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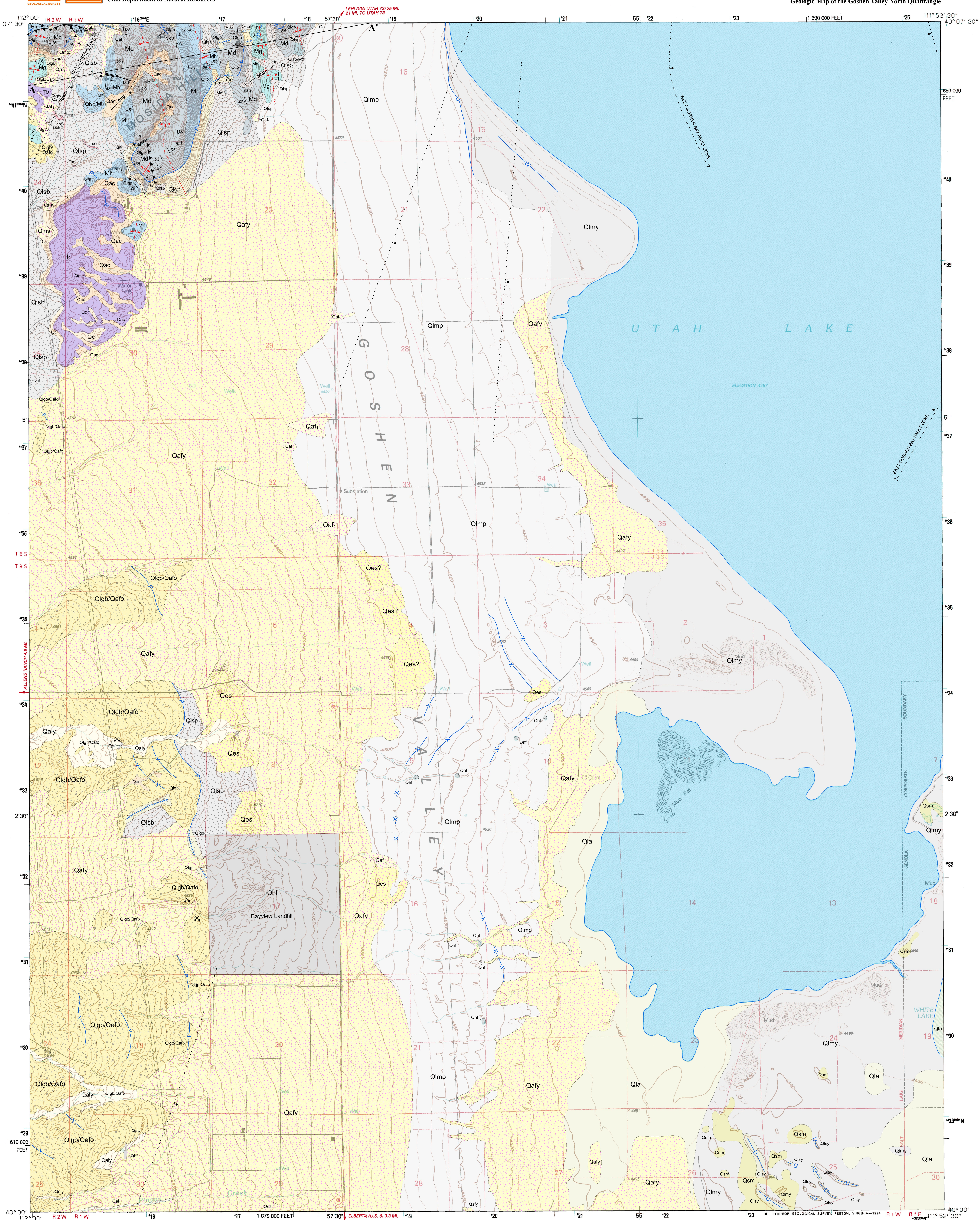



Base map from U.S.Geological Survey, Goshen Valley North 7.5' Quadrangle 1994

*North American Datum of 1927, UTM Zone 12 North*
*Mosida Hills is an unofficial geographic name.*

