

U.S. DEPARTMENT OF ENERGY  
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

**NUCLEAR WASTE TECHNICAL REVIEW BOARD  
FULL BOARD MEETING**

**SUBJECT: UPDATE ON SITE IN SITU  
THERMAL TESTS**

**PRESENTER: WILLIAM BOYLE**

**PRESENTER'S TITLE  
AND ORGANIZATION: TEAM LEAD, GEOENGINEERING  
YUCCA MOUNTAIN SITE CHARACTERIZATION OFFICE  
LAS VEGAS, NEVADA**

**TELEPHONE NUMBER: (702) 794-7595**

**LAS VEGAS, NEVADA  
JANUARY 10-11, 1996**

# Relationship of Thermal Testing to the Waste Isolation Strategy

- **Hypothesis 1: Flow will be low**
- **Hypothesis 2: Relative humidity will be low**
- **Hypothesis 3: Mobilization will be low**
- **Hypothesis 4: Migration will be slow**

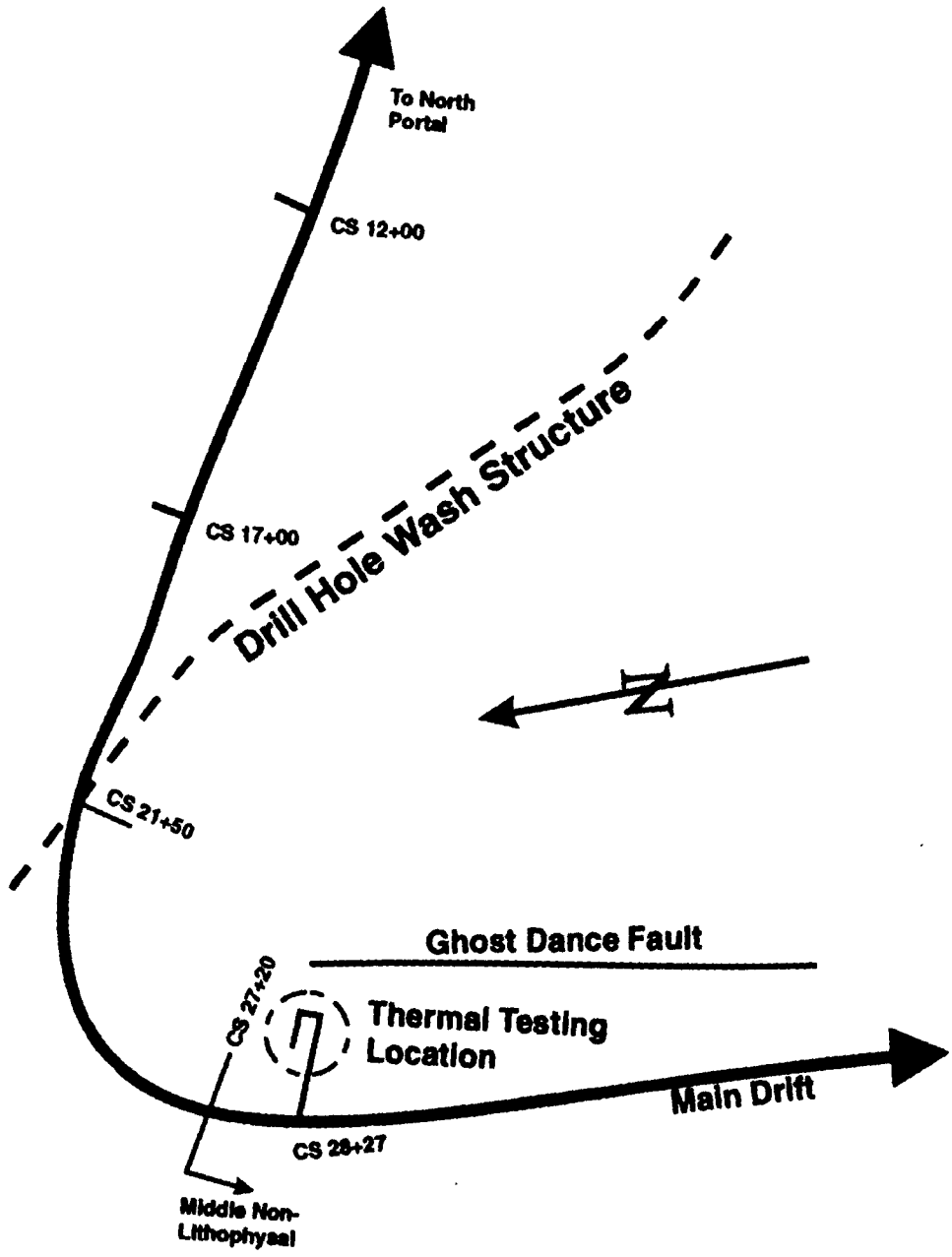
# **Amount of Thermal Test Data Related to Hypotheses**

- **Rock masses generally are not heated**
- **Southern Nevada experiments**
- **Laboratory tests**

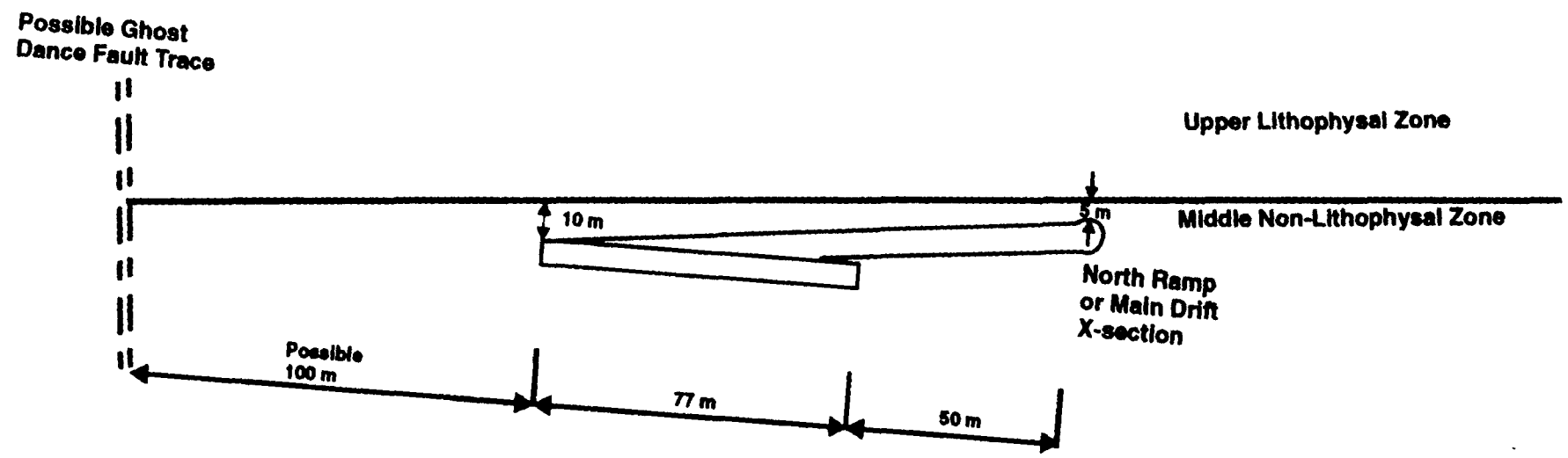
# Information to be Provided by ESF Thermal Tests

