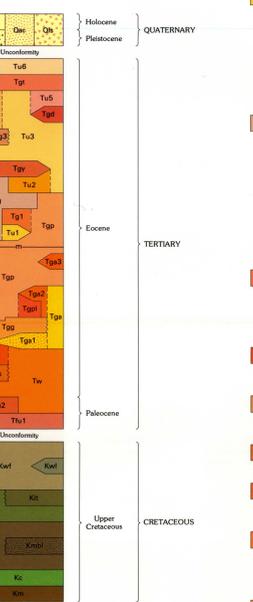


CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Qal Alluvium (Holocene)—Mud, silt, sand, and gravel. Mostly confined to stream valleys. Mostly derived from nearby sources; in valley of White River also includes rounded gravel from distant sources to the east. Includes some stope wash along steep valley walls and alluvial fans at mouths of branch streams.

Qch Alluvial and colluvial deposits undifferentiated (Holocene and Pleistocene)—Sand, silt, and some gravel. Mostly stope wash, alluvium and minor colluvial deposits.

Qcl Landslide deposits (Holocene and Pleistocene)—Coherent to chaotic masses derived from local bedrock.

Terrace gravels (Pleistocene)—Gravel in a sandy matrix at various levels along White River and other drainages. Along White River rounded pebbles and larger clasts are mostly siltified sandstone or siltstone, quartzite, abundant basalt or other dark volcanic rock; sparse granite and other crystalline or metamorphic rocks. Gravel clasts in other drainages include limestone, siltified sandstone or siltstone, with lesser chert and quartzite. Maximum clast size about 1 ft (0.3 m). Locally calcite cemented to form a resistant conglomerate. Locally covered by a thin veneer of younger colluvial and alluvial deposits. Maximum thickness about 20 ft (6 m).

Uita Formation (Eocene)—Mostly classic sediments of a prograding deltaic complex that ultimately filled the Eocene lake in which sediments of Green River Formation were deposited. Generally southward-thinning wedges composed chiefly of sandstone and siltstone that interfinger with marlstone of Green River Formation.

Unnamed tongue 6—Sandstone, conglomeratic sandstone, and conglomerate; includes some channel deposits. Some variably silty marlstone locally present in upper part. Sandstone is fine grained, light gray where quartzite and greenish gray and brown where impure. Conglomeratic beds contain rounded chert pebbles, grit-size clasts of chert and siltified sandstone and siltstone, and larger fragments of claystone and siltstone. Top not present in map area. Maximum thickness about 20 ft (6 m).

Unnamed tongue 5—Mostly sandstone, siltstone, and claystone; lesser marlstone, minor limestone. Sandstone beds are light to medium brown, fine to coarse grained, and contain considerable amount of clay, and rock and nonrock mineral fragments. Some alluvial channel deposits containing sparse clay pebbles and concretions. Most sandstone beds are poorly cemented and nonresistant, but locally form resistant ledges where cemented by lime. Siltstone is medium brown to greenish brown, and mostly argillaceous sandstone and siltstone become increasingly more silty to the south. Claystone beds, which predominate in upper part of unit, are commonly greenish brown to grayish green, variably silty, and locally sandy. Thickness ranges from about 80 to 140 ft (24-43 m).

Unnamed tongue 4—Light to medium-brown sandstone, lesser siltstone, siltstone, and marlstone. Sandstone includes some channel deposits. Basal contact probably disconformable, characterized by scouring and pincurrents; contemporaneous slumping. Maximum thickness about 110 ft (34 m).

Unnamed tongue 3—Sandstone and lesser amounts of siltstone, marlstone, claystone, and sparse limestone. Sandstone is light grayish brown to medium brown, fine to medium grained, locally coarse grained, and locally even bedded to crossbedded. Light gray where quartzite and greenish gray and brown where impure. Conglomeratic beds contain rounded chert pebbles, grit-size clasts of chert and siltified sandstone and siltstone, and larger fragments of claystone and siltstone. Top not present in map area. Maximum thickness about 20 ft (6 m).

Unnamed tongue 2—Light to dark-brown fine to medium-grained sandstone and siltstone. Contains several marlstone beds. Sandstone and siltstone are variably tuffaceous, many, and massive to even bedded. Contains sparse channel deposits. Forms conspicuous brown-weathering cliffs along Piceance Creek. Thickness ranges from about 120 ft (37 m) near Yellow Creek to about 450 ft (137 m) near Piceance Creek.

Unnamed tongue 1—Mostly light to dark brown fine to medium-grained sandstone, and lesser siltstone, in eastern part of map area, mostly dark gray clay shale, gray claystone interbedded with some dolomitic marlstone; also contains tuffaceous, locally limonitic, biotitic, and concretiferous. Near mouth of Barcus Creek strongly cemented by quartz, and is hard and resistant. Contains several channel deposits that have sharp disconformable basal contacts and basal conglomeratic beds containing soft-pebble clasts. Sharp disconformable contact with underlying Parachute Creek Member of Green River Formation (Tgp) in area of maximum thickness. Maximum thickness about 500 ft (152 m) in vicinity of Yellow Creek.

