Simplified Geologic Map of Yucca Mountain in the Vicinity of the Perimeter Drift and Associated Map Overlays

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October 1, 1990

Prepared for
Division of High-Level Waste Management
Office of Nuclear Material Safety and Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

NRC FIN D1018

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INTRODUCTION

The Bureau of Mines, under Work Directive 026, Task Order 002 of Interagency Agreement NRC-02-85-004, compiled a geologic map of the Yucca Mountain site based upon the Castor, et al (1) 1/ modification of Scott and Bonk's 1984 work (2), information from a Department of Energy (DOE) engineering contractor (3), and the DOE Yucca Mountain Site Characterization Plan (SCP) (4). A series of map overlays was also prepared. In addition, a report was prepared in which the purpose, source, and limitations of the compiled map and overlays was described.

PURPOSE

Many geologically oriented scientific and engineering studies have been conducted by the DOE or its contractors at the proposed high-level radioactive waste site at Yucca Mountain, NV. These include, but are not limited to preliminary geological mapping, geochemical sampling, trenching, and borehole drilling. The results of these studies, while generally available piecemeal, are not available in a single document. The purpose of Work Directive-026 is to compile a stand-alone work of selected natural resource-related investigations that have been, or are planned to be, conducted at the Yucca Mountain site by the DOE or its contractors.

1/Underlined numbers in parentheses refer to items in the reference list.

SOURCES OF INFORMATION

As indicated in the introduction, information for the map compilation and companion overlays was acquired primarily from five major sources which include:

° "Preliminary Geologic Map of Yucca Mountain, Nye County, Nevada with Geologic Sections" by R. B. Scott and J. Bonk (2);

° "Mineral Evaluation of the Yucca Mountain Addition, Nye County, Nevada" by S. B. Castor, S. C. Feldman, and J. V. Tingley (1);

° Nevada Nuclear Waste Storage Investigation Atlas of Field Activities--Drill holes, Trenches, and Roads, Sheets 57, 58, and 59 by Holmes and Narver, Inc., Energy Support Div.(3);

° Site Characterization Plan, Yucca Mountain Site, Nevada Research and Development Area, Nevada, U. S. Department of Energy (4), and;

° Aerial View of the Yucca Mountain Study Area, a photo-illustration produced by Holmes and Narver, Inc., Energy Support Div. (5).

A discussion of each source of information is presented in the following section.

DISCUSSION

Work of Scott and Bonk, 1984 (2)

In 1984, R. B. Scott and J. Bonk prepared a preliminary geologic map of Yucca Mountain, Nye County, Nevada on behalf of the DOE. The map, based on the U.S. Geological Survey's Topopah Spring NW and Topopah Spring SW 1:24,000 topographic maps, was drafted at the scale of 1:12,000 between 36° 47′ 46" and 36° 56′ 00" north latitude and 116° 22′ 30" and 116° 30′ 00" west longitude. Geologic information included rock unit contacts; dikes along faults; faults showing direction and dip; faults showing strike-slip displacement; horizontal beds; attitudes (strike and dip) of beds or foliation in welded tuffs; attitudes of vertical beds or foliation; attitudes of overturned beds or foliation; attitudes of flow-banded foliation in lava flows; drillhole locations; tectonic breccia zones; fractures; and fracture sets.

Rocks Mapped by Scott and Bonk

The following major rock units mapped by Scott and Bonk are presented here to provide an insight into the lithologic complexity of the Yucca Mountain area (unit zones and sub-zones omitted here). Those rock units indicated by an asterisk are included on Castor's simplified geologic map (see following section).

Quaternary

Alluvium and colluvium *

Tertiary volcanics

Rhyolite of Fortymile Canyon
Basalt Dikes of Yucca Mountain
Timber Mountain Tuff

Rainier Mesa Member *

Bedded tuff *
Rhyolite of Windy Wash
Paintbrush Tuff

Tiva Canyon Member *

Bedded tuff *

Yucca Mountain Member *

Topopah Spring Member *

Tuffaceous Beds of Calico Hills
Crater Flat Tuff

Prow Pass Member

Bedded Tuff

Bullfrog Member

Work of Castor, et al, 1990 (1)

Background

In January 1989, the DOE filed an application with the U. S. Bureau of Land Management (BLM) for an administrative land withdrawal of 4,255.5 acres bordering the western edge of the Nevada Test Site (NTS) and the southern edge of the Nellis Air Force Range (NAFR). This land is referred to as the Yucca Mountain Addition (YMA) (1, p. 1).

