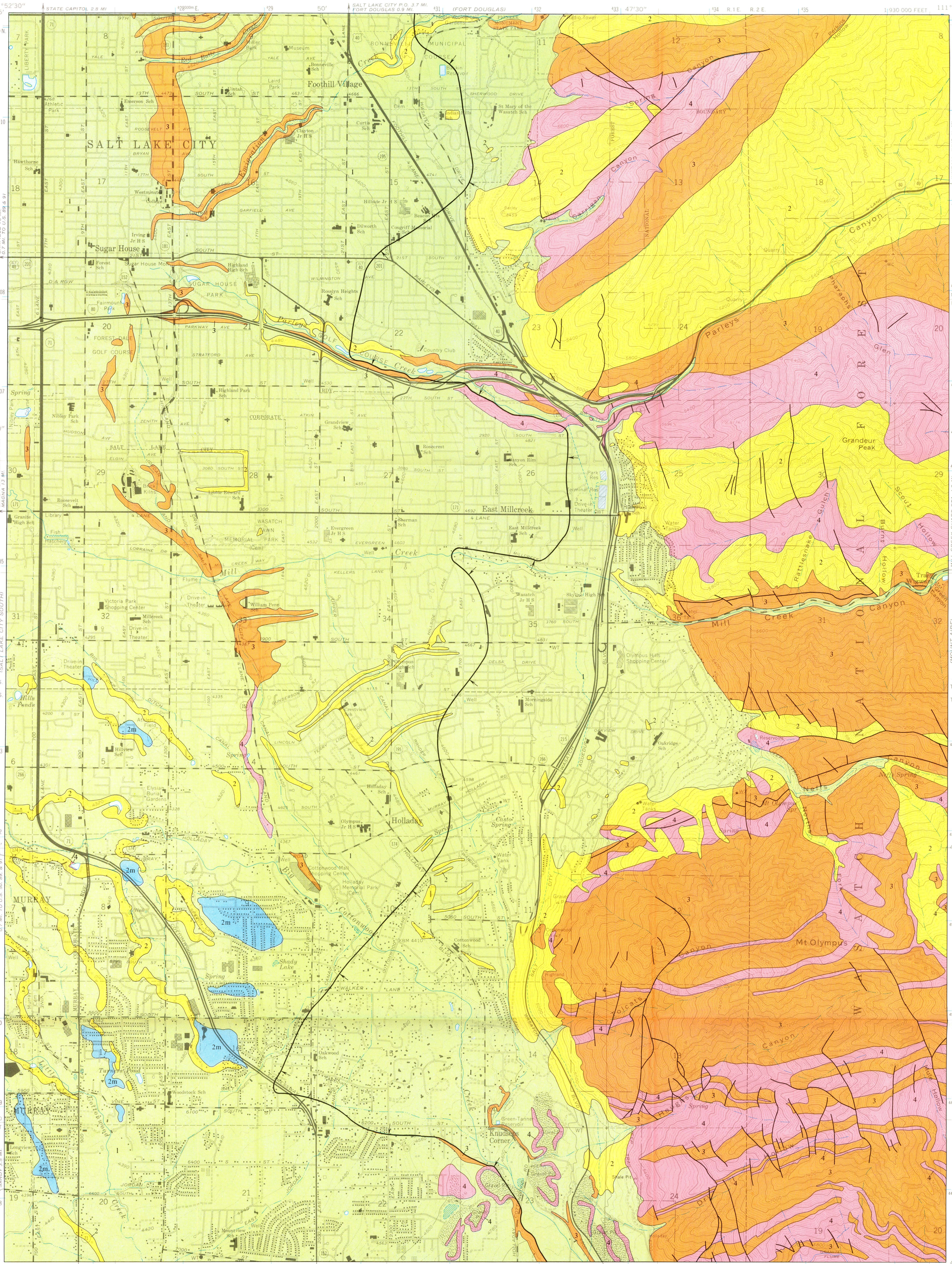
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

FOLIO OF THE
SUGAR HOUSE QUADRANGLE, UTAH
MAP I-766-E



Base from U.S. Geological Survey, 1963
Photorevised in 1969
10,000-foot grid based on Utah coordinate system, central zone
1000-meter Universal Transverse Mercator grid ticks, zone 12, shown in blue

APPROXIMATE MEAN DECLINATION, 1972

SCALE 1:24 000

CONTOUR INTERVAL 40 FEET
DOTTED LINES REPRESENT 10-FOOT CONTOURS
DATUM IS MEAN SEA LEVEL

QUADRANGLE LOCATION

Boundaries of units modified from Crittenden, (1965) and Van Horn (1972)

NOTE
Places that may appear stable on this map may be undesirable if other characteristics are evaluated.

