



**Department of Energy**  
Yucca Mountain Site Characterization  
Project Office  
P. O. Box 98608  
Las Vegas, NV 89193-8608

WBS 1.2.3  
QA: N/A

AUG 09 1993

**Michael D. Voegle**  
Technical Project Officer  
for Yucca Mountain  
Site Characterization Project  
Science Applications International Corporation  
Bank of America Center, Suite 407  
101 Convention Center Drive  
Las Vegas, NV 89109

**REQUEST TO INITIATE PLANNING ACTIVITIES - SITE PREPARATION, DRILLING,  
AND TESTING OF BOREHOLE UE-25 NRG-7 (SCP: N/A)**

Please initiate planning activities for site preparation, drilling, and testing of borehole NRG-7 at the location indicated on the enclosed map (enclosure 1). The workscope consolidation which describes the technical requirements for the borehole (enclosure 2) has been approved by the Regulatory & Site Evaluation Division with the following clarifications:

1. It is not necessary to core or sample the surficial materials (alluvium).
2. The borehole will penetrate the vitrophyre.
3. There will not be a systematic drilling (SD) component to this borehole. However, this work does not preclude future deepening for SD purposes should that effort be deemed necessary at a later date.

The borehole location and the drill pad have been staked in the field. The current schedule indicates that drilling could begin as soon as October 15, 1993. To meet this schedule, the appropriate planning documents and site preparation construction activities should be completed before October 15, 1993.

This letter authorizes Science Applications International Corporation to request detailed planning information and evaluations from all the responsible participants in accordance with the relevant administrative procedures in order to complete the necessary planning documents and other prerequisite activities.

102.8  
WM-11  
NH03

YMP-5

210090  
9309240006 930809  
PDR WASTE  
WM-11

PDR

AUG 09 1993

Michael D. Voegele

-2-

If you have any questions regarding drill pad preparation, please contact W. Arch Girdley at 295-7927. Questions regarding drilling can be referred to J. Timothy Sullivan at 794-7915.

  
J. Russell Dyer, Director  
Regulatory & Site Evaluation Division

RSED:JTS-5440

Enclosures:

1. Map
2. Workscope Consolidation

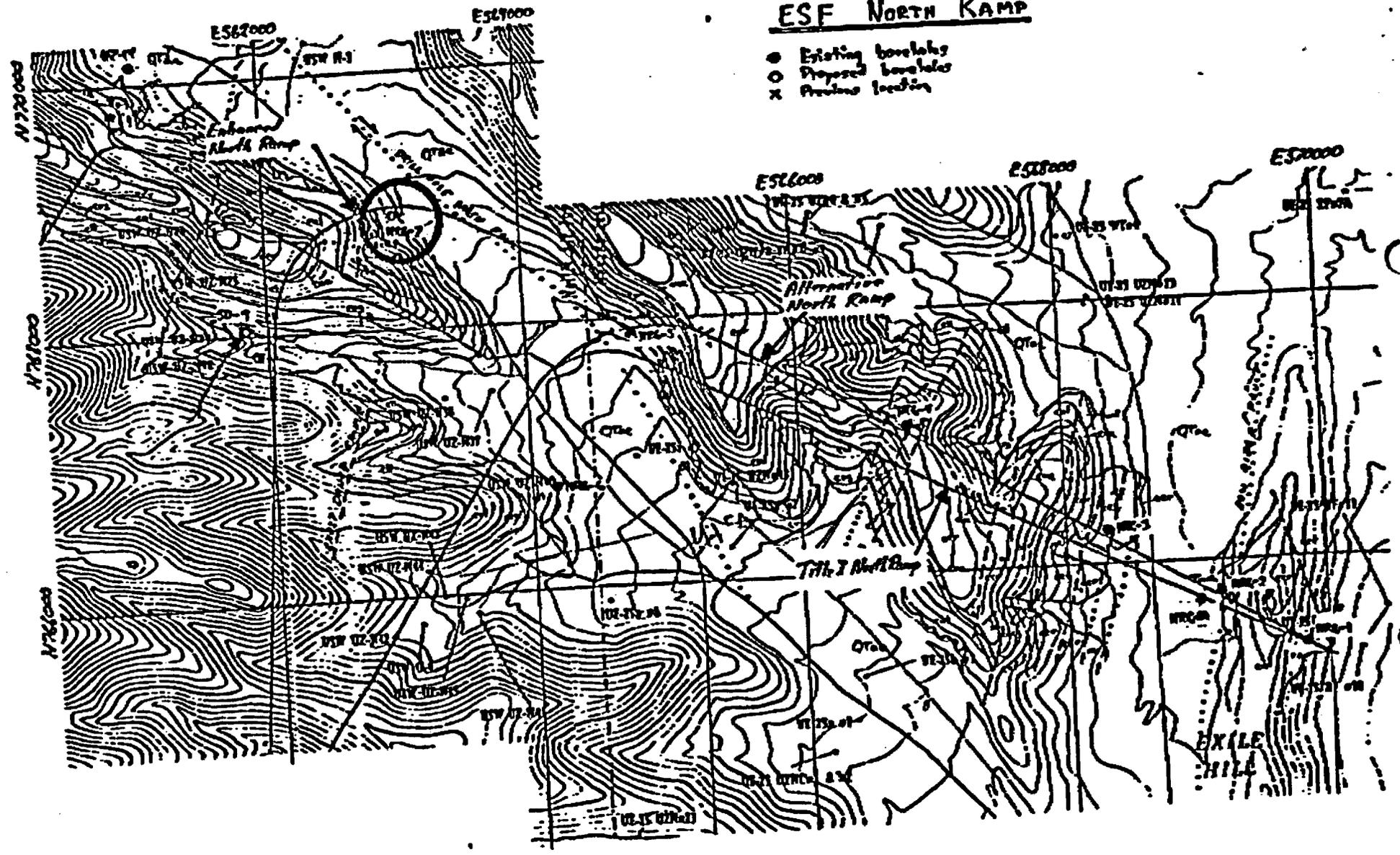
cc w/encls:

L. R. Hayes, USGS, Las Vegas, NV  
R. W. Craig, USGS, Las Vegas, NV  
L. E. Shephard, SNL, 6302, Albuquerque, NM  
D. S. Kessel, SNL, Las Vegas, NV  
W. L. Clarke, LLNL, Livermore, CA  
J. A. Canepa, LANL, Los Alamos, CA  
H. L. Lohn, SAIC, Las Vegas, NV  
S. C. Smith, SAIC, Las Vegas, NV  
R. F. Pritchett, REEC, Las Vegas, NV  
R. L. Bullock, RSN, Las Vegas, NV  
E. L. Wright, RSN, Las Vegas, NV  
N. E. Biggar, M&O/WCFS, Las Vegas, NV  
R. W. Elayer, M&O/MK, Las Vegas, NV  
W. A. Girdley, YMP, Mercury, NV, M/S 717  
R. C. Long, YMP, NV  
M. C. Tynan, YMP, NV  
J. T. Sullivan, YMP, NV  
D. R. Williams, YMP, NV

Figure 1

ESF NORTH RAMP

- Existing boreholes
- Proposed boreholes
- x Previous location



FROM NRC-LAS-VEGAS-----

09-15-93 10:27 AM

P04

ENCLOSURE

**TRW Environmental  
Safety Systems Inc.**

101 Convention Center Drive, Suite 527  
Las Vegas, NV 89109  
702.794.1800

B00000000-01717-2200-000

WBS: 1.2.3

QA: N/A

**Contract #: DE-AC01-91RW00134  
LV.SC.NEB.8/93-215  
August 5, 1993**

**J. Russell Dyer, Director  
Regulatory & Site Evaluation Division  
U. S. Department of Energy  
Yucca Mountain Site Characterization Project Office  
P. O. Box 98608**

**Attention: J. Timothy Sullivan**

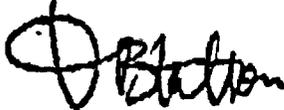
**Subject: Consolidated Work Scope for the USW NRG-7  
Borehole (SCP: 8.3.1.14.2)**

Attached is the consolidated workscope for the borehole USW NRG-7, which is primarily a borehole to support the design of the ESF north ramp; the requirements for this borehole from the engineering design group are attached as back-up information. Although this borehole is located at the northern apex of the proposed underground testing area, we have as yet received no feedback from LANL regarding any special interest they may have in this borehole location.

