OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
ANALYSIS/MODEL COVER SHEET
Complete Only Applicable Items

2. ☒ Analysis — Check all that apply

Type of Analysis:
- ☐ Engineering
- ☐ Performance Assessment
- ☒ Scientific

Intended Use of Analysis:
- ☐ Input to Calculation
- ☒ Input to another Analysis or Model
- ☒ Input to Technical Document
- ☐ Input to other Technical Products

Describe use:

Analyze available water-level altitudes to create a potentiometric surface map for use in the SZ site-scale model.

3. ☐ Model — Check all that apply

Type of Model:
- ☐ Conceptual Model
- ☐ Abstraction Model
- ☐ Mathematical Model
- ☐ System Model
- ☐ Process Model

Intended Use of Model:
- ☐ Input to Calculation
- ☐ Input to another Model or Analysis
- ☐ Input to Technical Document
- ☐ Input to other Technical Products

Describe use:

4. Title:

Water-Level Data Analysis for the Saturated Zone Site-Scale Flow and Transport Model

5. Document Identifier (including Rev. No. and Change No., if applicable):

ANL-NBS-HS-000034 REV 00

6. Total Attachments:

1

7. Attachment Numbers - No. of Pages in Each:

I-28

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9.	Checker	Charles Savard	SIGNATURE ON FILE	8/4/00
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Approved AMR

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
ANALYSIS/MODEL REVISION RECORD

Complete Only Applicable Items

2. Analysis or Model Title:

Water-Level Data Analysis for the Saturated Zone Site-Scale Flow and Transport Model

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4. Revision/Change No.	5. Description of Revision/Change
REV 00	Initial Issue

CONTENTS

FIGURES

TABLES

ACRONYMS

ACC	Accession Number
AMR	Analysis/Model Report
AP	Administrative Procedure (DOE)
CRWMS M&O	Civilian Radioactive Waste Management System Management & Operating Contractor
DIRS	Document Input Reference System
DOE	Department of Energy
DTN	Data Tracking Number
GIS	Geographic Information System
EWDP	Early Warning Drilling Program
ID	Identification
LHG	large hydraulic gradient
NWIS	National Water Information System
OCRWM	Office of Civilian Radioactive Waste Management
QAP	Quality Administrative Procedure (M&O)
QARD	Quality Assurance Requirements and Description
SZ	Saturated Zone
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
YMP	Yucca Mountain Site Characterization Project

1. PURPOSE

This Analysis/Model Report (AMR) documents an analysis of water-level data performed to provide the saturated-zone, site-scale flow and transport model (hereafter referred to as the saturated zone (SZ) site-scale model) (CRWMS M&O 2000a) with the configuration of the potentiometric surface and target water-level data for model calibration. This analysis is designed to use existing water-level data and analysis results as the basis for estimating water-level altitudes and the potentiometric surface in the SZ site-scale model domain. The objectives of this AMR are to develop computer files containing water-level data and a potentiometric-surface map. These data will be used to represent an approximation of the water table in the SZ site-scale model. In addition to being utilized by the SZ site-scale model, the water-level data and potentiometric-surface map contained within this report will be available to other government agencies and water users for ground-water management purposes. Because the potentiometric surface defines the upper boundary of the site-scale flow model, as well as the magnitude and direction of lateral ground-water flow within the flow system, the analysis documented in this AMR is important to SZ flow and transport calculations to be made in support of total system performance assessment.

The source data associated with this analysis and AMR include water-level data from boreholes within, and from one borehole (UE-25 J-11) adjacent to, the SZ site-scale model area. The SZ site-scale model area (Figure 1-1) is between a Universal Transverse Mercator (UTM) Easting of 533,340 meters and 563,340 meters and a UTM Northing of 4,046,782 meters and 4,091,782 meters (Zone 11, North American Datum 1927). The following types of information were gathered: borehole site name/identification (ID), location, land-surface altitude, water-level altitude, data source, reliability of data, minimum and maximum water levels (range), and open interval monitored with the associated water-level altitude and type.

Development of this analysis was performed pursuant to AMR Development Plan TDP-NBS-HS-000099 (USGS 2000a). The scope of this AMR includes:

- Compilation of available data within the model area
- Removal of duplicate measurements and sites
- Tabulation of measurement precision
- Assessment of the general reliability of the data
- Tabulation of the range in water levels for use in uncertainty analyses
- Documentation of the applicable use of water levels (potentiometric-surface development or SZ site-scale model calibration)
- Generation of the potentiometric-surface map representative of the early 1990s (the steady-state time period of the saturated-zone, regional-scale flow model that is used to provide boundary conditions to the SZ site-scale flow model)

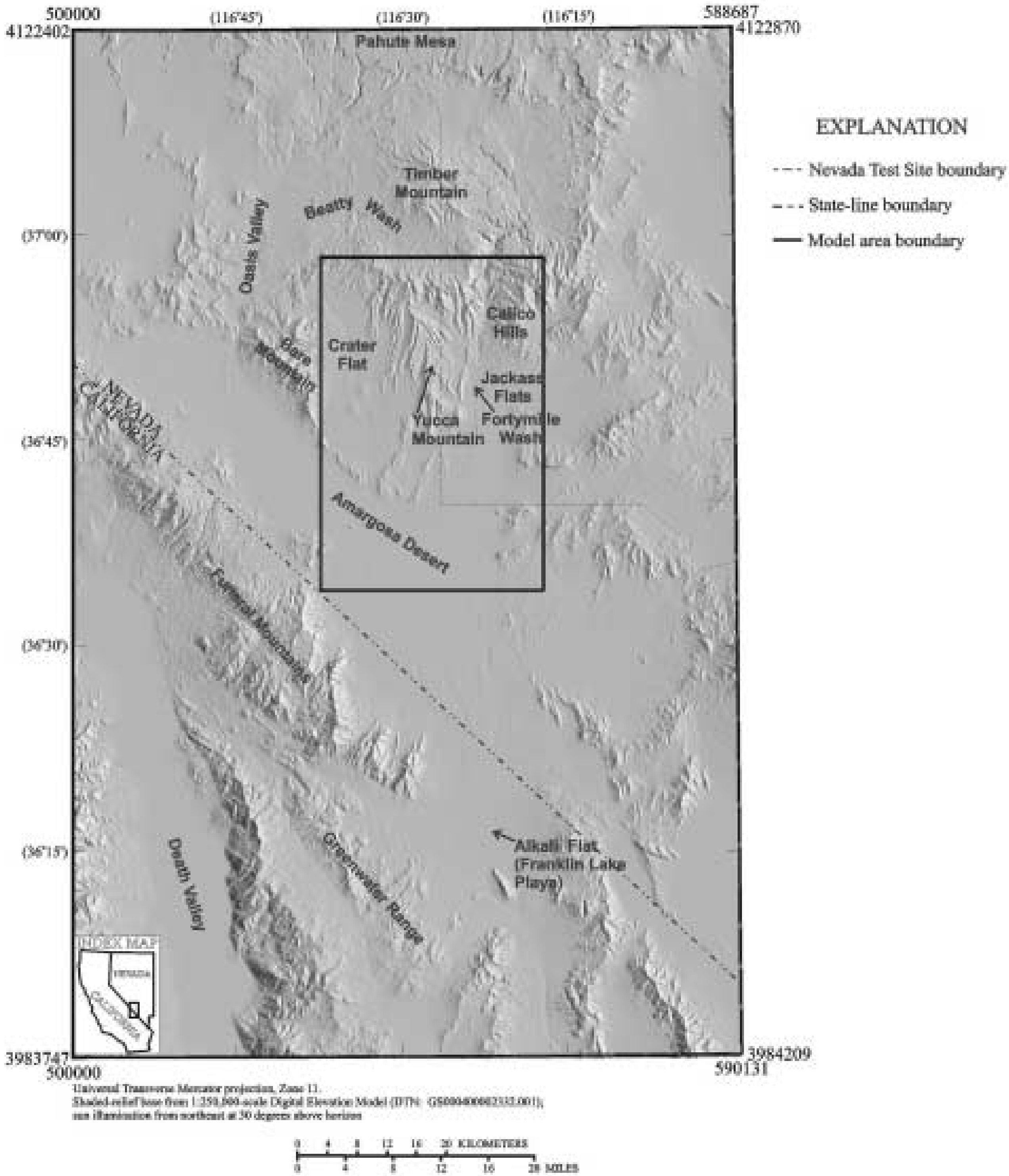

Figure 1-1. Location Map of the Study Area and Associated Geographic Features

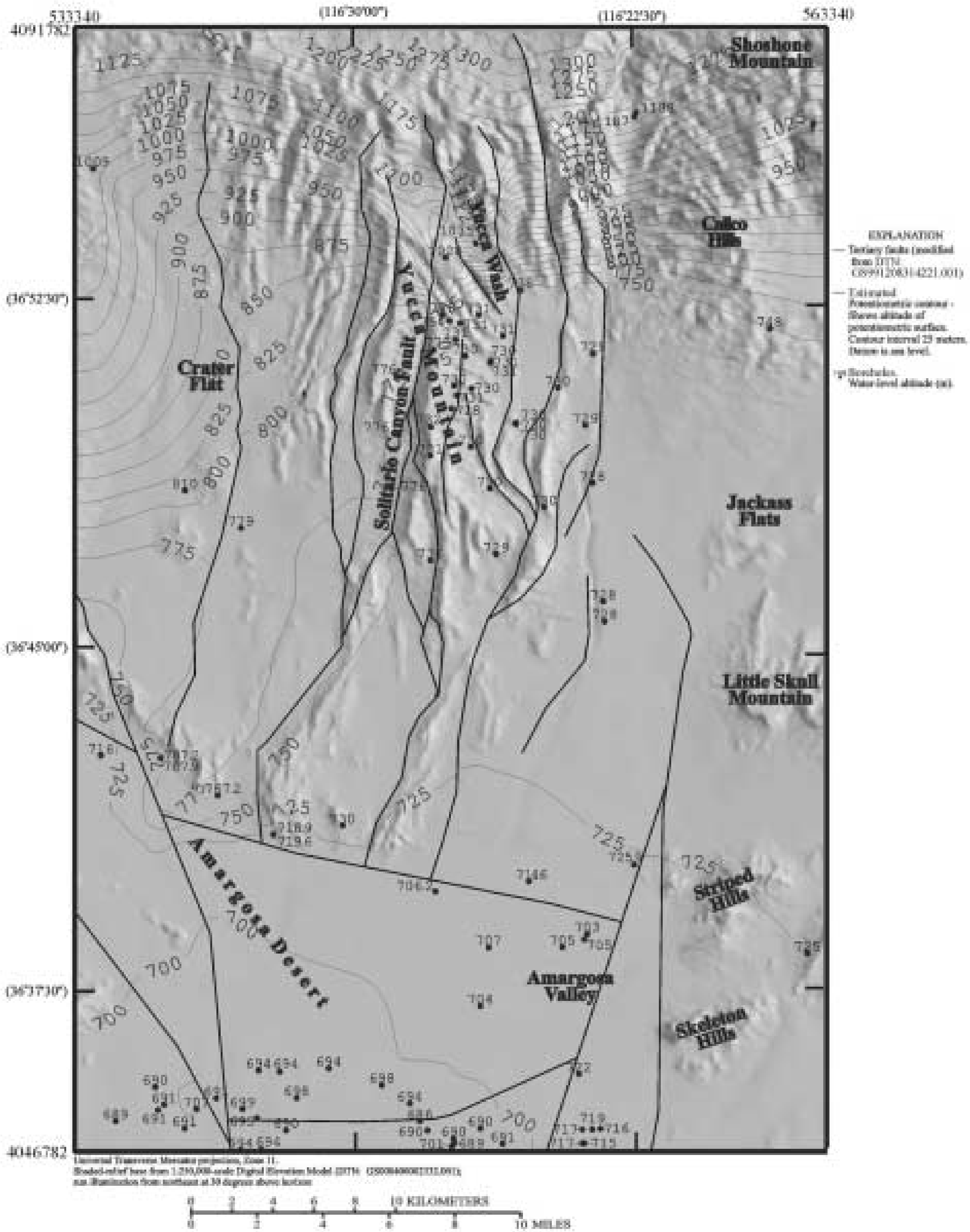

Figure 1-2. Borehole Locations, Water-Level Altitudes, Potentiometric Surface Contours, and Location of Tertiary Faults in SZ Site-Scale Model Area (DTN: GS000508312332.001)

In this analysis, the water-level data are used to generate a single representative potentiometric surface (Figure 1-2) for the SZ site-scale model domain. The potentiometric surface presented in this AMR represents an approximation of the water table in the upper saturated zone. Therefore, vertical hydraulic gradients were not considered as part of this analysis even though twelve of the boreholes that provided data for this analysis have multiple piezometers that isolate measurement intervals.

2. QUALITY ASSURANCE

The activities documented in this AMR were evaluated in accordance with QAP-2-0, *Conduct of Activities*, and were determined to be subject to the requirements of the U.S. DOE Office of Civilian Radioactive Waste Management (OCRWM) *Quality Assurance Requirements and Description* (QARD) (DOE 2000). This evaluation is documented in Wemheuer (1999, activity evaluation for work package WP 8191213SU1). This AMR has been prepared in accordance with procedure AP-3.10Q, *Analyses and Models.*

The work activities documented in this AMR depend on electronic media to store, maintain, retrieve, modify, update, and transmit quality affecting information. As part of the work process, electronic databases, spreadsheets, and sets of files were required to hold information intended for use to support the licensing position. In addition, the work process required the transfer of data and files electronically from one location to another. Consequently, all electronic files consisting of source data, development analysis inputs, analysis outputs, and post-processing results were maintained and processed according to the seven compliance criteria listed in AP-SV.1Q, *Control of the Electronic Management of Data* pursuant to the Development Plan governing these activities (USGS 2000a).

3. COMPUTER SOFTWARE AND MODEL USE

The water-level data were compiled and the potentiometric surface was constructed using geographic information system (GIS), spreadsheet, database, and gridding software. No controlled software codes were used to synthesize the water-level data for the SZ site-scale model. The software identified in Table 3-1 is currently being processed in accordance with Section 5.11 of AP-SI.1Q, *Software Management*.

Table 3-1. Software Used to Support Analysis Activity

Item No.	Software Name	Version	Software Tracking Number	Computer Platform, Operating System, Compiler	Description
1	ARCINFO	7.2.1	STN: 10033-7.2.1-00	Windows NT Workstation ver. 4 CPU ID#: 15409290306 Location: San Diego Projects Office, USGS/WRD, San Diego, CA	Plotting, digitizing, coordinate transformation, database, and visualization of analysis results.
2	PETROSYS	7.60d	STN: 10168-7.60d-00	Windows NT Workstation ver. 4 CPU ID#: 15409290306 Location: San Diego Projects Office, USGS/WRD, San Diego, CA	Gridding, contouring, plotting, and visualization of analysis results.

A brief description of how the software was used follows.

ARCINFO Version 7.2.1, published by Environmental Systems Research Institute, Inc., was used for plotting, digitizing, coordinate transformation, and visualization of analysis results. PETROSYS Version 7.60d, published by Petrosys Pty, Ltd., was used for gridding, contouring, plotting, and visualization of analysis results.

The use of software and data inputs for developing the potentiometric surface is summarized in Section 6.2.

4. INPUTS

4.1 DATA AND PARAMETERS

The data used to construct the potentiometric surface and to define target water-levels in selected boreholes for flow-model calibration were developed from available measurements of water levels in boreholes throughout and adjacent to the SZ site-scale flow model domain. Because, in general, these water-level measurements represent the configuration of the potentiometric surface in the upper part of the saturated zone and no additional control is available from springs and other surface-water occurrences, these data were considered to be appropriate for their intended use in defining the upper boundary and determining lateral hydraulic gradients for the SZ site-scale flow model. Additional support for the appropriateness of the data is covered in Section 1 (Purpose), which describes the scope of the data used; in Section 5.1 (Assumptions – Water-Level Data), which addresses the assumptions about the use of the data; in Section 6.1 (Analysis – Water-Level Data), which presents the analysis of the data used; and in Section 7.1 (Conclusion – Water-Level Data), which discusses potential errors and uncertainty. Specific input data sets, and associated Data Tracking Numbers (DTNs), are listed in Table 4-1. The Quality Assurance status of these input sources can be found in the Document Input Reference System (DIRS).

