IDAHO GEOLOGICAL SURVEY
MOSCOW-BOISE-POCATELLO

DIGITAL WEB MAP 12
OTHBERG, BRECKENRIDGE, AND WEISZ

SURFICIAL GEOLOGIC MAP OF THE LAPWAI QUADRANGLE, NEZ PERCE COUNTY, IDAHO

Disclaimer: This Digital Web Map is an informal report and may be revised and formally published at a later time. Its content and format may not conform to agency standards.

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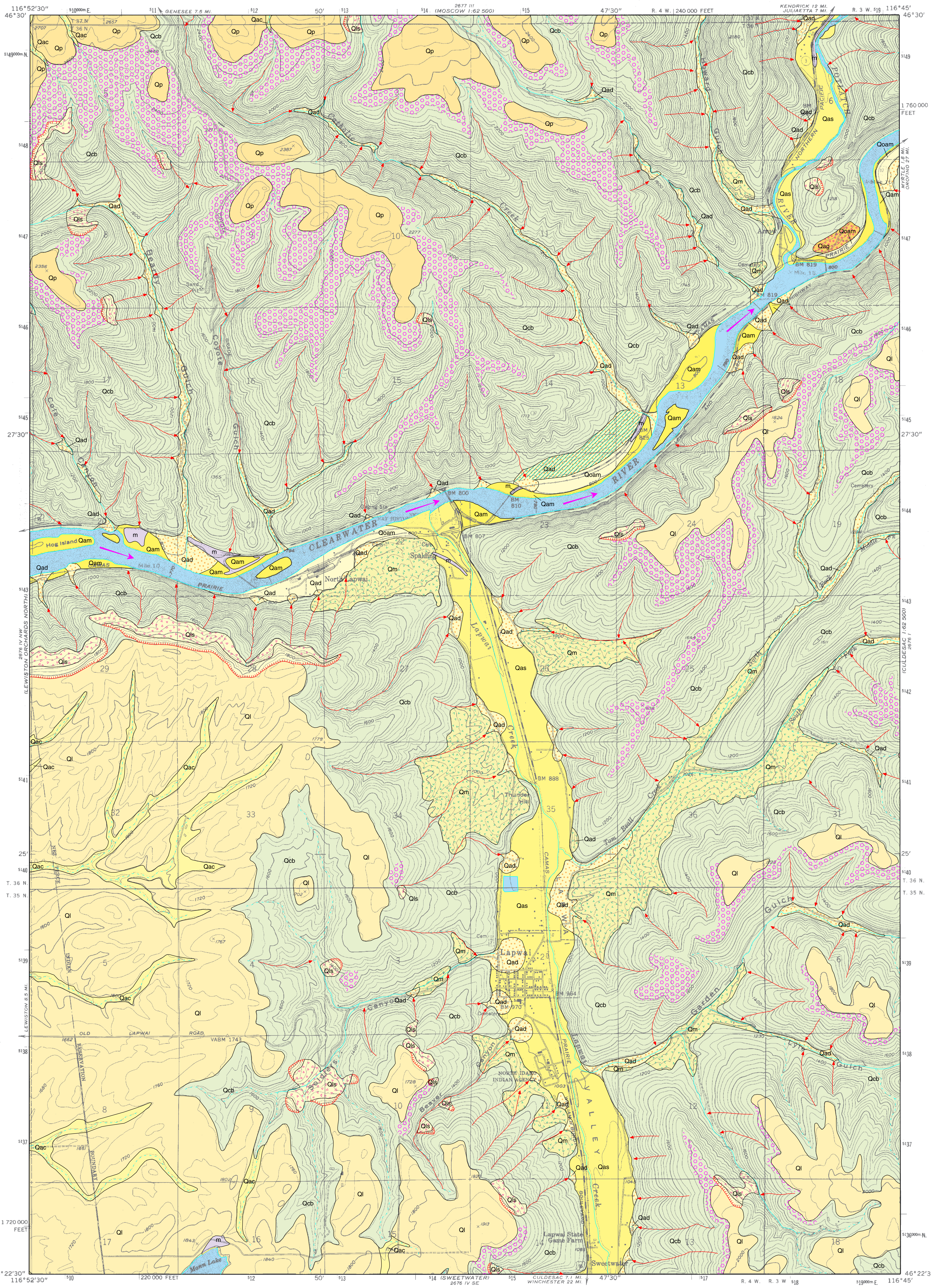
2003



