Preliminary Correlation Map of Geomorphic Surfaces in North-Central Frenchman Flat, Nevada Test Site

Prepared by

Bechtel Nevada
Geotechnical Sciences
Las Vegas, Nevada

Prepared for

U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Las Vegas, Nevada

August 2005

DISCLAIMER STATEMENT

Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the U.S. Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the U.S. Government or any agency thereof

AVAILABILITY STATEMENT

Available for sale to the public from—

U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Road
Springfield, VA, 22161-0002
Telephone: 800.553.6847
Fax: 703.605.6900
E-mail: orders@ntis.gov
Online ordering: <http://www.ntis.gov/ordering.htm>

Available electronically at <http://www.osti.gov/bridge>.

Available for a processing fee to U.S. Department of Energy and its contractors, in paper, from—

U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
Telephone: 865.576.8401
Fax: 865.576.5728
E-mail: reports@adonis.osti.gov

Preliminary Correlation Map of Geomorphic Surfaces in North-Central Frenchman Flat, Nevada Test Site

Prepared by

Bechtel Nevada
Geotechnical Sciences
Las Vegas, Nevada

Prepared for

U.S. Department of Energy
National Nuclear Security Administration
Nevada Site Office
Las Vegas, Nevada

August 2005

This page intentionally left blank.

**Preliminary Correlation Map of Geomorphic Surfaces in
North-Central Frenchman Flat, Nevada Test Site**

DOE/NV/11718--1097

Preface

Raytheon Services Nevada (RSN), predecessor to Bechtel Nevada, was among the entities responsible for characterizing the hydrogeology of the Area 5 Radioactive Waste Management Site (RWMS) at the Nevada Test Site for the U.S. Department of Energy in the early 1990s. Some of this work was documented in a series of unpublished maps and data reports. As part of Bechtel Nevada's current scope for closure planning for the Area 5 RWMS, these maps and data reports are being updated to current editorial standards for approval for public release so they will be accessible for public review and for citation in future documents.

The map in this document was prepared in 1993 by geoscientists of the RSN Environmental Restoration and Waste Management Division and the RSN subcontractor, Lockheed Environmental Systems and Technologies Company. This map is reproduced here unchanged since the 1993 effort, but an updated map legend is provided along with narrative information added to support the map data.

This page intentionally left blank.

**Geomorphic Surface Maps of Northern Frenchman Flat,
Nevada Test Site, Southern Nevada**

DOE/NV/11718--1097

Abstract

This correlation map (scale = 1:12,000) presents the results of a mapping initiative that was part of the comprehensive site characterization required to operate the Area 5 Radioactive Waste Management Site, a low-level radioactive waste disposal facility located in northern Frenchman Flat at the Nevada Test Site. Eight primary map units are recognized for Quaternary surfaces: remnants of six alluvial fan or terrace surfaces, one unit that includes colluvial aprons associated with hill slopes, and one unit for anthropogenically disturbed surfaces.

This surficial geology map provides fundamental data on natural processes for reconstruction of the Quaternary history of northern Frenchman Flat, which in turn will aid in the understanding of the natural processes that act to develop the landscape, and the time-frames involved in landscape development.

The mapping was conducted using color and color-infrared aerial photographs and field verification of map unit composition and boundaries. Criteria for defining the map unit composition of geomorphic surface units are based on relative geomorphic position, landform morphology, and degree of preservation of surface morphology. The bedrock units identified on this map were derived from previous published mapping efforts and are included for completeness.

This page intentionally left blank.

Table of Contents

Preface	iii
Abstract	v
List of Figures	vii
List of Tables	vii
List of Acronyms	viii
1.0 Introduction	1-1
1.1 Background Information	1-1
1.2 Project Description	1-1
1.3 Site Description	1-3
1.4 Purpose and Scope of Report	1-3
2.0 Methods	2-1
2.1 Methods	2-1
2.2 Mapping Units	2-1
3.0 References	3-1
Map Legend	
Distribution List	

List of Figures

<i>Number</i>	<i>Title</i>	<i>Page</i>
1-1	Location of Preliminary Geomorphic Surface Map of North-Central Frenchman Flat at the Nevada Test Site	1-2