The Federal Land Policy and Management Act of 1976 (FLPMA) requires an agency requesting such a land withdrawal to furnish Congress ". . . a report prepared by a qualified mining engineer, engineering geologist, or geologist which shall include but not be limited to information on: general geology, known mineral deposits, past and present mineral production, mining claims, mineral leases, evaluation of future mineral potential market demands" (1, p. 1).

S. Castor (2/), J. Tingley (2/), and S. Feldman (3/) conducted a mineral assessment of the Yucca Mountain Addition on behalf of the DOE's contractor, Science Applications International Corp., to meet the requirements of the FLPMA.

Geologic Map

As part of their mineral resource evaluation Castor, et al (1, plate 1) prepared a simplified geologic map of the YMA based on that of Scott and Bonk (2, sheet 1). Whereas Scott and Bonk included all identified rock units of Yucca Mountain on their map, Castor and his colleagues opted to simplify the geology by including only six major rock units. See (1) page 8 for a brief description of the YMA lithology. The rock unit "lumping" convention used by Castor is shown below.

Quaternary Units

1. Alluvium and colluvium.

Tertiary Volcanics

1. Rainier Mesa Member of the Timber Mountain Tuff (includes units Tmrw and Tmrn of Scott and Bonk 2, p. 2)

2. A distinctive bedded tuff unit (Scott and Bonk's unit bt, 2, p. 2);

3. Tiva Canyon Member of the Paintbrush tuff (includes units cu, ccr, cuc, cul, cks, clc, cgks, crks, cuks, cml, clks, crs, cll, chl, ch, and cc of Scott and Bonk 2, pp. 2-4)

4. A bedded tuff unit of the Paintbrush Tuff (Scott and Bonk's unit bt, 2, p. 5);

5. Yucca Mountain Member of the Paintbrush Tuff (included units ym, ymu, and yml of Scott and Bonk, 2, p. 4);

6. Topopah Spring Member of the Paintbrush Tuff (includes units tu, tc, tr, ttl, trl, tul, tll, tl, tnl, tgnl, to, tb, tob, tobl, tbob, tgrl, torl, tml, tpbl, trbb, tbol, tv, and tpw of Scott and Bonk 2, pp. 5-7);

7. An undivided ash-flow tuff west of Boomerang point mapped by Castor. This unit is beyond the limits of the Scott and Bonk geological map.

Major structural features such as faults, fractures, and fracture sets were included as well as geographic features and drill hole locations.

2/Nevada Bureau of Mines and Geology (NBMG).
3/Science Applications International Corp., Las Vegas, NV.

BUREAU OF MINES COMPILATIONS

Areas of Inconsistency

During compilation of the geologic map and companion overlays, a number of inconsistencies were noted. The area of greatest concern bears on the lack of consistency between illustrations in the SCP (4) and engineering drawings (3). Inconsistencies were also noted in a comparison of the Atlas (3) and the photo-illustration (5).

The discussion that follows summarizes the major inconsistencies encountered.

Plate 1--Simplified Geologic Map

The location and configuration of the perimeter drift and the placement of the NAFR/YMA boundary line are from engineering drawings produced by Holmes and Narver, Inc., of Las Vegas Nevada (3, sheets 57, 58, and 59, referred to herein as the "Atlas"). Atlas drawings were also used to draft locations of existing field activities depicted on Overlay 3 (discussed in following sections).

A close inspection of the Atlas drawings, however, reveal several discrepancies when compared to (1) Scott and Bonk (1, plate 1), (2) Figures 8.4.2-1a and 8.4.2-2a from the SCP (4, pp. 8.4.2-37 and 8.4.2-41, respectively), and (3) an aerial photo-illustration of the site--showing the perimeter drift, jurisdictional boundaries, and several borehole locations--also produced by DOE's contractor (5). Identified discrepancies include those listed below; other discrepancies may exist:

- Apparent mis-location of the NAFR/YMA boundary line. Scott and Bonk (2), the SCP (4, figure 8.4.2-1a, p. 8.4.2-37), and Holmes and Narver (5) indicate that the NAFR/YMA boundary transects borehole USW H-4. The Atlas drawing places the boundary approximately 300 ft south of the borehole location coincident with the public land system (PLS) section line.

- The configuration of the perimeter drift on the Atlas drawings is inconsistent with the Holmes and Narver air photo-illustration and SCP Figures 8.4.2-1a and 8.4.2-2a. Indeed, the perimeter drift configuration is different on all three references (3, 4, 5).

