.

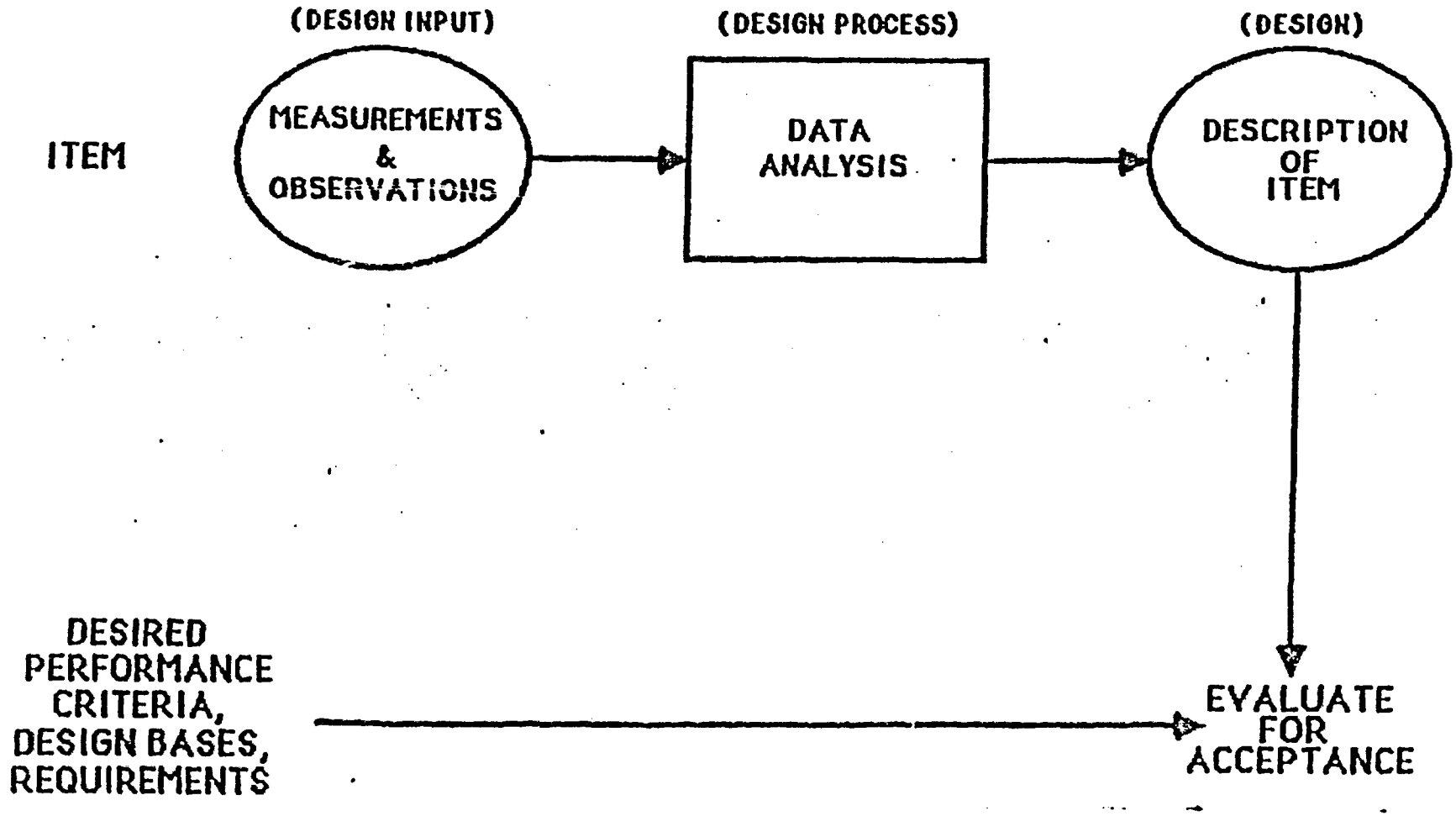
SITE CHARACTERIZATION

SCIENTIFIC DISCOVERY	VS.	ENGINEERING SPECIFICATION
10 CFR 60 defines "Site Characterization" .... "Program of exploration and research....to establish geological conditions."...		
NWPA Section 113 Outlines Site Characterization..." conduct...activities...to provide the data required for evaluation of the suitability of...site..."		
NRC Staff Site Technical Position 1.1 (STP-1.1) - An "approach...acceptable in determining what hydrogeologic testing...is required to produce the hydraulic data...to perform rigorous quantitative modeling"		NRC Review Plan - Identify issues, establish component performance requirements, identify information needs by discipline, plan, test.
BWIP Federal Register - Response to STP-1.1 "Sound approach...facilitate...agreement... vital...for successful characterization."		
USGS Letter to R. L. Morgan, August 25, 1983 "items of major concern...The need for three-dimensionally well-distributed hydraulic and geochemical data of good quality."		
BWIP Draft Environmental Assessment "a detailed understanding of the geologic and hydrologic conditions of the site is needed. Such an understanding is possible through site characterization."		