SCALE 1:24,000

1 0.5 0 1 MILE

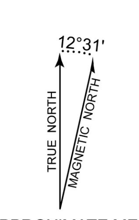
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 0.5 0 1 KILOMETER

CONTOUR INTERVAL 10 FEET



*This geologic map was funded by the Utah Geological Survey and the U.S. Geological Survey, National Cooperative Geologic Mapping Program, through USGS STATEMAP award number 05HQAG0084. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.*



APPROXIMATE MEAN DECLINATION, 2009

# GEOLOGIC MAP OF THE GOSHEN VALLEY NORTH QUADRANGLE, UTAH COUNTY, UTAH

by

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2009

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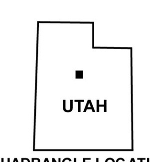

QUADRANGLE LOCATION

| | | |
|---|---|---|
| 1 | 2 | 3 |
| 4 | | 5 |
| 6 | 7 | 8 |

1 Goshen Pass
2 Soldiers Pass
3 Lincoln Point
4 Allens Ranch
5 West Mountain
6 Eureka
7 Goshen
8 Santaquin

ADJOINING 7.5' QUADRANGLE NAMES

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## MAP UNIT DESCRIPTIONS

### QUATERNARY

**Alluvial deposits**

Qal$_1$ **Level-1 stream deposits** (upper Holocene) − Moderately sorted sand, silt, clay, and pebble to boulder gravel deposited in active stream channels and flood plains; locally includes small alluvial-fan and colluvial deposits, and minor terraces up to about 10 feet (3 m) above current base level; mapped in an ephemeral wash draining the southern Lake Mountains (Mosida Hills, unofficial name) (NE1/4 section 19, T. 8 S., R. 1 W.) and along Pinyon Creek (section 30, T. 9 S., R. 1 W.); typically less than 20 feet (<6 m) thick.

Qaly **Younger alluvial deposits** (Holocene) – Moderately sorted sand, silt, clay, and local pebble gravel deposited in stream channels and flood plains; mapped along some drainages on margin of Goshen Valley; grades to young alluvial-fan deposits (Qafy); thickness probably less than 20 feet (<6 m).

Qaf$_1$ **Level-1 alluvial-fan deposits** (upper Holocene) − Poorly to moderately sorted, non-stratified, clay- to boulder-size sediment deposited principally by debris floods or clear-water floods at the distal end of the piedmont slope and at the mouths of active drainages; equivalent to the younger part of Qafy, but differentiated because its forms smaller, isolated fans; probably less than 20 feet (<6 m) thick.

Qafy **Young undifferentiated alluvial-fan deposits** (Holocene) − Similar to level-1 alluvial-fan deposits (Qaf1), but forms coalesced apron of post-Bonneville sediment shed off the East Tintic Mountains area (west of quadrangle); also includes coalesced fans emanating from streams draining the plain of lacustrine mud (Qlmp) adjacent to Utah Lake; upper parts of fans are locally deeply incised; thickness unknown, but likely as much as several tens of feet thick.

**Spring Deposits**

Qsm **Spring and marsh deposits** (Holocene) – Silt and clay with local sand; present in low-lying areas of Goshen Valley where seeps, springs, and marshy areas exist within areas of younger lacustrine deposits (Qlmy); thickness probably 0 to 10 feet (0-3 m).

**Lacustrine deposits**

Refer to table 1 for ages and elevations of major shorelines of Lake Bonneville and Utah Lake.

Qlmy **Younger lacustrine silt and clay deposits** (Holocene to upper Pleistocene) − Silt, clay, and minor fine-grained sand deposited along the margin of Utah Lake; locally organic rich, and locally includes pebbly beach gravel; locally includes small areas of spring and marsh deposits (Qsm) and mixed lacustrine and alluvial deposits (Qla) difficult to map at this scale; probably 0 to 10 feet (0-3 m) thick.

