

## Appendix 1. Lithologic description of Calico Hills Formation from selected boreholes in the study area.

[All depths reported in feet to maintain consistency with original data. Boreholes on the Nevada National Security Site (NNSS) are designated with UE (for Underground Exploratory), followed by the NNSS use area number (Area 25 in the immediate area of Yucca Mountain; for example, UE–25). For boreholes on Bureau of Land Management or Nellis Air Force Range land to the west and south of the NNSS, the prefix USW is used (for Underground, Southern Nevada, Waste). The prefix designators UE–25 and USW are not posted on figures in this report because of space limitations. Lithologic descriptions containing a question mark (?) indicate uncertainty on the part of the original observer. Abbreviations: mm, millimeter, cm, centimeter, ft, feet.]

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole UE–25 a#1 (data from Spengler and others, 1979)</b>		
1,363.9–1,789.0	Top of Calico Hills section; Tuff, ash-flow, light-brown to moderate-brown, moderate-reddish-orange, and pale reddish-brown, nonwelded, devitrified; pumice, devitrified to slightly zeolitized, 5–40 mm; less than 1 percent phenocrysts (sanidine, plagioclase, quartz, biotite); less than 1 percent dark-reddish-brown volcanic lithic fragments; ash-flow tuff intercalated with thin ash-fall and bedded tuffs (slightly argillized and zeolitized) at 1,383.5-1,386.3; 1,492–1,508; 1,582.4–1,585.5; 1,762.6–1,764; and 1,775.1–1,775.9 ft.	425.1
1,789.0–1,835.7	Tuff, bedded and reworked, pale-brown, moderate-red, light-red, moderate-orange-pink, yellowish-gray, moderate-greenish-yellow, and pale-olive, moderately to highly indurated; occasionally silicified; interbedded ash flow, air fall, reworked and tuffaceous sandstone; thickness of beds ranges from 0.05 to 3.0 ft; white to gray and yellow pumice, slightly argillized and zeolitized; volcanic lithic fragments vary from 2–20 percent (iron stained from 1,819.4 to 1,832.0 ft). Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.	46.7
<b>Borehole UE–25 b#1 (data from Lobmeyer and others, 1983)</b>		
1,385.2–1,840.0	Top of Calico Hills section; Tuff, ash-flow, light-brown, grayish-orange, yellowish-orange, and yellowish-gray, nonwelded, zeolitized; commonly 1–3 cm; 1–3 percent phenocrysts; about 5 percent brownish-gray and medium-gray volcanic lithic fragments, rhyolitic; commonly 1–4 cm.	454.7
1,840.0–1,869.2	Tuff, bedded, ash-fall (?). Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.	29.2
<b>Borehole UE–25 WT#4 (data from Wood, 2009)</b>		
1,154.0–1,170.0	Top of Calico Hills section; Breccia, autoclastic(?), rhyolitic, grayish-yellow, devitrified; rare quartz and sanidine phenocrysts; conspicuous conchoidal fragments; aphanitic groundmass; television camera log indicates an abundance of large black (unaltered[?]) angular blocks throughout this interval.	16.0
1,170.0–1,364.0	Lava, rhyolitic, grayish-yellow and grayish-black, dominantly glassy (slightly altered in places), perlitic cracks well developed; rare sanidine phenocrysts; black vitrophyre from 1,223 to 1,364 ft based on television camera observations.	194.0
1,364.0–1,510.0	Lava, rhyolitic, dusky-yellow and light-brown, dominantly devitrified (slightly zeolitic[?]); extremely rare phenocrysts of sanidine; interval from 1,364 to 1,369 ft and 1,383 to 1,420 ft. ;contains large unaltered blocks; vitrophyric layer from 1,431 to 1,436 ft based on television camera observations.	146.0
1,510.0–1,580.0	Tuff, ash-flow, grayish-orange, grayish-yellow, and light-brown, nonwelded, zeolitic; pumice, white and light-greenish-gray, zeolitic; less than 1 percent phenocrysts (quartz, sanidine, and biotite); 1 to 2 percent grayish-red rhyolitic lithic fragments. End of lithologic logging; well bottomed in Calico Hills Formation.	70.0

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole UE-25 WT#6 (data from Wood (2009) and R.M. Drake, II, USGS, written commun., 2013)</b>		
383.0–508.0	Top of Calico Hills section; Lava, rhyolitic, moderate-yellow-green and grayish- yellow-green, devitrified and zeolitic(?) (partially vitric with an aphanitic texture in upper 60 ft of interval); 1 percent phenocrysts of sanidine, quartz, and biotite; intervals of rock interpreted as monolithologic flow breccia(?) were observed on television camera log between 383 and 386 ft and between 457 and 489 ft; bit-cutting samples are very fine grained from 470 to 500 ft.	125.0
508.0–590.0	Lava, rhyolitic, grayish-yellow-green, dominantly devitrified (slightly vitric and zeolitic(?) in places; dominantly glassy from about 570 to 590 ft; less than 1 percent phenocrysts of quartz, sanidine, and biotite; contains abundant grayish-red rhyolitic lithic fragments from 500 to 520 ft; relict perlitic cracks; intervals of rock interpreted as flow-breccia were observed on television camera log from 508 to 515 ft and from 589 to 590 ft; bit cutting samples are very fine grained from 580 to 590 ft.	82.0
590.0–730.0	Lava, rhyolitic, dark-gray, grayish-black, light- brownish-gray, brownish-gray, and moderate-red, glassy; 2 percent phenocrysts (quartz, sanidine, plagioclase and biotite); perlitic cracks well developed from 640 to 660 ft; borehole wall becomes light in tone at 730 ft; bit cutting samples show transition from glassy to devitrified at 740 ft.	140.0
730.0–794.0	Lava, rhyolitic, grayish-red, yellowish-gray and light-olive-gray, devitrified (slightly zeolitic(?)); rare sanidine phenocrysts; intervals of rock interpreted as flow-breccia were observed on television camera log between 742 and 755 ft and between 774 and 783 ft.	64.0