Interstratified Uita and Green River Formations (Eocene)—Includes as many as nine tongues of Uita and Green River mapped separately in the Barcus Creek (Hail, 1964) and Barcus Creek SE (Hail, 1968) 7 1/2-minute quadrangles (table 1); tongues grouped together on this map owing to scale limitations. Tongues of Uita predominate in aggregate thickness and consist mostly of brown to gray, fine to coarse-grained tuffaceous sandstone and siltstone, but also include light-gray marlstone, mudstone, and claystone. Channel sandstone deposits are relatively common and are locally conglomeratic. Locally form resistant cliffs. Tongues of Green River are mostly light gray variably silty marlstone, some siltstone, minor sandstone, and very minor oil shale. Maximum thickness about 600 ft (200 m).

Green River Formation (Eocene)—Sediments deposited in a variety of mostly lacustrine environments.

Thirteen Mile Creek Tongue—Mostly light gray carbonate rocks including variably silty marlstone and limestone, and lesser gray to greenish-gray variably dolomitic or dolomitic claystone. Minor sandstone and siltstone. Limestone includes granular, oolitic, or algal beds, variably argillaceous. Marlstone and limestone beds are mostly hard and resistant, and commonly form stripped surfaces. Maximum thickness about 80 ft (24 m).

Dry Fork Tongue—Light gray to light-brown marlstone and calcareous siltstone. Locally contains one or two sandstone beds. Marlstone is variably to argillaceous. Fossil wood common at base east of Piceance Creek. Pines out to north and northeast. Maximum thickness about 70 ft (21 m).

Unnamed tongue 3—Light-gray marlstone, variably silty and sandy. Contains one or two sandstone beds. Numerous sandstone beds mark an abrupt facies change at east margin of outcrop area where map unit is arbitrarily terminated. Maximum thickness about 80 ft (24 m).

Unnamed tongue 2—Light-gray marlstone, variably silty and sandy. Represents merged unnamed tongue 3 (Tg3) and Yellow Creek Tongue (Tc). Maximum thickness about 80 ft (24 m).

Yellow Creek Tongue—Light gray to light-brown variably silty marlstone; lesser marly siltstone; some granular sparately oolitic limestone; minor sandstone. Very minor oil shale. Pines out eastward. Thickness ranges from about 10 to 90 ft (3-27 m).

Parachute Creek Member—Main body—Mostly dolomitic marlstone, oil shale, and some clay shale in lower part. Also contains several beds of marly siltstone, sparse sandstone, and numerous very thin beds of unbedded tuff. Marlstone is massive to platy, gray to light grayish brown. Oil shale is thin, even bedded to fissile, medium to dark brown. Both marlstone and oil shale weather light gray. Richest oil-shale beds weather light bluish gray. Clay shale is locally thin bedded to papery weathering, brown to brownish gray. Contains several zones of rich potentially valuable oil shale in and below the Mahogany ledge oil-shale zone. Also contains potentially valuable deposits of natrolite and laumontite (Hite and Dym, 1967). In area south of White River, oil-shale values decrease markedly northward along outcrop, and top and bottom of Mahogany ledge oil-shale zone is only identified north of mouth of Yellow Creek. In northeastern part of map area contains only minor low-grade oil shale. West of long 108° 15' local contact is placed at a somewhat lower stratigraphic horizon than to the east. Marlstone and oil shale are relatively resistant, and form cliffs of basin rim south of White River. East of Piceance Creek, upper part of main body is stratigraphically equivalent to the interstratified Uita and Green River Formations (Tgp) west of Piceance Creek. Thickness on outcrop south of White River ranges from about 800 to 1,300 ft (240-400 m). In northeastern part of map area thickness on outcrop is about 270 ft (83 m). In the subsurface, may be as thick as 2,150 ft (655 m) in southeastern part of the map area.

Top of Mahogany ledge oil-shale zone

Lower part—Medium to low-grade oil shale, medium bedded to massive. Weathers light gray; forms ledge. Thickness ranges from 17 to 325 ft (5-99 m).

Anvil Points Member—Main body—Sandstone, siltstone, shale, claystone; lesser limestone. Sandstone is mostly gray to brown, fine to medium grained, medium bedded to massive; forms ledges and slopes. Siltstone is gray to tan, nonresistant, forms slopes. Shale and claystone are dark gray to olive gray, nonresistant, forms slopes. Some oolitic, oolitic, and psilotic limestone. Minor algal stromatolites. Middle part includes lateral facies equivalent of Garden Gulch Member (Tgg). Maximum thickness of exposed beds about 1,500 ft (460 m).

Unit 3—Uppermost tongue of Anvil Points Member. Sandstone, light gray to white, fine to medium grained, medium to thick bedded. Forms cliffs and ledges. Pines out to west. Maximum thickness about 250 ft (76 m).

Unit 2—A westward-thinning tongue of Anvil Points Member. In the southeastern part of map area composed of sandstone, siltstone, claystone, and a few beds of mudstone and low-grade clay shale. Sandstone is gray, medium bedded to massive; resistant. Form ledges that are commonly ripple bedded. Claystone is olive gray, nonresistant, forms slopes. Siltstone is tan to gray, nonresistant, forms slopes. Maximum thickness about 180 ft (56 m). In the northern part of map area composed of sandstone which is calcareous, light gray to white, fine to medium grained, medium to thick bedded, resistant, and forms ledges and cliffs. Thickness ranges from about 150 to 290 ft (46-85 m).

