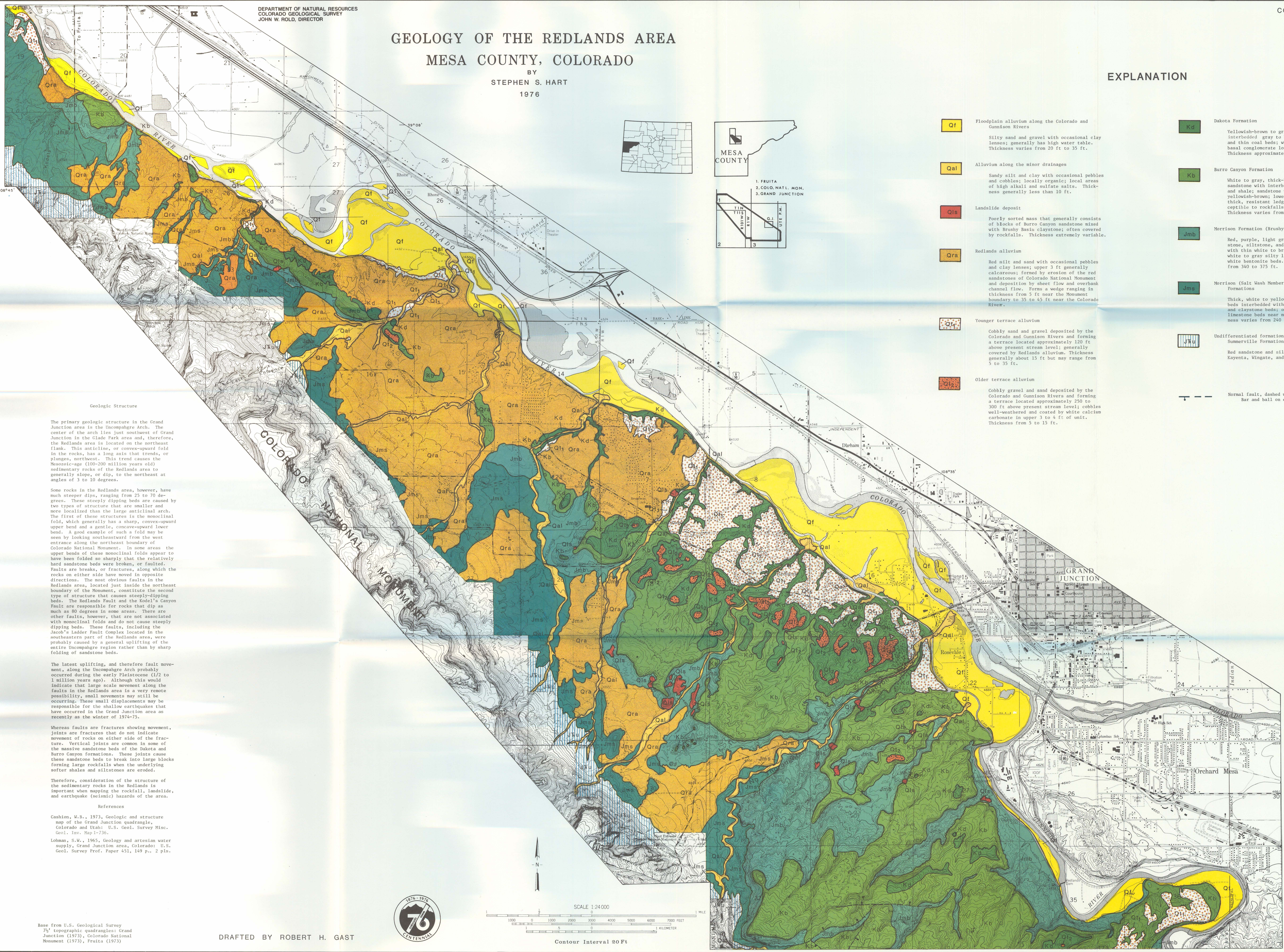
DEPARTMENT OF NATURAL RESOURCES
COLORADO GEOLOGICAL SURVEY
JOHN W. ROLD, DIRECTOR

GEOLOGY OF THE REDLANDS AREA
MESA COUNTY, COLORADO

BY
STEPHEN S. HART

1976



EXPLANATION

Qf — Floodplain alluvium along the Colorado and Gunnison Rivers

Silty sand and gravel with occasional clay lenses; generally has high water table. Thickness varies from 20 ft to 35 ft.

Qal — Alluvium along the minor drainages

Sandy silt and clay with occasional pebbles and cobbles; locally organic; local areas of high alkali and sulfate salts. Thickness generally less than 10 ft.

Qls — Landslide deposit

Poorly sorted mass that generally consists of blocks of Burro Canyon sandstone mixed with Brushy Basin claystone; often covered by rockfalls. Thickness extremely variable.

Qra — Redlands alluvium

Red silt and sand with occasional pebbles and clay lenses; upper 3 ft generally calcareous; formed by erosion of the red sandstones of Colorado National Monument and deposition by sheet flow and overbank channel flow. Forms a wedge ranging in thickness from 5 ft near the Monument boundary to 35 to 45 ft near the Colorado River.

Qt_1 — Younger terrace alluvium

Cobbly sand and gravel deposited by the Colorado and Gunnison Rivers and forming a terrace located approximately 120 ft above present stream level; generally covered by Redlands alluvium. Thickness generally about 15 ft but may range from 5 to 35 ft.

Qt_2 — Older terrace alluvium

Cobbly gravel and sand deposited by the Colorado and Gunnison Rivers and forming a terrace located approximately 250 to 300 ft above present stream level; cobbles well-weathered and coated by white calcium carbonate in upper 3 to 4 ft of unit. Thickness from 5 to 15 ft.