Table 4-1. Input Data Sources

Data Description	Data Tracking Number
Digital Elevation Models Death Valley East Scale 1:250,000.	GS000400002332.001
Water-Level Measurements at UE-25 C #2 and C #3, 1989.	GS000408312312.001
Revised Water-Level Altitude Data from the Periodic Network, First Quarter 1995.	GS000608312312.004
Water-Level Altitude Data, 1993.	GS000708312312.005
Revised Potentiometric Surface Map of Yucca Mountain and Vicinity, Nevada	GS921108312331.001
Water Levels in the Yucca Mountain Area, Nevada, 1990-91.	GS930408312312.015
Water Levels in Periodically Measured Wells in the Yucca Mountain Area, Nevada, 1981-87.	GS931008312312.025
Water-Level Altitude Data from the Periodic Network, Fourth Quarter, 1994.	GS950108312312.001
Potentiometric-Surface Map, 1993, Yucca Mountain and Vicinity, Nevada.	GS950508312312.005
28 Water-Level Measurements from the Periodic Network, Third Quarter, 1995 (7/1/95 - 9/30/95).	GS960208312312.003
Analysis of Water-Level Data in the Yucca Mountain Area, Nevada, 1985-1995.	GS960908312312.010
Water Level Altitude Data Collected at GEXA Well 4 and USW G-4.	GS970600012847.001
Water Level Data for Yucca Mountain Region and Amargosa Desert.	GS991100002330.001
Geologic Map of the Yucca Mountain Region.	GS991208314221.001
Water Level Measurements in Boreholes, NC-EWDP-1D, NC-EWDP-1D Shallow, & NC-EWDP-1D Deep, Nye County Early Warning Drilling Program.	MO0004NC99WL1D.000

Data Description	Data Tracking Number
Water Level Measurements in Borehole, NC-EWDP-1S, Nye County Early Warning Drilling Program.	MO0004NC99WL1S.000
Water Level Measurements in Borehole, NC-EWDP-Washburn-1X, Nye County Early Warning Drilling Program.	MO0004NC99WL1X.000
Water Level Measurements in Borehole, NC-EWDP-2D, Nye County Early Warning Drilling Program.	MO0004NC99WL2D.000
Water Level Measurements in Borehole, NC-EWDP-3D, Nye County Early Warning Drilling Program.	MO0004NC99WL3D.000
Water Level Measurements in Borehole, NC-EWDP-3S, Nye County Early Warning Drilling Program.	MO0004NC99WL3S.000
Water Level Measurements in Borehole, NC-EWDP-5S, Nye County Early Warning Drilling Program.	MO0004NC99WL5S.000
Water Level Measurements in Borehole, NC-EWDP-9S, Nye County Early Warning Drilling Program.	MO0004NC99WL9S.000
USW SD-7 Shift Drilling Summaries (1602.0'-2020.3'), Lithologic Logs (1600.0'-1925.0'), and Structure Logs (1632.0'-2020.3').	TM0000000SD7RS.003
USW SD-9 Shift Drilling Summaries, Structural Logs, and Lithological Logs.	TM0000000SD9RS.001
USW SD-12 Shift Drilling Summaries, Lithologic Logs, and Structure Logs from 1825.0'-2166.3'.	TM000000SD12RS.011

The locations of the boreholes and the water-level altitudes in these boreholes that were used to construct the potentiometric surface are shown in Figure 1-2 together with the inferred contoured configuration of the potentiometric surface. The borehole data are provided in Attachment I.

Data qualification efforts as needed will be conducted in accordance with AP-SIII.2Q, *Qualification of Unqualified Data and the Documentation of Rationale for Accepted Data*, and documented separately from this AMR.

4.2 CRITERIA

This AMR complies with the DOE interim guidance (Dyer 1999). Subparts of the interim guidance that apply to this analysis activity are those pertaining to the characterization of the Yucca Mountain site (Subpart B, Section 15), the compilation of information regarding hydrology of the site in support of the License Application (Subpart B, Section 21(c)(1)(ii)), and the definition of hydrologic parameters and conceptual models used in performance assessment (Subpart E, Section 114(a)).

4.3 CODES AND STANDARDS

No codes or standards have been identified as applying to this analysis.

5. ASSUMPTIONS

5.1 WATER-LEVEL DATA

In the analysis presented in this report, several assumptions are made as described in the following subsections. The nature of these assumptions entails established hydrologic practices for the determination of water-level altitudes to be used in the construction of a potentiometric-surface map and require no further confirmation.

1. Assumption: Averaging water levels from the 1980s to 1990s provide water-level altitudes representative of conditions that existed in early 1990s. The SZ site-scale model (CRWMS M&O 2000a) uses ground-water fluxes from the Death Valley regional ground-water flow model (hereafter referred to as the regional model) (D'Agnese et al. 1997) as calibration targets. The simulated fluxes in the regional model represent average, steady-state conditions from the early 1990's, not conditions for a specific year. Therefore, the water levels used to construct the potentiometric surface for the site-scale model must, to the extent allowed by data availability, represent conditions consistent with the regional model that used water-level data (altitudes) representing the early 1990s. Water levels in boreholes located at Yucca Mountain generally have not fluctuated by more than one meter during the time period from 1985 until 1995 (Graves et al. 1997). Some of the boreholes used in this analysis had no or very few water-level measurements taken during the 1980s and 1990s (Tables I-2 and I-4). For boreholes in this category, all available water-level altitudes, with the exception of anomalous ones noted in Attachment I, were used to calculate the mean water-level altitude (Table I-1). This is particularly true for boreholes located in the Amargosa Valley and Amargosa Desert (Figure 1-2). This assumption is used in Section 6.1 and Table I-1.

2. Assumption: Mean water-level altitudes, even when influenced by ground-water withdrawal, represent water-level altitudes consistent with ground-water fluxes used in the SZ site-scale model. Some boreholes in the model area are being actively pumped for commercial and domestic water supplies. Water-level altitudes in these and adjacent boreholes could be influenced by the effects of pumping. This is especially true in the southern part of the SZ site-scale model area. The mean water-level altitude, calculated by averaging available data, provides a datum point that is representative of the potentiometric surface for the time period being simulated. The rationale is that average-annual pumping values were used in the regional model (D'Agnese et al. 1997) and average water levels will, therefore, be consistent with the simulated conditions in the regional model. This assumption is used in Section 6.1 of this AMR.

3. Assumption: Where measurement location is unknown, the midpoint of the open interval or applicable packed-off interval is representative of the measurement location for SZ site-scale modeling purposes. Most of the water levels used in this analysis are composite data, for a long open or screened interval. In open boreholes, the midpoint can be calculated as the mean of the altitude of the bottom of the borehole and the altitude of the maximum water-level altitude. In packed-off intervals (screened intervals), the midpoint is calculated as the mean of the altitude of the bottom of the packed-off interval and the altitude of the top of the

packed-off interval. Because this method is used for all boreholes that contributed water-level altitude data for this analysis, it provides a means for standardizing SZ measurements locations (Table I-5). This assumption is used throughout the AMR.

5.2 POTENTIOMETRIC-SURFACE MAP

In the analysis presented in this report, it is assumed that the water level from the uppermost open interval from each borehole at each site, by definition, represents the potentiometric surface of the uppermost part of the saturated zone (i.e., the water table) and that vertical gradients of head are small. Most boreholes have only one water-level measurement interval, however, several boreholes have two or more packed off measurement intervals (Attachment I). In most boreholes, the uppermost interval is where the water was first encountered in the borehole (excluding perched-water zones where identified). The significance of this assumption is that the resulting configuration of the potentiometric surface that is incorporated into the SZ site-scale model helps determine the magnitude and direction of lateral ground-water flow in the upper SZ. This is of concern to the evaluation of potential radionuclide transport down gradient from the potential repository. This assumption is used in Section 6.2.

5.3 BOREHOLE LOCATIONS

Borehole locations used in this analysis, and compiled in USGS 2000b, are sufficiently accurate for the intended purpose. Borehole coordinates and altitudes from USGS 2000b and DTN: MO0002COV00088.001, which only contains YMP boreholes, were compared. Differences in the northing and easting coordinates contained in the two records exist in most borehole locations. The altitudes of the boreholes in the two data sets were identical. Borehole altitude is the most critical component of the borehole location used for calculating the water-level altitude. Where there are differences in northing and easting coordinates, the differences are not large enough to adversely effect the location of the potentiometric-contour lines, which have 25-meter spacing. This assumption is used throughout this AMR.

6. ANALYSIS/MODEL

Although the water-level data and resulting potentiometric-surface map provide technical input for the development of the site-scale, saturated-zone flow and transport model that addresses the retardation of radionuclide migration in the saturated zone, the analysis documented in this AMR does not estimate or otherwise directly address any of the principal factors, other factors, or potentially disruptive processes and events included within the Repository Safety Strategy (CRWMS M&O 2000b). Consequently, this AMR is considered to be of Level 3 importance pursuant to Attachment I of AP-3.10Q.

6.1 WATER-LEVEL DATA

The water-level data for the SZ site-scale model were compiled from project data sources and U.S. Geological Survey (USGS) National Water Information System (NWIS) water-level data. This data set was updated using new (collected between January and March, 1999) information from the Nye County Early Warning Drilling Program (EWDP) boreholes and from geologic mapping within the model area (DTN: GS991208314221.001). Water-level information and analyses were compiled from the data sources listed in Table 4-1 of this AMR. The results were assembled in tabular format for use as input to the SZ site-scale model (see Attachment I).

Water-level information used in this analysis was derived from a variety of sources. The large areal extent of the SZ site-scale model and the long history of water-level data collection in this area has resulted in similar (or in some cases duplicate) water-level information being contained in multiple data sources. Water-level data used in this AMR were based on the following prioritization: 1) qualified data from project databases; 2) data from accepted data sources; and, 3) corroborative data from other sources. This prioritization resulted in the following data sources being used in the order listed, with duplicate sites being removed:

1. DTN: GS960908312312.010
2. DTNs: GS991100002330.001, GS970600012847.001, GS930408312312.015, GS931008312312.025, GS960208312312.003, GS000408312312.001, GS950508312312.005, GS000608312312.004, GS000708312312.005, GS950108312312.001
3. DTNs: MO0004NC99WL1D.000, MO0004NC99WL1S.000, MO0004NC99WL2D.000, MO0004NC99WL3D.000, MO0004NC99WL3S.000, MO0004NC99WL5S.000, MO0004NC99WL9S.000, MO0004NC99WL1X.000
4. DTNs: TM0000000SD9RS.001, TM000000SD12RS.011, TM0000000SD7RS.003

If more than one site ID was found in NWIS for the same borehole, the site ID with the most measurements was used for calculating the average water-level altitude for the time period of interest. If location, land-surface altitude, or depth-to-water for a borehole was not available, the site was deleted. NWIS data is stored as depth-to-water measurements, not as water-level altitude, and in English units as opposed to metric units. Conversion from depth-to-water to water-level altitude was accomplished by subtracting the depth-to-water measurement from the land-surface altitude of the measurement location (the borehole and surface altitude). The resulting water-level altitude was converted from feet to meters by multiplying by 0.3048.

Borehole UE-25 p#1 is the only borehole that penetrates the deep lying Paleozoic carbonate rocks in, and adjacent to, the SZ site-scale model area. The water level measured in UE-25 p#1 is about 20 m higher than water levels measured in nearby boreholes that penetrate Tertiary volcanic rocks within the upper saturated zone at Yucca Mountain. Because the water level in UE-25 p#1 is measured in an interval open to Paleozoic carbonate rocks that are separated from overlying volcanic rocks by low-permeability volcanic and clastic rocks, it is concluded by Tucci and Burkhardt (1995) that the water level measured in UE-25 p#1 is representative of the Paleozoic carbonate aquifer and not the potentiometric head of the uppermost saturated zone. The water level from UE-25 p#1 has not been used in the construction of the potentiometric-surface map that was developed for input to the site-scale SZ model documented in this AMR.

There are two substantially different water-level gradients in the model area (Figure 1-2). Near the potential repository, the hydraulic gradient is small and water levels are known typically within 1 meter and do not vary a great deal over this area. Conversely, at the north end of the SZ site-scale model area and just north of the potential repository, the hydraulic gradient is large and water-level altitudes are hundreds of meters higher and vary greatly. These elevated water levels may or may not represent the uppermost part of the saturated zone (i.e., the water table), but may actually represent a zone of perched water.

Borehole information was examined to see if water levels potentially represented perched-water conditions. Professional judgment was used to determine whether water-level altitudes represented perched-water conditions, based on the following criteria: proximity to cold-water springs, proximity to recharge areas, steep or anomalous potentiometric surface slope, anomalous water-level altitudes, statistical water-level variability, water chemistry, pumping history, and hydrographs (O'Brien 1998). Potential perched-water levels identified during this analysis were flagged and identified as "suspected perched" (Table I-8). To prove perched-water occurrence unequivocally requires demonstrating partial saturation beneath a suspected perched-water body. The boreholes in question were either drilled using a water-based circulating fluid or were only completed a few tens of meters into the first zone of saturation. Unfortunately, partial saturation could not be proved or disproved unequivocally with the available data for the boreholes in question, USW G-2, USW G-1, UE-29 a#2, UE-25 a#3, USW UZ-N91, UE-25 WT #18, and UE-25 WT#6, (Table I-8, O'Brien 1998).

6.2 POTENTIOMETRIC-SURFACE MAP

The distribution of water-level data and the complex geology in the SZ site-scale model area allow for various interpretations of the configuration of the potentiometric surface (Luckey et al. 1996, pages 21-26). Several potentiometric-surface maps have been developed that encompass Yucca Mountain and vicinity, including the site-scale model area and the regional model area. Examination of other potentiometric-surface maps, that fully or partially cover the SZ site-scale model area, reveal no major differences in the shape of potentiometric-contour lines. This is not unexpected because similar, and in some cases the same, water-level data was used to create the potentiometric-contour lines; and, adhering to the rules that govern the construction of potentiometric contours, a limited number of configurations of the water-level data are possible. The differences observed between existing potentiometric-surface maps and the one presented in this AMR can be attributed to map scale, potentiometric-contour intervals, and more and newer water-level data. The potentiometric-surface map created for this AMR is an accurate interpretation based on the available water-level data, the geologic map of the Yucca Mountain region, and the regional potentiometric surface.

The potentiometric-surface map presented in Czarnecki et al. (1997, figure 5) is identical in areal extent and has the same contour interval as the potentiometric-surface map developed for this AMR. Examination of that potentiometric-surface map illustrates an alternative interpretation constructed from similar water-level data. Differences in the two maps occur at the boundaries of the maps, where there is little or no data, and where the potentiometric surface is influenced by major faults. The major difference in the shape of the potentiometric contours occurs in the northern and northwestern area of the maps. Czarnecki et al. (1997) suggest a closing of the contour lines to the north of the large hydraulic gradient (LHG), water-level altitudes as much as 150 meters shallower, and an east-west trend of the contours in southern Crater Flat. Larger-scale potentiometric-surface maps (Ervin et al. 1994, plate 1; Tucci and Burkhardt 1995, page 8) cover only a small portion of the site-scale model area in the vicinity of Yucca Mountain. The potentiometric-surface map by Ervin et al (1994) has water-level contour intervals of 0.25 meters. This map does not attempt to contour the areas of the LHG or the moderate hydraulic gradient to the west of the Solitario Canyon fault, but the general shape of the potentiometric contours are similar to the map constructed for this AMR. The potentiometric-surface map in Tucci and Burkhardt (1995) has contour intervals that are variable, from 0.50 meters to 20.00 meters. Comparing the same potentiometric contour (800-meter contour) on this map and the map constructed for this AMR reveals a similarity in shape. The shape of the water-level contours on these larger-scale potentiometric-surface provides an alternative interpretation based on similar water-level data. The regional potentiometric surface of the Death Valley region (D'Agnese et al. 1997, plate 1) is at a much smaller scale than the potentiometric-surface map in this AMR. The contour intervals on D'Agnese et al. (1997) are 100 meters, resulting in only a few contour lines intersecting the site-scale model area. As with the larger-scale potentiometric-surface maps, the same water-level contours that occur on D'Agnese et al. (1997, plate 1) and the potentiometric-surface map in this AMR can be compared. This comparison reveals that the potentiometric contours on both maps are similar.

