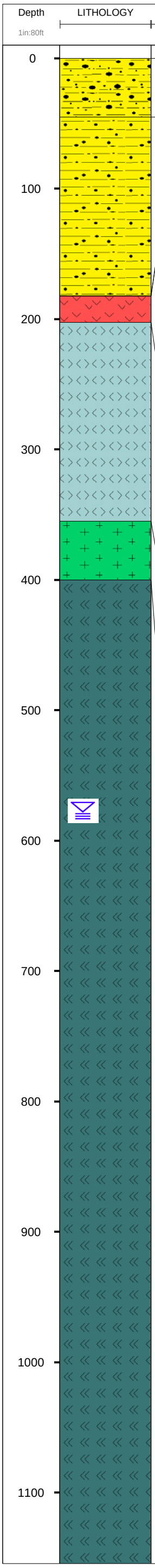
Nye County Early Warning Drilling Program

Summary Lithologic Log

BOREHOLE ID: NC-EWDP-27P



DESCRIPTION

(0 to 45 feet [ft]) WELL-GRADED SAND WITH SILT, CLAY AND GRAVEL (SW-SM/SC):
The interval consists almost totally of layers of well-graded sand with silt, clay and gravel (SW-SM/SC). Fines display no plasticity. Gravel clasts are volcanic in origin, with grain shape predominantly subrounded and locally subangular. Sediment colors range from predominantly reddish gray (5YR 5/2) to yellowish brown (10YR 5/4). No cementation is observed. Sediments react strongly to 10 percent (%) hydrochloric acid (HCl). All samples are dry.

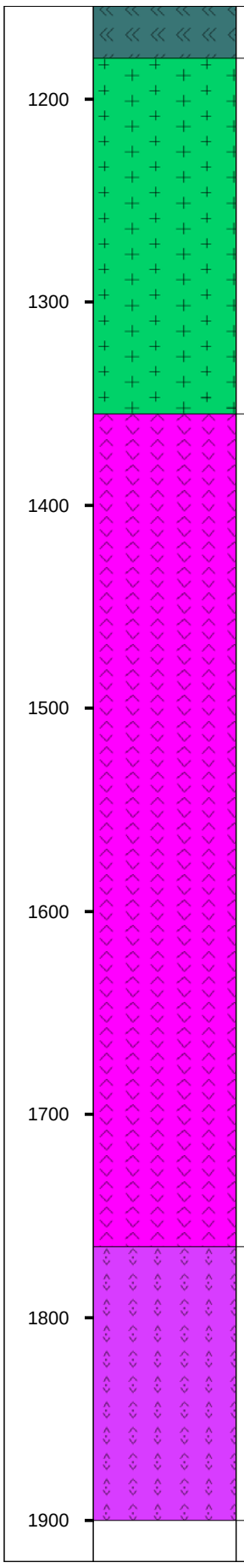
(45 to 182.5 ft) SILTY, CLAYEY SAND WITH GRAVEL (SM/SC):
The interval consists primarily of layers of silty, clayey sand with gravel (SM/SC). A layer of sandy clay with gravel (CL) occurs from 132.5 to 135 ft. Fines display no plasticity from 45 to 170 ft, and no to moderate plasticity from 170 to 182.5 ft. Gravel clasts are volcanic in origin and predominantly rounded. A zone of subrounded to subangular gravel clasts is observed from 50 to 57.5 ft. Sediment colors range from predominantly yellowish red (5YR 5/6) to reddish brown (5YR 5/4), reddish gray (5YR 5/2), dark grayish brown (10YR 4/2), and yellowish brown (10YR 5/4). No cementation is observed. Sediments react strongly to 10% HCl. Samples are dry from 45 to 160 and 175 to 180 ft, moist from 170 to 175 and 180 to 182.5 ft, and wet from 160 to 170 ft.