- A number of boreholes shown on SCP Figure 8.4.2-1a (4, p. 8.4.2-37) are not shown on the Atlas drawings.

The above inconsistencies notwithstanding, it was felt that the configuration of the perimeter drift as shown in the Atlas was probably the more accurate of the available drawings and, accordingly, was used on Plate 1, the simplified geologic map.

Overlay 1--Sample Locations in the Yucca Mountain Addition

Overlay 1 was redrawn from Castor et al (1). No inconsistencies were observed.

Overlay 2--Lineaments Drawn on an Enhanced SPOT Panchromatic Image of the Yucca Mountain Area

Overlay 2 was drafted with major modifications from Castor's Figure 19 (1, p. 43). The modifications were necessary for the following reasons:

1. The outline of the YMA on Figure 19 does not conform to that shown on plate 1 (1, plate 1);

2. The NAFR/YMA/NTS boundaries are mis-located;

3. The YMA outline has been rotated approximately 20° to the south with respect to the plotted lineaments.

4. The scale on the figure is in apparent error.

To correct these discrepancies, the jurisdictional boundaries were replotted using known points on Castor's Figure 19 (1, p. 43) compared to the same points on the Holmes and Narver aerial photo-illustration (5). Also, the configuration of the YMA was redrawn (to conform to Castor's plate 1) at the corrected scale of 1 in. = 7,200 ft.

Overlay 3--Locations of Existing DOE Surface-Based Field Activities

A discrepancy was noted when comparing SCP Figure 8.4.2-1a (location of existing field activities, 4, p. 8.4.2-37) to the Atlas. Some activities such as drillholes and/or trenches shown on SCP Figure 8.4.2-1a are not included in the Atlas. It is not known which reference is correct. Only those activities depicted in the Atlas were plotted on the overlay.

In order to maintain graphical consistency within this report, the perimeter drift configuration, as shown on Sheets 58 and 59 of the Atlas, has replaced the configuration shown on SCP Figure 8.4.2-1a (see Figure 1).

Overlay 4--Locations of Proposed DOE Surface-Based Field Activities

SCP Figure 8.4.2-2a (location of proposed field activities) was enlarged to match the scale of the Atlas. Following enlargement, it became apparent that both the size and configuration of the perimeter drift as depicted on the figure was significantly different from the Atlas. As such, the locations of the proposed activities may be in error.

Using the proposed exploratory shafts as an example of internal inconsistencies within the SCP, the geographic locations of the two shafts as shown on SCP figures 6-13, 8.4.2-2a, and 8.4.2-24 are mutually inconsistent not only with respect to the locations of the two shafts, but with respect to shaft designations as well. The locations and designations of the exploratory shafts as shown on Overlays 4 and 5 of this report are based on non-SCP documents which depict, to the NRC's understanding, the currently-considered (September, 1990) locations and designations of the shafts.

In order to maintain graphical consistency within this report, the perimeter drift configuration, as shown on Sheets 58 and 59 of the Atlas, has replaced the configuration shown on SCP Figure 8.4.2-2a (see Figure 3).

Overlay 5--Plan View of the Proposed Underground Facilities

SCP Figure 6-13 (4, p. 6-87) was also expanded to match the scale of the Atlas drawings with results similar to those described above. However, the match was much closer and required a minimum of modification to adapt the figure to the Atlas perimeter drift configuration.

Plate 1--Simplified Geological Map of Yucca Mountain in the Vicinity of the Perimeter Drift 4/

The simplified geological map compiled by the Bureau of Mines incorporates major map elements of both Scott and Bonk (2) and Castor, et al (1) to meet the requirements of Work Directive 026. Its purpose is (1) to extend Castor's map north and northeast to include the major geologic, structural, and geographic features within and surrounding the perimeter drift, and (2) to provide a base map for 5 companion overlays.

The map was drafted at the scale of 1:12,000 between 36° 47′ 46" and 36° 52′ 30" north latitude and 116° 26′ 20" and 116° 30′ 00" west longitude which includes portions of the NAFR, NTS, and the YMA. For the user's convenience, Nevada State Central Zone Coordinates from approximately 748,000 to 773,400 North and approximately 549,000 to 566,700 East are included. The map retains Castor's rock unit aggregation ("lumping") convention. Two stratigraphic units, the Yucca Mountain Member of the Paintbrush Tuff and an undivided ash-fall tuff, were added to the geologic column because of the increased geographic coverage of the modified map.