An alternative conceptual interpretation of the potentiometric surface in the northern part of Figure 1-2 could be considered if the water-level data defining the LHG were treated as representing a perched-water body. Boreholes where perched water is suspected to occur are listed in Table I-8. The exclusion of these data points would result in modifications to the potentiometric-surface map. Lower water-table altitudes would be depicted in the northern portion of the SZ site-scale model area, thereby reducing the LHG. However, limited hydraulic data preclude the determination that the water levels in these boreholes represent perched conditions. Therefore, this conceptual approach was not selected in the construction of the potentiometric-surface map for this AMR.

For SZ site-scale model construction purposes, the potentiometric-surface map was created (Figure 1-2). The water-level altitude from the upper interval of each borehole from a site was selected to represent the potentiometric surface (see Attachment I, Table I-1). Only water-level altitudes representing the uppermost aquifer system, typically the volcanic or alluvial system, were used.

Potentiometric data indicate a complex three-dimensional flow system. Luckey et al. (1996) discuss different gradients and interpretations of the SZ site-scale model. Ground-water flow in the welded volcanic rocks occurs primarily in fractures and secondarily in the matrix of the rock (Luckey et al. 1996). Therefore, this flow system may result from the presence of faults and associated fracture zones occurring in the welded volcanic hydrogeologic units. Depending upon where the potentiometric surface is located within the hydrostratigraphic sequence, it may be either confined or unconfined. Confined aquifers exist where a relatively impermeable hydrogeologic unit, such as a clay bed or argillic volcanic unit, overlies a permeable hydrogeologic unit. An unconfined aquifer has no overlying, relatively impermeable, hydrogeologic unit.

Many of the boreholes used in this analysis only partially penetrate a single hydrogeologic unit. In boreholes that do penetrate more than one hydrogeologic unit, no attempt was made to distinguish water-level measurements associated with specific hydrogeologic units or fracture zones. The water-level altitudes in some boreholes represent composite heads from multiple hydrogeologic units and fractures zones. Generally, water levels in the upper most saturated zone appear to represent a laterally continuous, well-connected aquifer system (Tucci and Burkhardt 1995, p.7). Little impact on the potentiometric surface is expected from boreholes that are open at different depth intervals and to different hydrogeologic units.

Water-level and fault data were used to grid and contour a potentiometric-surface map (Figure 1-2). Gridding is the process of creating a grid of values at regular intervals based on scattered input data. The PETROSYS gridding system and fault handling package was used to interpolate the potentiometric surface between existing water-level altitude points. A grid position coincident with the regional ground-water flow model of D’Agnese et al. (1997) was used. A grid increment of 500 m was chosen based on flow modeling requirements, rather than locally adjusting the grid for data density. This grid increment simplifies the available data near the repository and extrapolates from very widely spaced data in other areas of the model.

Many methods (both mathematical and interpretive) are available for use in creating grids. Most methods (except distance weighted average and the trend surface analysis) use a projected distance weighted average to obtain initial grid estimates from the input data. Once the initial estimation has been performed, the grid is allowed to converge to an optimum solution by using forced filtering. This filtering pass fills in the missing values in the grid.

The water-level data were loaded into the PETROSYS gridding software. The potentiometric contours previously developed by Ervin et al. (1994, DTN: GS921108312331.001) and by Tucci and Burkhardt (1995, DTN: GS950508312312.005) for Yucca Mountain and vicinity were digitized into ARCINFO to ensure conformity with these data sets. The contours were then exported as ASCII point files and loaded into PETROSYS. These larger-scale, more closely spaced digitized contour lines were used to help supplement the water-level data and guide the contouring of the potentiometric surface produced from this analysis. Water levels from Ciesnik (1995) were used outside the SZ site-scale model domain to help constrain the potentiometric surface in the southern portion of the SZ site-scale model area. Because it was necessary to construct an estimated potentiometric surface for the entire model area, gridding algorithms were allowed to use the available data to extrapolate the potentiometric surface beyond the data points on all boundaries. The extrapolation is based solely on trends in the data. Scientific Notebook SN-USGS-SCI-072-V2 (Faunt 2000) provides more information on the steps used to create this potentiometric surface map.

A hybrid gridding technique in PETROSYS was used to construct a continuous grid or surface utilizing a set of points in x,y,z space. The hybrid method is a combination of the minimum curvature and a first order least squares. It uses first order least squares within one grid cell of a fault and minimum curvature to calculate all other nodes. In heavily faulted datasets, such as Yucca Mountain, the results may be better than those obtained using the minimum-curvature method (widely used in geologic modeling).

Some of the major faults in the region are thought to affect water levels (Ervin et al. 1994; Tucci and Burkhardt 1995; Luckey et al. 1996; D'Agnese et al. 1997). As a result, several of these faults were selected to help interpret the water-level data used in the analysis (Figure 1-2). The selection was based on fault displacement of geologic units and persistence of the fault, both laterally and vertically. These fault traces were exported as ARC ungenerate files and loaded into the PETROSYS gridding software. These fault lines were used to help control assumed offsets in the potentiometric surface. Using a fault-handling package built into the gridding software, the fault traces were used during the final stage of the potentiometric-surface map construction. Where the grid crosses a fault, the grid is offset by the appropriate amount. Inherent in using fault traces is the simplification of these faults being traces of a vertical fault plane.

The location of some of the major faults helped to explain the water-level altitudes in some of the boreholes and the resulting potentiometric-surface map. For example, a moderate hydraulic gradient is associated with the area adjacent to the Solitario Canyon fault. Water-level altitudes to the west of the Solitario Canyon fault are more than 40 meters higher than those to the east (Ervin et al. 1994; Tucci and Burkhardt 1995).

The potentiometric surface is characterized by three major regions: (1) a small-gradient area to the east and southeast of Yucca Mountain where water levels range from about 728 to 732 m; (2) a moderate-gradient area to the west of Yucca Mountain (spatially associated with Solitario Canyon fault) where water levels range from about 740 to 800 m and (3) a large-gradient area to the north of the mapped area where water levels range from about 738 to 1188 m (Tucci and Burkhardt 1995). The potentiometric surface presented in this analysis and in previously published reports generally implies a hydraulically, well-connected flow system within the uppermost saturated zone (Tucci and Burkhardt 1995) as discussed above.

A number of explanations have been proposed to explain the presence of the apparent LHG at the north end of Yucca Mountain, an area where the altitude of the potentiometric surface appears to change by about 300 meters over a lateral distance of 2 kilometers (Czarnecki et al. 1994; Czarnecki et al. 1995). Prior to the construction of borehole USW G-2 in 1981, no water-level data existed at Yucca Mountain to indicate the presence of the LHG. As more boreholes were constructed in the northern part of Yucca Mountain, particularly boreholes UE-25 WT#6 and UE-25 WT#16, a somewhat better definition of the LHG developed. On a regional basis, other LHGs are associated with a contact in the Paleozoic rocks between clastic, confining unit rocks and the regional carbonate aquifer; however, the cause and nature of the LHG near Yucca Mountain is not evident. Explanations proposed for the LHG include: 1) faults that contain nontransmissive fault gouge (Czarnecki and Waddell 1984); 2) faults that juxtapose transmissive tuff against nontransmissive tuff (Czarnecki and Waddell 1984); 3) the presence of a less fractured lithologic unit (Czarnecki and Waddell 1984); 4) a change in the direction of the regional stress field and a resultant change in the intensity, interconnectedness, and orientation of open fractures on either side of the area with the LHG (Czarnecki and Waddell 1984); or 5) the apparent large gradient actually represents a disconnected, perched- or semi-perched- water body, so that the high water-level altitudes are caused by local hydraulic conditions and are not part of the regional saturated-zone flow system (Czarnecki et al. 1994; Ervin et al. 1994). Fridrich et al. (1994) suggest two hydrogeologic explanations for the LHG: 1) a highly permeable buried fault that drains water from the volcanic rock units into a deeper regional carbonate aquifer or 2) a buried fault that forms a 'spill-way' in the volcanic rocks. Their second explanation, in effect, juxtaposes transmissive tuff against non-transmissive tuff, and is therefore the same as 2) above.

7. CONCLUSIONS

This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur as a result of completing the confirmation activities will be reflected in subsequent revisions. The status of the input information quality may be confirmed by review of the DIRS database.

Some water-level measurements at UE-25 C #2 and C #3, and at USW G-4, which are used in this analysis, are To Be Verified. These data have minimal control on the shape of the potentiometric contours at Yucca Mountain. Qualified and accepted data from these same boreholes and nearby boreholes are sufficient to determine the shape of the potentiometric surface in this area.

ARCINFO V7.2.1 and PETROSYS V7.60d, used as explained in Section 3 of this AMR, are also To Be Verified. Consequently, the output data (DTN: GS000508312332.001) would also currently be statused To Be Verified by a user.

7.1 WATER-LEVEL DATA

Actual water-level altitudes (DTN: GS000508312332.001) in the SZ site-scale model area range over 400 meters. The data distribution generally is very uneven and the hydraulic character of the formations from which the water level is derived is variable. As a result, the range in water levels varies significantly over the SZ site-scale model area.

Most of the water levels used in this analysis were composite levels with water being produced from one or more hydrogeologic units or fracture zones as indicated in Attachment I of this AMR. Because of long open (uncased) or perforated/screened intervals, many boreholes intercept multiple permeable zones resulting in a composite water-level altitude.

Potential errors in the potentiometric surface, such as those resulting from perched-water bodies, and the general ranges in water levels could be evaluated using the borehole site-location accuracy, land-surface altitude accuracy, water-level altitude precision, and water-level measurements and methodology accuracy documented in Attachment I. This information could be used to evaluate the representativeness of the water-level altitudes used in this analysis and to determine whether or not they represent the potentiometric surface of the upper saturated zone.

In addition to measurement uncertainties, the range in water levels for a borehole can be used in the determination of an uncertainty of a mean water level at that site. Pumping is included in the flux rates used in the regional model; therefore water levels that may be influenced by pumping are included in the SZ site-scale model. Because of the uncertainties for water levels discussed in the previous paragraphs, the range in water-level altitudes and possible causes should be taken into account during SZ site-scale model calibration.

7.2 POTENTIOMETRIC-SURFACE MAP

The potentiometric surface shown in Figure 1-2 provides a contour-map representation of the potentiometric surface from water-level data that were developed as part of this analysis and that are available from the Technical Data Management System under DTN: GS000508312332.001.

The potentiometric surface developed from the data listed in Table 4-1 incorporates the potential errors and uncertainties identified in this AMR. Hence, the accuracy of the potentiometric surface will vary spatially. In the potential repository area, the potentiometric surface may be characterized within one meter; however, in other areas within the SZ site-scale model area the uncertainty in water levels is much greater. Areas where perched-water zones may exist, water-level drawdown associated with pumping in the Amargosa Valley, and the unknown effect of faults on water-level altitudes all add to the uncertainty of the accuracy of the potentiometric surface constructed using this data. If some of the water levels measured in the vicinity of Yucca Mountain represent perched-water conditions, the saturated-zone potentiometric surface could be substantially different. Therefore, the potentiometric-surface map associated with the AMR (Figure 1-2) is intended for SZ site-scale modeling purposes only.

The potentiometric surface presented herein does not strictly represent the water table, a concept reserved for the actual interface between the saturated and unsaturated zones. However, the potentiometric surface presented is probably a close and reasonable representation of the water table for the early 1990’s.

8. INPUTS AND REFERENCES

8.1 DOCUMENTS CITED

Ciesnik, M.S. 1995. *Ground-Water Altitudes and Well Data, Nye County, Nevada, and Inyo County, California.* Open-File Report 93-89. Denver, Colorado: U.S. Geological Survey. ACC: MOL.19940908.0078.

CRWMS M&O 2000a. *Calibration of the Site-Scale Saturated Zone Flow Model.* MDL-NBS-HS-000011 REV 00. Las Vegas, Nevada: CRWMS M&O. Submit to RPC URN-0191

CRWMS M&O 2000b. *Repository Safety Strategy: Plan to Prepare the Postclosure Safety Case to Support Yucca Mountain Site Recommendation and Licensing Considerations.* TDR-WIS-RL-000001 REV 03. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000119.0189.

Czarnecki, J.B. and Waddell, R.K. 1984. *Finite-Element Simulation of Ground-Water Flow in the Vicinity of Yucca Mountain, Nevada-California.* Water-Resources Investigations Report 84-4349. Denver, Colorado: U.S. Geological Survey. ACC: NNA.19870407.0173.

Czarnecki, J.B.; Faunt, C.C.; Gable, C.W.; and Zyvoloski, G.A. 1997. *Hydrogeology and Preliminary Three-Dimensional Finite-Element Ground-Water Flow Model of the Site Saturated Zone, Yucca Mountain, Nevada.* Milestone SP23NM3. Denver, Colorado: U.S. Geological Survey. ACC: MOL.19990812.0180.

Czarnecki, J.B.; Nelson, P.H.; O'Brien, G.M.; Sass, J.H.; Thapa, B.; Matsumoto, Y.; and Murakami, O. 1995. "Testing in Borehole USW G-2 at Yucca Mountain: The Saga Continues." *Eos*, *76*, (46), 191-192. Washington, D.C.: American Geophysical Union. TIC: 240933.

Czarnecki, J.B.; O'Brien, G.M.; Nelson, P.H.; Sass, J.H.; Bullard, J.W.; and Flint, A.L. 1994. "Is There Perched Water Under Yucca Mountain in Borehole USW G-2?." *1994 Fall Meeting, Supplement to Eos, November 1, 1994*, *75*, (44), 249-250. Washington, D.C.: American Geophysical Union. TIC: 226992.

D'Agnese, F.A.; Faunt, C.C.; Turner, A.K.; and Hill, M.C. 1997. *Hydrogeologic Evaluation and Numerical Simulation of the Death Valley Regional Ground-Water Flow System, Nevada and California.* Water-Resources Investigations Report 96-4300. Denver, Colorado: U.S. Geological Survey. ACC: MOL.19980306.0253.

DOE (U.S. Department of Energy) 2000. *Quality Assurance Requirements and Description.* DOE/RW-0333P, Rev. 10. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000427.0422.

Dyer, J.R. 1999. "Revised Interim Guidance Pending Issuance of New U.S. Nuclear Regulatory Commission (NRC) Regulations (Revision 01, July 22, 1999), for Yucca Mountain, Nevada." Letter from J.R. Dyer (DOE/YMSCO) to D.R. Wilkins (CRWMS M&O), September 3, 1999, OL&RC:SB-1714, with enclosure, "Interim Guidance Pending Issuance of New NRC Regulations for Yucca Mountain (Revision 01)." ACC: MOL.19990910.0079.

Ervin, E.M.; Luckey, R.R.; and Burkhardt, D.J. 1994. *Revised Potentiometric-Surface Map, Yucca Mountain and Vicinity, Nevada.* Water-Resources Investigations Report 93-4000. Denver, Colorado: U.S. Geological Survey. ACC: NNA.19930212.0018.

Faunt, C.C. 2000. Interim Submittal with June, 2000 Technical and Compliance Reviews, for Scientific Notebook SN-USGS-SCI-072-V2 Hydrogeologic Framework for the Site Saturated Zone Model. SN-USGS-SCI-072-V2. ACC: MOL.20000608.0164.

Fridrich, C.J.; Dudley, W.W., Jr.; and Stuckless, J.S. 1994. "Hydrogeologic Analysis of the Saturated-Zone Ground-Water System, Under Yucca Mountain, Nevada." *Journal of Hydrology, 154*, 133-168. Amsterdam, The Netherlands: Elsevier Science B.V. TIC: 224606.

Graves, R.P.; Tucci, P.; and O'Brien, G.M. 1997. *Analysis of Water-Level Data in the Yucca Mountain Area, Nevada, 1985-95*. Water-Resources Investigations 96-4256. Denver, Colorado: U.S. Geological Survey. ACC: MOL.19980219.0851.