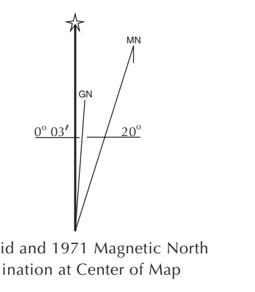
Base map from USGS digital raster graphic 1972.

Topography by photogrammetric methods from aerial photographs taken 1955. Field checked 1958.

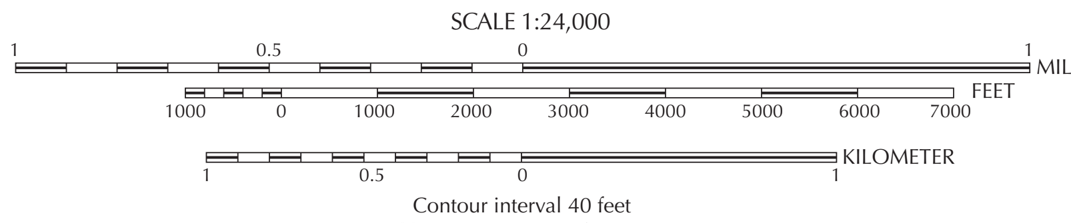
Polyconic projection. 1927 North American Datum.

10,000-foot grid ticks based on Idaho coordinate system, west zone.

1000-meter Universal Transverse Mercator grid ticks, zone 11.



UTM Grid and 1971 Magnetic North Declination at Center of Map



Contour interval 40 feet
Dotted lines represent 20-foot contours

QUADRANGLE LOCATION

Field work conducted 1999-2000.

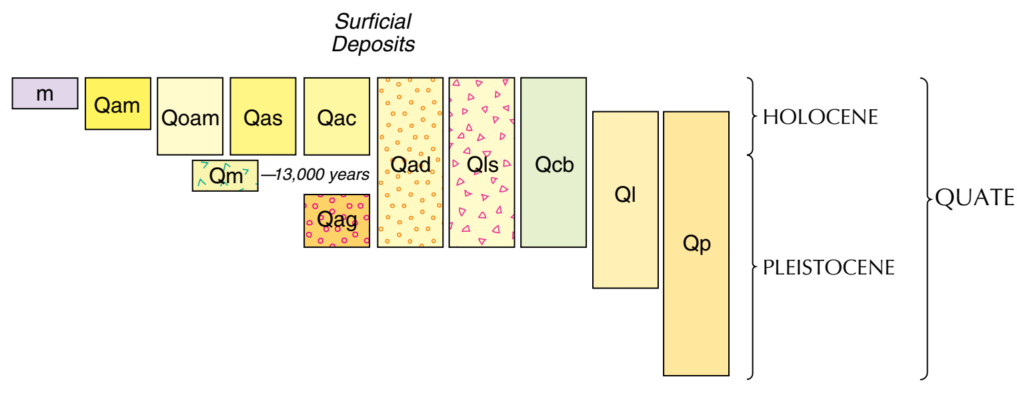
Field work and map preparation funded in part by U.S. Geological Survey's STATEMAP Program.

Reviewed by Terry Howard.

Digital cartography by Jane S. Freed at the Idaho Geological Survey's Digital Mapping Lab.

Map version 6-25-03.