(182.5 to 202.5 ft) ASH-FALL TUFF (RAINIER MESA TUFF):
The tuff is moderate orange pink (5YR 8/4), nonwelded, and vitric with an open/porous matrix. The unit appears slightly weathered throughout the interval. The upper section from 182.5 to 195 ft may be intercalated with alluvium. The tuff contains 40 to 50% light brown (5YR 5/6) glassy pumice clasts up to 12 millimeters (mm) in diameter, 2% grayish brown (5YR 3/2) lithic clasts up to 3 mm in diameter, 5% very light gray (N8) quartz phenocrysts up to 3 mm in long, 5% pale greenish yellow (5Y 8/1) feldspar phenocrysts up to 3 mm long, and 2 to 4% black (N1) biotite phenocrysts up to 2 mm long. The tuff unit is an unconsolidated, ash-rich air fall that may be a pre-Rainier Mesa tuff unit. The base lies in sharp contact with the underlying ash-flow tuff.

(202.5 to 355 ft) ASH-FLOW TUFF (TIVA CANYON TUFF):
Tuff colors range from grayish brown (5YR 3/2) to medium gray (N5) to dark yellowish orange (10YR 6/6). The tuff is nonwelded to densely welded and devitrified. The tuff is slightly weathered from 202.5 to 212.5 ft. The matrix is dense/nonporous, except for the nonwelded base from 350 to 355 ft, which has an open/porous matrix. Three zones are distinguished and defined by the degree of welding and devitrification. The color changes correspond closely with the zones, which are as follows:
202.5 to 339 ft (LOWER NONLITHOPHYSAL ZONE): The zone is grayish brown (5YR 3/2), weakly to moderately welded, and devitrified. The zone contains 0 to 1% light gray (N7) pumice clasts up to 2 mm in diameter; up to 5% light gray (N7) lithic clasts up to 2 mm in diameter; up to 2% colorless quartz phenocrysts up to 2 mm in diameter, decreasing with depth; up to 3% colorless and light gray (N3) feldspar phenocrysts, predominantly sanidine; and 1 to 3% mafic minerals, mostly altered bronze biotite. The base of the zone from 325 to 339 ft is spherulitic and grades into the underlying densely welded vitrophyre.
339 to 349 ft (BASAL VITROPHYRE): The zone is medium gray (N5), densely welded, vitric, and displays perlitic textures. The unit contains 1% medium light gray (N6) feldspar. No pumice or lithic fragments are observed. A thin, blackish-brown clay zone is present from 348.5 to 349 ft.
349 to 355 ft (NONWELDED BASAL ZONE): The zone is dark yellowish orange (10YR 6/6), nonwelded, and devitrified. The unit is crystal- and fragment-poor, has a devitrified, ashy matrix, and contains "root beer bottle" glass shards. This zone lies in sharp contact with the underlying ash-fall tuff.

(355 to 400 ft) ASH-FALL TUFF (PRE-TIVA CANYON TUFF):
The tuff is dark yellowish orange (10YR 6/6) from 355 to 375 ft and dusky yellow (5Y 6/4) from 375 to 400 ft. The unit is nonwelded and vitric with an open/porous matrix. The upper section from 355 to 375 ft is pumice-rich and contains 50% light yellowish gray (5Y 8/1) pumice clasts up to 20 mm in diameter. At 375 ft, pumice content and size decrease to 10% and 3 mm in diameter, respectively. The unit contains 1 to 3% light gray (N6) lithic clasts in the upper pumiceous section; up to 2% quartz phenocrysts up to 2 mm in diameter, some opalescent; 1 to 3% greenish gray (5GY 5/1) mafic minerals; and up to 2% colorless feldspar phenocrysts. Lithics become highly variable in color below 375 ft. This unit lies in sharp contact with the underlying ash-flow tuff.