Luckey, R.R.; Tucci, P.; Faunt, C.C.; Ervin, E.M.; Steinkampf, W.C.; D'Agnese, F.A.; and Patterson, G.L. 1996. *Status of Understanding of the Saturated-Zone Ground-Water Flow System at Yucca Mountain, Nevada, as of 1995.* Water-Resources Investigations Report 96-4077. Denver, Colorado: U.S. Geological Survey. ACC: MOL.19970513.0209.

O'Brien, G. 1998. "Milestone SPH40NM4 (Level 4) — Memo to TPO: Possible Perched-Water Occurrences North of Yucca Mountain." Memorandum from G. O'Brien (USGS) to R. Craig (USGS), September 28, 1998, with attachment, "Perched-Water Analysis Death Valley Region." ACC: MOL.19981130.0221; MOL.19990113.0213.

Tucci, P. and Burkhardt, D.J. 1995. *Potentiometric-Surface Map, 1993, Yucca Mountain and Vicinity, Nevada.* Water-Resources Investigations Report 95-4149. Denver, Colorado: U.S. Geological Survey. ACC: MOL.19960924.0517.

USGS (U.S. Geological Survey) 2000a. *Water-Level Data Analysis for the Saturated Zone Site-Scale Flow and Transport Model.* TDP-NBS-HS-000099 REV 00. Denver, Colorado: U.S. Geological Survey. ACC: MOL.20000630.0045.

USGS (U.S. Geological Survey) 2000b. *Locations and Elevations for Selected Wells in the Yucca Mountain Region and Amargosa Desert.* Denver, Colorado: U.S. Geological Survey. ACC: MOL.20000609.0111.

Wemheuer, R.F. 1999. "First Issue of FY00 NEPO QAP-2-0 Activity Evaluations." Interoffice correspondence from R.F. Wemheuer (CRWMS M&O) to R.A. Morgan, October 1, 1999, LV.NEPO.RTPS.TAG.10/99-155, with enclosures. ACC: MOL.19991028.0162.

8.2 STANDARDS, REGULATIONS, PLANS, AND PROCEDURES CITED

AP-3.10Q, Rev.2, ICN 2. *Analysis and Models*. Washington, D. C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000619.0576

AP-SI.1Q, Rev. 2, ICN 4. *Software Management*. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000223.0508

AP-SIII.2Q, Rev. 0, ICN 2. *Qualification of Unqualified Data and the Documentation of Rationale for Accepted Data.* Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste management. ACC: MOL.19991214.0625

AP-SV.1Q, Rev. 0, ICN 1. *Control of Electronic Management of Data*. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20000512.0068

QAP-2-0, Rev. 5, ICN 1 *Conduct of Activities.* Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19991109.0221.

8.3 SOFTWARE PROGRAMS

U.S. Geological Survey 2000. *Software Code: ARCINFO V7.2.1.* V7.2.1. 10033-7.2.1-00. URN-0342

U.S. Geological Survey 2000. *Software Code: Petrosys V7.60d.* V7.60d. 10168-7.60d-00. URN-0359

8.4 SOURCE DATA, LISTED BY DATA TRACKING NUMBER

GS000400002332.001. Digital Elevation Models Death Valley East Scale 1:250,000. Submittal date: 04/12/2000.

GS000408312312.001. Water-Level Measurements at UE-25 C #2 and C #3, 1989. Submittal date: 04/10/2000.

GS000608312312.004. Revised Water-Level Altitude Data from the Periodic Network, First Quarter 1995. Submittal date: 06/27/2000. Submit to RPC URN-0488

GS000708312312.005. Water-Level Altitude Data, 1993. Submittal date: 07/10/2000.

GS921108312331.001. Revised Potentiometric Surface Map of Yucca Mountain and Vicinity, Nevada. Submittal date: 10/07/1992.

GS930408312312.015. Water Levels in the Yucca Mountain Area, Nevada, 1990-91. Submittal date: 04/28/1993.

GS931008312312.025. Water Levels in Periodically Measured Wells in the Yucca Mountain Area, Nevada, 1981-87. Submittal date: 04/23/1993.

GS950108312312.001. Water-Level Altitude Data from the Periodic Network Fourth Quarter 1994. Submittal date: 01/19/1995.

GS950508312312.005. Potentiometric-Surface Map, 1993, Yucca Mountain and Vicinity, Nevada. Submittal date: 06/06/1995.

GS960208312312.003. 28 Water-Level Measurements from the Periodic Network, Third Quarter, 1995 (7/1/95 - 9/30/95). Submittal date: 02/20/1996.

GS960908312312.010. Analysis of Water-Level Data in the Yucca Mountain Area, Nevada, 1985-1995. Submittal date: 09/19/1996.

GS970600012847.001. Water Level Altitude Data Collected at GEXA Well 4 and USW G-4. Submittal date: 06/30/1997.

GS991100002330.001. Water Level Data for Yucca Mountain Region and Amargosa Desert. Submittal date: 03/29/2000.

GS991208314221.001. Geologic Map of the Yucca Mountain Region. Submittal date: 12/01/1999.

MO0002COV00088.001. Coverage BoresQ2. Submittal date: 02/24/2000.

MO0004NC99WL1D.000. Water Level Measurements in Boreholes, NC-EWDP-1D, NC-EWDP-1D Shallow, & NC-EWDP-1D Deep, Nye County Early Warning Drilling Program. Submittal date: 04/19/2000.

MO0004NC99WL1S.000. Water Level Measurements in Borehole, NC-EWDP-1S, Nye County Early Warning Drilling Program. Submittal date: 04/18/2000.

MO0004NC99WL1X.000. Water Level Measurements in Borehole, NC-EWDP-Washburn-1X, Nye County Early Warning Drilling Program. Submittal date: 04/17/2000.

MO0004NC99WL2D.000. Water Level Measurements in Borehole, NC-EWDP-2D, Nye County Early Warning Drilling Program. Submittal date: 04/18/2000.

MO0004NC99WL3D.000. Water Level Measurements in Borehole, NC-EWDP-3D, Nye County Early Warning Drilling Program. Submittal date: 04/18/2000.

MO0004NC99WL3S.000. Water Level Measurements in Borehole, NC-EWDP-3S, Nye County Early Warning Drilling Program. Submittal date: 04/18/2000.

MO0004NC99WL5S.000. Water Level Measurements in Borehole, NC-EWDP-5S, Nye County Early Warning Drilling Program. Submittal date: 04/19/2000.

MO0004NC99WL9S.000. Water Level Measurements in Borehole, NC-EWDP-9S, Nye County Early Warning Drilling Program. Submittal date: 04/19/2000.

TM0000000SD7RS.003. USW SD-7 Shift Drilling Summaries (1602.0'-2020.3'), Lithologic Logs (1600.0'-1925.0'), and Structure Logs (1632.0'-2020.3'). Submittal date: 09/22/1995.

TM0000000SD9RS.001. USW SD-9 Shift Drilling Summaries, Structural Logs, and Lithological Logs. Submittal date: 08/23/1994.

TM000000SD12RS.011. USW SD-12 Shift Drilling Summaries, Lithologic Logs, and Structure Logs from 1825.0'-2166.3'. Submittal date: 09/08/1995.

8.5 AMR OUTPUT DATA, LISTED BY DATA TRACKING NUMBER

GS000508312332.001. Water-Level Data Analysis for the Saturated Zone Site-Scale Flow and Transport Model. Submittal date: 05/19/2000.

ATTACHMENT I

BOREHOLE DATA

TOTAL PAGES: 28

The following sections describe the information pertaining to each of the columns in Attachment I.

USGS Site Identification

Unique site identifications (IDs) are assigned to each borehole for which the USGS maintains water-level data. Boreholes that contain multiple monitoring zones are assigned a unique site ID for each of the different zones. The site IDs are different than the site ID for the entire borehole, but usually contain a portion of the borehole site ID. Where more than one site ID for a given borehole exists (multiple monitoring zones), the site ID for the entire borehole is used in Attachment I.

Site Name

The common borehole site name available for a given site was recorded.

CONTENTS

Table I-1. Easting, Northing, Land Surface Altitude, Mean Water-level Altitude (DTN: GS000508312332.001)

Easting and Northing

Coordinates for boreholes were compiled in USGS 2000b, and were taken from sources as noted therein (see Assumption 5.3). UTM easting and northing were calculated using ARCINFO PROJECT command. The latitude/longitude, or state plane coordinate, was projected into UTM (meters, Zone 11, North American Datum 1927) coordinates and rounded to the nearest meter.

Land-surface Altitude (meters)

The land-surface altitudes for boreholes were compiled in USGS 2000b, and were taken from sources as noted therein (see Assumption 5.3). The altitude was converted from feet to meters by the following formula, where necessary:

$$\text{Altitude (ft)} \times 0.3048 \text{ (m/ft)} = \text{Altitude (m)}$$

The altitude was rounded to the nearest tenth of a meter.

Mean Water-level Altitude (meters)

For the period between 1985 and 1995, the mean water-level altitude was tabulated by Graves et al. (1997, table 2). Graves et al. (1997) used monthly mean water-level altitudes computed from hourly transducer data and periodic manual water-level altitude measurements to compute the mean water-level altitude. The mean water level for each site not included in this report was calculated. An example calculation follows:

$$(730.98+731.07+731.09)/3 = 731.0$$

The altitude was rounded to the nearest tenth of a meter, using software rounding.

In addition, the following exceptions were made when calculating the mean:

- NDOT well: Deleted the 1972 measurement (2,291.8 ft) from the calculation of the average. It is anomalously low and not representative of average conditions in the borehole.
- Donald O. Heath well: Deleted the 1961 measurement (2,342.0 ft) from the calculation of the average. It is anomalously high and not representative of average conditions in the borehole.
- Wm. R. Monroe well: Deleted the 1958 measurement (2,362.0 ft) from the calculation of the average. It is anomalously high and not representative of average conditions in the borehole.
- Cooks West well: Deleted the 1963 measurement (2,324.6 ft) from the calculation of the average. It is anomalously low and not representative of average conditions in the borehole.
- Cooks East well: Deleted the 2 measurements of 2,333.8 ft (12/20/1961) and 2,335.3 ft(04/09/1991) from the calculation of the average. They are anomalously low and not representative of average conditions in the borehole.
- DeFir well: Used the data obtained after 1982 as being more representative of the calibration period.
- Airport well: Deleted the 1964 measurement (2,348.8 ft) from the calculation of the average. It is anomalously high and not representative of average conditions in the borehole.
- GEXA Well 4: Deleted 1991 measurement (3133.2 ft.) from the calculations of the average. It is anomalously low and not representative of average conditions in the borehole.

USGS Site ID	Site Name	Easting	Northing	Land-surface Altitude (m)	Mean Water-level Altitude (m)
365629116222602	UE-29 a #2	555753	4088351	1215.4	1187.7
365520116370301	GEXA Well 4	534069	4086110	1198.1	1009.0
365340116264601	UE-25 WT #6	549352	4083103	1314.8	1034.6
365322116273501	USW G-2	548143	4082542	1554.0	1020.2
365239116253401	UE-25 WT #16	551146	4081234	1210.9	738.3
365208116274001	USW UZ-14	548032	4080260	1348.9	779.0
365207116264201	UE-25 WT #18	549468	4080238	1336.4	730.8
365200116272901	USW G-1	548306	4080016	1325.9	754.2
365147116185301	UE-25 a #3	561084	4079697	1385.6	748.3
365140116260301	UE-25 WT #4	550439	4079412	1169.3	730.8

USGS Site ID	Site Name	Easting	Northing	Land-surface Altitude (m)	Mean Water-level Altitude (m)
365116116233801	UE-25 WT #15	554034	4078694	1083.2	729.2
365114116270401	USW G-4	548933	4078602	1269.5	730.6
365105116262401	UE-25 a #1	549925	4078330	1199.2	731.0
365032116243501	UE-25 WT #14	552630	4077330	1076.4	729.7
365023116271801	USW WT-2	548595	4077028	1301.4	730.6
364947116254300	UE-25 c #1	550955	4075933	1130.6	730.2
364947116254501	UE-25 c #3	550930	4075902	1132.4	730.2
364947116254401	UE-25 c #2	550955	4075871	1132.2	730.2
364945116235001	UE-25 WT #13	553730	4075827	1032.5	729.1
364933116285701	USW WT- 7	546151	4075474	1196.9	775.8
364916116265601	USW WT- 1	549152	4074967	1201.4	730.4
364905116280101	USW G-3	547543	4074619	1480.6	730.5
364828116234001	UE-25 J -13	554017	4073517	1011.3	728.4
364825116290501	USW WT-10	545964	4073378	1123.4	776.0
364822116262601	UE-25 WT #17	549905	4073307	1124.0	729.7
365821116343701	USW VH-2	537738	4073214	974.5	810.4
364757116245801	UE-25 WT #3	552090	4072550	1030.0	729.6
364732116330701	USW VH-1	539976	4071714	963.5	779.4
364656116261601	UE-25 WT #12	550168	4070659	1074.7	729.5
364649116280201	USW WT-11	547542	4070428	1094.1	730.7
364554116232400	UE-25 J -12	554444	4068774	953.6	727.9
364528116232201	UE-25 JF #3	554498	4067974	944.4	727.8
364105116302601	Cind-R-Lite Well	544027	4059809	830.8	729.8
363907116235701	Ben Bossingham	553704	4056228	819.9	718.4
363836116234001	Fred Cobb	553808	4055459	811.4	702.8
363840116235000	Bob Whellock	553883	4055398	813.8	704.1
363840116234001	Louise Pereidra	554131	4055399	810.8	705.6
363840116233501	Joe Richards	554008	4055337	811.4	701.6
363835116234001	NDOT Well	553685	4055242	809.8	705.4
363742116263201	James H. Shaw	549863	4054911	795.5	706.7
363830116241401	Airport Well	552818	4054929	804.3	705.3
363815116175901	TW- 5	562604	4054686	931.5	725.1
363711116263701	Richard Washburn	549746	4053647	783.9	707.7
363621116263201	Richard Washburn	549679	4052322	774.2	704.4
363549116305001	Nye County Development Co	543481	4050069	742.2	694.3
363523116353701	Fred Wooldridge	536350	4050006	731.8	691.9
363525116325601	Fred J. Keefe	540673	4049994	735.2	694.3
363519116322001	Leslie Nickels	541518	4049937	737.0	694.3
363540116240801	L. Mason	553471	4049848	771.1	722.1
363527116292501	Unknown	545596	4049403	744.0	697.8
363521116352501	Davidson Well	536552	4049329	730.1	690.1
363456116335501	Eugene J. Mankinen	538889	4049000	740.7	707.4
363454116314201	Donald O. Heath	542194	4048892	733.7	694.1
363503116351501	Elvis Kelley	536903	4048621	727.9	691.0
363503116284001	Manuel Rodela	546718	4048669	740.7	693.6
363436116342301	Charles C. DeFir Jr.	538196	4048442	740.7	706.9
363436116333201	William R. Monroe	540035	4048450	731.5	693.7
363434116354001	DeFir Well	536655	4048405	727.1	690.2