List of Tables

<i>Number</i>	<i>Title</i>	<i>Page</i>
2-1	Relative Occurrence of Selected Characteristics of Geomorphic Surface Map Units within Northern Frenchman Flat	2-2

List of Acronyms and Abbreviations

BN	Bechtel Nevada
DOE	U.S. Department of Energy
NTS	Nevada Test Site
RSN	Raytheon Services Nevada
RWMS	Radioactive Waste Management Site
USGS	U.S. Geological Survey

1.0 Introduction

1.1 Background Information

Raytheon Services Nevada (RSN), a predecessor to Bechtel Nevada (BN), was among the entities responsible for characterizing the hydrogeology of the Area 5 Radioactive Waste Management Site (RWMS) at the Nevada Test Site (NTS). This work was conducted in 1993 for the U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office (formerly U.S. Department of Energy [DOE], Nevada Operations Office) Waste Management Division.

Some of this work was documented in a series of unpublished maps and data reports. As part of Bechtel Nevada's current scope for closure planning for the Area 5 RWMS, these maps and data reports are being updated to current editorial standards for approval for public release so they will be accessible for public review and for citation in future documents.

The map in this document was prepared by S. E. Rawlinson and D. L. Gustafson of the RSN Environmental Restoration and Waste Management Division (now of BN) and K. E. Snyder of the RSN subcontractor, Lockheed Environmental Systems and Technologies Company.

1.2 Project Description

This surficial geology map (scale = 1:12,000) of north-central Frenchman Flat was developed in 1993 as part of comprehensive site characterization required to operate the Area 5 RWMS, a low-level radioactive waste disposal facility located in northern Frenchman Flat. The region mapped is included within the area defined by the following latitude and longitude coordinates, and is shown in Figure 1-1:

Eastern Boundary:	115° 53' 58"
Western Boundary:	116° 00' 29"
Northern Boundary:	36° 57' 59"
Southern Boundary:	36° 50' 53"

Seven smaller scale maps (1:6,000) that cover this area were produced in 1995 to provide more detail (BN, 2005). This map shows the main surficial features at a larger, more convenient scale on one sheet.

The data produced by these mapping efforts provides fundamental information on natural processes that can be used to reconstruct the Quaternary history of northern Frenchman Flat. Reconstruction of the Quaternary history provides an understanding of the natural processes that act to develop the landscape, and the time-frames involved in landscape development.

Figure 1-1
Location of Map Area in Frenchman Flat at the Nevada Test Site

1.3 *Site Description*

The Area 5 RWMS is located within the northeast part of Frenchman Flat, in the northern portion of the Mojave desert (DOE, 2004). Annual precipitation for Frenchman Flat is approximately 12 centimeters (5 inches) (DOE, 1998). Precipitation in the area is sporadic, typically falling as small amounts of rain or snow during isolated, short-duration winter and summer storms. Severe weather can occur in the region, usually in the form of summer thunderstorms with intense lightning, strong winds, and localized heavy rainfall.

Frenchman Flat is an intermontane basin located in Basin and Range physiographic province. The sparsely vegetated valley floor slopes gently toward a central playa (dry lake bed). Ground level elevations range from 938 meters (3,078 feet) above sea level at the playa, to over 1,463 meters (4,800 feet) in the nearby surrounding highlands.

1.4 *Purpose and Scope of Report*

This report presents a preliminary correlation map of the surficial geology of the study area, available on paper at a size of approximately 91 centimeters (36 inches) square and in electronic form. Also included is a brief narrative (this document) describing the rationale and methods for the mapping project. The map legend provided at the end of this narrative includes detailed descriptions of the mapping units as well as information for correlating the 1993 map units with modern stratigraphic nomenclature from Slate et al. (1999) for these units.

This page intentionally left blank.

2.0 Methods

2.1 Methods

The mapping was conducted using color and color-infrared, 1:24,000-scale aerial photographs taken in August 1991 by EG&G Energy Measurements, Inc. The ground control for the topographic contours was taken from U.S. Geological Survey (USGS) topographic maps (USGS, 1986a; 1986b).