794.0–1,020.0	Lava, rhyolitic, yellowish-gray and dusky-yellow, devitrified and zeolitic(?); 1 percent phenocrysts (quartz, sanidine, plagioclase, and biotite); rare grayish-red rhyolitic lithic fragments; apparent increase in pale-red and light-brown crystal-rich and crystal-poor rhyolitic lithic fragments from 990 to 1,000 ft; possible breccia zone observed on television camera log from 794 to 800 ft.	226.0
1,020.0–1,210.0	Tuff, ash-flow, light-brown and grayish-orange, non- to partially welded, zeolitic(?); pumice, dominantly grayish-yellow and very pale orange, zeolitic(?); less than 1 percent phenocrysts (sanidine and biotite); abundant minute light-gray and grayish-red rhyolitic lithic fragments; no bedded unit identified at base of interval; basal contact based on a slight decrease and abrupt increase on induction and density logs, respectively.	190.0
1,210.0–1,256.5	Lava, rhyolitic, yellowish-gray to dusky-yellow, highly zeolitic; 2 to 3 percent phenocrysts (quartz, sanidine, plagioclase, and biotite); core collected from 1,250 to 1,256.5 ft, recovered 5.5 ft. End of lithologic logging; well bottomed in Calico Hills Formation.	46.5
<b>Borehole UE-25 WT#14 (data from Wood (2009) and R.M. Drake, II, written commun., 2013)</b>		
1,210.0–1,238.0	Top of Calico Hills section; Tuff, ash-flow, moderate-greenish-yellow to pale-greenish-yellow and grayish-yellow, nonwelded, zeolitic(?); pumice, pale-greenish- yellow to moderate-greenish-yellow, zeolitic(?); 1 to 2 percent phenocrysts (sanidine, quartz); sparse grayish-red volcanic lithic fragments; base of interval inferred at density minimum on density log.	28.0
1,238.0–1,250.0	Tuff, ash-fall, reworked, pale-reddish-brown and grayish-orange-pink, zeolitic; pumice, pale- greenish-yellow and yellowish-gray, zeolitic(?); less than 1 percent phenocrysts (sanidine and biotite); sparse grayish-red volcanic lithic fragments; base of interval inferred at density minimum on density log.	12.0
1,250.0–1,310.0	Tuff, ash-flow, pale-greenish-yellow to moderate-greenish-yellow, nonwelded, zeolitic; pumice, moderate-yellow-green to moderate-greenish-yellow, zeolitic; 2 to 3 percent phenocrysts (quartz, sanidine); sparse grayish-red volcanic lithic fragments; core collected from 1,300 to 1,310 ft, recovered 10 ft (3.0 m). End of lithologic logging; well bottomed in Calico Hills Formation.	60.0

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole UE-25 WT#16 (data from Wood, 2009)</b>		
1,068.0–1,240.0	Top of Calico Hills section; Lava, dusky-yellow and grayish-yellow, rhyolitic, partially glassy, partially altered(?); 1 percent phenocrysts (quartz, sanidine, biotite); perlitic cracks well developed; many smooth planar surfaces on bit cuttings suggests abundant fracturing; rock appears highly silicified from 1,220 to 1,240 ft; from observations on television camera log, base of unit is at an increase in reflectance characteristic of borehole wall.	172.0
1,240.0–1,337.0	Lava, dominantly medium-dark-gray and dark-gray and light-olive-gray, glassy (vitrophyre); rare sanidine phenocrysts; perlitic cracks well developed; change in textural characteristics of borehole wall seen on television camera log marks base of interval.	97.0
1,337.0–1,530.0	Lava, moderate-pink, pale-red, and medium-gray, devitrified (abundant vapor-phase crystallization) below 1,410 to 1,450 ft; grayish-orange-pink altered vitrophyre from 1,460 to 1,530 ft, perlitic cracks still visible; abundant grayish-red spherulites; 1 to 3 percent phenocrysts (sanidine, quartz, biotite, hornblende); interval from 1,405 to 1429 ft is large dark (vitrophyric) blocks in a light matrix dominated by vapor-phase crystallization; base of unit confirmed on television camera log.	193.0
1,530.0–1,630.0	Lava, very light gray, light-brown, and grayish-black, glassy, vitrophyre; bit cuttings very fine-grained.	100.0
1,630.0–1,709.0	Lava, grayish-pink and pale-red, devitrified, partially vitric; 1 to 2 percent phenocrysts (sanidine and biotite); highly fractured; cored from 1,700 to 1,709 ft; recovered 8.6 ft. End of lithologic logging; well bottomed in Calico Hills Formation.	79.0
<b>Borehole UE-25 WT#18 (data from Wood, 2009)</b>		
1,620.0–1,760.0	Top of Calico Hills section; Lava, rhyolite, yellowish-gray, pale-olive, grayish-yellow, and moderate-greenish-yellow, devitrified, partly zeolitic(?), aphanitic; upper few feet are very light gray and vitric; rare sanidine and biotite phenocrysts; upper 9 ft of unit appears brecciated and interval from 1,637 to 1,650 ft appears glassy on television camera log.	140.0
1,760.0–2,043.0	Tuff, ash-flow, grayish-pink, and grayish-orange-pink, nonwelded, zeolitic(?); pumice, grayish-yellow, zeolitic; less than 1 percent phenocrysts (sanidine and biotite); cored from 2,033 to 2,043 ft, recovered 9.3 ft. End of lithologic logging; well bottomed in Calico Hills Formation.	283.0
<b>Borehole UE-29 a#2 (data from Waddell, 1985)</b>		
188.0–213.3	Top of Calico Hills section; Tuff, light tan to orange-pink and yellow-green, massive, with light purplish-gray lithic fragments, including phenocryst-poor lava with fine flow-banding; very few phenocrysts. Core (165 to 195.9 ft) is locally broken by small faults and fractures; clayey, zeolitic, secondary silica, and iron stains.	25.3
213.3–620.1	Rhyolite (?), white to pink, light green an dreddish-brown, hydrothermally altered; few phenocrysts; probably rhyolite lava of Calico Hills.	406.8