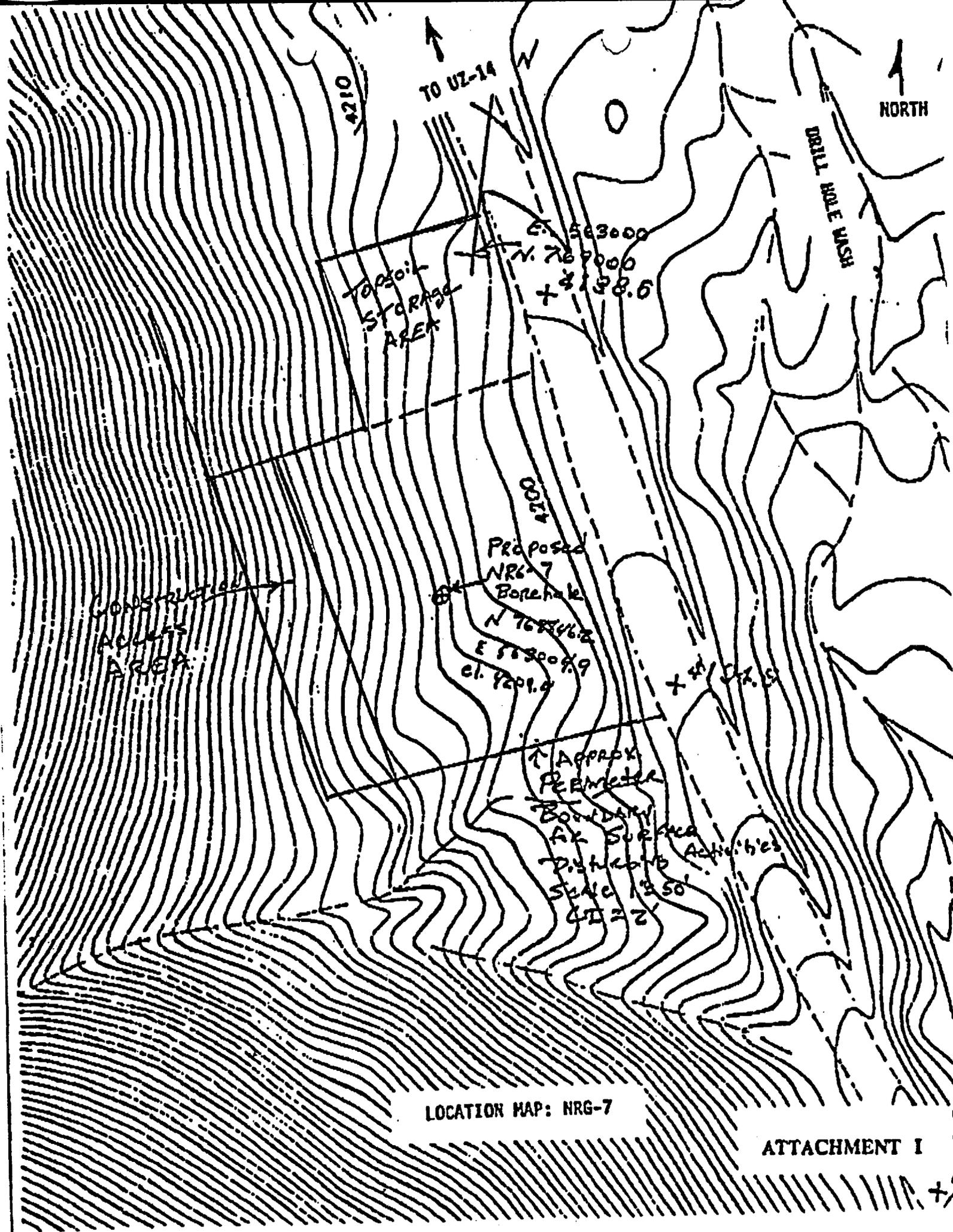
The schedule for acquiring core from this borehole and having the laboratory tests conducted in time for input to Design Package 2C requires that approximately 35 ft/day of core be collected during the month of October, assuming that the borehole is started on October 1. At this rate, it is anticipated that the ramp interval will be penetrated by the end of the month, and (barely) sufficient time is available to send the samples to the laboratory and receive test data back by the 15th of January, 1994.

If you have any questions, please call Norma Biggar at (702) 794-7428.

Sincerely,



**C. Thomas Statton, Manager  
Site Characterization  
Management and Operating Contractor**



LOCATION MAP: HRG-7

ATTACHMENT I

- to accommodate long-term gaseous monitoring equipment that may be emplaced in the hole at a future date.

7. **Coring Interval:** Core is to be collected from ground surface to TD. If the October 1, 1993 start date for drilling the borehole cannot be met, the coring interval may need to be revised following discussion with the design engineers regarding the schedule for input of data into the design process.
- The minimum coring interval is from the base of the Pah Canyon Member (at an estimated depth of 275 ft [Table 1 of Attachment II]) to TD.
8. **Core size:**
- 2.4 inches in diameter (HQ core)
  - If conditions mandate, core size can be reduced to 1.9 in. (NQ core)
9. **Special Core/Sample Handling at Wellhead**

The following special handling requests have been made by secondary users of the borehole, and are subject to review by the SOC. All core not packaged per the below requests should be boxed in non-sealed core boxes of suitable strength to allow safe transport to the SMF.

Matrix Properties of the Unsaturated Zone (Ref. 3):

Collect 2-inches to 3-inches of core at nominally 3 ft intervals and place in lexan liners and then in ProtecCore. If possible, do not break the core to provide the necessary sample pieces. Place spacers at each end of the core so that the end caps do not cover the core. If the ProtecCore is removed for examination of the core, replace it as soon as possible to prevent drying.