USGS Site ID	Site Name	Easting	Northing	Land-surface Altitude (m)	Mean Water-level Altitude (m)
363438116324601	Edwin H. Mankinen	540608	4048083	727.9	695.2
363442116363301	Bill Strickland	534967	4047966	725.7	689.2
363440116282401	M. Meese	547120	4047963	731.5	686.4
363415116275101	Theo E. Selbach	547941	4047782	741.9	696.2
363407116342501	C.L. Caldwell	537727	4047670	723.3	691.4
363407116243501	Leonard Siegel	552390	4047685	762.0	709.0
363429116315901	James K. Pierce	541778	4047596	729.1	690.4
363405116321501	James K. Pierce	541381	4047563	740.7	705.6
363428116240301	Cooks West Well	553609	4047631	754.3	720.1
363428116234701	Cooks East Well	554006	4047633	755.2	718.9
363417116271801	Nye County Land Company	548466	4047261	740.7	690.1
363411116272901	Amargosa Town Complex	548492	4047077	739.1	688.8
363410116261101	Nye County Development Co	550431	4047057	743.7	691.2
363410116240301	Lewis C. Cook	553612	4047076	748.6	717.4
363410116240001	Lewis C. Cook	553687	4047077	749.8	714.8
363407116273301	Amargosa Valley Water	548393	4046953	737.9	701.3
363342116335701	Earl N. Selbach	539147	4046844	723.9	696.5
363340116332901	Lewis N. Dansby	539968	4046817	724.2	694.2
363342116325101	Edwin H. Mankinen	540788	4046821	724.2	694.0
363350116252101	Willard Johns	552097	4046882	746.8	699.5
365157116271202	USW H-1 tube 1	548727	4079926	1303.0	785.5
365157116271203	USW H-1 tube 2	548727	4079926	1303.0	736.0
365157116271204	USW H-1 tube 3	548727	4079926	1303.0	730.6
365157116271205	USW H-1 tube 4	548727	4079926	1303.0	730.8
365122116275502	USW H-5 upper	547668	4078841	1478.9	775.5
365122116275503	USW H-5 lower	547668	4078841	1478.9	775.6
365108116262302	UE-25 b #1 lower	549949	4078423	1200.7	729.7
365108116262303	UE-25 b #1 upper	549949	4078423	1200.7	730.6
365049116285502	USW H-6 upper	546188	4077816	1301.8	776.0
365049116285505	USW H-6 lower	546188	4077816	1301.8	775.9
365032116265402	USW H-4 upper	549188	4077309	1248.5	730.4
365032116265403	USW H-4 lower	549188	4077309	1248.5	730.5
364942116280002	USW H-3 upper	547562	4075759	1483.2	731.5
364942116280003	USW H-3 lower	547562	4075759	1483.2	755.9
364938116252102	UE-25 p #1 (Lwr Intrvl)	551501	4075659	1114.2	752.4
not available yet	USW SD-7	548384	4076499	1363.1	727.6
not available yet	USW SD-9	548550	4079256	1303.4	731.1
not available yet	USW SD-12	548492	4077415	1323.7	730.0
not available yet	NC-EWDP-1D	536768	4062502	803.6	787.2
not available yet	NC-EWDP-1S	536771	4062498	803.8	787.9
not available yet	NC-EWDP-2D	547744	4057164	801.2	706.2
not available yet	NC-EWDP-3D	541273	4059444	799.4	718.9
not available yet	NC-EWDP-3S	541269	4059445	798.8	719.6
not available yet	NC-EWDP-5S	555676	4058229	840.3	725.9
not available yet	NC-EWDP-9S	539039	4061004	797.3	767.2
not available yet	NC-Washburn-1X	551465	4057563	824.1	714.6
364706116170601	UE-25 J -11	563799	4071058	1049.5	732.2
364237116365401	BGMW-11	534386	4062600	787.9	715.9

USGS Site ID	Site Name	Easting	Northing	Land-surface Altitude (m)	Mean Water-level Altitude (m)
363709116264601	Richard Washburn	549529	4052567	775.7	704.0
363409116233701	L. Cook	551348	4047432	755.9	713.2
363411116264701	Unknown	549532	4047668	745.2	689.5
363428116281201	Amargosa Water	547420	4047594	738.2	690.4
363429116233401	Lewis C. Cook	554329	4047666	755.3	715.7
363511116335101	Unknown	538989	4048877	729.4	690.8
365624116222901	USW UZ-N91	555680	4088196	1203.0	1186.7

Table I-2. Number of Data Points Used, Source, and Use

Number of Data Points Used

The number of data points used to determine the mean (Table I-1) was tabulated.

Source

The Data Tracking Number for the source from which the water-level data used to determine the mean (Table I-1) and minimum and maximum (Table I-4) water level altitude is tabulated.

Use

The most appropriate use for each water level was identified:
Potentiometric-surface map and calibration (WT)
Calibration (C)
Unreliable (U) and therefore not used in the construction of the potentiometric-surface map. It is recommended that these water-level observations not be used for SZ site-scale model calibration.

A water-level measurement was identified as applicable for potentiometric-surface map construction if it was:
The water level from the upper interval (or only interval) from a borehole.
The water-level interval in the shallow (uppermost) aquifer system, typically the volcanic- or alluvial-aquifer system.

A water-level measurement was identified as unreliable on the basis of the criteria listed in Section 6.1.9. In addition, the following boreholes contained in Attachment I were excluded from this analysis for the reasons stated below:

- Two Lewis C. Cook boreholes (ID numbers 363410116240001 and 363410116240301): The data for these boreholes consist of two water-level measurements in each borehole that span more than 20 years and differ by quite a bit. An average of the two values for each of these boreholes does not produce a water level that is representative of the early 1990's. The average is considered "Unreliable." There are other boreholes nearby that have reliable water levels that are sufficient for the SZ site-scale modeling.
- Fred Cobb well: Basically similar arguments apply as for the Lewis C. Cook boreholes. It is not critical to include the water-level data from this borehole.
- Fred Woolridge well: Basically similar arguments apply as for the Lewis C. Cook boreholes. It is not critical to include these data.

The remaining water-level data were labeled as suitable for calibration only. Calibration of the SZ site-scale model should include all data except that labeled as unreliable (U).

USGS Site ID	Site Name	Number of Data Points Used	Source	Use
365629116222602	UE-29 a #2	208	GS991100002330.001	WT
365520116370301	GEXA Well 4	52	GS991100002330.001	WT
365340116264601	UE-25 WT #6	117	GS960908312312.010	WT
365322116273501	USW G-2	28	GS960908312312.010	WT
365239116253401	UE-25 WT #16	123	GS960908312312.010	WT
365208116274001	USW UZ-14	Estimate	GS950508312312.005	WT
365207116264201	UE-25 WT #18	38	GS960908312312.010	WT
365200116272901	USW G-1	1	GS991100002330.001	WT
365147116185301	UE-25 a #3	1	GS991100002330.001	WT
365140116260301	UE-25 WT #4	131	GS960908312312.010	WT
365116116233801	UE-25 WT #15	124	GS960908312312.010	WT
365114116270401	USW G-4	29	GS931008312312.025 GS970600012847.001 GS991100002330.001	WT
365105116262401	UE-25 a #1	40	GS991100002330.001	WT
365032116243501	UE-25 WT #14	135	GS960908312312.010	WT
365023116271801	USW WT-2	106	GS960908312312.010	WT
364947116254300	UE-25 c #1	3	GS991100002330.001	WT

USGS Site ID	Site Name	Number of Data Points Used	Source	Use
364947116254501	UE-25 c #3	8	GS960208312312.003 GS000608312312.004 GS000708312312.005 GS000408312312.001	WT
364947116254401	UE-25 c #2	10	GS930408312312.015 GS000608312312.004 GS000708312312.005 GS000408312312.001 GS950108312312.001	WT
364945116235001	UE-25 WT #13	118	GS960908312312.010	WT
364933116285701	USW WT- 7	113	GS960908312312.010	WT
364916116265601	USW WT- 1	128	GS960908312312.010	WT
364905116280101	USW G-3	113	GS960908312312.010	WT
364828116234001	UE-25 J -13	121	GS960908312312.010	WT
364825116290501	USW WT-10	132	GS960908312312.010	WT
364822116262601	UE-25 WT #17	117	GS960908312312.010	WT
365821116343701	USW VH-2	1	GS991100002330.001	WT
364757116245801	UE-25 WT #3	119	GS960908312312.010	WT
364732116330701	USW VH-1	147	GS960908312312.010	WT
364656116261601	UE-25 WT #12	123	GS960908312312.010	WT
364649116280201	USW WT-11	119	GS960908312312.010	WT
364554116232400	UE-25 J -12	100	GS960908312312.010	WT
364528116232201	UE-25 JF #3	234	GS991100002330.001	WT
364105116302601	Cind-R-Lite Well	62	GS991100002330.001	WT
363907116235701	Ben Bossingham	1	GS991100002330.001	U
363836116234001	Fred Cobb	2	GS991100002330.001	U
363840116235000	Bob Whellock	1	GS991100002330.001	U
363840116234001	Louise Pereidra	1	GS991100002330.001	U
363840116233501	Joe Richards	1	GS991100002330.001	U
363835116234001	NDOT Well	87	GS991100002330.001	WT
363742116263201	James H. Shaw	3	GS991100002330.001	WT
363830116241401	Airport Well	90	GS991100002330.001	WT
363815116175901	TW- 5	99	GS991100002330.001	WT
363711116263701	Richard Washburn	4	GS991100002330.001	U
363621116263201	Richard Washburn	1	GS991100002330.001	U
363549116305001	Nye County Development Co	3	GS991100002330.001	WT
363523116353701	Fred Wooldridge	3	GS991100002330.001	U
363525116325601	Fred J. Keefe	6	GS991100002330.001	WT
363519116322001	Leslie Nickels	4	GS991100002330.001	WT
363540116240801	L. Mason	22	GS991100002330.001	WT
363527116292501	Unknown	2	GS991100002330.001	WT
363521116352501	Davidson Well	63	GS991100002330.001	WT
363456116335501	Eugene J. Mankinen	4	GS991100002330.001	U
363454116314201	Donald O. Heath	4	GS991100002330.001	WT
363503116351501	Elvis Kelley	3	GS991100002330.001	WT
363503116284001	Manuel Rodela	2	GS991100002330.001	WT
363436116342301	Charles C. DeFir Jr.	5	GS991100002330.001	WT
363436116333201	William R. Monroe	4	GS991100002330.001	WT
363434116354001	DeFir Well	19	GS991100002330.001	WT

USGS Site ID	Site Name	Number of Data Points Used	Source	Use
363438116324601	Edwin H. Mankinen	4	GS991100002330.001	WT
363442116363301	Bill Strickland	1	GS991100002330.001	WT
363440116282401	M. Meese	1	GS991100002330.001	U
363415116275101	Theo E. Selbach	1	GS991100002330.001	U
363407116342501	C.L. Caldwell	3	GS991100002330.001	WT
363407116243501	Leonard Siegel	1	GS991100002330.001	U
363429116315901	James K. Pierce	3	GS991100002330.001	WT
363405116321501	James K. Pierce	2	GS991100002330.001	U
363428116240301	Cooks West Well	3	GS991100002330.001	WT
363428116234701	Cooks East Well	88	GS991100002330.001	WT
363417116271801	Nye County Land Company	2	GS991100002330.001	WT
363411116272901	Amargosa Town Complex	1	GS991100002330.001	WT
363410116261101	Nye County Development Co	1	GS991100002330.001	WT
363410116240301	Lewis C. Cook	2	GS991100002330.001	U
363410116240001	Lewis C. Cook	2	GS991100002330.001	U
363407116273301	Amargosa Valley Water	1	GS991100002330.001	WT
363342116335701	Earl N. Selbach	1	GS991100002330.001	U
363340116332901	Lewis N. Dansby	48	GS991100002330.001	WT
363342116325101	Edwin H. Mankinen	46	GS991100002330.001	WT
363350116252101	Willard Johns	2	GS991100002330.001	U
365157116271202	USW H-1 tube 1	101	GS960908312312.010	C
365157116271203	USW H-1 tube 2	75	GS960908312312.010	C
365157116271204	USW H-1 tube 3	108	GS960908312312.010	C
365157116271205	USW H-1 tube 4	124	GS960908312312.010	WT
365122116275502	USW H-5 upper	106	GS960908312312.010	WT
365122116275503	USW H-5 lower	54	GS960908312312.010	C
365108116262302	UE-25 b #1 lower	67	GS960908312312.010	C
365108116262303	UE-25 b #1 upper	99	GS960908312312.010	WT
365049116285502	USW H-6 upper	118	GS960908312312.010	WT
365049116285505	USW H-6 lower	79	GS960908312312.010	C
365032116265402	USW H-4 upper	128	GS960908312312.010	WT
365032116265403	USW H-4 lower	101	GS960908312312.010	C
364942116280002	USW H-3 upper	128	GS960908312312.010	WT
364942116280003	USW H-3 lower	59	GS960908312312.010	C
364938116252102	UE-25 p #1(Lwr Intrvl)	120	GS960908312312.010	C
not available yet	USW SD-7	1	TM0000000SD7RS.003	WT
not available yet	USW SD-9	1	TM0000000SD9RS.001	WT
not available yet	USW SD-12	1	TM000000SD12RS.011	WT
not available yet	NC-EWDP-1D	5	MO0004NC99WL1D.000	WT
not available yet	NC-EWDP-1S	1	MO0004NC99WL1S.000	WT
not available yet	NC-EWDP-2D	2	MO0004NC99WL2D.000	WT
not available yet	NC-EWDP-3D	15	MO0004NC99WL3D.000	WT
not available yet	NC-EWDP-3S	3	MO0004NC99WL3S.000	WT
not available yet	NC-EWDP-5S	19	MO0004NC99WL5S.000	WT
not available yet	NC-EWDP-9S	6	MO0004NC99WL9S.000	WT
not available yet	NC-Washburn-1X	18	MO0004NC99WL1X.000	WT
364706116170601	UE-25 J -11	71	GS960908312312.010	WT
364237116365401	BGMW-11	51	GS991100002330.001	WT

USGS Site ID	Site Name	Number of Data Points Used	Source	Use
363709116264601	Richard Washburn	1	GS991100002330.001	WT
363409116233701	L. Cook	1	GS991100002330.001	U
363411116264701	Unknown	1	GS991100002330.001	WT
363428116281201	Amargosa Water	1	GS991100002330.001	WT
363429116233401	Lewis C. Cook	1	GS991100002330.001	WT
363511116335101	Unknown	1	GS991100002330.001	WT
365624116222901	USW UZ-N91	209	GS991100002330.001	WT

Table I-3. Reliability of Measurements

Reliability of Measurements

Using professional judgement, an assessment of the overall reliability of the average water-level data to represent 1990's water levels (Table I-1) was made. The following categories were assigned:
Best (average water level documented in Graves et al. 1997)
Reliable (all others not identified in the other four categories)
Less Reliable (less than 5 water-level measurements) or (latest measurement made prior to 1980)
Unreliable (less than 5 measurements made prior to 1980)

USGS Site ID	Site Name	Reliability of Measurements
365629116222602	UE-29 a #2	Reliable
365520116370301	GEXA Well 4	Reliable
365340116264601	UE-25 WT #6	Best
365322116273501	USW G-2	Best
365239116253401	UE-25 WT #16	Best
365208116274001	USW UZ-14	Less Reliable (less than 5 measurements)
365207116264201	UE-25 WT #18	Best
365200116272901	USW G-1	Less Reliable (less than 5 measurements)
365147116185301	UE-25 a #3	Less Reliable (less than 5 measurements)
365140116260301	UE-25 WT #4	Best
365116116233801	UE-25 WT #15	Best
365114116270401	USW G-4	Reliable
365105116262401	UE-25 a #1	Reliable
365032116243501	UE-25 WT #14	Best
365023116271801	USW WT-2	Best
364947116254300	UE-25 c #1	Less Reliable (less than 5 measurements)
364947116254501	UE-25 c #3	Reliable
364947116254401	UE-25 c #2	Reliable
364945116235001	UE-25 WT #13	Best
364933116285701	USW WT- 7	Best
364916116265601	USW WT- 1	Best
364905116280101	USW G-3	Best
364828116234001	UE-25 J -13	Best
364825116290501	USW WT-10	Best
364822116262601	UE-25 WT #17	Best
365821116343701	USW VH-2	Less Reliable (less than 5 measurements)
364757116245801	UE-25 WT #3	Best
364732116330701	USW VH-1	Best
364656116261601	UE-25 WT #12	Best
364649116280201	USW WT-11	Best
364554116232400	UE-25 J -12	Best
364528116232201	UE-25 JF #3	Reliable
364105116302601	Cind-R-Lite Well	Reliable
363907116235701	Ben Bossingham	Unreliable (less than 5 measurements before 1980)
363836116234001	Fred Cobb	Unreliable (less than 5 measurements before 1980)
363840116235000	Bob Whellock	Unreliable (less than 5 measurements before 1980)
363840116234001	Louise Pereidra	Unreliable (less than 5 measurements before 1980)
363840116233501	Joe Richards	Unreliable (less than 5 measurements before 1980)
363835116234001	NDOT Well	Reliable
363742116263201	James H. Shaw	Less Reliable (less than 5 measurements)