(400 to 1,180 ft) ASH-FLOW TUFF (TOPOPAH SPRING TUFF):
Six zones are identified in this unit and defined primarily by degree of vapor-phase alteration, degree of devitrification, and presence or absence of lithophysae. The matrix is dense/nonporous, except for the interval from 400 to 415 ft, which has an open/porous matrix. Samples are wet beyond 600 ft. Individual zones and colors are described below.
400 to 600 ft (UPPER NONLITHOPHYSAL ZONE): The zone color is variable and appears to be related to the degree of welding in the rock. Colors vary from light brownish gray (5YR 6/1) in the nonwelded top from 400 to 415 ft, to brownish gray (5YR 4/1) in the weakly and moderately welded section from 415 to 470 ft, to moderate brown (5YR 4/4) in the densely welded section from 470 to 600 ft. The zone is devitrified, except at 470 and 495 ft, where minor vapor-phase alteration is present. At 465 ft, calcite coatings appear on cooling joint faces. Pumice is largely absent except at 465 ft, where a few clasts appear that also contain trace biotite. There are 1 to 2% black (N1) and grayish black (N2) lithics from 400 to 500 ft. At 465 ft, pink reaction halos surround the lithic clasts. No lithic clasts are observed below 500 ft. The zone is crystal-poor, with 1% feldspar phenocrysts, trace quartz phenocrysts, and 1% mafics from 470 to 535 ft.
600 to 665 ft (UPPER LITHOPHYSAL ZONE): The zone colors range from moderate brown (5YR 4/4) to grayish red (10R 4/2) to pale brown (5YR 5/2) and contain 15 to 20% light gray (N8) to pinkish gray (10R 8/2) vapor-phase alteration as spots and rims on lithophysae. Lithophysae content varies from 10 to 15% throughout most the interval and decreases to 5% near the base, and are typically less than 10 mm long in drill cuttings. The zone is densely welded, contains no pumice or lithics, and is crystal-poor, with 1% quartz, 1% sanidine feldspar, and no mafics. A few sanidine phenocrysts are enveloped by vapor-phase mineralization. The lower contact is gradational with the underlying nonlithophysal zone.
665 to 740 ft (MIDDLE NONLITHOPHYSAL ZONE): The zone is pale brown (5YR 5/2), densely welded, and devitrified. Some clasts display spherulitic texture. Vapor-phase alteration and lithophysae are rare to absent. The zone contains no pumice, no lithics, and is crystal-poor, with 1% quartz, 1% mafics, and 1% feldspar. Fractures are typically smooth and planar and a few have a thin, 1-mm calcite coating. The lower contact is sharp with the underlying lithophysal zone.
740 to 1,015 ft (LOWER LITHOPHYSAL ZONE): The zone is mottled moderate brown (5YR 3/4), yellowish brown (10YR 5/2) and densely welded. Vapor-phase alteration comprises 20% of the zone and is present as very light gray (N7) to pale grayish red (10R 6/1) spots, streaks, veinlets, fracture surfaces, and lithophysal cavity coatings. Lithophysae comprise less than 5% of the zone and are elongate, with major axes typically less than 10 mm in drill cuttings. During borehole advancement in this zone, the driller reported numerous cavities up to 2 ft wide. Pumice is absent and small lithic clasts less than 5 mm long comprise less than 1% of the rock and have black (N1), glassy textures. Very light gray (N7) reaction rims surround a few lithic clasts and extend into the matrix 3 to 5 mm. The zone is crystal-poor with 1% anhedral quartz, rare biotite, and 1% feldspar. Euhedral sanidine is the predominant feldspar and is less than 3 mm long. Fractures are smooth and planar. The lower contact of the zone is gradational with the underlying nonlithophysal zone.
1,015 to 1,062 (LOWER NONLITHOPHYSAL ZONE): The zone grades downward from moderate brown (5YR 3/4) to a mottled light brown (5YR 5/6) and grayish brown (5YR 3/2) below 1,045 ft. The tuff is densely welded and devitrified. A remnant shard texture occurs throughout and is best preserved in the upper section where mottling has not obscured it. Vapor-phase mineralization is present in minor amounts and occurs as very thin, less than 1 mm veinlets and small, diffuse blebs. The rock tends to break along the veinlets. Pumice and lithic clasts are absent. Phenocrysts comprise 1% of the rock and consist of sanidine feldspar and quartz. Fractures are rough and irregular. The lower contact is sharp with the underlying zone.
1,062 to 1,180 ft (BASAL VITROPHYRE): Three subunits are distinguished in this zone and defined by degree of welding and devitrification. From 1,062 to 1,082 ft, the rock is composed of densely welded, dark gray (N3) and black (N1) glass. From 1,082 to 1,142 ft the rock is devitrified, moderate brown (5YR 3/4), and moderately welded. Devitrified, moderate orange pink (10R 7/4) pumice clasts begin appearing in this middle subunit, which contains up to 10% lithics composed of devitrified, crystal-poor volcanic clasts that are medium dark gray (N4) from 1,082 to 1,100 ft and varied in color from 1,100 to 1,142 ft. From 1,142 to 1,180 ft, the rock is devitrified, light brown (5YR 6/4), and nonwelded. Pumice clasts are undeformed in this lower subunit. Phenocrysts were observed only from 1,075 to 1,080 ft, where trace sanidine and rare biotite phenocrysts occur. The rock breaks along smooth irregular fractures, a few of which have thin coatings of pale-blue vapor-phase mineralization. The lower contact is sharp with the underlying ash-flow tuff.