Qlsy **Younger lacustrine sand and silt deposits** (Holocene to upper Pleistocene) − Sand, silt and minor gravel deposited in low linear ridges south of Utah Lake; locally organic rich; mapped within areas of younger lacustrine silt and clay (Qlmy); probably beach deposits formed from fluctuations at and near the Utah Lake highstand; probably 0 to 10 feet (0-3 m) thick.

Deposits of the regressive (Provo) phase of the Bonneville lake cycle (Currey and Oviatt, 1985; Oviatt and others, 1992) are identified with the last map symbol letter “p,” and deposits of the transgressive (Bonneville) phase of the Bonneville lake cycle are identified with the last map symbol letter “b.”

Qlgp / Qlgb **Lacustrine gravel and sand** (upper Pleistocene) − Moderately to well-sorted, moderately to well-rounded, clast-supported, pebble to cobble gravel and lesser pebbly sand; thin- to thick-bedded; typically interbedded with or laterally gradational to sand and silt facies; gastropods common in sandy lenses; locally partly cemented with calcium carbonate; typically forms wave-cut or wave-built benches, bars, and spits; wave-cut benches are commonly partly covered by colluvium derived from adjacent oversteepened slopes; intermediate shorelines are locally well developed on Provo deposits; Qlgp deposited at and below the Provo shoreline, and Qlgb deposited at and below highest Bonneville shoreline, but above the Provo shoreline; typically 0 to 30 feet (0-9 m) thick.

Qlsp / Qlsb **Lacustrine sand and silt** (upper Pleistocene) − Fine- to coarse-grained sand and silt with minor gravel; typically well sorted and laminated in thick beds; gastropods locally common; grades downslope from sandy nearshore deposits to finer grained offshore deposits; shorelines typically poorly developed on this facies; locally concealed by loess veneer; Qlsp deposited at and below the Provo shoreline, and Qlsb deposited at and below highest Bonneville shoreline, but above the Provo shoreline; probably less than 30 feet (<9 m) thick.

Qlmp **Lacustrine silt and clay** (upper Pleistocene) − Calcareous silt (marl) with minor clay and fine-grained sand; typically laminated, but weathers to appear thick bedded; locally grades upslope into lacustrine sand and silt (Qlsp) and locally concealed by loess veneer; shorelines typically poorly developed on this facies; contact with distal parts of younger alluvial-fan deposits is difficult to identify and commonly based on subtle geomorphic differences; Qlmp deposited below the Provo shoreline, but likely includes similar silt and clay deposits of the transgressive (Bonneville) phase at depth; thickness uncertain, but may exceed several tens of feet thick.

Qllp **Lagoon-fill deposits** (upper Pleistocene) − Not exposed, but likely consists of thick-bedded silt with sand and minor pebbles washed in from adjacent slopes; may be capped by loess, and is typically concealed by a veneer of colluvial deposits; forms level, grassy areas behind offshore gravel bars near the Provo shoreline; probably less than 20 feet (<6 m) thick.

**Colluvial deposits**

Qc **Colluvial deposits** (Holocene to upper Pleistocene) − Poorly to moderately sorted, angular, clay- to boulder-size, locally derived sediment deposited by slope wash and soil creep on moderate slopes and in shallow depressions; locally grades downslope into mixed alluvial and colluvial deposits; because many bedrock slopes are covered by at least a veneer of colluvium, only the larger, thicker deposits are mapped; typically 0 to 20 feet (0-6 m) thick.

**Eolian deposits**

Qes **Eolian sand deposits** (Holocene to upper Pleistocene) − Well- to very well-sorted, fine- to medium-grained, well-rounded, windblown sand near Allens Ranch Road and the Bayview Landfill; queried for uncertain correlation east of State Route 68 due to extensive cultivation; forms small dunes mostly stabilized by vegetation; locally overlapped by young alluvial-fan deposits (Qafy); may be locally derived from Provo-phase off-shore sand deposits; typically 0 to 10 feet (0-3 m) thick.

**Human Disturbance**

Qhf **Fill and disturbed land** (Historical) − Local earth materials used to construct dams for stock and wildlife watering ponds; includes disturbed land in pond depressions; some smaller watering ponds not mapped due to scale constraints; thickness 0 to 20 feet (0-6 m).