- **Shakedown**
- **Processes and parameters**
- **Preclosure**
  - **Thermal properties**
  - **Deformation and strength**
  - **Near-field environment**
- **Postclosure**
  - **Heat-driven processes**
  - **Near- and far-field environment**

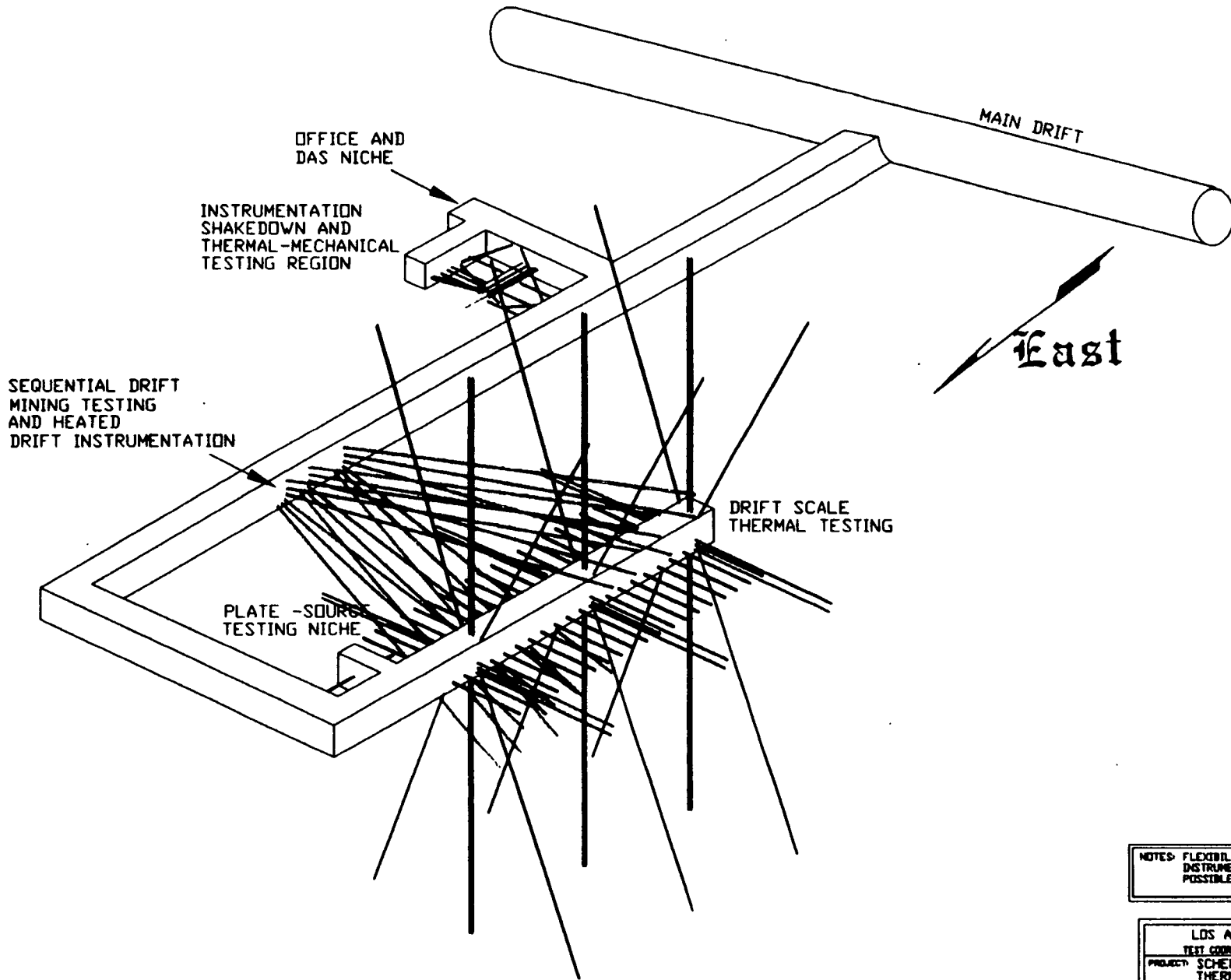
# ● Plan View of Thermal Test Area



# Cross-Section of Thermal Test Area



# SCHEMATIC ILLUSTRATION OF THE THERMAL TESTING REGION LAYOUT



NOTES: FLEXIBILITY MUST BE MAINTAINED TO FIELD THE INSTRUMENTATION SHUTDOWN AS EARLY AS POSSIBLE FROM THE BREAKOUT POINT.

NOTES: STROKE, DRP, AND THERMO-MECHANICAL CONTACT INFORMATION IS BASED ON DRL OR DRAWING 8-00-10-02 V GALS 'E' NORTH RAMP CROSS SECTION ALONG RAMP FROM 0+00 TO 29+00.30 P. (PT.)