(1,180 to 1,355 ft) REWORKED ASH-FLOW TUFF, VOLCANICLASTIC SANDSTONE, AND ASH-FLOW TUFF (PRE-TOPOPAH SPRING BEDDED TUFF):
The formation is light brown (5YR 6/4, 5/6) and becomes orange pink (5YR 8/4) and pale orange (10 YR 8/3) below 1,315 ft. Volcanic units are nonwelded, with an open/porous matrix. The formation is comprised of three units: an upper, reworked ash-flow sequence from 1,180 to 1,265 ft; a middle, immature volcaniclastic conglomeratic sandstone from 1,265 to 1,315 ft that grades downward into volcaniclastic sandstone from 1,315 to 1,325 ft; and an altered, basal, reworked ash-flow tuff from 1,325 to 1,355 ft. The formation is highly weathered and the ashy matrix material is argillic and poorly recovered. The upper units from 1,180 to 1,325 ft are compositionally related and represent volcaniclastic reworking of a felsic pumice- and lithic-rich ash-flow sequence. The textural and compositional maturity of the sedimentary units increases with depth. The upper reworked tuff from 1,180 to 1,265 ft is phenocryst-poor and contains 10 to 25% variably colored lithic clasts, including glassy porphyritic lava flow fragments. The matrix ash is essentially non-recovered. The reworked tuff grades into volcaniclastic conglomeratic sandstone at approximately 1,265 ft. The matrix material becomes clastic, well-sorted, and rounded. The volcaniclastic sandstone consists of well-sorted, sand-sized grains of reworked phenocrysts of quartz and feldspar, pumice, and lithic clasts. The basal unit from 1,325 to 1,355 ft consists of an argillically altered reworked tuff with poor recovery of an altered ashy component. The reworked tuff contains 10% white (N9) pumice clasts up to 3 mm in diameter, 5% variably colored lithic clasts up to 2 mm in diameter, 5% light gray (N7) quartz phenocryst up to 1 mm in diameter, 2% white (N9) feldspar phenocrysts, and 1% grayish black (N2) biotite phenocrysts. The rock is in sharp contact with the underlying ash-flow tuff.