Map unit composition and boundaries were verified in the field. Available pit and trench walls at the Area 5 RWMS and nearby areas were also mapped and sampled to obtain detailed near-surface information about the Quaternary alluvium and to check for the presence of faults.

2.2 Mapping Units

The map shows the extent of the eight units used to map Quaternary surfaces in the study area. These units were defined and identified on the basis of bounding discontinuities, which may be either disconformities or buried soils. Criteria for defining the map unit composition of geomorphic surface units are based on relative geomorphic position, landform morphology, and degree of preservation of surface morphology.

The eight geomorphic surfaces mapped (Units Q2 through Q7, Qcu, and Qd) span the time from the early Quaternary to the present. This correlation of geomorphic surfaces was based on the preliminary photo-interpretation of surficial geology by Rawlinson (1991). Each geomorphic surface exhibits a distinctive degree of six geologic characteristics: desert pavement, carbonate and/or silica platelets on the surface, varnished clasts, rubified clasts, preserved bar-and-swale morphology, and an eolian mantle (Table 2-1). The unit definitions were adapted from Gibson et al. (1992) and Wesling et al. (1992), who performed similar mapping work in the nearby Midway Valley at the NTS. Detailed descriptions of all the geomorphic surface mapping units are provided in the legend at the end of this report.

Geomorphic surface mapping units Q7 (youngest) through Q3 are generally present throughout most of the map area. Units Q2 and Qcu are generally not extensive and are restricted to mountain front or upper alluvial fan locations. This map also indicates the location and extent of disturbed areas (Unit Qd) and surfaces cut in bedrock units.

Bedrock units shown on this map are primarily Tertiary volcanic rocks and the Ordovician Antelope Valley Limestone. The stratigraphic symbols used for the bedrock units for the 1993 map were modified from Hinrichs and McKay (1965), Poole (1965), Poole et al. (1965), and Rawlinson (1991). The updated stratigraphic nomenclature for the bedrock units, modified from Slate et al. (1999), is listed in the legend with the older unit names for the convenience of the reader.

Table 2-1
Relative Occurrence of Selected Characteristics of Geomorphic Surface Map
Units within Northern Frenchman Flat

Geologic Characteristic	Geomorphic Surface Map Unit					
	Q2	Q3	Q4	Q5	Q6	Q7
Desert pavement	••••	••••	•• to •••	• to ••	N.O.	N.O.
Carbonate/silica platelets on surface	••	••	•	N.O.	N.O.	N.O.
Varnished clasts	••••	••••	•• to •••	••	•	N.O.
Rubified clasts	••••	••••	•• to •••	••	•	N.O.
Bar-and-swale morphology preserved	•	•	••	•••	••••	••••
Eolian mantle	•••• to ••••	•••• to ••••	•• to •••	• to ••	•	N.P.

Notes:

Adapted from Gibson et al. (1992).

Unit Qcu had not been studied to the same extent as the other mapping units at the time this map was made, and is not included on this table.

Dots (•) show the typical, relative development of selected geologic and geomorphic characteristics for the mapping units.

Geologic and Geomorphic Characteristics:

- = Very well developed
- = Well developed
- = Moderately well developed
- = Observed but poorly developed
- N.O. = Not observed

Dots (•) indicate relative thickness of eolian mantle:

- = Very thick
- = Thick
- = Thin
- = Very thin
- N.P. = Not present

3.0 References

- Bechtel Nevada, 2005. *Geomorphic Surface Maps of Northern Frenchman Flat, Nevada Test Site, Southern Nevada*. Prepared for U.S. Department of Energy. Report DOE/NV/11718--1091. Las Vegas, NV.
- BN, see Bechtel Nevada.
- DOE, see U.S. Department of Energy.
- Gibson, J. D., J. R. Wesling, F. H. Swan, and T. F. Bullard, 1992. *Recent Characterization Activities of Midway Valley as a Potential Repository Surface Facility Site*. Sandia National Laboratories Report SAND92-0091C, Albuquerque, NM. 20 pp.
- Hinrichs, E. N., and E. J. McKay, 1965. *Geologic Map of the Plutonium Valley Quadrangle, Nye and Lincoln Counties, Nevada*. U.S. Geological Survey Geologic Quadrangle Map GQ-384, scale 1:24,000.
- Poole, F.G. 1965. *Geologic Map of the Frenchman Flat Quadrangle, Nye, Lincoln, and Clark Counties, Nevada*. U.S. Geological Survey Geologic Quadrangle Map GQ-456, scale 1:24,000.
- Poole, F.G., D.P. Elston, and W.J. Carr. 1965. *Geologic Map of the Cane Spring Quadrangle, Nye County, Nevada*. U.S. Geological Survey Geologic Quadrangle Map GQ-455, scale 1:24,000.
- Rawlinson, S. E., 19991. "Preliminary Photointerpretative Surficial Geology Map of North-Central Frenchman Flat, Nevada Test Site." *In: Surficial Geology of the Area 5 Radioactive Waste Management Site and Vicinity, Nevada Test Site*. Raytheon Services Nevada Report. Las Vegas, NV.
- Slate, J. L., M. E. Berry, P. D. Rowley, C. J. Fridrich, K. S. Morgan, J. B. Workman, O. D. Young, G. L. Dixon, V. S. Williams, E. H. McKee, D. A. Ponce, T. G. Hildenbrand, WC Swadley, S. C. Lundstrom, E. B. Ekren, R. G. Warren, J. C. Cole, R. J. Fleck, M. A. Lanphere, D. A. Sawyer, S. A. Minor, D. J. Grunwald, R. J. Laczniak, C. M. Menges, J. C. Yount and A. S. Jayko, 1999. *Digital Geologic Map of the Map of the Nevada Test Site and Vicinity, Nye, Lincoln, and Clark Counties, Nevada and Inyo County, California*. U.S. Geological Survey Open-File Report 99B554BA, scale 1:120,000.
- U.S. Department of Energy, Nevada Operations Office, 1998. *Routine Radiological Environmental Monitoring Plan*, Report DOE/NV/11718--244. Prepared by Bechtel Nevada. Las Vegas, NV.
- U.S. Department of Energy, National Nuclear Security Administration Nevada Site Office, 2004. *Nevada Test Site Environmental Report 2003*. DOE/NV/11718--971. Prepared by Bechtel Nevada. Las Vegas, NV.
- U.S. Geological Survey, 1986a. *Topographic Map of the Frenchman Flat Quadrangle, Nevada - Nye County*. Scale = 1:24,000.
- U.S. Geological Survey, 1986b. *Topographic Map of the Plutonium Valley Quadrangle, Nevada - Nye County*. Scale = 1:24,000.

USGS, see U.S. Geological Survey.

Wesling, J. R., T. F. Bullard, F. H. Swan, R. C. Perman, M. M. Angell, and J. D. Gibson, 1992.
*Preliminary Mapping of Surficial Geology of Midway Valley, Yucca Mountain Project, Nye
County, Nevada.* Interim Data Report: Sandia National Laboratories Report SAND91-0607.

Legend for Preliminary Correlation Map of Geomorphic Surfaces in North-Central Frenchman Flat, Nevada Test Site