ENGINEERING SPECIFICATION PROCESS



SCIENTIFIC DISCOVERY PROCESS

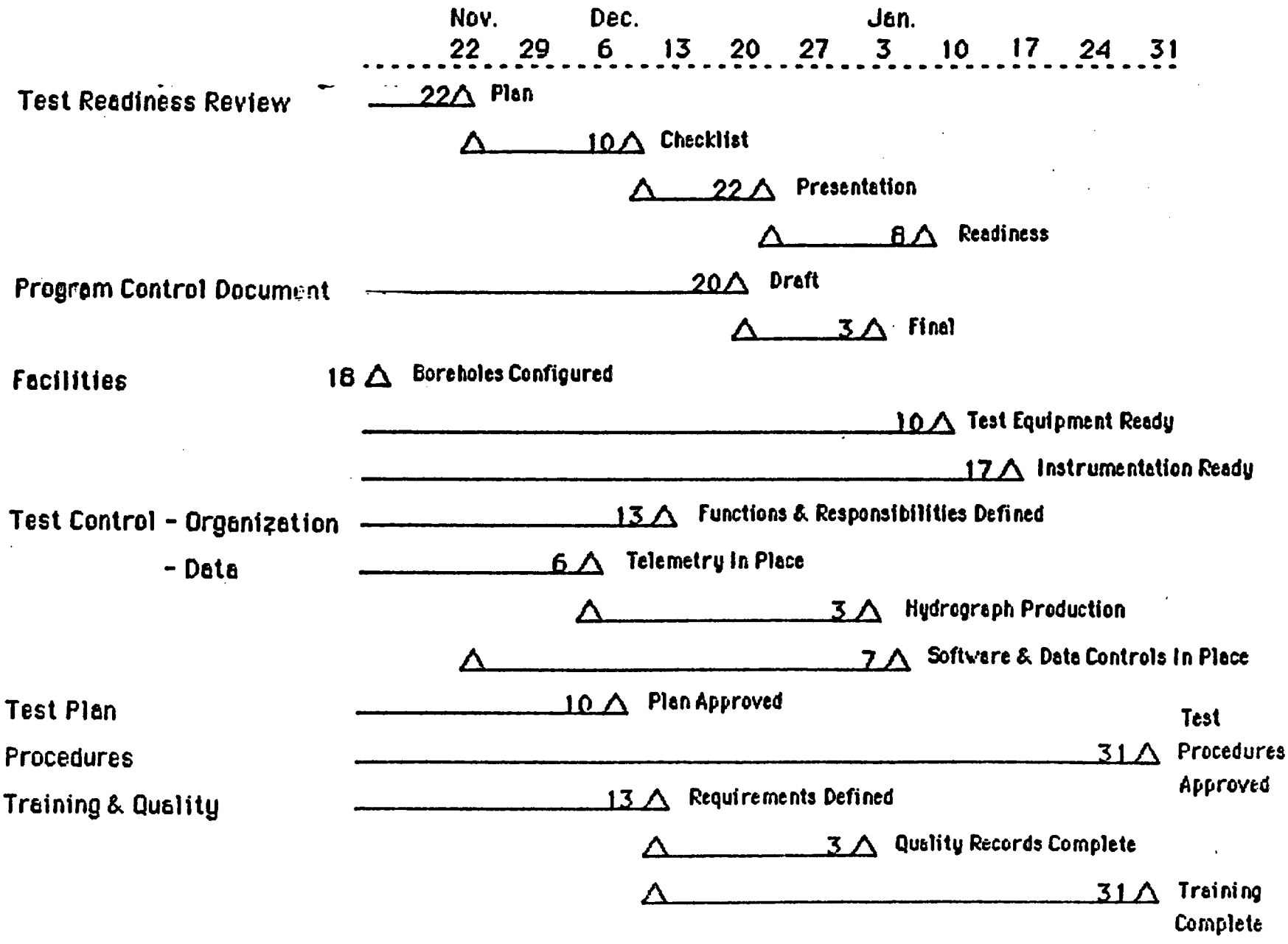


LHS TEST PROGRAM CONTROL MANUAL

DOCUMENT PURPOSE

- DEFINE THE PORTION OF THE NATURAL SYSTEM THAT IS IMPORTANT TO WASTE ISOLATION
- PROVIDE A BASES FOR ASSIGNING QUALITY REQUIREMENTS TO SPECIFIC TECHNICAL ACTIVITIES
- ASSIGN QUALITY REQUIREMENTS FOR LHS TESTING ACTIVITIES
  - FACILITATE TIMELY AND SUCCESSFUL TEST PROGRAM EXECUTION
  - PROVIDE A FORMAL SYSTEM TO CONTROL FIELD ACTIVITIES
  - EXPAND CRITERION 3 OF 10 CFR 50 APPENDIX B TO CONTROL DATA ACQUISITION