Unit 1—Main body—Sandstone, siltstone, shale, claystone, and limestone. A westward-thinning wedge of mostly lacustrine rocks, but also includes fluvial lenticular channel sandstone. Channel sandstone beds are common in lower half of unit in east-central part of map area. These are calcareous, light gray, fine to coarse grained, bedded to massive, form cliffs and ledges. Lacustrine rocks of upper part of unit 1 in the eastern part of map area are mostly sandstone and siltstone, and lesser shale. These sandstone beds are gray to brown, fine to medium grained, medium bedded to massive, and form cliffs and ledges. Siltstone and shale are gray to tan, form slopes. Becomes almost entirely lacustrine toward the west and includes sandstone, siltstone, claystone, shale, and limestone. Sandstone beds are commonly brown weathering, abundantly oolitic, locally fine to medium grained, massive to even bedded to crossbedded. Siltstone and limestone beds are commonly brown weathering, argillaceous, and locally argillaceous. Upper 170 ft (52 m), above Loyd Sandstone Bed, is gray to brown weathering, locally silty, soft clay shale containing yellow-orange spherulites and concretions. Upper 170 ft (52 m), above Loyd Sandstone Bed, is light gray to brown weathering, locally silty, and contains several resistant siltstone and sandstone beds. In underlying White River shale in lower part, becoming increasingly silty and sandy in upper part, and contains several resistant siltstone and sandstone beds. Loyd Sandstone Bed of Buck Tongue—Mostly thin bedded sandstone and lesser sandy shale. Forms cliffs and ledges locally. Nonresistant and locally phases out laterally into shale. Lies about 170 ft (52 m) below top of Buck Tongue (Kmb), and is about 70 ft (21 m) thick.

Castlegate Sandstone (Upper Cretaceous)—Marine sandstone, light brown to yellowish gray, brown weathering, thin bedded to massive, very fine to fine grained. Minor dark-gray shale in lower part. Very hard and resistant; forms persistent cliffs and dip slopes. Thickness ranges from about 40 to 60 ft (12-18 m).

Wasatch Formation (Paleocene and Eocene)—Main body (Paleocene and Eocene)—Rocks mostly of fluvial origin. Claystone, siltstone, lesser mudstone and shale, gray, greenish gray, green, red, purple, and yellowish brown. Abundant channel sandstone beds; medium to coarse grained, crossbedded, locally conglomeratic. Also includes minor brown to gray, locally oolitic clay shale, and several beds of oolitic or oolitic limestone of lacustrine origin, and brown carbonaceous shale of paludal origin. Lower part of undifferentiated Wasatch in eastern part of map area is equivalent in part to upper unit of Fort Union Formation (Th2) in western part of map area and consists mostly of drab gray and white claystone. Thickness of exposed rocks of main body ranges from about 1,000 ft (300 m) in western part of map area where units Two and Twoa are mapped separately to about 3,500 ft (1,070 m) in northeastern part of map area.

Upper part (Eocene)—Mostly gray and varicolored red and purple claystone, minor sandstone. Several beds of gray crossbedded alluvial channel sandstone. Mapped only in western part of map area where dark shale facies (Twoa) is present. Maximum thickness about 250 ft (76 m).

Dark shale facies (Eocene)—Rocks of fluvial, lacustrine, and paludal origin. Green or gray to sparsely varicolored fluvial claystone, siltstone, and oolitic limestone. Sandstone and siltstone are relatively dark aspect. Even-bedded shale, and thin, persistent lacustrine sandstone and limestone beds form a layered appearance. Lacustrine sandstone and limestone beds locally form resistant ledges and dip slopes. Exposed just east of Yellow Creek were designated a reference section of Cow Ridge Member of Green River Formation by Johnson (1964, p. 2, 9, pl. 1). Maximum thickness about 250 ft (76 m).

Fort Union Formation (Paleocene)—Unit 2—Brown to gray shale, carbonaceous shale and claystone, minor coaly shale including a few thin shaly coal beds; thin relatively persistent sandstone beds; lesser siltstone and claystone. Minor channel sandstone beds, some containing clay-pebble conglomerate. Mostly of paludal origin. Equivalent strata probably include two lower part of Wasatch Formation (Tw) in northeastern part of map area. Thickness ranges from about 300 to 530 ft (91-162 m).

Unit 1—In northeastern part of map area roughly equal proportions of light gray to light-brown fluvial channel sandstone, and olive-green to gray fluvial claystone and mudstone. Minor siltstone, carbonaceous shale, and limestone. Sandstone beds are mostly nonpersistent, massive to crossbedded, mostly fine to medium grained, calcareous, contain a few conglomeratic lenses with soft-rock clasts, and weathering brown cliffs and ledges. Sharp unconformable basal contact with underlying Cretaceous Williams Fork Formation (Kw). In northeastern part of map area mostly sandstone, light gray to brown weathering, medium to coarse grained; ledge forming. Lesser olive-gray shale, claystone, and siltstone. Some carbonaceous shale zones and coal beds. Several conglomeratic beds in basal 40-70 ft (12-21 m). Thickness in western part of map area ranges from about 150 to 1,800 ft (46-550 m). Thickness in eastern part of map area ranges from about 1,200 to 1,400 ft (370-430 m).