CORRELATION OF MAP UNITS



INTRODUCTION

The surficial geologic map of the Lapwai quadrangle identifies earth materials on the surface and in the shallow subsurface. It is intended for those interested in the area's natural resources, urban and rural growth, and private and public land development. The information relates to assessing diverse conditions and activities, such as slope stability, construction design, sewage drainage, solid waste disposal, and ground-water use and recharge.

The geology was intensively investigated during a one-year period. Natural and artificial exposures of the geology were examined and selectively sampled. In addition to field investigations, aerial photographs were studied to aid in identifying boundaries between map units through photogeologic mapping of landforms. In most areas map-unit boundaries (contacts) are approximate and were drawn by outlining well-defined landforms. It is rare that contacts between two units can be seen in the field without excavation operations which are beyond the purpose and scope of this map. The contacts are inferred where landforms are poorly defined and where lithologic characteristics grade from one map unit into another. The precision of a contact with respect to actual topography also depends on the accuracy and scale of the topographic base. Details depicted at this scale, therefore, provide an overview of the area's geology. Further intensive analyses at specific locations should be arranged through independent geotechnical specialists.

Lapwai Creek and the Clearwater River are the prominent features on the map. Lapwai Creek drains the escarpment of the plateau just south of the quadrangle, which is the southern boundary of the Lewiston basin. The basin is a crustal depression between the Northern Rocky Mountains, the Blue Mountains, and the Palouse portion of the Columbia Plateau. Miocene basalt flows of the Columbia River Basalt Group are folded in this part of the Lewiston basin, and the streams have cut deeply into the basalt. Sediments of the Latah Formation are interbedded with basalt flows in the basin, reflecting the effect of tectonic deformation on the drainage system. In the late Pleistocene, Lapwai Creek and the Clearwater River were inundated by Lake Missoula Floods. Several times the catastrophic flood waters reversed the flow of the Clearwater River and Lapwai Creek depositing silt, sand, and ice-rafted cobbles and boulders in the valleys up to an elevation of 1,200 feet. The cooler and dryer climate of the Pleistocene brought on the cyclical deposition of wind-blown silt that forms the loess capping basalt flows on the gently sloping surfaces west of Lapwai. The flooding potential of Lapwai Creek is represented by youthful channel and flood plain deposits that form the bottom of the valley.

The map on the bedrock geology of the Lapwai quadrangle by Bush and Garwood (2001) details the Columbia River basalt flows and the folds and faults that have deformed the rocks. The bedrock map's cross section is especially useful for interpreting subsurface conditions suitable for siting water wells and assessing the extent and limits of ground water in the area.

DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

m **Made ground (Holocene)**—Large-scale artificial fills composed of excavated, transported, and emplaced construction materials of highly varying composition, but typically derived from local sources.