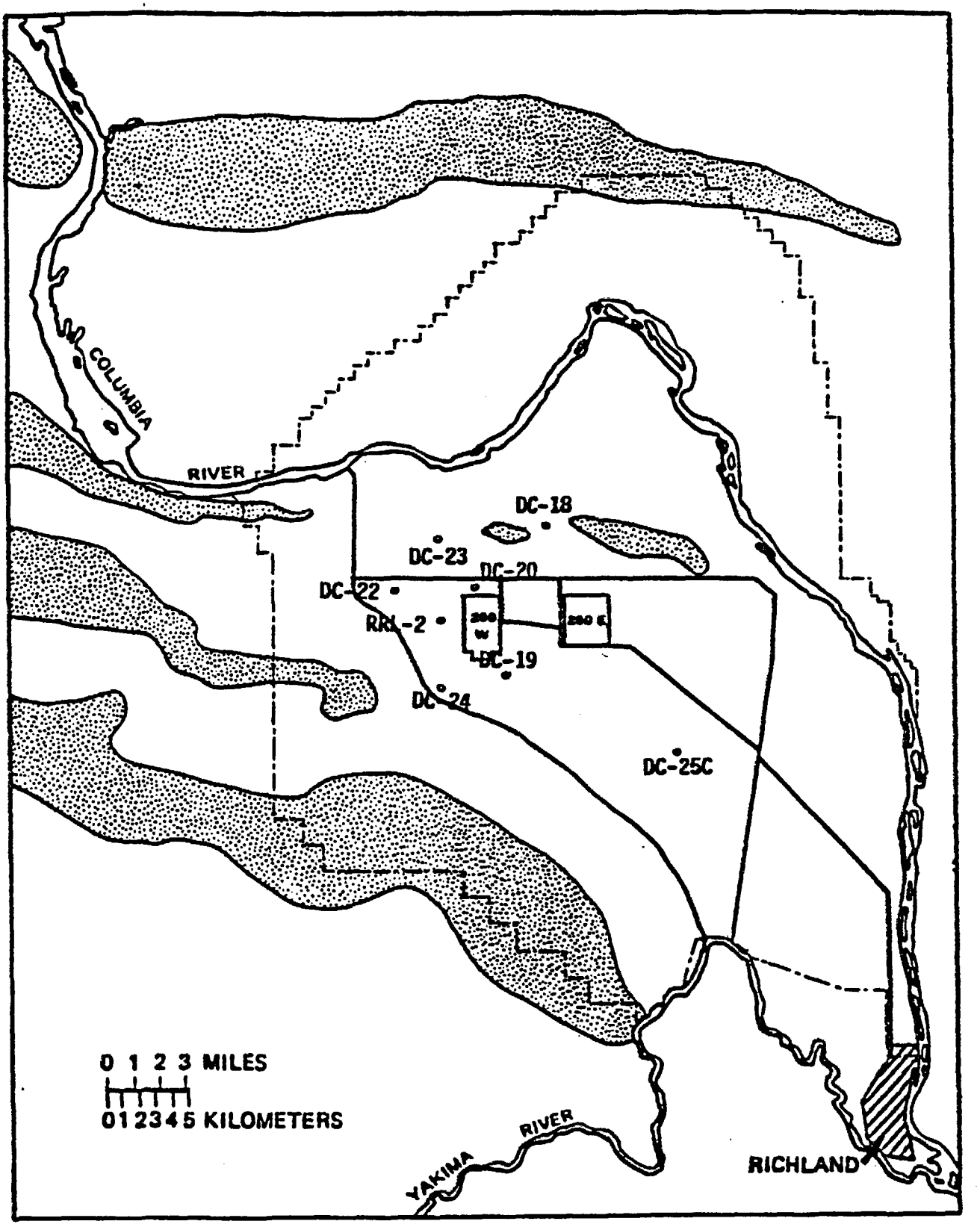
LHS Test Readiness Functional Schedule



SCHEDULE OF SITE ACTIVITIES

K. M. THOMPSON
W. H. PRICE

NRC/DOE MEETING
RICHLAND, WASHINGTON
DECEMBER 9, 1985


COLUMBIA
RIVER
DC-18
DC-23
DC-20
DC-22
RRL-2
200 W
200 E
DC-19
DC-24
DC-25C
0 1 2 3 MILES
0 1 2 3 4 5 KILOMETERS
YAKIMA
RIVER
RICHLAND

TASKS

COMPLETE TIMELY INSTALLATION OF PIEZOMETER NETWORK TO SUPPORT LHS TESTING FROM RRL-2B AND TO SUPPORT GROUNDWATER MONITORING.

CONDUCT FIRST LHS TEST PRIOR TO SCHEDULED START DATE OF EXPLORATORY SHAFT.

BE PREPARED TO INITIATE CONSTRUCTION OF ES IN AUGUST 1986.

PLANNING ASSUMPTIONS
FOR DRILLING AND LHS TESTING

THE CURRENT NETWORK OF PIEZOMETERS AND INSTRUMENTED BOREHOLES IS ADEQUATE TO CONDUCT LHS TESTS OF THE ROCKY COULEE FLOW TOP AND COHASSETT FLOW TOP.

INSTALLATION OF DC-23GR AND DC-24GR PIEZOMETERS AND ESTABLISHMENT OF A BASELINE IN THE COHASSETT FLOW TOP, GRANDE RONDE 5 FLOW TOP, AND UMTANUM FLOW TOP ARE REQUIRED PRIOR TO INITIATION OF THE GRANDE RONDE 5 TEST.