Williams Fork Formation of Mesaverde Group (Upper Cretaceous)—Main body—In northeastern part of map area rocks are entirely of nonmarine origin. Roughly equal proportions of channel and other fluvial sandstone, and fine-grained rocks, mostly claystone, shale, and mudstone. Also fairly abundant carbonaceous shale and coal. Sandstone beds are mostly nonpersistent, lenticular, light to medium gray, crossbedded to massive, and very fine to medium grained. Contains a considerable number of thin, even bedded, tabular sandstone beds. Sandstone are resistant and form strong cliffs and ledges. Claystone and mudstone mostly gray to grayish green, soft, nonresistant. Includes two major coal-bearing zones, one in lower 300 ft (90 m) of formation; the other occupies approximately upper one-third of formation but does not persist westward. In northeastern part of map area interbedded sandstone, siltstone, clay shale, carbonaceous shale, and coal. Most of sandstone is light gray to brown, fine to medium grained, lenticular, forming prominent ledges. Includes rocks of marine and nonmarine origin. Includes in descending order three coal zones: the Lion Canyon, Golf, and Fairfield zones (Hancock and Eby, 1930, p. 206). Formation ranges in thickness from about 2,000 ft (610 m) at east west of map area, to about 4,000 ft (1,220 m) in northeast.

Lion Canyon Sandstone Member—Sandstone, very light gray to white, fine grained. Locally separated into an upper and lower part by shale and siltstone containing marlstone fossils. Maximum thickness about 200 ft (61 m).

Hie Formation of Mesaverde Group (Upper Cretaceous)—Main body—Upper part mostly massive lenticular brown-weathering sandstone, and light-gray-weathering mudstone and claystone; sparse carbonaceous shale except near top where a few thin coal beds are locally present. Lower part mostly gray claystone and mudstone, thin sandstone, abundant carbonaceous shale containing sparse thin coal beds. Basal sandstone unit is massive, all higher beds probably nonmarine. Thickness of main body ranges from about 600 to 750 ft (180-230 m).

Trout Creek Sandstone Member—Light gray to light-brown massive to crossbedded, fine to medium-grained sandstone. Locally absent and is mapped only in northern part of Hie Formation outcrop area. Where Trout Creek is absent, Williams Fork facies contact is absent at base of lower coal bed of basal Williams Fork coal-bearing carbonaceous zone. In map area Trout Creek is nonmarine. Maximum thickness about 110 ft (34 m) near north boundary of map area.

Mancos Shale (Upper Cretaceous)—Main body—Mostly brown to gray marine shale, also contains a few nonresistant sandstone and siltstone beds, and sparse yellow to orange-weathering concretions. Soft, nonresistant, mostly poorly exposed. Thickness of exposed rocks about 2,200 ft (670 m).

Buck Tongue—Mostly brown to gray marine shale, lesser siltstone and sandstone. Lower 300 ft (91 m), below Loyd Sandstone Bed (Kmb), is gray to brown weathering, locally silty, soft clay shale containing yellow-orange spherulites and concretions. Upper 170 ft (52 m), above Loyd Sandstone Bed, is light gray to brown weathering, locally silty, and contains several resistant siltstone and sandstone beds. In underlying White River shale in lower part, becoming increasingly silty and sandy in upper part, and contains several resistant siltstone and sandstone beds. Loyd Sandstone Bed of Buck Tongue—Mostly thin bedded sandstone and lesser sandy shale. Forms cliffs and ledges locally. Nonresistant and locally phases out laterally into shale. Lies about 170 ft (52 m) below top of Buck Tongue (Kmb), and is about 70 ft (21 m) thick.

Garden Gulch Member—Shale (including some oil shale), in lower dolomitic marlstone, and limestone, in eastern part of map area, mostly dark gray clay shale, gray claystone interbedded with some dolomitic marlstone; also contains algal stromatolites, numerous beds of ledge-forming medium-grained sandstone, and oolitic and psilotic sandy limestone; minor fusile oil shale. In central to western part of map area, brown, gray, and grayish-green, thin bedded, fissile to papery clay shale, including at least some clay-rich oil shale in upper part, and a few thin beds of oolitic limestone or dolomitic shale beds, and a few thin beds of oolitic limestone in lower part. Also includes several very thin beds of unbedded tuff. Most of Garden Gulch Member is nonresistant ledge-forming. West of long 108° 15' upper part is placed at a somewhat lower stratigraphic horizon than to east. Thickness ranges from about 160 to 900 ft (49-273 m).

