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Civilian Radioactive Waste Management System
Management & Operating Contractor

Environmental Baseline File for Water Resources

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June 1999

Prepared for:

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Yucca Mountain Site Characterization Office
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1. INTRODUCTION

1.1 PURPOSE AND OBJECTIVE

The Water Resources Environmental Baseline File provides references that will be used to establish water quality and quantity baseline conditions at Yucca Mountain and surrounding areas for use in preparing the repository Environmental Impact Statement. The data describe the water quality and quantity for the affected area which includes the Yucca Mountain Project Site, Nevada Test Site, Ash Meadows, Death Valley and the proposed Nevada rail and heavy haul corridors.

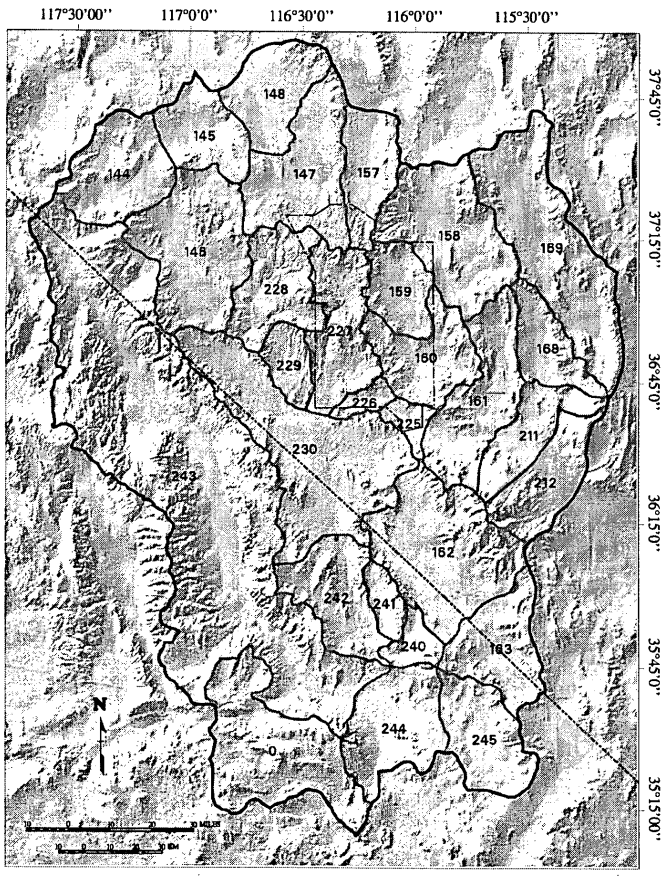
Documents were identified through review of project water resource data files and through discussions of issues with key personnel.

1.2 STUDY AREA

Hydrographic areas consist of valleys (topographic lows) that extend to their surrounding surface water drainage divides (topographic highs). The state is divided into 14 major hydrographic regions or basins, which are further divided into 232 minor hydrographic areas (Bauer et al. 1996, p 542-543).

The Yucca Mountain Site is part of a regional groundwater basin referred to as Death Valley Regional Groundwater Flow System (D'Agnese et. al. 1997; Eakin et. al. 1976) (Figure 1), which is administered by the States of Nevada and California. This regional groundwater basin is subdivided by the state into 28 hydrographic areas on the basis of surface water drainage. Within the regional basin are three subbasins, Alkali Flat-Furnace Creek Ranch, Ash Meadows, and Oasis Valley, and each of these subbasins have separate discharge locations (Figure 2). The Alkali Flat-Furnace Creek Ranch subbasin includes Yucca Mountain, Amargosa Valley. The Ash Meadows subbasin includes the Nevada Test Site, Devil's Hole, and Ash Meadows. The Oasis Valley subbasin is not a part of the study area. Limited water resources data for the potential rail and heavy haul corridors in Nevada are also included in this report. Rail and heavy haul corridors extend throughout the state, well beyond the limits of the Death Valley Regional Groundwater Flow System.