Hydrochemistry Study, Unsaturated Zone (Ref 4):

The following requested core is to be wrapped in plastic wrap, placed in a capped and sealed lexan liner, and sealed in ProtecCore:

- From non-welded to partially welded tuff
  - >5 ft thick: Three 6-inch samples, preferably adjacent sections of core, for a total of 18 inches of sample for every 10 feet of core.
  - < 5 ft thick: One to two 6-inch samples, as continuous or closely spaced as possible.
- From moderately to densely welded tuff: Five 6-inch pieces, preferably in adjacent sections, for a total of 30 inches of sample per 3 feet.
- From calcite-filled fractures  $\geq$  2 mm wide and/or vugs containing calcite crystals  $\geq$  2 mm wide: one 6-inch piece of core containing the calcite, as

well as two 6-inch samples above and below; total of 18 inches of sample per 30 ft of core.

- From lithologic contacts: one 6-inch-long sample of contact, plus two 6-inch-long samples from above and below the contact, for a total of 18 inches of sample.

- From wet or moist zones:

- In non- to partially welded tuff: Three 6-inch core sample (18 inches total) for every 10 ft of wet zone; if multiple wet zones are present, collect two 6-inch segments (12 inches total) of each wet zone.
- In moderately to densely welded tuff: Five 6-inch core segments (30 inches total); if multiple wet zones, collect three 6-inch segments in each wet zone (18 inches total).

Water Movement Tracer Tests (Ref 5):

- Ream-bit cuttings are to be collected from the same stratigraphic intervals from which core samples are specified for hydrochemical testing.
- If no hydrochemical samples are collected, cutting samples should still be collected from the prescribed interval.
- Cuttings should be collected from a 0.5 to 1.0-ft-interval of ream-down; expected sample weight is 50 - 130 lbs.
- Additional cuttings are requested from selected weathered fractures or fracture zones, as evidenced by iron staining in core, and determined by the drillsite geologist.

10. Logging:

- Cuttings are to be logged for all intervals not cored.
- Complete geologic and rock structure descriptions of the cored interval, including (Attachment II):
  - core run intervals
  - percent recovery
  - run RQD
  - fracture descriptions
  - RQD per 10-ft section of core
  - hardness estimate
  - weathering description
  - percent lithophysae
  - graphic lithologic log
  - lithologic description and stratigraphy.
- Geophysical logging to be conducted in the borehole will be determined after the results in the logging in NRG-6 are analyzed.

- 11. Tracers, Fluids and Materials:**
- The hole will be drilled with a gas tracer added to the drilling air. If SF<sub>6</sub> is selected, it will be added at concentrations ranging from 0.75 to 2.5 ppm.
  - No tracers, fluids, or other materials are to be introduced downhole prior to collection of the ream-bit cuttings, other than those specifically identified in this consolidated work scope, or in the appropriate TPP, job package, work program, or test interference evaluation for the borehole (Ref 5).
- 12. Testing and Monitoring of the Unsaturated Zone**      At the present time, no requests have been made by the participants for testing and monitoring to be conducted in this borehole after geophysical logging has been conducted. The USGS may decide to install instruments in the future to monitor gaseous phase movement in the unsaturated zone.
- 13. Responsible Principal Investigators:**

From about 0 ft depth to TD (about 1445 ft):

Primary User:      Dave Kessel, SNL; Soil and Rock Properties (8.3.1.14.2)

#### MISCELLANEOUS SPECIFICATIONS

- 1. Access Road:**      Drill Hole Wash Road
- 2. Drill Pad:**      An estimated area of approximately 22,500 square feet, with a minimum width of 125 feet, is required for the drill rig.
- 3. Water Table:**      The borehole is not anticipated to be of sufficient depth to encounter the water table. A moist zone was encountered at the top of the vitrophyte in UZ-14, about 3500 ft to the northwest. Therefore, there is a possibility the a moist zone may be encountered in this borehole above the vitrophyte.
- 4. Water Discharge:**      No discharge of water from the borehole is anticipated.
- 5. Equipment/Special Services to be Supplied by Contractor:**  
  
Drill rig and associated services/equipment.
- 6. Environmental Study Plots:**      There are no environmental study plots shown in close proximity to the proposed borehole location in the EG&G data base.

## REFERENCES

1. Field map drawn by DOE Field Test Coordinator (Attachment 1), received on July 30, 1993.
2. Letter to Simecka (YMPO) from Sandifer (M&O), dated July 20, 1993, "Borehole Information Schedule for ESF design," LV.SB.RWE.7/93-573
3. Memo to Deborah Edwards from Alan Flint, dated May 20, 1993, regarding instructions for core collection for SRG-5/SD-11.
4. Comments/Directions, Sample Request for USW SRG-5/SD-11, received from D. Edwards, late May, 1993.
5. Memo to J. Dyer from R. Oliver (LANL), dated June 3, 1993: "USW SRG-5/SD-11 and NRG-4 Drilling Activities Design and Test-Related Information - SCP 8.3.1.2.2.1"

Handwritten scribbles and markings on the right side of the page, including a large 'X' and various lines.