4/A "drift", in mining terms, is a horizontal underground passage (Source: U.S. Bureau of Mines. A Dictionary of Mining, Mineral, and Related Terms). The "perimeter drift" is a passage driven on the boundary of the underground facility from which the main and emplacement drifts are driven. As depicted on the map, the perimeter drift is a surface projection of the physical boundary of the proposed underground facilities.

Major structural features, geographic names, jurisdictional boundary lines, and the approximate boundary of the perimeter drift (perimeter drift configuration redrawn from 3) are included; drillhole locations plotted by Castor were omitted (see Overlay 3 for existing drillhole locations). Because of spatial constraints at the 1:12,000 scale, most of the conceptual controlled area boundary falls beyond the region depicted on the simplified geologic map and consequently is not shown.

Map Overlays

Overlay 1--Sample Locations in the Yucca Mountain Addition

Sample locations plotted on Overlay 1 are those of Castor, et al (1, plate 1). The overlay, plotted at the scale of 1:12,000, is intended for use with the base geologic map. The following description of sample collection in the YMA and subsequent sample analyses is repeated with modification from Castor, et al (1, pp. 9, 12-13):

Field Work

During the evaluation, outcrops were examined and samples collected along foot traverses made over the entire YMA. Sample locations were plotted on copies of the 1:12,000 scale geologic map of Scott and Bonk (2) and on 1:12,000 scale enlargements of 7.5 minute quadrangle maps. During sample collection, visual descriptions of mineralogy, lithology, and structures encountered were recorded. Samples were collected mainly from veins, fracture coatings, fault zones, bodies of tectonic breccia, and areas of altered rock 5/. Initially, 200 samples were collected from the YMA study area.

Samples were submitted to Geochemical Services Inc. (GSI), of Rocklin, California, for 15-element inductively-coupled plasma (ICP) emission spectroscopic analyses, and gold analysis by graphite furnace atomic absorption. Sample crushing and pulverization were done using either NBMG bucking facilities, or those of GSI located in Sparks, Nevada. Ten blank quartz samples were submitted initially along with Yucca Mountain samples to monitor possible contamination during sample preparation.

Following receipt of analytical results for the initial samples, 20 samples were submitted for corroborative analyses to the NBMG geochemical laboratory. In addition, 38 samples sites, including all sites that yielded samples with elevated trace element contents, were revisited, resampled, and marked. During this resampling work, 22 samples were collected from new sites. Altogether, 260 samples were collected from the YMA and subjected to multi-element analyses.

5/Drill core was not available for analysis.

Mineralogic and petrographic work was done by NBMG and Desert Research Institute personnel on selected samples from the YMA; X-ray diffraction analyses were performed on 54 samples. In addition, 8 thin sections of representative veins, breccias, and altered rocks from the YMA were analyzed petrographically.

Geochemical Results

Several samples from the YMA were found to contain slightly anomalous 6/ amounts of silver, arsenic, bismuth, lead, and (or) thallium; however, the highest contents of most analyzed elements in samples collected during this study are near or below background values in the earth's crust (6). Analyses for three elements, palladium, selenium, and tellurium, fell below detection levels (Table 1). Most of the anomalous YMA samples were taken from the Paintbrush bedded tuff unit (mainly silicified rock), but one is from unaltered, glassy air-fall tuff, and one is from a glassy tuff dike.

A sample of bright red silicified air-fall tuff (SC-52) 7/ was collected from a north-trending vein on the west flank of Yucca Crest. The vein is probably less than 20 cm wide and could be followed on the surface for only a few meters. This sample contains 4 to 8 parts per million (ppm; grams per metric ton) bismuth and 109 to 145 ppm lead. A single analysis of sample SC-92, brown silicified air-fall tuff from a zone approximately parallel to the nearby SC-52 vein, yielded a value of 1 ppm bismuth.

Sample SC-22, containing 3 to 4 ppm bismuth, 64 to 97 ppm zinc, and 2 ppm thallium, was collected from a 3-cm-wide dike of friable, glassy, pink and white, air-fall tuff which dips steeply southwest. This tuff dike cuts an irregular 5- to 10-cm-wide northeasterly zone of gray opalized tuff (sample SC-22S) carrying 0.6 to 1.8 ppm bismuth. The host rock at this locality is gray glassy welded tuff which appears to be in the Paintbrush bedded tuff sequence.

Sample SC-31, a composite of purplish-gray silicified air-fall tuff and hematitic gouge from a fault dipping steeply west, contains 0.6 to 1.5 ppm bismuth and 60 to 68 ppm zinc. Sample SC-31B, hematitic air-fall tuff taken from the hanging wall of this fault, contains 27 ppm arsenic and 0.3 ppm bismuth.