RELATIVE SLOPE STABILITY MAP OF THE SUGAR HOUSE QUADRANGLE, SALT LAKE COUNTY, UTAH

By
Richard Van Horn
1972

EXPLANATION

1 — MOST STABLE (CLASS 1) – These slopes are thought to be the most stable areas in the quadrangle. They consist entirely of surficial material; bedrock was excluded from class-1 slopes because it mostly is associated with very steep slopes and is generally subject to creep of surface layers. Included in class-1 slopes are: all artificial fill associated with Highway I-80; slopes of less than 8 percent that are underlain by other artificial fill and by lake-deposited clay and silt; and slopes of less than 30 percent that are underlain by alluvial fan deposits and lake-deposited sand and gravel.

2 — GENERALLY STABLE (CLASS 2) – These slopes are potentially less stable than class-1 slopes but more stable than class-3 slopes. Class-2 slopes include: all glacial deposits; slopes between 45 percent and 30 percent that are underlain by lake-deposited sand and gravel; slopes between 45 percent and 8 percent that are underlain by lake-deposited clay and silt not associated with springs; slopes greater than 30 percent that are underlain by alluvial fan deposits; slopes of more than 8 percent that are underlain by artificial fill, except for artificial fill associated with Highway I-80; and bedrock formations consisting of thin beds of, or alternating thin beds of, limestone, sandstone, and shale that tend to weather and erode into gently rounded subsidiary ridges and valley sides (Twin Creek Limestone, Thaynes Formation, Park City Formation, and Doughnut Formation).

2m — Generally stable (class 2m) – This unit consists entirely of slopes of less than 3 percent that are underlain by filled or drained marshy areas (not present on steeper slopes). I have not examined buildings in these areas so cannot say if they have undergone more than average deterioration. I also do not know if permanent drainage facilities have been installed in the marshy areas, or if they have been merely filled by a few feet of earth. The concept of a new subdivision built over a former marsh is, however, suspect, and I have classified former marshy areas as less stable. This would indicate that a planner, developer, or prospective owner should at least investigate the stability of this material.

3 — MODERATELY STABLE (CLASS 3) – This class of slope includes surficial deposits that underlie steep slopes or that are associated with springs, as well as bedrock that may be a source of falling rock. Included in class-3 slopes are: slopes greater than 45 percent underlain by lake-deposited clay and silt not associated with springs, and sand except for dry sand; slopes between 100 percent and 45 percent underlain by lake-deposited gravel; slopes between 45 percent and 8 percent underlain by lake-deposited clay and silt associated with springs; and bedrock formations consisting of thick beds of hard and brittle quartzite, sandstone, limestone, and dolomite that are subject to rock falls when they form steep slopes adjacent to the main ridges extending into the mountains (Nugget Sandstone, Weber Quartzite, Round Valley Limestone, Humbug Formation, Deseret Limestone, Gardison Limestone, Fitchville Formation, Maxfield Limestone, Tintic Quartzite, Mutual Formation, and quartzite units in the Big Cottonwood Formation).

4 — POTENTIALLY UNSTABLE (CLASS 4) – These potentially unstable slopes are underlain by all known landslide deposits and, in addition, all other rocks and surficial deposits similar to those involved in landslides that have slopes and indications of springs similar to the ones found at the landslides. Also included in this class is a zone 100 feet wide along faults in bedrock. Rock of any type which is in such a zone is presumed to be fractured and would therefore be potentially unstable. The potentially unstable slopes include: all landslide deposits; slopes greater than 100 percent underlain by lake-deposited gravel; slopes greater than 45 percent underlain by lake-deposited dry sand and by lake-deposited clay and silt that are associated with springs (the latter locally includes some slopes of less than 45 percent); talus, which is present only beneath slopes greater than 30 percent; and bedrock formations consisting of shale, mudstone, siltstone, and shaly sandstone that weather into plastic debris, erode readily, and tend to form valleys (Ankareh Formation, Woodside Shale, Ophir Formation and shale or siltstone units in the Big Cottonwood Formation).