The Yucca Mountain area drains mainly eastward toward Fortymile Wash, a tributary of the Amargosa River. The western flank of Yucca Mountain drains westward toward Solitario Canyon Wash, which joins the Amargosa River by way of Crater Flat (CRWMS M&O 1999a). The main tributaries to Fortymile Wash are Yucca Wash, to the north of the proposed repository; Drillhole Wash, which drains most of the proposed repository area; and Busted Butte Wash to the south of the proposed repository (CRWMS M&O 1999a). There are no perennial streams at Yucca Mountain.



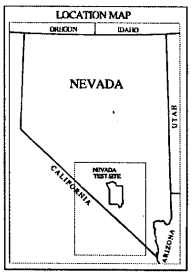
Yucca Mountain Site
Characterization Project

Hydrographic Areas (subbasins) of the Death Valley Region

(Adapted from Eakin et al., 1976 and D'Agnese et al., 1996)

Death Valley Regional Flow System Boundary and Hydrographic Area Boundaries obtained by scanning figure 5.3-257 from DOE/YMP Report B00000000-01717-5700-00019 REV 00. Image was georeferenced using ERDAS IMAGINE software. Boundaries were screen digitized and converted into an ARC/INFO coverage. Hillshade created by resampling Digital Elevation Mode (DEM) of Death Valley from 917-foot cell-size to 100-foot cell-size (cubic convolution, sun azimuth: 315 degrees, sun angle: 45 degrees). DEM obtained from United States Geologic Survey (USGS). Nevada Test Site data obtained from DOE NV/Bechtel, 1997. Nevada Test Site Administrative Boundaries coverage. DOE NV/Bechtel, Las Vegas, NV. Western States And Counties data obtained from ESRI Modified USGS 1:2,000,000 scale Digital Line Graph data for the Southwestern portion of the United States. Perimeter Drift Area data obtained from M&O/Morrison-Knudsen, 1997, Drawing Exchange File (DXF) of Preliminary Repository Layout, Model 12 - 04/21/97, Preliminary Draft. US Department of Energy, YMSCO, Las Vegas, NV. Projection: Stateplane Feet, Zone 4626, Datum NAD27. Map compiled by CRWMS/M&O TDM on June 27, 1998.

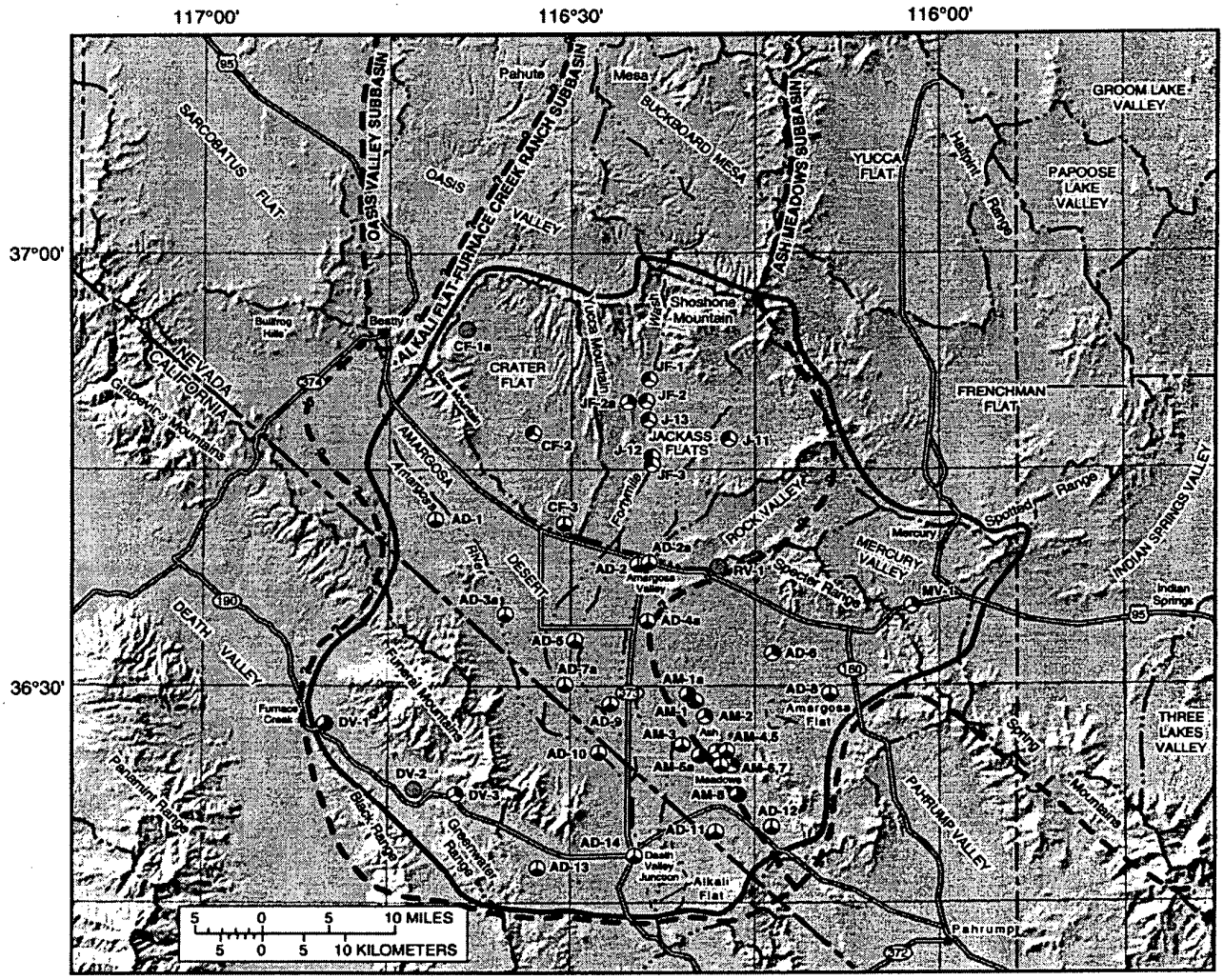
- Death Valley Regional Flow System Boundary
- Hydrographic Area Boundary
- Proposed Repository Layout
- Nevada Test Site Boundary
- State Boundary