Wasatch Formation (Paleocene and Eocene)—Main body (Paleocene and Eocene)—Rocks mostly of fluvial origin. Claystone, siltstone, lesser mudstone and shale, gray, greenish gray, green, red, purple, and yellowish brown. Abundant channel sandstone beds; medium to coarse grained, crossbedded, locally conglomeratic. Also includes minor brown to gray, locally oolitic clay shale, and several beds of oolitic or oolitic limestone of lacustrine origin, and brown carbonaceous shale of paludal origin. Lower part of undifferentiated Wasatch in eastern part of map area is equivalent in part to upper unit of Fort Union Formation (Th2) in western part of map area and consists mostly of drab gray and white claystone. Thickness of exposed rocks of main body ranges from about 1,000 ft (300 m) in western part of map area where units Two and Twoa are mapped separately to about 3,500 ft (1,070 m) in northeastern part of map area.

Upper part (Eocene)—Mostly gray and varicolored red and purple claystone, minor sandstone. Several beds of gray crossbedded alluvial channel sandstone. Mapped only in western part of map area where dark shale facies (Twoa) is present. Maximum thickness about 250 ft (76 m).

Dark shale facies (Eocene)—Rocks of fluvial, lacustrine, and paludal origin. Green or gray to sparsely varicolored fluvial claystone, siltstone, and oolitic limestone. Sandstone and siltstone are relatively dark aspect. Even-bedded shale, and thin, persistent lacustrine sandstone and limestone beds form a layered appearance. Lacustrine sandstone and limestone beds locally form resistant ledges and dip slopes. Exposed just east of Yellow Creek were designated a reference section of Cow Ridge Member of Green River Formation by Johnson (1964, p. 2, 9, pl. 1). Maximum thickness about 250 ft (76 m).

Fort Union Formation (Paleocene)—Unit 2—Brown to gray shale, carbonaceous shale and claystone, minor coaly shale including a few thin shaly coal beds; thin relatively persistent sandstone beds; lesser siltstone and claystone. Minor channel sandstone beds, some containing clay-pebble conglomerate. Mostly of paludal origin. Equivalent strata probably include two lower part of Wasatch Formation (Tw) in northeastern part of map area. Thickness ranges from about 300 to 530 ft (91-162 m).

Unit 1—In northeastern part of map area roughly equal proportions of light gray to light-brown fluvial channel sandstone, and olive-green to gray fluvial claystone and mudstone. Minor siltstone, carbonaceous shale, and limestone. Sandstone beds are mostly nonpersistent, massive to crossbedded, mostly fine to medium grained, calcareous, contain a few conglomeratic lenses with soft-rock clasts, and weathering brown cliffs and ledges. Sharp unconformable basal contact with underlying Cretaceous Williams Fork Formation (Kw). In northeastern part of map area mostly sandstone, light gray to brown weathering, medium to coarse grained; ledge forming. Lesser olive-gray shale, claystone, and siltstone. Some carbonaceous shale zones and coal beds. Several conglomeratic beds in basal 40-70 ft (12-21 m). Thickness in western part of map area ranges from about 150 to 1,800 ft (46-550 m). Thickness in eastern part of map area ranges from about 1,200 to 1,400 ft (370-430 m).

Williams Fork Formation of Mesaverde Group (Upper Cretaceous)—Main body—In northeastern part of map area rocks are entirely of nonmarine origin. Roughly equal proportions of channel and other fluvial sandstone, and fine-grained rocks, mostly claystone, shale, and mudstone. Also fairly abundant carbonaceous shale and coal. Sandstone beds are mostly nonpersistent, lenticular, light to medium gray, crossbedded to massive, and very fine to medium grained. Contains a considerable number of thin, even bedded, tabular sandstone beds. Sandstone are resistant and form strong cliffs and ledges. Claystone and mudstone mostly gray to grayish green, soft, nonresistant. Includes two major coal-bearing zones, one in lower 300 ft (90 m) of formation; the other occupies approximately upper one-third of formation but does not persist westward. In northeastern part of map area interbedded sandstone, siltstone, clay shale, carbonaceous shale, and coal. Most of sandstone is light gray to brown, fine to medium grained, lenticular, forming prominent ledges. Includes rocks of marine and nonmarine origin. Includes in descending order three coal zones: the Lion Canyon, Golf, and Fairfield zones (Hancock and Eby, 1930, p. 206). Formation ranges in thickness from about 2,000 ft (610 m) at east west of map area, to about 4,000 ft (1,220 m) in northeast.

Lion Canyon Sandstone Member—Sandstone, very light gray to white, fine grained. Locally separated into an upper and lower part by shale and siltstone containing marlstone fossils. Maximum thickness about 200 ft (61 m).

Hie Formation of Mesaverde Group (Upper Cretaceous)—Main body—Upper part mostly massive lenticular brown-weathering sandstone, and light-gray-weathering mudstone and claystone; sparse carbonaceous shale except near top where a few thin coal beds are locally present. Lower part mostly gray claystone and mudstone, thin sandstone, abundant carbonaceous shale containing sparse thin coal beds. Basal sandstone unit is massive, all higher beds probably nonmarine. Thickness of main body ranges from about 600 to 750 ft (180-230 m).

Trout Creek Sandstone Member—Light gray to light-brown massive to crossbedded, fine to medium-grained sandstone. Locally absent and is mapped only in northern part of Hie Formation outcrop area. Where Trout Creek is absent, Williams Fork facies contact is absent at base of lower coal bed of basal Williams Fork coal-bearing carbonaceous zone. In map area Trout Creek is nonmarine. Maximum thickness about 110 ft (34 m) near north boundary of map area.