Qhl **Landfill** (Historical) − Landfill material and cover deposits, and undisturbed buffer land (generally consisting of map units Qlgb/Qafo, Qafy, Qes) associated with the Bayview Landfill, operated by the South Utah Valley Solid Waste District, located in section 17, T. 9 S., R. 1 W.; driller’s log indicates unconsolidated deposits were encountered in a boring to a total depth of 270 feet (80 m) with the ground-water level at 245 feet (75 m) depth; variable thickness.

**Mass-movement deposits**

Qms **Landslide deposits** (Historical? to upper Pleistocene?) − Very poorly sorted, locally derived material deposited by rotational and translational movement; typically clay- to boulder-size debris; characterized by hummocky topography and chaotic bedding attitudes; developed on oversteepened slopes along margin of trachybasalt outcrop (Tb); undivided as to inferred age because new research shows that even landslides with subdued morphology (suggesting that they are older, weathered, and have not moved recently) may continue to exhibit slow creep or are capable of renewed movement if stability thresholds are exceeded (F.X. Ashland, Utah Geological Survey, verbal communication, April 2006); age and stability determinations require detailed geotechnical investigations; thickness highly variable.

**Mixed-environment deposits**

Qac **Alluvial and colluvial deposits** (Holocene to upper Pleistocene) − Poorly to moderately sorted, generally poorly stratified, clay- to boulder-size, locally derived sediment deposited in swales and small drainages by fluvial, slope-wash, and creep processes; generally less than 20 feet (6 m) thick.

Qla **Lacustrine and alluvial deposits** (Holocene to upper Pleistocene) – Moderately to well-sorted, fine-grained sand, silt, and clay; lower parts of younger lacustrine deposits likely grade into silt and clay deposits of the Bonneville Lake cycle and upper parts grade into younger alluvial-fan and lacustrine deposits; mapped in Goshen Valley; thickness unknown.

Qmtc **Talus and colluvium** (Holocene to upper Pleistocene) − Very poorly sorted, angular to subangular cobbles and boulders and finer-grained interstitial sediment deposited by rock fall and slope wash on and at the base of steep slopes; generally less than 20 feet (<6 m) thick.

**Stacked-unit deposits**

Stacked units are here used to denote various surficial and bedrock units, partly eroded by wave action associated with the rise and fall of Lake Bonneville, that are concealed by a discontinuous veneer of lacustrine gravel, sand, silt, or clay; coarser-grained lacustrine facies commonly exhibit intermediate-level shorelines.

Qlgp/Qafo / Qlgb/Qafo **Lacustrine gravel and sand over older alluvial-fan deposits** (upper Pleistocene/upper to lower? Pleistocene) − Thin cover of coarse-grained lacustrine deposits over a deeply dissected alluvial apron (Qafo) emanating from the East Tintic Mountains area; this alluvial apron is truncated by, and thus predates, the Provo shoreline; mapped along the western margin of Goshen Valley.

Qlsb/Mh **Lacustrine sand and silt over the Humbug Formation** (upper Pleistocene/Upper Mississippian) − Mapped in the Mosida Hills in the northwest part of the quadrangle (SW1/4, section 18, T. 8 S., R. 1 W.).

Qlsp/Md **Lacustrine sand and silt over the Deseret Limestone** (upper Pleistocene/Upper to Lower Mississippian) − Mapped in the Mosida Hills in the northwest part of the quadrangle (NE1/4, section 17, T. 8 S., R. 1 W.).

*Unconformity*

### TERTIARY

New formal and informal names herein applied to Tertiary rock units are from units mapped in the adjacent Soldiers Pass quadrangle (see Biek and others, 2006; Christiansen and others, 2007; Biek and others, in press). Also refer to Biek and others (2006) for geochemical data; new geochronologic data are presented by Christiansen and others (2007), and UGS and NMGRL (2007). The low hills south of Goshen Pass (see Goshen Pass quadrangle) were formerly known as the Mosida Hills and the hills between Goshen Pass and Soldiers Pass as the Fox Hills, but are not presently indicated as such on the U.S. Geological Survey topographic base map. Time scale is after International Commission on Stratigraphy (2007).