144 Lida Valley
145 Stonewall Flat
146 Sarcobatus Flat
147 Gold Flat
148 Cactus Flat
157 Kawich Valley
158 Emigrant Valley
159 Yucca Flat
160 Frenchman Flat
161 Indian Springs Valley
162 Pahrump Valley
163 Mesquite Valley
168 N. Three Lakes Valley
169 Tikaboo Valley
211 S. Three Lakes Valley
212 N. Las Vegas Valley
225 Mercury Valley
226 Rock Valley
227 Fortymile Canyon
228 Oasis Valley
229 Crater Flat
230 Amargosa Valley
240 California Valley
241 Chicago Valley
242 Lower Amargosa Valley
243 Death Valley
244 Valjean Valley
245 Shadow Valley
xxx No hydrographic area number available

YMP-98-139.1

Figure 1. Hydrographic Areas (Subbasins) of the Death Valley Region (Adapted from Eakin Et Al., 1976 and D'Agnese et al., 1997)



Base from U.S. Geological Survey digital elevation data, 1:250,000, 1987, and digital data, 1:100,000, 1981-89; Universal Transverse Mercator projection, Zone 11. Shaded-relief base from 1:250,000-scale Digital Elevation Model; sun illumination from northwest at 30 degrees above horizon

EXPLANATION

Study-area boundary

Ground-water subbasin boundary—From Laczniak and others (1996, pl. 1). Queried where location uncertain

Hydrographic-area boundary

Data-collection site—Site number and primary contributing unit are indicated

AD-6 **Carbonate rock**

CF-2 **Volcanic rock**

AD-1 **Valley fill**

DV-2 **Undifferentiated sedimentary rock**

DV-1 **Combined carbonate rock and valley fill**

Figure 2. Groundwater Level and Discharge Monitoring Sites in the Yucca Mountain Project Water Resources Study Area (LaCamera and Locke 1997)