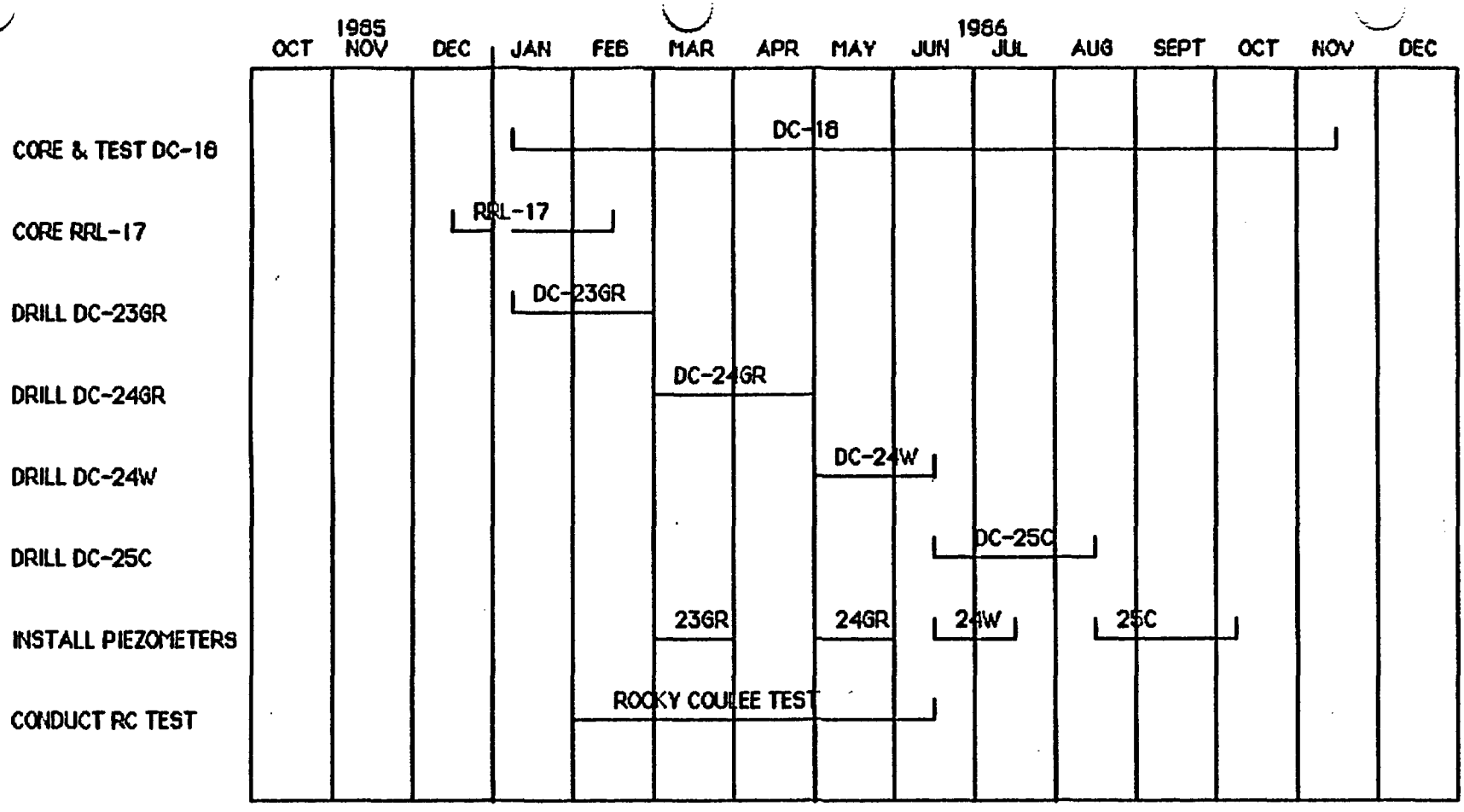
DRILLING OF RRL-17 THROUGH THE GRANDE RONDE 5 FLOW TOP, AND ESTABLISHMENT OF A BASELINE FOR THE FLOW TOP IS REQUIRED PRIOR TO INITIATION OF THE GRANDE RONDE 5 TEST.

ALL TESTING FROM RRL-2B WILL BE SUSPENDED UPON PENETRATION OF THE GRANDE RONDE BY THE EXPLORATORY SHAFT.

