



DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

HUMAN-MADE DEPOSITS

- af** **Artificial fill (latest Holocene)** — Riprap, engineered fill, and refuse placed during construction of roads, railroads, buildings, dams, and landfills. Generally consists of unsorted silt, sand, clay, and rock fragments. The average thickness of the unit is less than 20 feet. Artificial fill may be subject to settlement, slumping, and erosion if not adequately compacted.
- dr** **Disturbed and/or reclaimed ground (latest Holocene)** — Waste rock, sediment, and fill materials where land has been disturbed by gravel pit operations. Generally consists of unsorted silt, sand, clay, and small rock fragments. The thickness of this unit typically exceeds 10 feet. The fill material may be subject to settlement, slumping, and erosion if not adequately compacted.

ALLUVIAL DEPOSITS

- Qs** **Alluvium one (late Holocene)** — Tan to pale-brown, poorly to moderately sorted, poorly to moderately consolidated, sand, gravel, silt, and minor clay and sparse boulders in the currently active stream channels or in low stream-terrace deposits less than 5 feet higher than the current stream channel. Clasts are subrounded to well rounded and the dominant sediment is sandy gravel with a sandy silt matrix. The unit correlates with the Post-Piney Creek alluvium described by Hunt (1954) in the Denver area and of Maberry and Lindvall (1972). The unit is subject to frequent flooding and is a source of sand and gravel. Maximum exposed thickness of the unit locally exceeds 5 feet.
- Qs<sub>2</sub>** **Alluvium two (late Holocene)** — Dark-gray to brown, poorly to well-sorted, moderately to well-consolidated, silt, sand, gravel, and minor clay and sparse boulders in stream-terrace deposits approximately 6-12 feet higher than the modern flood plain or as non-terrace forming alluvium in valley headwaters. Clasts are subrounded to well rounded and the dominant sediment is sandy gravel with a silty sand matrix. Thinly-bedded (1-4 in thick) clay seams are present in the lower parts of the unit. The unit is generally correlative, by virtue of height and soil characteristics, with the Piney Creek alluvium described by Hunt (1954) in the Denver area and of Maberry and Lindvall (1972). The unit is subject to occasional flooding and is a potential source of sand and gravel. Maximum exposed thickness of the unit locally exceeds 20 feet.
- Qs<sub>3</sub>** **Alluvium three (late Pleistocene)** — Dark-brown to grayish-brown, poorly sorted, moderately consolidated, poorly to moderately stratified silt, sand, gravel, and cobbly gravel and sparse boulders in stream terrace deposits approximately 10-20 feet higher than the modern flood plain or as non-terrace forming alluvium in valley headwaters that underlies the younger alluviums. The unit contains dark-gray clay beds that may be expansive. Clasts are subrounded to well rounded and the dominant sediment is sandy gravel with a sandy matrix. The unit is generally correlative, by virtue of height and soil characteristics with the Broadway Alluvium described by Hunt (1954) in the Denver area and of Maberry and Lindvall (1972). The unit is a potential source of sand and gravel. Maximum exposed thickness of the unit locally exceeds 20 feet.
- Qau** **Alluvial deposits, undivided (Holocene to late Pleistocene)** — Gray-brown to tan-brown, poorly sorted sand and fine gravel in valley heads in the upper parts of drainages and in main trunk streams where differentiation of specific alluvial units was not possible due to poor exposure. The unit includes sheetwash and stream-deposited alluvium that are undivided. The unit may be overlain by thin laminae of eolian sand. Maximum exposed thickness of the unit locally exceeds 15 feet.
- Qf<sub>1</sub>** **Alluvial fan deposit one (late Holocene)** — Tan to pale-brown, poorly to moderately sorted, poorly consolidated clay, silt, sand, and gravel deposited as alluvial fans at the mouths of perennial streams. They have a fan-like shape and consist of subangular to well-rounded clasts of varied lithology that are derived from local surficial deposits; however, sand and gravel derived from the Dawson Arkose and Denver Formation are major constituents. These deposits are similar to and positionally related to unit Qs. Sediments are deposited primarily by streams with significant input from sheetwash, debris flows, and hyperconcentrated flows. Deposits locally exceed 10 feet in thickness. Areas mapped as alluvial fans are subject to future flash floods and debris flow events. Deposits may be prone to collapse, hydrocompaction, or slope failure when wetted or loaded. Deposit is a potential source of sand and gravel.
- Qf<sub>2</sub>** **Alluvial fan deposit two (late Holocene)** — Dark-gray to brown, poorly to moderately sorted, poorly consolidated clay, silt, sand, and gravel deposited as alluvial fans at the mouths of perennial streams. They have a fan-like shape and consist of subangular to well-rounded clasts of varied lithology that are derived from local surficial deposits; however, sand and gravel derived from the Dawson Arkose and Denver Formation are major constituents. These deposits are similar to and positionally related to unit Qs. They have a fan-like shape, but are more dissected than younger Qf<sub>1</sub> deposits. Sediments are deposited primarily by streams with significant input from sheetwash, debris flows, and hyperconcentrated flows. The apex of the fan is as much as 15 feet higher than modern streams. Deposit locally exceeds 15 feet in thickness. Areas mapped as alluvial fans are subject to future flash floods and debris flow events. Deposits may be prone to collapse, hydrocompaction, or slope failure when wetted or loaded. Deposit is a potential source of sand and gravel.
- Qf<sub>3</sub>** **Alluvial fan deposit three (late Pleistocene)** — Dark-brown to grayish-brown, poorly to moderately sorted, moderately consolidated clay, silt, sand, gravel, and boulders deposited as alluvial fans at the mouths of perennial streams. Clasts are subangular to well rounded and have varied lithology that are derived from local surficial deposits and the Dawson Arkose. These deposits are similar to and positionally related to unit Qs. They have a fan-like shape, but are more dissected and their axial profile is flatter than younger Qf<sub>1</sub> deposits. Sediments are deposited primarily by streams with significant input from sheetwash, debris flows, and hyperconcentrated flows. The apex of the fan is as much as 20 feet higher than modern streams. Deposit locally exceeds 20 feet in thickness. Areas mapped as alluvial fans are subject to future flash floods and debris flow events. Deposits may be prone to collapse, hydrocompaction, or slope failure when wetted or loaded. Deposit is a potential source of sand and gravel.