Tb **Mosida Basalt** (lower Miocene) – Medium-dark-gray, weathering to light-olive-gray and blue-gray, porphyritic, potassic trachybasalt (or absarokite in some classifications) lava flow. Contains phenocrysts (10 to 20%) of olivine ($Fo_{60}$), plagioclase ($An_{60}$ to $An_{70}$), and clinopyroxene (Mg# 0.78 to 0.72) in a fine-grained groundmass; olivine commonly altered to iddingsite (rust-colored blebs); locally vesicular. Forms blocky ledges at two outcrops in the Mosida Hills. Named for nearby exposures (Christiansen and others, 2007; Biek and others, in preparation). Source vent unknown, but probably located near Soldiers Pass. K-Ar age of about 17.0 Ma (McKee and others, 1993), and new $^{40}Ar/^{39}Ar$ age of 19.5 Ma (Christiansen and others, 2007; UGS and NMGRL, 2007). Exposed thickness from 50 to 100 feet (15-30 m); up to 120 feet (40 m) thick in adjacent Soldiers Pass quadrangle (Biek and others, 2006).

*Unconformity*

Tsc **Soldiers Pass Formation, Chimney Rock Pass Tuff Member** (upper Eocene) – Yellowish-gray, weathering to grayish-orange and medium-dark-gray, non-welded, pumice-rich, porphyritic, rhyolitic ash-flow tuff. Contains phenocrysts (20%) of quartz, reversely zoned plagioclase ($An_{30}$ to $An_{50}$), Ba-rich sanidine ($Or_{50}$ to $Or_{75}$), and biotite in a glassy groundmass; also contains pumice fragments (20%) up to 6 inches (15 cm) and lithic fragments. Forms three poor exposures in the Mosida Hills. Named for exposures in Chimney Rock Pass in adjacent Allens Ranch quadrangle, and also well exposed at the “pumice pit” west of Soldiers Pass (Christiansen and others, 2007; Biek and others, in press); source vent unknown. Preliminary $^{40}Ar/^{39}Ar$ age of 34.2 Ma (S.T. Nelson, Brigham Young University, unpublished data), and new $^{40}Ar/^{39}Ar$ age of 34.7 Ma (Christiansen and others, 2007; UGS and NMGRL, 2007). Exposed thickness is 10 feet (3 m); up to 60 feet (20 m) thick in adjacent Soldiers Pass quadrangle (Biek and others, 2006).

*major unconformity*

### MISSISSIPPIAN

Mgb? **Great Blue Formation?, undivided** (Upper Mississippian) – Shown in cross section only.

Mh **Humbug Formation** (Upper Mississippian) – Interbedded calcareous quartz sandstone, quartzite, and limestone that weather to ledgy slopes. Sandstone and quartzite is light- to dark-brown weathering, pale yellowish brown to olive gray, medium to very thick bedded, variably calcareous or siliceous, fine to medium grained, locally with planar or low-angle cross-stratification. Limestone rarely contains dark-gray chert nodules and is: (1) light-gray weathering, medium dark gray, medium to thick bedded, and fine grained with local small white chert blebs; (2) dark gray, very thick bedded with small white calcite blebs; or (3) locally medium to coarse grained with sparse fossil hash. Formation occurs as folded strata in the Mosida Hills. Age from Morris and Lovering (1961). Upper part of formation not present, but exposed thickness is about 500 feet (150 m); the Humbug is 650 feet (200 m) thick in the East Tintic Mountains (Morris and Lovering, 1979), about 700 to 750 feet (210-230 m) thick in the Lake Mountains (Biek, 2004; Biek and others, 2006), and 785 feet (240 m) thick in West Mountain (Clark, 2009).