PROBABLE MUDFLOW BOUNDARY – Mudflows pose a special problem of classification for this map because they are the transporting medium between weathered material on potentially unstable slopes and deposits on stable flatter ground subject to water flooding. The previously existing slope at places where a mudflow comes to rest is not necessarily unstable. The new slope formed by the mudflow will occupy an area classified as potentially unstable because it may be covered by later mudflows. The probable mudflow boundary is at the probable maximum westward extent of mudflows originating in any of the small valleys in the Wasatch Range shown on this map and is determined from: (1) slope, (2) extent of previous mudflows incorporated into alluvial fan deposits, (3) drainage area of valleys in the Wasatch Range, and (4) rock types present in the valleys. Most mudflows will not flow more than a few hundred feet beyond the mountain front, but some of the very largest might reach or even pass the boundary.

FAULT – Shown only in bedrock where a zone as much as 50 feet in width on either side of the fault may consist of fractured rock that is potentially unstable.

INTRODUCTION

Although we often speak of "terra firma" (firm earth), the surface of the earth is actually in constant motion. The amount and rapidity of surface movement varies from catastrophic landslides to the nearly imperceptible rise and fall caused by earth tides, determinable only by delicate instruments. A stable slope, as the term is used herein, is one that I believe will not have any significant component of outward and downward movement but will remain in its original position. Conversely, an unstable slope is one in which any part is subject to significant outward and downward movement such that it will not return to its original position. In the Sugar House quadrangle unstable slopes may result from slides, falls, flows, and imperceptibly slow downhill creep of surface layers, as well as lateral flowage from under a foundation or other load of rocks or surficial deposits (soil in an engineering sense). Erosion by running water or wind is not included.

Slope movement follows complex natural laws and is often triggered by earth vibrations, excessive water content, or excessive loads that break the natural bond of the rock or surficial deposit. The relative slope stability map of the Sugar House quadrangle is an attempt to show an estimate of the relative resistance to unbalancing forces. The selection of map units is based, at least in part, on the consideration that something must modify or influence any present slope before it will fail. Such modifications or influences might include, among others, placing a major structure on the upper part of a slope; natural or manmade major excavations in the lower part of a slope; several years of unusually high precipitation; a localized increase in shallow ground water from septic systems, irrigation, or leakage from artificial lakes and water mains; or increased vibrations of the ground from blasting, heavy traffic, industrial plants, or earthquakes.

There is no assurance that any area shown as most stable will not move in a manner detrimental to humans nor that every area labeled potentially unstable will move in a detrimental manner. However, the map does show my opinion as to which parcels of land are less likely to move when compared to others. Private consultants available in Salt Lake City can make mathematical slope stability analyses to determine whether or not a particular parcel of land will be stable when subjected to known building weights and construction practices. This map can help landowners decide if they need such studies, and it can be used also for general land-use planning, zoning, and developing. It would not be judicious, for example, to construct a house or an aqueduct in potentially unstable areas without suitable geologic and soils investigations. On the other hand, a city planner might find such areas desirable for parks or playgrounds.

HOW THIS MAP WAS MADE

The relative slope stability map was made by studying the information presented on several maps and reports and combining the information into the four classes shown on the map. The classes, in order from most stable to least stable, are: (1) most stable, (2) generally stable, (3) moderately stable, and (4) potentially unstable. The other maps used in constructing this map include geologic maps of the bedrock (Crittenden, 1965) and surficial deposits (Van Horn, 1972a), a slope map (Van Horn, 1972c), and a landslide map (Van Horn, 1972d). Former marshy areas were located by examining different editions (1934, 1952, 1963, 1969) of U.S. Geological Survey topographic maps of the quadrangle. Information about springs came from my geologic studies and from reports by Hely, Mower, and Harr (1971), Marine and Price (1964), Mundorff (1971), Taylor and Leggette (1949). Several dikes shown on the geologic maps in the eastern part of the quadrangle are so thin that they probably will not significantly affect the slope stability and are therefore not shown on this map. The locations of faults in the surficial deposits west of the Wasatch Range were not considered in this slope-stability study. Earthquakes are related to fault movement and are powerful triggering mechanisms for landslides; thus readers interested in the western part of the quadrangle may wish to refer to a fault map (Van Horn, 1972b) for the relative ages of faults in the Sugar House quadrangle. A major earthquake in the Salt Lake City area could result in slope movements anywhere in the quadrangle.