Mancos Shale (Upper Cretaceous)—Main body—Mostly brown to gray marine shale, also contains a few nonresistant sandstone and siltstone beds, and sparse yellow to orange-weathering concretions. Soft, nonresistant, mostly poorly exposed. Thickness of exposed rocks about 2,200 ft (670 m).

Buck Tongue—Mostly brown to gray marine shale, lesser siltstone and sandstone. Lower 300 ft (91 m), below Loyd Sandstone Bed (Kmb), is gray to brown weathering, locally silty, soft clay shale containing yellow-orange spherulites and concretions. Upper 170 ft (52 m), above Loyd Sandstone Bed, is light gray to brown weathering, locally silty, and contains several resistant siltstone and sandstone beds. In underlying White River shale in lower part, becoming increasingly silty and sandy in upper part, and contains several resistant siltstone and sandstone beds. Loyd Sandstone Bed of Buck Tongue—Mostly thin bedded sandstone and lesser sandy shale. Forms cliffs and ledges locally. Nonresistant and locally phases out laterally into shale. Lies about 170 ft (52 m) below top of Buck Tongue (Kmb), and is about 70 ft (21 m) thick.

Castlegate Sandstone (Upper Cretaceous)—Marine sandstone, light brown to yellowish gray, brown weathering, thin bedded to massive, very fine to fine grained. Minor dark-gray shale in lower part. Very hard and resistant; forms persistent cliffs and dip slopes. Thickness ranges from about 40 to 60 ft (12-18 m).

Wasatch Formation (Paleocene and Eocene)—Main body (Paleocene and Eocene)—Rocks mostly of fluvial origin. Claystone, siltstone, lesser mudstone and shale, gray, greenish gray, green, red, purple, and yellowish brown. Abundant channel sandstone beds; medium to coarse grained, crossbedded, locally conglomeratic. Also includes minor brown to gray, locally oolitic clay shale, and several beds of oolitic or oolitic limestone of lacustrine origin, and brown carbonaceous shale of paludal origin. Lower part of undifferentiated Wasatch in eastern part of map area is equivalent in part to upper unit of Fort Union Formation (Th2) in western part of map area and consists mostly of drab gray and white claystone. Thickness of exposed rocks of main body ranges from about 1,000 ft (300 m) in western part of map area where units Two and Twoa are mapped separately to about 3,500 ft (1,070 m) in northeastern part of map area.

Upper part (Eocene)—Mostly gray and varicolored red and purple claystone, minor sandstone. Several beds of gray crossbedded alluvial channel sandstone. Mapped only in western part of map area where dark shale facies (Twoa) is present. Maximum thickness about 250 ft (76 m).

Dark shale facies (Eocene)—Rocks of fluvial, lacustrine, and paludal origin. Green or gray to sparsely varicolored fluvial claystone, siltstone, and oolitic limestone. Sandstone and siltstone are relatively dark aspect. Even-bedded shale, and thin, persistent lacustrine sandstone and limestone beds form a layered appearance. Lacustrine sandstone and limestone beds locally form resistant ledges and dip slopes. Exposed just east of Yellow Creek were designated a reference section of Cow Ridge Member of Green River Formation by Johnson (1964, p. 2, 9, pl. 1). Maximum thickness about 250 ft (76 m).

Fort Union Formation (Paleocene)—Unit 2—Brown to gray shale, carbonaceous shale and claystone, minor coaly shale including a few thin shaly coal beds; thin relatively persistent sandstone beds; lesser siltstone and claystone. Minor channel sandstone beds, some containing clay-pebble conglomerate. Mostly of paludal origin. Equivalent strata probably include two lower part of Wasatch Formation (Tw) in northeastern part of map area. Thickness ranges from about 300 to 530 ft (91-162 m).

Unit 1—In northeastern part of map area roughly equal proportions of light gray to light-brown fluvial channel sandstone, and olive-green to gray fluvial claystone and mudstone. Minor siltstone, carbonaceous shale, and limestone. Sandstone beds are mostly nonpersistent, massive to crossbedded, mostly fine to medium grained, calcareous, contain a few conglomeratic lenses with soft-rock clasts, and weathering brown cliffs and ledges. Sharp unconformable basal contact with underlying Cretaceous Williams Fork Formation (Kw). In northeastern part of map area mostly sandstone, light gray to brown weathering, medium to coarse grained; ledge forming. Lesser olive-gray shale, claystone, and siltstone. Some carbonaceous shale zones and coal beds. Several conglomeratic beds in basal 40-70 ft (12-21 m). Thickness in western part of map area ranges from about 150 to 1,800 ft (46-550 m). Thickness in eastern part of map area ranges from about 1,200 to 1,400 ft (370-430 m).