1.3 LOCATION

The Yucca Mountain site is located in southwestern Nevada, approximately 100 miles northwest of Las Vegas, Nevada. The site occupies lands administered by the U.S. Department of Energy (Nevada Test Site), the U.S. Department of Defense (Nellis Air Force Base Bombing and Gunnery Range), and the U.S. Department of the Interior (public lands administered by the Bureau of Land Management). In general, activities, such as groundwater withdrawals related to the site characterization, are restricted to the eastern side of Yucca Mountain. Groundwater flow in the Death Valley Hydrographic Region is generally towards the south (CRWMS M&O 1999a). The potential exists that groundwater withdrawal for the proposed repository at Yucca Mountain could affect downgradient water levels and water quality. Therefore, wells and springs are monitored at Yucca Mountain, Ash Meadows, and Death Valley to establish baseline conditions. The U.S. Geological Survey , which measures groundwater levels and water quality at selected wells and springs both at and downgradient of Yucca Mountain operate the monitoring program. The well and spring locations are shown on Figure 2. The data from this monitoring program is included in the U.S. Geological Survey annual Water Resources Data Reports for Nevada (Section 2.1.1) as well as Open File Reports.

No naturally occurring permanent surface water happens at Yucca Mountain. The nearest surface water impoundments are Peterson Reservoir, Crystal Reservoir, Lower Crystal Marsh, and Horseshoe Reservoir. The Largest of these is Crystal Reservoir, with a capacity 1,840,000 cubic meters (1492 acre feet) (CRWMS M&O 1999a), at Ash Meadows.

1.4 SENSITIVE RECEPTORS

Sensitive receptors include threatened and endangered species at Devils Hole, Ash Meadows, Death Valley (CRWMS M&O 1999b), and human populations living in the town of Amargosa Valley and throughout Death Valley, and workers at Yucca Mountain (CRWMS M&O 1999c).

2. WATER RESOURCES

2.1 WATER QUANTITY

2.1.1 Groundwater Data

La Camera and Locke 1997; La Camera et. al. 1996; Westenburg and La Camera 1996; Hale and Westenburg 1995; La Camera and Westenburg 1994–Forty wells and springs are monitored quarterly as part of the Yucca Mountain monitoring program within the Alkali Flat-Furnace Creek Ranch and Ash Meadows groundwater subbasins. The monitoring covers the area between latitudes 36 degrees 15 minutes and 37 degrees North and longitudes 116 degrees and 117 degrees West (Figure 2). The La Camera et al. (1996) report was incorporated into the U.S. Geological Survey Water Resources Data Report for Nevada (Bostic et. al., 1997). The 1998 monitoring data contained in the quarterly monitoring reports is considered by the U.S. Geological Survey to be preliminary and will be finalized when published in a U.S. Geological Survey Open File Report.

Bonner et. al. 1998; Bostic et. al. 1997; Bauer et. al. 1996; Clary et. al. 1994; and Emett et. al. 1994–Data from various U.S. Geological Survey hydrologic monitoring projects are presented in the U.S. Geological Survey Water Resources Data Reports for Nevada. The areas of interest include the Nevada Test Site, Amargosa Desert Basin, and Yucca Mountain. Hydrologic data includes water levels, discharge data from Ash Meadows National Wildlife Refuge, other data provided includes aquifer, well characteristics, and period of record. Latitude and longitude locations for the various water monitoring sites are provided. The locations of observation wells, water-use sites, groundwater quality monitoring sites, and springs, included in the above-referenced monitoring projects for water year 1995 through 1996, are shown on Figure 38 of Bostic et. al. (1997, p. 549). Approximately 30 of the monitoring sites are further identified in a table (Bostic et. al. 1997, p. 548) that precedes Figure 38.

Perfect et al. (1995)–Compiled available well completion data in data tables for wells in the Death Valley regional groundwater system. This database is useful in its electronic format, as it can be easily searched. Sample locations have been assigned a latitude and longitude location. Useful information includes water level, well depth, aquifer materials and information on whether the measurement is from a well or spring. Spring water samples were collected in an area between latitude 35 degrees North to latitude 38 degrees North and longitude 115 degrees West to longitude 118 degrees West which includes Yucca Mountain and the Death Valley regional groundwater system. Dissolved chemical species only are presented in a Lotus 1-2-3 spreadsheet.