Map Unit Symbol	Current Unit Map Symbol ^a	Unit Description
Q7	7	Unit Q7 (Late Holocene) consists of fine to medium sand, sandy gravel, or both, deposited by fluvial processes and located in confined active channels or on active parts of fans. Rock fragments range between pebbles and large boulders. Clasts are subangular to subrounded. The largest clasts tend to be concentrated along the sides of channels or are covered by finer-grained sediments in channel bottoms. Deposits are typically planar-bedded, but may be cross-bedded or massive, depending on the sediment transport mechanism. The original bar-and-swale relief is unaltered. Surfaces are barren or sparsely vegetated, show no soil or pavement development, and are the youngest surfaces in the area. Included in Q7 are areas of Q6 too small to map.
Q6	6	Unit Q6 (Holocene) consists of fine to medium sand, sandy gravel, or both, deposited by fluvial processes. The unit occurs along the active washes as low (less than 1 meter) flood plains, and as vegetated bars along washes. Surface relief reflects preservation of original bar-and-swale morphology. Rock fragments range between pebbles and large boulders. Clasts are subangular to subrounded. Deposits are typically planar-bedded, but may be cross-bedded or massive, depending on the sediment transport mechanism. Surfaces are sparsely vegetated and show very little or no pavement or soil development. Included in Q6 are areas of Q7 too small to map. Unit Q6 is the second-youngest of the map units.
Q5	5	Unit Q5 (Late Pleistocene to Holocene) consists of fine to medium sand, sandy gravel, or both, deposited by fluvial processes. The surface of Q5 displays typical bar-and-swale morphology. Rock fragments range between pebble and large boulders. Clasts are subangular to subrounded. Deposits are typically planar-bedded, but may be cross-bedded or massive, depending on the sediment transport mechanism. Surface are typically less than 1 meter above any adjacent Q6 or Q7 surfaces. Surfaces are vegetated and may show a weakly formed desert pavement, rock varnish, and soil development. Included in Q5 are incised channels and wide swales of younger units too small to map.
Q4	4	Unit Q4 (Late Pleistocene) consists of fine to medium sand, sandy gravel, or both, deposited by fluvial processes adjacent to active channels and as fan and valley-fill alluvium. Rock fragments range between pebbles and large boulders. Clasts are subangular to subrounded. Overbank deposits commonly overlie gravel deposits. Deposits are typically planar-bedded, but may be cross-bedded or massive depending on the sediment transport mechanism. Surfaces are typically less than 2 meters above adjacent Q5 or Q6 surfaces. Surfaces have moderately dense vegetation. Desert pavement formed on Q4 may be moderately developed, but not as well packed as pavements found on older Q3 and Q2 surfaces. Clasts are moderately to well varnished on surface that have a well-developed pavement. Bar-and-swale relief on Q4 has been reduced to clast height above the surface, and shows some soil development. Included in Q4 are incised channels and wide swales of younger units too small to map.
Q3	3	Unit Q3 (Middle to Late Pleistocene [?]) consists of fine to medium sand, sandy gravel, or both, deposited by fluvial processes. Colluviation may contribute some sediment in toe-slope positions. Rock fragments range between pebbles and large boulders. Clasts are angular to subrounded. Deposits are typically planar-bedded, but may be cross-bedded or massive, depending on the sediment transport mechanism. Unit Q3 deposits commonly show interbeds of caliche or zones of calcrete. Surfaces have moderately dense vegetation, and may show well-developed desert pavement and varnished clasts. The original depositional bar-and-swale morphology has been reduced to the height of individual clasts above the surface. Included in Q3 are incised channels and wide swales of younger units too small to map.

**Legend for Preliminary Correlation Map of Geomorphic Surfaces in
North-Central Frenchman Flat, Nevada Test Site (continued)**