Williams Fork Formation of Mesaverde Group (Upper Cretaceous)—Main body—In northeastern part of map area rocks are entirely of nonmarine origin. Roughly equal proportions of channel and other fluvial sandstone, and fine-grained rocks, mostly claystone, shale, and mudstone. Also fairly abundant carbonaceous shale and coal. Sandstone beds are mostly nonpersistent, lenticular, light to medium gray, crossbedded to massive, and very fine to medium grained. Contains a considerable number of thin, even bedded, tabular sandstone beds. Sandstone are resistant and form strong cliffs and ledges. Claystone and mudstone mostly gray to grayish green, soft, nonresistant. Includes two major coal-bearing zones, one in lower 300 ft (90 m) of formation; the other occupies approximately upper one-third of formation but does not persist westward. In northeastern part of map area interbedded sandstone, siltstone, clay shale, carbonaceous shale, and coal. Most of sandstone is light gray to brown, fine to medium grained, lenticular, forming prominent ledges. Includes rocks of marine and nonmarine origin. Includes in descending order three coal zones: the Lion Canyon, Golf, and Fairfield zones (Hancock and Eby, 1930, p. 206). Formation ranges in thickness from about 2,000 ft (610 m) at east west of map area, to about 4,000 ft (1,220 m) in northeast.

Lion Canyon Sandstone Member—Sandstone, very light gray to white, fine grained. Locally separated into an upper and lower part by shale and siltstone containing marlstone fossils. Maximum thickness about 200 ft (61 m).

Hie Formation of Mesaverde Group (Upper Cretaceous)—Main body—Upper part mostly massive lenticular brown-weathering sandstone, and light-gray-weathering mudstone and claystone; sparse carbonaceous shale except near top where a few thin coal beds are locally present. Lower part mostly gray claystone and mudstone, thin sandstone, abundant carbonaceous shale containing sparse thin coal beds. Basal sandstone unit is massive, all higher beds probably nonmarine. Thickness of main body ranges from about 600 to 750 ft (180-230 m).

Trout Creek Sandstone Member—Light gray to light-brown massive to crossbedded, fine to medium-grained sandstone. Locally absent and is mapped only in northern part of Hie Formation outcrop area. Where Trout Creek is absent, Williams Fork facies contact is absent at base of lower coal bed of basal Williams Fork coal-bearing carbonaceous zone. In map area Trout Creek is nonmarine. Maximum thickness about 110 ft (34 m) near north boundary of map area.

Mancos Shale (Upper Cretaceous)—Main body—Mostly brown to gray marine shale, also contains a few nonresistant sandstone and siltstone beds, and sparse yellow to orange-weathering concretions. Soft, nonresistant, mostly poorly exposed. Thickness of exposed rocks about 2,200 ft (670 m).

Buck Tongue—Mostly brown to gray marine shale, lesser siltstone and sandstone. Lower 300 ft (91 m), below Loyd Sandstone Bed (Kmb), is gray to brown weathering, locally silty, soft clay shale containing yellow-orange spherulites and concretions. Upper 170 ft (52 m), above Loyd Sandstone Bed, is light gray to brown weathering, locally silty, and contains several resistant siltstone and sandstone beds. In underlying White River shale in lower part, becoming increasingly silty and sandy in upper part, and contains several resistant siltstone and sandstone beds. Loyd Sandstone Bed of Buck Tongue—Mostly thin bedded sandstone and lesser sandy shale. Forms cliffs and ledges locally. Nonresistant and locally phases out laterally into shale. Lies about 170 ft (52 m) below top of Buck Tongue (Kmb), and is about 70 ft (21 m) thick.

Castlegate Sandstone (Upper Cretaceous)—Marine sandstone, light brown to yellowish gray, brown weathering, thin bedded to massive, very fine to fine grained. Minor dark-gray shale in lower part. Very hard and resistant; forms persistent cliffs and dip slopes. Thickness ranges from about 40 to 60 ft (12-18 m).

Wasatch Formation (Paleocene and Eocene)—Main body (Paleocene and Eocene)—Rocks mostly of fluvial origin. Claystone, siltstone, lesser mudstone and shale, gray, greenish gray, green, red, purple, and yellowish brown. Abundant channel sandstone beds; medium to coarse grained, crossbedded, locally conglomeratic. Also includes minor brown to gray, locally oolitic clay shale, and several beds of oolitic or oolitic limestone of lacustrine origin, and brown carbonaceous shale of paludal origin. Lower part of undifferentiated Wasatch in eastern part of map area is equivalent in part to upper unit of Fort Union Formation (Th2) in western part of map area and consists mostly of drab gray and white claystone. Thickness of exposed rocks of main body ranges from about 1,000 ft (300 m) in western part of map area where units Two and Twoa are mapped separately to about 3,500 ft (1,070 m) in northeastern part of map area.

Upper part (Eocene)—Mostly gray and varicolored red and purple claystone, minor sandstone. Several beds of gray crossbedded alluvial channel sandstone. Mapped only in western part of map area where dark shale facies (Twoa) is present. Maximum thickness about 250 ft (76 m).

Dark shale facies (Eocene)—Rocks of fluvial, lacustrine, and paludal origin. Green or gray to sparsely varicolored fluvial claystone, siltstone, and oolitic limestone. Sandstone and siltstone are relatively dark aspect. Even-bedded shale, and thin, persistent lacustrine sandstone and limestone beds form a layered appearance. Lacustrine sandstone and limestone beds locally form resistant ledges and dip slopes. Exposed just east of Yellow Creek were designated a reference section of Cow Ridge Member of Green River Formation by Johnson (1964, p. 2, 9, pl. 1). Maximum thickness about 250 ft (76 m).