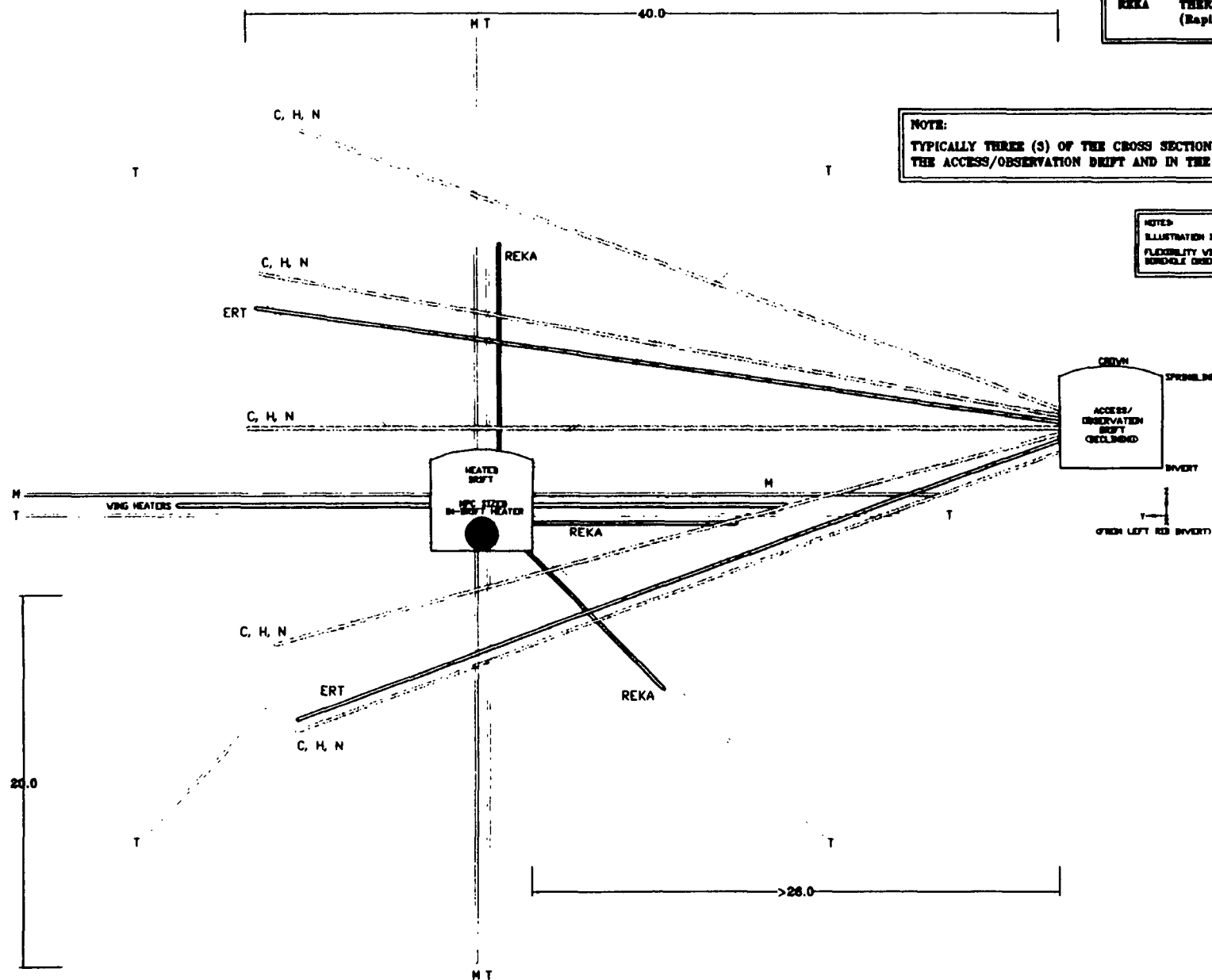
LOS ALAMOS NATIONAL LABORATORY  
TEST COORDINATION OFFICE - YUCCA MOUNTAIN PROJECT

LOS ALAMOS NATIONAL LABORATORY TEST COORDINATION OFFICE - YUCCA MOUNTAIN PROJECT			
PROJECT: SCHEMATIC ILLUSTRATION OF THERMAL TESTING IN THE ESF - PHASE I			
CAD FILE: THRMINDING	AUTOCAD FILE: A	REVISED:	NOTED:
DRAWN BY: EJ. WEAVER	APPROVED BY: R.E. OLSON/R.E. OLIVER	DATE: 08/01/93	REVISION: AS
NOTES: ADMINISTRATIVE/ILLUSTRATIVE USE ONLY			PLOT DATE:

# THEMAL TESTING IN THE OF - PHASE I

## HEATED DRIFT STAGE - BOREHOLE ARRANGEMENT AND TYPICAL CROSS-SECTION

### SECTION A-A TYPICAL CROSS SECTION W/ BOREHOLE PROJECTIONS



#### LEGEND:

T	TEMPERATURE HOLES
N	NEUTRON HOLES
C	CHEMISTRY HOLES
H	HYDROLOGY HOLES
M	MECHANICAL HOLES
ERT	ELECTRICAL RESISTIVITY TOMOGRAPHY
REKA	THERMAL CONDUCTIVITY AND DIFFUSIVITY (Rapid Evaluation of K and Alpha Thermal Probes)

#### NOTE:

TYPICALLY THREE (3) OF THE CROSS SECTIONS DEPICTED ABOVE WILL BE LOCATED ALONG THE ACCESS/OBSERVATION DRIFT AND IN THE HEATED DRIFT.

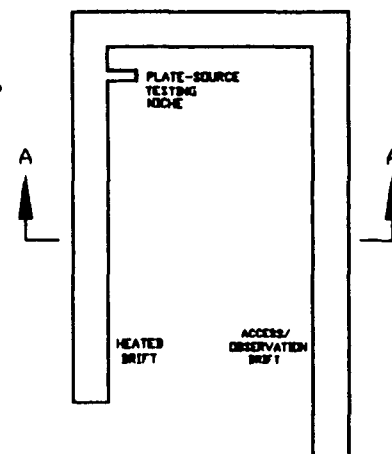
#### NOTES:

ILLUSTRATION IS FOR ADMINISTRATIVE USE ONLY. ALL DIMENSIONS IN METERS. FLEXIBILITY WILL BE MAINTAINED TO ADJUST ACTUAL CELLAR PLACEMENTS AND BOREHOLE ORIENTATION TO GEOLOGY ENCOUNTERED IN THE ALLOVES AND ACCESS.

#### REFERENCE:

FOR CELLAR COORDINATE HOLE DESCRIPTION AND CRITERIA, SEE SPEARSHEET, 'HEATED DRIFT HEATING STAGE - BOREHOLE LAYOUT TABLE,' THRUFILE.S.L.

#### CROSS-SECTION LEGEND



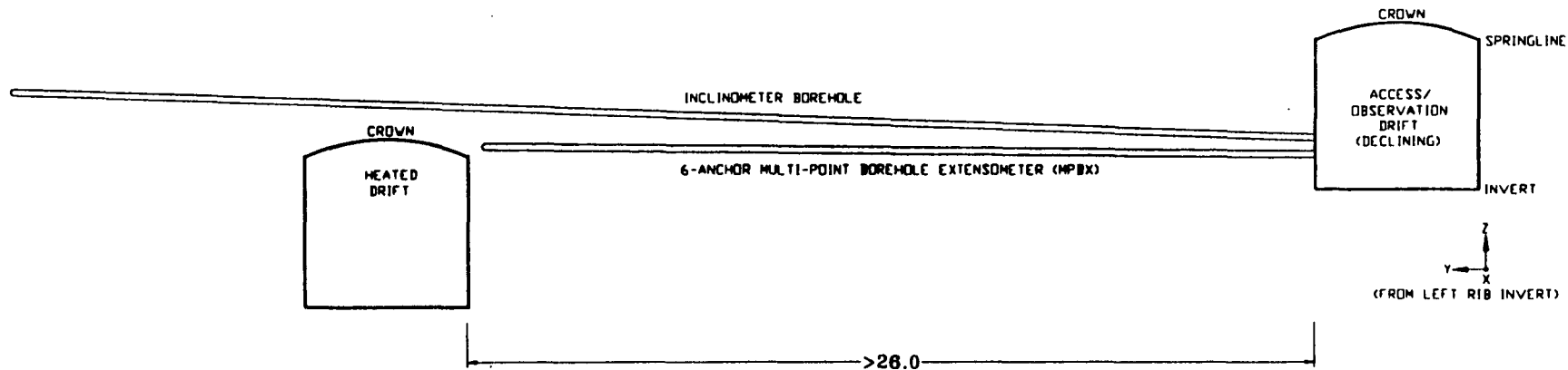
LDS ALAMOS NATIONAL LABORATORY					
TEST OBSERVATION OFFICE - YUCCA MOUNTAIN PROJECT					
PROJECT: SCHEMATIC ILLUSTRATION OF THE HEATED DRIFT STAGE BOREHOLE ARRANGEMENT					
CAD FILE: CDR/DRIFT/ARR	AUTOCAD FILE: A	DATE: 8/24/93	REVISED: 8/24/93	BY: [ ]	BY: [ ]
DRN BY: [ ]	APPROVED BY: [ ]	DATE: 8/24/93			
EL: [ ]	EL: [ ]	PLAT DATE: [ ]			
NOTES: ADMINISTRATIVE/ILLUSTRATIVE USE ONLY					