Md **Deseret Limestone** (Upper to Lower Mississippian) – Medium- to very thick bedded, medium-dark-gray, variably sandy and fossiliferous limestone that contains distinctive white calcite nodules and blebs and local brown-weathering chert nodules and locally brown-weathering bands (case hardened surface); fossils include rugose corals, uncommon brachiopods, crinoids, bryozoans, and fossil hash; locally few thin interbeds of calcareous sandstone. Lower part (about 100 feet [30 m]) is marked by slope-forming, light-red to dark-gray phosphatic shale and thin-bedded cherty limestone of the Delle Phosphatic Member. Formation occurs as folded strata in the Mosida Hills. Upper contact is conformable and gradational and corresponds to a change from fossiliferous limestone (Deseret) to predominantly sandstone (Humbug). Age from Morris and Lovering (1961), and Sandberg and Gutschick (1984). Thickness is about 1000 feet (300 m) from cross section construction; the Deseret is 1000 feet (300 m) thick in the East Tintic Mountains (Morris and Lovering, 1979), about 700 to 750 feet (210-230 m) thick in the Lake Mountains (Biek, 2004; Biek and others, 2006), and 765 feet (235 m) thick in West Mountain (Clark, 2009). Previously mapped as the Pine Canyon limestone (Hoffman, 1951).

Mg **Gardison Limestone** (Lower Mississippian) – Medium- to very thick bedded, medium-gray to medium-dark-gray limestone, cherty limestone, and fossiliferous limestone. Chert is present as black, irregularly shaped nodules and thin, discontinuous beds; fossils include rugose and colonial corals, brachiopods, gastropods, and bryozoans replaced by white calcite. Formation occurs as folded strata in Mosida Hills; queried in exposure adjacent to Tintic Prince fault? where uncertain correlation. Upper contact appears conformable and gradational and generally corresponds to a break in slope, with ledgy, thicker bedded, cherty limestone below and slope-forming shale and thin-bedded limestone (Delle) above. Age from Morris and Lovering (1961). Base not exposed in quadrangle. Thickness is 500 feet (150 m) in East Tintic Mountains (Morris and Lovering, 1961), about 500 to 650 feet (150-200 m) thick in Lake Mountains (Biek, 2004; Biek and others, 2006), and 620 feet (190 m) thick in West Mountain (Clark, 2009). The Gardison Limestone and underlying Fitchville Formation were previously mapped as the Gardner dolomite (Hoffman, 1951).

## PREVIOUS WORK AND ACKNOWLEDGMENTS

Harold J. Bissell, Brigham Young University (BYU), conducted the first geologic mapping of surficial deposits in this area as part of his Ph.D. dissertation (1948), later published as part of a USGS Professional Paper (1963). He advised BYU graduate students Hoffman (1951) and Williams (1951) on mapping projects within and adjacent to the quadrangle, respectively. The late Paul Proctor, Brigham Young University, mapped the adjacent Allens Ranch quadrangle under contract to the Utah Geological Survey (UGS) (Proctor, 1985). This area also served as a training ground for field classes led by Eric H. Christiansen at BYU, and several recent BYU undergraduate students contributed to the understanding of the southern Lake Mountains, Fox Hills, and Mosida Hills. Baxter and others (2005) and Christiansen and others (2007) recently conducted petrologic, geochemical, and geochronologic analyses on the Tertiary volcanic rocks of the area. UGS staff Barry Solomon, Grant Willis, and Robert Ressetar reviewed this map, while Kent Brown set up the digital photogrammetry, and Jim Parker and Lori Douglas prepared the drawings for plate 2.

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## GEOLOGIC SYMBOLS

- Contact – Dashed where approximately located
- Normal fault – Dashed where approximately located, dotted where concealed and approximately located; bar and ball on down-dropped side
- Normal fault, concealed – Inferred principally from gravity and other geophysical data (Brimhall and others, 1976; Floyd, 1993; Cook and others, 1997); very approximately located; bar and ball on down-dropped side
- Oblique-slip fault – Dotted where concealed and approximately located; arrows, bar and ball, and ● (toward) + (away) symbols show relative direction of displacement
- Thrust or reverse fault – Dashed where approximately located, dotted where concealed and approximately located; teeth on upper plate
- Axial trace of anticline – Dashed where approximately located; dotted where concealed and approximately located
- Axial trace of syncline – Dashed where approximately located; dotted where concealed and approximately located
- Shorelines of the Bonneville lake cycle – Mapped at the top of the wave-cut platform of erosional shorelines and top of constructional bars and barrier beaches; may coincide with geologic contacts; Bonneville shoreline not present in quadrangle
  - Y — Other transgressive shorelines
  - P — Provo shoreline
  - X — Other regressive shorelines
- Crest of Lake Bonneville barrier beach or spit
- Utah Lake shorelines –
  - U — Utah Lake highstand and contact between Qlmy and other surficial deposits
  - W — Other Utah Lake shorelines
- Strike and dip of bedding in sedimentary rocks
  - 20 — Inclined
  - Inclined – approximate
  - Vertical
- x — Prospect
- Sand and gravel pit
- A——A' Line of cross section