Map Unit Symbol	Current Unit Map Symbol ^a	Unit Description
Q2	2	Unit Q2 (Middle Pleistocene) consists of fine to medium sand, sandy gravel, or both. Rock fragments range between pebbles and large boulders. Clasts are angular to subrounded. Deposits are typically planar-bedded, but may be cross-bedded or massive, depending on the sediment transport mechanism, and commonly show interbeds of caliche or zones of calcrete. Surfaces are typically more than 2 meters above adjacent Q3 deposits in the middle or proximal fan zones. Surface have moderately dense vegetation, and commonly include soil, pavement, and varnish development. Unit Q2 may be incised by younger surfaces that are as much as several meters deep and are too small to map.
Qcu	Qai(?) ^b	Unit Qcu (Holocene to Late Pleistocene) consists of colluvium and debris flows that mantle the lower hill slopes surrounding Frenchman Flat. Deposits are sand or sandy gravel, or both. Rock fragments range between pebbles and large boulders. Clasts are angular to subrounded, with subangular clasts most common. Deposits are typically massive, but may be poorly bedded in down-slope positions from re-transport by sheet flow. Surfaces show little to moderately dense vegetation, and commonly show poor to moderate soil development, pavement, and varnished clasts.
Qd	d	Unit Qd (Late Holocene) consists of any deposits emplaced by cutting or filling.
Qtb	Tybf	Basalt of Frenchman Flat (Quaternary). Bluish-black, fine-grained olivine basalt dikes and sills.
Tpat2	Tma	Timber Mountain Group (Tertiary) ^c Ammonia Tanks Tuff. Grayish-brown, densely welded devitrified, ash-flow tuff with conspicuous biotite.
Tpat1	Tma	Ammonia Tanks Tuff. Gray, densely welded, devitrified ash-flow tuff. Grades downward through brown, vitric, partially welded tuff. Locally, unit is entirely brown, partially welded tuff with large fragments of pale olive-tan pumice.
Tpr2	Tmr	Rainier Mesa Tuff. Pale-gray, devitrified, partially welded tuff with porous vapor-phase zone at top. Weathers to bench and steep slope covered with desert-varnished boulders.
Tpr1	Tmr	Rainier Mesa Tuff. Gray and purplish-brown, densely welded, devitrified ash-flow tuff. Grades downward through pink, partially welded, vitric tuff to pale-gray nonwelded ash-flow tuff. Weathers to a steep slope littered with platy fragments above discontinuous knobby columns and low cavernous cliffs.
Tpra	Tmr	Rainier Mesa Tuff. Ash-fall tuff, yellow and gray zeolitic bedded tuff; small amount of pale-gray vitric tuff. Weathers to a slope.
Tpt	Tpt	Paintbrush Group (Tertiary) Topopah Spring Tuff. Multiple-flow, simple cooling unit; chiefly brown, welded, devitrified and black vitrophyric ash-flow tuff. Includes rhyolitic bedded tuff and possibly minor nonwelded ash-flow tuff, generally zeolitized. [Paintbrush Tuff, Poole, 1965].
Tps	Th	Calico Hills Formation (Tertiary) Pale gray and brown, vitric bedded tuff. Many cycles made up of brown, chiefly fine but also poorly sorted tuff, in beds 0.3 to 1.2 meters thick, underlain by pale gray, fine to lapilli, thin-bedded, medium to well-sorted tuff. [Survey Butte (?) Member, Hinrichs and McKay, 1965]

**Legend for Preliminary Correlation Map of Geomorphic Surfaces in
North-Central Frenchman Flat, Nevada Test Site (continued)**

Map Unit Symbol	Current Unit Map Symbol ^a	Unit Description
Twf	Tw	Wahmonie Formation (Tertiary) ^d Lava flows and flow breccias. Dacite, dark gray to black; flows characteristically zoned with stony interior, grading outward through glassy zone into zone of flow breccia. Generally flow-banded and sheeted. Glassy to holocrystalline; porphyritic. Unit equivalent to upper part of flow sequence of Wahmonie Flat area.
Twtb	Tw	Tuff, sandstone, and lithic tuff breccia. Gray, white, and red laminated to very thick-bedded, biotite-rich, pumiceous tuff, sandstone, and lithic tuff breccia.
Ti	Th	Calico Hills Formation (Tertiary) Bedded tuff and tuffaceous sandstone. Tuff is gray, pink, and brown, and most of it is zeolitic. Subordinate sandstone in reddish brown. [Indian Trail (?) Formation, Hinrichs and McKay, 1965]
Tms	Tws	Wahmonie Formation (Tertiary) ^d Salyer Member. Tuff and tuffaceous rock. Reddish-brown tuffaceous sandstone and siltstone; locally conglomeratic; gray, yellow, orange, and red zeolitic and argillic bedded tuff, some biotite-rich.
Tpa	Tgp	Rocks of Pavits Spring (Tertiary) ^e Bedded tuff. Gray, yellow, and red, vitric and zeolitic; locally conglomeratic, carbonaceous, and fossiliferous.
Tpan	Tgp	Nonwelded ash-flow (?) tuff. Gray, yellow, and brown, mostly zeolitic; slightly flattened pumice.
Oa	Oa	Pogonip Group (Ordovician) Antelope Valley Limestone. Medium gray, fine- to medium-crystalline, sparsely fossiliferous; thin tan quartzite in upper part.