# THERMAL TESTING IN THE ES - PHASE I

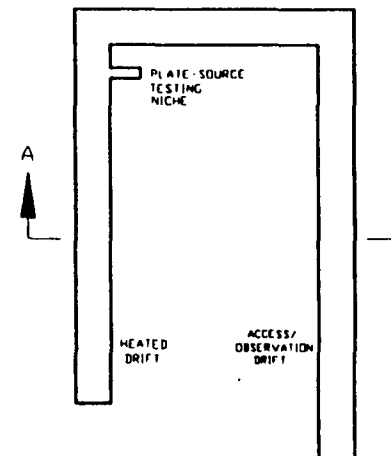
## SEQUENTIAL DRIFT MINING STAGE - BOREHOLE ARRANGEMENT AND TYPICAL CROSS-SECTION

### SECTION A-A TYPICAL CROSS SECTION W/ BOREHOLE PROJECTIONS



**NOTE:**  
TYPICALLY FIVE (5) SEQUENTIAL DRIFT MINING STATIONS (AS DEPICTED ABOVE) WILL BE LOCATED ALONG THE ACCESS/OBSERVATION DRIFT.

### CROSS-SECTION LEGEND



**NOTES:**  
ILLUSTRATION IS FOR ADMINISTRATIVE USE ONLY. ALL DIMENSIONS IN METERS.  
FLEXIBILITY WILL BE MAINTAINED TO ADJUST ACTUAL COLLAR PLACEMENTS AND BOREHOLE ORIENTATION TO GEOLOGY ENCOUNTERED IN THE ALCOVES AND ACCESSSES.

**REFERENCE:**  
FOR COLLAR COORDINATES, HOLE DESCRIPTION AND CRITERIA SEE SPREADSHEET, "SEQUENTIAL DRIFT MINING STAGE - BOREHOLE LAYOUT TABLE," THORNDIKE/ALS

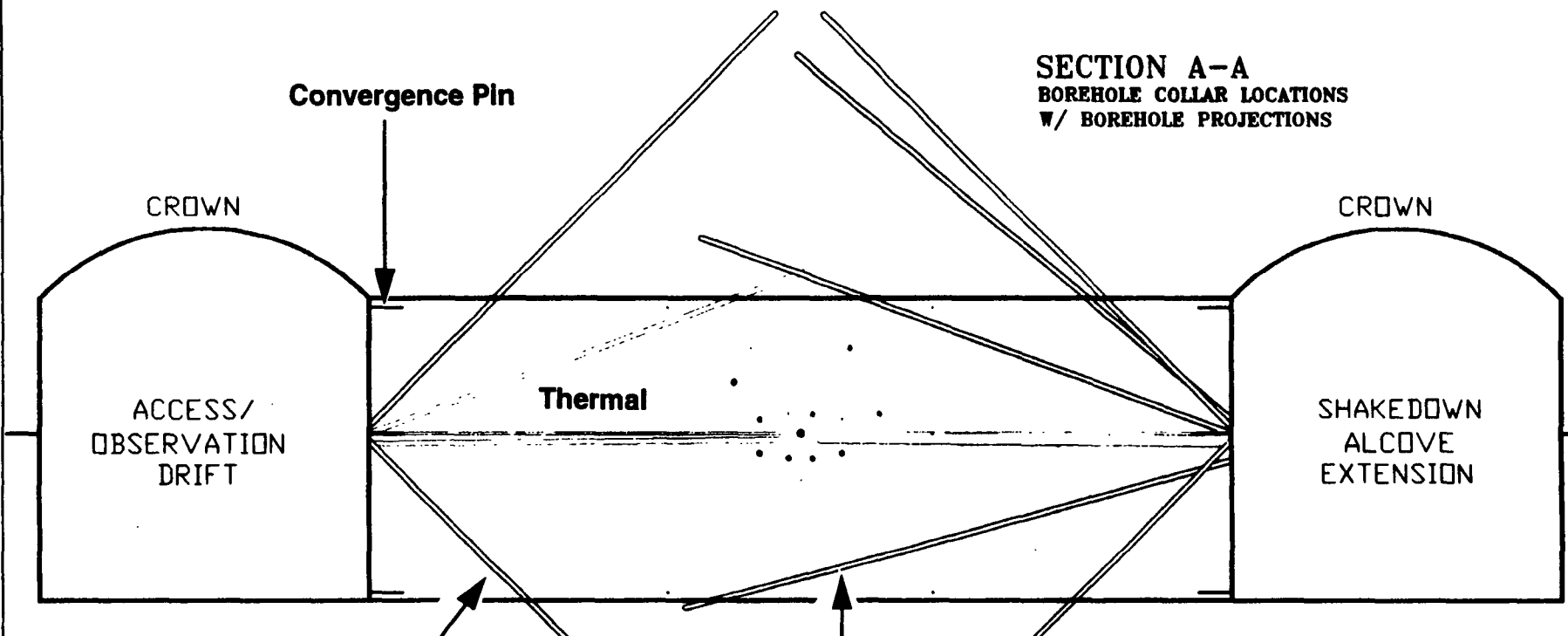
LOS ALAMOS NATIONAL LABORATORY  
TEST COORDINATION OFFICE - YUCCA MOUNTAIN PROJECT  
PROJECT: SCHEMATIC ILLUSTRATION OF THE SEQUENTIAL DRIFT MINING STAGE BOREHOLE ARRANGEMENT

CAD FILE: SMOCKING.DWG AUTOCAD RIB: A1  
BY: [Signature] DATE: 10/27/95  
NOTES: ADMINISTRATIVE/ILLUSTRATIVE USE ONLY

# THERMAL TESTING IN THE YF - PHASE I

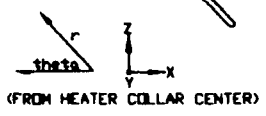
## SHAKEDOWN STAGE - ADMINISTRATIVE BOREHOLE ARRANGEMENT

### SECTION A-A BOREHOLE COLLAR LOCATIONS W/ BOREHOLE PROJECTIONS



ERT

Neutron

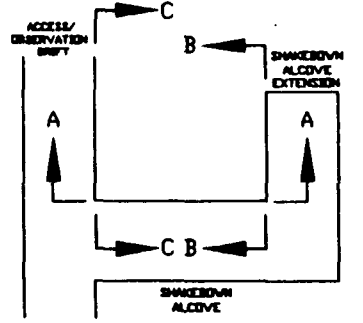


**NOTES**  
ILLUSTRATION IS FOR ADMINISTRATIVE USE ONLY. ALL DIMENSIONS IN METERS.  
FLEXIBILITY WILL BE MAINTAINED TO ADJUST ACTUAL COLLAR PLACEMENTS AND  
BOREHOLE ORIENTATION TO GEOLOGY ENCOUNTERED IN THE ALCOVE.