Kd — Dakota Formation

Yellowish-brown to gray sandstone with interbedded gray to black organic shale and thin coal beds; white, coarse-grained basal conglomerate locally present. Thickness approximately 150 ft.

Kb — Burro Canyon Formation

White to gray, thick-bedded to massive sandstone with interbedded green siltstone and shale; sandstone weathers to dark yellowish-brown; lower sandstone forms thick, resistant ledge that is very susceptible to rockfalls and rockslides. Thickness varies from 50 to 85 ft.

Jmb — Morrison Formation (Brushy Basin Member)

Red, purple, light green, and gray claystone, siltstone, and shale interbedded with thin white to brown sandstone beds, white to gray silty limestone beds, and white bentonite beds. Thickness varies from 340 to 375 ft.

Jms — Morrison (Salt Wash Member) and Summerville Formations

Thick, white to yellowish-brown sandstone beds interbedded with varicolored siltstone and claystone beds; occasional thin gray limestone beds near middle of unit. Thickness varies from 240 to 255 ft.

JŦu — Undifferentiated formations older than the Summerville Formation

Red sandstone and siltstone of the Entrada, Kayenta, Wingate, and Chinle Formations.

Normal fault, dashed where approximate. Bar and ball on downthrown side.

Geologic Structure

The primary geologic structure in the Grand Junction area is the Uncompahgre Arch. The center of the arch lies just southwest of Grand Junction in the Glade Park area and, therefore, the Redlands area is located on the northeast flank. This anticline, or convex-upward fold in the rocks, has a long axis that trends, or plunges, northwest. This trend causes the Mesozoic-age (100-200 million years old) sedimentary rocks of the Redlands area to generally slope, or dip, to the northeast at angles of 3 to 10 degrees.

Some rocks in the Redlands area, however, have much steeper dips, ranging from 25 to 70 degrees. These steeply dipping beds are caused by two types of structure that are smaller and more localized than the large anticlinal arch. The first of these structures is the monoclinal fold, which generally has a sharp, convex-upward upper bend and a gentle, concave-upward lower bend. A good example of such a fold may be seen by looking southeastward from the west entrance along the northeast boundary of Colorado National Monument. In some areas the upper bends of these monoclinal folds appear to have been folded so sharply that the relatively hard sandstone beds were broken, or faulted. Faults are breaks, or fractures, along which the rocks on either side have moved in opposite directions. The most obvious faults in the Redlands area, located just inside the northeast boundary of the Monument, constitute the second type of structure that causes steeply-dipping beds. The Redlands Fault and the Kodel's Canyon Fault are responsible for rocks that dip as much as 80 degrees in some areas. There are other faults, however, that are not associated with monoclinal folds and do not cause steeply dipping beds. These faults, including the Jacob's Ladder Fault Complex located in the southeastern part of the Redlands area, were probably caused by a general uplifting of the entire Uncompahgre region rather than by sharp folding of sandstone beds.

The latest uplifting, and therefore fault movement, along the Uncompahgre Arch probably occurred during the early Pleistocene (1/2 to 1 million years ago). Although this would indicate that large scale movement along the faults in the Redlands area is a very remote possibility, small movements may still be occurring. These small displacements may be responsible for the shallow earthquakes that have occurred in the Grand Junction area as recently as the winter of 1974-75.

Whereas faults are fractures showing movement, joints are fractures that do not indicate movement of rocks on either side of the fracture. Vertical joints are common in some of the massive sandstone beds of the Dakota and Burro Canyon formations. These joints cause these sandstone beds to break into large blocks forming large rockfalls when the underlying softer shales and siltstones are eroded.

Therefore, consideration of the structure of the sedimentary rocks in the Redlands is important when mapping the rockfall, landslide, and earthquake (seismic) hazards of the area.

References

Cashion, W.B., 1973, Geologic and structure map of the Grand Junction quadrangle, Colorado and Utah: U.S. Geol. Survey Misc. Geol. Inv. Map I-736.

Lohman, S.W., 1965, Geology and artesian water supply, Grand Junction area, Colorado: U.S. Geol. Survey Prof. Paper 451, 149 p., 2 pls.

Base from U.S. Geological Survey 7½' topographic quadrangles: Grand Junction (1973), Colorado National Monument (1973), Fruita (1973)