Qam **Alluvium of mainstreams (Holocene)**—Channel and flood-plain deposits of the Clearwater River that are actively being formed on a seasonal or annual basis. Two grain-size suites are typically present: Well-sorted and rounded sandy gravel of river bars and islands, and coarse sand forming thin shoreline deposits. The gravel includes clasts of basaltic, granitic, and metamorphic rocks. Soils developed in mainstream alluvium include riverwash-aquents and the Bridgewater, Lapwai, Joseph series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qoam **Older alluvium of mainstreams (Holocene)—**Fine- to coarse-grained bedded sand and silty sand overlying river channel gravel. These alluvial deposits form one or more levels of old point bars and flood plains that are younger than the Lake Missoula Floods backwater deposits, but older than alluvium of the present river. Surface heights above present mean water level range from 9 to 45 feet. Relative heights and soil characteristics suggest a late Holocene age, and the lower of these surfaces may have been inundated by the highest seasonal flood waters before the stream flows were controlled by Dworshak dam. The sand overlying channel gravel is several feet thick. Soils developed in older mainstream alluvium include the Lapwai, Bridgewater, Uhlig, and Wistona series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qas **Alluvium of side streams (Holocene)**—Channel and flood-plain deposits of Lapwai Creek and the Potlatch River. Primarily coarse channel gravel deposited during high-energy stream flows. Subrounded to rounded pebbles, cobbles, and boulders of basalt in a sand matrix. Moderately stratified and sorted. Includes intercalated colluvium and debris flow deposits from steep side slopes. Braided channel features in the valley floor of Lapwai Creek are visible on aerial photographs, indicating recent flood-plain activity. Low terraces in Lapwai Creek valley have a silty surface and probably grade to the older point bars of the Clearwater River (*Qoam*). Soils developed in side-stream alluvium include the Bridgewater, Joseph, Lapwai, and Tombeall series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qac **Alluvium and colluvium (Holocene)**—Stream, slope-wash, and gravity deposits. Predominantly beds of silt, clay, and sand derived from erosion of adjacent units. Stream deposits typically are thin and interfinger with laterally thickening deposits of slope wash and colluvium derived from local loess deposits and weathered basalt. Soils developed in these deposits include the Alpowa, Broadax, and Lickskillet series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qad **Alluvial-fan and debris-flow deposits (Holocene and Pleistocene)**—Primarily crudely bedded, poorly sorted brown muddy gravel shed from canyon slopes of basalt colluvium. Gravel is composed of subangular and angular pebbles, cobbles, and boulders of basalt in a matrix of granules, sand, silt, and clay. May include beds of silt and sand derived from reworked loess, Mazama ash, and Lake Missoula Floods backwater deposits. Thickness varies, but typically ranges from 6-50 feet. Fans composed of alluvium and debris-flow deposits commonly occur in canyon bottoms below steep debris-flow chutes (see Symbols).

Qls **Landslide deposits (Holocene and Pleistocene)**—Poorly sorted and poorly stratified angular basalt cobbles and boulders mixed with silt and clay. Landslide deposits include debris slides as well as blocks of basalt, sedimentary interbeds that have been rotated and moved laterally. Debris slides mainly composed of unstratified, unsorted gravel rubble in a clayey matrix. In addition to the landslide deposit, the unit may include the landslide scarp and the headwall (steep area adjacent to and below the landslide scarp) from which material broke away (see Symbols). The headwall area may include talus formed after landslide movement. Location of landslide deposits in canyons is controlled by the presence of sedimentary interbeds and the hydrogeologic regime. The largest landslides occur where canyon-cutting has exposed landslide-prone sediments to steep topography. Slope failures have occurred where the fine-grained sedimentary interbeds are saturated by ground water moving toward the valleys. This relationship is so prevalent that the major sedimentary interbeds may be traced by locating landslide deposits along the valley sides. The landslides range in age from ancient, relatively stable features, to those that have been active within the past few years. The factors that cause landslides have been prevalent in the region for thousands of years. The frequency of landsliding may have been greater in the Pleistocene. Today, initiation and reactivation of landslides is closely tied to unusual climatic events and land-use changes. Even small landslide activity on the upper parts of canyon slopes can transform into high-energy debris flows that endanger roads, buildings, and people below (see *Debris-flow chute* under Symbols). Landslide debris is highly unstable when modified through natural variations in precipitation, artificial cuts, fills, and changes to surface drainage and ground water.