**REFERENCE**  
FOR COLLAR COORDINATES, HOLE DESCRIPTION AND CRITERIA, SEE  
SPREADSHEET, "SHAKEDOWN STAGE - BOREHOLE LAYOUT TABLE",  
THERM.S.I.L.

**NOTE**  
FOR COLLAR COORDINATES AND BOREHOLE LENGTH, THE TEST BLOCK  
IS ASSUMED TO BE 32 METERS IN HEIGHT. ACTUAL HEIGHT MAY  
BE SLIGHTLY GREATER TO ALLOW FOR OVERBREAK.

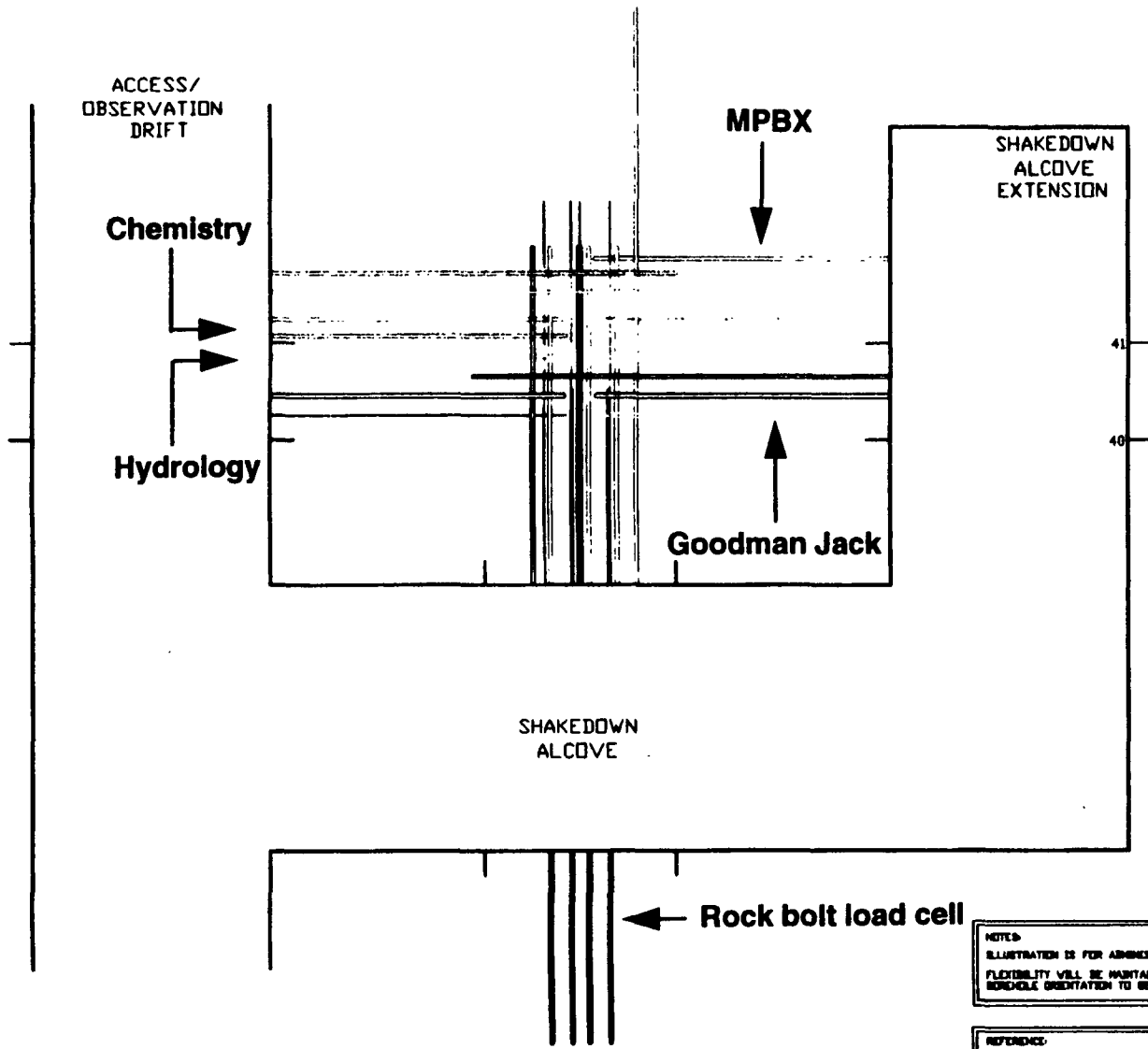
### CROSS-SECTION LEGEND



LOS ALAMOS NATIONAL LABORATORY			
THE OPERATIONAL SYSTEM - WOODS HOLE PROJECT			
PROJECT: SCHEMATIC ILLUSTRATION OF SHAKEDOWN STAGE BOREHOLE ARRANGEMENT			
CAR FILE NO.	INTEGRATED FILE NO.	DATE	REVISION
DRG. BY	APPROVED BY	DATE DRG.	
J.L. WOODS	J.L. WOODS	02/28/78	
NOTES	ADMINISTRATIVE/ILLUSTRATIVE USE ONLY		PLAT. DATE

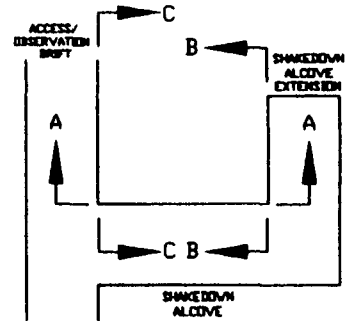
# THE THERMAL TESTING IN THE EST - PHASE I

