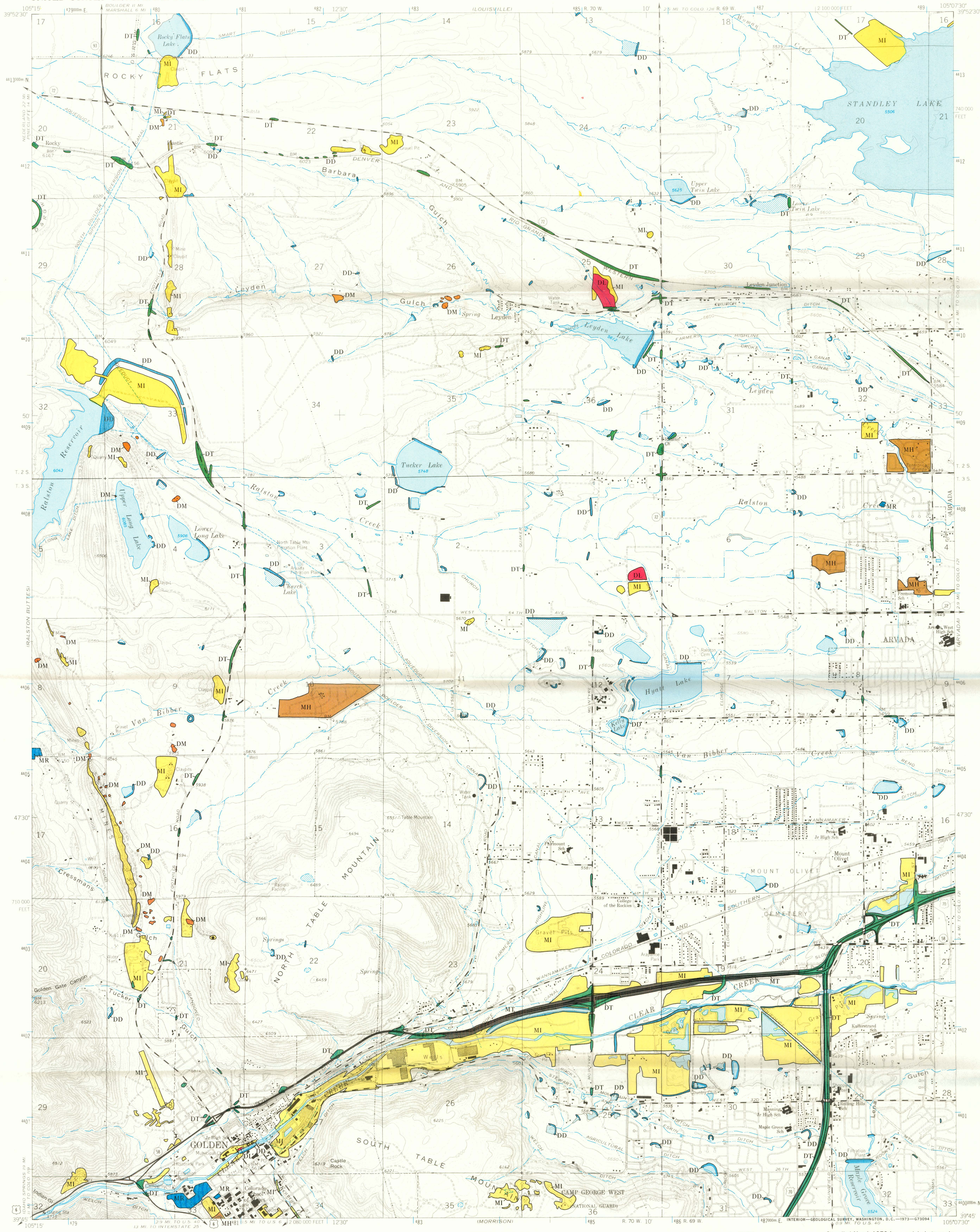
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

FOLIO OF THE
GOLDEN QUADRANGLE, COLORADO
MAP I-761-E



Base from U.S. Geological Survey, 1965
Photorevision as of 1972
10,000-foot grid based on Colorado coordinate system, central zone
1000-meter Universal Transverse Mercator grid ticks, zone 13, shown in blue