Qcb **Colluvium from basalt (Holocene and Pleistocene)**—Primarily poorly sorted brown muddy gravel composed of angular and subangular pebbles, cobbles, and boulders of basalt in a matrix of silt and clay. Emplaced by gravity movements on steep-sided canyons and gullies cut into Columbia River basalt. Includes outcrops of basalt that are common on steep, dry, southerly aspects where colluvium is thinner and the more erosion-resistant basalt flows form laterally traceable ledges. More gently sloping areas are mantled with thin loess (typically 1-5 feet thick), especially near boundaries with loess (*Ql* and *Qp*). Distribution and thickness of colluvium is dependent on slope aspect, upper and lower slope position, basalt and sediment stratigraphy, and association with landslides. Colluvium is thin and associated with many basalt outcrops on dry, southerly facing slopes, and may exhibit patterned-ground features (see Symbols). Colluvium is thicker on north- and east-facing slopes, and is associated with landslides (*Qls*) and debris-flow chutes (see Symbols), especially where more moisture is retained and where sedimentary interbeds are present. Areas of thicker colluvium have fewer outcrops of basalt, and the surface may have a patterned ground of crescent-shaped lobes of colluvium, probably relicts of Pleistocene solifluction. Unit includes landslides too small to map separately, and talus below cliffs and ledges of basalt. Colluvium typically increases in thickness toward the base of slopes where it interfingers with alluvium in valley bottoms. May include all of valley-bottom sediment where streams have little discharge or are ephemeral. Soils developed in basalt colluvium include the Almota, Alpowa, Kettenbach, Lickskillet, Linville, and Waha series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

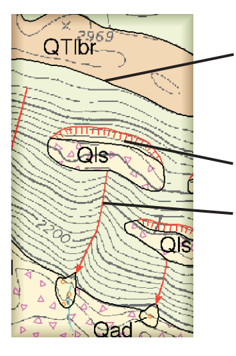
Ql **Loess (Holocene and Pleistocene)**—Calcareous wind-blown silt; sandy near Lake Missoula Floods deposits. Exposures show one to several layers of loess that represent periods of rapid deposition of air-borne dust. Thickest layers may have formed immediately after Lake Missoula Floods backwater events in the Clearwater River and Lapwai Creek valleys. Buried soils mark the tops of loess depositional units. Forms cap on youngest Lake Missoula Floods deposits and blankets the relatively flat dip-slope surface of basalt. Partly correlates with the Palouse Formation, but lacks the distinctive Palouse Hills of the eastern Columbia Plateau, and unlike the Palouse Formation, is predominantly composed of a single late Pleistocene deposit. Thickness 5-20 feet based on well logs, field observations, and map relationships. In some areas apparent thickness based on topography may be misleading, and relief is due to erosion of underlying basalt surface before loess deposition. Thickness may be greater than 20 feet on some north-facing slopes where it is thickened by primary wind drift and where vegetation prevents subsequent erosion. Loess is thinnest on steep, south-facing slopes where sheet wash erosion is common. Thin loess with Holocene soil development caps Lake Missoula Floods backwater sediments, and probably represents rapid deposition following the Lake Missoula Floods at the end of the Pleistocene. Loess less than 5 feet is not included in this unit, but thin loess is a common soil parent material throughout the map area (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999). Soils developed in loess include the Broadax, Hatwai, Naff, Palouse, and Slickpoo series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qp **Palouse Formation (Holocene and Pleistocene)**—Silty and clayey loess of the Palouse hills. Remnants of Palouse hills occur in the north part of the quadrangle, but are mostly found in adjoining areas to the north where the Palouse Formation blankets Miocene basalt flows of the eastern Columbia Plateau and forms hills of loess up to 200 feet thick (Othberg and others, 2001a, 2001b). In the Palouse hills, many layers of loess represent periods of rapid deposition from air-borne dust transported into the Palouse from the Pasco basin. Buried soils mark the tops of most depositional units, which form complex surface and subsurface patterns that are discontinuous and difficult to map. Thicker loess includes middle- to early-Pleistocene deposits that are locally exposed through erosion or in artificial cuts. Where loess is thin, it is mostly Holocene and late Pleistocene in age. Previous usage mostly restricted the Palouse Formation to the Pleistocene (see Newcomb, 1961; Keroher, 1966; Richmond and others, 1965; Ringe, 1968; Griggs, 1973; Foley, 1982; Schuster and others, 1997). Holocene loess, however, was included in the Palouse Formation by Hooper and Webster (1982) and Hooper and others (1985). Along boundaries between Palouse hills and canyon slopes, thick loess gradually thins into a patterned ground formed in basalt colluvium (*Qcb*) at the upper surface of basalt units (see Symbols). The soils developed in the Palouse Formation form a pattern that reflects the complex interaction of erosion and deposition of loess throughout the Quaternary. These soils include the Athena, Naff, Palouse, and Thatuna series (Barker, 1981; U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qm
Qm **Lake Missoula Floods backwater deposits (Pleistocene)**—Rhythmites deposited when backwaters from Lake Missoula Floods inundated the Clearwater River and Lapwai Creek valleys. Primarily alternating thin beds of gray sand and pale brown silt. Cross-bedded, dark-gray, basalt-rich granule gravel and coarse sand may be present at the base. Includes cut and fill structures and sandy clastic dikes. Similar depositional environment, sedimentology, and age as Lake Missoula Floods rhythmites of eastern Washington (Smith, 1993; Waitt, 1980, 1985). Typically capped by 1-3 feet of loess. Commonly reworked into sandy, silty colluvium. Found locally up to 1,200 feet in elevation, the approximate maximum flood level. Mapped as a diagonal line pattern where sandy, silty rhythmites mantle deposits of debris flows and alluvial fans (*Qad*). Downstream at Lewiston in the Snake River valley, Lake Missoula Floods backwater deposits overlie Bonneville Flood gravel. In the Clearwater River drainage, Bonneville Flood deposits have not been recognized. Lake Missoula Floods temporarily reversed the course of the Clearwater Rivers within the area of backwater inundation (see *Flow direction* in Symbols). The Chard and Uhlig series are the most common soils formed in Lake Missoula Floods deposits (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