Fort Union Formation (Paleocene)—Unit 2—Brown to gray shale, carbonaceous shale and claystone, minor coaly shale including a few thin shaly coal beds; thin relatively persistent sandstone beds; lesser siltstone and claystone. Minor channel sandstone beds, some containing clay-pebble conglomerate. Mostly of paludal origin. Equivalent strata probably include two lower part of Wasatch Formation (Tw) in northeastern part of map area. Thickness ranges from about 300 to 530 ft (91-162 m).

Unit 1—In northeastern part of map area roughly equal proportions of light gray to light-brown fluvial channel sandstone, and olive-green to gray fluvial claystone and mudstone. Minor siltstone, carbonaceous shale, and limestone. Sandstone beds are mostly nonpersistent, massive to crossbedded, mostly fine to medium grained, calcareous, contain a few conglomeratic lenses with soft-rock clasts, and weathering brown cliffs and ledges. Sharp unconformable basal contact with underlying Cretaceous Williams Fork Formation (Kw). In northeastern part of map area mostly sandstone, light gray to brown weathering, medium to coarse grained; ledge forming. Lesser olive-gray shale, claystone, and siltstone. Some carbonaceous shale zones and coal beds. Several conglomeratic beds in basal 40-70 ft (12-21 m). Thickness in western part of map area ranges from about 150 to 1,800 ft (46-550 m). Thickness in eastern part of map area ranges from about 1,200 to 1,400 ft (370-430 m).

Williams Fork Formation of Mesaverde Group (Upper Cretaceous)—Main body—In northeastern part of map area rocks are entirely of nonmarine origin. Roughly equal proportions of channel and other fluvial sandstone, and fine-grained rocks, mostly claystone, shale, and mudstone. Also fairly abundant carbonaceous shale and coal. Sandstone beds are mostly nonpersistent, lenticular, light to medium gray, crossbedded to massive, and very fine to medium grained. Contains a considerable number of thin, even bedded, tabular sandstone beds. Sandstone are resistant and form strong cliffs and ledges. Claystone and mudstone mostly gray to grayish green, soft, nonresistant. Includes two major coal-bearing zones, one in lower 300 ft (90 m) of formation; the other occupies approximately upper one-third of formation but does not persist westward. In northeastern part of map area interbedded sandstone, siltstone, clay shale, carbonaceous shale, and coal. Most of sandstone is light gray to brown, fine to medium grained, lenticular, forming prominent ledges. Includes rocks of marine and nonmarine origin. Includes in descending order three coal zones: the Lion Canyon, Golf, and Fairfield zones (Hancock and Eby, 1930, p. 206). Formation ranges in thickness from about 2,000 ft (610 m) at east west of map area, to about 4,000 ft (1,220 m) in northeast.

Lion Canyon Sandstone Member—Sandstone, very light gray to white, fine grained. Locally separated into an upper and lower part by shale and siltstone containing marlstone fossils. Maximum thickness about 200 ft (61 m).

Hie Formation of Mesaverde Group (Upper Cretaceous)—Main body—Upper part mostly massive lenticular brown-weathering sandstone, and light-gray-weathering mudstone and claystone; sparse carbonaceous shale except near top where a few thin coal beds are locally present. Lower part mostly gray claystone and mudstone, thin sandstone, abundant carbonaceous shale containing sparse thin coal beds. Basal sandstone unit is massive, all higher beds probably nonmarine. Thickness of main body ranges from about 600 to 750 ft (180-230 m).

Trout Creek Sandstone Member—Light gray to light-brown massive to crossbedded, fine to medium-grained sandstone. Locally absent and is mapped only in northern part of Hie Formation outcrop area. Where Trout Creek is absent, Williams Fork facies contact is absent at base of lower coal bed of basal Williams Fork coal-bearing carbonaceous zone. In map area Trout Creek is nonmarine. Maximum thickness about 110 ft (34 m) near north boundary of map area.

Mancos Shale (Upper Cretaceous)—Main body—Mostly brown to gray marine shale, also contains a few nonresistant sandstone and siltstone beds, and sparse yellow to orange-weathering concretions. Soft, nonresistant, mostly poorly exposed. Thickness of exposed rocks about 2,200 ft (670 m).

Buck Tongue—Mostly brown to gray marine shale, lesser siltstone and sandstone. Lower 300 ft (91 m), below Loyd Sandstone Bed (Kmb), is gray to brown weathering, locally silty, soft clay shale containing yellow-orange spherulites and concretions. Upper 170 ft (52 m), above Loyd Sandstone Bed, is light gray to brown weathering, locally silty, and contains several resistant siltstone and sandstone beds. In underlying White River shale in lower part, becoming increasingly silty and sandy in upper part, and contains several resistant siltstone and sandstone beds. Loyd Sandstone Bed of Buck Tongue—Mostly thin bedded sandstone and lesser sandy shale. Forms cliffs and ledges locally. Nonresistant and locally phases out laterally into shale. Lies about 170 ft (52 m) below top of Buck Tongue (Kmb), and is about 70 ft (21 m) thick.

Castlegate Sand