APPROXIMATE MEAN DECLINATION, 1973

SCALE 1:24 000

CONTOUR INTERVAL 10 FEET
DATUM IS MEAN SEA LEVEL

QUADRANGLE LOCATION

Compiled March 1972 from aerial photographs dated August 8, 1971

MAP SHOWING MAN-MODIFIED LAND AND MAN-MADE DEPOSITS IN THE GOLDEN QUADRANGLE, JEFFERSON COUNTY, COLORADO

By
Howard E. Simpson
1973

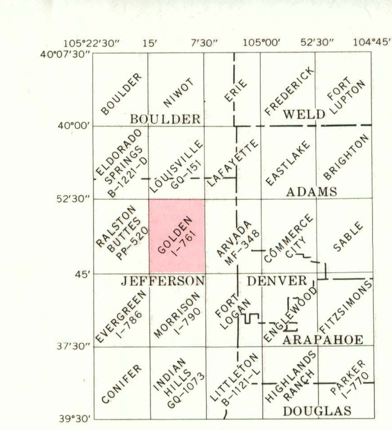
EXPLANATION

MAN-MODIFIED LAND: Land altered by excavation and filling, including leveled land, pits and quarries with adjacent storage areas, and areas stripped of topsoil. Excludes modified land now densely occupied by homes, businesses or industries, schools, and churches. Classification based on apparent principal use.

- MI — Land modified for industrial purposes
- MH — Land modified for housing construction
- MR — Land modified for recreational use
- MT — Land modified for transporation construction

MAN-MADE DEPOSITS: Earth and rock, much solid waste in places; includes trash dumps and sanitary landfills, dams and dikes, road and railroad grade fills, mine-tailings piles, and irrigation-canal spoil piles; thickness exceeds 3 feet, and volume exceeds about 5 cubic yards

- DL — Trash dumps and sanitary landfills – Trash dumps covered with earth; sanitary landfills interlayered with earth
- DT — Road, railroad, and irrigation-canal grade fills – Contain no trash
- DD — Dams and dikes – Contain no trash; form ponds for reservoirs, stock use, fire use, and flood control
- DM — Mine-tailings piles – Trash absent to negligible
- Irrigation-canal spoil piles – Contain no trash; locally forms canal embankment, in places site of canal-patrol road; shown on base by hachured pattern along canals



INDEX SHOWING LOCATION OF GOLDEN QUADRANGLE

INTRODUCTION

Man-modified land and man-made deposits are important because they may cause land-development problems. The most common of these problems is compaction, which leads to subsidence and settlement damage to structures, poor surface drainage, and pollution of ground-water supplies. Nearly all such problems can be avoided by wise planning.

Man-modified areas and man-made deposits shown on the map are identified according to the apparent principal use or purpose of the feature. The following discussion defines terms where needed, explains some of the potential effects of land modification and filling, and shows the significance of these features for land-use planners, architects, engineers, landowners, students, and any others who may be interested.

The map and explanation present the distribution and character of the chosen map units to the extent permitted by the scale of the base map. Use of the map does not in general eliminate the need for detailed geologic and engineering study of a proposed site prior to acquisition, design, and construction.

A map showing man-modified land, landfills, and other man-made deposits in an area of dynamic urban growth, such as the Golden quadrangle, identifies such features only as they exist at a certain time. The purpose is to indicate for future reference areas of potentially troublesome engineering properties. For example, if earth materials are excavated, the newly exposed underlying material may differ physically from the excavated material; similarly, the excavated material generally differs physically from the same material before it was disturbed. In addition, old quarries and pits may be converted to trash dumps or sanitary landfills, covered with earth, and eventually forgotten. With time, the materials may settle, especially when loaded by construction or more or less saturated by the irrigation of lawns. Because nearly all ground settlement is not uniform, differential movement may damage structures. Thus, recognition of filled pits or quarries permits more effective planning and design for appropriate land use. Finally, the map may identify potential sources of earth materials for possible future use as landfill.