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SCALE 1:24 000

Contour Interval 20 Ft

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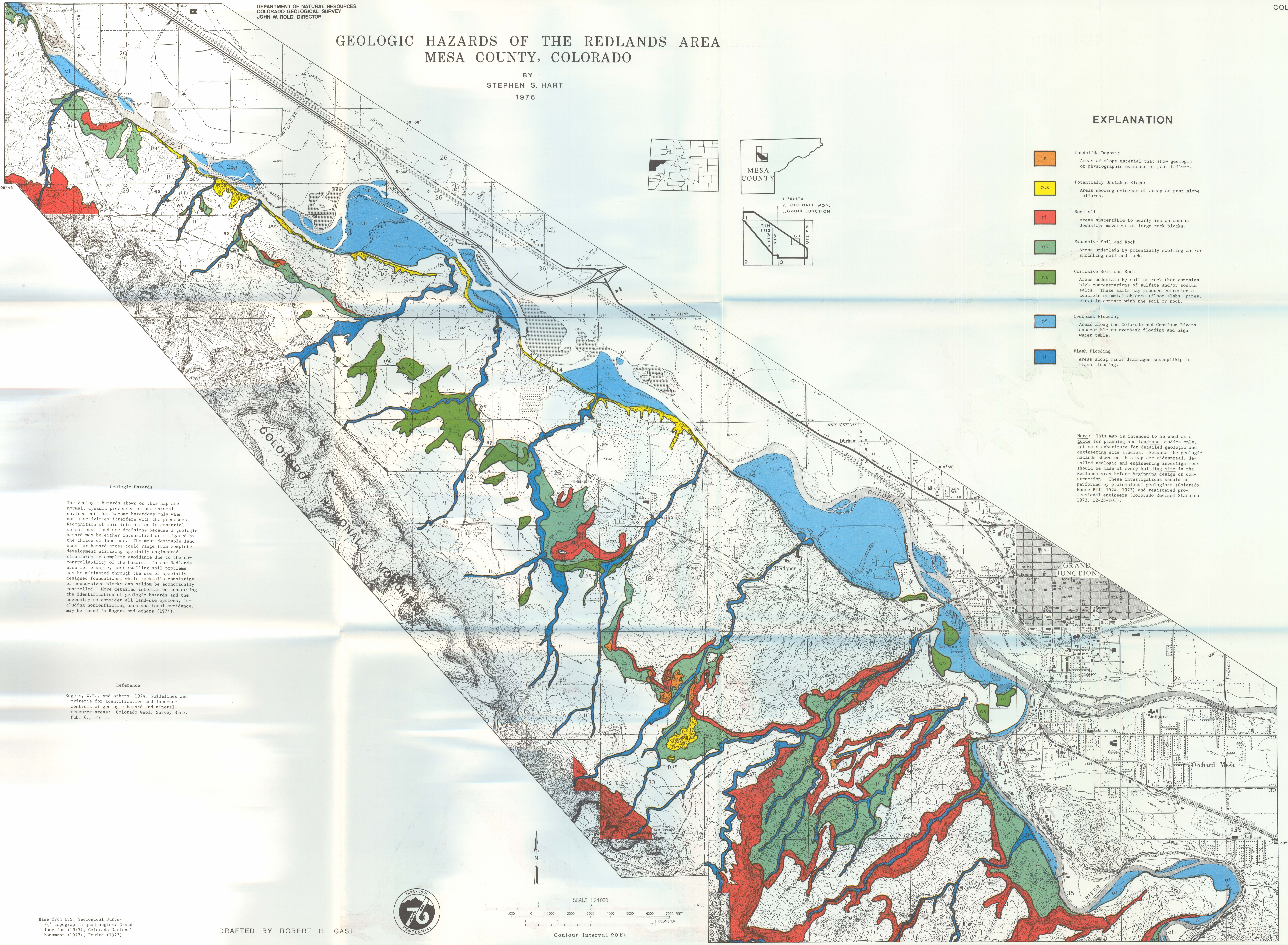
GEOLOGIC HAZARDS OF THE REDLANDS AREA MESA COUNTY, COLORADO

BY
STEPHEN S. HART
1976



EXPLANATION

ls	**Landslide Deposit** — Areas of slope material that show geologic or physiographic evidence of past failure.
pus	**Potentially Unstable Slopes** — Areas showing evidence of creep or past slope failures.
rf	**Rockfall** — Areas susceptible to nearly instantaneous downslope movement of large rock blocks.
es	**Expansive Soil and Rock** — Areas underlain by potentially swelling and/or shrinking soil and rock.
cs	**Corrosive Soil and Rock** — Areas underlain by soil or rock that contains high concentrations of sulfate and/or sodium salts. These salts may produce corrosion of concrete or metal objects (floor slabs, pipes, etc.) in contact with the soil or rock.
of	**Overbank Flooding** — Areas along the Colorado and Gunnison Rivers susceptible to overbank flooding and high water table.
ff	**Flash Flooding** — Areas along minor drainages susceptible to flash flooding.

Note: This map is intended to be used as a guide for planning and land-use studies only, not as a substitute for detailed geologic and engineering site studies. Because the geologic hazards shown on this map are widespread, detailed geologic and engineering investigations should be made at every building site in the Redlands area before beginning design or construction. These investigations should be performed by professional geologists (Colorado House Bill 1574, 1973) and registered professional engineers (Colorado Revised Statutes 1973, 12-25-101).

Geologic Hazards

The geologic hazards shown on this map are normal, dynamic processes of our natural environment that become hazardous only when man's activities interfere with the processes. Recognition of this interaction is essential to rational land-use decisions because a geologic hazard may be either intensified or mitigated by the choice of land use. The most desirable land uses for hazard areas could range from complete development utilizing specially engineered structures to complete avoidance due to the uncontrollability of the hazard. In the Redlands area for example, most swelling soil problems may be mitigated through the use of specially designed foundations, while rockfalls consisting of house-sized blocks can seldom be economically controlled. More detailed information concerning the identification of geologic hazards and the necessity to consider all land-use options, including nonconflicting uses and total avoidance, may be found in Rogers and others (1974).

Reference

Rogers, W.P., and others, 1974, Guidelines and criteria for identification and land-use controls of geologic hazard and mineral resource areas: Colorado Geol. Survey Spec. Pub. 6., 146 p.