(1,355 to 1,765 ft) ASH-FLOW TUFF (PROW PASS TUFF):
The tuff ranges in color from grayish orange pink (5YR 7/2) from 1,355 to 1,500 ft, light brownish gray (5YR 6/1) from 1,500 to 1,585 ft, light gray (N7) from 1,585 to 1,630 ft, pinkish gray (5YR 6/1) from 1,630 to 1,645 ft, reddish pink (5YR 6/4, 7/4) from 1,645 to 1,655 ft, grayish orange (10YR 8/3, 7/3) from 1,655 to 1,760 ft and reddish brown (10YR 4/6) from 1,760 to 1,765 ft. The tuff is nonwelded from 1,355 to 1,500 ft, weakly to moderately welded from 1,500 to 1,640 ft, and nonwelded below 1,640 ft. The tuff is devitrified throughout the interval, with weakly developed vapor-phase alteration from 1,400 to 1,415 ft and 1,450 to 1,455 ft. The tuff unit is moderately weathered from 1,355 to 1,400 ft, slightly weathered from 1,400 to 1,500 ft and unweathered from 1,500 to 1,760 ft. The basal contact zone from 1,760 to 1,765 ft is highly weathered and oxidized. The tuff matrix is open/porous except from 1,635 to 1,675 ft, where it displays a dense/nonporous matrix due to zeolitic alteration. Based on color, phenocrysts, lithic clast type, and geophysical response (i.e. gamma, resistivity, sonic, and density), the tuff is divided into an upper ash-flow unit from 1,355 to 1,630 ft and a lower ash-flow unit from 1,630 to 1,765 ft. The upper unit is generally pumice-poor, with up to 1% light gray (N7) and pinkish gray (5YR 8/1) pumice clasts up to 8 mm in diameter. Two sections are pumice-rich. From 1,400 to 1,440 ft, the upper unit has 5 to 30% light gray (N7) pumice clasts up to 15 mm in diameter and from 1,560 to 1,630 ft the unit has 5 to 15 % pinkish gray (5YR 8/1) and pale orange (10YR 8/2) pumice clasts up to 10 mm in diameter. The upper unit contains 1 to 25% variably colored, mostly dark gray (N3) and brown (5YR 6/1) lithic clasts up to 15 mm in diameter and locally distinctive dark red (5R 2/6) siltstone lithic clasts up to 25 mm in diameter. The upper unit is generally phenocryst-poor and contains 1% colorless and very light gray (N8) quartz phenocrysts up to 3 mm in diameter from 1,480 to 1,520 ft, up to 2% colorless, predominantly sanidine, feldspar up to 3 mm long, and locally up to 2% grayish black (N2) and bronze biotite up to 3 mm long. The lower unit from 1,630 to 1,765 ft is pumice- and lithic-rich, which imparts a distinctive punky texture that is especially well-developed between 1,660 and 1,720 ft. The lower unit contains 5 to 30% variably colored pumice clasts, predominantly grayish yellow (5Y 8/4) and yellowish orange (10YR 8/6) up to 12 mm in diameter, and 5 to 40% variably colored brown (5YR) and reddish brown (5R) lithic clasts, including siltstone, up to 10 mm in diameter. The lower unit also contains 1% colorless and very light gray (N8) quartz phenocrysts up to 2 mm in diameter from 1,640 to 1,670 ft and 1,700 to 1,735 ft, 2 to 5% colorless feldspar phenocrysts up to 3 mm long, and locally 1% grayish black (N2) biotite up to 1 mm long. Zeolitic alteration in the upper section of the lower unit from 1,645 to 1,655 ft replaces pumice clasts and matrix and imparts a reddish pink (5R 3/4, 5R 8/4) color to the zone. The basal zone from 1,760 to 1,765 ft is strongly oxidized and reddish brown (10YR 7/3, 10YR 4/6). The lower contact with the underlying ash-flow tuff is sharp.

(1,765 to 1,900 ft Total Depth) ASH-FLOW TUFF (BULLFROG TUFF):
This tuff ranges in color from light brownish gray (5YR 6/1) from 1,765 to 1,855 ft to moderate brown (5YR 3/4) below 1,855 ft. The tuff is weakly welded from 1,765 to 1,815 ft, moderately welded from 1,815 to 1,885 ft, and densely welded from 1,885 to 1,900 ft. The tuff matrix is devitrified, with weak vapor-phase alteration beginning at 1,800 ft and increasing with depth. The tuff is unweathered, except for a slightly weathered 5-ft interval from 1,765 to 1,770 ft at the top of the unit. The tuff has an open/porous matrix from 1,765 to 1,815 ft and a dense/nonporous matrix below 1,815 ft. The tuff can be informally divided into an upper lithic-rich and crystal-poor zone from 1,765 to 1,830 ft and a lower crystal-rich zone from 1,830 to 1,900 ft. The tuff contains 1% light brownish gray (5YR 6/1) to grayish red (5R 4/2) to light gray (N7) pumice clasts up to 10 mm in diameter from 1,800 to 1,855 ft; 1 to 3% black (N2) and brown (5YR 3/4) lithic clasts up to 5 mm in diameter; 1 to 2% light gray (N8) to dark gray (N4) quartz phenocrysts up to 2 mm in diameter from 1,775 to 1,900 ft; 1 to 2% colorless feldspar, mostly sanadine, phenocrysts up to 3 mm long from 1,765 to 1,830 ft, increasing to 8 to 10% beyond 1,830 ft; and 1 to 3% black (N2) and bronze biotite up to 4 mm long. Scattered weak reaction to 10% HCl is observed from 1,840 to 1,845 ft and 1,890 to 1,900 ft.