Features shown on the accompanying map are classified in part as to how the ground has been altered (by excavation or filling) and in part as to the purpose of that alteration. Two main groups of features consist of several subgroups: (1) man-modified land, including cut-and-fill areas, pits and quarries and their adjacent operating and storage areas, and land stripped of topsoil; and (2) man-made deposits, including both sanitary and earthen landfills, embankments for transportation use (highways, railroads, and irrigation canals) and the control of surface water (dams and dikes), and other man-made deposits (mine tailings and the spoil piles along irrigation canals).

MAN-MODIFIED LAND

Cut-and-fill. The land surface commonly is altered during development by excavating high areas and filling low areas to achieve a more desirable surface form, to reduce slopes, and, in general, to increase the desirability and value of the property. The ground pattern of cut-and-fill may be very complex. The distinction between cut areas and filled areas commonly becomes difficult to make as construction proceeds, and may be impossible to recognize after vegetation is established. How cutting and filling affects the quality of the land for construction depends on the physical characteristics of the newly exposed rock and earth material, whether the transferred material is properly emplaced and compacted according to sound engineering practice, and the effect of the cutting and filling on the original drainage pattern.

Cutting and filling must be done correctly to obtain the desired results. For example, the cutting may expose unsuitable foundation material. Improperly placed fills may block natural drainage routes and may cause cross-lot flooding, erosion, and wet basements, or the fill may settle, especially if wetted or heavily loaded. Local variations in the composition of the fill material may cause the amount of such compaction to differ from point to point, which may lead to different amounts of settlement under various parts of the structure, and thus cause damage. Structures especially subject to such damage are those placed partly on undisturbed material and partly on poorly compacted or uncompacted fill. Problems caused by differential subsidence or by poor foundation material can sometimes be avoided if pilings or cement-filled caissons are used to transfer the structural load to stronger material below.

The side slopes of a fill, particularly those of an uncompacted fill, are vulnerable to serious erosion, especially during heavy rainstorms. An inch of rain in an hour may erode several cubic yards of earth, cutting large gullies and depositing the debris on adjacent lawns, streets, and sidewalks to depths of several inches to a few feet. The hazard is reduced somewhat by engineered compaction of the fill material, inasmuch as compacted fills are more resistant to erosion; by providing drainage that controls runoff, particularly in over-the-edge rivulets; and by planting fast-growing ground cover on a fill and its marginal slopes immediately on completion of the earthmoving.

Quarries and pits. – Quarries and pits may be backfilled to dispose of waste and to reclaim an area for other use. Unless fills are carefully placed and compacted, settlement may damage structures built on them. Compaction of a carefully prepared earthen landfill is the most difficult at the contact between the fill material and the wall of the pit or quarry, especially if the wall is very steep.

Quarry and pit operations generally require an adjacent storage area, from which the topsoil may or may not have been removed. The ground surface may be leveled by cutting and filling to improve drainage and operations. Thus, the expectable engineering behavior of the ground in an area about a pit or quarry may be altered significantly.

Land stripped of topsoil. – Topsoil is generally stripped from land to be developed before cutting and filling begins, and because of the market value of topsoil in an urban area, only 1 or 2 inches will be replaced after grading, the remainder being sold. The effect of stripping and partial replacement depends on the character of the soil and the underlying material. For example, if the topsoil contains a clayey zone (the B-horizon as recognized by soil scientists) and overlies loose, permeable material, the amount and rate of soak-in and the depth of moisture penetration may increase significantly. If the underlying material is impermeable, the runoff and erosion may be sharply increased. Either condition may cause use of more water and fertilizer for lawn maintenance.

MAN-MADE DEPOSITS

Earthen landfills. – Earth, locally mixed with a small amount of solid waste, is commonly used to fill excavations or to raise the land surface. On this map, areas of earthen landfill are distinguished from areas of cut-and-fill by the lack of an intimate, in some places complex, pattern of cutting. Most buildings in the Golden quadrangle have been backfilled around the foundation, and many have been placed upon individual landfills. Such deposits have not been mapped either separately or together because of their great number and their concentration in urban parts of the quadrangle. No landfills of large area or of thickness greater than a few feet are known. Earthen landfills may present the same problems to property owners as do the fill areas of cut-and-fill.