2.1.2 Surface Water Data

Bonner et. al. 1998; Bostic et. al. 1997; Bauer et. al. 1996; Clary et. al. 1994; and Emett et. al. 1994; U.S. Geological Survey Water Resources Data Reports for Nevada–The annual U.S. Geological Survey Water Resources Data Reports present an update of the previous years records. A full record for a specific station can be obtained directly from the U.S. Geological Survey database without reference to the annual reports (note: the reports cited do not cover the

full record period for all stations). Data from various U.S. Geological Survey hydrologic monitoring projects are presented in these reports in the *Special Networks and Projects* sections. The areas of interest include the Nevada Test Site and adjacent areas, Amargosa Desert Basin, and Yucca Mountain. Hydrologic data collected and compiled includes discharge data from ephemeral stream near Yucca Mountain and in Amargosa Desert, and precipitation data. Figure 38 in Bostic et al. (1997) is a schematic diagram of the flow, which identifies springs, observation wells, water-use sites, groundwater quality monitoring sites, precipitation sites, springs, and others. Miscellaneous precipitation sites that are part of the Yucca Mountain Surface-Water Monitoring Project are shown on Figures 12, 15, and 38 of Bostic et. al. (1997).

Savard 1995 and Savard 1996–Stream flow data was collected from a network of up to four continuous recording gage stations and three crest-stage gages in the lower Fortymile Wash drainage basin.

2.1.3 Proposed Transportation Corridors in Nevada

Bonner et. al. 1998; Bostic et. al. 1997; Bauer et. al. 1996: The following types of surface and subsurface monitoring data for selected areas in the state of Nevada are contained in the annual U.S. Geological Survey Water Resources Data reports for Nevada:

- Water discharge measured at gauging stations on streams, canals, and drains
- Discharge for peak-flow stations and miscellaneous sites, and springs
- Stage and contents for lakes and reservoirs
- Water-quality data for stream, lake, canal, spring, precipitation, drain sites, and wells
- Precipitation totals for stations
- Water levels for continuous record wells, and observation wells
- Water withdrawal volumes for selected wells.

CRWMS M&O 1999b–The Biological Resources Environmental Baseline File has an attachment entitled *Maps of Biological Resources Along Transportation Corridors and Intermodal Transfer Facilities*. This attachment shows the locations of springs and waterbodies along the corridors and the transportation appendices provide additional information for each of the identified springs or waterbodies.

Proposed Rail and Heavy Haul routes are shown in Figures 1 and 2.

2.2 WATER QUALITY

2.2.1 Groundwater Quality

Perfect et al. 1995 (Lotus 1-2-3 spreadsheet *Dissolved Chemical Species Only*)–The author has compiled a hydrochemical data base from an area between latitude 35 degrees North to latitude 38 degrees North and longitude 115 degrees West to longitude 118 degrees West. This area includes the Nevada Test Site, Yucca Mountain, and the Death Valley regional groundwater system. This area is the Death Valley Regional Groundwater Flow System as shown in Figure 1. This is a summary document that contains almost 4,000 records, each with a latitude and longitude location. The database is useful in its electronic format. According to Perfect et al.

(1995), it provides groundwater chemistry data from samples collected within an approximately 100,000 square kilometer area encompassing the Death Valley regional groundwater system. The data were compiled from published U.S. Geological Survey and National Water Information System reports and previously unpublished U.S. Geological Survey files. The dates of the analyses range from 1910 through 1991. Other information often provided in the database includes the name of the analytical laboratory, the sample source, the lithology of the aquifer, and a comment section. Some of the sample collection sites are shown on Figure 2.

Oliver and Root 1997–This document is a summary of data for the Yucca Mountain area. It contains a sample location map and isocontour maps. Excel spreadsheet; well depth and aquifer information: Saturated zone groundwater sample analytical data were obtained for approximately 25 wells in Jackass Flats, Yucca Mountain, Crater Flat, and Amargosa Valley. The parameters include major ion and trace-metal chemistry and physical parameters, stable and radioisotope analyses. This document builds on the Perfect et. al. (1995) report. Additions include recent hydrochemical and isotopic data. The Microsoft Excel® database is separated into four workbooks, entitled *Hydrochem, Isotope, Summary, and References*. A Conclusions section is provided on page seven of the Oliver and Root (1997) report.