Qag **Alluvial gravel (Pleistocene)—**Well-rounded pebble and cobble gravel of remnant point bars that range 52 to 78 feet above the Clearwater River. Gravel poorly exposed owing to mantle of Lake Missoula Floods backwater sediments (*Qm*). Interfingers with colluvium and debris-flow deposits at toe of canyon slope. The gravel was deposited by the ancestral Clearwater River prior to the latest Lake Missoula Floods and may have formed during periodic greater discharges of the river during the Wisconsin glaciation. Soils mapped in areas of Pleistocene alluvial gravel include the Chard and Uhlig series (U.S. Department of Agriculture, Natural Resources Conservation Service, 1999).

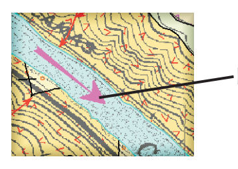
SYMBOLS



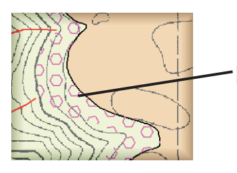
Contact: Line showing the approximate boundary between one map unit and another. The apparent ground width of the line representing the contact is about 80 feet at this scale (1:24,000).

Landslide scarp and headwall: Ticks show top of scarp.

Debris-flow chute in canyons. High-energy, short duration floods and debris flows may occur in these chutes in response to severe climatic conditions, such as thunderstorms and rain-on-snow events. Debris flows can also be triggered by landslides. These events are historically infrequent, dependent on weather, with a recurrence cycle on the order of years to decades. The most prominent debris-flow chutes are shown on the map, but any steep-gradient valley sides and canyon bottoms have the potential for these catastrophic events. Thin and discontinuous alluvial-fan and debris-flow deposits (*Qad*) may be present, but are not mappable at this scale.



Flow direction of Lake Missoula Floods backwater inundation.



Patterned ground associated with the weathered, differentially eroded surface of basalt. Pattern consists of regularly spaced, subround fracture system in basalt with silty mounds between fractures. Silty mounds give way to fractured basalt downslope, but thicken upslope where they gradually obscure the fracture pattern and merge with loess deposits or weathered basalt. Probably formed by stripping of loess from the basalt surface through Pleistocene periglacial processes. Original patterned-ground features destroyed by field plowing in many locations.