Other anomalous samples within the Paintbrush bedded tuff sequence are SC-14C, a bed of fine, well-sorted, and apparently unaltered lapilli tuff containing 0.4 to 0.52 ppm silver; and SC-88 from a near vertical northerly calcrete-silica vein system with 1 ppm bismuth.

6/It is assumed that the term "anomalous", as used by Castor, means "anomalously high."

7/ YMA samples were reported by Castor with the prefix "YM" to indicate the sample was collected at Yucca Mountain. The "YM" prefix has been omitted here to conform with Castor's sample location map (1, plate 2). Sample designations such as "SC", "SF", "DD", refer to the person that collected the sample; i. e., sample SC-1 was collected by S. Castor.

Table 1. Elements analyzed, detection limits, sample number 1/, highest sample value 1/, average crustal abundance 2/, and median values in YMA.

(All values in ppm)

Element	Detection limit	Sample No.	Sample value	Crustal abundance	YMA
Ag	0.015	SC-14C	0.520	0.07	0.026
As	1.00	DD-36A	32.30	1.80	3.07
Au	0.0005	DD-3A	0.009	0.004	0.001
Cu	0.05	PG-9	21.1	55.0	6.88
Hg	0.10	SC-85	0.3600	0.08	<0.10
Mo	0.10	SC-52A	4.030	1.50	1.02
Pb	0.25	SC-52A	145.000	12.5	3.68
Sb	0.25	SC-74	0.794	0.2	<0.25
Tl	0.50	SC-22A	1.990	0.45	<0.50
Zn	1.00	SC-22A	96.70	70.0	22.50
Bi	0.25	SC-52A	6.100	0.17	<0.25
Cd	0.10	SC-68	0.642	0.20	<0.10
Ga	0.50	DD-23B	2.260	15.0	0.66
Pd	0.50	PG-7	<1.000	0.004	<0.50
Se	1.00	SC-5H	<1.120	0.05	<1.00
Te	0.50	SC-5H	<0.561	0.001	<0.50

1/Source: (1, appendix A).
2/Source: (6).

Sample DD-36A, which contains 32 ppm arsenic and 1 ppm bismuth, is purplish-gray silicified breccia with some irregular veins of white opal collected from a fault dipping steeping southwest. Sample SC-45, with 0.1 ppm silver, is of calcrete vein material from a poor exposure. The host rock for both occurrences is devitrified ash-flow tuff of the Topopah Spring Member of the Paintbrush Tuff.

None of the samples collected from the YMA can be said to have highly anomalous gold contents. The highest gold value for any YMA sample reported by GSI is 0.026 ppm (SC-66); however, analysis of a blind resubmitted sample resulted in a 0.003 ppm gold value, and gold was not detected in rock obtained by resampling the same outcrop (sample SC-66A). The highest gold value for all other samples from the YMA analyzed by GSI (DD-3A) is 0.009 ppm, equivalent to 0.0003 ounces per ton.

Analyses performed by the NBMG geochemical laboratory on YMA samples yielded higher gold numbers than those obtained by GSI. The NBMG analyses were performed by fire assay with atomic absorption finish, a technique which can be expected to yield higher results than that used by GSI, which may not extract all of the gold in the sample during dissolution.

Chemical analyses of samples taken by Castor, et al from the YMA are presented in Appendix A (1). Mineralogic results from X-ray diffraction of selected YMA samples are presented in Appendix B (1).

Overlay 2. Lineaments Drawn on an Enhanced SPOT Panchromatic Image of the Yucca Mountain Area

The lineaments presented on Overlay 2 were drafted from Castor's Figure 19, (1, p. 43). Continuation of some of the lineaments beyond the boundaries of the YMA were omitted due to spatial constraints at the 1:12,000 scale.

With regard to YMA lineaments, the following discussion is repeated from Castor, et al (1, p. 42):

"SPOT digital data of the Yucca Mountain Addition were processed with a high-pass filter (Figure 19) and lineaments were drawn on the resulting image. Directionally filtered images were also produced and lineaments recognized on these (i.e., Figure 20, 8/) were transferred to a non-directional biased filtered image with a percentage of the original image added back to the filtered image. Figure 20 was enhanced for northwest-southeast lineaments, but shows lineaments in other orientations as well. Lineaments drawn on Figure 19 are indicated on Figure 20 8/ with arrows.

8/Not included here.