Base from U.S. Geological Survey 7½' topographic quadrangles: Grand Junction (1973), Colorado National Monument (1973), Fruita (1973)

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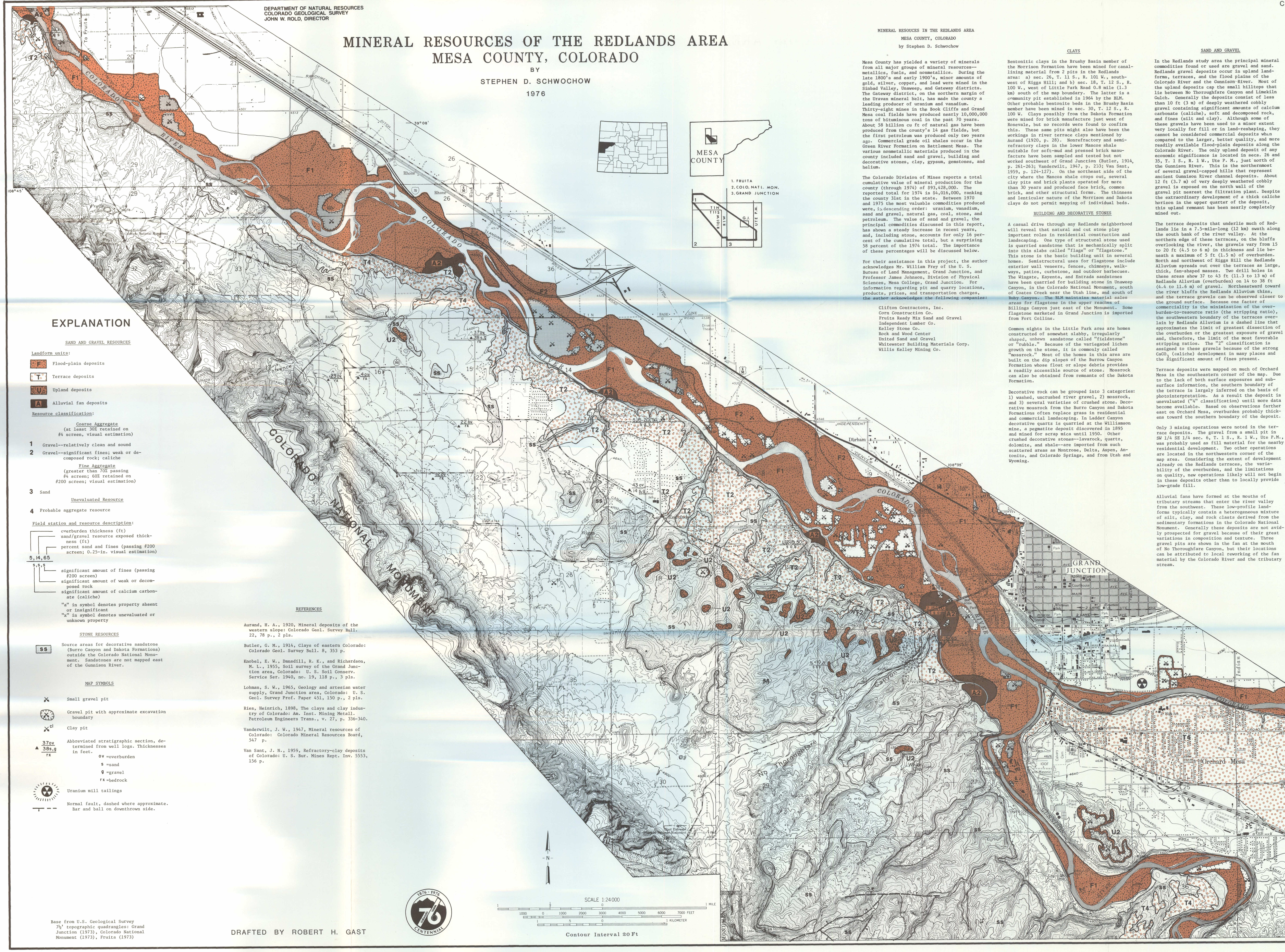
MINERAL RESOURCES

MINERAL RESOURCES OF THE REDLANDS AREA MESA COUNTY, COLORADO

BY

STEPHEN D. SCHWOCHOW

1976



EXPLANATION

SAND AND GRAVEL RESOURCES

Landform units:

- F — Flood-plain deposits
- T — Terrace deposits
- U — Upland deposits
- A — Alluvial fan deposits

Resource classification:

Coarse Aggregate
(at least 30% retained on #4 screen, visual estimation)

1 Gravel--relatively clean and sound

2 Gravel--significant fines; weak or decomposed rock; caliche

Fine Aggregate
(greater than 70% passing #4 screen; 60% retained on #200 screen; visual estimation)

3 Sand

Unevaluated Resource

4 Probable aggregate resource

Field station and resource description:

5,14,65
- overburden thickness (ft)
- sand/gravel resource exposed thickness (ft)
- percent sand and fines (passing #200 screen; 0.25-in. visual estimation)

s,s,s
- significant amount of fines (passing #200 screen)
- significant amount of weak or decomposed rock
- significant amount of calcium carbonate (caliche)

"a" in symbol denotes property absent or insignificant
"x" in symbol denotes unevaluated or unknown property

STONE RESOURCES

SS — Source areas for decorative sandstone (Burro Canyon and Dakota Formations) outside the Colorado National Monument. Sandstones are not mapped east of the Gunnison River.

MAP SYMBOLS

- Small gravel pit
- Gravel pit with approximate excavation boundary
- cl — Clay pit
- 37ov / 38s,g / rx — Abbreviated stratigraphic section, determined from well logs. Thicknesses in feet.
  - ov =overburden
  - s =sand
  - g =gravel
  - rx =bedrock
- Uranium mill tailings
- Normal fault, dashed where approximate. Bar and ball on downthrown side.

Base from U.S. Geological Survey 7½' topographic quadrangles: Grand Junction (1973), Colorado National Monument (1973), Fruita (1973)

DRAFTED BY ROBERT H. GAST

REFERENCES

Aurand, H. A., 1920, Mineral deposits of the western slope: Colorado Geol. Survey Bull. 22, 78 p., 2 pls.

