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Table 2-9. Preliminary Subsurface Excavation Dimensions for the Base Case Repository Layout

Designation	Excavated Diameter or Size meters (ft)	Length meters (ft)	Notes
Access Ramps • North Ramp • South Ramp	 7.62 (25.0) 7.62 (25.0)	 2,804 (9,199) 2,223 (7,293)	The access ramps were constructed as part of the Exploratory Studies Facility and will be upgraded for use by the repository
Main Drifts • East Main • North Main • South Main • West Main • North Ramp Extension • North Ramp Curve	7.62 (25.0)	12,988 (42,612)	Typical 300 mm (1 ft) concrete layer over concrete invert segment
Exhaust Main Drift	7.62 (25.0)	6,542 (21,463)	Located below the emplacement horizon
Turnouts	7.0 × 8.0 (23.0 × 26.2)	Varies	7 m (23 ft) high with 4 m (13.1 ft) radius arch; 24 m (78.7 ft) straight section and variable curve lengths
Emplacement Drifts	5.50 (18.0)	56,222 (184,455)	52 each (for base case) on 81-m (266 ft) center-to-center spacings. Typical 908-mm (3-ft) thick circular segment invert fill.
Enhanced Characterization of the Repository Block Cross-Drift	5.0 (16.4)	2,681 (8,796)	This facility is already constructed; measured length from as-built surveys.
Observation Drifts • Observation Drift #1 • Observation Drift #2 • Observation Drift #3	 5.50 (18.0) 5.50 (18.0) 5.50 (18.0)	 1,931 (6,335) 2,103 (6,900) 1,568 (5,144)	
Ventilation Shafts	8.0 (26.2)	Varies	Three intake, three exhaust, one development; variable lengths because of fluctuations in surface terrain
Ventilation Raises	2.0 (6.6)	15 (49.2)	
Alcoves	Varies	Varies	Various configurations, minor excavations

NOTES: Dimensions are approximate unless already constructed. Sources: BSC 2001d, Sections 6.2 and 6.3; for Enhanced Characterization of the Repository Block Cross-Drift dimensions, CRWMS M&O 1999f, Section 4.2.

performance confirmation functions. The 70,000-MTHM layout includes other drifts, such as the postclosure test drifts and the observation drifts, which are used for the performance confirmation program discussed in Sections 2.5 and 4.6.

The access mains to the emplacement area for the 70,000-MTHM layout include the north main, west main, north ramp extension, east main north extension, east main south extension, and south main. These access mains account for approximately 12,988 m (42,612 ft) of excavation. The access mains would be excavated to a diameter of 7.62 m (25 ft). The east and west mains, including the east main north and south extensions, would be used primarily for access to the emplacement drifts during waste emplacement operations. The north and south mains have been configured between the east and west mains to provide access from one side of the repository block to the other. The north ramp extension is provided to the north end of the repository block as a bypass from the north ramp to allow waste emplacement operations concurrent with subsurface facilities development.

The exhaust main, excavated to a diameter of 7.62 m (25 ft), is approximately 6,542 m (21,463 ft) in length and is situated a minimum of 10 m (33 ft) below the emplacement horizon, extending from the north end of the repository block to the extreme south end. The exhaust main is graded upwards in the vicinity of the north and south mains to allow interception for access into the exhaust main from either end of the repository block. The ventilation system uses three intake shafts, excavated to a diameter of 8 m (26.2 ft), in addition to the north and south ramps, for air intake. The development shaft in the south end,

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is most sensitive to a combination of parameters (k/α): the product of fracture permeability, k, and the capillary strength parameter, $1/\alpha$. With this simplification, seepage can be treated as a function of just two variables (i.e., percolation flux and k/α).

The abstraction for TSPA focuses on two quantities: (1) the seepage fraction, which is the fraction of waste package locations (i.e., model realizations) for which seepage is predicted and (2) the seepage flow rate, which is the volumetric flow rate of seepage in a drift segment of specified length. Details of the abstraction procedure are provided in supporting documentation (CRWMS M&O 2000by, Sections 6.2.2 and 6.4). Table 4-14 summarizes the abstracted seepage distributions as they vary with percolation flux for ambient conditions (not the nearly dry conditions expected during repository heating). Seepage threshold values of approximately 200 mm/yr (7.8 in./yr), 15 mm/yr (0.6 in./yr), and 5 mm/yr (0.2 in./yr) are estimated for the minimum, expected (i.e., most likely), and maximum seepage conditions, respectively. Note that these values are different from the previously discussed seepage threshold of 200 mm/yr (7.8 in./yr) (CRWMS M&O 2000c, Section 3.9.4.7) for a single location in Niche 2 in the middle nonlithophysal zone.

Summary and Conclusions for the Drift Seepage Model—Seepage into waste emplacement drifts is important to the performance of a repository at Yucca Mountain. Numerical modeling, field testing, and observations at analogue sites suggest that seepage into repository emplacement drift openings would be substantially less than the local percolation flux. This performance results mainly from capillarity retaining the water in the rock and diverting the flow around the openings. The effectiveness of this capillary barrier principle depends on the percolation flux magnitude, the hydrologic properties of the rock, and the drift opening geometry.

A sequence of models was developed to predict the seepage percentage, seepage threshold, and seepage flow rate for waste emplacement drifts. The seepage model was calibrated against relevant data from liquid injection tests in the Exploratory Studies Facility. Seepage percentages and flow rates were then calculated for a wide range of parameter values representing uncertainty in the model and summarized in a probabilistic abstraction model for TSPA. The results indicate that only 13 percent of waste packages are likely to be

Table 4-14. Uncertainty in Seepage Parameters as a Function of Percolation

	Minimum Value of k/α			Peak Value of k/α			Maximum Value of k/α		
q, mm/yr (in./yr)	f_s	Mean Q_s, m^3/yr (ft^3/yr)	Std. Dev. Q_s, m^3/yr (ft^3/yr)	f_s	Mean Q_s, m^3/yr (ft^3/yr)	Std. Dev. Q_s, m^3/yr (ft^3/yr)	f_s	Mean Q_s, m^3/yr (ft^3/yr)	Std. Dev. Q_s, m^3/yr (ft^3/yr)
5 (0.2)	0	0	0	0	0	0	1.97×10^{-3}	3.21×10^{-3} (0.113)	3.16×10^{-3} (0.112)
14.6 (0.6)	0	0	0	2.45×10^{-3}	7.95×10^{-3} (0.28)	7.09×10^{-3} (0.25)	5.75×10^{-2}	2.26×10^{-2} (0.799)	2.45×10^{-2} (0.865)
73.2 (2.9)	0	0	0	0.250	0.106 (3.74)	0.198 (6.99)	0.744	0.404 (14.3)	0.409 (14.4)
213 (8.4)	4.91×10^{-3}	0.284 (10)	0.188 (6.64)	0.487	1.51 (53.3)	1.15 (40.6)	0.944	3.31 (117)	2.24 (79.1)
500 (20)	6.01×10^{-2}	0.992 (35)	1.05 (37.1)	0.925	5.50 (194)	4.48 (158)	0.999	13.0 (459)	5.74 (203)

NOTES: q = percolation flux; f_s = seepage fraction; Q_s = seep flow rate. Source: Modified from CRWMS M&O 2000by, Table 11.