620.1–1,382.9	Rhyolite, similar to that in depth interval from 213.3 to 620.1 ft, but white to purplish-gray, massive at top; flow banding observed in lower core; contains about 5 percent white altered feldspar, minor quartz, and biotite. Partly silicified, a little clay and minor slickensides on some fractures. Core shows numerous fractures at 812 to 818 ft. Dark gray to purple from 815 to 1,170 ft; resistivity 400 to 600 ohm-m from 810.4 to 1,118.8 ft as contrasted to less than 100 ohm-m through much of the rest of the hole. Color becomes light gray again at 1,164.8 ft. More hydrothermally altered from about 1,214 ft to total depth. Color red to pinkish-brown and white from 1,328.8 to total depth. Probably rhyolite lava of Calico Hills. End of lithologic logging; well bottomed in Calico Hills Formation.	762.8

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole USW G-1 (data from Spengler and others (1981) and Wood (2009))</b>		
1,425.5–1,539.2	Top of Calico Hills section; Tuff, ash-flow, light brown, moderate orange-pink, and light olive-gray, nonwelded, devitrified (zeolitized and slightly argillic); pumice, pinkish-gray, yellowish-gray, dusky-yellow, moderate orange-pink, and light red, zeolitized, slightly argillic, commonly 5 mm to 2 cm, as large as 3.5 cm; 2-3 percent phenocrysts (sanidine, quartz, and plagioclase); sparse medium-light gray, grayish-red, and dark reddish-brown volcanic lithic fragments, commonly 5–30 mm in length, as large as 6 cm; unit shows a gradational downward increase to 4–7 percent lithic fragments 2–3 cm in length from 1,468.0-1,482.0 ft; apparent increase in zeolitization from 1,520.9-1,540.9 ft.	113.7
1,539.2–1,540.9	Tuff, bedded, reworked, moderate orange-pink to moderate yellow-green, slightly indurated; 70-80 percent pumice fragments, zeolitized; abundant grayish-red volcanic lithic fragments, 5 mm to 1 cm.	1.7
1,540.9–1,557.1	Tuff, ash-flow, grayish-orange, nonwelded, zeolitized; pumice, very pale orange, grayish-yellow to moderate greenish-yellow, devitrified, zeolitized, commonly 5 mm to 2 cm; less than 1 percent phenocrysts; sparse grayish-red and black volcanic lithic fragments, commonly 2–3 mm, but as large as 2–5 cm.	16.2
1,557.1–1,558.5	Tuff, bedded, reworked, and air-fall, moderate orange-pink; pumice, white to moderate orange-pink, 10-80 percent zeolitized, 1–10 mm; notable concentration of grayish-brown volcanic lithic fragments, commonly less than 2 mm.	1.4
1,558.5–1,570.3	Tuff, ash-flow, light brown to grayish-orange, nonwelded to partially welded, devitrified and zeolitized (slightly argillic); pumice, grayish-yellow to yellowish-gray and grayish-pink, zeolitized, commonly 1–3 cm in length; less than 1 percent phenocrysts (sanidine and plagioclase); sparse grayish-brown volcanic lithic fragments, commonly less than 2.0 mm, but as large as 1 cm.	11.8
1,570.3–1,570.7	Tuff, reworked, brownish-gray to olive-gray, zeolitized; pumice, 2 mm to 1 cm, subrounded, conspicuous brownish-gray volcanic lithic fragments, 1–5 mm.	0.4
1,570.7–1,692.8	Tuff, ash-flow, light red to moderate reddish-brown, grayish-orange-pink, and light brown (mottled grayish-black in places), nonwelded, zeolitized and slightly argillic; pumice, dusky-yellow, yellowish-gray, pale yellowish-orange, grayish-orange-pink, grayish-orange, and very pale orange, commonly 5–10 mm, but as large as 6 cm, grayish-orange-pink pumice commonly argillic; less than 1 percent phenocrysts; rare grayish-brown volcanic lithic fragments, commonly less than 1.0 cm in size.	122.1
1,692.8–1,695.6	Tuff, bedded, reworked, and air-fall, moderate reddish-brown, moderate orange-pink, pale olive, and yellowish-gray, zeolitized; pumice, commonly pale greenish-yellow and grayish-orange-pink, 1–20 mm, subrounded, content within individual beds ranges from 5 to 80 percent; beds range in thickness from 1–10 cm; grayish-brown volcanic lithic fragments are conspicuous in some beds, commonly less than 2 mm.	2.8
1,695.6–1,736.4	Tuff, ash-flow, pale olive, light brown, and grayish-orange-pink, nonwelded, zeolitized; pumice, very pale orange, grayish-pink, and yellowish-gray, commonly less than 1 cm, but as large as 4 cm; less than 1 percent phenocrysts; sparse grayish-brown volcanic lithic fragments, commonly less than 1 cm, increase in size and abundance near base of unit, as large as 3 cm near base.	40.8
1,736.4–1,801.5	Tuff, bedded, reworked, air-fall, and tuffaceous sandstone, pale yellowish-brown, pale olive, yellowish-gray, pale greenish-yellow, moderate greenish-yellow, and pale reddish-brown, varying degrees of zeolitization and silicification; pumice, white, grayish-yellow, and pale greenish-yellow, zeolitized; beds contain varying amounts of brownish-gray volcanic lithic fragments, commonly less than 1 cm; individual beds commonly 1–3 ft thick, some as thin as 2 cm, lower 2 ft of interval extremely zeolitic. Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.	62.6

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole USW G-2 (data from Maldonado and Koether (1983) and Wood (2009))</b>		
1,757.0–1,808.3	Top of Calico Hills section; Tuff, ash-flow, grayish-orange-pink, nonwelded, devitrified, zeolitized; pumice, very pale orange, partly vitric and partly argillized and zeolitized, as large as 5 cm; 1 percent quartz, sanidine, and plagioclase phenocrysts; abundant brown volcanic lithics, as large as 1 cm.	51.3
1,808.3–1,809.0	Tuff, bedded, reworked, moderate yellowish-brown, thin grayish-orange-pink, air-fall intercalated with the bedded tuff; pumice fragments, pale greenish-yellow, and zeolitized, rounded, as large as 2 cm; grayish-brown volcanic lithics, as large as 2 mm.	0.7