Butler, G. M., 1914, Clays of eastern Colorado: Colorado Geol. Survey Bull. 8, 353 p.

Knobel, E. W., Dansdill, R. K., and Richardson, M. L., 1955, Soil survey of the Grand Junction area, Colorado: U. S. Soil Conserv. Service Ser. 1940, no. 19, 118 p., 3 pls.

Lohman, S. W., 1965, Geology and artesian water supply, Grand Junction area, Colorado: U. S. Geol. Survey Prof. Paper 451, 150 p., 2 pls.

Ries, Heinrich, 1898, The clays and clay industry of Colorado: Am. Inst. Mining Metall. Petroleum Engineers Trans., v. 27, p. 336-340.

Vanderwilt, J. W., 1947, Mineral resources of Colorado: Colorado Mineral Resources Board, 547 p.

Van Sant, J. N., 1959, Refractory-clay deposits of Colorado: U. S. Bur. Mines Rept. Inv. 5553, 156 p.

MINERAL RESOUCES IN THE REDLANDS AREA MESA COUNTY, COLORADO

by Stephen D. Schwochow

Mesa County has yielded a variety of minerals from all major groups of mineral resources--metallics, fuels, and nonmetallics. During the late 1800's and early 1900's, minor amounts of gold, silver, copper, and lead were mined in the Sinbad Valley, Unaweep, and Gateway districts. The Gateway district, on the northern margin of the Uravan mineral belt, has made the county a leading producer of uranium and vanadium. Thirty-eight mines in the Book Cliffs and Grand Mesa coal fields have produced nearly 10,000,000 tons of bituminous coal in the past 70 years. About 58 billion cu ft of natural gas have been produced from the county's 14 gas fields, but the first petroleum was produced only two years ago. Commercial grade oil shales occur in the Green River Formation on Battlement Mesa. The various nonmetallic materials produced in the county included sand and gravel, building and decorative stones, clay, gypsum, gemstones, and helium.

The Colorado Division of Mines reports a total cumulative value of mineral production for the county (through 1974) of $93,428,000. The reported total for 1974 is $4,016,000, ranking the county 31st in the state. Between 1970 and 1975 the most valuable commodities produced were, in descending order: uranium, vanadium, sand and gravel, natural gas, coal, stone, and petroleum. The value of sand and gravel, the principal commodities discussed in this report, has shown a steady increase in recent years, and, including stone, accounts for only 16 percent of the cumulative total, but a surprising 58 percent of the 1974 total. The importance of these percentages will be discussed below.

For their assistance in this project, the author acknowledges Mr. William Frey of the U. S. Bureau of Land Management, Grand Junction, and Professor James Johnson, Division of Physical Sciences, Mesa College, Grand Junction. For information regarding pit and quarry locations, products, prices, and transportation charges, the author acknowledges the following companies:

Clifton Contractors, Inc.
Corn Construction Co.
Fruita Ready Mix Sand and Gravel
Independent Lumber Co.
Kelley Stone Co.
Rock and Wood Center
United Sand and Gravel
Whitewater Building Materials Corp.
Willis Kelley Mining Co.

CLAYS

Bentonitic clays in the Brushy Basin member of the Morrison Formation have been mined for canal-lining material from 2 pits in the Redlands area: a) sec. 26, T. 11 S., R. 101 W., southwest of Riggs Hill; and b) sec. 18, T. 12 S., R. 100 W., west of Little Park Road 0.8 mile (1.3 km) south of the map boundary. The latter is a community pit established in 1964 by the BLM. Other probable bentonite beds in the Brushy Basin member have been mined in sec. 30, T. 12 S., R. 100 W. Clays possibly from the Dakota Formation were mined for brick manufacture just west of Rosevale, but no records were found to confirm this. These same pits might also have been the workings in river terrace clays mentioned by Aurand (1920, p. 28). Nonrefractory and semi-refractory clays in the lower Mancos shale suitable for soft-mud and pressed brick manufacture have been sampled and tested but not worked southwest of Grand Junction (Butler, 1914, p. 261-263; Vanderwilt, 1947, p. 233; Van Sant, 1959, p. 124-127). On the northeast side of the city where the Mancos shale crops out, several clay pits and brick plants operated for more than 30 years and produced face brick, common brick, and other structural forms. The thinness and lenticular nature of the Morrison and Dakota clays do not permit mapping of individual beds.

BUILDING AND DECORATIVE STONES

A casual drive through any Redlands neighborhood will reveal that natural and cut stone play important roles in residential construction and landscaping. One type of structural stone used is quarried sandstone that is mechanically split into thin slabs called "flags" or "flagstone." This stone is the basic building unit in several homes. Semistructural uses for flagstone include exterior wall veneers, fences, chimneys, walkways, patios, curbstone, and outdoor barbecues. The Wingate, Kayenta, and Entrada sandstones have been quarried for building stone in Unaweep Canyon, in the Colorado National Monument, south of Coates Creek near the Utah line, and south of Ruby Canyon. The BLM maintains material sales areas for flagstone in the upper reaches of Billings Canyon just east of the Monument. Some flagstone marketed in Grand Junction is imported from Fort Collins.

Common sights in the Little Park area are homes constructed of somewhat slabby, irregularly shaped, unhewn sandstone called "fieldstone" or "rubble." Because of the variegated lichen growth on the stone, it is commonly called "mossrock." Most of the homes in this area are built on the dip slopes of the Burrow Canyon Formation whose float or slope debris provides a readily accessible source of stone. Mossrock can also be obtained from remnants of the Dakota Formation.