- Qg<sub>1</sub>** **Gravel deposit one (middle Pleistocene)** — Brownish-red to reddish-tan, poorly sorted, moderately to poorly stratified pebble and cobble gravel derived from the Dawson Arkose, Denver Formation and outcrops of Castle Rock Conglomerate located south of the mapped area. Clasts are subrounded to rounded and are moderately weathered. Top of the unit is 60 to 75 feet above adjacent modern streams and the unit locally exceeds 30 feet in thickness. The unit is generally correlative, by virtue of height and soil characteristics, with the Slocum Alluvium (Scott and Wobus, 1973). The deposit forms a stable building surface, but excavations may be prone to slumping. The unit is a potential source of sand and gravel. This unit is labeled Qg<sub>1</sub> to remain consistent with nomenclature of surrounding CGS geologic maps.
- Qg** **High-level gravel deposits (early Pleistocene)** — Light-reddish-brown to grayish-brown, poorly sorted, pebble, cobble and boulder gravel with a fine to coarse sand matrix. Clasts are subrounded to well rounded. Matrix typically consists of feldspar and quartz sand likely derived from the local bedrock units or pre-existing outcrops of Castle Rock Conglomerate. Clast types within the gravel are predominantly pink granite, white vein quartz, quartzite, and rare welded tuff. The clast types and position in the landscape suggest the unit may be reworked and disaggregated Castle Rock Conglomerate. Top of the unit is 200 to 250 feet higher than mainstem creeks. The unit locally exceeds 10 feet in thickness. The deposit forms a stable building surface, but excavations may be prone to slumping. The unit is a potential source of sand and gravel.
- Qsw** **Sheetwash alluvium (Holocene to late Pleistocene)** — Light-grayish-brown, pale-brown, to brown, poorly sorted sand, silty and clayey sand, and minor amounts of gravel including some cobbles. Unit consists chiefly of local materials transported on moderate slopes (~10 percent grade) by sheet flow but also includes some sediment delivered by runoff in rills and minor gullies. Maximum exposed thickness is 20 feet.