**Recommended Drilling Program  
for Proposed Enhanced ESF North Ramp Design  
R. Elayer July 26, 1993**

**Introduction**

At present, there are seven boreholes drilled in support of the ESF north ramp design. Because of the introduction of the proposed enhanced ESF design, additional drilling is needed for control of the extension of the ramp west of the Drill Hole Wash fault. It is proposed that a new borehole (NRG-7) be drilled in this area. Results from NRG-7 and another borehole, SD-9, proposed as part of the main drift drilling, will provide information for the design of the north ramp. This document outlines the requirements for this drilling.

*\* corrected as per conversation D.B. Elayer NRE 8/1/93  
SURVEIL coordinates: N768,840, E563,005*

**Borehole Description**

Borehole NRG-7 is proposed to be located at the edge of Drill Hole Wash at approximate coordinates N768850, E563000 and at an elevation of about 4210 feet (Figure 1). At this location, the borehole will be about 100 feet south of the projected path of the ramp and within the western block of the Drill Hole Wash Fault. The borehole must be located so it is at least 40 feet from the ramp.

This borehole should be cored from about 300 feet to the total depth of 850 feet (Figure 2). The strata to be included in the cored interval is from the pre-Pah Canyon bedded tuff to the middle nonlithophysal zone of the Topopah Spring Member. This interval will include the proposed enhanced ESF north ramp intercept and stratigraphically higher units that were missed in borehole NRG-5.

**Projected Stratigraphy**

The projected stratigraphic picks for the <sup>north</sup> ~~south~~ ramp boreholes are presented in Table 1. The picks are based on the cross sections developed from the USGS Lynx demonstration model (April 26, 1993) and Scott and Bonk "Preliminary Geologic Map of Yucca Mountain, Nye County, Nevada, with Geologic Sections" (1984).

**Geology and Rock Structure Logging**

Geology and rock structure logs are needed for this borehole. The logs should be of the same format as are being used for the other north ramp boreholes. These logs include:

- core run intervals
- percent recovery
- run RQD
- fracture descriptions
- RQD per 10-foot section
- fractures per 10-foot section
- hardness estimate
- weathering description
- percent lithophysae

**ATTACHMENT II**

- graphic lithology log
- lithologic description and stratigraphy

#### **Geophysical Down-hole Logging**

Geophysical down-hole logging is recommended for this borehole. The logs to be run will be decided at a later date based on the outcome and determined usefulness of the logging for the other north ramp boreholes.

#### **Geotechnical Sampling and Testing**

The geotechnical testing that was performed on samples from the other north ramp boreholes should also be performed on this borehole. The tests that were performed include:

- uniaxial compression
- triaxial compression
- Brazilian tensile
- physical properties (density, moisture content, porosity)
- thermal properties (thermal conductivity, heat capacity, coefficient of thermal expansion)

The details of the sampling and testing program will be developed in cooperation with SNL. Schedules for sampling of core from this borehole is presented in Table 2 (unconfined compression), Table 3 (triaxial compression), Table 4 (Brazilian tensile), and Table 5 (thermal properties). These schedules should be used as a guide for selecting the intervals and frequency of sampling. For the uniaxial and triaxial tests, a minimum six-inch length of core is needed. For Brazilian tensile and thermal properties tests, a minimum four-inch core length is needed. Physical properties will be determined for each sample taken.

#### **Schedule Requirements**

The NRG-7 borehole is to be drilled mainly for information to design the north ramp and north end of the main drift. Information for engineering design is needed by January 1994.

Timeliness in data transfer is very important. Preliminary data should be delivered when available so the design work can precede on schedule. Delaying distribution of this data while waiting for completeness is detrimental to our schedule and design work.

Table 1. Projected stratigraphic picks for the proposed NRG-7 borehole. Shaded portion identifies interval to be cored.