1,809.0–1,824.7	Tuff, ash-flow, grayish-orange-pink, nonwelded, devitrified, zeolitized; pumice, pale yellowish-orange, zeolitized, partly argillized, as large as 5 cm; approximately 5 percent phenocrysts (quartz, sanidine, and plagioclase); grayish-brown volcanic lithics common, as large as 1 cm.	15.7
1,824.7–1,825.2	Tuff, bedded, reworked, and ash-fall, grayish-orange-pink; pumice lithics, pale greenish-yellow, zeolitized, as large as 1 mm, rounded and grayish-brown volcanic lithics, as large as 1 mm, rounded.	0.5
1,825.2–1,890.5	Tuff, ash-flow, grayish-orange-pink, nonwelded, devitrified, zeolitized; pumice, very pale orange, zeolitized and argillized, as large as 2 cm; approximately 1 percent quartz, sanidine, and plagioclase phenocrysts; grayish-brown volcanic lithics common, as large as 2 cm.	65.3
1,890.5–1,890.7	Tuff, ash-fall, grayish-orange pink, very fine grained, argillized, contains approximately 1 percent quartz and feldspar phenocrysts.	0.2
1,890.7–1,960.0	Tuff, ash-flow, grayish-orange-pink to moderate orange-pink, nonwelded, devitrified, zeolitized; pumice, grayish-pink and very pale orange, zeolitized, as large as 5 cm; approximately 2 percent quartz, sanidine, and plagioclase phenocrysts; grayish-brown volcanic lithics common, as much as 2 cm.	69.3
1,960.0–1,960.5	Tuff, bedded, reworked, with a 1 cm ash-fall at base, moderate orange-pink; pumice lithics, moderate reddish-orange, zeolitized, as large as 2 cm, rounded, flattened; grayish-brown volcanic lithics common, as large as 1 cm, rounded.	0.5
1,960.5–1,999.0	Tuff, ash-flow, moderate orange-pink, nonwelded, zeolitized; pumice, grayish-pink, zeolitized, as large as 5 cm; 2 percent quartz, sanidine, and plagioclase phenocrysts; grayish-brown volcanic lithics common, as large as 2 cm.	38.5
1,999.0–2,010.7	Tuff, bedded, reworked with some ash-fall, pinkish-gray and pale yellowish-brown; ash-fall occurs in upper 1.6 ft; concentration of grayish-brown and light gray volcanic lithics and zeolitized pumice fragments occur toward base of unit; slickensides at 2,005.6 ft and 2,008.9 ft.	11.7
2,010.7–2,121.6	Tuff, ash-flow, grayish-pink and very pale orange, nonwelded, zeolitized; pumice, white and very pale orange, zeolitized, as large as 3 cm; 5 percent quartz, sanidine, plagioclase, and biotite phenocrysts; grayish-brown and light gray volcanic lithics common, as large as 5 cm.	110.9
2,121.6–2,123.0	Tuff, ash-fall, grayish-orange-pink, argillized, and partly zeolitized; conspicuous biotite phenocrysts and occasional quartz, sanidine, and plagioclase phenocrysts; banding present, dipping approximately 60 degrees.	1.4
2,123.0–2,232.0	Tuff, ash-flow, grayish-pink to grayish-orange-pink, and yellowish-gray, nonwelded, zeolitized; pumice, white and pale greenish-yellow, zeolitized and argillized, as large as 3 cm; approximately 5 percent phenocrysts, consisting of quartz (some resorbed), sanidine, plagioclase, and biotite; conspicuous reddish-brown and light-gray lithics as large as 7 cm, tuff lithics, approximately 12 cm toward top of unit.	109.0
2,232.0–2,242.0	Tuff, bedded, reworked, and ash-fall, pale greenish-yellow, grayish-orange-pink and very light gray; individual beds range from about 1 cm to 6.6 ft and consist of rounded reddish-brown and light gray volcanic lithics and pale greenish-yellow pumice, zeolitized; thin (1 cm) ash-fall towards base.	10.0
2,242.0–2,278.3	Tuff, ash-flow, pale yellowish-orange, nonwelded, argillized and zeolitized; pumice, white, argillized, as large as 3 cm; approximately 5 percent phenocrysts consisting of quartz (some resorbed), sanidine, plagioclase, and biotite; reddish-brown volcanic lithics common, as large as 2 cm.	36.3

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole USW G-2 (data from Maldonado and Koether (1983) and Wood (2009)—continued</b>		
2,278.3–2,282.7	Tuff, bedded, reworked, pale purple and grayish-orange-pink, zeolitized, and argillized; conspicuous biotite phenocrysts; reddish-brown volcanic lithics, as large as 10 cm.	4.4
2,282.7–2,304.6	Tuff, ash-flow, very pale orange, nonwelded, devitrified, zeolitized; pumice, argillized, as large as 2 cm; approximately 5 percent phenocrysts consisting of quartz (some resorbed), sanidine, plagioclase and biotite; reddish-brown volcanic lithics common, and tuff lithics as large as 10 cm toward top of subunit.	21.9
2,304.6–2,307.0	Tuff, bedded, reworked, very pale orange; blocks of tuff and pale purple ash-fall tuff common; banding (lamination) present at 2,305.4–2,306.1 ft.	2.4
2,307.0–2,337.8	Tuff, ash-flow, very pale orange, nonwelded, devitrified, zeolitized; pumice, white, argillized, as large as 2 cm; approximately 5 percent phenocrysts consisting of quartz (some resorbed), sanidine, plagioclase, and biotite; reddish-brown volcanic lithics common, as large as 3 cm.	30.8
2,337.8–2,341.6	Tuff, bedded, reworked, very pale orange and pale yellowish-brown; individual beds range from 1-10 cm, and consist of reddish-brown and light gray volcanic lithics, rounded, as large as 2 cm, and pumice lithics, pale greenish-yellow, zeolitized, as large as 1 cm.	3.8
2,341.6–2,363.4	Tuff, ash-flow, moderate orange-pink, nonwelded, devitrified, zeolitized; pumice, white, argillized, as large as 7 cm, biotite in pumice more common; 5-10 percent phenocrysts of quartz (some resorbed), sanidine, plagioclase, and biotite (more biotite than above subunit); reddish-brown volcanic lithics common, as large as 2 cm.	21.8