Decorative rock can be grouped into 3 categories: 1) washed, uncrushed river gravel, 2) mossrock, and 3) several varieties of crushed stone. Decorative mossrock from the Burro Canyon and Dakota Formations often replace grass in residential and commercial landscaping. In Ladder Canyon decorative quartz is quarried at the Williamson mine, a pegmatite deposit discovered in 1895 and mined for scrap mica until 1950. Other crushed decorative stones--lavarock, quartz, dolomite, and shale--are imported from such scattered areas as Montrose, Delta, Aspen, Antonito, and Colorado Springs, and from Utah and Wyoming.

SAND AND GRAVEL

In the Redlands study area the principal mineral commodities found or used are gravel and sand. Redlands gravel deposits occur in upland landforms, terraces, and the flood plains of the Colorado River and the Gunnison River. Most of the upland deposits cap the small hilltops that lie between No Thoroughfare Canyon and Limekiln Gulch. Generally the deposits consist of less than 10 ft (3 m) of deeply weathered cobbly gravel containing significant amounts of calcium carbonate (caliche), soft and decomposed rock, and fines (silt and clay). Although some of these gravels have been used to a minor extent very locally for fill or in land-reshaping, they cannot be considered commercial deposits when compared to the larger, better quality, and more readily available flood-plain deposits along the Colorado River. The only upland deposit of any economic significance is located in secs. 26 and 35, T. 1 S., R. 1 W., Ute P. M., just north of the Gunnison River. This is the northernmost of several gravel-capped hills that represent ancient Gunnison River channel deposits. About 12 ft (3.7 m) of very deeply weathered cobbly gravel is exposed on the north wall of the gravel pit nearest the filtration plant. Despite the extraordinary development of a thick caliche horizon in the upper quarter of the deposit, this upland remnant has been nearly completely mined out.

The terrace deposits that underlie much of Redlands lie in a 7.5-mile-long (12 km) swath along the south bank of the river valley. At the northern edge of these terraces, on the bluffs overlooking the river, the gravels vary from 15 to 20 ft (4.5 to 6 m) in thickness and lie beneath a maximum of 5 ft (1.5 m) of overburden. North and northwest of Riggs Hill the Redlands Alluvium spreads out over the terraces as large, thick, fan-shaped masses. Two drill holes in these areas show 37 to 43 ft (11.3 to 13 m) of Redlands Alluvium (overburden) on 14 to 38 ft (4.4 to 11.6 m) of gravel. Northeastward toward the river bluffs the Redlands Alluvium thins, and the terrace gravels can be observed closer to the ground surface. Because one factor of commerciality is the minimization of the overburden-to-resource ratio (the stripping ratio), the southwestern boundary of the terraces overlain by Redlands Alluvium is a dashed line that approximates the limit of greatest dissection of the overburden or the greatest exposure of gravel and, therefore, the limit of the most favorable stripping ratios. The "2" classification is assigned to these gravels because of the strong $CaCO_3$ (caliche) development in many places and the significant amount of fines present.

Terrace deposits were mapped on much of Orchard Mesa in the southeastern corner of the map. Due to the lack of both surface exposures and subsurface information, the southern boundary of the terrace is largely inferred on the basis of photointerpretation. As a result the deposit is unevaluated ("4" classification) until more data become available. Based on observations farther east on Orchard Mesa, overburden probably thickens toward the southern boundary of the deposit.

Only 3 mining operations were noted in the terrace deposits. The gravel from a small pit in SW 1/4 SE 1/4 sec. 6, T. 1 S., R. 1 W., Ute P.M., was probably used as fill material for the nearby residential development. Two other operations are located in the northwestern corner of the map area. Considering the extent of development already on the Redlands terraces, the variability of the overburden, and the limitations on quality, new operations likely will not begin in these deposits other than to locally provide low-grade fill.

Alluvial fans have formed at the mouths of tributary streams that enter the river valley from the southwest. These low-profile landforms typically contain a heterogeneous mixture of silt, clay, and rock clasts derived from the sedimentary formations in the Colorado National Monument. Generally these deposits are not avidly prospected for gravel because of their great variations in composition and texture. Three gravel pits are shown in the fan at the mouth of No Thoroughfare Canyon, but their locations can be attributed to local reworking of the fan material by the Colorado River and the tributary stream.

Flood-plain gravels extend the entire length of the project area and are bounded on the south by a prominent line of bluffs. Well logs in the valley immediately west of Grand Junction show 18 to 29 ft (5.5 to 8.8 m) of gravel, thinning toward the northeast. As many as 8 different rock types comprise the deposit--mostly granite, sandstone, orthoquartzite, and Mancos shale, with subordinate amounts of gneiss, volcanic rock (basalt and tuff), quartz, and Green River (oil) shale.

A vast colluvial-alluvial apron extending from the base of the Book Cliffs has buried the northern boundary of the deposit, which, without ample subsurface information, cannot even be reasonably approximated. Several principles were used to define a map boundary that has geologic, economic, and land-use significance. The boundary line, as mapped, represents in many places both a topographic or geomorphic discontinuity and a pedological contact between soil series as shown on the soil survey map of the Grand Junction area (Knobel and others, 1955). The area mapped as "F1" represents the river lowlands, which consist of the Green River soil series and a "riverwash" land type--two units characterized by coarse gravel with little or no overburden. Areas mapped as "F2" represent a phase of the Billings silty clay that consists of about 5 ft (1.5 m) of "overburden" on river gravel. The area north of the map unit represents other types and phases of the Billings, Ravola, and Fruita soil series, all of which are characterized by very thick overburden. The geologic significance of the northern boundary is that a topographic break was formed where the river meandered and truncated the toe of the enroaching colluvial apron. This undercutting and periodic flooding have removed much of the finer-grained soil cover (essentially the overburden), thus exposing the underlying coarse gravel. The economic significance is that these normal geologic processes have created an area, F1, in which the stripping ratio is quite low (1:5 and less) and, therefore, most attractive for gravel mining. The locations of the abandoned, inactive, and active gravel pits obviously confirm this observation. Areas mapped as F2 can be considered potentially or marginally economic because of the thicker overburden and slightly less attractive stripping ratios (1:3 or 1:2). To the north, areas characterized by stripping ratios of 1:1 and greater cannot practicably be considered as gravel reserves.