Many of the lineaments coincide with mapped units, and some extend the faults into the alluvium. The northern part of the Solitario Canyon fault does not show up well, but a significant lineament follows the wash in Solitario Canyon. Three east-west lineaments that do not coincide with mapped faults have been recognized, the southernmost one being the most prominent (Figures 19 and 20). If these relatively long lineaments are faults, the number of fault intersections would be higher in the Yucca Mountain Addition than is indicated by geologic mapping. However, none of the lineaments drawn on the images were checked in the field to establish the presence or absence of faults (emphasis added)."

Overlay 3. Locations of existing DOE surface-based field activities.

Overlay 3 was drafted at the scale of 1:12,000 and presents the locations of drilling and trenching activities conducted by DOE or its contractors in the vicinity of the perimeter drift. Roads, trails, and pavements have been omitted for purposes of clarity. Also, because of spatial constraints at the 1:12,000 base map scale, existing surface-based field activities beyond the bounds of approximately 748,000 to 773,400 North and 549,000 to 566,700 East (Nevada State Coordinate System, Central Zone) occur outside the area of the map and consequently cannot be shown on the overlay.

The overlay was drafted from copies of sheets 56, 57 and 58 of the Atlas (3). While every effort has been made to faithfully reproduce the illustrations, some distortion is unavoidable. Further, Nevada Central Zone Coordinate System grid ticks of Castor (used on the base map) do not fully coincide with those of the Atlas drawings--most likely due to distortion introduced during copying. However, the error is relatively small and will not diminish the overall serviceability of the map or overlay.

As stated earlier, a number of existing surface-based activities shown on SCP Figure 8.4.2-1a do not appear in the Atlas; those activities were omitted from Overlay 3.

Overlay 4. Locations of Proposed DOE Surface-Based Field Activities

Overlay 4 presents the locations of surface-based field activities proposed by DOE for completion during the course of site characterization (4, Figure 8.4.2-2a, p. 8.4.2-41). The perimeter drift configuration is redrawn from the Atlas (3). Like Overlay 3, roads, trails, and pavements have been omitted for purposes of clarity. Also, because of spatial constraints at the 1:12,000 base map scale, proposed surface-based field activities beyond the bounds of approximately 748,000 to 773,400 North and 549,000 to 566,700 East (Nevada State Coordinate System, Central Zone) have been omitted.

Overlay 5. Underground Facilities-Waste Emplacement Area for Vertical Emplacement

Overlay 5 presents a general plan view of the proposed underground waste emplacement facilities at Yucca Mountain. It was redrafted at a scale of 1:12,000 from a copy of Figure 6-13 of the SCP; some distortion is unavoidable. Also, a comparison of DOE Figure 6-13 and the Atlas (3) reveals a discrepancy in the shape perimeter drift boundary. It is unknown (to the present author) which of the two drawings is correct (or the most current).

Existing and Proposed Activities Beyond the Immediate Perimeter Drift

Existing Activities

There is a need to know what (and where) activities have been conducted beyond the limits of the area shown in this report. To this end, SCP Figure 8.4.2-1a (location of existing field activities) and its accompanying legend, SCP Figure 8.4.2-1b (4, pp. 8.4.2-37 and 8.4.2-38, respectively), were redrawn and modified as described below, and are presented here as Figures 1 and 2, respectively.

Figures 1 and 2 were redrawn from the best available copies (third or greater generation) and may contain symbolic errors or errors of omission, especially where drillholes or trenches are closely spaced. Also, a close comparison of SCP Figure 8.4.2-1a and the Atlas reveals several discrepancies. For example, SCP Figure 8.4.2-1a, based on Sandia National Laboratories Drawing R07003A and compiled by DOE in September, 1988, appears to have more drillholes and/or trenches plotted than are shown on the Atlas.

Proposed Activities

To provide information on proposed activities beyond the map limits, Figure 8.4.2-2a (proposed field activities) and the accompanying legend, Figure 8.4.2-2b, both from the SCP (4, pp. 8.4.2-41 and 8.4.2-42, respectively), were redrawn and modified as described below and are presented here as Figures 3 and 4, respectively.

A comparison of Figure 3 and Overlay 4 reveals a significant discrepancy in the shape, relative size, and placement of the perimeter drift boundary (see discussion in "Areas of Inconsistencies" section).