2,363.4–2,365.6	Tuff, reworked, massive, yellowish-gray; contains pumice, pale greenish-yellow, zeolitized, as large as 1 cm, subrounded to rounded, and subrounded to rounded reddish-brown volcanic lithics, as large as 1 cm.	2.2
2,365.6–2,374.0	Tuff, ash-flow, moderate orange-pink, nonwelded, devitrified, zeolitized; pumice, white, argillized, as large as 4 cm; 5–10 percent phenocrysts of quartz (some resorbed), sanidine, plagioclase, and biotite; reddish-brown volcanic lithics common, as large as 2 cm.	8.4
2,374.0–2,374.3	Tuff, reworked, contains subrounded to rounded pumice, pale greenish-yellow, zeolitized, as large as 5 mm, reddish-brown volcanic lithics, as large as 5 mm.	0.3
2,374.3–2,379.4	Tuff, ash-flow, moderate orange-pink, nonwelded, devitrified, zeolitized; pumice, white, argillized, as large as 4 cm; 5–10 percent phenocrysts of quartz (some resorbed), sanidine, plagioclase, and biotite; reddish-brown volcanic lithics common, as large as 2 cm.	5.1
2,379.4–2,380.0	Tuff, reworked, massive, yellowish-gray; contains pumice lithics, zeolitized, pale greenish-yellow, as large as 5 mm, and subrounded to rounded reddish-brown volcanic lithics as large as 5 mm.	0.6
2,380.0–2,384.0	Tuff, ash-flow, moderate orange-pink, nonwelded, devitrified, zeolitized; pumice, white, argillized, as large as 5 cm; 5–10 percent phenocrysts of quartz (some resorbed), sanidine, plagioclase, and biotite; reddish-brown volcanic lithics common, as large as 1 cm.	4.0
2,384.0–2,385.2	Tuff, reworked, massive, very pale orange, contains pumice lithics, pale greenish-yellow, zeolitized, as large as 1 cm, and reddish-brown volcanic lithics, as large as 1 cm, subrounded to rounded.	1.2
2,385.2–2,576.7	Tuff, ash-flow, grayish-orange-pink to moderate orange-pink, nonwelded, devitrified, zeolitized; pumice, grayish-pink to grayish-orange-pink, argillized and zeolitized, as large as 5 cm; contains 5-10 percent phenocrysts of quartz (some resorbed), sanidine, plagioclase, and biotite; reddish-brown volcanic lithics common, as large as 2 cm.	191.5

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole USW G-2 (data from Maldonado and Koether (1983) and Wood (2009)—continued</b>		
2,576.7–2,587.9	Tuff, bedded, reworked, light brown, grayish-pink, and very light gray; individual beds range from 1 cm to 4.9 ft and contains pumice, pale greenish-yellow, zeolitized, as large as 2 cm, and reddish-brown and light gray volcanic lithics as large as 1 cm.	11.2
2,587.9–2,704.7	Tuff, ash-flow, pale red, and grayish-orange-pink, nonwelded to partially welded, devitrified, zeolitized; pumice, white, grayish-pink, argillized and zeolitized, biotite in pumice very common, as large as 3 cm; approximately 15–25 percent phenocrysts of quartz (some resorbed), sanidine, plagioclase, and biotite; reddish-brown volcanic lithics, as large as 5 cm; healed fracture toward base, dipping approximately 55 degrees, slickensides at approximately 2,703.7 ft. Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.	116.8
<b>Borehole USW G-4 (data from Spengler and Chornack (1984) and Wood (2009)</b>		
1,409.4–1,424.5	Top of Calico Hills section; Tuff, ash-flow, moderate orange-pink, moderate reddish-orange, and light brown, nonwelded, vitric (slightly zeolitic); pumice, grayish-orange, very pale orange, yellowish-gray, and medium-light gray, dominantly vitric, commonly range from 0.5–5 cm, as large as 11 cm, larger pumice fragments occur in upper 4 ft of unit; less than 2 percent phenocrysts (quartz, sanidine, plagioclase, and biotite); sparse grayish-red rhyolitic and grayish-black to medium gray, slightly altered, vitrophyric lithic fragments, commonly range in size from 3–35 mm; higher concentration of lithics in lower 6.5 ft of unit.	15.1
1,424.5–1,426.3	Tuff, bedded, reworked, moderate orange-pink, pale red, and grayish-orange-pink, moderately to highly indurated, zeolitic; dominantly composed of pumice, grayish-orange-pink and grayish-orange, zeolitic, subrounded, commonly less than 5 mm; abundant grayish-red rhyolitic lithic fragments, commonly less than 2 mm in size; individual beds range from 0.1–0.8 ft.	1.8
1,426.3–1,447.0	Tuff, ash-flow, grayish-orange, grayish-orange-pink, and moderate reddish-orange, nonwelded, zeolitic; pumice, very pale orange, grayish-orange-pink, moderate orange-pink, and yellowish-gray, zeolitic, commonly range from 3–35 mm, but as large as 5 cm; less than 2 percent phenocrysts (quartz, sanidine, and plagioclase); rare medium-dark gray and brownish-gray rhyolitic lithic fragments, commonly less than 5 mm, occasionally as large as 5 cm, larger fragments are commonly slightly altered vitrophyric fragments.	20.7
1,447.0–1,456.5	Tuff, reworked, ash-fall, bedded, light brown, pale red, grayish-orange-pink, and moderate orange-pink, moderately indurated, zeolitic and, in places, silicified; dominantly composed of pumice fragments having similar colors to those listed above, pumice commonly less than 1 cm in size, zeolitic; subordinate amounts of brownish-gray and medium gray rhyolitic lithic fragments, less than 1 cm in size; individual beds range in thickness from a few cm to 2.2 ft.	9.5
1,456.5–1,560.6	Tuff, ash-flow, moderate orange-pink, grayish-orange-pink, light brown, grayish-orange, and dusky-yellow, nonwelded, zeolitic (dominantly clinoptilolite); pumice, very pale orange, pale red, moderate pink, grayish-orange-pink, yellowish-gray, grayish-yellow, grayish-orange, zeolitic, commonly range from 0.2–4.5 cm; 1–3 percent phenocrysts (quartz, sanidine, plagioclase, and biotite); rare to sparse moderate brown and grayish-red rhyolitic lithic fragments, commonly less than 2 cm in size, slight increase in amount of lithics in lower 11 ft of unit; fault plane with slickensides present from 1,556.4–1,557.2 ft.	104.1