Although the F1 and F2 landforms include the economic and marginally economic portions of the entire resource, not all of the mapped area can be considered a reserve--the actual percentage of the total resource that is economically minable. One should realize that the economic size of the total deposit must be reduced because of mined-out tracts, unfavorable zoning, existing residential and commercial developments overlying the gravel, and adjacent or conflicting land uses. Local variations in quality and the sporadic occurrence of silt and clay seams also will reduce the amount of usable material in the deposit. Such variations cannot, however, be shown on a map of this scale even with ample subsurface information. The marginally economic areas, F2, although not very large compared to the other flood-plain deposits, are still important in a resource management analysis.

Numerous gravel operations adjoin the Colorado River between Grand Junction and Fruita. Some large pits shown on the map as lakes or ponds contain several pit symbols that correspond to individual operations discernible on older aerial photographs.

Along the Gunnison River probable gravel pits are shown on the site of the ERDA (formerly AEC) complex, in the prominent meander in the southeastern corner of the map, and again at Whitewater several miles beyond the map boundary.

Typical aggregate and gravel materials produced in the area include concrete and asphalt aggregates, asphalt surfacing aggregate, concrete sand, masonry sand, road base, and pit run material. Average pit prices (December 1975) of some commodities are listed below.

	price/yd^3
1 1/2" washed rock	$2.20-$2.70
3/4" washed rock	$2.90-$3.55
3/4" concrete mix	$4.50
sand	$5.25-$5.50
masonry sand	$5.50-$6.00
pit run	$1.50

Transportation costs in the 20-mile-long market area become a significant factor in the production and consumption of low-unit-value commodities. In the Redlands area these costs are based on either 1) a fixed price per cubic yard (yd^3) from Grand Junction and Fruita, or 2) a fixed charge within a specified radius with incremental charges per yd^3-mile beyond that radius. Fixed charges vary from $1.60/$yd^3$ to $3.90/$yd^3$. Incremental charges vary from 5¢ to 10¢/yd^3-mile up to 8 miles from the pit.

Several examples of mined-land reclamation can be seen in the valley between Clifton and Fruita. East of Grand Junction are abandoned and inactive pits that have been converted to farm storage, wildlife preserve, water storage, and landfill. West of Grand Junction near the mouth of Red Canyon several abandoned pits were incorporated into Connected Lakes Park, a Mesa County Parks Department greenbelt project. Other abandoned pits have revegetated themselves naturally. The accessibility of these mined areas to Redlands and Grand Junction residents make them excellent sites for recreational and open-space uses.

The importance of the aggregate industry to this area is born out by the fact stated earlier that gravel and stone now account for more than half of Mesa County's annual mineral production. With the exception of the Whitewater area, the county's entire gravel production comes from the Clifton-Grand Junction-Fruita corridor. Numerous gravel operations along the Colorado River provide materials for the construction of new homes and businesses and for the construction and maintenance of major highways, county roads, and city streets. Inasmuch as great quantities of material are required to sustain the city of Grand Junction, large amounts of raw materials are required to start, maintain, and expand suburban areas, such as Redlands. Proper management of these valuable resources depends on recognition of four important factors. First, gravel can be mined only where it has been deposited by Nature. Second, economics dictate that raw materials be mined and processed as close as possible to existing and potential markets. Third, untapped resources must be kept available for future use. Fourth, proper reclamation of mined land can be achieved for the benefit of the community. With the exception of several small areas, most of the river gravels in this area still remain available. New laws and policies will, however, force local government to devise new ways of conserving these resources--by redirecting growth, by establishing mineral conservancy zones or districts and flood-plain regulations, or by designating such areas under H.B. 1041. Attaining proper resource management is a team effort that requires the cooperation of local government, industry, and the citizenry.