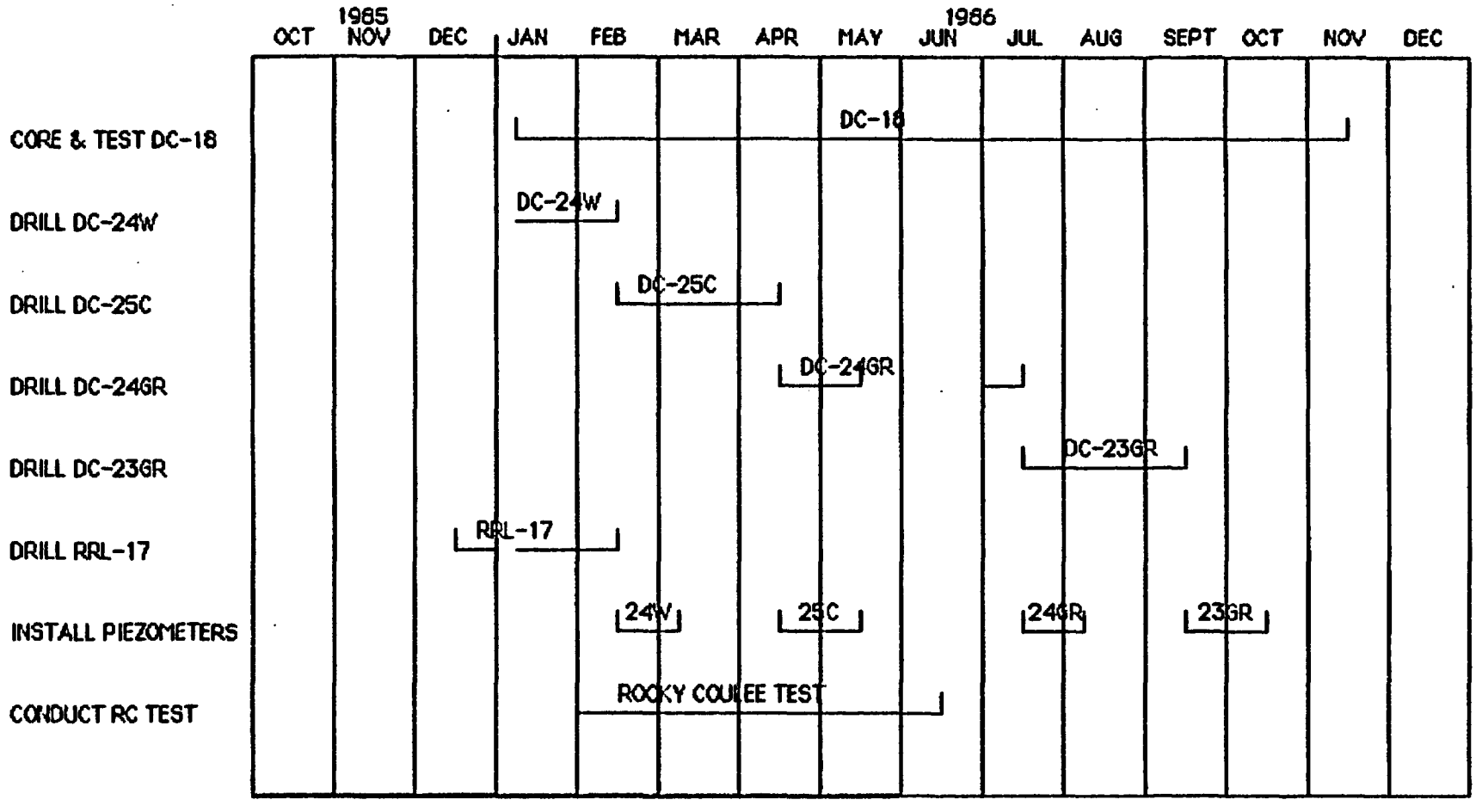
IF DRILLING ACTIVITIES IMPACT BWIP'S ABILITY TO CONDUCT THE ROCKY COULEE FLOW TOP TEST (IE. DISTURBANCE OF THE BASELINE), THE ACTIVITIES WILL BE TERMINATED AND REDIRECTED AWAY FROM THE RRL.

RISK ASSESSMENT FOR DATA INTERPRETATION FROM CONCURRENT DRILLING & LHS TESTING OF THE ROCKY COULEE FLOW TOP AT RRL-2

	HIGH	MEDIUM	LOW
DC-23GR (S&W SECTION)		X	
DC-23GR (GR SECTION)	X		
DC-24GR (S&W SECTION)		X	
DC-24GR (GR SECTION)	X		
DC-24W		X	
DC-25C			X
RRL-17 (RC & COH FT SECTION)	X		
RRL-17 (COH INTERIOR SECTION)		X	
DC-18 (W SECTION)			X


1985
1986
OCT
NOV
DEC
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEPT
OCT
NOV
DEC
CORE & TEST DC-18
DC-18
CORE RRL-17
RRL-17
DRILL DC-23GR
DC-23GR
DRILL DC-24GR
DC-24GR
DRILL DC-24W
DC-24W
DRILL DC-25C
DC-25C
INSTALL PIEZOMETERS
23GR
24GR
24W
25C
CONDUCT RC TEST
ROCKY COULEE TEST