Trash dumps and sanitary landfills. – Trash commonly is disposed of by dumping in small valleys or in abandoned pits and quarries. These open dumps are distinguished by their lack of mechanical compaction during accumulation and by the addition daily, or more frequently, of a covering layer of earth, from sanitary landfills, an increasingly popular method of solid-waste disposal. Two large trash deposits are located in the Golden quadrangle. One fills a former gravel pit about half a mile north of Hyatt Lake, in the southeast quarter of sec. 1, T. 3 S., R. 70 W. This dump, which is about 10 feet deep, has not been used for several years and is covered with a layer of earth. The second deposit is in the southeast quarter of sec. 25, T. 2 S., R. 70 W., just upstream from a double earth embankment. It is managed essentially as a sanitary landfill, although an earth cover is not necessarily added daily; cover material is obtained from the adjacent sides of the valley.

Poorly planned or managed trash deposits are potential environmental hazards, mainly because of possible pollution of surface- or ground-water supplies. Water may enter a trash deposit as rainfall, as a surface stream, or as ground water percolating through permeable earth or rock; the effluent, or leachate, that leaves the deposit may contain undesirable materials in solution or suspension. The pollution hazard is greatest if the leachate seeps into a geologic unit that supplies water to wells or it flows directly into a surface stream. Trash deposits are best situated geologically when placed above the ground-water table, and within earth materials that are virtually impermeable and easily excavated for use as compacted cover material. Surface water should be diverted by a compacted earth cover; in some situations the deposit may need to be sealed off by an impermeable membrane both top and bottom.

Embankments. – The most numerous man-made deposits in the quadrangle are earth embankments. These serve as dams for stockponds and reservoirs, as flood-control dikes, and as grade fills for roads, railroads, and irrigation canals. They have been built with differing degrees of planning and care, determined largely by their intended use. For example, the compacted grade-fills for U.S. Interstate 70 were designed to support calculated loads without slump failure or significant natural compaction by emplacing the earth in layers, or lifts, several inches thick, and mechanically compacting each a predetermined amount. At the other extreme, some of the small stock-pond dams were simply bulldozed into position. Embankments do not constitute a significant source of earth material for construction purposes.

Tailing piles and spoil piles. – Waste material from the operation of mines, quarries, and pits and from the excavation of irrigation canals is included in this category. The deposits consist of material just as it comes from the ground, and the principal change with time has been natural compaction. Such deposits may provide small quantities of material for landfills; their engineering characteristics will differ from place to place because of variation in the source material.

SOURCES OF DATA

Some deposits shown on the map were copied from a geologic map by Van Horn (1968) and an engineering geologic map by Gardner, Simpson, and Hart (1971); most data were compiled by H. E. Simpson in March 1972 from aerial photographs taken August 8, 1971. Areas of man-modified land were compiled by Simpson from the same photographs. Publications used in the preparation of this map are listed below; the list also includes additional referenced by Van Horn (1972) and by Simpson (1972).

Gardner, M. E., Simpson, H. E., and Hart, S. S., 1971, Preliminary engineering geologic map of the Golden quadrangle, Jefferson County, Colorado: U.S. Geol. Survey Misc. Field Studies Map MF-308 [1972].

Simpson, H. E., 1972, Map showing earth materials that may compact and cause settlement in the Golden quadrangle, Jefferson County, Colorado: U.S. Geol. Survey Misc. Geol. Inv. Map I-761-D.

Van Horn, Richard, 1968, Preliminary surficial geologic map of the Golden quadrangle, Jefferson County, Colorado: U.S. Geol. Survey open-file report.

_______1972, Surficial and bedrock geologic map of the Golden quadrangle, Jefferson County, Colorado: U.S. Geol. Survey Misc. Geol. Inv. Map I-761-A.

For sale by U.S. Geological Survey, price 75 cents