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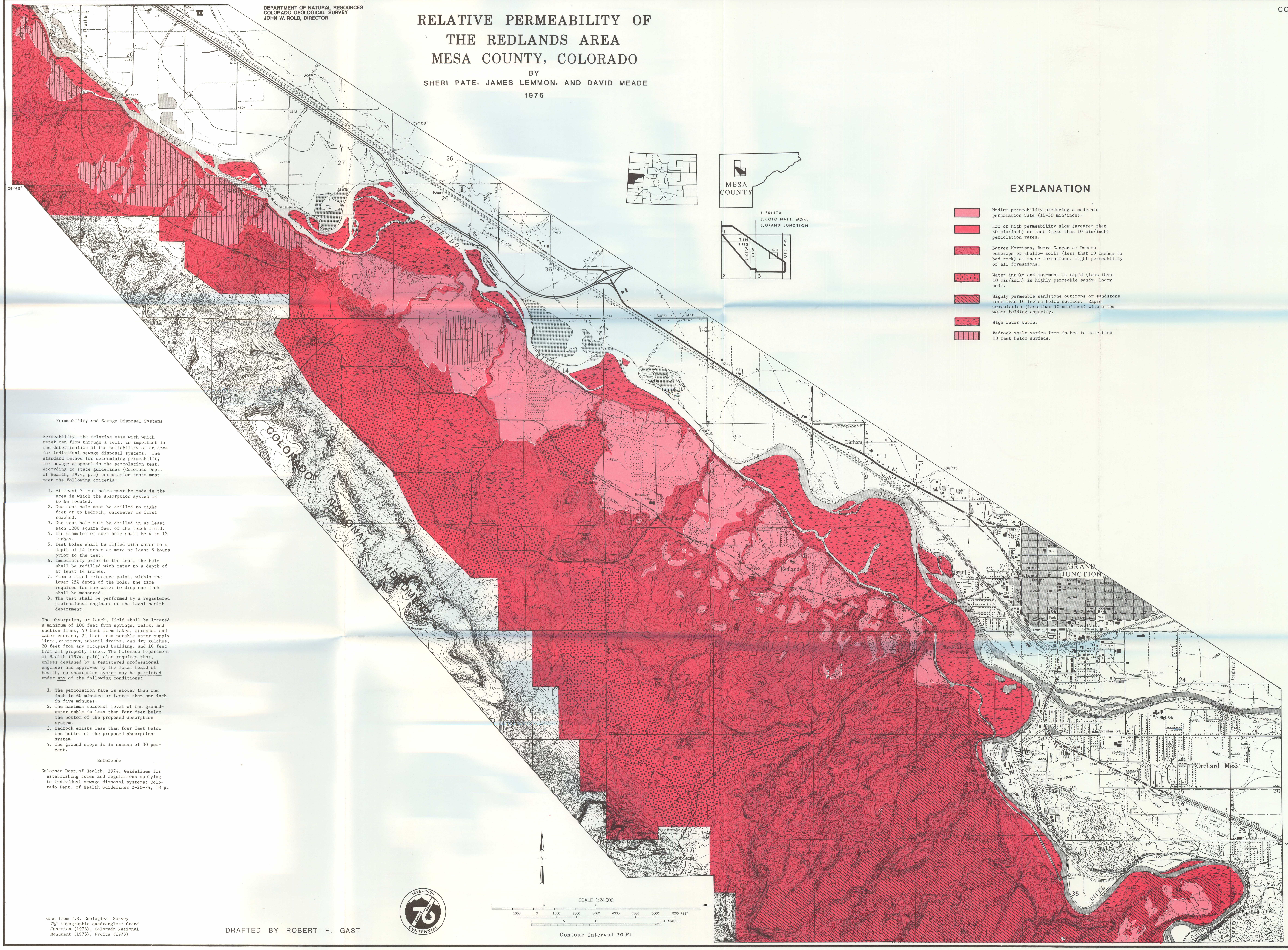
JOHN W. ROLD, DIRECTOR

RELATIVE PERMEABILITY OF THE REDLANDS AREA MESA COUNTY, COLORADO

BY
SHERI PATE, JAMES LEMMON, AND DAVID MEADE

1976



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EXPLANATION

- Medium permeability producing a moderate percolation rate (10-30 min/inch).
- Low or high permeability, slow (greater than 30 min/inch) or fast (less than 10 min/inch) percolation rates.
- Barren Morrison, Burro Canyon or Dakota outcrops or shallow soils (less that 10 inches to bed rock) of these formations. Tight permeability of all formations.
- Water intake and movement is rapid (less than 10 min/inch) in highly permeable sandy, loamy soil.
- Highly permeable sandstone outcrops or sandstone less than 10 inches below surface. Rapid percolation (less than 10 min/inch) with a low water holding capacity.
- High water table.
- Bedrock shale varies from inches to more than 10 feet below surface.

Permeability and Sewage Disposal Systems

Permeability, the relative ease with which water can flow through a soil, is important in the determination of the suitability of an area for individual sewage disposal systems. The standard method for determining permeability for sewage disposal is the percolation test. According to state guidelines (Colorado Dept. of Health, 1974, p.5) percolation tests must meet the following criteria:

1. At least 3 test holes must be made in the area in which the absorption system is to be located.
2. One test hole must be drilled to eight feet or to bedrock, whichever is first reached.
3. One test hole must be drilled in at least each 1200 square feet of the leach field.
4. The diameter of each hole shall be 4 to 12 inches.
5. Test holes shall be filled with water to a depth of 14 inches or more at least 8 hours prior to the test.
6. Immediately prior to the test, the hole shall be refilled with water to a depth of at least 14 inches.
7. From a fixed reference point, within the lower 25% depth of the hole, the time required for the water to drop one inch shall be measured.
8. The test shall be performed by a registered professional engineer or the local health department.

The absorption, or leach, field shall be located a minimum of 100 feet from springs, wells, and suction lines, 50 feet from lakes, streams, and water courses, 25 feet from potable water supply lines, cisterns, subsoil drains, and dry gulches, 20 feet from any occupied building, and 10 feet from all property lines. The Colorado Department of Health (1974, p.10) also requires that, unless designed by a registered professional engineer and approved by the local board of health, no absorption system may be permitted under any of the following conditions:

1. The percolation rate is slower than one inch in 60 minutes or faster than one inch in five minutes.
2. The maximum seasonal level of the ground-water table is less than four feet below the bottom of the proposed absorption system.
3. Bedrock exists less than four feet below the bottom of the proposed absorption system.
4. The ground slope is in excess of 30 percent.

Reference

Colorado Dept. of Health, 1974, Guidelines for establishing rules and regulations applying to individual sewage disposal systems: Colorado Dept. of Health Guidelines 2-20-74, 18 p.

Base from U.S. Geological Survey 7½' topographic quadrangles: Grand Junction (1973), Colorado National Monument (1973), Fruita (1973)

DRAFTED BY ROBERT H. GAST