- a Additional work in this area, documented on later maps (i.e., BN, 2005 for the Quaternary units; Slate et al., 1999 for the Tertiary and pre-Tertiary units) has resulted in renaming of some of the units used on this map. For the convenience of the reader, this chart may serve as a correlation of the mapping unit symbols used on this map and later maps of this area. The 1993 map terminology and original source for the Tertiary units is included in brackets [] for those units with major changes in nomenclature.
- b Qcu does not correlate with Unit 1 of BN, 2005. May be included in Qai, Intermediate alluvial deposits, of Slate et al., 1999.
- c Both Tpat1 and Tpat2 (Hinrichs and McKay, 1965) are now included in Tma. Tpr1, Tpr2, and Tpra (Hinrichs and McKay, 1965) are now included in Tmr.
- d Both Twf and Twcb (Poole et al., 1965) and Tms (Tuffs and Tuffaceous Rocks of Mount Salyer [Hinrichs and McKay, 1965]) are now included in Tw.
- e Both Tpa and Tpan (Tuff of Pavits Spring, Hinrichs and McKay, 1965) are included in Tgp.

Distribution List

U. S. Department of Energy

	<u>Copies</u>
Jhon Carilli Waste Management Division U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	2
B. M. Crowe Apogen Technologies U.S. Department of Energy National Nuclear Security Administration Nevada Site Office P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1
U.S. Department of Energy National Nuclear Security Administration Nevada Site Office Technical Library P.O. Box 98518, M/S 505 Las Vegas, NV 89193-8518	1 (uncontrolled)
U.S. Department of Energy National Nuclear Security Administration Nevada Site Office Nuclear Testing Archive Public Reading Facility P.O. Box 98518, M/S 400 Las Vegas, NV 89193-8518	2 (electronic, uncontrolled)
U.S. Department of Energy Office of Scientific and Technical Information Post Office Box 62 Oak Ridge, Tennessee 37831-0062	1 (electronic, uncontrolled)

Distribution List (continued)

	<u>Copies</u>
<u>Bechtel Nevada</u>	
Max Dolenc Bechtel Nevada P.O. Box 98521, M/S NSF080 Las Vegas, NV 89193-8521	1
Environmental Management Library Bechtel Nevada P.O. Box 98521, NLV094 Las Vegas, NV 89193-8521	1
Steve Nacht Bechtel Nevada P.O. Box 98521, NSF083 Las Vegas, NV 89193-8521	1
Stuart Rawlinson Bechtel Nevada P.O. Box 98521, NTS416 Las Vegas, NV 89193-8521	1
Dan Tobiason Bechtel Nevada P.O. Box 98521, NTS416 Las Vegas, NV 89193-8521	1

RELATIVE OCCURRENCE OF SELECTED CHARACTERISTICS
OF MAP UNITS WITHIN NORTHERN FRENCHMAN FLAT

GEOLOGIC CHARACTERISTIC	MAP UNIT						
	Q2	Q3	Q4	Q5	Q6	Q7	
DESERT PAVEMENT	****	****	to	to	N.O.	N.O.	
CARBONATE/SILICA PLATELETS ON SURFACE	**	**	*	N.O.	N.O.	N.O.	
VARNISHED CLASTS	****	****	to	**	*	N.O.	
RUBIFIED CLASTS	****	****	to	**	*	N.O.	
BAR- and SWALE MORPHOLOGY PRESERVED	*	*	**	***	****	****	
EQUIAN MANTLE	to	to	to	to	*	N.P.	

UNIT Qcu HAS NOT BEEN STUDIED TO THE EXTENT OF OTHER MAPPING UNITS AND
IS NOT INCLUDED IN THIS TABLE.

Asterisks show the typical relative development of selected geologic and geomorphic
characteristics for the mapping units. Geologic and geomorphic characteristics:

**** : VERY WELL DEVELOPED
*** : WELL DEVELOPED
** : MODERATELY WELL DEVELOPED
* : OBSERVED, BUT POORLY DEVELOPED
N.O. : NOT OBSERVED

Asterisks for Eolian Mantle indicate relative thickness:

**** : VERY THICK
*** : THICK
** : THIN
* : VERY THIN
N.P. : NOT PRESENT

Adapted from Gibson and others (1992).

EXPLANATION

- CONTACT (dashed where inferred)
- FAULT (dashed where inferred, dotted where
buried, bar and ball on down-thrown side)
- UNIMPROVED ROAD
- SECONDARY HIGHWAY, HARD SURFACE

NORTH