La Camera and Westenburg 1994–This document summarizes data collected from 1910 through 1992 and compares the data to drinking water standards. The data was collected in the following hydrographic areas; Crater Flat, Jackass Flats, Rock Valley, Mercury Valley, parts of Amargosa Desert, and parts of Death Valley. Included are radiochemical constituents and stable isotopes, volatile organic industrial compounds, semi-volatile organic industrial compounds, organochlorine and organophosphorus pesticides (1990 through 1992) for the Yucca Mountain region (Tables 7 through 12 of La Camera and Westenburg 1994). A comparison of the chemical data to accepted and proposed drinking water standards is provided in Table 14 of the La Camera and Westenburg (1994) report.

2.2.2 Surface Water Quality

Savard 1996–Chemical and compositions of two stream samples were collected from the Delirium Canyon and Pah Canyon tributaries to Fortymile Wash and are presented in Table 10 (p. 8).

Emett et. al. 1994–Water quality measurements from the Yucca Mountain Surface Water Monitoring Project are tabulated on page 550.

***Yucca Mountain Site Description* (CRWMS M&O 1998)**–A compilation of surface water data is provided in Table 6.2-5a entitled *Physical Characteristics and Chemical Compositions of Water Samples at Surface Water Sites in the Yucca Mountain Area* and Table 6.2-5b entitled *Trace Ion Chemistry and Isotopic Composition of Water Samples at Surface Water Sites in the Yucca Mountain Area* (pp. T5.1-14 through T5.1-19). A discussion is provided in Section 5.1.6, Chemistry of Surface Water (pp. 5.1-26 through 5.1-30) and Section 6.2.4.3 Surface-Water Chemistry Data (pp. 5.2-11 and 6.2-12).

2.2.3 Radiological Data

***Yucca Mountain Site Characterization Project Radiological Programs White Paper* (CRWMS M&O 1997)**–During the first half of 1997 the U.S. Geqlogical Survey sampled three wells at Yucca Mountain and five wells and springs in the Amargosa Valley. The water samples were analyzed for gross alpha and gross beta activities, combined Radium Ra-226 and Ra-228 activities, and concentrations of man made beta and gamma radionuclides (p. 8). The results were compared to accepted standards (p. 9).

U.S. Department of Energy (DOE) 1994–Radionuclide data for groundwater monitoring sites at the Nevada Test Site are presented and the data is compared to drinking water standards. Earlier volumes are available.

U.S. Environmental Protection Agency (EPA) 1990–This document contains groundwater tritium levels measured at the Nevada Test Site and surrounding areas.

2.3 WATER RIGHTS AND WATER RESOURCES

Thiel Engineering Consultants 1999–This report contains a review of the overall status of the basin inventory and yields for the Death Valley Hydrographic Region No. 14 (pp. 4 through 12). U.S. Geological Survey reports (Rush 1970; Walker and Eakin 1963) describe perennial yields for some of the basins that are substantially lower than a State of Nevada Report (Nevada State Engineer's Office 1971). This report provides a range of yields for each of the basins that are discussed.

Buqo 1996–Appendix B of Buqo's report lists water rights for hydrographic areas in the vicinity of Yucca Mountain.

2.4 SUBSURFACE ASPECTS AND WATER USE IN THE YUCCA MOUNTAIN AREA

The hydrology of the Yucca Mountain area is described in the *Geology/Hydrology Environmental Baseline* (CRWMS M&O 1999a). The water table at Yucca Mountain is generally encountered in the Calico Hills Formation and older rocks. The saturated zone has been divided into three volcanic aquifers, three volcanic confining units, two carbonate aquifers, and clastic or carbonate confining units (Figure 2-3, p. 2-10 and 2-11 of CRWMS M&O 1999a). They are listed as follows (from youngest to oldest): upper volcanic aquifer and upper volcanic confining unit; and the lower carbonate aquifer. Water used at Yucca Mountain comes from the upper and lower volcanic aquifers, Luckey et. al. (1996, p. 19). Many wells in the Amargosa Desert draw from the alluvial valley fill aquifer. Approximately 27,000 acre-feet per year of groundwater in the Amargosa Desert is used for irrigation, industrial, commercial, wildlife, domestic, and municipal purposes.

2.5 ANTICIPATED REPOSITORY WATER NEEDS

The Subsurface Engineering File, (CRWMS M&O 1999d) and the Repository Surface Design (CRWMS M&O 1999e), contain estimates of the water needs for construction and operation phases of the repository.

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