## SHAKEDOWN STAGE - ADMINISTRATIVE BOREHOLE ARRANGEMENT



**PLAN VIEW**  
BOREHOLE COLLAR LOCATIONS  
W/ BOREHOLE PROJECTIONS

### CROSS-SECTION LEGEND



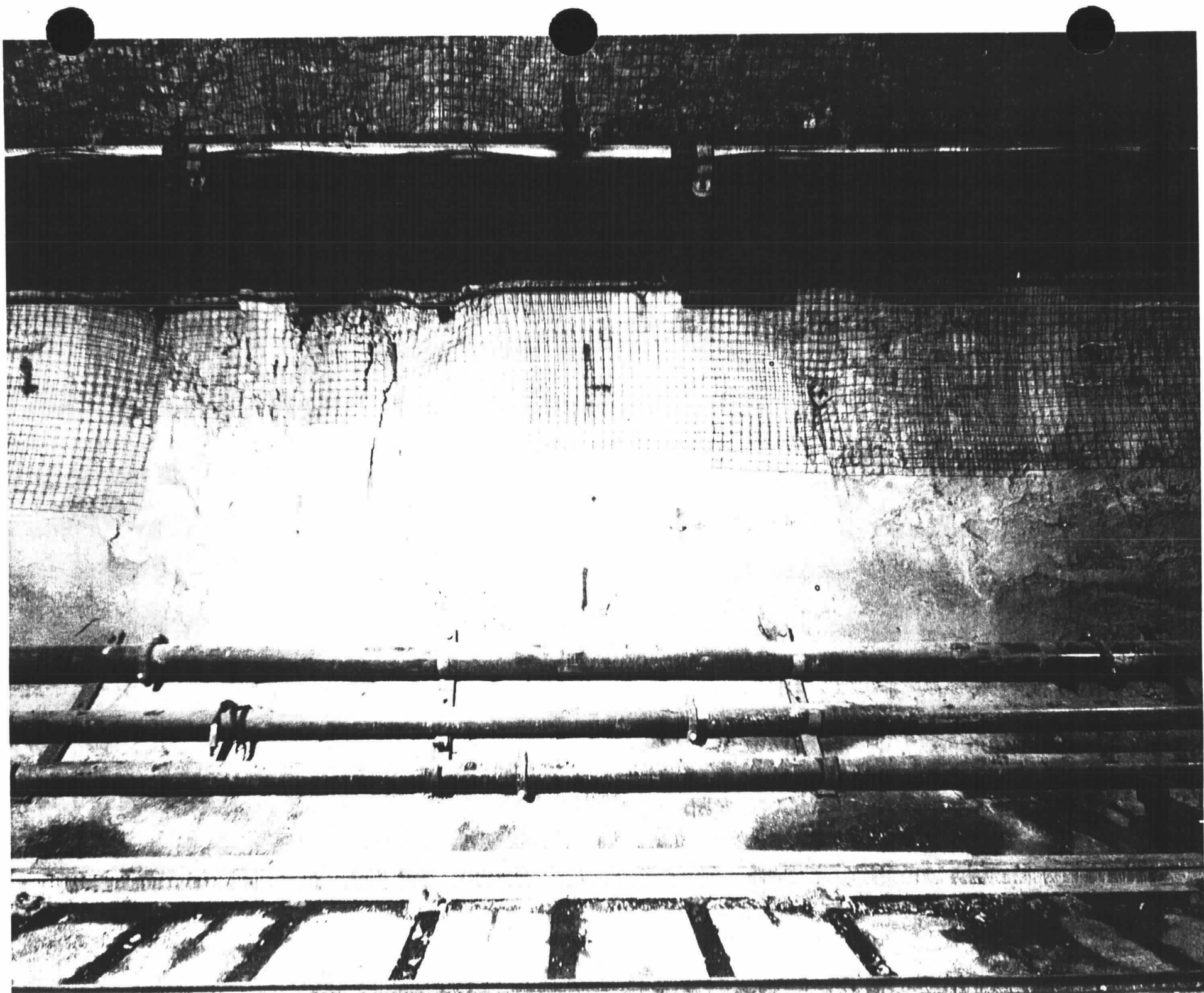
**NOTE:**  
ILLUSTRATION IS FOR ADMINISTRATIVE USE ONLY. ALL DIMENSIONS IN METERS.  
FLEXIBILITY WILL BE MAINTAINED TO ADJUST ACTUAL COLLAR PLACEMENTS AND  
BOREHOLE ORIENTATION TO GEOLOGY ENCOUNTERED IN THE ALCOVE.

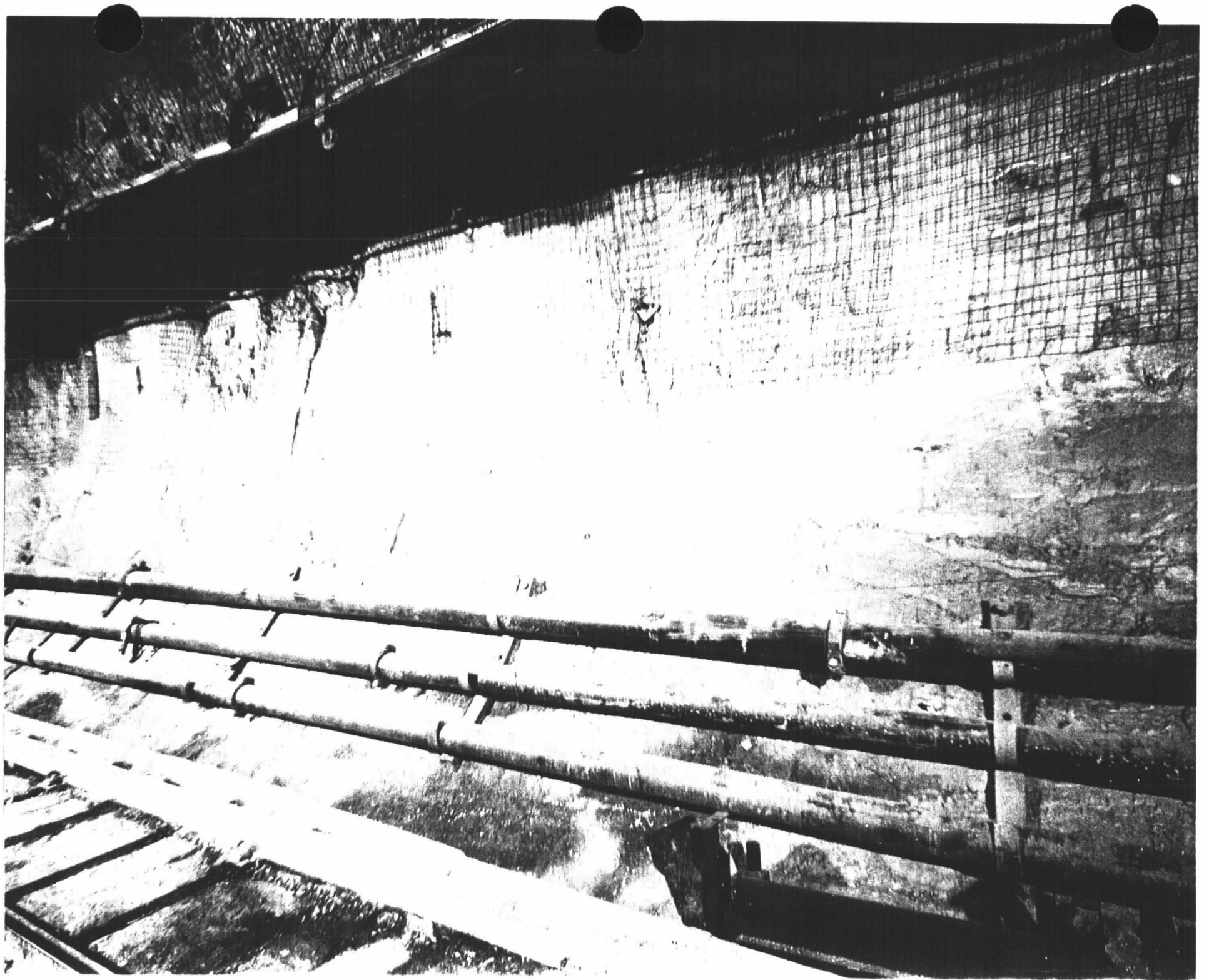
**REFERENCE:**  
FOR COLLAR COORDINATES, HOLE DESCRIPTION AND CRITERIA, SEE  
SPREADSHEET, "SHAKEDOWN STAGE - BOREHOLE LAYOUT TABLE,"  
THERMALS.E.L.