1,560.6–1,563.9	Tuff, ash-fall and reworked, moderate orange-pink and grayish-orange, moderately indurated, zeolitic; dominantly composed of pumice, grayish-yellow, grayish-orange-pink, dusky-yellow, and very pale orange, zeolitic, commonly less than 2 cm in size, subangular to subrounded, poorly sorted; subordinate amounts (10–20 percent) of volcanic lithic fragments, grayish-red, dark gray, and medium-light gray, subangular to subrounded, poorly sorted, range in size from 1–23 mm; lower 1.5 ft of unit contains minor amounts of lithics; individual beds range in thickness from 0.2–1.0 ft.	3.3

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole USW G-4 (data from Spengler and Chornack (1984) and Wood (2009)—continued</b>		
1,563.9–1,663.0	Tuff, ash-flow, grayish-orange, light brown, and moderate reddish-orange, and, in places, dark yellowish-brown, nonwelded, zeolitic (principally clinoptilolite and mordenite); pumice, very pale orange, grayish-yellow, dusky-yellow, moderate greenish-yellow, zeolitic, commonly range in size from 3–31 mm, as large as 57 mm; 1–2 percent phenocrysts (quartz, sanidine, and plagioclase); sparse (1–2 percent) rhyolitic lithic fragments, brownish-gray and brownish-black, commonly less than 1 cm in size; ash-fall parting, 1-cm thick, present at 1,606.8 ft, ash-fall parting, 6.3 cm in thickness present from 1,662.2–1,662.4 ft.	99.1
1,663.0–1,663.4	Tuff, ash-fall, moderate orange-pink and moderate reddish-brown, moderately to highly indurated, lower 3 cm of unit slightly silicified(?), zeolitic; dominantly composed of grayish-pink to moderate orange-pink, zeolitic, pumice fragments, subangular to subrounded, commonly less than 5 mm in size; rare grayish-red volcanic lithic fragments, commonly 1–3 mm in size; dominantly gradational bedding.	0.4
1,663.4–1,705.4	Tuff, ash-flow, moderate orange-pink, light brown, nonwelded, zeolitic; pumice, very pale orange, pale yellowish-orange, and grayish-yellow, zeolitic, commonly range in size from 2–38 mm; 1–3 percent phenocrysts (sanidine, plagioclase, quartz, and biotite); sparse brownish-gray and brownish-black volcanic lithic fragments, commonly less than 5 mm in size.	42.0
1,705.4–1,761.4	Tuff, ash-fall, reworked, tuffaceous sandstone, grayish-yellow, yellowish-gray, light brown, greenish-gray, moderate reddish-brown, dusky-yellow, pale yellowish-brown, grayish-yellow, zeolitic (in places, silicified), moderately to highly indurated; pumice, moderate orange-pink, grayish-pink, very pale orange, pale greenish-yellow, and grayish-yellow, zeolitic, commonly less than 5 mm in size; sparse to abundant brownish-black, brownish-gray, and medium gray rhyolitic lithic fragments, commonly less than 5 mm in size; individual beds range in thickness from a few cm to 5 ft; numerous silicified beds are present from 1,705.4–1,708.1 ft; basal part of unit, from 1,759.1–1,761.4 ft consists of well sorted, pale yellowish-brown to dark yellowish-brown tuffaceous sandstone, abundant biotite, individual beds range from 0.5–8.5 cm thick. Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.	56.0
<b>Borehole USW H-1 (data from Rush and others, 1983)</b>		
1,506.0–1,801.3	Top of Calico Hills section; Tuff, ash-flow, pink, nonwelded and zeolitized; pumice and volcanic lithic fragments common.	295.3
1,801.3–1,857.0	Tuff, bedded, pink, slightly indurated, zeolitized. Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.	55.8
<b>Borehole USW H-4 (data from Whitfield and others (1984) and Wood (2009)</b>		
1,317.0–1,572.0	Tuff, ash-flow, moderate orange-pink, very pale orange, and grayish-yellow, nonwelded to partly welded, devitrified and zeolitized(?), upper 36.1 ft silicified(?); pumice, white, pink, and grayish-yellow, zeolitized(?); less than 1 percent phenocrysts (quartz and biotite); abundant light gray and medium-light gray, and grayish-red rhyolitic lithic fragments. Sidewall samples collected at 1,312.0 ft, 1,419.9 ft, 1,453.1 ft, and 1,549.9 ft; all sidewall samples vary in color; in descending order, colors include very pale orange, grayish-orange-pink and light brown; all samples are nonwelded, zeolitized(?), and partly silicified; sample at 1,419.9 ft indicates a decrease in degree of silicification.	255.0
1,572.0–1,626.9	Tuff, bedded, reworked, yellowish-gray, pale reddish-brown, grayish-yellow, devitrified & zeolitized(?); lower 15.1 ft, pale red, highly silicified. Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.	54.9

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole USW H-5 (data from Bently and others (1983) and Wood (2009))</b>		
1,705.0–1,879.9	Top of Calico Hills section; Tuff, ash-flow, very pale orange, white, and moderate orange-pink, non-to-partially welded, vitric; pumice, white, vitric; less than 5 percent phenocrysts (sanidine, plagioclase, quartz, and biotite); black, glassy lithic fragments are common; in television-camera log, top of a lithic-rich zone was recognized at 1,732.9 ft, and bedding planes were recognized at 1,745.1 ft, 1,748.0 ft, 1,753.9 ft, 1,755.9 ft, 1,774.9 ft, and 1,798.9 ft; sidewall samples collected at 1,762.1 ft, 1,799.9 ft, 1,852.0 ft, and 1,875.0 ft.	174.9