## LITHOLOGIC COLUMN

| TIME-STRATIGRAPHIC UNIT | | | MAP UNIT | | MAP SYMBOL | THICKNESS Feet (Meters) | LITHOLOGY |
|---|---|---|---|---|---|---|---|
| TERT. | Mio. | lower | Mosida Basalt | | Tb | 50-100 (20-30) | 19.5 Ma Ar/Ar |
| TERT. | Eo. | upper | Soldiers Pass Formation | Chimney Rock Pass Tuff Mbr. | Tsc | 10+ (3+) | Unconformity; 34.7 Ma Ar/Ar |
| Major unconformity | | | | | | | |
| MISSISSIPPIAN | Upper | | Humbug Formation | | Mh | 500+ (150+) | Top not exposed |
| MISSISSIPPIAN | Upper | | Deseret Limestone | | Md | 1000 (300) | Delle Phosphatic Member |
| MISSISSIPPIAN | Lower | | Gardison Limestone | | Mg | 400+ (120+) | Base not exposed |

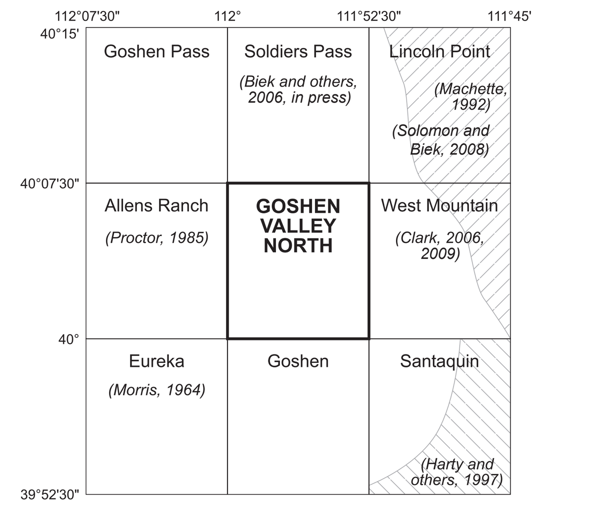


**Figure 2.** Index map showing selected geologic maps available for the Goshen Valley North and adjacent 7.5' quadrangles.