The features considered in preparing the relative slope stability map include: steepness of slope, type of rock or surficial deposit, and locations of bedrock faults, springs, and former marshes. These features were evaluated according to their relation to known landslide deposits and talus accumulations, to the observed deterioration of buildings in the area, and, in small part, to plausible predictions. An example of such a prediction concerns subdivisions built on old marshes on slopes of less than 3 percent (class 2m).

The slope-stability classes are an evaluation of the relative chances of movement and not the relative hazard that would result from movement. Thus a large mass movement, such as a rockfall on a class-3 slope, may be more catastrophic and hazardous than a small movement of a talus slope in class 4. The boundaries between slope classes are approximately located.

REFERENCES CITED

Crittenden, M. D., Jr., 1965, Geology of the Sugar House quadrangle, Salt Lake County, Utah: U.S. Geol. Survey Geol. Quad. Map GQ-380.
Hely, A. G., Mower, R. W., and Harr, A. C., 1971, Water resources of Salt Lake County, Utah: Utah Dept. Nat. Resources Tech. Pub. 31, 244 p.
Marine, W. I., and Price, Don, 1964, Geology and ground-water resources of the Jordan Valley, Utah: Utah Geol. and Mineralog. Survey Water-Resources Bull. 7, 67 p.
Mundorff, J. C., 1971, Nonthermal springs of Utah: Utah Geol. and Mineralog. Survey Water-Resources Bull. 16, 70 p.
Taylor, G. H., and Leggette, R. M., 1949, Ground water in the Jordan Valley, Utah: U.S. Geol. Survey Water-Supply Paper 1029, 357 p.
Van Horn, Richard, 1972a, Surficial geologic map of the Sugar House quadrangle, Salt Lake County, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-766-A.
________1972b, Map showing relative ages of faults in the Sugar House quadrangle, Salt Lake County, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-766-B.
________1972c, Slope map of the Sugar House quadrangle, Salt Lake County, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-766-C.
________1972d, Map showing landslide and associated deposits in the Sugar House quadrangle, Salt Lake County, Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-766-D.

CRITERIA FOR THE RELATIVE SLOPE STABILITY CLASSES USED IN THIS REPORT

<table>
<tr><th colspan="5" rowspan="2">MATERIAL</th><th colspan="6">PERCENT SLOPE</th></tr>
<tr><th colspan="6">3 8 30 45 100</th></tr>
<tr><td rowspan="11">Surficial deposit</td><td rowspan="2">Artificial fill</td><td colspan="3">Highway I-80</td><td colspan="6">1</td></tr>
<tr><td colspan="3">All other</td><td colspan="2">1</td><td colspan="4">2</td></tr>
<tr><td rowspan="8">Not a marsh</td><td rowspan="4">Ancient lake deposit</td><td rowspan="2">Clay and silt</td><td>Without springs</td><td colspan="2">1</td><td colspan="2">2</td><td colspan="2">3</td></tr>
<tr><td>With springs</td><td colspan="2">1</td><td colspan="2">3</td><td colspan="2">4</td></tr>
<tr><td colspan="2">Sand</td><td colspan="3">1</td><td>2</td><td colspan="2">3 (4 if dry)</td></tr>
<tr><td colspan="2">Gravel</td><td colspan="3">1</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td colspan="3">Alluvial fan</td><td colspan="3">1</td><td colspan="3">2</td></tr>
<tr><td colspan="3">Glacial deposit</td><td colspan="6">2</td></tr>
<tr><td colspan="3">Talus</td><td colspan="3">Do not exist</td><td colspan="3">4</td></tr>
<tr><td colspan="3">Landslide</td><td colspan="6">4</td></tr>
<tr><td colspan="4">Filled or drained marsh</td><td>2m</td><td colspan="5">Do not exist</td></tr>
<tr><td rowspan="5">Bedrock</td><td colspan="4">Thin-bedded</td><td colspan="6">2</td></tr>
<tr><td colspan="4">Massive</td><td colspan="6">3</td></tr>
<tr><td colspan="4">Shaly</td><td colspan="6">4</td></tr>
<tr><td colspan="4">Faults</td><td colspan="6">4</td></tr>
<tr><td colspan="4">Dikes</td><td colspan="6">Not shown</td></tr>
</table>

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