1,879.9–1,944.9	Tuff, bedded, reworked, ash-fall(?), yellowish-gray, zeolitic; subequal proportions of phenocrysts and subrounded pumice fragments; in television-camera log, a coarse pumice ash-fall was identified at 1,880.9 ft, and bedding planes were recognized at 1,879.9 ft, 1,880.9 ft, 1,885.8 ft, 1,892.1 ft, 1,894.0 ft, 1,895.0 ft, 1,899.0 ft, 1,903.9 ft, 1,908.1 ft, 1,911.1 ft, 1,913.1 ft, 1,920.9 ft, and 1,935.0 ft; sidewall sample collected at 1,917.0 ft contains about 25 percent phenocrysts of sanidine, plagioclase, quartz, and biotite in a zeolitic groundmass. Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.	65.0
<b>Borehole USW H-6 (data from Craig and others (1983) and Wood (2009))</b>		
1,356.0–1,458.0	Top of Calico Hills section; Tuff, ash-flow, moderate reddish-orange, light brown, non-to-partially welded, vitric; pumice, grayish-orange-pink, light gray, very light gray, yellowish-gray, vitric, particles range in size from 3-60 mm; less than 2 percent phenocrysts (sanidine); sparse brownish-gray rhyolitic lithic fragments and light gray to black vitrophyre lithic fragments. (Bedded tuff interval from 1,418.0-1,418.6 ft, moderate pink to grayish-orange-pink, moderately indurated, vitric, dominantly pumice fragments, rare brownish-gray, rhyolitic lithic fragments). (Television camera videotape observations suggest the base of the interval is 1,458.0 ft).	102.0
1,458.0–1,508.0	Tuff, bedded, reworked, moderate orange-pink, grayish-yellow, pale yellowish-brown; dominantly zeolitic and argillic pumice fragments; lower 9.8 ft well sorted. Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.	50.0
<b>Borehole USW SD-6 (data from Wood, 2009)</b>		
1,479.9–1,561.0	Calico Hills Formation; undifferentiated [Generic description based on geophysical log correlations]	81.1

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole USW SD-9 (data from Engstrom and Rautman (1996b), Moyer and others (1995), and Wood (2009))</b>		
1,479.9–1,586.1	<p>Top of Calico Hills section; Ashflow Unit 3 of Moyer and Geslin (1995) - Sharp but irregular contact, weakly reworked zone (possible paleosol) at top, light orange-gray light porous microgranular (sandy) texture, partially clast-supported, 7–10 percent white porcellaneous subangular rhyolite lithics averaging 5–6 mm, 3–5 percent dark quartz latite subangular hard lithics 2–3 mm associated with abundant Mn oxide, some are vitric (obsidian), 5–7 percent cognate vesicular pumice altered to zeolite, 1–2 percent quartz, sanidine and biotite, with rare sericitic mica. At 1,483.7 ft increase in dark lithic content to 5–7 percent, at 1,485.9 ft light pink white with increased lithic size and content, average rhyolite lithic 6–8 mm average quartz latite lithic 4–5 mm. At 1,487.6 ft 1–3 percent mixed composition angular-to-subangular lithics averaging 3–4 mm size, become 3–5 percent mostly vitric quartz latite averaging 5–7 mm. Below 1,500 feet, 35–40 percent slightly elongate light orange-pink pumice averaging 10–12 mm of which 5 percent are zeolitic, groundmass dense zeolitic altered, porous, microcrystalline grading to slightly porcellaneous in spots. Below 1,540 ft, pale orange-pink nonwelded, zeolitic, 12–15 percent large very light pink pumice up to 35 mm, many pumice vitric with stretched texture, 40 percent smaller cellular pumice from very pale green to totally zeolitized, 2–5 percent dark red-brown angular crystal-rich quartz latite lithics average 5 mm size, groundmass less than 1 percent quartz or sanidine phenocrysts and zeolitized to pink micro-crystalline which obliterates much of original texture but preserves cellular structure of pumice cores. From 1,479.9–1,586.1 ft, zeolitization increases downward, noticeably stronger below 1,572.0 ft. From 1,572.0–1,574.0 ft crowded large lithic subzone, slight increase in zeolitic alteration. From 1,584.9–1,586.1 ft lithic-rich pumice fallout subzone, increase in zeolitic alteration to deep pink, lithics average 2–3 mm.</p>	106.2
1,586.1–1,737.5	<p>Ashflow Unit 2 of Moyer and Geslin (1995) - pale orange-pink, nonwelded, zeolitic-altered matrix, 15 percent to 25 percent light orange pumice up to 20 mm size, some pumice are vitric with stretched fabric, 1–2 percent lithics composed of red-brown or red-orange fragments of varying compositions, 1–2 percent quartz sanidine and lesser biotite phenocrysts. Interval between 1,602 to 1,604.5 strongly zeolitized, especially pumice; groundmass pale green-yellow. Blow 1,610 ft heavily zeolitized matrix, very pale red-gray nonwelded, color darkens downward, 15–30 percent pale yellow-orange pumice generally less than 15 mm, but ranges from microscopic up to 65 mm, 2–4 percent red-brown lithics of varying compositions, 1–2 percent sanidine, quartz and lesser biotite phenos. From 1,616.5–1,617.0 ft, heavily zeolitized. Below 1,680 ft, very pale red-gray, heavily zeolitized non-welded matrix, 15–30 percent pale yellow to orange pumice generally 8 mm, but ranges from 2 to 35 mm, 2–3 percent red-brown subround quartz latite lithics of varying textures, 1–2 percent quartz, sanidine and biotite phenos, thin pumice or ashfall bedding breaks at 1,685.2, 1,704.0, 1,708.5, 1,723.3 and 1,735.0 ft. At 1,723.3 ft, bedding break, dense 30 mm weakly porcellaneous salmon-pink clay layer. At 1,350.0 ft, basal ash falls and pumice falls; cm-thick beds, porcellaneous textured ash fall, clast-supported pumice fall with clasts less than 15mm diameter, 3–5 percent lithics with up to 10 percent locally.</p>	151.4