EOLIAN or ALLUVIAL DEPOSITS

- Qs** **Eolian sand deposits (Holocene to late Pleistocene)** — Yellowish-brown to tan, fine- to coarse-grained, frosted sand and silt deposited by wind or sheetflow. Typically this unit is faintly stratified and non-cohesive; dune forms are not present. The lower, older parts of the unit are weakly cemented by calcium-carbonate and can hold a face where recently excavated. The unit is likely deposited as a sandsheet by winds capable of moving very fine gravel-sized clasts. These sand deposits are moderately compacted, easily excavated; however, they can hold surface water. This unit may be prone to hydrocompaction. Unit locally may exceed 10 feet in thickness.

POND DEPOSITS

- Qp** **Pond deposits (Holocene)** — Gray to dark-brown, moderately well sorted, moderately consolidated, clay, silt, sand, and scattered granules. Forms flat-surfaced seasonal ponds within sand deposits (Qs). In some areas this unit may be overlain by a thin veneer of windblown sand and sheetwash deposits.

MASS-WASTING DEPOSITS

- Qls** **Landslide deposits (Holocene)** — Heterogeneous deposits consisting of unsorted and unstratified clay, silt, and sand, and cobble-size bedrock fragments. Unit includes rotational slides and small earthflow mass movements. In most places, landslides show obvious geomorphic expression that disrupts the profile of the slopes. Generally, head scarps are readily recognizable; however, some scarps may be eroded or covered and not pronounced. Other common diagnostic features include hummocky topography, closed depressions, sag ponds, fissures, terracettes, tension cracks, and pressure ridges at the toe of the mobilized mass.
- Qss** **Soil slip deposits (Holocene)** — Areas where the surface soil has detached and migrated downhill exposing bedrock within the detachment zone. The slip surfaces are typically parallel to the slope and less than 3 feet below the surface. These features commonly form where water seeps are exiting the slope causing the soil to become saturated and flow under gravity. Areas mapped as soil slips are prone to future movement if saturated by runoff or precipitation. Thickness of soil slip deposits is typically less than 5 feet.

BEDROCK

Denver Basin Group

- Tda** **Dawson Arkose (Paleocene to Eocene)** — White and tan, thick to massive, cross-bedded arkoses, pebbly arkoses, and arkosic pebble conglomerates. Contains beds of white and tan fine- to medium-grained feldspathic cross-bedded friable sandstone that are poorly sorted, have high clay contents, and are commonly thin or medium bedded. The unit also contains sparse interbeds of thin-bedded gray claystone and sandy claystone or dark-brown, organic-rich siltstone to coarse sandstone that contains fossilized plant fragments. Thickness may reach 1000 feet in the Monument area, however, the exposed thickness in the Watkins SE quadrangle is approximately 250 feet. The unit is prone to swelling when wet. The Dawson Arkose is described in detail by Thorson (2011).

- TKd** **Denver Formation (Upper Cretaceous to Paleocene)** — The Denver Formation is separated from the overlying Dawson Arkose by a distinct zone of gray to pink to dark red clays up to 40 feet thick interpreted to represent a paleosurface of soil formation which also approximates the Paleocene — Eocene boundary (Raynolds, 2002; Thorson and Madole, 2002; Thorson, 2003). The distinctly different weathered colors and clay-rich content between the coarser grained Dawson Arkose and the finer grained Denver Formation make this zone recognizable. This zone also contains abundant root casts, has a distinct mottled and banded character and has economic use as brick-making clay.

The Denver Formation consists of tan, brown, and gray cross-bedded arkosic sandstone and greenish-gray sandy claystone. The sandstones are poorly sorted and contain abundant clay. They can be thin or medium bedded with ripple cross laminations. Some zones below the paleosol contain discontinuous pebbly conglomerate lenses of pink granite and vein quartz that are commonly less than 1 foot thick and typically weather out of deteriorated outcrops. Exposed thickness in the mapped area is less than 250 feet.

- Kl** **Laramie Formation (Upper Cretaceous)** — Shown on cross section only

- Kfm** **Fox Hills Sandstone (Upper Cretaceous)** — Shown on cross section only

- Kp** **Pierre Shale (Upper Cretaceous)** — Shown on cross section only

- Contact**—Approximately located
- Strike and dip of inclined bedding**—Showing direction and angle of dip

- Alignment of cross section**

References

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The geologic unit contacts were mapped at approximately 1:6,000 scale using 1-meter resolution National Agricultural Imagery Program (NAIP) photography that was photometrically rendered in 3D. Due to the high resolution and accuracy of these images, the mapped contacts may not align to features depicted on the 1:24,000 scale topographic base map.