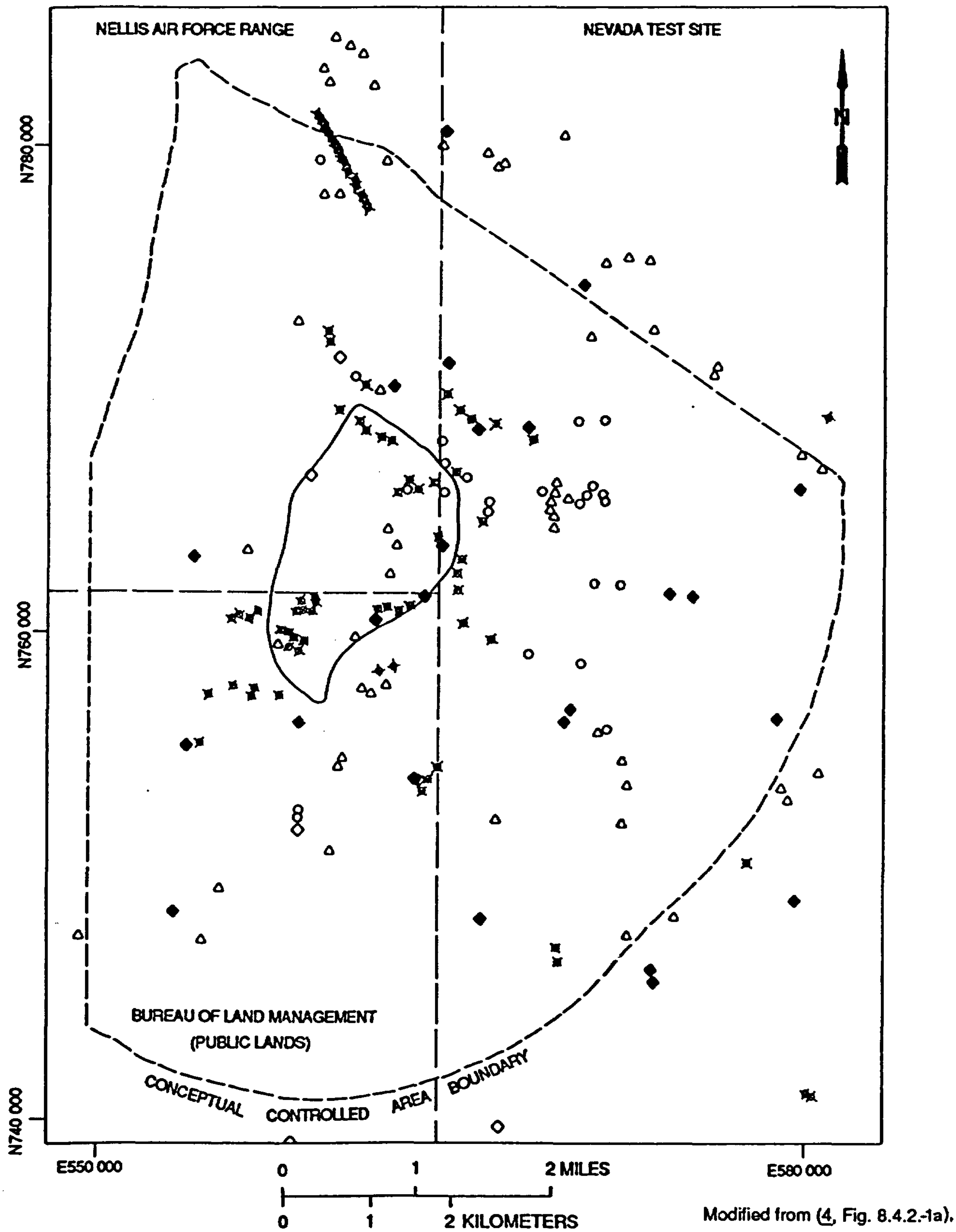

FIGURE 1.–Existing surface-based field activities showing the conceptual controlled area boundary

LEGEND

- ⌘ Shallow borings <100ft
- ◇ Dry drillholes--unsaturated zone boreholes
- ○ Coreholes
- ◆ Saturated zone and water table boreholes
- △ Trenches
- ◯ Conceptual Perimeter Drift Boundary

SOURCES:

1956 1:24,000 USGS Topographic maps
1976 1:24,000 USGS Orthophoto maps
1983 1:100,000 USGS Topographic maps
7/1986 and 9/1987 1:24,000 Aerial photography
Grid ticks based on Nevada State Coordinate System, Central Zone
Conceptual PDB-SNL Drawing R07003A
Map compiled in September 1988