USGS Site ID	Site Name	Reliability of Measurements
363830116241401	Airport Well	Reliable
363815116175901	TW- 5	Reliable
363711116263701	Richard Washburn	Unreliable (less than 5 measurements before 1980)
363621116263201	Richard Washburn	Unreliable (less than 5 measurements before 1980)
363549116305001	Nye County Development Co	Less Reliable (less than 5 measurements)
363523116353701	Fred Wooldridge	Unreliable (less than 5 measurements before 1980)
363525116325601	Fred J. Keefe	Reliable
363519116322001	Leslie Nickels	Less Reliable (less than 5 measurements)
363540116240801	L. Mason	Less Reliable (latest Measurement prior to 1980)
363527116292501	Unknown	Less Reliable (less than 5 measurements)
363521116352501	Davidson Well	Reliable
363456116335501	Eugene J. Mankinen	Unreliable (less than 5 measurements before 1980)
363454116314201	Donald O. Heath	Reliable
363503116351501	Elvis Kelley	Less Reliable (less than 5 measurements)
363503116284001	Manuel Rodela	Less Reliable (less than 5 measurements)
363436116342301	Charles C. DeFir Jr.	Reliable
363436116333201	William R. Monroe	Reliable
363434116354001	DeFir Well	Reliable
363438116324601	Edwin H. Mankinen	Less Reliable (less than 5 measurements)
363442116363301	Bill Strickland	Less Reliable (less than 5 measurements)
363440116282401	M. Meese	Unreliable (less than 5 measurements before 1980)
363415116275101	Theo E. Selbach	Unreliable (less than 5 measurements before 1980)
363407116342501	C.L. Caldwell	Less Reliable (less than 5 measurements)
363407116243501	Leonard Siegel	Unreliable (less than 5 measurements before 1980)
363429116315901	James K. Pierce	Less Reliable (less than 5 measurements)
363405116321501	James K. Pierce	Unreliable (less than 5 measurements before 1980)
363428116240301	Cooks West Well	Less Reliable (less than 5 measurements)
363428116234701	Cooks East Well	Reliable
363417116271801	Nye County Land Company	Less Reliable (less than 5 measurements)
363411116272901	Amargosa Town Complex	Less Reliable (less than 5 measurements)
363410116261101	Nye County Development Co	Less Reliable (less than 5 measurements)
363410116240301	Lewis C. Cook	Unreliable (less than 5 measurements before 1980)
363410116240001	Lewis C. Cook	Unreliable (less than 5 measurements before 1980)
363407116273301	Amargosa Valley Water	Less Reliable (less than 5 measurements)
363342116335701	Earl N. Selbach	Unreliable (less than 5 measurements before 1980)
363340116332901	Lewis N. Dansby	Reliable
363342116325101	Edwin H. Mankinen	Less Reliable (latest Measurement prior to 1980)
363350116252101	Willard Johns	Unreliable (less than 5 measurements before 1980)
365157116271202	USW H-1 tube 1	Best
365157116271203	USW H-1 tube 2	Best
365157116271204	USW H-1 tube 3	Best
365157116271205	USW H-1 tube 4	Best
365122116275502	USW H-5 upper	Best
365122116275503	USW H-5 lower	Best
365108116262302	UE-25 b #1 lower	Best
365108116262303	UE-25 b #1 upper	Best
365049116285502	USW H-6 upper	Best
365049116285505	USW H-6 lower	Best
365032116265402	USW H-4 upper	Best

USGS Site ID	Site Name	Reliability of Measurements
365032116265403	USW H-4 lower	Best
364942116280002	USW H-3 upper	Best
364942116280003	USW H-3 lower	Best
364938116252102	UE-25 p #1(Lwr Intrvl)	Best
not available yet	USW SD-7	Less Reliable (less than 5 measurements)
not available yet	USW SD-9	Less Reliable (less than 5 measurements)
not available yet	USW SD-12	Less Reliable (less than 5 measurements)
not available yet	NC-EWDP-1D	Reliable
not available yet	NC-EWDP-1S	Less Reliable (less than 5 measurements)
not available yet	NC-EWDP-2D	Less Reliable (less than 5 measurements)
not available yet	NC-EWDP-3D	Reliable
not available yet	NC-EWDP-3S	Less Reliable (less than 5 measurements)
not available yet	NC-EWDP-5S	Reliable
not available yet	NC-EWDP-9S	Reliable
not available yet	NC-Washburn-1X	Reliable
364706116170601	UE-25 J -11	Best
364237116365401	BGMW-11	Reliable
363709116264601	Richard Washburn	Less Reliable (less than 5 measurements)
363409116233701	L. Cook	Unreliable (less than 5 measurements before 1980)
363411116264701	Unknown	Less Reliable (less than 5 measurements)
363428116281201	Amargosa Water	Less Reliable (less than 5 measurements)
363429116233401	Lewis C. Cook	Less Reliable (less than 5 measurements)
363511116335101	Unknown	Less Reliable (less than 5 measurements)
365624116222901	USW UZ-N91	Reliable

Table I-4. Earliest Year of Measurement, Latest Year of Measurement, Minimum Water-level Altitude, and Maximum Water-level Altitude (DTN: GS000508312332.001)

Earliest Year of Measurement/Latest Year of Measurement

The earliest and latest year of reported measurement used in the calculation of the mean was determined and recorded. The data tabulated by Graves et al. (1997) were not checked for earlier or later measurements. The data reported in Graves et al. (1997) were collected for the water-level monitoring studies being conducted as part of Yucca Mountain site characterization activities and, as such, were collected after 1986 under an approved quality assurance program.

Minimum Water-level Altitude/Maximum Water-level Altitude (meters)

The smallest and largest water-level altitudes for the data used to calculate mean water-level altitude were compiled and tabulated. The altitude was converted from feet to meters by the following formula, where necessary:

Altitude (ft) x 0.3048 (m/ft) = Altitude (m)

The altitude was rounded to the nearest tenth of a meter.

USGS Site ID	Site Name	Earliest Year of Measurement	Latest Year of Measurement	Minimum Water-level Altitude (m)	Maximum Water-level Altitude (m)
365629116222602	UE-29 a #2	1985	1996	1186.2	1191.3
365520116370301	GEXA Well 4	1989	1996	995.3	1010.1
365340116264601	UE-25 WT #6	1985	1995	1033.3	1036.1
365322116273501	USW G-2	1992	1995	1019.6	1020.6
365239116253401	UE-25 WT #16	1985	1995	737.8	738.6
365208116274001	USW UZ-14	N/A	N/A	N/A	N/A
365207116264201	UE-25 WT #18	1991	1995	730.5	730.9
365200116272901	USW G-1	1982	1982	754.2	754.2
365147116185301	UE-25 a #3	1979	1979	748.3	748.3
365140116260301	UE-25 WT #4	1985	1995	730.3	731.2
365116116233801	UE-25 WT #15	1985	1995	729.0	729.4
365114116270401	USW G-4	1983	1990	730.0	730.9
365105116262401	UE-25 a #1	1982	1985	730.7	731.2
365032116243501	UE-25 WT #14	1985	1995	729.3	730.0
365023116271801	USW WT-2	1985	1995	730.1	730.8
364947116254300	UE-25 c #1	1983	1984	730.1	730.3
364947116254501	UE-25 c #3	1989	1995	730.1	730.3
364947116254401	UE-25 c #2	1989	1995	729.9	730.6
364945116235001	UE-25 WT #13	1985	1995	728.5	729.4
364933116285701	USW WT- 7	1985	1995	775.5	776.0
364916116265601	USW WT- 1	1985	1995	730.0	730.5
364905116280101	USW G-3	1985	1995	730.0	730.8
364828116234001	UE-25 J -13	1986	1995	728.3	728.7
364825116290501	USW WT-10	1985	1995	775.6	776.2
364822116262601	UE-25 WT #17	1985	1995	729.5	729.8
365821116343701	USW VH-2	1983	1983	810.4	810.4
364757116245801	UE-25 WT #3	1985	1995	729.4	729.9
364732116330701	USW VH-1	1985	1995	779.3	779.6
364656116261601	UE-25 WT #12	1985	1995	729.1	729.6
364649116280201	USW WT-11	1985	1995	730.2	730.8
364554116232400	UE-25 J -12	1989	1995	727.8	728.2
364528116232201	UE-25 JF #3	1992	1998	727.3	728.1

USGS Site ID	Site Name	Earliest Year of Measurement	Latest Year of Measurement	Minimum Water-level Altitude (m)	Maximum Water-level Altitude (m)
364105116302601	Cind-R-Lite Well	1992	1998	727.1	729.9
363907116235701	Ben Bossingham	1961	1961	718.4	718.4
363836116234001	Fred Cobb	1964	1990	700.1	705.4
363840116235000	Bob Whellock	1955	1955	704.1	704.1
363840116234001	Louise Pereidra	1952	1952	705.6	705.6
363840116233501	Joe Richards	1955	1955	701.6	701.6
363835116234001	NDOT Well	1991	1998	704.9	705.6
363742116263201	James H. Shaw	1953	1987	705.4	708.1
363830116241401	Airport Well	1987	1998	705.2	705.5
363815116175901	TW- 5	1962	1998	724.8	729.2
363711116263701	Richard Washburn	1958	1962	706.1	709.3
363621116263201	Richard Washburn	1958	1958	704.4	704.4
363549116305001	Nye County Development Co	1963	1987	691.3	695.9
363523116353701	Fred Wooldridge	1960	1984	688.4	694.0
363525116325601	Fred J. Keefe	1960	1987	691.4	696.3
363519116322001	Leslie Nickels	1962	1987	693.5	696.1
363540116240801	L. Mason	1963	1973	721.5	726.0
363527116292501	Unknown	1962	1987	696.9	698.7
363521116352501	Davidson Well	1963	1998	689.7	692.0
363456116335501	Eugene J. Mankinen	1961	1962	707.1	707.7
363454116314201	Donald O. Heath	1962	1987	693.2	696.2
363503116351501	Elvis Kelley	1984	1987	690.5	691.3
363503116284001	Manuel Rodela	1965	1987	692.2	694.9
363436116342301	Charles C. DeFir Jr.	1959	1987	705.3	708.8
363436116333201	William R. Monroe	1962	1987	691.5	696.0
363434116354001	DeFir Well	1987	1993	689.1	690.4
363438116324601	Edwin H. Mankinen	1961	1987	692.4	698.0
363442116363301	Bill Strickland	1982	1982	689.2	689.2
363440116282401	M. Meese	1962	1962	686.4	686.4
363415116275101	Theo E. Selbach	1958	1958	696.2	696.2
363407116342501	C.L. Caldwell	1958	1984	690.1	692.8
363407116243501	Leonard Siegel	1962	1962	709.0	709.0
363429116315901	James K. Pierce	1965	1987	689.5	692.1
363405116321501	James K. Pierce	1960	1962	704.7	706.6
363428116240301	Cooks West Well	1987	1991	719.6	720.4
363428116234701	Cooks East Well	1987	1998	717.7	720.3
363417116271801	Nye County Land Company	1962	1984	688.3	691.9
363411116272901	Amargosa Town Complex	1980	1980	688.8	688.8
363410116261101	Nye County Development Co	1987	1987	691.2	691.2
363410116240301	Lewis C. Cook	1966	1987	714.0	720.9
363410116240001	Lewis C. Cook	1962	1987	705.9	723.6
363407116273301	Amargosa Valley Water	1988	1988	701.3	701.3
363342116335701	Earl N. Selbach	1958	1958	696.5	696.5
363340116332901	Lewis N. Dansby	1954	1987	692.4	696.2
363342116325101	Edwin H. Mankinen	1955	1974	692.7	695.1
363350116252101	Willard Johns	1959	1962	698.5	700.4

USGS Site ID	Site Name	Earliest Year of Measurement	Latest Year of Measurement	Minimum Water-level Altitude (m)	Maximum Water-level Altitude (m)
365157116271202	USW H-1 tube 1	1985	1995	785.0	786.1
365157116271203	USW H-1 tube 2	1985	1995	735.7	736.3
365157116271204	USW H-1 tube 3	1985	1995	730.4	730.8
365157116271205	USW H-1 tube 4	1985	1995	730.5	731.0
365122116275502	USW H-5 upper	1985	1995	775.0	775.7
365122116275503	USW H-5 lower	1985	1995	775.0	775.9
365108116262302	UE-25 b #1 lower	1985	1995	728.5	730.3
365108116262303	UE-25 b #1 upper	1985	1995	730.5	730.8
365049116285502	USW H-6 upper	1985	1995	775.8	776.2
365049116285505	USW H-6 lower	1988	1995	775.7	776.1
365032116265402	USW H-4 upper	1985	1995	730.2	730.5
365032116265403	USW H-4 lower	1985	1995	730.2	730.8
364942116280002	USW H-3 upper	1985	1995	731.1	731.9
364942116280003	USW H-3 lower	1991	1995	747.4	759.6
364938116252102	UE-25 p #1(Lwr Intrvl)	1985	1995	751.9	752.7
not available yet	USW SD-7	1995	1995	727.6	727.6
not available yet	USW SD-9	1994	1994	731.1	731.1
not available yet	USW SD-12	1995	1995	730.0	730.0
not available yet	NC-EWDP-1D	1999	1999	786.9	787.5
not available yet	NC-EWDP-1S	1999	1999	787.9	787.9
not available yet	NC-EWDP-2D	1999	1999	706.1	706.2
not available yet	NC-EWDP-3D	1999	1999	718.4	720.2
not available yet	NC-EWDP-3S	1999	1999	719.6	719.6
not available yet	NC-EWDP-5S	1999	1999	725.8	726.1
not available yet	NC-EWDP-9S	1999	1999	767.2	767.3
not available yet	NC-Washburn-1X	1999	1999	714.5	714.6
364706116170601	UE-25 J -11	1989	1995	732.1	732.4
364237116365401	BGMW-11	1989	1999	715.5	716.2
363709116264601	Richard Washburn	1987	1987	704.0	704.0
363409116233701	L. Cook	1962	1962	713.2	713.2
363411116264701	Unknown	1987	1987	689.5	689.5
363428116281201	Amargosa Water	1987	1987	690.4	690.4
363429116233401	Lewis C. Cook	1987	1987	715.7	715.7
363511116335101	Unknown	1987	1987	690.8	690.8
365624116222901	USW UZ-N91	1986	1996	1185.6	1191.3

Table I-5. Top of Interval, Bottom of Interval, and Midpoint of Interval

Top of Interval/Bottom of Interval (meters)

Where available, the altitude of the top and bottom of screened or packed-off intervals were used. If the altitude of the screened or packed-off interval was not available, the borehole was treated as an open borehole. If the altitude of the bottom of a borehole interval was not available, the altitude of the base of the borehole was used for the bottom of the interval. Likewise, if the altitude of the top of a borehole interval was not available, the maximum water level was used for the altitude of the top of the interval. The altitudes were converted from feet to meters by the following formula:

$$\text{Altitude (ft)} \times 0.3048 \text{ (m/ft)} = \text{Altitude (m)}$$

The altitude was rounded to the nearest tenth of a meter.

Midpoint of Interval (meters)

Most of the water levels represent a composite water-level altitude for a borehole. Composite water-level altitudes refer to water levels derived from a open interval, in which any portion of the open interval may contribute to the water level. Because the altitude at which the hydraulic head measurement applies is uncertain, the midpoint of either the water column for open (uncased) boreholes or the midpoint of a screened or packed-off interval within the borehole is identified. The altitude of the midpoint of the interval was calculated by the following formula:

$$\text{Midpoint} = (\text{Top}+\text{Bottom})/2$$

The altitude was rounded to the nearest tenth of a meter.