**NOTE:**  
FOR COLLAR COORDINATES AND BOREHOLE LENGTH, THE TEST BLOCK  
IS ASSUMED TO BE 22 METERS IN WIDTH. ACTUAL WIDTH MAY  
BE SLIGHTLY GREATER TO ALLOW FOR OVERBREAK.

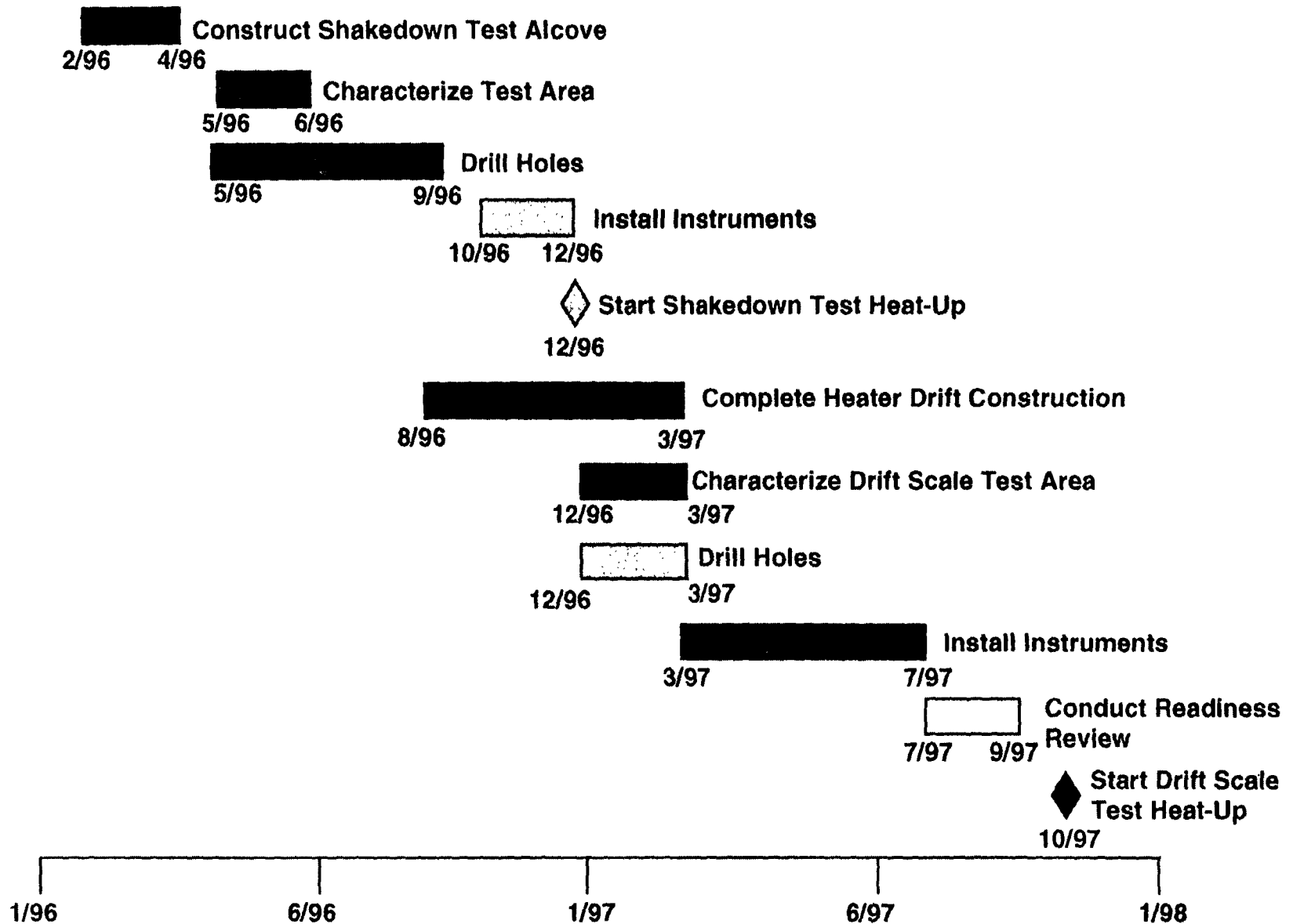


LOS ALAMOS NATIONAL LABORATORY			
TEST COORDINATION OFFICE - WUCA MOUNTAIN PROJECT			
PROJECT: SCHEMATIC ILLUSTRATION OF SHAKEDOWN STAGE BOREHOLE ARRANGEMENT			
CAD FILE: BOREHOLE	AUTOCAD FILE: A	DATE: 08/15/98	REVISION: 01
DRN: 01	APPROVED BY:	DATE: 08/15/98	
BY: WUCO	BY: BUREAU: WUCO		
REVISED: ADMINISTRATIVE/ILLUSTRATIVE USE ONLY		PLOT DATE:	