FIGURE 2.-Legend for Figure 1

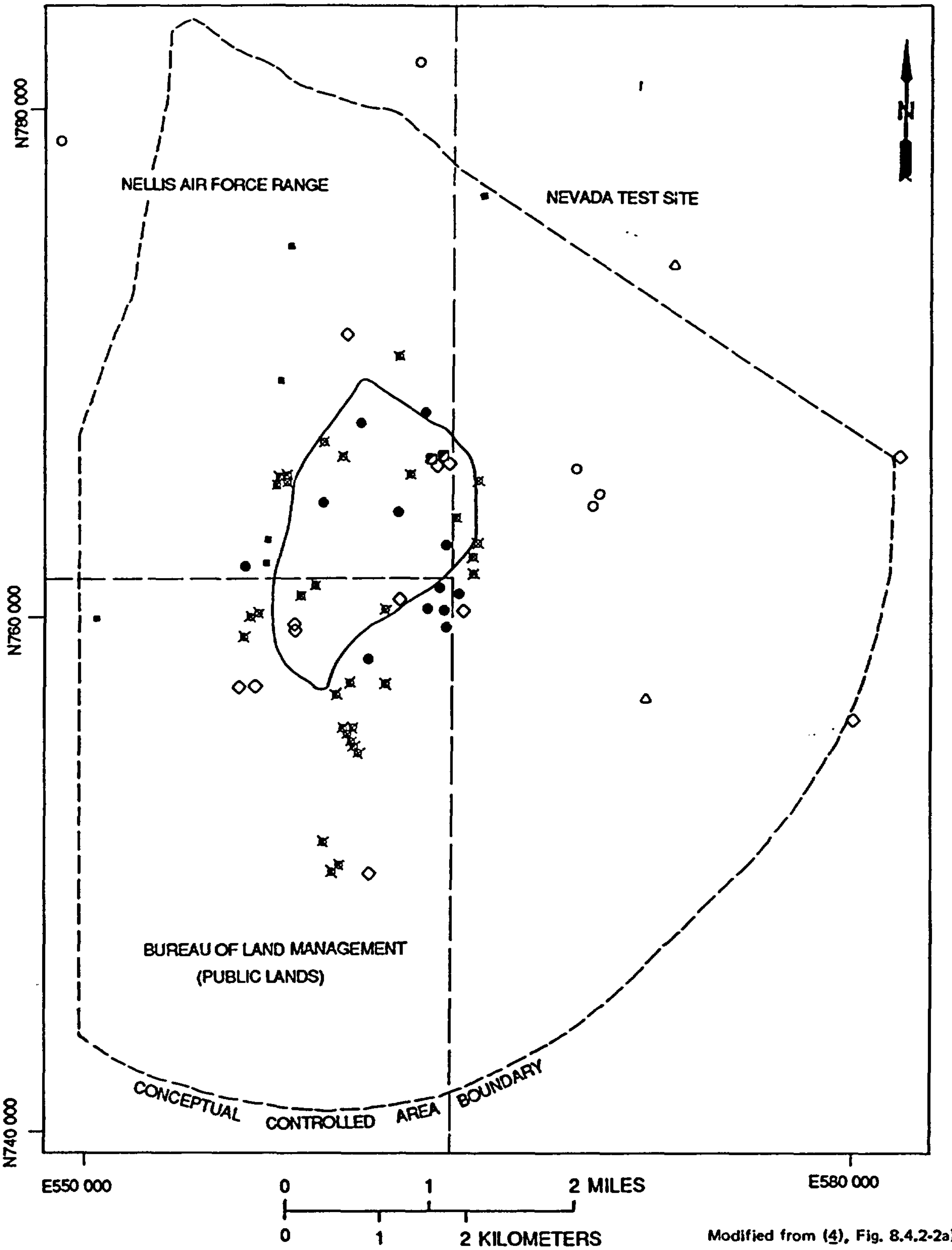

FIGURE 3.– Proposed surface-based field activities–showing the conceptual controlled area boundary

LEGEND

- ⌘ Dry drillholes--shallow unsaturated zone neutron holes (<100ft)
- ◇ Dry drillholes--unsaturated zone boreholes
- ● Systematic drilling program holes
- ○ Coreholes
- ▪ Saturated zone and water table boreholes
- △ Trenches
- ◘ Exploratory shafts
- ⬯ Conceptual Perimeter Drift Boundary

SOURCES:

1956 1:24,000 USGS Topographic maps
1976 1:24,000 USGS Orthophoto maps
1983 1:100,000 USGS Topographic maps
7/1986 and 9/1987 1:24,000 Aerial photography
Grid ticks based on Nevada State Coordinate System. Central Zone
Conceptual PDB-SNL Drawing R07003A
Map compiled in September 1988

FIGURE 4.-Legend for Figure 3

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