STRATIGRAPHIC UNIT	SYMBOL	T/M UNIT	NRG-7 DEPTH TO TOP (FT)
Alluvium and colluvium	Q <sub>loc</sub>	UO	0
<u>TIMBER MOUNTAIN TUFF</u> Rainier-Hesa Member	Trm	UO	N/A
bedded tuff	bt	UO	N/A
<u>PAINTBRUSH TUFF</u> Tiva Canyon Member Caprock	ccr	TCW	N/A
Upper cliff	cuc		N/A
Upper lithophysal	cul		N/A
Nonlithophysal clinkstone	cks		N/A
Lower lithophysal	cll		N/A
Hackly	ch		5
Columnar	cc		20
Shardy base	ccs	70	
bedded tuff	bt	PTn	110
<u>PAINTBRUSH TUFF</u> Yucca Mountain Member	ym		120
bedded tuff	bt		170
<u>PAINTBRUSH TUFF</u> Fab Canyon Member	pc		190
bedded tuff	bt		275
<u>PAINTBRUSH TUFF</u> Topopah Spring Member Caprock	tc	TSw1	280
Rounded	tr		340
Upper lithophysal	cul		510
Middle nonlithophysal	tmn	TSw2	800
Lower lithophysal	tll		925
Lower nonlithophysal	tin		1260
Vitrophyre	tv	TSw3	1390
Partially welded		CHn1 CHn2	
<u>TUFFACEOUS BEDS OF CALICO HILLS</u>	Thc		
<u>CRATER FLAT TUFF</u> Frow Pass Member	Tcp	CHn3 PPw	

Total Depth

900

Table 2. Recommended sampling intervals for unconfined compression laboratory tests. Shaded portion indicates interval to be cored.

STRATIGRAPHIC UNIT	SYMBOL	T/M UNIT	SAMPLES for NRS-7
Alluvium and colluvium	QTC		
<del>TIMBER MOUNTAIN TUFF</del> Rainier Mesa Member	Trm		
bedded tuff	bt		
<del>PAINTBRUSH TUFF</del> Tiva Canyon Member	ccr	TCW	
bedded tuff	bt	PTn	
<del>PAINTBRUSH TUFF</del> Yucca Mountain Member	ym		
bedded tuff	bt		
<del>PAINTBRUSH TUFF</del> Pah Canyon Member	pc		
bedded tuff			
<del>PAINTBRUSH TUFF</del> Topopah Spring Member Caprock	tc	TSw1	
Rounded	tr		
Upper lithophysal	tul		
Middle nonlithophysal	tan	TSw2	
Lower lithophysal	tll		
Lower nonlithophysal	tin		
Vitrophyte	tv	TSw3	
<del>TUFFACEOUS BEDS OF CALICO HILLS</del>	Tht		
<del>CRATER FLAT TUFF</del> Prow Pass Member	Tcp	PPW	

Total

62

Table 3. Recommended sampling intervals for triaxial compression laboratory tests. Shaded portion indicates interval to be cored.

STRATIGRAPHIC UNIT	SYMBOL	T/M UNIT	SAMPLES for NRG-7
Alluvium and colluvium	QOC		
<u>TIMBER MOUNTAIN TUFF</u> Rainier Mass Member	Trm		
bedded tuff	bt		
<u>PAINTBRUSH TUFF</u> Tiva Canyon Member	ccr	TCV	
bedded tuff	bt	PTn	
<u>PAINTBRUSH TUFF</u> Yucca Mountain Member	ym		
bedded tuff	bt		
<u>PAINTBRUSH TUFF</u> Fah Canyon Member	pc		
bedded tuff	bt		
<u>PAINTBRUSH TUFF</u> Topopah Spring Member Caprock	cc	TSW1	
Rounded	cr		6
Upper lithophysal	tul		22
Middle nonlithophysal	tmn	TSW2	6
Lower lithophysal	tll		
Lower nonlithophysal	tln		
Vitrophyre	cv	TSW3	
<u>TUFFACEOUS BEDS OF CALICO HILLS</u>	Thc		
<u>CRATER FLAT TUFF</u> Frow Pass Member	Tcp	PPV	

Total.

24

Table 4. Recommended sampling intervals for Brazilian tensile laboratory tests. Shaded portion indicates interval to be cored.

STRATIGRAPHIC UNIT	SYMBOL	T/N UNIT	SAMPLES FOR NRG-7
Alluvium and colluvium	QToC		
<b>TIMBER MOUNTAIN TUFF</b> Rainier Mesa Member	Trm		
bedded tuff	bt		
<b>PAINTBRUSH TUFF</b> Tiva Canyon Member	ccr	TCV	
bedded tuff	bt	PTn	
<b>PAINTBRUSH TUFF</b> Yucca Mountain Member	ym		
bedded tuff	bt		
<b>PAINTBRUSH TUFF</b> Fah Canyon Member	pc		
bedded tuff	bt		3
<b>PAINTBRUSH TUFF</b> Topopah Spring Member Caprock	tc	TSw1	2
Rounded	tr		11
Upper lithophysal	tul		10
Middle nonlithophysal	tmm	TSw2	7
Lower lithophysal	tl1		
Lower nonlithophysal	tln		
Vitrophyre	tv	TSw3	
<b>TUFFACEOUS BEDS OF CALICO HILLS</b>	Thc		
<b>CRATER FLAT TUFF</b> Frow Pass Member	Tcp	FPW	

Total .

42

Table 5. Recommended sampling intervals for thermal properties laboratory tests. Shaded portion indicates interval to be cored.