Sources

Sources are tabulated in Table I-2

USGS Site ID	Site Name	Top of Interval (m)	Bottom of Interval (m)	Midpoint of Interval (m)
365629116222602	UE-29 a #2	1187.7	793.9	990.8
365520116370301	GEXA Well 4	1008.0	710.5	859.2
365340116264601	UE-25 WT #6	1034.6	931.8	983.2
365322116273501	USW G-2	1020.2	748.0	884.1
365239116253401	UE-25 WT #16	738.3	689.9	714.1
365208116274001	USW UZ-14	915.9	670.9	793.4
365207116264201	UE-25 WT #18	730.8	713.4	722.1
365200116272901	USW G-1	754.2	-502.9	125.7
365147116185301	UE-25 a #3	748.3	614.5	681.4
365140116260301	UE-25 WT #4	730.8	687.3	709.0
365116116233801	UE-25 WT #15	729.2	668.2	698.7
365114116270401	USW G-4	730.1	354.2	542.2
365105116262401	UE-25 a #1	731.0	436.9	584.0
365032116243501	UE-25 WT #14	729.7	677.4	703.6
365023116271801	USW WT-2	730.7	673.4	702.0
364947116254300	UE-25 c #1	730.3	216.2	473.2
364947116254501	UE-25 c #3	730.3	218.3	474.3
364947116254401	UE-25 c #2	730.2	376.3	553.2
364945116235001	UE-25 WT #13	729.1	678.5	703.8
364933116285701	USW WT- 7	775.8	705.9	740.9
364916116265601	USW WT- 1	730.4	686.4	708.4
364905116280101	USW G-3	688.6	-52.4	318.1
364828116234001	UE-25 J -13	707.7	1.8	354.8
364825116290501	USW WT-10	776.0	692.4	734.2
364822116262601	UE-25 WT #17	729.7	681.0	705.4

USGS Site ID	Site Name	Top of Interval (m)	Bottom of Interval (m)	Midpoint of Interval (m)
365821116343701	USW VH-2	810.5	-244.8	282.8
364757116245801	UE-25 WT #3	729.6	682.0	705.8
364732116330701	USW VH-1	779.4	201.5	490.5
364656116261601	UE-25 WT #12	729.5	675.7	702.6
364649116280201	USW WT-11	730.7	653.1	691.9
364554116232400	UE-25 J -12	712.6	606.6	659.6
364528116232201	UE-25 JF #3	727.8	597.5	662.7
364105116302601	Cind-R-Lite Well	729.8	690.6	710.2
363907116235701	Ben Bossingham	718.4	676.4	697.4
363836116234001	Fred Cobb	702.8	648.3	675.6
363840116235000	Bob Whellock	704.1	659.9	682.0
363840116234001	Louise Pereidra	705.6	690.4	698.0
363840116233501	Joe Richards	701.7	656.9	679.3
363835116234001	NDOT Well	705.3	658.9	682.1
363742116263201	James H. Shaw	706.7	621.8	664.3
363830116241401	Airport Well	705.5	567.5	636.5
363815116175901	TW- 5	725.1	652.3	688.7
363711116263701	Richard Washburn	707.7	632.2	669.9
363621116263201	Richard Washburn	704.4	646.2	675.3
363549116305001	Nye County Development Co	694.4	582.8	638.6
363523116353701	Fred Wooldridge	691.9	655.6	673.8
363525116325601	Fred J. Keefe	694.3	659.0	676.7
363519116322001	Leslie Nickels	694.4	615.1	654.7
363540116240801	L. Mason	722.1	676.4	699.2
363527116292501	Unknown	697.8	637.4	667.6
363521116352501	Davidson Well	690.2	653.9	672.0
363456116335501	Eugene J. Mankinen	707.4	649.9	678.6
363454116314201	Donald O. Heath	698.1	605.0	651.6
363503116351501	Elvis Kelley	691.0	679.1	685.1
363503116284001	Manuel Rodela	693.6	679.7	686.7
363436116342301	Charles C. DeFir Jr.	706.9	664.5	685.7
363436116333201	William R. Monroe	699.0	640.1	669.5
363434116354001	DeFir Well	691.3	650.9	671.1
363438116324601	Edwin H. Mankinen	695.2	630.3	662.8
363442116363301	Bill Strickland	689.2	664.8	677.0
363440116282401	M. Meese	686.4	642.8	664.6
363415116275101	Theo E. Selbach	696.2	650.5	673.3
363407116342501	C.L. Caldwell	691.4	617.5	654.5
363407116243501	Leonard Siegel	709.0	625.5	667.2
363429116315901	James K. Pierce	690.4	637.7	664.0
363405116321501	James K. Pierce	705.7	648.6	677.1
363428116240301	Cooks West Well	717.2	663.1	690.2
363428116234701	Cooks East Well	718.8	668.1	693.4
363417116271801	Nye County Land Company	690.1	740.7	715.4
363411116272901	Amargosa Town Complex	688.9	647.7	668.3
363410116261101	Nye County Development Co	691.2	539.5	615.4
363410116240301	Lewis C. Cook	717.4	687.7	702.5
363410116240001	Lewis C. Cook	714.8	662.7	688.7
363407116273301	Amargosa Valley Water	701.4	646.5	673.9

USGS Site ID	Site Name	Top of Interval (m)	Bottom of Interval (m)	Midpoint of Interval (m)
363342116335701	Earl N. Selbach	696.5	647.7	672.1
363340116332901	Lewis N. Dansby	694.2	635.2	664.7
363342116325101	Edwin H. Mankinen	694.0	678.5	686.2
363350116252101	Willard Johns	699.5	658.4	678.9
365157116271202	USW H-1 tube 1	-480.0	-511.0	-495.5
365157116271203	USW H-1 tube 2	206.0	180.0	193.0
365157116271204	USW H-1 tube 3	587.0	538.0	562.5
365157116271205	USW H-1 tube 4	731.0	630.0	680.5
365122116275502	USW H-5 upper	775.5	632.9	704.2
365122116275503	USW H-5 lower	632.9	259.9	446.4
365108116262302	UE-25 b #1 lower	1.7	-19.3	-8.8
365108116262303	UE-25 b #1 upper	730.7	1.7	366.2
365049116285502	USW H-6 upper	776.0	549.8	662.9
365049116285505	USW H-6 lower	549.8	81.8	315.8
365032116265402	USW H-4 upper	730.4	60.5	395.5
365032116265403	USW H-4 lower	60.5	29.5	45.0
364942116280002	USW H-3 upper	731.5	422.2	576.9
364942116280003	USW H-3 lower	422.2	264.2	343.2
364938116252102	UE-25 p #1(Lwr Intrvl)	-129.8	-690.8	-410.3
not available yet	USW SD-7	727.6	547.7	637.7
not available yet	USW SD-9	731.1	625.6	678.3
not available yet	USW SD-12	730.0	663.4	696.7
not available yet	NC-EWDP-1D	785.8	41.2	413.5
not available yet	NC-EWDP-1S	786.7	708.9	747.8
not available yet	NC-EWDP-2D	706.3	308.0	507.2
not available yet	NC-EWDP-3D	717.0	36.3	376.7
not available yet	NC-EWDP-3S	722.1	716.0	719.1
not available yet	NC-EWDP-5S	724.1	483.6	603.9
not available yet	NC-EWDP-9S	766.0	676.3	721.2
not available yet	NC-Washburn-1X	714.6	622.9	668.8
364706116170601	UE-25 J -11	721.2	653.3	687.2
364237116365401	BGMW-11	715.9	631.0	673.4
363709116264601	Richard Washburn	704.1	775.7	739.9
363409116233701	L. Cook	713.3	695.0	704.1
363411116264701	Unknown	689.5	694.1	691.8
363428116281201	Amargosa Water	690.4	738.2	714.3
363429116233401	Lewis C. Cook	715.7	755.3	735.5
363511116335101	Unknown	690.8	729.4	710.1
365624116222901	USW UZ-N91	1186.8	1174.4	1180.6

Table I-6. Interval Description and Accuracy of Location

Interval Description

Where available, the interval type and description were compiled from the NWIS data files (DTN: GS991100002330.001).

Accuracy of Location/Accuracy of Land-surface Altitude (meters)

Location and land-surface altitude accuracy were compiled from the NWIS data files (DTN: GS991100002330.001).

Sources

Sources are tabulated in Table I-2

USGS Site ID	Site Name	Interval Description	Accuracy of Location
365629116222602	UE-29 a #2	Open Hole, No Screen	+/- 1 second
365520116370301	GEXA Well 4	Perforated, Porous, or Slotted Casing	+/- 1 second
365340116264601	UE-25 WT #6	Wire-Wound Screen	+/- 10 seconds
365322116273501	USW G-2	Open Hole, No Screen	+/- 1 second
365239116253401	UE-25 WT #16	Wire-Wound Screen	+/- 1 second
365208116274001	USW UZ-14	Fractured Rock Openings	unknown
365207116264201	UE-25 WT #18	Wire-Wound Screen	+/- 1 second
365200116272901	USW G-1	Open Hole, No Screen	+/- 1 second
365147116185301	UE-25 a #3	Open Hole, No Screen	+/- 1 second
365140116260301	UE-25 WT #4	Wire-Wound Screen	+/- 1 second
365116116233801	UE-25 WT #15	Open Hole, No Screen	+/- 1 second
365114116270401	USW G-4	Open Hole, No Screen	+/- 1 second
365105116262401	UE-25 a #1	Unknown	+/- 1 second
365032116243501	UE-25 WT #14	Wire-Wound Screen	+/- 1 second
365023116271801	USW WT-2	Wire-Wound Screen	+/- 1 second
364947116254300	UE-25 c #1	Composite interval - entire saturated section	+/- 1 second
364947116254501	UE-25 c #3	Composite interval - entire saturated section	+/- 1 second
364947116254401	UE-25 c #2	Upper interval - above inflatable packer	+/- 1 second
364945116235001	UE-25 WT #13	Open Hole, No Screen	+/- 1 second
364933116285701	USW WT- 7	Wire-Wound Screen	+/- 1 second
364916116265601	USW WT- 1	Wire-Wound Screen	+/- 1 second
364905116280101	USW G-3	Open Hole, No Screen	+/- 1 second
364828116234001	UE-25 J -13	Open Hole, No Screen	+/- 1 second
364825116290501	USW WT-10	Wire-Wound Screen	+/- 1 second
364822116262601	UE-25 WT #17	Wire-Wound Screen	+/- 1 second
365821116343701	USW VH-2	Fractured Rock Openings	
364757116245801	UE-25 WT #3	Wire-Wound Screen	+/- 1 second
364732116330701	USW VH-1	Open Hole, No Screen	+/- 1 second
364656116261601	UE-25 WT #12	Wire-Wound Screen	+/- 1 second
364649116280201	USW WT-11	Wire-Wound Screen	+/- 1 second
364554116232400	UE-25 J -12	Perforated, Porous, or Slotted Casing	
364528116232201	UE-25 JF #3	Perforated, Porous, or Slotted Casing	+/- 1 second
364105116302601	Cind-R-Lite Well	Perforated, Porous, or Slotted Casing	+/- 1 second
363907116235701	Ben Bossingham	Perforated, Porous, or Slotted Casing	+/- 1 second
363836116234001	Fred Cobb	Perforated, Porous, or Slotted Casing	+/- 1 second
363840116235000	Bob Whellock	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363840116234001	Louise Pereidra	Perforated, Porous, or Slotted Casing	+/- 1 minute

USGS Site ID	Site Name	Interval Description	Accuracy of Location
363840116233501	Joe Richards	Perforated, Porous, or Slotted Casing	+/- 1 second
363835116234001	NDOT Well	Perforated, Porous, or Slotted Casing	+/- 1 second
363742116263201	James H. Shaw	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363830116241401	Airport Well	Perforated, Porous, or Slotted Casing	+/- 1 second
363815116175901	TW- 5	Open Hole, No Screen	+/- 1 second
363711116263701	Richard Washburn	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363621116263201	Richard Washburn	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363549116305001	Nye County Development Co	Perforated, Porous, or Slotted Casing	+/- 1 second
363523116353701	Fred Wooldridge	Perforated, Porous, or Slotted Casing	+/- 10 seconds
363525116325601	Fred J. Keefe	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363519116322001	Leslie Nickels	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363540116240801	L. Mason	Perforated, Porous, or Slotted Casing	+/- 10 seconds
363527116292501	Unknown	Unknown	+/- 5 seconds
363521116352501	Davidson Well	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363456116335501	Eugene J. Mankinen	Perforated, Porous, or Slotted Casing	+/- 1 minute
363454116314201	Donald O. Heath	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363503116351501	Elvis Kelley	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363503116284001	Manuel Rodela	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363436116342301	Charles C. DeFir Jr.	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363436116333201	William R. Monroe	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363434116354001	DeFir Well	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363438116324601	Edwin H. Mankinen	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363442116363301	Bill Strickland	Perforated, Porous, or Slotted Casing	+/- 1 second
363440116282401	M. Meese	Unknown	+/- 1 minute
363415116275101	Theo E. Selbach	Unknown	+/- 10 seconds
363407116342501	C.L. Caldwell	Perforated, Porous, or Slotted Casing	+/- 10 seconds
363407116243501	Leonard Siegel	Unknown	+/- 1 minute
363429116315901	James K. Pierce	Perforated, Porous, or Slotted Casing	+/- 1 second
363405116321501	James K. Pierce	Perforated, Porous, or Slotted Casing	+/- 10 seconds
363428116240301	Cooks West Well	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363428116234701	Cooks East Well	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363417116271801	Nye County Land Company	Unknown	+/- 1 minute
363411116272901	Amargosa Town Complex	Perforated, Porous, or Slotted Casing	+/- 1 second
363410116261101	Nye County Development Co	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363410116240301	Lewis C. Cook	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363410116240001	Lewis C. Cook	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363407116273301	Amargosa Valley Water	Perforated, Porous, or Slotted Casing	+/- 1 second
363342116335701	Earl N. Selbach	Unknown	+/- 10 seconds
363340116332901	Lewis N. Dansby	Perforated, Porous, or Slotted Casing	+/- 5 seconds
363342116325101	Edwin H. Mankinen	Unknown	+/- 10 seconds
363350116252101	Willard Johns	Perforated, Porous, or Slotted Casing	+/- 10 seconds
365157116271202	USW H-1 tube 1	Tube 1 - deepest interval in piezometer	
365157116271203	USW H-1 tube 2	Tube 2 - second deepest interval in piezometer	
365157116271204	USW H-1 tube 3	Tube 3 - second shallowest interval in piezometer	
365157116271205	USW H-1 tube 4	Tube 4 - shallowest interval in piezometer	+/- 1 second
365122116275502	USW H-5 upper	Upper interval - above inflatable packer	

USGS Site ID	Site Name	Interval Description	Accuracy of Location
365122116275503	USW H-5 lower	Lower interval - below inflatable packer	+/- 1 second
365108116262302	UE-25 b #1 lower	Lower interval - below inflatable packer	
365108116262303	UE-25 b #1 upper	Upper interval - above inflatable packer	+/- 1 second
365049116285502	USW H-6 upper	Upper interval - above inflatable packer	
365049116285505	USW H-6 lower	Lower interval - below inflatable packer	+/- 1 second
365032116265402	USW H-4 upper	Upper interval - above inflatable packer	
365032116265403	USW H-4 lower	Lower interval - below inflatable packer	+/- 1 second
364942116280002	USW H-3 upper	Upper interval - above inflatable packer	
364942116280003	USW H-3 lower	Lower interval - below inflatable packer	
364938116252102	UE-25 p #1(Lwr Intrvl)	Paleozoics units monitored	
not available yet	USW SD-7	Fractured Rock Openings	unknown
not available yet	USW SD-9	Fractured Rock Openings	unknown
not available yet	USW SD-12	Fractured Rock Openings	unknown
not available yet	NC-EWDP-1D	Unknown	unknown
not available yet	NC-EWDP-1S	Unknown	unknown
not available yet	NC-EWDP-2D	Unknown	unknown
not available yet	NC-EWDP-3D	Unknown	unknown
not available yet	NC-EWDP-3S	Unknown	unknown
not available yet	NC-EWDP-5S	Unknown	unknown
not available yet	NC-EWDP-9S	Unknown	unknown
not available yet	NC-Washburn-1X	Unknown	unknown
364706116170601	UE-25 J -11	Open Hole, No Screen	+/- 1 second
364237116365401	BGMW-11	Open Hole, No Screen	+/- 1 second
363709116264601	Richard Washburn	Unknown	+/- 1 second
363409116233701	L. Cook	Unknown	+/- 1 minute
363411116264701	Unknown	Unknown	+/- 5 seconds
363428116281201	Amargosa Water	Unknown	+/- 5 seconds
363429116233401	Lewis C. Cook	Unknown	+/- 5 seconds
363511116335101	Unknown	Unknown	+/- 1 second
365624116222901	USW UZ-N91	Open Hole, No Screen	

Table I-7. Accuracy of Land-surface Altitude and Latest Water-level Measurement Method Description

Accuracy of Location/Accuracy of Land-surface Altitude (meters)

Location and land-surface altitude accuracy were compiled from the NWIS data files (DTN: GS991100002330.001).