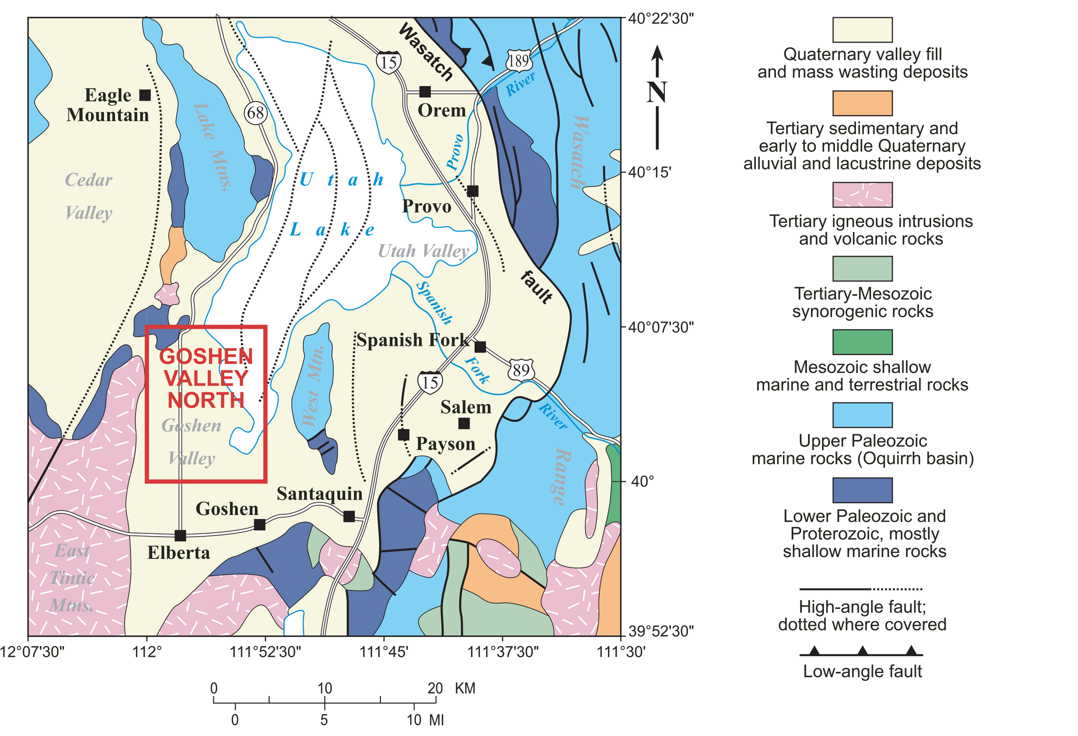


Figure 1. Index map showing primary geographic features and generalized geology in the vicinity of the Goshen Valley North quadrangle. Modified from Hintze and others (2000).

*Table 1. Ages and elevations of major shorelines of Lake Bonneville and Utah Lake in the Goshen Valley North quadrangle.*

| Lake Cycle and Phase | Shoreline (map symbol) | Age: radiocarbon years B.P. | Age: calendar years B.P.[1] | Elevation feet (meters) |
|---|---|---|---|---|
| Lake Bonneville | | | | |
| Transgressive Phase | Stansbury | 22,000-20,000[2] | 24,400-23,200 | Not exposed |
| | Bonneville (flood) | 15,500-14,500[3] | 18,000-16,800 | Not exposed |
| Regressive Phase | Provo (P) | 14,500-12,000[4] | 16,800-13,500[5] | 4760-4780 (1451-1457) |
| | Gilbert | 11,000-10,000[6] | 12,800-11,600 | Not exposed |
| Utah Lake | | | | |
| | Utah Lake highstand (U) | 12,000-11,500[7] | ----- | 4500-4505 (1372-1373) |

[1]Calendar-calibrated ages of most shorelines have not been published. Calendar-calibrated ages shown here, except for the age of the end of the Provo shoreline, are from D.R. Currey, University of Utah (written communication to Utah Geological Survey, 1996; cal yr B.P. = 1.16 $^{14}C$ yr B.P.).
[2]Oviatt and others (1990); Currey (written communication to Utah Geological Survey, 1996, assumed a maximum age for the Stansbury shoreline of 21,000 $^{14}C$ yr B.P., which is used in the conversion to calendar years).
[3]Oviatt and others (1992), Oviatt (1997).
[4]Godsey and others (2005) revised the timing of the occupation of the Provo shoreline and subsequent regression; Oviatt and others (1992) and Oviatt (1997) proposed a range from 14,500 to 14,000 $^{14}C$ yr B.P. Oviatt and Thompson (2002) summarized many recent changes in the interpretation of the Lake Bonneville radiocarbon chronology.
[5]Calendar-calibrated age of the end of the Provo shoreline estimated by interpolation from data in Godsey and others (2005), table 1, who used Stuiver and Reimer (1993) for calibration.
[6]Murchison (1989), figure 20.
[7]Estimated from data in Godsey and others (2005); Machette (1992) estimated the age of the regression of Lake Bonneville below the Utah Valley threshold at 13,000 $^{14}C$ yr B.P. from earlier data.

## CORRELATION OF MAP UNITS