1,737.5–1,764.4	<p>Ashflow Unit 1 of Moyer and Geslin (1995) - pale gray-orange nonwelded, highly zeolitized altered matrix, 15–25 percent yellow-gray (5Y8/1) pumice generally less than 20 mm, 3–5 percent phenocrysts of quartz, sanidine, biotite, 3–5 percent red-brown lithics of varying composition and texture, averaging less than 5 mm but may be up to 18 mm. Below 1,750 ft, pale gray-orange nonwelded, highly zeolitized altered matrix, 20–30 percent gray- yellow pumice generally less than 20 mm, 7–10 percent quartz, sanidine, lesser biotite phenocrysts, 10–15 percent medium red-brown lithics that average 8 mm but can be up to 20 mm.</p>	26.9
764.4–1,803.4	<p>Bedded tuff unit of Moyer and Geslin (1995) - heavily zeolitized ash-flow tuff containing 7–10 percent white pumice fragments, 10–15 percent quartz, feldspar, and minor biotite phenocrysts, 10 percent small red-brown lithic clasts in upper 3.8 ft. Remainder of deposit composed of zeolitized pumice-fall or ash-fall. Coarse-grained pumice falls cored between 1,775.1–1,799.4 ft.</p>	39.0
1,803.4–1,820.7	<p>Basal tuffaceous sandstone of Moyer and Geslin (1995) - Red-brown, immature, tuffaceous sandstone. Upper part of unit to depth of 1,810.7 ft characterized by intervals of subrounded, reworked pumice clasts in pale red-brown sandstone. Separated from lower part of unit by thin, dark red-brown sandstone bed exhibiting load casts at 1,811.5 ft. Lower sandstone interval pale-red-brown and contains 5–10 percent altered pumice fragments. Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.</p>	17.3

Depth below land surface (feet)	Lithologic description	Interval thickness (feet)
<b>Borehole USW SD-12 (data from Engstrom and Rautman (1996a), Moyer and others (1995), and Wood (2009))</b>		
1,411.5–1,475.0	Top of Calico Hills section; Ashflow Unit 4 of Moyer and Geslin (1995) - Light pink-orange, nonwelded, zeolitized, vitric; 20 percent-25 percent large (to 40mm) orange-brown umice clasts , 15–25 percent lightgray vitric lithic fragments (2–20mm) with biotite flakes, 1–2 percent subangular hard lithics including dark-gray vitric and red-brown devitrified volcanic varieties, both porphyritic and pumiceous; 1–2 percent quartz eyes, 2–3 percent feldspar phenocrysts, and 1–2 percent biotite flakes. Groundmass almost totally recrystallized to zeolite; pumice and vitric lithics 25–30 percent are partially zeolitized. At 1,447.0 ft pumice and lithics become less crowded, content decreases to 10–20 percent smaller pumice, 7–10 percent smaller lithics. Below 1,447.0 ft, weakly vapor-phase altered, intensity increases downward toward the bedded interval. At 1,448.0 ft, matrix color begins to lighten, becoming pale pink-gray by 1,467.0 (possibly less zeolitic alteration or more vapor phase alteration?). Below 1,470, light-medium brown, sandy, clast-supported bedded tuff, nonwelded, zeolitized; 10–20 percent small light pink angular lithics less than 7mm, 5–7 percent small dark vitric lithics, 1–2 percent angular 2–3 mm red-brown devitrified volcanic lithics, 1–3 percent phenocrysts of quartz, feldspar, and biotite, in zeolitized sandy, ashy matrix; from 1,471.6–1,471.8 ft, white pumice fall, larger clasts to 10– 15 mm. From 1,471.8–1,472.6 ft, recovered medium brown sand.	63.5
1,475.0–1,554.0	Ashflow Unit 3 of Moyer and Geslin (1995) - sandy, reworked top (possible paleosol). Pale pink-gray, nonwelded, lithic-rich, vitric, zeolitized; 20–40 percent mixed-composition lithic clasts with some up to 70 mm, that include red-brown or black devitrified volcanic, black vitric (obsidian), and less common red-orange pumiceous tuff varieties (to 2–50 mm), large complex composition lithics contain fragments of other volcanic rock types, large lithics decrease in number down to 1505.0 ft, 20–30 percent pale pink pumice up to 10–12 mm, 2–3 percent quartz, feldspar, and biotite. From 1,544.0–1,563.0 ft, argillic alteration, up to 40–50 percent replacement by white clay. From 1,549.4–1,557.1 ft, color lighter; pumice content increases.	79.0
1,554.0–1,599.5	Ashflow Unit 2 of Moyer and Geslin (1995) - Pale orange-pink, nonwelded, vitric, zeolitized; 20–40 percent pale yellow-green to white pumice less than 20 mm, 1–3 percent small black and brown and rare red-orange tuffaceous devitrified volcanic lithics, 1–6 percent quartz, feldspar, biotite phenocrysts. Lithics increase in number to 3–5 percent around 1,590.0 ft. Below 1,598.0 ft, increase in light pink or yellow subangular pumice up to 15 mm. Between 1,599.1–1,600.6ft is basal bedded interval of Unit 2; sandy, pumiceous, bedded tuff with 50 percent small white pumice clasts, 15 percent small dark lithics, 2–3 percent quartz, feldspar and biotite phenocrysts in fine-grained sandy-ashy matrix. At 1,600.3 moderately zeolitized, porcelaneous, cm-thick ash-fall interval.	45.5
1,599.5–1,611.6	Ashflow Unit 1 of Moyer and Geslin (1995) - Pale pink-brown, nonwelded, vitric, zeolitized, somewhat sandy reworked texture; 5–10 percent pale yellow gray pumice less than 10 mm, 3–5 percent red-brown devitrified volcanic lithics, 5–10 percent quartz, feldspar, biotite phenocrysts. Between 1,601.5–1,602.0 ft, pumice fall with 60 percent pale yellow pumice, 10 percent small dark devitrified volcanic lithics. Between 1,602.0 –1,6078.1 ft, pink, sandy, clast-supported bedded tuff, grades into ash-flow tuff with sandy-ashy matrix, which grades into basal pumice fall. Between 1,607.1–1,611.6 - ash-flow tuff, fine-grained, sandy; intensely zeolitized, overall pale yellow-green color. Base of Calico Hills section; unit overlies Prow Pass Tuff of the Crater Flat Group.	12.1
<b>Borehole USW WT-24 (data from Wood, 2009)</b>		
1,768.8–2,834.0	Calico Hills Formation, undifferentiated. [Generic description based on geophysical log correlations]	1,065.2