Latest Water-level Measurement Method Description

Typical water-level measurement method was compiled from the NWIS data files (DTN: GS991100002330.001). The method used for the latest measurement prior to 1992 was used as the most typical for the period.

USGS Site ID	Site Name	Accuracy of Land-surface Altitude (m)	Latest Water-level Measurement Method Description
365629116222602	UE-29 a #2	0.1	Steel-tape measurement
365520116370301	GEXA Well 4	0.1	Electric-tape measurement
365340116264601	UE-25 WT #6	0.1	Steel-tape measurement
365322116273501	USW G-2	0.1	Electric-tape measurement
365239116253401	UE-25 WT #16	0.1	Steel-tape measurement
365208116274001	USW UZ-14	unknown	unknown
365207116264201	UE-25 WT #18	0.1	Steel-tape measurement
365200116272901	USW G-1	0.1	Unknown
365147116185301	UE-25 a #3	0.1	Reported, method not known
365140116260301	UE-25 WT #4	0.1	Steel-tape measurement
365116116233801	UE-25 WT #15	0.1	Steel-tape measurement
365114116270401	USW G-4	0.1	Manometer measurement
365105116262401	UE-25 a #1	0.1	Calibrated electric-tape measurement
365032116243501	UE-25 WT #14	0.1	Steel-tape measurement
365023116271801	USW WT-2	0.1	Steel-tape measurement
364947116254300	UE-25 c #1	0.1	Analog or graphic recorder
364947116254501	UE-25 c #3	0.1	Steel-tape measurement
364947116254401	UE-25 c #2	0.1	Reported, method not known
364945116235001	UE-25 WT #13	0.1	Steel-tape measurement
364933116285701	USW WT- 7	0.1	Manometer measurement
364916116265601	USW WT- 1	0.1	Electric-tape measurement
364905116280101	USW G-3	0.1	unknown
364828116234001	UE-25 J -13	0.1	Steel-tape measurement
364825116290501	USW WT-10	0.1	Electric-tape measurement
364822116262601	UE-25 WT #17	0.1	Steel-tape measurement
365821116343701	USW VH-2	unknown	unknown
364757116245801	UE-25 WT #3	0.1	Steel-tape measurement
364732116330701	USW VH-1	0.1	Steel-tape measurement
364656116261601	UE-25 WT #12	0.1	Steel-tape measurement
364649116280201	USW WT-11	0.1	Reported, method not known
364554116232400	UE-25 J -12	0.1	unknown
364528116232201	UE-25 JF #3	0.1	Unknown
364105116302601	Cind-R-Lite Well	0.1	Unknown
363907116235701	Ben Bossingham	1.0	Reported, method not known
363836116234001	Fred Cobb	0.5	Electric-tape measurement
363840116235000	Bob Whellock	3.0	Reported, method not known
363840116234001	Louise Pereidra	2.0	Reported, method not known
363840116233501	Joe Richards	0.5	Reported, method not known
363835116234001	NDOT Well	0.1	Steel-tape measurement
363742116263201	James H. Shaw	0.5	Steel-tape measurement

USGS Site ID	Site Name	Accuracy of Land-surface Altitude (m)	Latest Water-level Measurement Method Description
363830116241401	Airport Well	0.1	Calibrated electric-tape measurement
363815116175901	TW- 5	0.1	Electric-tape measurement
363711116263701	Richard Washburn	0.1	Steel-tape measurement
363621116263201	Richard Washburn	0.5	Reported, method not known
363549116305001	Nye County Development Co	2.0	Steel-tape measurement
363523116353701	Fred Wooldridge	0.5	unknown
363525116325601	Fred J. Keefe	0.5	Electric-tape measurement
363519116322001	Leslie Nickels	2.0	Steel-tape measurement
363540116240801	L. Mason	1.0	Unknown
363527116292501	Unknown	0.5	Electric-tape measurement
363521116352501	Davidson Well	0.5	Steel-tape measurement
363456116335501	Eugene J. Mankinen	0.5	Steel-tape measurement
363454116314201	Donald O. Heath	0.5	Steel-tape measurement
363503116351501	Elvis Kelley	0.5	Steel-tape measurement
363503116284001	Manuel Rodela	0.5	Steel-tape measurement
363436116342301	Charles C. DeFir Jr.	2.0	Electric-tape measurement
363436116333201	William R. Monroe	2.0	Steel-tape measurement
363434116354001	DeFir Well	0.1	Steel-tape measurement
363438116324601	Edwin H. Mankinen	0.5	Steel-tape measurement
363442116363301	Bill Strickland	0.5	Reported, method not known
363440116282401	M. Meese	0.1	unknown
363415116275101	Theo E. Selbach	0.5	Reported, method not known
363407116342501	C.L. Caldwell	2.0	unknown
363407116243501	Leonard Siegel	1.0	Steel-tape measurement
363429116315901	James K. Pierce	0.5	Steel-tape measurement
363405116321501	James K. Pierce	2.0	Steel-tape measurement
363428116240301	Cooks West Well	2.0	Steel-tape measurement
363428116234701	Cooks East Well	0.1	Calibrated electric-tape measurement
363417116271801	Nye County Land Company	0.1	unknown
363411116272901	Amargosa Town Complex	0.5	Reported, method not known
363410116261101	Nye County Development Co	0.5	Steel-tape measurement
363410116240301	Lewis C. Cook	0.5	Steel-tape measurement
363410116240001	Lewis C. Cook	1.0	Steel-tape measurement
363407116273301	Amargosa Valley Water	0.5	Reported, method not known
363342116335701	Earl N. Selbach	0.5	Reported, method not known
363340116332901	Lewis N. Dansby	2.0	Steel-tape measurement
363342116325101	Edwin H. Mankinen	2.0	Unknown
363350116252101	Willard Johns	0.5	Steel-tape measurement
365157116271202	USW H-1 tube 1	0.1	Steel-tape measurement
365157116271203	USW H-1 tube 2	0.1	Steel-tape measurement
365157116271204	USW H-1 tube 3	0.1	Steel-tape measurement
365157116271205	USW H-1 tube 4	0.1	Steel-tape measurement
365122116275502	USW H-5 upper	0.1	Steel-tape measurement
365122116275503	USW H-5 lower	0.1	Steel-tape measurement
365108116262302	UE-25 b #1 lower	0.1	Steel-tape measurement
365108116262303	UE-25 b #1 upper	0.1	Steel-tape measurement
365049116285502	USW H-6 upper	0.1	Steel-tape measurement
365049116285505	USW H-6 lower	0.1	unknown
365032116265402	USW H-4 upper	0.1	Unknown

USGS Site ID	Site Name	Accuracy of Land-surface Altitude (m)	Latest Water-level Measurement Method Description
365032116265403	USW H-4 lower	0.1	Steel-tape measurement
364942116280002	USW H-3 upper	0.1	Steel-tape measurement
364942116280003	USW H-3 lower	0.1	Calibrated electric-tape measurement
364938116252102	UE-25 p #1(Lwr Intrvl)	0.1	Steel-tape measurement
not available yet	USW SD-7	unknown	unknown
not available yet	USW SD-9	unknown	unknown
not available yet	USW SD-12	unknown	unknown
not available yet	NC-EWDP-1D	unknown	unknown
not available yet	NC-EWDP-1S	unknown	unknown
not available yet	NC-EWDP-2D	unknown	unknown
not available yet	NC-EWDP-3D	unknown	unknown
not available yet	NC-EWDP-3S	unknown	unknown
not available yet	NC-EWDP-5S	unknown	unknown
not available yet	NC-EWDP-9S	unknown	unknown
not available yet	NC-Washburn-1X	unknown	unknown
364706116170601	UE-25 J -11	0.1	Calibrated electric-tape measurement
364237116365401	BGMW-11	0.5	Steel-tape measurement
363709116264601	Richard Washburn	0.5	Steel-tape measurement
363409116233701	L. Cook	0.1	Reported, method not known
363411116264701	Unknown	0.1	Steel-tape measurement
363428116281201	Amargosa Water	0.5	Steel-tape measurement
363429116233401	Lewis C. Cook	1.0	Steel-tape measurement
363511116335101	Unknown	0.5	Steel-tape measurement
365624116222901	USW UZ-N91	unknown	Steel-tape measurement

Table I-8. Water Level Measurement Accuracy and Perched?

Water-level Measurement Accuracy

Water-level altitude accuracy was compiled from the NWIS data files (DTN: GS991100002330.001).

Perched?

Potential perched-water levels identified during this analysis (O'Brien, 1998) were flagged and identified as "suspected perched."

USGS Site ID	Site Name	Water Level Measurement Accuracy	Perched?
365629116222602	UE-29 a #2	Nearest 0.01 feet.	Suspected perched
365520116370301	GEXA Well 4	Nearest 0.01 feet.	
365340116264601	UE-25 WT #6	Nearest 0.01 feet.	Suspected perched
365322116273501	USW G-2	unknown	Suspected perched
365239116253401	UE-25 WT #16	Nearest 0.01 feet.	
365208116274001	USW UZ-14	unknown	
365207116264201	UE-25 WT #18	Nearest 0.01 feet.	Suspected perched
365200116272901	USW G-1	unknown	Suspected perched
365147116185301	UE-25 a #3	Nearest foot.	Suspected perched
365140116260301	UE-25 WT #4	Nearest 0.01 feet.	
365116116233801	UE-25 WT #15	Nearest 0.01 feet.	
365114116270401	USW G-4	Nearest 0.01 feet.	
365105116262401	UE-25 a #1	unknown	
365032116243501	UE-25 WT #14	Nearest 0.01 feet.	
365023116271801	USW WT-2	Nearest 0.01 feet.	
364947116254300	UE-25 c #1	Nearest 0.01 feet.	
364947116254501	UE-25 c #3	Nearest 0.01 feet.	
364947116254401	UE-25 c #2	Nearest foot.	
364945116235001	UE-25 WT #13	Nearest 0.01 feet.	
364933116285701	USW WT- 7	Nearest 0.01 feet.	
364916116265601	USW WT- 1	Nearest 0.1 feet.	
364905116280101	USW G-3	unknown	
364828116234001	UE-25 J -13	Nearest 0.01 feet.	
364825116290501	USW WT-10	Nearest foot.	
364822116262601	UE-25 WT #17	Nearest 0.01 feet.	
365821116343701	USW VH-2	unknown	
364757116245801	UE-25 WT #3	Nearest 0.01 feet.	
364732116330701	USW VH-1	Nearest 0.01 feet.	
364656116261601	UE-25 WT #12	Nearest 0.01 feet.	
364649116280201	USW WT-11	Nearest foot.	
364554116232400	UE-25 J -12	Nearest 0.01 feet.	
364528116232201	UE-25 JF #3	unknown	
364105116302601	Cind-R-Lite Well	Nearest 0.1 feet.	
363907116235701	Ben Bossingham	Nearest foot.	
363836116234001	Fred Cobb	Nearest 0.1 feet.	
363840116235000	Bob Whellock	Nearest foot.	
363840116234001	Louise Pereidra	Nearest foot.	
363840116233501	Joe Richards	Nearest foot.	
363835116234001	NDOT Well	Nearest 0.01 feet.	
363742116263201	James H. Shaw	Nearest 0.01 feet.	
363830116241401	Airport Well	Nearest 0.01 feet.	

USGS Site ID	Site Name	Water Level Measurement Accuracy	Perched?
363815116175901	TW- 5	Nearest 0.01 feet.	
363711116263701	Richard Washburn	Nearest 0.01 feet.	
363621116263201	Richard Washburn	Nearest foot.	
363549116305001	Nye County Development Co	Nearest 0.01 feet.	
363523116353701	Fred Wooldridge	Nearest 0.1 feet.	
363525116325601	Fred J. Keefe	Nearest 0.1 feet.	
363519116322001	Leslie Nickels	Nearest 0.01 feet.	
363540116240801	L. Mason	Nearest 0.01 feet.	
363527116292501	Unknown	Nearest 0.1 feet.	
363521116352501	Davidson Well	Nearest 0.01 feet.	
363456116335501	Eugene J. Mankinen	Nearest 0.01 feet.	
363454116314201	Donald O. Heath	Nearest 0.01 feet.	
363503116351501	Elvis Kelley	Nearest 0.01 feet.	
363503116284001	Manuel Rodela	Nearest 0.01 feet.	
363436116342301	Charles C. DeFir Jr.	Nearest 0.1 feet.	
363436116333201	William R. Monroe	Nearest 0.01 feet.	
363434116354001	DeFir Well	Nearest 0.01 feet.	
363438116324601	Edwin H. Mankinen	Nearest 0.01 feet.	
363442116363301	Bill Strickland	Nearest foot.	
363440116282401	M. Meese	Nearest 0.01 feet.	
363415116275101	Theo E. Selbach	Nearest foot.	
363407116342501	C.L. Caldwell	Nearest foot.	
363407116243501	Leonard Siegel	Nearest 0.01 feet.	
363429116315901	James K. Pierce	Nearest 0.01 feet.	
363405116321501	James K. Pierce	Nearest 0.01 feet.	
363428116240301	Cooks West Well	Nearest 0.01 feet.	
363428116234701	Cooks East Well	Nearest 0.01 feet.	
363417116271801	Nye County Land Company	Nearest 0.1 feet.	
363411116272901	Amargosa Town Complex	Nearest foot.	
363410116261101	Nye County Development Co	Nearest 0.01 feet.	
363410116240301	Lewis C. Cook	Nearest 0.01 feet.	
363410116240001	Lewis C. Cook	Nearest 0.01 feet.	
363407116273301	Amargosa Valley Water	Nearest foot.	
363342116335701	Earl N. Selbach	Nearest foot.	
363340116332901	Lewis N. Dansby	Nearest 0.01 feet.	
363342116325101	Edwin H. Mankinen	Nearest 0.01 feet.	
363350116252101	Willard Johns	Nearest 0.01 feet.	
365157116271202	USW H-1 tube 1	Nearest 0.01 feet.	
365157116271203	USW H-1 tube 2	Nearest 0.01 feet.	
365157116271204	USW H-1 tube 3	Nearest 0.01 feet.	
365157116271205	USW H-1 tube 4	Nearest 0.01 feet.	
365122116275502	USW H-5 upper	Nearest 0.01 feet.	
365122116275503	USW H-5 lower	Nearest 0.01 feet.	
365108116262302	UE-25 b #1 lower	Nearest 0.01 feet.	
365108116262303	UE-25 b #1 upper	Nearest 0.01 feet.	
365049116285502	USW H-6 upper	Nearest 0.01 feet.	
365049116285505	USW H-6 lower	unknown	
365032116265402	USW H-4 upper	unknown	
365032116265403	USW H-4 lower	Nearest 0.01 feet.	

USGS Site ID	Site Name	Water Level Measurement Accuracy	Perched?
364942116280002	USW H-3 upper	Nearest 0.01 feet.	
364942116280003	USW H-3 lower	unknown	
364938116252102	UE-25 p #1(Lwr Intrvl)	Nearest 0.01 feet.	
not available yet	USW SD-7	unknown	
not available yet	USW SD-9	unknown	
not available yet	USW SD-12	unknown	
not available yet	NC-EWDP-1D	unknown	
not available yet	NC-EWDP-1S	unknown	
not available yet	NC-EWDP-2D	unknown	
not available yet	NC-EWDP-3D	unknown	
not available yet	NC-EWDP-3S	unknown	
not available yet	NC-EWDP-5S	unknown	
not available yet	NC-EWDP-9S	unknown	
not available yet	NC-Washburn-1X	unknown	
364706116170601	UE-25 J -11	Nearest 0.01 feet.	
364237116365401	BGMW-11	Nearest 0.01 feet.	
363709116264601	Richard Washburn	Nearest 0.01 feet.	
363409116233701	L. Cook	Nearest foot.	
363411116264701	Unknown	Nearest 0.01 feet.	
363428116281201	Amargosa Water	Nearest 0.01 feet.	
363429116233401	Lewis C. Cook	Nearest 0.01 feet.	
363511116335101	Unknown	Nearest 0.01 feet.	
365624116222901	USW UZ-N91	Nearest 0.01 feet.	Suspected perched