REFERENCES

Bush, J.H. and D.L. Garwood, 2001, Bedrock geologic map of the Lapwai quadrangle, Nez Perce County, Idaho: Idaho Geological Survey Technical Report 01-1, scale 1:24,000.

Foley, L.L., 1982, Quaternary chronology of the Palouse loess near Washtucna, eastern Washington: Western Washington University M.S. thesis, 137 p.

Griggs, A.B., 1973, Geologic map of the Spokane quadrangle, Washington, Idaho, and Montana: U.S. Geological Survey Miscellaneous Geologic Investigations Map I-768, scale 1:250,000.

Hooper, P.R., G.D. Webster, and V.E. Camp, 1985, Geologic map of the Clarkston 15-minute quadrangle, Washington and Idaho: Washington Division of Geology and Earth Resources Geologic Map GM-31, scale 1:48,000.

Hooper, P.R., and G.D. Webster, 1982, Geology of the Pullman, Moscow West, Colton, and Uniontown 7½N quadrangles, Washington and Idaho: Washington Division of Geology and Earth Resources Geologic Map GM-26, scale 1:62,500.

Keroher, G.C., 1966, Lexicon of geologic names of the United States, 1936-1960: U.S. Geological Survey Bulletin 1200, 4341 p.

Newcomb, R.C., 1961, Age of the Palouse Formation in the Walla Walla and Umatilla River basins, Oregon and Washington: Northwest Science, v. 35, p. 122-127.

Othberg, K.L., R.M. Breckenridge, and D.W. Weisz , 2001a, Surficial Geologic Map of the Green Knob Quadrangle, Latah and Nez Perce Counties, Idaho, Idaho Geological Survey Surficial Geologic Map 10, scale 1:24,000.

Othberg, K.L., R.M. Breckenridge, and D.W. Weisz , 2001b, Surficial Geologic Map of the Genesee Quadrangle and Part of the Uniontown Quadrangle, Latah and Nez Perce Counties, Idaho: Idaho Geological Survey Surficial Geologic Map 13, scale 1:24,000.

Richmond, G.M., R. Fryxell, G.E. Neff, and P.L. Weis, 1965, The Cordilleran ice sheet of the Northern Rocky Mountains and related Quaternary history of the Columbia Plateau, in H.E. Wright and D.G. Frey, eds., The Quaternary of the United States: New Jersey, Princeton University Press, p. 231-242.

Ringe, L.D., 1968, Geomorphology of the Palouse hills, southeastern Washington: Washington State University Ph.D. dissertation, 73 p.

Schuster, J.E., C.W. Gulick, S.P. Reidel, K.R. Fecht, and S. Zurenko, 1997, Geologic map of Washington–southeast quadrant: Washington Division of Geology and Earth Resources Geologic Map GM-45, scale 1:250,000.

Smith, G.A., 1993, Missoula flood dynamics and magnitudes inferred from sedimentology of slackwater deposits on the Columbia Plateau, Washington: Geological Society of America Bulletin. v. 105, p. 77-100.

U.S. Department of Agriculture, Natural Resources Conservation Service, 1999, Soil survey geographic (SSURGO) database for Lewis and Nez Perce counties: USDA-NRCS Soil Survey Division, National SSURGO Database Data Access, ID611, http://www.ftw.nrcs.usda.gov/ssur_data.html.

Waitt, R.B., Jr., 1985, Case for periodic, colossal jökulhaups from Pleistocene glacial Lake Missoula: Geological Society of America Bulletin, v. 95, p. 1271-1286.

Waitt, R.B., Jr., 1980, About 40 last-glacial Lake Missoula jökulhaups through southern Washington: Journal of Geology, v. 88, p. 653-679.

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