12/10/85
WHP


1985
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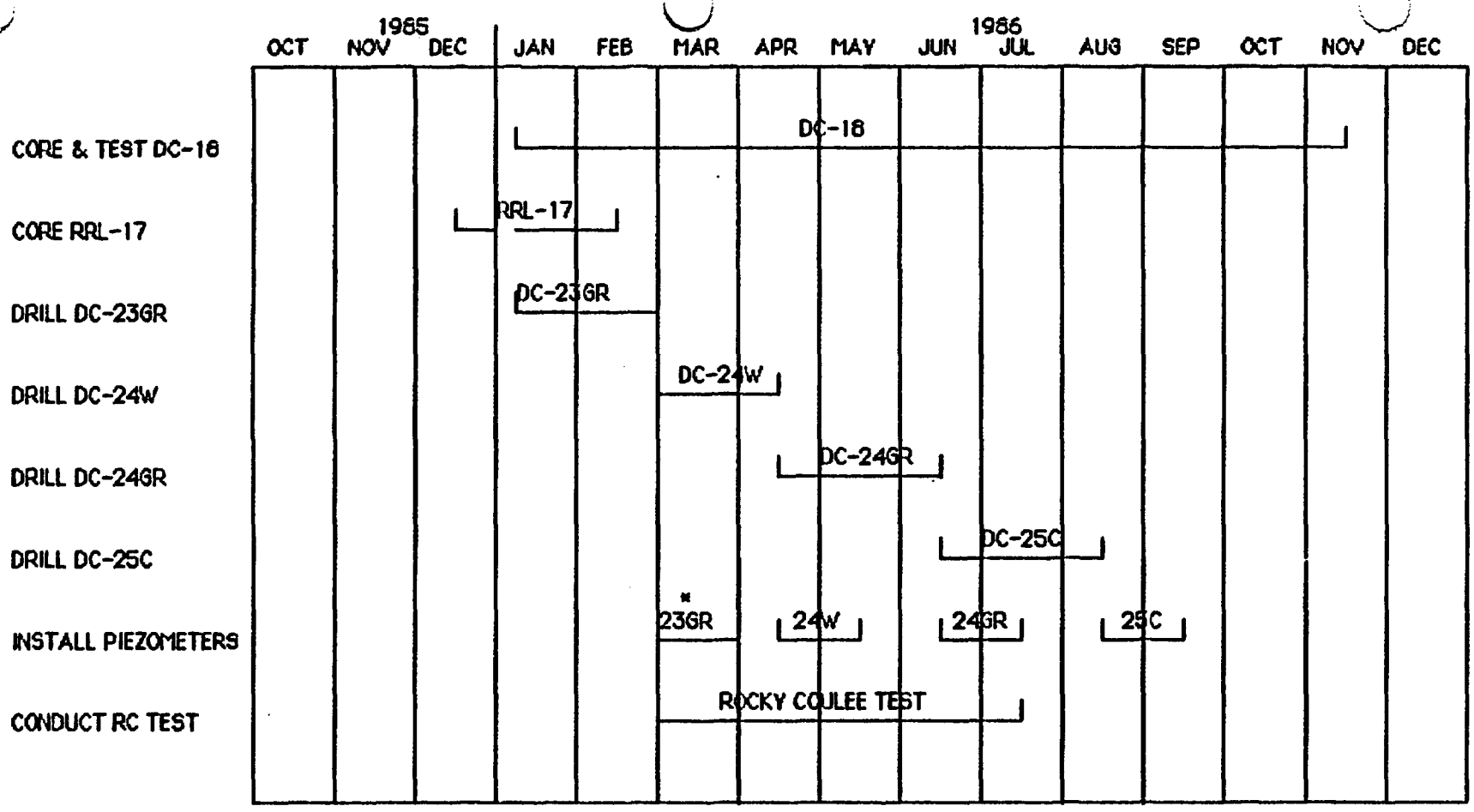
DEC
CORE & TEST DC-18
DC-18
DRILL DC-24W
DC-24W
DRILL DC-25C
DC-25C
DRILL DC-24GR
DC-24GR
DRILL DC-23GR
DC-23GR
DRILL RRL-17
RRL-17
INSTALL PIEZOMETERS
24W
25C
24GR
23GR
CONDUCT RC TEST
ROCKY COULEE TEST

12/10/85
WHP



*MAY POSTPONE DEPENDING ON MAGNITUDE OF DISTURBANCE OBSERVED DURING DRILLING

12/10/85
WHP