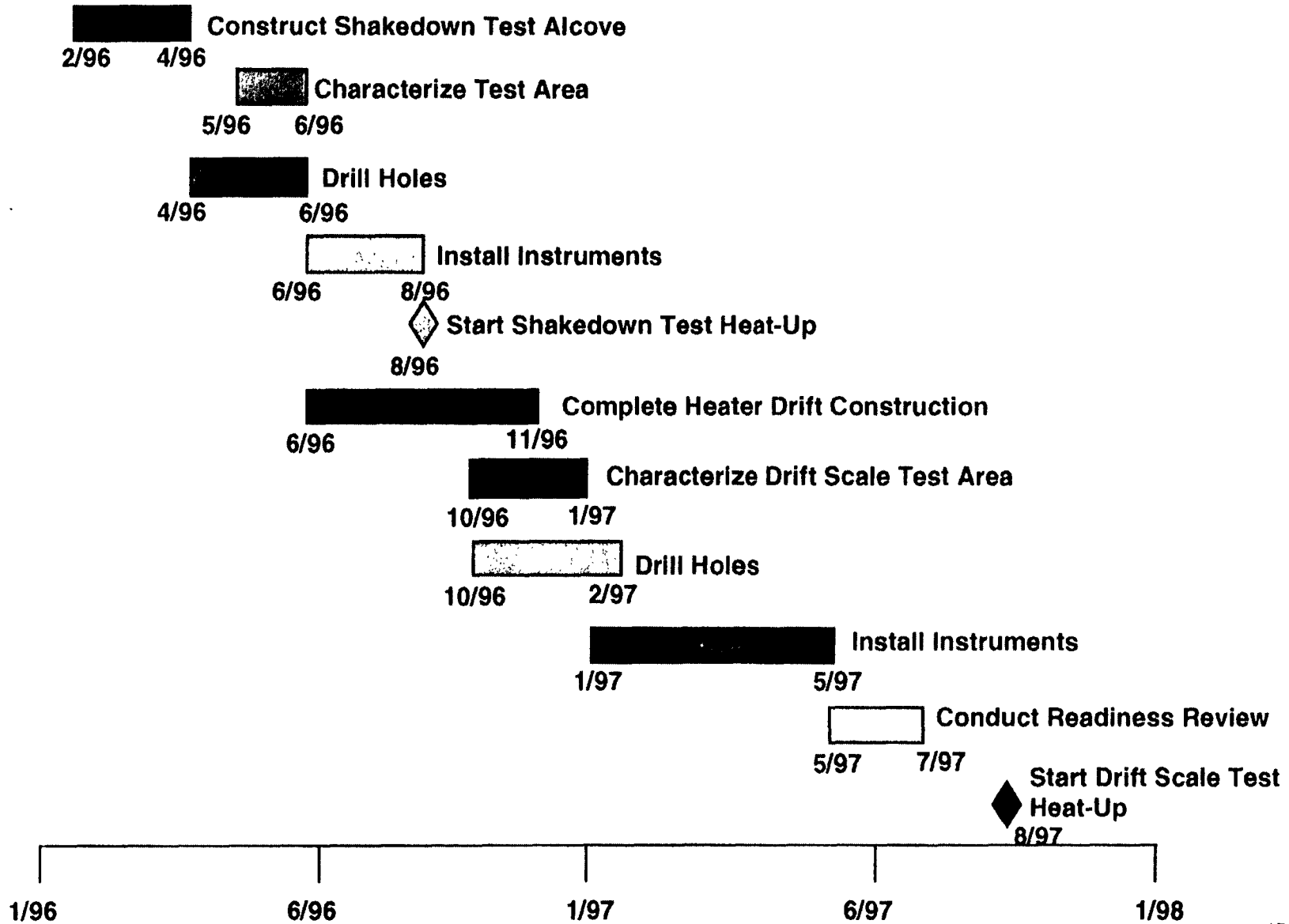




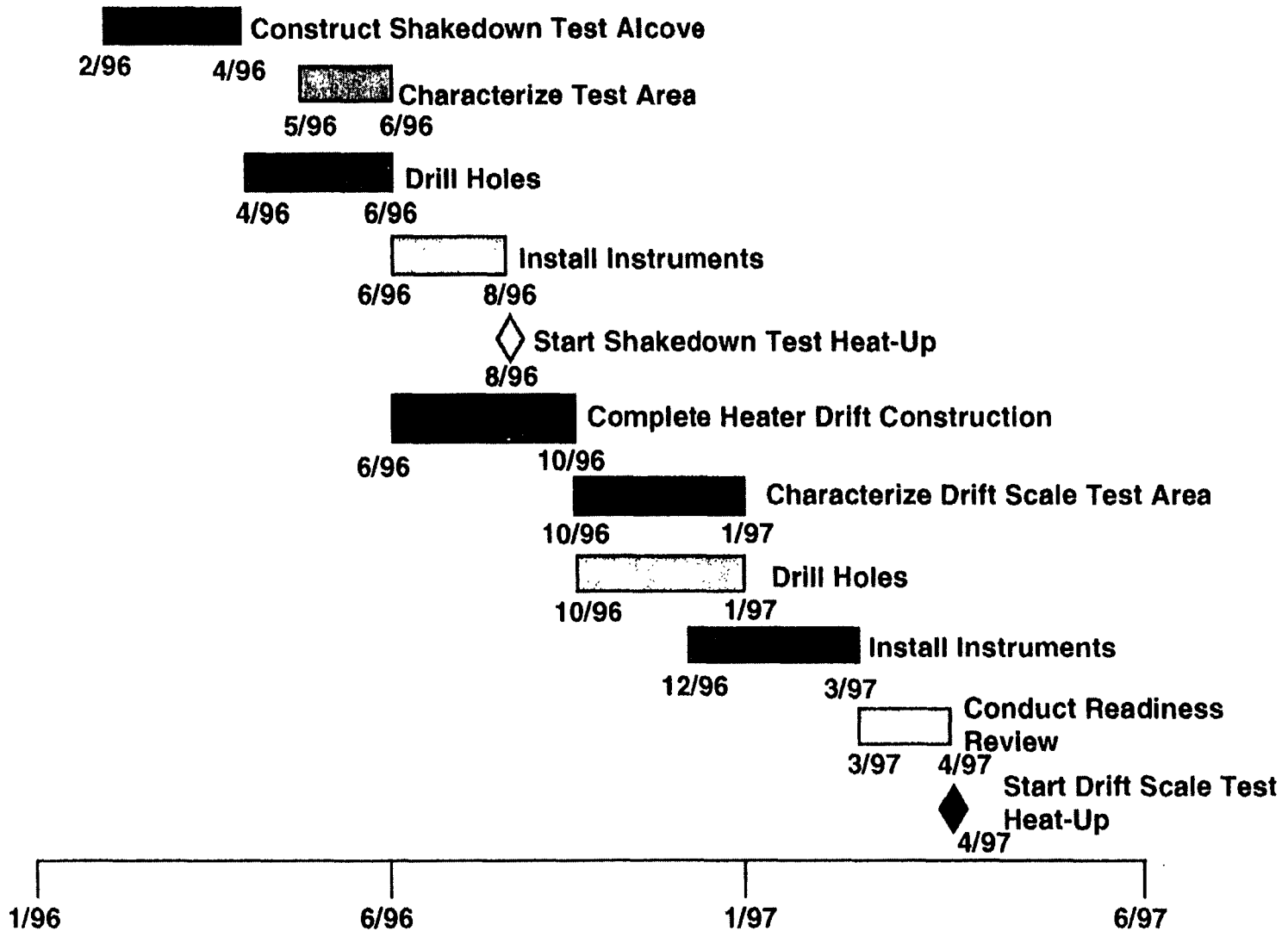
# ESF Thermal Test Schedule: Scenario #1



# ESF Thermal Test Schedule: Scenario #2



# ESF Thermal Test Schedule: Scenario #3





# Summary

- **Geologic disposal is based on using “equipment” largely supplied by nature**
- **Thermal load is one critical variable largely in the project’s control**