STRATIGRAPHIC UNIT	SYMBOL	T/M UNIT	SAMPLES for NRG-7
Alluvium and colluvium	QToc		
<u>TIGER MOUNTAIN TUFF</u> Rainier Mesa Member	Trm		
bedded tuff	bt		
<u>PAINTBRUSH TUFF</u> Tiva Canyon Member	ccr	TCV	
bedded tuff	bt	PTn	
<u>PAINTBRUSH TUFF</u> Yucca Mountain Member	ym		
bedded tuff	bt		
<u>PAINTBRUSH TUFF</u> Pah Canyon Member	pc		
bedded tuff			2
<u>PAINTBRUSH TUFF</u> Topopah Spring Member Caprock	tc	TSw1	4
Rounded	tr		6
Upper lithophysal	tul		12
Middle nonlithophysal	cmn	TSw2	6
Lower lithophysal	tll		
Lower nonlithophysal	tin		
Vitrephyre	tv	TSw3	
<u>TUPPACHONS BEDS OF CALICO HILLS</u>	Tht		
<u>CRATER FLAT TUFF</u> Frow Pass Member	Tcp	PPw	

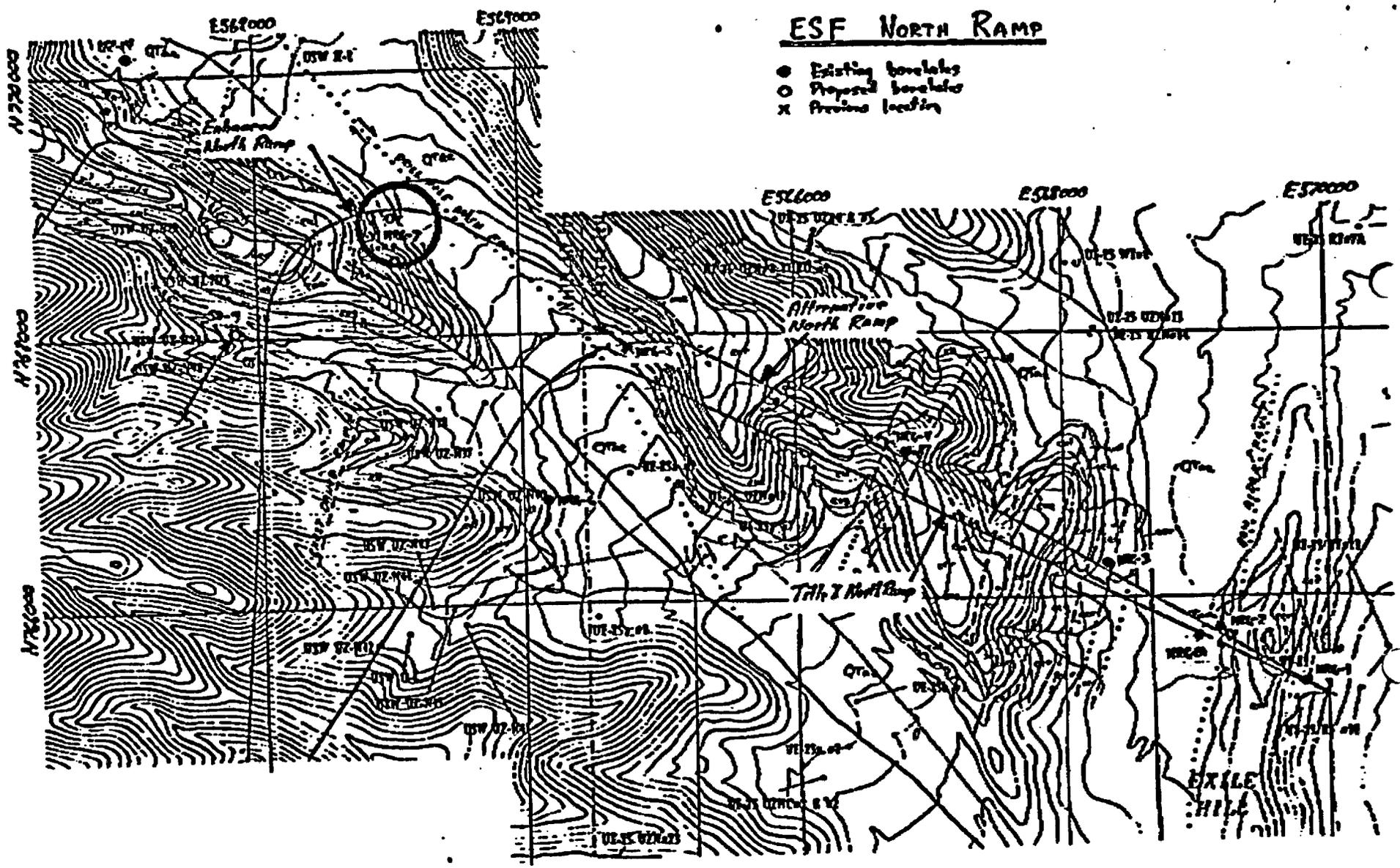
Total

28

Figure 1

ESF NORTH RAMP

- Existing boreholes
- Proposed boreholes
- x Previous location



Drill Hole  
Wash Fault

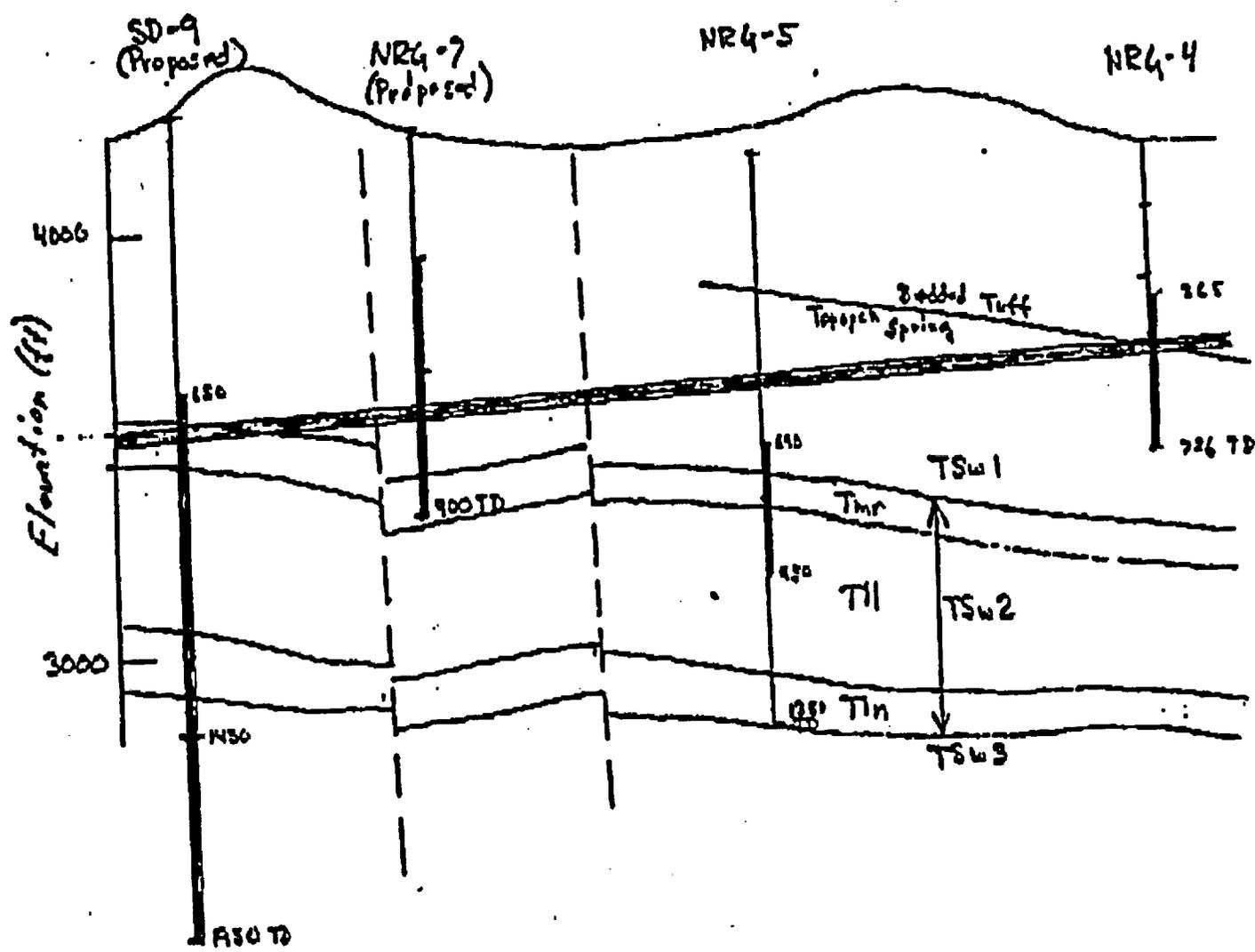


Figure 2  
North Ramp Profile  
through Drill Hole Wash Extension

SUBSURFACE MINERAL RESOURCE  
ANALYSIS, YUCCA MOUNTAIN, NEVADA:  
FINAL REPORT OF CHEMICAL ANALYSES

*by Castor, Tingley and Bonken*

Nevada Bureau of Mines and Geology

MACKAY SCHOOL OF MINES



UNIVERSITY OF NEVADA  
RENO

*dated Mar 23, 1993*

*25 pp.*